Glacial Geology of the Northern Hudson through Southern Champlain Lowlands

By

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With a contribution from
Robert J. Dineen & Eric L. Hanson

Guidebook to Field Trips
For the
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May 30-31 & June 1, 2008

Cohoes Falls in Early Spring Remains a Trickle Compared to the IroMohawk River

Hosted by
The Six Flags Great Escape Lodge & Indoor Waterpark
Queensbury, NY

Sponsored by
New York State Geological Association (NYSGA)
De Simone Geoscience Investigations (DGI)

We Dedicate This Field Trip to

Robert G. La Fleur
Professor Emeritus, Rensselaer Polytechnic Institute

"Dr. Bob" taught many of the trip participants the value of making a good map. The advice was if you make a good map, then no one can take that away from you. Even if the interpretation changes, the map remains for others to use long after you're gone.
He continues to inspire us to teach as well as he did, to not be driven by ego and to know what the priorities in life should be.

It's all about the band!

If you can't get the tape off the reel, it's hopeless.

Hey...I'm retired now.

Okay, you got it. Let's go fishing.

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David J. De Simone[1] Gary R. Wall[2] Norton G. Miller[3] John A. Rayburn[4] Andrew L. Kozlowski[5]

Table of Contents

Abstract..4
Purpose..7
Organization of the Guidebook..7
Introduction...8
Continuity of 4.0ft/mi Tilted Water Planes from Champlain to Hudson Lowlands.......9
Summary of Northern Hudson Lowland Lakes...11
Why the Luzerne Readvance Hypothesis should be Discarded...................................12
Lake Coveville Halfmoon Threshold Hypothesis..15
IroMohawk River Discharge & Origin of the Cohoes Falls by Gary R. Wall..............17
The Cohoes Mastodon & Younger Dryas in Eastern New York by Norton G. Miller...19
Appendix A: Timing of Albany II – Quaker Springs Transition by Robert J. Dineen[6] & Eric L. Hanson[7]..26
Appendix B: Trip Stop Locations & Descriptions...28
References Cited...50

Figure 1: Lake Coveville Halfmoon threshold area includes H-C Canal Lock #1 but extends through the reach of the river as far south as the Waterford Bridge. Bedrock nick point is at lock with half moon entrenched meander arching to right and merging with main channel near site of photo. Steep lacustrine sediment bluff extends beneath house under construction in the distance.

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Abstract

Water planes tilt at 4.0ft/mi; Strandline features from the Hudson-Mohawk (H-M) confluence through the southern Champlain Valley fall onto 5 parallel water planes which tilt at 4.0ft/mi +/-0.2ft/mi or 0.75m/km +/-0.03m/km and represent the following glacial lakes:

*ABI, Albany I	(Woodworth, 1905)
*ABII, Albany II	(Lowered Albany of De Simone, 1985)
*QS, Quaker Springs	(Woodworth, 1905)
*CV, Coveville	(Woodworth, 1905)
*FA, Fort Ann	(Chapman, 1937)

Outlets for ABI, ABII and QS remain problematic. But projections of these water planes indicate possible thresholds all south of Catskill, NY. A CV threshold is proposed in this volume to be in Halfmoon, NY. The Fort Ann outlet channels are well known and have been studied since Woodworth's (1905) time. The Fort Ann phase was entirely fluvial in the Hudson Valley.

Age constraints on Lakes Quaker Springs and Coveville; The timing and duration of Lakes Albany I and Albany II remain uncertain. Calibration (Stuiver et al, 2005) of the dates reported in this volume suggests the ABII-QS transition was after 13,800 cal yr BP and QS lasted until ~ 13,400 cal yr BP. If this age is correct for the onset of QS, then it suggests a rate of ice retreat of 0.2/km/yr, significantly less than that for the bulk of the Champlain Valley. It seems more likely that QS began as much as 100-200 years later than the dates reported in this guidebook. A duration of 200 years for QS would suggest a rate of ice retreat of 0.4km/yr as the ice withdrew approximately 80km from just north of the Batten Kill to just north of the Neshobe River. Lake Coveville lasted ~ 200 years until 13,200 cal yr BP. Lake Fort Ann lasted ~ 200 years until 13,000 cal yr BP.

Lake Quaker Springs extended to Brandon, VT; Detailed mapping in Brandon, VT, indicates Lake Quaker Springs was present there due to the deposition of a large delta and several beaches (De Simone, 2006, De Simone and Becker, 2007). Some beaches are distant from the mountain front indicating this was not a local ice marginal high level lake. Previous work indicates that QS may have extended slightly farther north on the eastern side of the Champlain. However, the steep western margin of the southern Champlain Valley along the base of the Adirondacks may have allowed the Hudson-Champlain (H-C) lobe to maintain its front farther south; the Street Road delta near Crown Point was deposited into Lake Coveville and no higher deltas are yet recognized.

Readvance hypotheses need to be re-assessed; Readvance hypotheses were prevalent from the 1950's through the late 1970's and represent the popular paradigm of the times. Evidence from modern glacial environments accumulated over the last 3 decades has greatly improved our understanding of the conditions for ice surges and larger readvances. A new paradigm would require stronger evidence for a readvance before the hypothesis is accepted and that there be a correlation to the paleoclimatic record.

Interpreted glacial history in the Hudson-Champlain lowlands has traditionally included readvance hypotheses such as the 20km Rosendale, 48km Middleburg, 32km Delmar, 50km Luzerne and the Bridport. These hypotheses have often been accepted rather than severely tested. Under a new paradigm, readvances of such magnitude should be positively correlated to the paleoclimatic record documented by marine and ice core data. Testing of the above readvance hypotheses and those proposed elsewhere is

warranted. Previous acceptance of readvance hypotheses without adequate testing has hampered our interpretation of Hudson Lowland deglacial history and has encouraged researchers outside the region to falsely accept these unproven hypotheses.

The Luzerne readvance hypothesis should be abandoned; Connally and Cadwell (2002) depict a Luzerne readvance margin that includes much of Washington County, NY, to the 3000ft Taconic summits along the NY-VT border. No readvance is shown in the Mettawee and Vermont Valleys of southwestern VT although glaciological considerations make this likely. Detailed mapping in VT and NY does **NOT** support this readvance (De Simone, 2007, 2005, 2004, 2001, 1985). There are no exposures of deformed sediment with evidence of ice override. The readvance is postulated to have ended in an east-west segment of the Batten Kill Valley but no evidence for ice override exists here. There is no “plethora of stagnant ice features probably left by wasting ice” (Connally and Cadwell, 2002) from the readvance. There is no evidence of “forced drainage eastward into the Batten Kill drainage system” (Connally and Cadwell, 2002).

The Luzerne hypothesis suggests ice obliterated earlier Lake Albany (AB) deposits yet left no readvance till. It is more plausible the higher waters of Lake Albany were never present since the lake lowered to Quaker Springs (QS) with the ice just north of the outlet of the Batten Kill (Woodworth, 1905, De Simone, 1983).

The Hidden Valley moraine is the proposed western limit of readvance; but there are no cited exposures to document ice override. Nearby outwash and kame terraces are considered the result of stagnation zone retreat. These deposits mark simple recession of H-C ice, not a western limit of readvance (De Simone, 2008).

The type sections of the Luzerne have been interpreted as middle and late Wisconsinan tills separated by lacustrines (Woodworth, 1905). My study suggests sediment flow diamictons as another alternative interpretation. The compiled work of La Fleur (personal communication) and his students at the time suggest the type section does not represent a readvance.

It is inconceivable that a readvance hypothesis should state the ice left no evidence of its override of existing deposits and that the only evidence of the readvance is a single road cut that may have equally viable alternative explanations for its origins. **Thus, the body of evidence does not support the occurrence of a Luzerne readvance and the hypothesis should be abandoned.**

Lake Coveville Halfmoon threshold proposal; **Multiple data sources indicate there may have been an ice contact sediment dam across the Hudson Valley in the river reach extending from the Waterford Bridge north to Lock #1 of the H-C Canal**. Halfmoon on the west and Speigletown on the east side of the valley both have exceptionally extensive kame moraine deposits, the most extensive deposits between Albany and Glens Falls.

A plausible reason for an extended still stand in ice retreat lies with the longitudinal profile of the Hudson-Battenkill channel near Lock #1 where there is a buried nick point (Dineen, personal communication). A step in the valley profile here would have provided a grounding line for the retreating H-C ice and enabled the ice to maintain this position. Schock (1963) reported in his investigation of the Troy North quadrangle that the Newtown Road and Ballard deltas, both ice contact deltas, were graded to different lake levels. Indeed, the higher Newtown Road delta is AB I while the lower Ballard delta is AB II. Schock dismissed the possibility that the lake lowered while the ice stood at this front. However, this may be the best explanation for the multiple kame delta elevations. A drop in lake level would have further promoted grounding of the ice and ensured a continuous source of sediment to a stable ice margin via the dirt machine (Lowell, 2008). To the south, the Prospect Hill subaqueous fan extends to an elevation of 200ft and there are remnants of ice contact sediment in Pleasantdale on the east side of the valley. This would be consistent with the 200-220ft elevation dam spanning the Hudson necessary to retain Lake Coveville.

Once Lake Coveville was established, Wall notes there would have been a difference in base level between the present path of the Mohawk River and its northerly distributaries, a complex of channels studied by Stoller (1911, 1916, 1918), La Fleur (1965, 1975, 1979) and others (Dahl, 1978, De Simone, 1977, Hanson, 1977). The lower base level below the CV dam at Halfmoon would have provided a hydraulic reason for the IroMohawk River to favor and dissect this pathway to the Hudson and abandon the northerly distributaries.

The Younger Dryas of eastern New York was 5-10°C colder than at present; Miller reports on macrofossil remains from Younger Dryas (YD) material in Cohoes. The YD vegetation of eastern NY consisted of a spruce and fir forest with some tamarack and only minor alder. The YD in Nova Scotia and New Brunswick, CA, was a tundra environment. This indicates there was a steeper gradient from boreal forest to tundra in northeastern North America during the YD than today. An age on mastodon bone from the deepest part of one pothole indicates a minimum age for the exposure of the pothole following a lowering of water level along the IroMohawk River. This would approximate the abandonment of the IroMohawk in favor of drainage around Covey Hill. This bone age is approximately 12,900 – 13,100 cal yr BP, an age that slightly post-dates the CV-FA transition at approximately 13,200 cal yr BP.

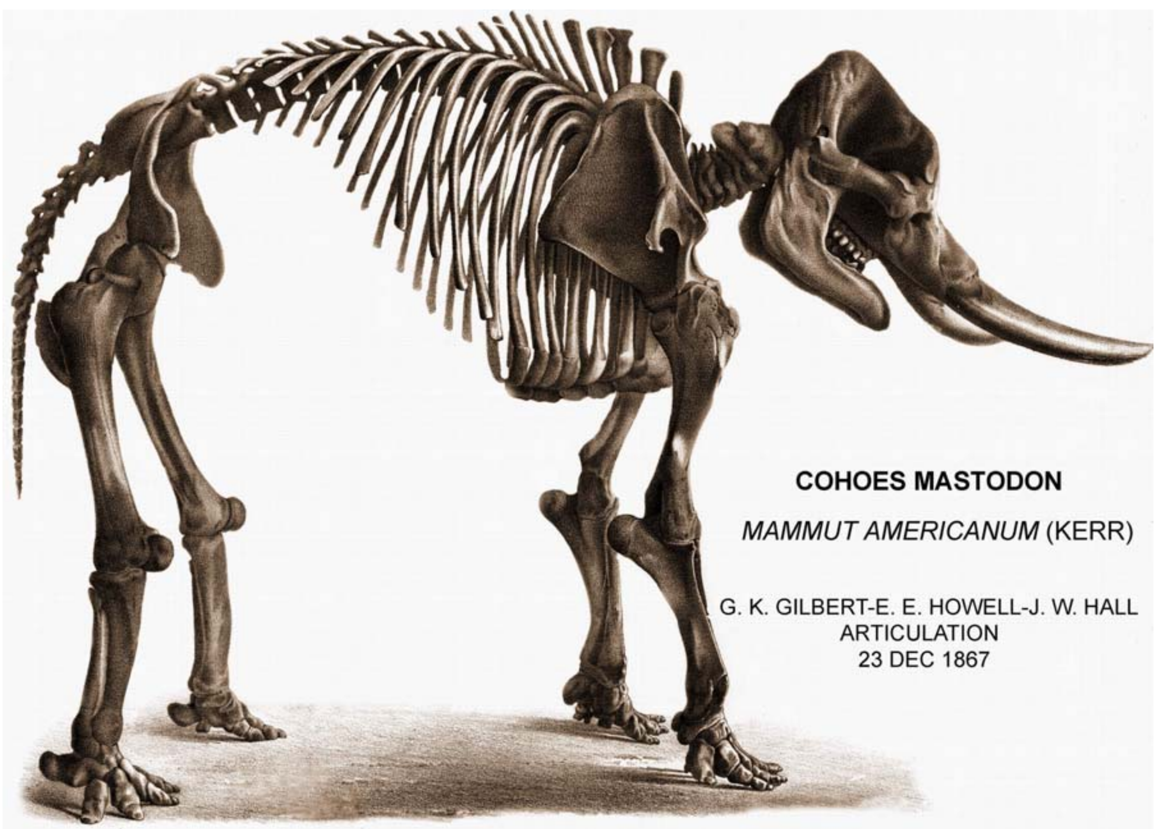


Figure 2: The first Friend of the Pleistocene?

Purpose

Field trip guidebooks have typically found a welcome place on our book shelves as reference volumes on the geology of an area. We all often check our guidebooks to refresh ourselves or get our first introduction to a place. However, as students and professionals, we must remember these guidebooks represent a summary or synthesis of the views of a single researcher or a small group of workers who probably share enough commonality in their interpretation of the geology to generate the synthesis. Different perspectives might not find their way into a guidebook. The danger is that someone may consult a trip guidebook and/or attend the field trip and believe the story represents the only view or the final word. Some guidebooks clearly state the piece is meant to be a report of progress and not the final word. This guidebook is just such a progress report meant to inspire students and professionals to address the questions raised by our story, to remember this is not a peer reviewed journal article, and that more work is needed.

It also serves to bring together a diverse group of researchers – new, old and returning – who are or will become active in figuring out the details of the retreat of the H-C ice lobe. Investigation into the glacial geology of the Hudson Valley has once again become a wide open field of research, vibrant with fresh professionals and already with a spur of interest from students.

The original spirit of FOP field trips is to bring a group together to see the geology and hear the story but most importantly to discuss the interpretations and improve our understanding of the story by adding an “outside” perspective.

Organization of the Guidebook

Historically, guidebooks include a trip road log that takes you along the route from stop to stop, tenth of a mile by tenth of a mile. Then, the actual trip rarely follows the guidebook, often skipping stops for expediency or due to a lack of access. Yes, it’s nice to have the turn by turn road log. But, in this day of such readily available online maps and driving directions, it seems superfluous to include a road log that may never be followed by anyone. Rather, we (notice the editorial “we” of your senior author) have decided to provide you with detailed locations of a collection of trip stops in the field trip area. These locations include the UTM coordinates for the entrance to a pit or to the parking area for an exposure. We also include the directions from the nearest main road intersection and leave it to the user to customize their own route to see the geology they choose to see.

In today’s litigious world, access to pits and other private property is increasingly difficult. To facilitate your own future access to the stops, we have included the names and telephone numbers and any pertinent advice for each stop. Pits or private lands where access was denied for this trip have not been included among the collection of stops.

Finally, the stops are organized by their proximity to tributaries to the Hudson River. So, we have Batten Kill stops, Hoosic River stops, Hudson-Mohawk stops, Hudson River-Fort Edward channel stops, Mettawee River stops, Poultney-Castleton River stops, Neshobe River stops, and the Street Road delta stop.

Introduction

On the 70th annual reunion of the Northeastern Friends of the Pleistocene, we took you on a tour of the deglaciation of the northern Lake Champlain Valley (Franzi et al., 2007). The field guide included an estimated ice margin retreat through the region of about 0.4 – 0.5 km/year and a description of the termination of Lake Coveville. We recognized Lake Coveville as the highest, and therefore oldest, glacial lacustrine lake in the Champlain Valley (Chapman, 1937; Rayburn, 2004). Below Lake Coveville, we recognize many strandlines for Lake Fort Ann ranging from about 24 - 50 m below the Coveville level. The lowest of these - Lower Fort Ann - is the best developed, and so we suggested that it was controlled by a stable threshold. The cause for the Coveville - Fort Ann transition was a flood event related to the coalescence of Coveville Lake Vermont and glacial Lake Iroquois when the ice margin reached the northern flank of the Adirondacks, and we demonstrated evidence for this at Cobblestone Hill on Altona Flat Rock (Rayburn et al., 2005).

At one of the field stops, we discussed varve chronology and estimated that Lake Fort Ann lasted for approximately 200 years before ice margin retreat opened the drainage route through the Gulf of St. Lawrence, Lake Fort Ann drained away, and the Champlain Sea entered the isostatically depressed valley. The highest level of the Champlain Sea was about 91 m below the Coveville level (Rayburn et al., 2005). Varve chronology combined with radiocarbon ages (Rayburn et al., 2007) indicates that the Champlain Sea began around 13,000 calibrated years BP.

<u>The Lacustrine Link Between the Hudson and Champlain Lowlands;</u> The observation that Lake Coveville dropped catastrophically to Lake Fort Ann during the Lake Iroquois flood allowed us to hypothesize that the flood breached the Coveville threshold. Woodworth (1905) first proposed “The Cove” near the mouth of Fish Creek on the Schuylerville quadrangle and Chapman (1937) concurred this was the threshold for Lake Coveville. Investigation of “The Cove” by De Simone (1977, 1985) led him to conclude that “The Cove” was an entrenched meander of the Hudson but did carry a portion of the IroMohawk River discharge that flowed through the Saratoga Lake basin. Rayburn (2004) concurred and projected the Coveville level well above “The Cove” and southward down the Hudson Valley. The Coveville level is, thusly, our connection between the basins.

Lake Albany I and Lake Albany II had dropped to the next lower lake, Lake Quaker Springs, while ice remained in the Hudson Lowland. Therefore, these two lakes have no extension into the Champlain Lowland. At one of our stops, we will suggest the approximate position of the ice margin at the time AB I dropped to AB II.

Lake Quaker Springs was first recognized also by Woodworth (1905) who named the lake for the threshold he inferred at Quaker Springs, NY, near the better known city of Saratoga Springs. A current hypothesis (De Simone, 2006) suggests the actual dam for the lake may have been at a nick point along the Hudson near the Rensselaer-Columbia County line. The extension of Lake Quaker Springs into the Champlain Lowland has remained problematic. Previously, strandline features on the VT side of the lowland have been correlated to QS but no one has recognized any QS strandline features on the NY side. Recent work (De Simone, 2006, De Simone and Becker, 2007) indicates that QS penetrated as far north as Brandon, VT, on the east side of the lowland but probably not much farther north. This is consistent with earlier work in the Brandon area (Connally, 1970). A reasonable re-construction of ice margins enables us to resolve the apparent disparity of QS on the east side of the lowland but not on the west side.

Continuity of 4.0ft/mi Tilted Water Planes from Champlain to Hudson Lowlands

Currently, more than 40 strandline features in the northern Hudson through southern Champlain lowlands have been identified on maps and in the field. Deltas from tributaries were given primary importance because the topset-foreset contact positively correlates to the recognizable break in slope in the delta morphology on a topographic map. This assumes that the delta fore-slope has not been severely modified by post-depositional erosion. Elevations of some strandline features have been determined by both a Brunton MNS Multi-Navigator GPS-Altimeter-Barometer and a Garmin Foretrex 101 GPS unit that was cross-checked with the Brunton unit. The Brunton unit was periodically corrected for atmospheric variation by re-calibration at bench marks. Exposed topset-foreset contacts that have been measured closely match map determination of the same contact based upon delta morphology. The elevation of each strandline feature was identified on a topographic map with either a 10 foot or 20 foot contour interval. Range of error in the elevation of a feature is assigned to be +/- 10 feet or +/- 3 meters.

Shoreline features such as beaches with a typical beach profile and sand spits deposited by long-shore currents were used. Wave cut terraces, if present, were also used.

River terraces must be used with more caution as there are numerous terraces along the Hudson River and its tributaries. These terraces have many elevations which may or may not coincide with any known water level. For example, the use of low terraces along the Hudson River would result in a scatter of points through which anywhere from 1-3 Fort Ann “water planes” might be drawn, none of which would be statistically valid. The terraces are merely a record of the down-cutting to lower base level by streams. All terrace surfaces below the Coveville level in the Hudson Lowland represent fluvial terraces and do not represent lacustrine strandlines.

Isobases and trend lines; All strandline features were projected normal to a *curved* trend line through the Hudson-Champlain divide region. In the southernmost Champlain Lowland, south of Brandon, VT, isobases are oriented approximately E-W and the trend line is aligned N-S. Isobases through the curving Hudson-Champlain divide area are aligned normal to the curving axis of the lowland. This reflects the thickest ice cover occupying the lowland versus the thinner ice cover that was present over the adjacent uplands; there is an appropriate difference in isostatic depression in the lowland versus the uplands. The trend line used to plot the strand line features approximately follows the path of the Hudson-Champlain barge canal and Wood Creek. From Fort Edward, NY, southward into the northern Hudson Lowland, the trend line approximately follows the path of the Hudson River. Thus, the trend line is oriented N 35 E from Granville, NY, to Schuylerville, NY; a N 25 E from Schuylerville, NY, to Mechanicville, NY; and N 10 E from Mechanicville, NY, to Troy, NY. These 3 trend line orientations reflect respective isobase trends of N 55 W through N 65 W to N 80 W, returning to almost an E-W isobase trend comparable to that in the southern Champlain Lowland.

The use of a trend line that follows the paleo-thalweg through the H-C divide region seems reasonable but has not been modeled or verified. When used, however, it results in a very satisfying plot of deltas from the major streams entering the lowlands.

Water planes tilt at 4.0ft/mi +/- 0.2ft/mi (0.75m/km +/- 0.03): The plot by Rayburn illustrated in **Figure 3** represents an integration of the data assembled by De Simone with data from Rayburn for the entire Champlain Lowland. This plot does not employ the curved trend line cited above but does include all of the Champlain Valley data.

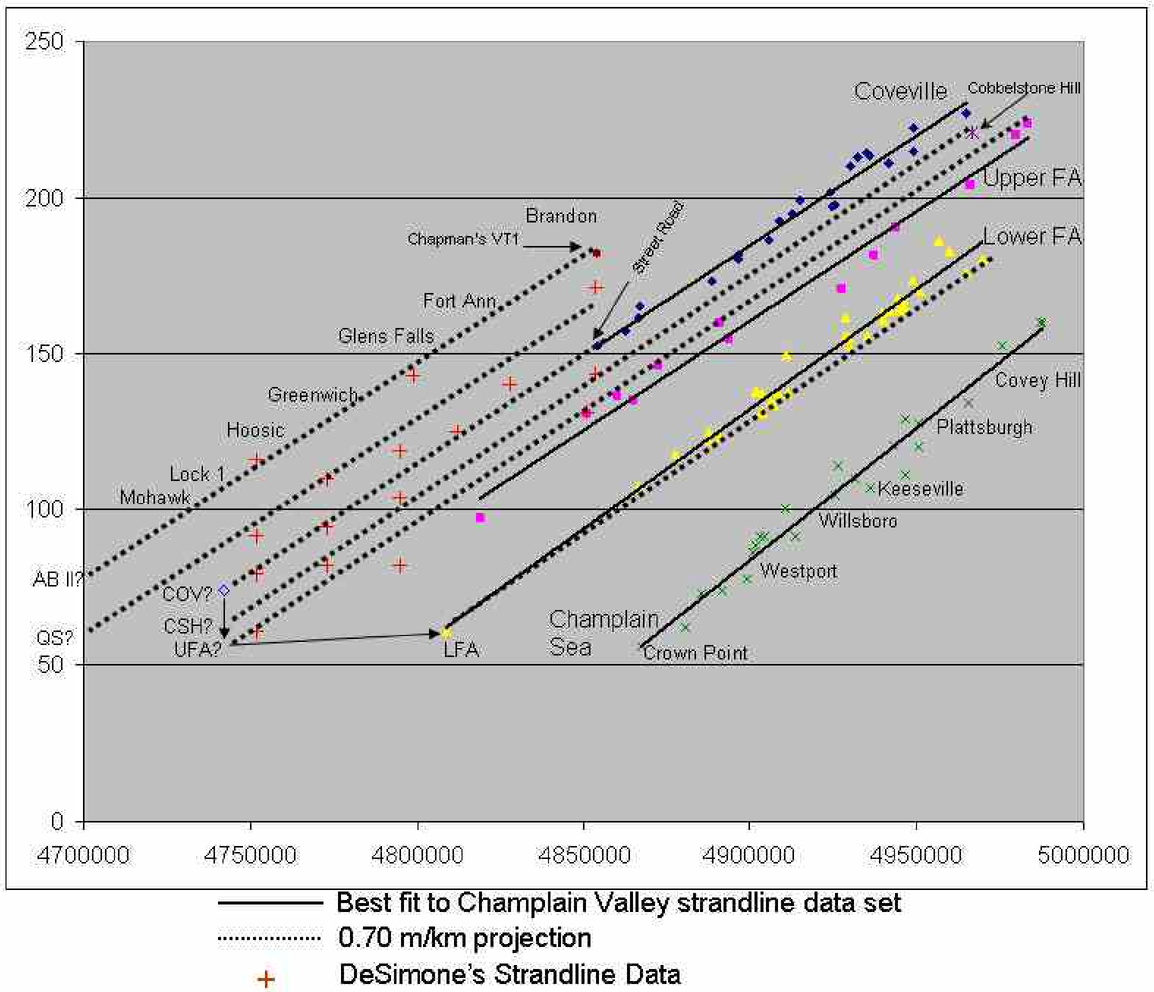


Figure 3: A plot of some of the northern Hudson through southern Champlain Lowland's strandline data combined with Chapman's data from the entire Champlain Valley completed by Rayburn for this report.

Historically, strandline data for the Hudson Valley were correlated to indicate water planes with abnormally low tilts compared to the surrounding Ontario, Erie, St. Lawrence and Connecticut Lowlands. Woodworth (1905) first plotted shoreline features for the H-C region and produced a plot indicating water planes with tilts less than 3ft/mi. Every worker since then has largely duplicated Woodworth's initial effort with only slight modifications. A different approach was taken (De Simone, 2006) to attempt to rectify what appeared to be a long standing error in the plots of Hudson Valley strand line features.

The approach was to accept the recent plot of approximately 4.0ft/mi data for the CV and FA water planes in the Champlain Valley and project these water planes into the northern Hudson Valley. Strandline data were then plotted normal to this curving trend line as detailed above. The data were initially limited to the deltas deposited by tributaries to the Hudson Valley, those deposited by the GlacioHudson River as it exited the Adirondack Mountains, and ice contact deltas deposited generally in the middle of the Hudson Valley from subglacial melt water sources. The resulting hand drafted plot on simple graph paper resulted in a strong positive correlation for CV deltas along an extension of Rayburn's 4.0ft/mi plot of Champlain Valley data. This was surprising, however, the most surprising result was that higher deltas in the northern Hudson Valley also all fit nicely along 4.0ft/mi tilted water planes that were identified as QS, AB II and AB I.

Comparison of this delta set with ice margins re-constructed by De Simone (see field map on trip) enabled an approximate determination of the location of the ice margin at the time of each transition from one lake level to the next and lower lake level. The synthesis adds clarity to the picture of deltas deposited by tributary streams. The GlacioHudson River produced no AB I delta in the Glens Falls region because that outlet was still blocked by ice. The GlacioHudson River flowed south following the Kayderosseras Creek Valley and deposited the Milton Delta into AB I. The Batten Kill has neither AB I nor AB II deltas because it was ice blocked for both those lakes and only opened after the lake level dropped to QS.

The ice margin reconstruction led us to examine Schock's (1963) surficial map of the Troy North quadrangle because the data indicated there may have been a lake level transition from AB I to AB II with an ice front somewhere in the quadrangle. Schock's map and interpretation of the Newtown Road and Ballard deltas came to light in a thesis that had long been forgotten by recent workers. Schock's observation on the possible change in lake level during deposition of the 2 ice contact deltas along the same ice margin added much to the emerging picture of the CV threshold discussed later.

Specifically, the projections of the 4.0ft/mi water planes for CV, QS, AB II and AB I southward suggest possible areas to look for the location of the thresholds or dams for each of these lakes.

Summary of Northern Hudson Lowland Lakes

Lake Albany I (AB I); This is recognized as a post-Erie interstadial lake occupying the lower through middle Hudson Valley and extending along the eastern lateral margin of the Hudson-Champlain (H-C) ice lobe as far north as the mouth of the Hoosic River on the Schagticoke, NY, quadrangle where there is an AB I delta. Along the western margin of the H-C lobe, the Queensbury Delta of the Glaciohudson River plots below the ABI water plane but above the AB II. This delta is south of Glen Lake on the Glens Falls, NY, quadrangle but might also represent deposition into an ice marginal lake separate from AB I. If the Queensbury Delta was deposited into AB I, then using ice surface profile data and projecting to the eastern margin of the H-C lobe, it seems reasonable that the mouth of the Batten Kill would have been open. Yet, there is no AB I delta of the Batten Kill. Therefore, the Milton Delta represents the northernmost AB I delta clearly deposited into the western extension of AB I along the western margin of the H-C lobe. This indicates the H-C lobe position extended across the Hudson Valley near Saratoga Springs, NY.

The AB I water plane projects below sea level in the lower Hudson Valley where Hell's Gate and/or the Terminal Moraine may have served as the threshold. It is also possible that a moraine dam in the Hudson Highlands held back the waters of AB I.

Lake Albany II (AB II); The ice retreated from the Troy North quadrangle where Schock's mapping (1963) suggests an ice front location when AB I dropped some 80ft to AB II. There is no AB II delta of the Batten Kill and Woodworth (1905) and De Simone (1983) suggest an ice margin location for the farthest northward extent of AB II just north of the mouth of the Batten Kill. . The AB II water plane projects into lake sediments in the vicinity of Hudson and Catskill, NY. La Fleur's suggestion (1979) that the uplifting lake bottom served as a lake threshold may be an appropriate hypothesis.

Lake Quaker Springs (QS); The retreating H-C lobe defended a northward expanding Lake Quaker Springs as the ice retreated from north of the Batten Kill confluence to a position at least north of the Forest Dale Delta and Fern Lake on the Brandon, VT, quadrangle. The ice margin at the time of lowering to CV may have been just north of the Neshobe River through the Fernville area on the east side of the valley. On the west side of the valley, there is no identified QS delta above the CV Street Road delta in Crown Point, so the Crown Point area must still have been ice covered.

The QS water plane projects deep into the lake bottom sediments along the Rensselaer County-Columbia County line. Again, the exposed and up tilting lake bottom may have served as the threshold for Lake Quaker Springs. However, there is a pinching of the valley width here. Dineen (personal communication) reports a buried nick point at the confluence of the Hudson-Battenkill channel with a southward extension of the preglacial conjoined Colonie & Mohawk channel near Coeymans, just north of the county line. A nick point may have provided the same grounding line for the retreating glacier and established a condition similar to that where the CV threshold developed. Further study is planned.

Lake Coveville (CV); Lake Coveville fronted the retreating H-C ice lobe through the northern Champlain Valley as previously detailed by Chapman (1937) and elaborated upon by numerous subsequent workers. The CV water plane projects into the lake bottom sediments south of Albany and Rensselaer, NY. However, it is also possible that the CV waters were held back by the thick ice marginal sediments composed of sand and gravel near Waterford, NY (see later discussion).

Why the Luzerne Readvance Hypothesis Should be Discarded

Stratigraphy of the Corinth Road "type" sections; Connally & Sirkin (1969) initially outlined the Luzerne readvance hypothesis as an event that terminated in the Glens Falls, NY, region and occurred during the duration of Glacial Lake Albany. The Luzerne readvance hypothesis was more formally proposed 2 years later (Connally & Sirkin, 1971) as a 20-35 mile readvance of the Hudson-Champlain lobe into Lake Albany. A "type section" was designated among a series of roadside exposures along Corinth Road west of Glens Falls within a steep gorge of the Hudson River as it exits the Palmertown Range.

Their "type section" was described as multiple tills separated by lacustrine sediments. A 17ft thick basal "gray-black bouldery, silty-clay till containing clasts of dark-gray, contorted lacustrine sediment" is overlain by a 4ft thick "thinly-laminated to thin-bedded sand", in turn overlain by 5-12ft of "moderate-olive-gray till, very compact, very bouldery, with a sandy-loam matrix and many limestone and shale clasts," finally topped by 4-10ft of "moderate-olive-gray till and colluvium overlain by spoil and vegetation." To the east of this section, another section reports 6ft of till similar to the basal till above but underlain by 10ft of dark gray, laminated and rhythmically bedded lacustrine clay, silt and fine sand, greatly contorted. A third section still farther east reports 20ft of oxidized pebbly sand beneath the gray-black till with 4-20ft of light brown till containing a sandy matrix and angular boulders showing crude stratification. The authors interpreted the upper "till" in the westernmost section as the readvance till with the bray-black till as a basal Wisconsinan till.

Prior workers did not interpret the sections as from a readvance; Prior workers did not attribute the observed sediments as representing a readvance (Chadwick, 1928, Hansen et al, 1961) while Woodworth (1905) dismissed the notion of a readvance in the stratigraphy of the Hartman Terrace kamic gravels exposed farther to the west and at considerably higher elevation. Deformation structures perhaps indicative of ice override are present in the basal dark gray till but are not described in the upper or readvance till. Hansen et al (1961) describe only one till in an exposure that may be the easternmost of the 3 sections described by Connally & Sirkin.

<u>Alternative interpretations of the stratigraphy;</u> La Fleur (personal communication) took students to the site to measure, describe and interpret the Corinth Road sections. I was among those students as were many of the trip participants. We cleaned the type sections, measured, described and collectively decided there was insufficient evidence of a readvance. The type sections can be alternatively interpreted. The lower diamicton may be a true till, likely is, but there are no data on the age of this till. Indeed, its location is one where an older till of pre-Wisconsinan age could be preserved. The middle of the section is lacustrine with rhythmically bedded fine sediment. The contact with the lower unit is not visible along the several sections of road cut. We found no evidence of a preserved paleosoil, though. This could mean the underlying lacustrines are older than Late Wisconsinan. One notion at the time was that they were deposited ahead of the advancing Woodfordian ice in a lake dammed by the advancing ice. Connally interpreted the upper till to be the readvance till. I recall no deformation at the contact between the upper diamicton and the underlying lacustrines. I recall the contact to be a simple truncation surface. Connally's old photos of the easternmost section illustrate 2 tills in contact. When we cleared the same section we observed no evidence of readvance at the contact between these two diamictons. We interpreted the lower dense unit to be the Woodfordian till and the upper unit to be an ablation till. The sequence is capped by terrace gravel, too, that was visible farther up the road in a higher cut. So, the upper diamicton might also be a poorly sorted fan deposit dumped much later onto the lodgement till. So, there are several viable alternatives to a readvance here.

<u>Detailed surficial geologic mapping reveals no evidence of a readvance throughout the primary region where it supposedly occurred;</u> A readvance of 30 miles is proposed but no evidence of overridden sediment has ever been cited. Detailed surficial geologic mapping over the entire area of the proposed readvance has revealed no observed evidence to support a readvance. The 12 quadrangles shown in this figure were compiled at a smaller scale but the original 1:24,000 compilation map underlies the entire poster and can be examined in detail. Please feel free to lift maps and peruse the old fashioned hand colored compilation!

Connally & Cadwell (2002) state the readvance “forced drainage eastward into the Batten Kill drainage system” and state “there is a plethora of stagnant ice features probably left by wasting ice from the Luzerne readvance.” These statements are not supported by the results of detailed surficial geologic mapping shown in this report (De Simone 2006, 1992, 1985, 1977; De Simone & La Fleur, 1986, 1985; De Simone & Newton, 1994; De Simone, Dethier & De Simone, 1996; Dineen et al, 1988). The distribution of glacial deposits tells a very different story, one of systematic stagnation zone retreat of an active Hudson-Champlain ice lobe from the northern Hudson lowland and from the adjacent Taconic foothills east of the lowland. Numerous exposures were studied during this extensive mapping effort and all available well logs were examined. None of the data support any readvance of glacial ice.

Problems with the hypothesized extent of the Luzerne readvance; Connally & Sirkin (1971) stated the extent of recession prior to readvance can only be estimated. However, they cited one piece of evidence, that Woodworth (1905) inferred the lake sediment on the floor of Wood Creek showed signs of being "ice worn." Wood Creek is approximately 12-13 miles east of the proposed readvance type section. Detailed mapping of the Wood Creek area indicates the channel is part of the Fort Ann Outlet Channels complex. As such, the sediment on the floor of the channel was scoured, not by ice, but by outflow from Lake Fort Ann. Based upon this one citation, the Luzerne readvance was hypothesized to have an extent of 20-35 miles.

Most recently, Connally & Cadwell (2002) described a total readvance of 30 miles (50km). They stated that the readvance obliterated all prior melt water sediments but left no deposits to mark the overriding glacier.

Glaciological problem with the hypothesized readvance; As most recently depicted (Connally & Cadwell, 2002), the Luzerne readvance of Hudson-Champlain ice covered much of Washington County, NY. Ice overtopped Taconic upland summits exceeding 1400ft at Willard Mountain immediately adjacent to the Hudson lowland and overtopped high Taconic Range summits along the NY-VT border with elevations above 2000ft. The readvance stopped along the western crest of Mt. Equinox (3840ft) and Mother Myrick Mtn. (3361ft) west of Dorset & Manchester, VT. This Taconic summit ridge exceeds 3000ft in elevation at several locations.

However, the readvance is not postulated to have brought ice up the Mettawee River valley oriented approximately parallel to ice flow. The present drainage divide between the north-flowing Mettawee River and south-flowing West Branch Batten Kill occurs in Dorset village at an elevation of only approximately 930ft.

Wouldn't readvancing ice have flowed up the Mettawee Valley and into the Vermont Valley through the Manchester region? De Simone's detailed surficial geologic mapping and examination of subsurface data in Dorset (2007), Manchester (2005, 2004) and Arlington (2001), VT, does not support a Luzerne readvance.

Why the Luzerne readvance hypothesis should be discarded;

*The type sections do not expose an acceptable readvance diamicton.
*The proposed extent of the readvance is not supported by any mapped evidence.
*The proposed extent of the readvance leaves out areas that would have been covered by advancing ice and these areas reveal no evidence to support a readvance.
*The timing of the proposed readvance has not been matched to the paleoclimatic record.
*Therefore, the Luzerne readvance hypothesis is untenable based upon a reasonable assessment of the data. The hypothesis should be abandoned.

Suggested criteria for a readvance diamicton unit; Our current understanding of the glaciological settings for ice surges coupled with a well documented paleoclimatic record indicates that any readvance hypothesis should meet certain minimum standards of evidence. A distinction should also be made in the hypothesis between a surge of ice that is confined to a valley and is likely the result of local glaciological conditions, not driven by significant climatic changes and a larger scale readvance. The readvance would have ice override both valley and upland sites and would be driven by significant regional or global climate change.

A set of criteria are suggested for future readvance hypotheses (De Simone, 2008). Also, these same criteria might be applied to other previously proposed readvance hypotheses in an attempt to determine if these hypotheses are valid. Here are these criteria:

*Deformed sediment: A readvance diamicton should contain deformed sediments derived from the deposits beneath the advancing ice. This would include folded and contorted beds of any underlying lacustrine sediments if the ice was readvancing into a glacial lake basin. Ripped up clasts of deformed sediments might be mixed with a diamicton facies resembling basal till. A deformed till unit may be present that would represent a true readvance till. This till would likely contain fragments of the underlying sediments advanced over as recognizable or barely recognizable facies within the till.

*Evidence of ice override along the basal contact: The basal portion of the readvance diamicton should contain structures indicative of emplacement by advancing ice. The contact with the underlying sediment must also show deformation associated with ice override.

*Mappable extent: The readvance diamicton should be aerially widespread and be identifiable as a mappable unit of deformed till. A readvance diamicton identified from only one location might be of only local significance and should not be used to hypothesize a widespread readvance.

Lake Coveville Halfmoon Threshold Hypothesis

Multiple data sources indicate there may have been an ice contact sediment dam across the Hudson Valley in the river reach extending from the Waterford Bridge north to Lock #1 of the H-C Canal **(Figure 1 on Table of Contents page).** Halfmoon on the west and Speigletown on the east side of the valley both have exceptionally extensive kame moraine deposits, the most extensive deposits between Albany and Glens Falls. This extensive largely kame moraine consists of subaqueous fan deposits of sand and gravel that piled up in places to form 2 deltas built into Lake Albany I and Lake Albany II on the Halfmoon side. The moraine extends as an arcuate deposit more than 5 miles long with fluvial sediment exceeding 200ft in thickness throughout much of the moraine. The moraine on the Speigletown side extends for more than 3.5 miles but its thickness is less well known. The form of the moraine on both sides of the valley is V-shaped with the narrow apex of the “V” in the vicinity of the Waterford Bridge over the Hudson River. This kame moraine represents the largest ice marginal accumulation of sediment from Albany to Glens Falls. Thus, it represents a deposit formed by a significant still stand in the retreat of the H-C ice lobe.

A plausible reason for an extended still stand in ice retreat lies with the longitudinal profile of the Hudson-Battenkill channel near Lock #1 where there is a buried nick point (Dineen, personal communication). A step in the valley profile here would have provided a grounding line for the retreating H-C ice and enabled the ice to maintain this position. Schock (1963) reported in his investigation of the Troy North quadrangle that the Newtown Road and Ballard deltas, both ice contact deltas, were graded to different lake levels. Indeed, the higher Newtown Road delta is AB I while the lower Ballard delta is AB II. Schock dismissed the possibility that the lake lowered while the ice stood at this front. However, this may be the best explanation for the multiple kame delta elevations. A drop in lake level would have further promoted grounding of the ice and ensured a continuous source of sediment to a stable ice margin via the dirt machine (Lowell, 2008). To the south, the Prospect Hill subaqueous fan extends to an elevation of 200ft and there are remnants of ice contact sediment in Pleasantdale on the east side of the valley. This would be consistent with the 200-220ft elevation dam spanning the Hudson necessary to retain Lake Coveville. The earthen dam possibly extended for a 2.5 mile stretch of the river from Lock #1 south to the Waterford Bridge. While holding back Lake Coveville, this earthen dam undoubtedly was continuously being eroded but it may have been substantial enough through its thickness to retain the lake waters for the 200 year or so duration of Lake Coveville.

Once Lake Coveville was established, Wall notes there would have been a difference in base level between the present path of the Mohawk River and its northerly distributaries, a complex of channels studied by Stoller (1911, 1916, 1918), La Fleur (1965, 1975, 1979) and others (Dahl, 1978, De Simone, 1977, Hanson, 1977). Wall notes in his description of the Cohoes Falls stop that a dam somewhere south of the IroMohawk distributary channels – that would be south of Mechanicville – and north of the present Hudson-Mohawk confluence would have furnished a difference in base level between the present path of the Mohawk River and the other distributary channels that would have entered Lake Coveville. The lower base level below the CV dam at Halfmoon would have provided a hydraulic reason for the IroMohawk River to favor and dissect this pathway to the Hudson and abandon the northerly distributaries.

Historically, the Dutch name "Halve Moon" was applied to the large arcuate re-entrant of the Hudson River that exists today just below Lock #1. The rapids in the river at the present lock inhibited river traffic and a ferry was established sometime before 1685 across the river here (Huey, 1996). By 1714, "Halve Moon Fort" had a population of 80 persons and was situated on the east side of the Kings Highway – present day Rte 4 on the Halfmoon side of the river. Another ferry existed across the Hudson at the site known as Halfmoon Point or Nachtenach in Mahican language, the southern tip of present day Waterford. There were riffs or rapids in the Hudson River above this ferry, not surprising considering the exposed bedrock on both sides of the river north of the Waterford Bridge. That ferry linked the east or Lansingburgh side of the Hudson River with the Halfmoon side of the river exactly at the confluence with the northernmost of the present Mohawk River's spruyts or distributaries. These spruyts were shallow enough to wade across at all times except for the annual spring freshet along the modern Mohawk. Thus, the Kings Highway crossed each of the Mohawk's spruyts and carried the bulk of north-south foot, wagon and cannon traffic across the Hudson- Mohawk confluence. This was the most shallow and easiest place to cross the river and control of this site had strategic advantages to the Dutch, British, Colonials and the Mahicans before them. The Hudson Valley was Mahican territory prior to European settlement and a large Mahican village was sited on Havre Island (Peebles Island). As the Dutch population expanded, the Dutch purchased Havre Island from a dwindling Mahican population and the Mahican village was displaced to the site of Halve Moon Fort. By 1700, the area's Mahican population is estimated to have diminished by disease and displacement to approximately 500 persons.

The historical descriptions of the Hudson River in the reach where the inferred Coveville dam existed offer interesting anecdotal data on the river's profile. There were rapids above Halfmoon Point and at Lock #1. The river was deeper in between these two sections. It might reflect the buried step in the river profile that has been suggested to be present. The long history of the name Halfmoon indicates this is the most appropriate name for the hypothesized threshold for Lake Coveville. Now, if we were playing the lake naming game according to the rules, then we should re-name the water body Lake Halfmoon. However, there is a very long history of using the name Lake Coveville and that name should be retained.

IroMohawk River Discharge & Origin of the Cohoes Falls by Gary R. Wall

The course of the Mohawk River between Schenectady and Cohoes has long been recognized as post-glacial in origin (Cook, 1909; Dineen and Hanson, 1983). Stoller (1920) attributed the position of Cohoes Falls to the steady-state headward-retreat of the western wall of the Hudson Valley by the Mohawk River. Stoller's view has been largely unquestioned and his block diagram (Stoller, 1920 - figure 7) depicting his interpretation of the origin of the falls is known to many field trippers to this day. An important component of this diagram, first surveyed in great detail by G.K. Gilbert (Hall 1871 - Plate 3), is the plunge pool at the base of the falls (Hall, 1871 – Plate 2 no. 3) and an irregular sub-channel extending downstream of the pool (**Figure 4)**. The bottom of this pool varies from 0 to ~40 ft below the bedrock floor of the gorge immediately downstream. If the position of the falls is due to the steady headward retreat of the modern river then we should expect the floor of the gorge to grade to the level of the bottom of the pool, which it does not. Similarly we should expect the floor of the gorge to be uneven similar to the depths of the plunge pool, but rather the floor is exceptionally flat across the gorge with the notable exception of the sub-channel. The varying depth and width of the plunge pool along its length reflects the relative volumes of water observed spilling over different parts of the fall during high-flow conditions today; therefore it seems reasonable that the modern river has produced the dimensions of the plunge pool. However, the depth of the pool relative to bedrock immediately downstream indicates the flow conditions which formed the gorge downstream of the pool are different from those observed today.

The Earl of Bellomont first noted the depth of the plunge pool in 1699 as "6 fathoms deep" (Masten, 1877), so industrialization of the river cannot account for the change in flow conditions. Since the gorge is postglacial in origin and the modern river is not responsible for the position of the falls or development of the gorge, the Iromohawk River is the likely agent for the development of both. The Iromohawk drained Lake Iroquois from the Ontario Basin until the gap at Covey Hill was deglaciated (Muller and Prest, 1985). Wall (1995) estimated the lower limit to a maximum Iromohawk discharge at ~1.5 x 10^6 cfs (~42,500 m^3s^{-1}).

The Iromohawk swept into the Hudson Valley eroding glacial and glaciolacustrine sediment from the area around the Hudson-Mohawk confluence and exposing bedrock. As the Iromohawk began to channelize across this bedrock, nick points developed at the western Hudson Valley wall and just west of the modern Hudson River. The headward migration of the upper nick point formed the gorge above the falls and the headward retreat of the lower nick point carved a network of distributary channels at the mouth of the Mohawk which coalesced to form the lower gorge. When the Covey Hill gap opened, Lake Iroquois lowered and the Iromohawk and the headward retreat of the lower nick point ceased. The position of the falls today is much as it was the day Covey Hill gap opened, the falls retreating no further in that time than the width of the modern plunge pool. The exceptionally low rate of retreat results from the fact that the modern river is underfit in the gorge. The work of the modern Mohawk includes the plunge pool and the irregular sub-channel in the floor of the lower gorge which appears to be an interconnected series of Iromohawk potholes. Although Hall and Gilbert didn't recognize the Mohawk as underfit, Gilbert's cross-section of the lower gorge puts the work of the modern river relative to the Iromohawk in perspective (Hall, 1871 – Plate 2 no. 2).

The base level required for the Iromohawk to cut the gorge downstream of the falls needs to be approximately that of the modern Hudson. Therefore no glacial lake existed in the Hudson Valley at the Hudson-Mohawk confluence at the time of the demise of Lake Iroquois and the Iromohawk. If Lake Iroquois spilled into the Coveville phase of glacial Lake Vermont (Rayburn et al, 2005) and Lake Coveville drained through the Hudson Valley, then the Coveville threshold must have been north of the Mohawk-Hudson confluence. If the threshold was south of Mechanicville as proposed by De Simone, then a long-standing debate over why the modern Mohawk occupies the southernmost of 3 major Iromohawk distributary channels, which cut across the Hudson-Mohawk lowland, can be explained by the southern route having a lower base-level than the others during the later stages of Iromohawk drainage.

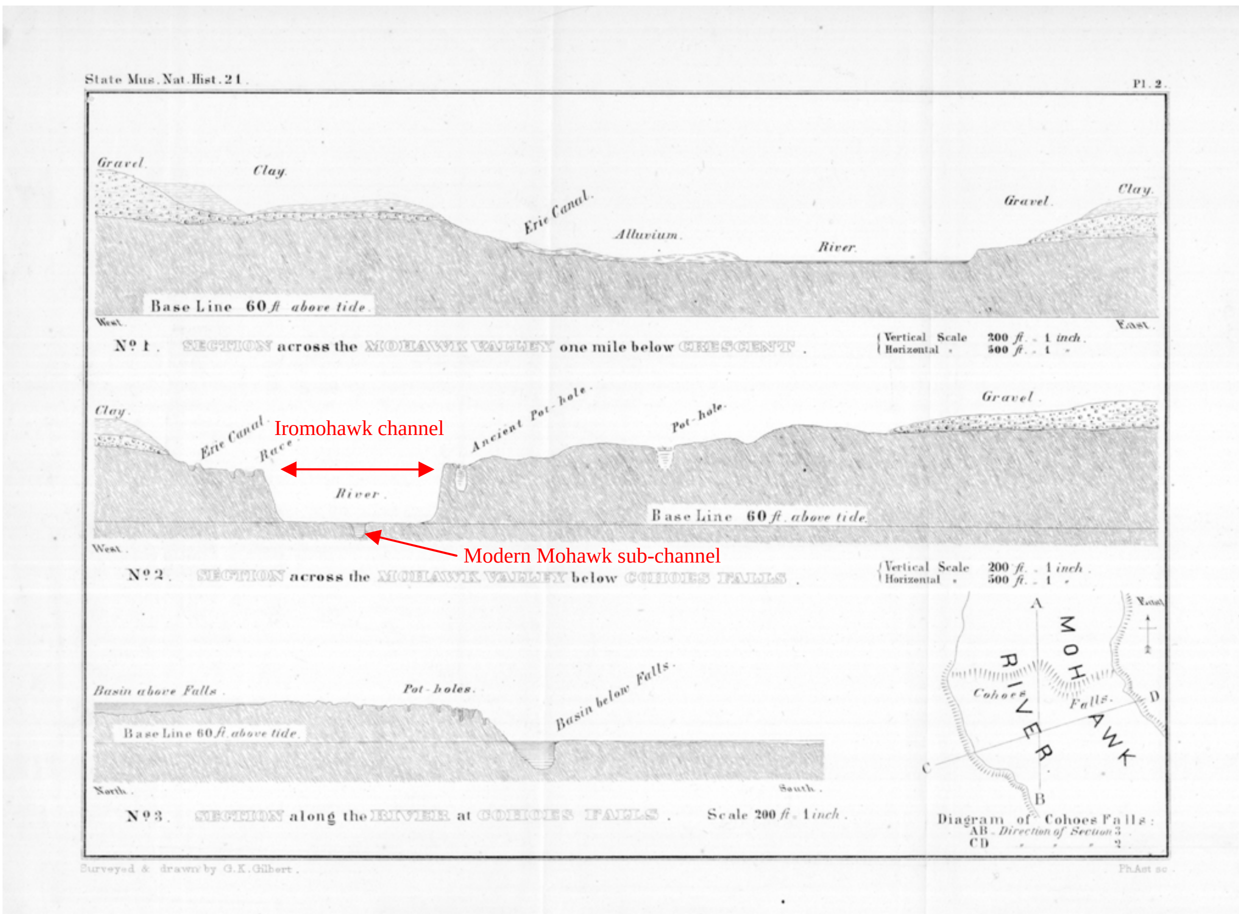


Figure 4: Base from Hall (1871, Plate 2) showing cross sections and a profile along the Mohawk River. Note the modern Mohawk occupies only a very small channel within the bottom of the IroMohawk gorge. The modern Mohawk River is a severely underfit stream.

The Cohoes Mastodon & Younger Dryas in Eastern New York by Norton G. Miller

<u>Introduction:</u>

The purpose of this section is to present information about the drainage history of the Mohawk River, Younger Dryas plant fossils and associated sediments in an excavation in Cohoes, and the radiocarbon-dated Cohoes mastodon.

Discoveries of the Cohoes mastodon [Mammut americanum (Kerr), Figure 2] in 1866, and articulation of the skeleton by late 1867, were major paleontological achievements in the United States in the period immediately following the close of the Civil War. The work was under the direction of James W. Hall, New York State Geologist, and he was assisted by G. K. Gilbert, who was at the start of a distinguished career in geology, E. E. Howell, and various surveyors, map makers, and assistants. A report of the investigations (Hall, 1871) was for many years one of the most thorough studies available of a mastodon skeleton and its depositional setting. Bones of the Cohoes mastodon, a nearly mature adult male, were found near and under the northwest corner of Harmony Mill No. 3 during its construction in two potholes 60 ft apart (**Figure 5**). Unfortunately, the associated plant remains received no attention from Hall and his coworkers, and as a result the vegetational context of this particular herbivore is unknown.

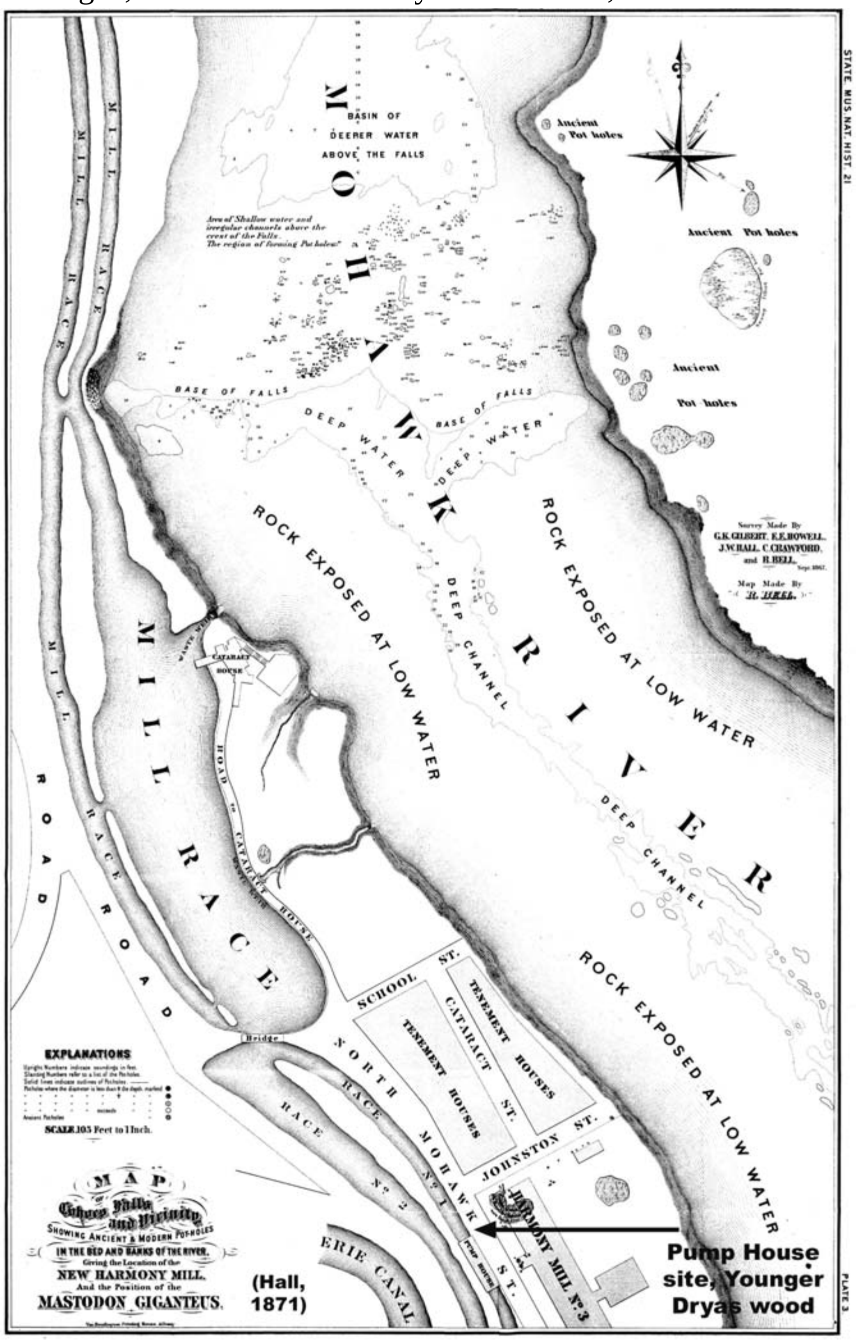


Figure 5. Harmony Mills site.

The articulated skeleton was displayed in Albany at the New York State Museum (and at its precursors) until it was disassembled in 1976 when the Museum was moved to new quarters in Albany in the Cultural Education Center. From late 1995 to 1997, the skeleton underwent extensive conservation, casts were made for the missing bones, and the skeleton was rearticulated for display. At that time, I had a sample of bone cut from the lower end of the left femur for radiocarbon dating. Purified collagen from this sample was dated by accelerator mass spectrometry at 11,070 ± 60 ^{14}C yr BP by Thomas Stafford, then at the University of Colorado. Daniel Fisher (University of Michigan) was engaged by the State Museum to ascertain the life history of the animal, using sections of tusk and molars, which contain records of growth, nutrition, and sexual maturation, and by general osteological observation. Fisher and Fox (2007) have established that the Cohoes mastodon died in the spring at age 32 from an unhealed puncture wound in the left temporal fossa (head), such as might occur in a musth battle between males. An earlier injury at age 11 had damaged the lower right cheek dentition and its subsequent development, but the animal "matured normally and engaged in normal musth behavior." Moreover, using stable nitrogen isotope analysis they found no evidence of long-term nutritional stress despite a weakened dental function. Thus, there is substantial evidence that this animal seems not to have been limited by forage quality or quantity toward the end of its life.

Logs and peat, potentially the same age as the Cohoes mastodon, were uncovered beneath a layer of lake clay in a small area 29 m southwest of the northwest corner of Mill No. 3 in Cohoes on 19 November 2002 in a trench dug along North Mohawk Street for a new water main (**Figure 6**). The presence of clay over wood immediately sparked my interest. The fossil bed (42°46'57.3" N, 73°42'25.6"W) is at an altitude of ca. 46 m (about 30.5 m above the Mohawk River and 0.6 km south of base of Cohoes Falls). It is located a few meters northeast of Lock 37 of the original Erie Canal, which opened in 1825. This lock was in use by 1823, and its floor is in bedrock ~7.5 m (25 ft) below grade, according to NYS Museum historian Craig Williams. A portion of the canal can still be seen underground in a passage accessible through a grated opening along North Mohawk Street. I visited the trench on the same day the logs were discovered and on the following day with NYS Museum geologist Donald Cadwell. White spruce cones and conifer wood indicated a late-glacial age for the organics (i.e., roughly the same age as the mastodon), but because of back-filling, the stratigraphy was visible in only a small part of the trench. In July 2003, with the trench reopened through the courtesy of the City of Cohoes, Robert LaFleur and I studied the sediments in more detail and collected additional samples, including wood and other plant remains, peat, and clay for paleobotanical study and radiocarbon dating.

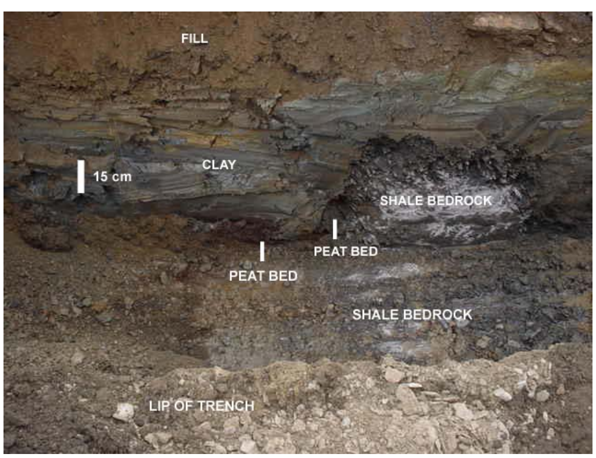


Figure 6. Peat and wood from organic layer atop shale in a pothole in Cohoes, NY.

Methods:

Pollen was isolated from samples of the peat and the clay by standard palynological laboratory processing, mounted in 2000-cs silicone oil, and identified and counted at 500×. Large-volume samples of peat were disaggregated by hand in warm water (75°C) and washed through a 250-micron-mesh sieve. Macrofossils were picked at low power magnification from volumetric sub samples of the residue. Wood samples were cleaned of adhering sediment in tap water. A band saw was used to cut cross sections for ring counts and wood identification. Transverse surfaces were cut with a razor blade to view ring structure and width. Species identifications were made from microscope study of very thin sections taken from the transverse, radial, and tangential surfaces. Potential surface contaminants were removed from peat, plant macrofossils, and wood samples, and beta-decay or accelerator mass spectrometric radiocarbon dating was performed at the Illinois State Geological Survey from oven-dried samples of very small to large mass depending on the nature of the fossil. Samples from the logs consisted of the outer 3–5 rings.

Results:

Stratigraphy; The peat and wood rested on shale bedrock. The thickness of the organic layer varied from 10–40 cm. Above it was a clay layer (maximum thickness 60 cm), similar in color and texture to Lake Albany clay, with thin stringers of organic detritus, small pieces of embedded wood, and rootlets. The radiocarbon age of one of these, a piece of hop hornbeam (*Ostrya virginiana*), was 290 ± 35 yr BP (ISGS-A0475), indicating that the clay contained organic components that dated to the late 18th century. Moreover, a Holocene pollen assemblage was present in a sample of the clay. Above the clay was fill from street and other construction projects.

*Radiocarbon Ages (**Table 1**);* The peat, a white spruce cone, and wood samples (spruce and balsam fir) dated to the middle of the Younger Dryas cold interval, whereas the age of an associated fragment of a paper birch log dated to 9540 yr BP, or about 500 yr after the end of the YD. Radiocarbon ages for wood and other plant remains established that the fossils were several hundred radiocarbon years younger than the Cohoes mastodon.

*Pollen (**Table 2**);* The pollen assemblage in the peat consisted of 98% tree and shrub pollen, mostly spruce, pine, balsam fir, birch, and tamarack. Minor amounts of alder pollen (both speckled and mountain alder) were registered. No pollen from aquatic plants was present, although a few fossils of the colonial alga *Pediastrum*, an indicator of lakes and ponds, were recovered.

*Plant Macrofossils (**Table 3**);* Needles of tamarack, spruce, and balsam fir dominated the peat macrofossil assemblage. Cones and cone fragments, seeds and seed wings, and branch fragments of all three conifer types were present in lesser amounts. A few miscellaneous seeds and/or fruits were present, e.g., pondweed (*Potamogeton*), rush (*Juncus*), and blackberry (*Rubus*). Several balsam fir and spruce logs had beaver (*Castor canadensis*) tooth marks.

Dendrochronology (courtesy of Dr. Carol B. Griggs, Tree-Ring Laboratory, Cornell University, Ithaca, New York; Miller & Griggs, 2002); The wood samples consisted of small-diameter trees of spruce and balsam fir. Nine spruce samples (five trees) contained from 28 to 86 rings. Bark was present in two of the five samples, both from short-lived trees. Many of rings of the short-lived spruce trees contained compression-release growth cells, the result of the tree attempting to maintain a vertical posture. Six balsam fir samples (four trees) contained from 31 to 38 rings. One fir tree had very large rings, indicating a very favorable environment for growth; rings in the other two were narrower.

Discussion:

The plant fossils appear to have been deposited in a small (~10-m-long) depression in bedrock. The peat contained small, angular shale clasts, perhaps indicating deposition from flowing water. The thinness of the organic deposit suggests that the sediment-accumulating basin functioned for a short time or that topmost sediments were removed by erosion or by other means. Because the overlying clay appears to date from the colonial period, it appears to have been transported from elsewhere and emplaced during construction, possibly during canal building. Some of the organic deposit may have been removed at this time or later during extensive and repeated industrial and other development that occurred along this part of the Mohawk River, or possibly the entire organic bed is the result of excavation.

The pollen and plant macrofossil assemblages consist almost entirely of fossils from the conifer dominants of the extant boreal forest, namely white spruce, balsam fir, and tamarack. Presence of only a few fossils from fen or other non-forest plant communities indicates that the vegetation was largely forest. The peat contained fossil cones of white spruce (*Picea glauca*), and this species may have been the principal Younger Dryas spruce in the region. No macrofossils of pine were present, but pine pollen, morphologically similar to that of jack pine (*Pinus banksiana*), comprises about 14% of the assemblage, which indicates that jack pine occurred beyond the source area of the macrofossils. No alder macrofossils were found, but a small amount of alder pollen (1.5% from both *A. rugosa* and *A. crispa*) indicates a minor role for alder in the vegetation.

Comparisons between percentages of spruce, balsam fir, and tamarack in pollen, needle, and wood assemblages showed the following: spruce needles are under-represented relative to pollen and about proportionately represented relative to wood; balsam fir pollen is over-represented relative to needles, and its pollen and needles are greatly under-represented relative to wood; and tamarack needles are greatly over-represented relative to pollen and wood. These data indicate that the forest was largely spruce and balsam fir, but with some tamarack. The recovered trees were all of small diameter, indicating either a relatively young stand or taphonomic factors such as sorting in flowing water were responsible for assembling tree-trunk segments of similar diameters.

Radiocarbon ages of the wood, peat, and a white spruce cone varied from 9540 ± 30 (white birch wood) to 10,640 ± 80 ^{14}C yr BP (peat), and many of the ages differed statistically at 2 σ. This suggests that the logs could have been assembled (eroded and re-deposited) by natural means, or that they were excavated and used as fill as a result of canal building or a similar activity. The pollen and macrofossil data are internally consistent and compatible with the radiocarbon ages. If construction-related re-deposition produced the deposit of logs and peat, no major stratigraphic mixing was involved.

Nearly all the wood samples date to the late-Pleistocene Younger Dryas interval, which was a period of lower temperature preceded and followed by intervals of higher temperature. The YD lasted about 1100 years (between ~11,000 and 10,000 radiocarbon years ago [equal to calendar years 12,800–11,700]). The cooling signal is strong in the North Atlantic region, especially northwest Europe, Greenland, and the Canadian Maritimes (New Brunswick and Nova Scotia), and evidence is accumulating that the cooling may have been worldwide. Stratigraphic studies of the amount of ^{18}O (a stable isotope proxy measure of paleotemperature) in ice cores from the Greenland plateau glacier clearly show the YD cold interval, and also a very rapid change to warmer conditions at its close (Björck et al., 1998).

Younger Dryas cooling has remained poorly documented or controversial farther south in eastern North America. In the lower Hudson Valley region of New York State and in Connecticut and New Jersey, changes in pollen stratigraphy, mainly increased spruce, balsam fir, and alder representation, have been interpreted to indicate lower temperatures during the radiocarbon-dated interval ~11,000 to 10,000. These results were obtained from fossils in lake-bottom sediment (Peteet et al., 1990, 1993; Maenza-Gmelch, 1997a, b). Plant macrofossil evidence from the Cohoes Pump House site supports this interpretation in so far as documenting abundant balsam fir but differs in the meager record of alder.

Annual tree-ring patterns indicate three environments in the area where the trees grew: (1) open forest, competition reduced [samples 10+11 (plus sign here and below means different pieces of the same tree), 20]; (2) dense forest, competition for sunlight and nutrients evident in narrower ring width and a reduction or absence of the normal pattern of wide to narrower ring widths from pith to bark (samples 14, 15, 22); and (3) riverbank, topography sloping and/or sustained winds causing trees to produce the compression-release growth cells in order to maintain a vertical posture (samples 17+18+19, 12+16, 13+21). Group 3 trees contained scars possibly resulting from beaver or other animal damage or by a rise in water level during floods and associated winter ice-block damage.

A tentative floating tree-ring chronology for three spruce trees showed 75 years of normal growth, then a dramatic drop in ring width for about 10 years. The ring-width decrease occurred only in sample 15, and it may indicate a cooling trend or the onset of adverse edaphic conditions such as a rise in water table. However, because all chronologies except one (sample 15) are less than 75 rings, the cross dating is not secure. The radiocarbon ages help with this problem, but during parts of the Younger Dryas, there are plateaus of constant radiocarbon age, and therefore problems converting ^{14}C ages to calendar years.

Beavers were a part of the Younger Dryas ecosystem and appear to have used conifers for food and/or building, in contrast to their current preference for aspen and other angiosperms.

Conclusions:

Younger Dryas vegetation of what is now east-central New York consisted of forest dominated by spruce, balsam fir, and some tamarack, with jack pine probably also present but in a different, and perhaps distant, plant community. In contrast, tundra occurred in New Brunswick and Nova Scotia, Canada, 800 km (500 mi) northeast (Mayle & Cwynar, 1995). A much steeper vegetation gradient existed northeastward in glaciated eastern North America in the Younger Dryas than now occurs in Canada between boreal forest and tundra. Alder appears to have played a minor role in the YD vegetation at the Cohoes site, on the basis of its almost insignificant presence in the fossil pollen and macrofossil assemblages.

The large reduction in growth in wood sample 15 beginning in its 70th year may be an indicator of intra-Younger-Dryas cooling, as could the equally large reductions in ring growth from pith to outer rings in samples 10+11 and 17+18+19. The temperature of east-central New York during the Younger Dryas was similar to that of central Quebec, i.e., annual temperature 5–10°C colder than at present.

Since the largest concentration of mastodon bones was found in the deepest portion of one of the potholes on “a bed of clay, broken slate, gravel, and water worn pebbles” (Hall, 1871, pp. 100–101), the radiocarbon age of the Cohoes mastodon (11,070 ± 60 ^{14}C yr BP) is a minimum age for pothole exposure following a drop in high-water discharge during the drainage of Lake Iroquois. This corresponds closely to the age of organics (11,000 ± 55 ^{14}C yr BP) immediately above pebbles at the bottom of the north end of Ballston Lake. The onset of organic deposition there marks the abandonment of a channel of the Mohawk River and the establishment of Ballston Lake (Toney et al., 2003).

Table 1. Harmony Mills Pump House Site, Cohoes, New York:
Radiocarbon Ages of Plant Fossils (AMS Unless Otherwise Noted)

Sample No.	Identification	Age (^{14}C yr BP)	Notes
HM1, 22	balsam fir (*Abies balsamea*) wood	(1)10,490 ± 80 (ISGS-5338) (22)10,475 ± 40 (ISGS-A0533)	(1)β-decay, beaver-chewed log; (22)log: 41 rings
HM2	white spruce (*Picea glauca*) cone	10,465 ± 35 (ISGS-A0405)	preservation excellent
HMPHS1	balsam fir (*Abies balsamea*) wood	10,340 ± 140 (ISGS-5486)	β-decay; beaver-chewed log
HMPHS3A	paper birch (*Betula papyrifera*) wood	9540 ± 30 (ISGS-A0474)	outer rings
HMPHS9	peat	10,640 ± 80 (ISGS-5481)	β-decay; needles and cones in peat
HMPHS 10, 11	balsam fir (*Abies balsamea*) wood	(10)10,160 ± 40 (ISGS-A0494)	logs: (10)33, (11)39 rings
HMPHS12, 16	spruce (*Picea* sp.) wood	(12)10,350 ± 40 (ISGS-A0529)	logs: (12)67, (16)65 rings
HMPHS13, 21	spruce (*Picea* sp.) wood	(13)10,175 ± 40 (ISGS-A0495) (21)10,175 ± 45 (ISGS-A0496)	logs: (13)36, (21)29 rings plus bark
HMPHS14	balsam fir (*Abies balsamea*) wood	10,465 ± 40 (ISGS-A0530)	log: 31 rings
HMPHS15	spruce (*Picea* sp.) wood	10,320 ± 35 (ISGS-A0507)	log: 90 rings
HMPHS17, 18, 19	spruce (*Picea* sp.) wood	(17)10,205 ± 40 (ISGS-A0531)	logs: (17)27, (18)25, (19)28 rings plus bark
HMPHS20	spruce (*Picea* sp.) wood	10,075 ± 50 (ISGS-A0532)	log: 45 rings

**Table 2. Harmony Mills Pump House Site, Cohoes, New York:
Pollen (as Percentages of Total Trees, Shrubs, Herbs) in two Samples from YD Peat**

Sample number/Pollen type	#1	#2	Mean
TREES			
Spruce (*Picea*)	54.7	55.7	55.2
Balsam fir (*Abies balsamea*)	8.1	8.5	8.3
Tamarack (*Larix laricina*)	2.6	2.5	2.6
Pine (*Pinus*)	13.4	14.1	13.8
Cedar/juniper (*Thuja*/*Juniperus*)	trace	trace	trace
Oak (*Quercus*)	0.8	1.3	1.1
Birch *(Betula)*	9.4	7.0	8.2
Ironwood/hornbeam *(Carpinus*/*Ostrya)*	2.5	0.8	1.7
Elm (*Ulmus*)	trace	trace	trace
Aspen/poplar (*Populus*)	trace	-	trace
SHRUBS			
Willow (*Salix*)	trace	trace	trace
Mountain alder (*Alnus crispa*)	0.4	1.3	0.9
Speckled alder (*A. rugosa*)	0.6	0.5	0.6
Sweet gale (*Myrica gale*)	4.9	5.6	5.3
HERBS			
Grasses (Gramineae)	1	1.4	1.2
Sedges (Cyperaceae)	0.6	0.4	0.5
Other	0.4	0.4	0.4
SUM TREE & SHRUB POLLEN	**98**	**97.8**	**97.9**
SUM HERB POLLEN	**2**	**2.2**	**2.1**

Table 3. Harmony Mills Pump House Site, Cohoes, New York: Plant Macrofossils (number per 10 ml of wet sieve residue) in Younger Dryas Peat

Sample no./macrofossil type	1	2	3	mean
Picea needles	89	88	105	94
P. sterigma[1]	3	10	17	10
P. seeds	9	5	14	9
P. seed wings	8	10	20	13
Larix laricina needles	255	289	401	315
L. short shoots	-	-	1	t[2]
L. cones/cone scales	-	-	3	1
L. seeds	-	2	3	2
Abies balsamea needles	12	9	6	9
A. branches	2	-	-	t
A. seeds	2	-	-	1
A. seed wings	3	-	-	1
A. cone scales	2	2	1	2
Potamogeton fruitstones	2	-	1	1
Juncus seeds	-	3	6	3

[1]Solitary sterigma and multiple sterigmata attached to bark. [2]t (trace), one fossil in one or two samples.

Appendix A

Timing of Lake Albany II – Quaker Springs Transition by Robert J. Dineen & Eric L. Hanson

We present an overview of the chronostratigraphic context of two radiocarbon dates from the upper Hudson Valley. The dates are from organic-matter rich lacustrine sediment overlying a disconformity between varved Lake Albany clay and laminated Quaker Springs sand. The older date (#41; 11,770 $\pm$ 115 ^{14}C yr; ETH 5051) is on allochthonous moss peat, while the younger (#42; 11,100 $\pm$ 450 ^{14}C yr; GX14348) is on bulk sediment. **Figure 7** shows the locations of the material for these dates in the context of surrounding sites with C14 dates.

The older, AMS date is on material eroded from the wall of the Drummond channel during the initial catastrophic Lake Iroquois overflow from the Ontario Basin (**Figure. 8**). The younger date is a mix of allochthonous and autochthonous organic and inorganic carbon. The dates are within two sigma of each other.

The material was sampled by Eric Hanson in a core boring drilled as part of a water resources project in Northumberland Township of Saratoga County, NY. The drill site is in a dunefield overlying the Wilton fan. The drill penetrated 2 m of aeolian sand before encountering 6.2 m of lacustrine sand (**Figure. 9**). The basal 0.3 m of the lacustrine sand is organic matter-rich and contains scattered clasts of gravel and moss peat. The lacustrine sand disconformably overlies varved lacustrine clay. The contact between the sand and clay is sharp and irregular and was carved by flood currents from the Drummond Channel, whose mouth is 18 km to the south-southwest. The overlying sand was deposited as a subaqueous fan that overspread Northumberland Township. The surface of the fan was reworked by northwest winds after the lake fell to the Coveville stage.

These are the only *in situ* radiocarbon dates from Lake Albany deposits (Dineen and Miller, 2006). This text summarizes Dineen, Miller, and Hanson, (in prep). One-hundred-and-eleven radiocarbon dates were compiled from the literature (request Excel file of data). They include bulk sediment, wood, bone, shell, plant macrofossils, and peat dates. The geographic and stratigraphic contexts of the regional radiocarbon dates were determined from the literature.

Wood dates at Cohoes are related to the Younger *Dryas* as discussed by Miller in this volume.

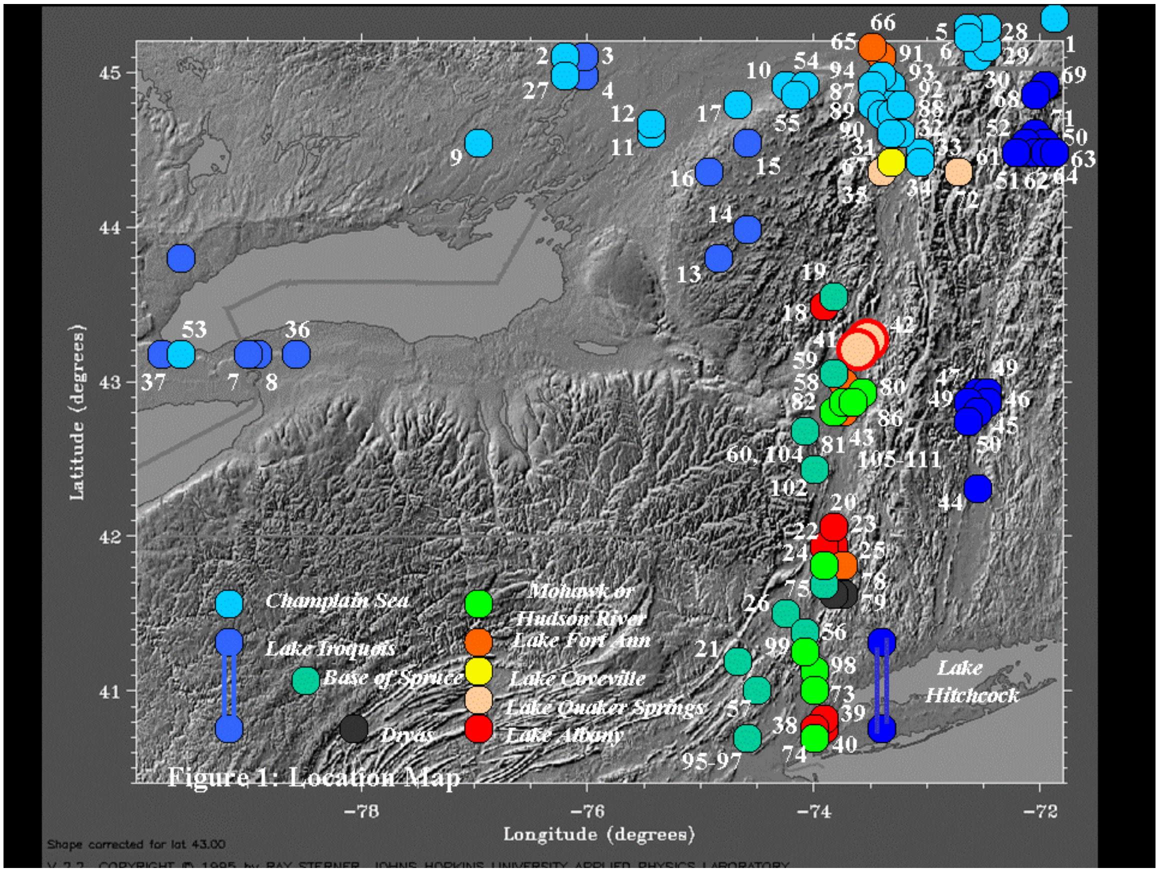
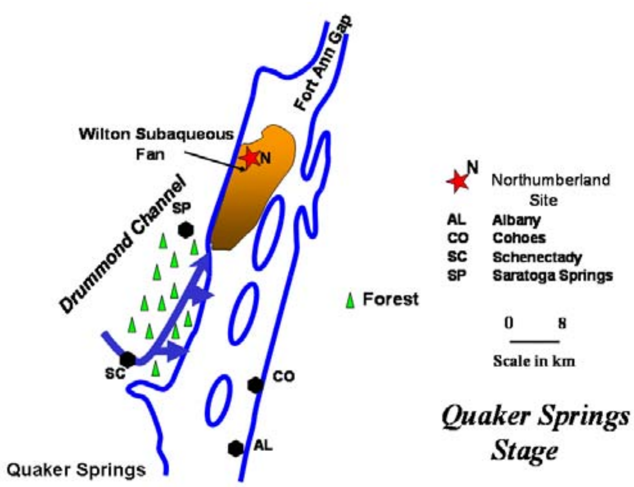


Figure 7. Location of C14 dated materials in the Hudson Lowland and surrounding regions.



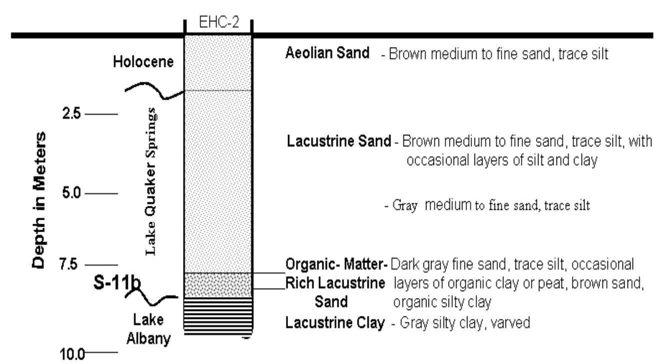


Figure 8. Site of Boring.

Figure 9. Boring log.

Appendix B

Trip Stop Locations and Descriptions

Regional road map with collections of stops outlined.

- **A. Crown Point stops**
- **B. Neshobe River confluence stops**
- **C. Poultney-Castleton River confluence stops**
- **D. Mettawee River confluence stops**
- **E. Hudson River-Fort Edward Channel confluence stops**
- **F. Batten Kill confluence stops**
- **G. Hoosic River confluence stops**
- **H. Hudson-Mohawk confluence stops**

A. Crown Point to Whitehall, NY, Stops

Crown Point CV Delta:

Location: Crown Point quadrangle. Proceed along Rte 9N from north of Crown Point to the intersection with Street Road. The main entrance to this pit is on the west side of the road. However, if you loop back and turn west toward the town transfer station, there is another upper entrance to this pit. The main or lower entrance is preferred for easy parking of large vehicles. Note that you can drive up to the high level of the pit from below along the access road in the north face of the pit. It is a wide and safe route but not for a bus.

Parking: N 4861517, E 0625137, lower or main entrance parking area.

Ownership & permission: Gerald Huestis is the owner and the pit is operated by his 2 sons. Mr. Huestis does not need prior arrangement for access to his excavation but it is good to call and introduce yourself. 518-623-3671.

Description: The lower portion of the pit exposes the bottomset sand beds of the delta. The upper portion of the pit beautifully reveals the topset-forest contact at 525ft within interbedded gravels with some sand. There is no ice contact deformation evident in the exposure and supports the notion this is an open water delta of the small brook exiting the Adirondacks. The valley wall portion of the Street Road delta has numerous kettles and suggests the delta buried recently stranded ice.

Discussion: Rayburn (2004) mapped Champlain Valley strandlines as far south as Ticonderoga, NY, and Brandon, VT. On the New York side of the valley, no strandlines higher than Lake Coveville were found; across the valley in Vermont, there are higher deltas in Brandon, VT. The highest one is Chapman's (1937) Forest Dale delta that was originally thought to be CV but it is better correlated with QS at 560-570ft. The northern termination of QS strandlines perhaps at the Fernville kame moraine at the north end of Forest Dale suggest that this may have been the ice margin position when the lake dropped from QS to CV. It is interesting that there is no QS delta or obvious kame terrace above the Street Road delta. But, the vicinity is tightly constrained by the surrounding Adirondack Mountains where the brook spills out onto the lowland and there may have been little or no time passage between ice recession to the kettled area next to the valley wall and the drop from QS to CV.

However, south of the Street Road delta on the Ticonderoga and Putnam quadrangles, there are lake sediments that correlate to a higher lake and suggest the ice margin was near or at the Street Road delta at the time QS dropped to CV.

Just north of the Street Road delta is are a complete series of well defined CV and FA strandlines in the upland west of the Town of Crown Point. Most of these strandlines were recognized by Connally and Cadwell (2002), but correlated to different levels than stated in Rayburn (2004). A small delta fan at 525ft (161m) is at the Coveville level. Terraces at 440ft (135m), 350ft (108m), and 185ft (56m), are at the highest Fort Ann, lowest Fort Ann, and highest Champlain Sea levels respectively (Rayburn, 2004). The Town of Crown Point is built on the highest Champlain Sea delta terrace. The foreset-topset contact in the Coveville level Street Road delta is at about 525ft (161m). These strandline measurements are in good agreement with the 0.70 m/km isostatic rebound estimate for the entire valley data set.

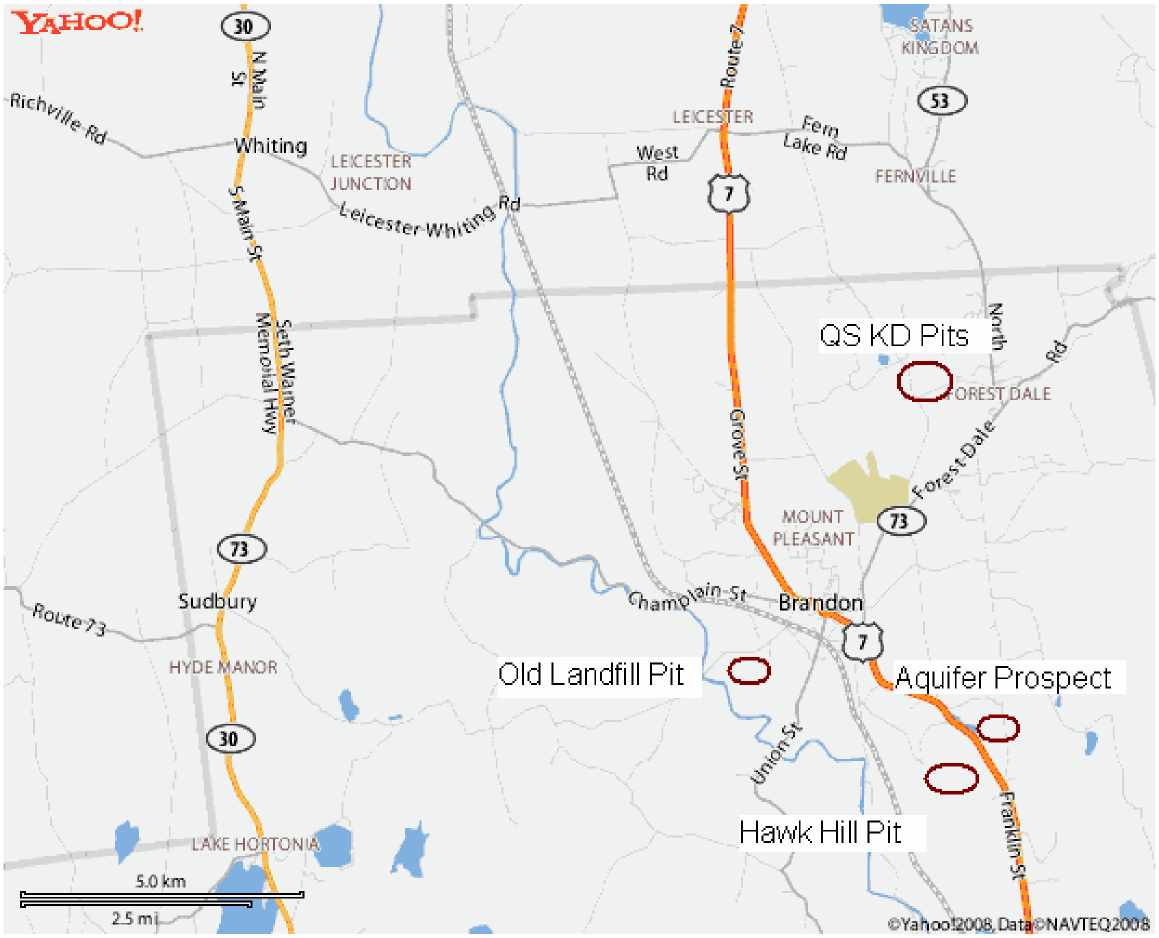
By projecting this rebound trend southward into the Hudson Valley we hope to unravel the earlier deglacial story hidden among the Lake Albany strandlines, lacustrine sediments, and ice marginal deposits.

Topsets over Foresets in Street Road Delta

Bottomsets of Street Road Delta

Dresden Station Subaqueous Fan:
Location: Putnam quadrangle along Rte 22.
Parking: N 4836666, E 0627970 at entrance to the pit.
Ownership & permission: Richard Dedrick Trucking & Excavating of Putnam Station, NY. Call Richard @ 518-547-8432.
Description: Striated and grooved bedrock ridges with steep flanks are capped with subaqueous fan gravel and sand beds that fine upward to lacustrine sand. The top of the deposit has been terraced at an elevation of 190ft, likely a FA terracing event. There is no till atop the bedrock.

B. Neshobe Valley Stops



Friday Trip Stops

Ice Contact Fan, Glaciolacustrine Sediment and a Coveville Beach Spit:

Location: Brandon quadrangle along Rte 7. Proceed 0.1mi north from the Rte 7-McConnell Road junction. Turn west into the entrance of Naylor & Breen Builders, 2335 Franklin (Rte 7). Bear left at the pit entrance.

Parking: N 4848598, E 0656624, at the pit gate. Drive into the pit and park at a convenient location near the bottom of the excavations.

Ownership & permission: Markowski Excavating, Inc.; Greg Markowski @ 802-483-6469. Access has always been granted to this pit.

Description: Folded carbonate rock exposed in places is polished and striated with striations averaging 182° and ranging from 180-185°. The rock is jointed and there are dissolution pockets along some joint surfaces. Slumped and normally faulted ice contact gravel and sand interbeds lie directly in contact with bedrock; there is no till. Small boulder to cobble gravels infill lows in the bedrock topography. The proximal subaqueous fan gravel and sand unit generally fines upward to interbedded sand with gravel. There are ripple drift laminations, graded beds and flame structures within the lacustrine sands. The sediments fine upwards to interbedded fine sand and silt, distal and deeper water lacustrine sediments. The topmost unit of the excavation can be seen against the flank of the Hawk Hill steep cliff. Here, a sand spit is exposed. The medium to fine sand and cross stratification along with the morphology of the deposit indicates this is a spit of sand deposited by a long shore transport of sand. The 430ft level is consistent with deposition in Lake Coveville.

Discussion: The subaqueous fan and bulk of the deep water lacustrine sediment was most likely deposited in Lake Quaker Springs. There are QS strand line features elsewhere in the quadrangle. When QS drained to CV, this area became very shallow water and a cap of shallow water lake sand exists further north in this small, narrow but deep valley. Coveville strand line features are common throughout the area.

Quaker Springs Kame Delta & Forest Dale Delta:

Location: Brandon quadrangle on Blackberry Lane off Country Club Road. Proceed 3.4mi north on McConnell Road from the Rte 7 junction. Turn east on Rte 73for 0.4mi and turn on Rte 53 in Forest Dale. The route takes you across the top of the Neshobe River's Forest Dale delta deposited into QS. Go 0.2mi on Rte 53 and turn west on Newton Road. Take Newton Road 0.8mi to its end. You have traversed down the Forest Dale delta across a transitional QS to CV fan. Turn north on Country Club Road, cross the Neshobe River, and turn east at 0.4mi onto Blackberry Lane. Follow this dirt road to entrances to 2 excavations.

Parking: N 4855378, E 0655046, at the pit entrances. Drive into the pits if the gates are open.

Ownership & permission: The pit on the left is owned by Markowski Excavating. As with the previous pit, call Greg Markowski for permission @ 802-483-6469. The pit on the right is owned by DF Excavating & Paving of Middlebury, VT. Call Gary Dupoise @ 802-388-2338.

Description: Collectively, both pits reveal a generally progradational sequence of deltaic gravel and sand deposited from a melt water source in the ice to the north. The Markowski pit reveals a likely point source of sediment as the beds dip both to the west and east, fanning outward from a central melt water source. The DF pit has gravel and sand beds burying carbonate bedrock ridges that have a steeply sloping topography. The polished and striated bedrock surfaces reveal the initial flow of ice up at 120-130° and across the steep flank of the bedrock ridge with a more regional ice flow trend of 160-170° on the top of the ridge.

The progradational sequence reveals foreset type sand and gravel beds prograded over finer bottomset type sands. There is evidence in the form of graded beds and gravel lenses and pods of down slope flow and/or slump of sediment on the fore slope of the deposit. The top of the DF pit reveals several feet of horizontally bedded gravel and sand that represents topset beds. The east wall of the DF pit reveals a bouldery deposit that may represent deposition from supraglacial debris, perhaps a lateral moraine that slid or slumped into the prograding delta.

Discussion: This deltaic sediment was deposited contemporaneously with the Neshobe River's Forest Dale delta into QS. While the Forest Dale delta was from a meteoric or Green Mountain melt water source, the Fernville kame moraine deposits that end with the observed deltaic sediments was from a lateral ice marginal melt water source. It would be interesting to compare the lithologies and mineralogies of the sediment at both the clast scale and at the microscopic scale in this and other deposits where a very different bedrock source may be in play.

Old Town Landfill Excavation in Subaqueous Fan, Lacustrine and Fort Ann Beach:

Location: Brandon quadrangle. Proceed into Brandon village and approach the junction of Rte 7 and Rte 73W. At the post office, turn south onto Pearl Street, not onto Rte 73W.

Go 0.5mi on Pearl Street to Corona Street and turn south on Corona. Continue only approximately 0.2mi just past the log house on the west.
Parking: N 4850390, E 0652939, at pit entrance. Turn into the old pit entrance and park. There is no easy turn around at this access point so you may have to back multiple vehicles out onto Corona Street when you leave.
Ownership & permission: The Town of Brandon owns this property and operates a transfer station at the end of Corona Street. Do not block the transfer station access. Arrange for access at the Town Offices located along Main Street (Rte 7) at the corner at the end of the row of shops on the north side of the street.
Description: The carbonate bedrock exposed throughout this pit has been beautifully sculpted by glacial abrasion. There are numerous small ridges and troughs in the bedrock and all are polished and striated with striations averaging 160°. Local flow of ice between, up, over and down the ridges can be verified by the curving striations present.

Proximal subaqueous fan gravel and sand was deposited in the north end of the pit atop the bedrock with more distal fan sand in the south end of the pit. There is no till. In the deeper waters to the south, the sequence fines upward. Deep water distal fine grained lacustrine sediment can be seen near the top. At the north end of the pit, there is a coarsening of sediment consistent with the development of a Fort Ann strand line or beach at approximately 420ft elevation.

Old Town Landfill Pit

McConnell Road Aquifer Prospect Initial Evaluation:
Location: Brandon quadrangle. Proceed 0.6mi north on McConnell Road from the McConnell Road junction with Rte 7.
Parking: N 4849393, E 0656624. Turn off onto the edge of the corn field and park.
Ownership & permission: The farm is owned by the Terry family and the house is the first one you see to the south on this road.
Description & Discussion: The Vermont Geological Survey (VGS) recently competed mapping of the surficial geology and hydrogeology of the Town (De Simone, 2005). The analysis of well logs throughout the town indicated several likely overburden aquifer prospects in addition to the Town's main overburden aquifer in the Forest Dale delta and ice contact deltaic sediments that comprise the first stop in this section. The Neshobe River, a proven losing stream, contributes considerable recharge to the aquifer in Forest Dale. The town was interested in learning more about this McConnell Road aquifer prospect due to its location distant from the Neshobe River and the current water supply aquifer and located in the southern part of the town.

Accordingly, the town contracted with the VGS to undertake seismic and gravity surveys of this farm field in order to better understand the depth to bedrock, the texture and thickness of the overburden materials, and to aid in the determination of a site for test drilling. The nature and results of the survey will be part of the Friday field discussion.

Aquifer Prospecting in Brandon

C. Poultney-Castleton Valley Stops

Like the Mettawee Valley, the Poultney and Castleton valleys drained towards the retreating ice and, thus, were sites of ice fronted glacial lakes. The up valley regions have not recently been studied in detail although part of the upper Castleton Valley is scheduled for mapping this season by the VT Geological Survey.

The Poultney valley glacial lake drained into and merged with Lake Quaker Springs when the ice retreated from East Poultney, VT. There is an extensive outwash fan and delta that extends from East Poultney through Poultney to Hampton, VT.

Along the Castleton Valley just south of Castleton Corners, there is what may be a head of outwash in the south draining Lewis Brook valley that appears to be graded to QS. Exposures in this ice contact deposit reveal south dipping beds and this may be the path of the Castleton Valley drainage. There are 2 good commercial excavations, one just north of the junction of Rte 30 with South Street, and the second one accessed from Walker Road approximately 2 mi south along Rte 30.

Later, the Poultney and Castleton Rivers deposited a single large CV delta extending through Fair Haven and Low Hampton, VT.

No stops along these valleys are planned for this trip.

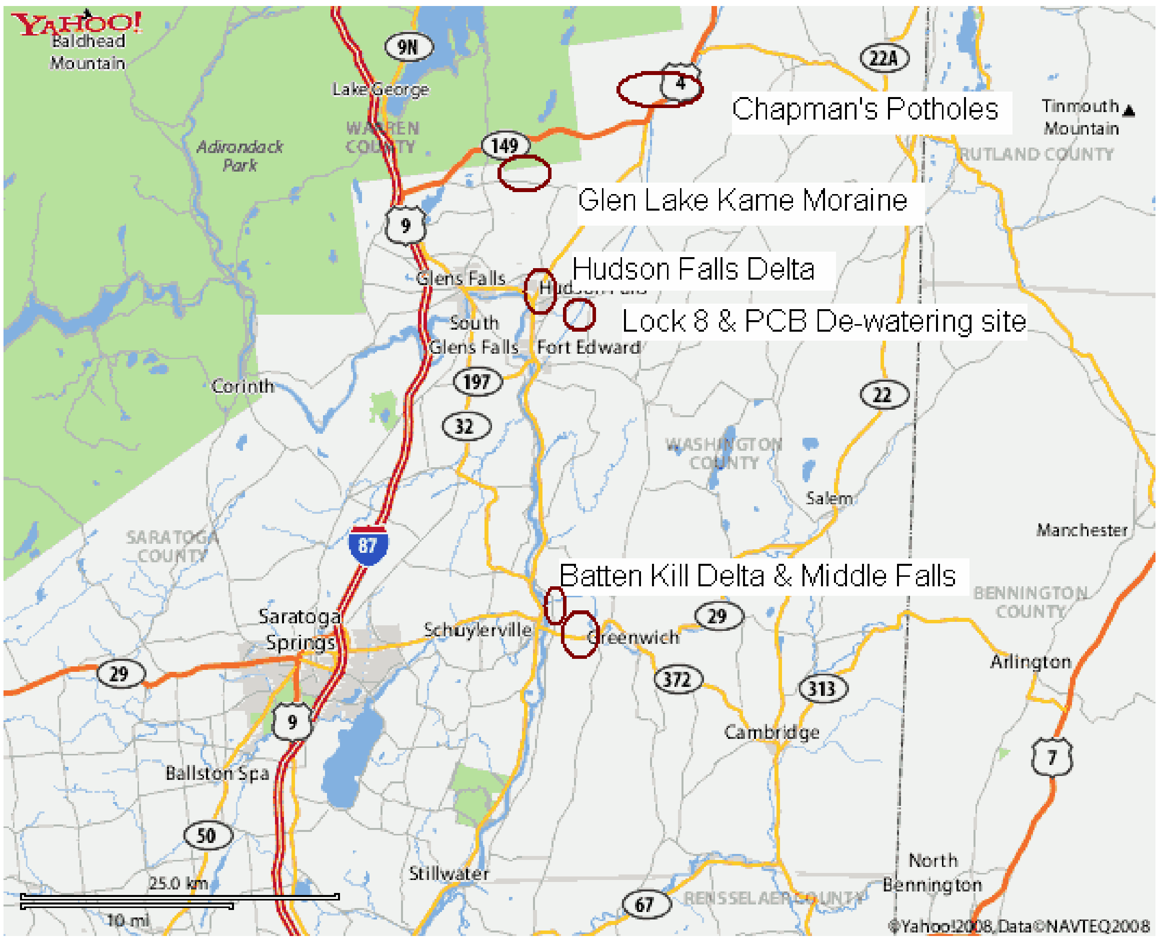
D. Mettawee Valley Stops

There are numerous good features to see in this valley from the drainage divide with the Batten Kill in Dorset, VT, down valley to the confluence of the Mettawee River with Wood Creek and the H-C Canal in Whitehall, NY. This upper part of the valley was the site of a series of ice fronted lakes distinct from Lake Quaker Springs. Mapping in

Dorset (De Simone, 2007) reveals the first lake, Lake Dorset, drained across the divide and down the Batten Kill valley. The later lake, Lake Granville (De Simone, 1985, De Simone & LaFleur, 1985, 1986) may have had multiple levels controlled by the retreating ice. However, when the ice retreated far enough to open the valley at Granville, the lake merged with Lake Quaker Springs. There is a QS delta at Granville (see De Simone & La Fleur, 1985, Stop #8) and a CV delta down valley at West Granville. There is no FA delta of the Mettawee River as the river was merging with the flowing waters discharging through the Wood Creek and Fort Edward channels above the threshold.

No stops are detailed for this trip as none are planned and old exposures in the area are no longer in excellent condition.

E. Hudson River-Fort Edward Channel Confluence Stops



Saturday Trip Stops

These stops encompass the area where the Hudson River spills out of the Adirondack Mountains and flows across the overburden mantled valley to its confluence with the Fort Edward Channel, the main channel of the Fort Ann Outlet Channels that carried the Fort Ann outflow down the Hudson Lowland. The western portion of this area will also be examined during the NYSGA meeting in September, 2008. So, please come along and we will study many different exposures than on this trip. The September trip will focus on areas to the west and north of our FOP host facility while this trip dwells on areas mostly to the east and south.

Glen Lake Kame Moraine – Kame Terrace:

Location: Putnam Mountain quadrangle. Proceed approximately 2.8mi east on Rte 149 from the junction of Rte 9 and Rte 149, near I-87 Exit 20. Continue past the Bay Road junction east for an additional 1.4mi to the Rte 9L junction. From this point, there are several gravel and sand excavations with access from Rte 149. The first is approximately 0.8mi to the east with another smaller pit in sand another 0.1mi east behind the self storage facility. Continue along Rte 149 from the Rte 9L junction a total of 1.6mi to Patten Mills Road and turn south on this road. Proceed 0.8mi to the entrance of the Jointa Galusha excavation. There is another excavation adjacent to the Washington County closed pit on Tripoli Road. This excavation can be accessed by continuing on Rte 149 to the next intersection with Tripoli Road on the south and Hadlock Pond Road on the north.

Parking: N 4805293, E 0613466 at the entrance gate. After checking in at the scales office, drive to the left and park before the sorting operation if it is busy or drive down to the edge of the pond at the bottom of the pit if there is no activity.

Ownership & permission: Jointa Galusha, John Davidson @ 5158-792-5029.

Description: Bedrock ridges in the pit trend approximately 070° and striations. Although faint in the gray gneiss and black amphibolite, average 220° and range from 210-230°.So, the H-C ice lobe flowed subparallel to the orientation of the bedrock ridges in this area during at least the later thin ice stages.

In the bottom of the excavation, well sorted sand and well sorted gravel occur. The sand beds show some ripples and deformation likely the result of loading and de-watering of the sediment. Above, there are interbeds of gravel and sand. Some cobble gravel beds are free of matrix Clast supported gravel beds might exhibit grading upward to sand beds. The sequence is repeated a few times in these thick beds. Near the top of the excavation, sand beds predominate and the sediment appears more lacustrine. Small dunes are evident on the top surface of the feature.

Discussion: The Glen Lake kame moraine-kame terrace is an extensive deposit that covers portions of 4 quadrangles – Putnam Mountain, Hudson Falls, Lake George and Glens Falls. The deposit is the most extensive ice marginal accumulation of sediment north of the Hudson-Mohawk confluence. Likely, the H-C lobe maintained a position here along its western-northern lateral margin while the front of the lobe and eastern margin retreated rapidly. This was possible due to the Glen Lake area being close to the ice source coming from the Champlain Valley. The long duration of the ice margin here would account for the extensive and thick accumulation of sediment.

The kame terrace generally tops at approximately 520-490ft along its entire length of approximately 14 miles to the base of the Luzerne Mountains. It is a recessional moraine and there is no evidence of readvance observed within exposures as of this writing. It is very possible the deposition in this deposit was time transgressive with some portions of the moraine accumulating before other portions. However, the moraine is apparently graded to a persistent base level along what was the northern and western edge of the H-C lobe. An ice marginal lake may have persisted in the area of the kame moraine, a lake dammed by the ice and extending northward into the Lake George basin and adjacent basins. If true, then 500ft would be an approximate maximum elevation of the highest level of Glacial Lake George.

Ice recession from the base of the Palmertown Range to the south allowed the GlacioHudson River to have its first access to the valley and it deposited the West Glens Falls open water delta into AB II. Eventual ice recession from the kame moraine allowed Glacial Lake George to lower and this outflow deposited the Oneida Corners fan delta into Lake Quaker Springs. Contemporaneously, the GlacioHudson River built its major Glens Falls delta into QS.

Ice margins (De Simone, 1985, De Simone & La Fleur, 1985, 1986) through this area are similar to those of Chadwick (1928) and La Fleur (1979).

Hadlock Pond:
As mentioned above, Hadlock Pond road joins Rte 149 opposite the junction with Tripoli Road. One of the most prominent news events to affect the Town of Fort Ann in recent memory was the failure of the newly replaced Hadlock Pond earthen dam. The new dam can be seen a short distance along the road to the pond. The down stream impacts of this catastrophic flood event are visible along Rte 149 where the outflow stream crosses the road in 2 places.

Hudson Falls CV Delta:
Location: Hudson Falls quadrangle. Proceed south along Rte 32, Burgoyne Avenue, approximately 1.0mi from the junction with Rte 4 in the city of Hudson Falls. The flat surface you are crossing is the top of the delta. At the junction of Burgoyne Ave and Rte 196, Maple Street, continue on Burgoyne for approximately 0.6mi to the entrance to the Feeder Canal Park on the east side of the street.
Parking: N 4794657, E 0615975. There is limited parking in this small lot.
Ownership & permission: This is a public park owned by the city of Hudson Falls.
Description: In 1984 when this site was first visited by your senior author (not quite so senior at the time), the pit was freshly exposed and not much material had been removed. A photograph was taken that shows the topset-foreset contact in this delta at approximately 260ft. The exposed sediment was predominantly sand and the topset beds were approximately 10ft thick. The elevation at the parking area was measured at 270ft, in close agreement. There is little exposed sediment except on the high north bank of the landfill. A short walk down the trail will lead you to a stream bank exposing bottomset and perhaps foreset beds of the delta.
Discussion: the Feeder Canal serviced the sawmills at Glens Falls from the 1820-s to the 1840’s, approximately 3 miles uphill from the H-C Canal below you. The steepest lock section known as the 5 combines is preserved here in the park. The locks were necessary as river traffic along the Hudson below Glens Falls is blocked by another major falls, Bakers Falls, the site of a former power dam and an intake to the well publicized General Electric PCB capacitor and transformer plant in the city of Hudson Falls.

The GlacioHudson River has AB II, QS and CV deltas successively stepped down to the east from where the GlacioHudson spilled onto the lowland from the Adirondack Mountains. Prior to the opening of the Hudson Valley west of this site during AB II time, the Hudson was blocked and flowed along the path of the Kayderosseras Creek where it spilled onto the valley floor and deposited its AB I delta at Milton many miles to the south.

H-C Canal Lock #8 and the PCB Dredging Story:
Location: Hudson Falls quadrangle. Proceed east along Rte 196 from the Burgoyne Avenue-Maple Street intersection mentioned above. Go approximately 1.0mi and turn south at the new access road to the lock just before the bridge over the canal at Dunham’s Basin. Continue along this new road atop the canal dredgings on the west bank of the canal to the canal park.
Parking: N 4793013, E 0616915.

Ownership & permission: This is property maintained by the NY State Canal Authority but the public has access to the park at the lock.
Description: The elevation of the Hudson-Champlain divide at the Wood Creek-Dead Creek drainage divide several miles to the east is 147ft. At this parking area, the elevation was GPS measured as 145ft, identical to the benchmark at the lock. This is the floor of the Fort Edward channel, the largest of the Fort Ann outlet channels as originally described by Woodworth (1905), elaborated upon by Chapman (1937) and further detailed by De Simone & La Fleur (1985, 1986). The Wood Creek channel is comparatively broad, flat floored and cut into lacustrine silt-clay. In contrast, the Fort Edward channel is more sharply delineated along its flanks and has eroded overburden down to bedrock in many places between Fort Ann and the Hudson-Mohawk confluence we will visit on Sunday. The modern Hudson River is confined between the walls of this Fort Edward channel due to the erosion caused by the Fort Ann outflow. To the south, the Fort Edward channel joins the pre-glacial channel of the Batten Kill and has been referred to as the Hudson-Battenkill channel. The modern Hudson joins this channel approximately 2.5mi to the south.
Discussion: The sign across from the canal lock identifies the entrance to the Hudson River PCB de-watering facility undergoing construction. Dredging of the Hudson River PCB hot spots is scheduled to begin in April 2009 and no further delays in this dredging are anticipated. The de-watering facility will extract water from the contaminated sediment and the sediment will be shipped by rail to an off site location.

The history of the contamination of the Hudson River with PCB's is an interesting and curious one with seemingly fateful events.

PCB Contamination of the Hudson River;

Here are a few facts about the history of PCB use obtained from www.clearwater.org :

*1929 Monsanto begins making PCB's.
*1936 First study reveals they may cause health problems.
*1947 GE uses PCB's in the manufacture of capacitors at the Fort Edward plant.
*1952 GE uses PCB's at a second plant in Hudson Falls.
*1973 DEC removes dam from the river at Fort Edward and PCB's migrate down river. PCB's had been largely isolated – but no one knew this – in the sediment below the dam between Hudson Falls and Fort Edward.
*1974 EPA testing reveals high levels of PCB's in fish.
*1976 Toxic Substances Control Act bans PCB production in USA by 1/1/77.
*1976 Major flood in April sends PCB's down river to accumulate in approximately 40 hot spots.
*1976 GE and DEC agree to halt PCB discharges into the river and that GE would not be liable for cleanup provided there are no more discharges into the river.
*1978 DEC proposes dredging 40 hot spots.
*1980 Superfund lists PCB hot spots as possible sites. GE would be $ responsible.
*1982 EPA recommends dredging.
*1984 EPA proposes "no action" be taken to remove the PCB's.
*1987 EPA proposes test dredging.
*1989 EPA & DEC propose $300,000,000 dredging plan.
*1991 Hudson River PCB levels down to 45ppt and fish levels range from 3-5ppm. 2.0ppm considered safe for consumption.
*1992 Hudson River PCB level UP to 4,539ppt. Fish levels up to 18-65ppm. WHY? In 1990 or 1991, a 20x20 foot wooden gate across the old raceway into the abandoned Hudson Falls plant rotted and failed probably during a high flow event. The river flooded the basement of the abandoned plant which was full

of PCB. The liquid PCB emptied into the river. This represented a new discharge and violated the 1976 liability agreement.

*Subsequent analysis revealed seepage coming into the river from the shale cliffs beneath the abandoned plant consisted of 28% H_2O and 72% PCB. Was the shale cliff a source of contamination since 1952?

*1993 DEC & GE agree to begin clean-up of the plant facilities.

*1994 EPA delays final decision.

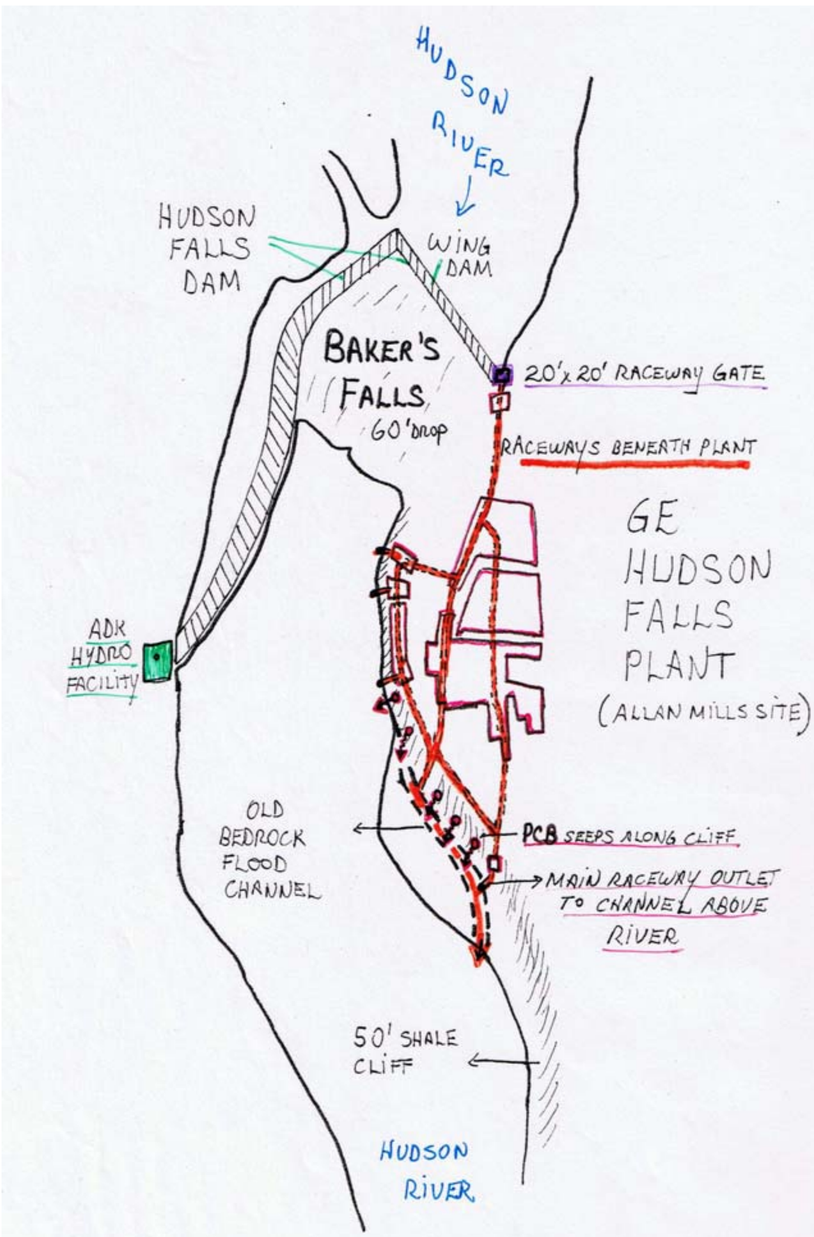
*1999 EPA delays decision again.

*2000 EPA recommends dredging.

*2001 EPA Record of Decision (ROD) represents a legally binding order to remediate.

*2002 EPA's ROD calls for dredging 2,650,000 cubic yards of contaminated sediment from major hot spots between the former Fort Edward dam and the Federal Dam in Troy over a 6 year period. A facility site selection summary was issued.

*2004 The site adjacent to Lock #8 was selected as the de-watering facility location. Modification of the canal and construction of a rail yard are part of the plan to ship the de-watered sediment off site to a secure landfill.



Sketch of the PCB contamination source area

Chapman's Potholes:
Location: Fort Ann quadrangle on Flat Rock Road, a small loop of old Rte 4 between the H-C Canal and present Rte 4. The junction with Rte 4 is approximately 1.5mi north of the Rte 4 – Rte 149 junction in Fort Ann Village. The road is between the village of Fort Ann and the Rte 22 junction north of the village.
Parking: N 4809487, E 0624274; park at the edge of the railroad tracks and proceed across the tracks and up onto the outcrop to the south.
Description: There is a pothole visible in the opposite wall of the canal. Also, there appear to be potholes present on the top of the outcrop in the brush near the south end of the outcrop and along the south face of the outcrop. These potholes have been largely covered by organic litter and have vegetation growing in them.
Location: Fort Ann quadrangle on the north side of Rte 4 approximately 0.4mi south from the junction with Flat Rock Road. *This is a very heavily traveled 55mph passing zone along Rte 4 and extreme caution is urged!*
Parking: N 4809022, E 0623199; park off the north side of the road where there is a little used turnoff into the grassy area.
Description: There are 4 large potholes visible in this outcrop of granitic gneiss. All are semi-circular in form and extend down below the present graded ground surface.
Discussion: Chapman (1937) described the location of numerous potholes along the Hudson-Champlain Canal north of the village of Fort Ann. These potholes have been interpreted to be the result of the outflow of Lake Fort Ann as that discharge passed through the primary Fort Edward channel of the Fort Ann outlet channels. More specifically, the potholes are concentrated in the area where the channel is constricted by the steep granitic gneiss flank of Battle Hill to the north and the predominantly carbonate bedrock platform to the south.

Pothole formation has been attributed to mechanical abrasion by stream bed load into the rock bottom of a channel. Eddying in very powerful flow may be the mechanism of formation for the potholes observed in this Fort Ann outlet.

Pothole in Canal Wall

Pothole on Flank of Battle Hill in Gneiss

F. Batten Kill Confluence Stops

Batten Kill Quaker Springs Delta:

Location: Schuylerville quadrangle on Windy Hill Road. Proceed approximately 0.5mi west along Rte 29 from the Rte 29 – Rte 40 junction. Turn north onto Windy Hill Road and proceed approximately 0.9mi to the Tracy Materials bank entrance on the west side of the road opposite the red barn.

Parking: N 4773456, E 0616473; park at the gate if it is locked but drive into the pit if the gate is open.

Ownership & permission: Tracy Materials, Windy Hill Bank; Charles & Ken Tracy @ 518-695-3009. The Tracy brothers have traditionally allowed access to their operations on both sides of Windy Hill Road. Call first.

Description: This shallow bank exposes the topset – foreset contact in the Quaker Springs delta of the Batten Kill. The elevation of this contact is 323ft as measured by both Garmin Foretrex 100 GPS and Brunton Altimeter.

Discussion: The adjacent Hollingsworth-Vose paper mill landfill formerly exposed the same topset – foreset contact at a map determined elevation of 320ft. This landfill can be seen from the Windy Hill bank.

The sediment previously exposed along a traverse down to the Batten Kill from the red barn on the east side of Windy Hill Road consists of deltaic gravel and sand of inferred topset, foreset and bottomset origins interfingering with and transitioning downward to bottomset lacustrine silt and clay with till and bedrock exposed along the river.

The ridge trending NE and shown on the topographic map represents a bedrock promontory that aligns with Bald Mountain to the northeast. Carbonate rock has been quarried at the foot of Bald Mountain and in another ridge that strikes northeast through Middle Falls about 1 mile to the east (Peckham Industries). At Middle Falls, the Batten Kill has dissected through the ridge and a prominent nick point with a falls and downs stream gorge exists. This nick point and gorge represents the path of the Batten Kill initiated after Lake Quaker Springs dropped to Lake Coveville and subsequent lower base levels represented by the Fort Ann discharge through the Holocene. Downstream at Clarks Mills, is the lower falls of the Batten Kill. Here, the river has cut across and through the east wall of the primary Fort Edward channel that carried the bulk of the Fort Ann discharge. The upper falls of the Batten Kill is located within Greenwich, approximately 1.3mi as the crow flies from the middle falls. Between the middle and upper falls lies the pre-glacial channel of the Batten Kill. This channel cuts southwest and follows the prevailing bedrock strike to the present Hudson River. The Hudson River flows in the Battenkill channel as depicted by Dineen (1983) below this confluence of preglacial channels.

There are neither Lake Albany I nor Lake Albany II deltas of the Batten Kill. As previously detailed (De Simone, 1977, 1983, 1985, De Simone & La Fleur, 1985, 1986, Dineen, De Simone & Hanson, 1988), Lake Albany had dropped to Lake Quaker Springs before the Batten Kill confluence with the Hudson was deglaciated. This conclusion merely adds detail to an observation made by Woodworth (1905).

The onset of Lake Quaker Springs was possibly the result of a catastrophic failure of an unknown moraine dam that held the lake. Once Lake Coveville was established, the Batten Kill dissected through the Quaker Springs delta. The narrow gorge cut by the Batten Kill may explain why there is no Coveville delta of the Batten Kill. There is a series of fluvial terraces that contain 5-20ft of poorly sorted fluvial gravel with sand, predominantly horizontally bedded and deposited atop truncation surfaces developed upon foreset and bottomset beds of the delta.

Lower Falls of the Batten Kill:
Location: Schuylerville quadrangle on River Road. Continue on Windy Hill Road from the previous stop to the junction with Hogsback Road and proceed straight on Hogsback Road down the fore slope of the delta to the junction with River Road.
Parking: N 4774395, E 0616473; park at the side of the road at the fishing access sign. Walk cautiously along the path up the rock outcrop to view the falls.
Ownership & permission: Hollingsworth-Vose property with open access for recreational use.
Description: This is the Clarks Mills or lower falls of the Batten Kill described above. Prior to minor grading along the path up to the falls, there was till/bedrock exposed along the path. The bedrock was striated. A photograph exists of this site in the senior author's files. Elevation at the top of the falls is 123ft.

H-C Canal and Park at Lock #5:
Location: Schuylerville quadrangle east of Rte 4 and north of the village of Schuylerville. From the previous stop, proceed south along the River Road approximately 1.2 mi to the junction with Rte 29. Turn west on Rte 29, across the Hudson River into Schuylerville. Turn north at the stop light on Rte 4 and proceed approximately 0.8mi to the access road for the lock marked by a sign.
Parking: N 4774095, E 0615615; parking lot with picnic tables for a possible lunch stop.
Ownership & permission: The NY State Canal Authority controls access to the property but the picnic area is open to the public.
Description: The old 1824 canal is preserved here along side the present canal.

G. Hoosic River Confluence Stops

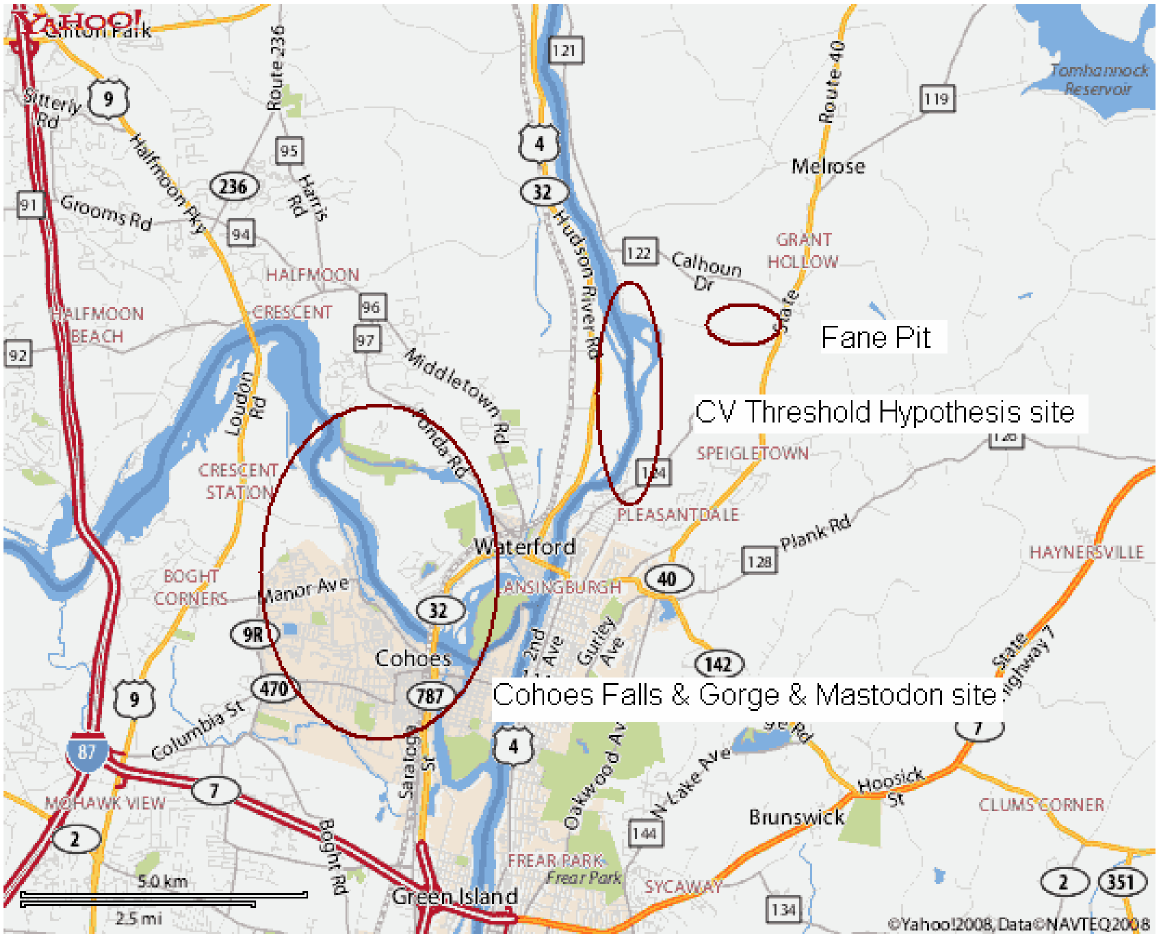
Fort Ann Fluvial Terrace:
Location: Mechanicville quadrangle on River Road. Proceed east across the Hudson River from the junction of Rte 4 and Rte 67E. In 2008, the bridge over the Hudson here was undergoing renovation with one lane traffic only. The approach to this intersection on Rte 4 from the south was detoured. Expect traffic delays. Proceed approximately 0.5mi from this intersection into Hemstreet Park to the junction with North Linden Ave. Turn south on this street which becomes River Road and continue approximately 1.1mi to the pit entrance on the east side of the road.
Parking: N 4748686, E 0608102; The UTM coordinates mark the pit entrance. Turn in and follow the access road to a convenient place to park.
Ownership & permission: Troy Sand & Gravel, Reynolds Pit; Carl Clemente @ 518-674-2854. Advance permission will be required and some time may pass before permission is granted. Hard hat required by the owner.
Description: The elevation at the pond situated in an abandoned Hudson River channel is 84ft. The terrace elevation is 110ft. The base of the pit exposes truncated lacustrine silt and clay varves. Atop the truncation surface is approximately 5-6ft of poorly sorted pebble and cobble gravel with sand. The terrace sediment generally fines upward but much of the top of the terrace has been excavated. The pit reveals knobs of shale eroded of glacial sediment cover by the Fort Ann discharge. Waning flow likely deposited the fluvial sediment as sand and gravel bars in a possibly braided channel setting.

Location: A second pit in the same sediment is better exposed. Proceed south on River Road approximately 0.7mi to the Allen Road junction. Turn north on Allen Road and continue approximately 0.5mi to the pit entrance.
Parking: N 4748182, E 0608649; These are the UTM coordinates for the pit entrance.
Ownership & permission: Not known but the pit operator was very friendly and allowed access on site, no questions asked.
Description: Nearly 15ft of interbedded sand and gravel is exposed in an extensive set of pit faces. The sand and gravel represents low angle channel fill gravel with a fine to medium pebble and small cobble gravel. This is consistent with a series of braid bar channel deposits left during waning flow of the Fort Ann discharge, perhaps due to seasonal or event variations in flow or following the initial Fort Ann flood burst.
Discussion: The form of the deposits at both pits collectively represents at least 3 large gravel bars separated by 3 shallow channels east of the present Hudson River. The elevation of the terraces places them well above the flood plain. Remember, the Hudson River is maintained effectively at flood stage due to the series of canal locks. The true meandering path of the Hudson within the Fort Ann flood channel can be seen only in the winter before the gates are closed at the locks.

Most of the pits in the deltas of the Hoosic River have closed over the years.

Fort Ann Terrace Sediment

H. Hudson-Mohawk Confluence Stops



Sunday Trip Stops

Cohoes Falls:

Location: Troy North quadrangle at the Cohoes Falls Overlook Park.

Parking: Limited parking is available along the narrow residential streets near the overlook. Please park in the lot across from the large arch in the Harmony Mills main mill building. From there, walk up the hill and cross the heavily used street to reach the overlook.

Ownership & permission: This is a state owned public park.

Description: Gary Wall's text in the guidebook describes the falls, gorge and modern underfit channel of the Mohawk River in detail.

Discussion: The IroMohawk River eroded much of the overburden from the bedrock as it swept downstream to this junction with the Hudson River. As you look around the area above the gorge, notice the escarpment behind you as this was where the initial flood burst reached. The Iromohawk began to channelize across this exposed bedrock and nick points developed at the western Hudson Valley wall and just west of the modern Hudson River. The headward migration of the upper nick point formed the gorge above the falls and the headward retreat of the lower nick point carved a network of distributary channels at the mouth of the Mohawk which coalesced to form the lower gorge. When the Covey Hill gap opened, Lake Iroquois lowered and the Iromohawk and the headward retreat of the lower nick point ceased. The position of the falls today is much as it was the day Covey Hill gap opened, the falls retreating no further in that time than the width of the modern plunge pool. The exceptionally low rate of retreat results from the fact that the modern river is underfit in the gorge. The work of the modern Mohawk includes the plunge pool and the irregular sub-channel in the floor of the lower gorge which appears to be an interconnected series of Iromohawk potholes. Although Hall (1871) didn't recognize the Mohawk as underfit, his cross-section of the lower gorge puts the work of the modern river relative to the Iromohawk in perspective (Hall, 1871 – Plate 2 no. 2).

The base level required for the Iromohawk to cut the gorge downstream of the falls needs to be approximately that of the modern Hudson. Therefore no glacial lake existed in the Hudson Valley at the Hudson-Mohawk confluence at the time of the demise of Lake Iroquois and the Iromohawk. If Lake Iroquois spilled into the Coveville phase of glacial Lake Vermont (Rayburn, 2005) and Lake Coveville drained through the Hudson Valley, then the Coveville threshold must have been north of the Mohawk-Hudson confluence. If the threshold was south of Mechanicville as proposed by De Simone, then a long-standing debate over why the modern Mohawk occupies the southernmost of 3 major Iromohawk distributary channels, which cut across the Hudson-Mohawk lowland, can be explained by the southern route having a lower base-level than the others during the later stages of Iromohawk drainage.

Cohoes Mastodon, Younger Dryas Forest and Surficial Geology:

Location: Troy North quadrangle at the Cohoes Falls Overlook Park. Walk to the south end of the park path to the down stream view. The area in back of the Harmony Mills main building is visible below.

Description: Norton Miller's text in the guidebook describes this site in detail.

Discussion: The purpose of this stop is to present information about the drainage history of the Mohawk River, Younger Dryas plant fossils and associated sediments in an excavation in Cohoes, and the radiocarbon-dated Cohoes mastodon.

The plant fossils appear to have been deposited in a small (~10-m-long) depression in bedrock. The peat contained small, angular shale clasts, perhaps indicating deposition from flowing water. The thinness of the organic deposit suggests that the sediment-accumulating basin functioned for a short time or that topmost sediments were removed by erosion or by other means. Because the overlying clay appears to date from the colonial period, it appears to have been transported from elsewhere and emplaced during construction, possibly during canal building. Some of the organic deposit may have been removed at this time or later during extensive and repeated industrial and other development that occurred along this part of the Mohawk River, or possibly the entire organic bed is the result of excavation.

The pollen and plant macrofossil assemblages consist almost entirely of fossils from the conifer dominants of the extant boreal forest, namely white spruce, balsam fir, and tamarack. Presence of only a few fossils from fen or other non-forest plant communities indicates that the vegetation was largely forest. The peat contained fossil cones of white spruce (*Picea glauca*), and this species may have been the principal Younger Dryas spruce in the region. No macrofossils of pine were present, but pine pollen, morphologically similar to that of jack pine (*Pinus banksiana*), comprises about 14% of the assemblage, which indicates that jack pine occurred beyond the source area of the macrofossils. No alder macrofossils were found, but a small amount of alder pollen (1.5% from both *A. rugosa* and *A. crispa*) indicates a minor role for alder in the vegetation.

Comparisons between percentages of spruce, balsam fir, and tamarack in pollen, needle, and wood assemblages showed the following: spruce needles are under-represented relative to pollen and about proportionately represented relative to wood; balsam fir pollen is over-represented relative to needles, and its pollen and needles are greatly under-represented relative to wood; and tamarack needles are greatly over-represented relative to pollen and wood. These data indicate that the forest was largely spruce and balsam fir, but with some tamarack. The recovered trees were all of small diameter, indicating either a relatively young stand or that taphonomic factors such as sorting in flowing water were responsible for assembling tree-trunk segments of similar diameters.

Radiocarbon ages of the wood, peat, and a white spruce cone varied from 9540 ± 30 (white birch wood) to 10,640 ± 80 ^{14}C yr BP (peat), and many of the ages differed statistically at 2 σ. This suggests that the logs could have been assembled (eroded and re-deposited) by natural means, or that they were excavated and used as fill as a result of canal building or a similar activity. The pollen and macrofossil data are internally consistent and compatible with the radiocarbon ages. If construction-related re-deposition produced the deposit of logs and peat, no major stratigraphic mixing was involved.

Nearly all the wood samples date to the late-Pleistocene Younger Dryas interval, which was a period of lower temperature preceded and followed by intervals of higher temperature. The YD lasted about 1100 years (between ~11,000 and 10,000 radiocarbon years ago [equal to calendar years 12,800–11,700]). The cooling signal is strong in the North Atlantic region, especially northwest Europe, Greenland, and the Canadian Maritimes (New Brunswick and Nova Scotia), and evidence is accumulating that the cooling may have been worldwide. Stratigraphic studies of the amount of ^{18}O (a stable isotope proxy measure of paleotemperature) in ice cores from the Greenland plateau glacier clearly show the YD cold interval, and also a very rapid change to warmer conditions at its close (Björck et al., 1998).

Younger Dryas cooling has remained poorly documented or controversial farther south in eastern North America. In the lower Hudson Valley region of New York State and in Connecticut and New Jersey, changes in pollen stratigraphy, mainly increased spruce, balsam fir, and alder representation, have been interpreted to indicate lower temperatures during the radiocarbon-dated interval ~11,000 to 10,000. These results were obtained from fossils in lake-bottom sediment (Peteet et al., 1990, 1993; Maenza-Gmelch, 1997a, b). Plant macrofossil evidence from the Cohoes Pump House site supports this interpretation in so far as documenting abundant balsam fir but differs in the meager record of alder.

Unexcavated Cohoes pothole survey:

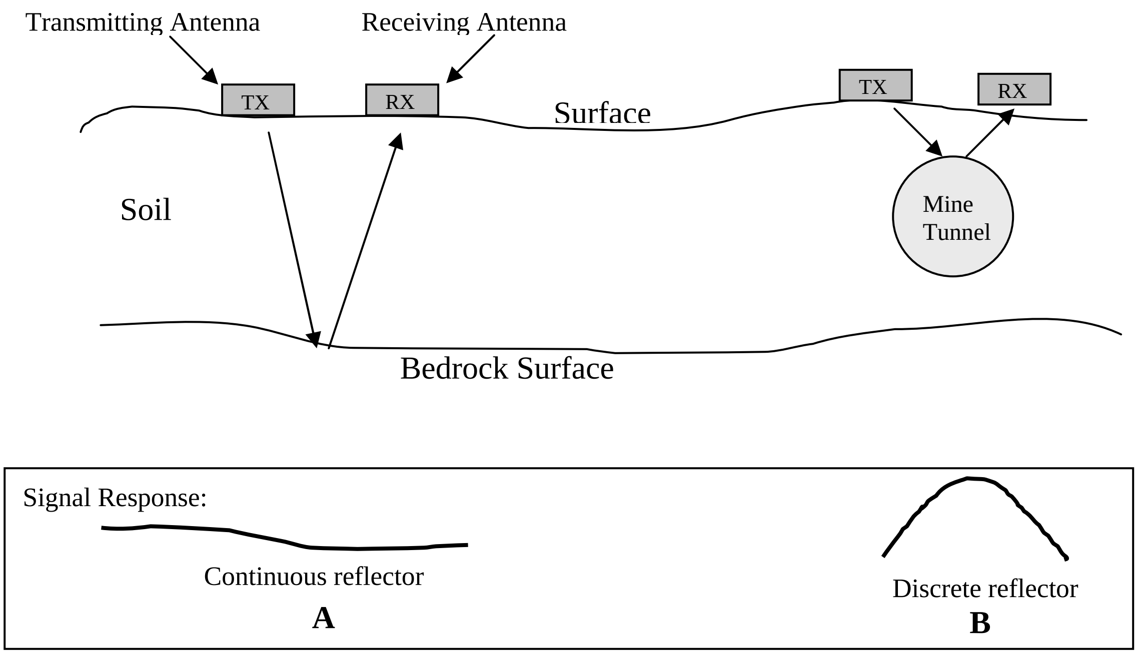
Location: Troy North quadrangle at the Cohoes Falls Overlook Park. Walk to the south end of the park path to the down stream view. The area in back of the Harmony Mills main building is visible below.

Description & Discussion: The discovery of the Cohoes Mastodon during construction of Harmony Mills building #3 in the fall of 1866 brought great attention. The mastodon was found incomplete and mostly disarticulated in a large and irregularly shaped pothole roughly 60’ wide and at least 60’ deep under what is now the northwest corner of the mill. Hall (1871) described the mastodon remains as under ~50’ of fill and organic matter and “lying directly on the clay and broken slate, and above the water-worn pebbles.” The depth of gravel was probed with a steel rod to 10’ without reaching bottom.

In 1867 Hall set out to study the character of numerous potholes around the falls, both in and out of the gorge, to better understand their relation to the mastodon pothole. He observed that all the large and deep potholes, similar to the mastodon pothole, existed outside the gorge and referred to these as “ancient” potholes, concluding that the modern Mohawk was incapable of forming potholes on this scale.

Hall described another “ancient” pothole approximately 150’ east of the mastodon location. This pothole is described as a peat bog at the surface and was sounded by Hall to a depth of 26’ “without reaching any hard substance.” Today the bog is covered by a parking lot behind Harmony Mills building #3.

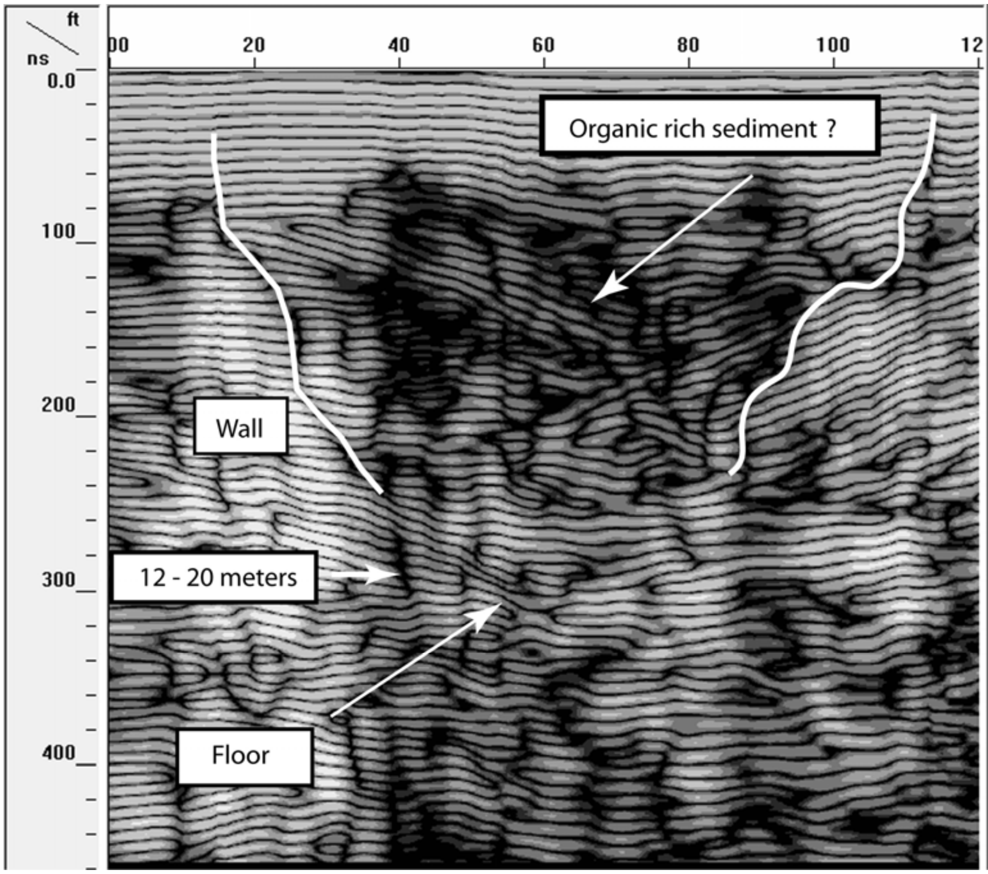
Ground Penetrating Radar (GPR) is an echo sounding technique that identifies changes in electromagnetic (EM) properties of sediments, and objects and provides a practical means to map subsurface conditions nondestructively. This task is accomplished by transmitting an EM pulse from a shielded ground-coupled transmitting antenna into the subsurface. As the EM wave propagates into the subsurface and encounters an interface or discrete object of contrasting EM properties, some energy is reflected back to the surface as low energy EM waves that are collected to a ground-coupled receiving antenna.



Schematic diagram of ground penetrating radar (GPR) operation and the signal response for a continuous stratigraphic subsurface reflector (A) and discrete reflector such as a grave, boulder or void (B).

Originally developed for work on glaciers, GPR has been successfully adapted over the course of 3 decades and now includes a variety of subsurface applications such as archeology, construction and infrastructure, mining, mapping, geology & geotechnical applications, forensics, environmental science, space exploration and biological & ecological applications.

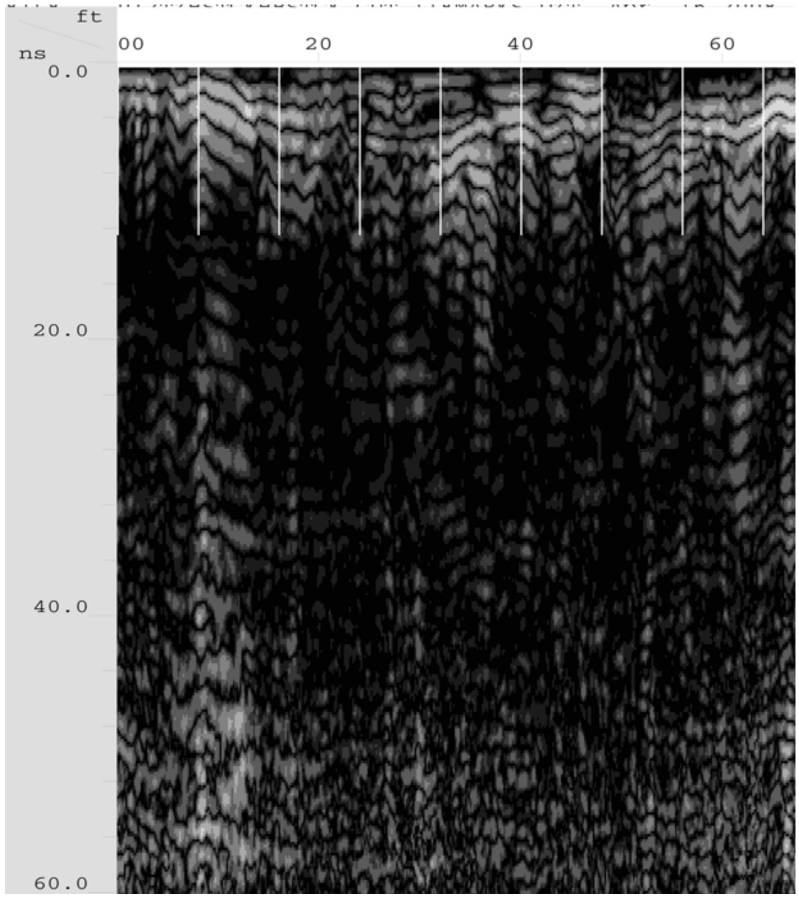
The target resolution and depth penetration of GPR to map subsurface features is controlled primarily by 2 factors, frequency of the antenna and the nature of the geologic media. Penetration is a function of the conductivity of the soil and in general conductive sediments attenuate signal penetration. However, a greater control on penetration is related to frequency; lower frequencies penetrate deeper than EM waves emitted from higher frequency antennas although lower frequency antennas have less resolution.



100 MHz GPR transect across Harmony Mill Mega-Pothole with interpretation. Estimated depth of Pothole is 12-20 meters & width is 15-20 meters.

The GPR Survey was conducted with a set of 100 MHz bi-static antennae operated in point mode at a 1 foot interval along a transect believed to lie over the western flank of the Pothole described by Hall (1871). The results of the survey display a large anomaly centered at about 60 feet along the transect; of particular interest is the very low amplitude response of the radar in this portion of the survey. Such responses are often observed in areas of conductive soils and have been observed in peat bogs in Maine. Hall noted that the pothole containing the Cohoes Mastodon contained large amounts of peat-like material. The GPR record also displays sharply truncated flanks that would appear to correlate with the side walls of the pothole. An irregular horizontal layer tentatively identified as the floor of the pothole has been identified at about 300 nanoseconds along the vertical axis. This layer displays a stronger amplitude response than would be expected from the rock-soil interface. Additionally, it appears that there are tensional fault structures near the surface that correlate with the interpreted walls of the potholes; such tension faults are common structural features associated with the stratigraphy of kettles or depressions containing compressible materials that experience post-depositional deformation.

Another survey conducted to determine the depth of the pothole suggests a depth of 20 meters is possible. Further, a 400 MHz frequency antenna was used in an attempt to provide better resolution of the pothole and its potential contents. However, the conductive soils contained within the pothole severely attenuated the radar signal.



400 MHz GPR transect across Harmony Mills Pothole. Time in nanoseconds is on the vertical axis and distance in feet is along the top axis. Note the loss of signal response over the center of the image suggesting the presence of abundant conductive organic sediments as described by Hall in 1871. Note: different transect coordinates were used for the 100 & 400 MHz surveys.

Speigletown Kame Terrace/Moraine & Lake Albany Beach:

Location: Troy North quadrangle on Rte 40. From the Cohoes Falls Overlook Park, proceed south along Mohawk Street approximately 0.9mi to the junction of Rte 32. Turn north on Rte 32, cross over the Mohawk River, and continue on Rte 32 approximately 1.8mi into the village of Waterford to the junction with Rte 4. Continue straight or east on Rte 4, cross over the Hudson River at 02.mi; follow Rte 4 turning right or south at the Hannaford Market (0.2mi) to the next light at the Price Chopper Market (0.2mi). Turn east on Rte 142 here. The exposed shale behind the market was stripped of overburden by the IroMohawk and Fort Ann flood discharges. Continue on Rte 142 through the village of Lansingburgh for approximately 1.0mi to the junction of Rte 40. Turn north on Rte 40 and continue for approximately 2.1mi to the entrance of the Fane Materials Pit on the west side of the road.

Parking: N 4740606, E 0611300; Stop and check in at the office on the left. Once cleared, drive into the pit and park out of the way of any current activity.

Ownership & permission: Warren W. Fane @ 518-235-5531. Mr. Fane accommodates visitors to his operation. But, you should stop by the office and make a personal request.

Description: The upper surface of the pit represents the gently sloping beach face of AB I at an elevation measured to range from 342-353ft. There is a higher berm to the beach along the power line. Finer grained lacustrine sediment reaches up to an elevation of 333ft below the beach berm.

The beach sediment caps the sequence here. It consists of sand, typical beach and shore face facies. There is a pocket of silt-clay below the berm that may represent a small pond along the beach. There is a narrow zone of highly deformed shore face sediment that spectacularly includes a silt-clay laminae rolled entirely into a loose ball with sand trapped within the roll. It's the "jelly roll" section of the pit. Rapid dewatering of the beach sediment with possible down slope movement may have been the result of a drop in lake level from AB I to AB II.

The shore face sediments truncate and overlie an ice contact facies composed of interbedded gravel and sand with typical ice contact deformation. Near the deeper west end of the pit, there is a nicely exposed section of ice contact sediments with arched bedding indicating deposition in a broad ice tunnel. The flanking sediments drape the ice tunnel deposits and are deformed from slumping. A test pit encountered hardpan or till beneath the ground water filled pond at the bottom of one pit and the till can be seen in a pile next to the pit.

Fine grained lacustrine sediments have an onlap relationship to the ice contact sediments indicating the quieter water facies were deposited after retreat of the ice removed the source of the proximal gravel and sand facies.

Discussion: This is one of the finest sections of Lake Albany beach preserved in a still rural setting. Look across to the road bordering the south face of the pit and you can see the beach profile. The berm here is exceptionally high and this appears to be a natural feature, not built up at all for the power line construction.

There are remnants of ice contact sand and gravel deposits that can be seen north of Rte 142, west of Rte 40 and continuing down to toward the Hudson River in Pleasantdale. However, these are not shown on the 1963 surficial map of Schock. Mr. Fane reports hunting along trials leading down to the river and finding a large area of gravel buried by the silt-clay. These comments are worth noting as we contemplate the next stop and the Halfmoon Threshold hypothesis for Lake Coveville.

The entire ice contact sediment complex here is the Speigletown kame terrace/moraine. It extends north from here for an additional 2+ miles. It represents part of an ice marginal sediment complex deposited between the eastern margin of the H-C lobe and the Hudson Valley wall. This physiographic junction persists to the north and south and is controlled by the structural geology. The line approximated by the path of Rte 40 on the east side of the Hudson Valley marks the western extent of thrust faulted Taconian allochthonous rock.

Deformed lake sediment making the "jelly roll."

Hudson-Champlain Canal Lock #1 Deep Water Lacustrine Facies and a Coveville Threshold Hypothesis:

Location: Troy North quadrangle. Proceed about 1.0mi north along Rte 40 from the Fane pit entrance to the junction of Rte 121 – Calhoun Road. Turn west on Calhoun Road. Along this road, note the presence of discrete steps down onto progressively lower terraces. There are sand veneers here on these terraces that mark strand lines for AB II and QS. The road drops steeply to the Hudson River. At approximately 1.9mi, the road ends at the junction with River Road. Turn south on River Road and continue for about 0.6mi to a small turn out next to Lock #1.

Parking: The area is small but adequate for several vans.

Ownership & permission: The NY State Canal Authority has control over the access to the lock and the immediate surrounding area but the parking here is allowable for recreational users of the river.

Description: If you visit during the winter or early spring before 1 May, the canal lock gates will be open and the river level will be low enough to walk out onto the point bar gravels up river from the lock. The channel here is the eroded Hudson-Battenkill channel of the Hudson. The exposed shale knobs all along the river are primarily the result of the Fort Ann high discharge that stripped overburden from the bedrock. The modern Hudson is largely confined to the channel defined by this Fort Ann outflow. Since the end of the Fort Ann discharge and throughout the Holocene, the Hudson has been aggrading in this channel as sea level and base level rose to the present sea level. The modern H-C canal system of locks effectively maintains the river at an historic flood stage. Prior to canal construction, Native American people and the European settlers saw a much narrower river. If access down the bank is not precluded by a high river, then walk north along the road about 0.1mi to a path leading down to the flood plain just across a small tributary. Follow this path onto the flood plain and walk north. The channel wall of shale here is topped with till.

Proceed on foot back past the parking area and around the bend in the road to the first of a series of road side exposures of lacustrine sediment. This first exposure is very interesting as the basal sediment represents thick proximal varves liberally sprinkled with drop stones and drop clots amid the summer layers. The drop stones appear to have largely been deposited in late summer as they penetrate the summer layer and deform both the summer sand and the underlying winter layer of finer sand and silt.

Higher up on the face of this exposure, the varves are thinner but still mostly >0.5 meter thick. Still higher exposures continue along this bluff but are not easily accessible from the road. These are best observed by parking along the dead end roads – Turner Road and Irish Road – that head west from Rte 40 to the south, bracketing the Fane quarry.

River Road is closed to traffic approximately 0.4mi ahead. You can drive to the end of the road and park. From there, a traverse is easy to do along the closed section of River Road. Along this traverse, you will see several text book rotational failures of the fine grained lacustrine sediment into the river. There are also good views back along the river toward the lock. The slumps are instructional for students and the road is still a publicly accessible trail owned by Rensselaer County.

Discussion: The road follows the edge of the entrenched meander that gave the name Halfmoon to this portion of the Hudson. There is a tentative plan to conduct seismic surveys across and along the river in this vicinity to learn the depth to bedrock beneath the river bed. The bedrock at the lock, the entrenched meander and the distribution of Campbell Island and the smaller islands in the river suggest a possibility there is a buried step or, perhaps even a plunge pool, along this stretch of the river.

This would add an interesting facet to the proposal discussed in the text that there was formerly a thick ice contact sand and gravel sediment dam that once spanned the Hudson Valley between Lock #1 and the Waterford Bridge. The preserved ice contact subaqueous fan gravel and sand of Prospect Hill in Waterford and the existence of a prominent ice marginal band of sediment on both sides of the valley supports the notion of a formerly more extensive accumulation of sand and gravel.

Drop stones and drop clots of till in the basal lacustrine sequence exposed along River Road at Lock #1.

If, indeed, there is a step in the valley profile at the lock, then the H-C lobe may have grounded at this step and maintained an ice margin position for a long period of time, long enough to deposit the thick sediment we see preserved. Additional evidence for a long still stand and even for a reason the ice may have grounded here comes from the original mapping of Schock. Schock first noted the 2 ice contact deltas within the kame moraine on the west side of the valley were graded to 2 different lake levels. He postulated Lake Albany may have lowered while deposition continued. However, Schock dismissed this possibility for no valid reason other than it being coincidental to have the lake level drop with the ice at this position. Rather than being coincidental, it is a telling remark. The 2 ice contact deltas represent deposition with the ice at the same position as the lake level dropped from AB I to AB II. The drop in lake level would further favor a grounding of the ice and an extensive build-up of ice marginal sediment. As discussed in the text, this is the most extensive accumulation of ice marginal sediment along the Hudson Valley from Albany to Glens Falls.

Finally, Wall notes that for the IroMohawk River to have favored its southern of 3 distributary channels and form the Cohoes Falls, then the dam for Lake Coveville must have been somewhere between the 2 northern distributaries and the southern one. The dam would have provided a lower base level for the southern distributary versus the 2 northern distributaries. This leaves only a few miles of river reach for the dam to have been located, somewhere between Mechanicville and Waterford.

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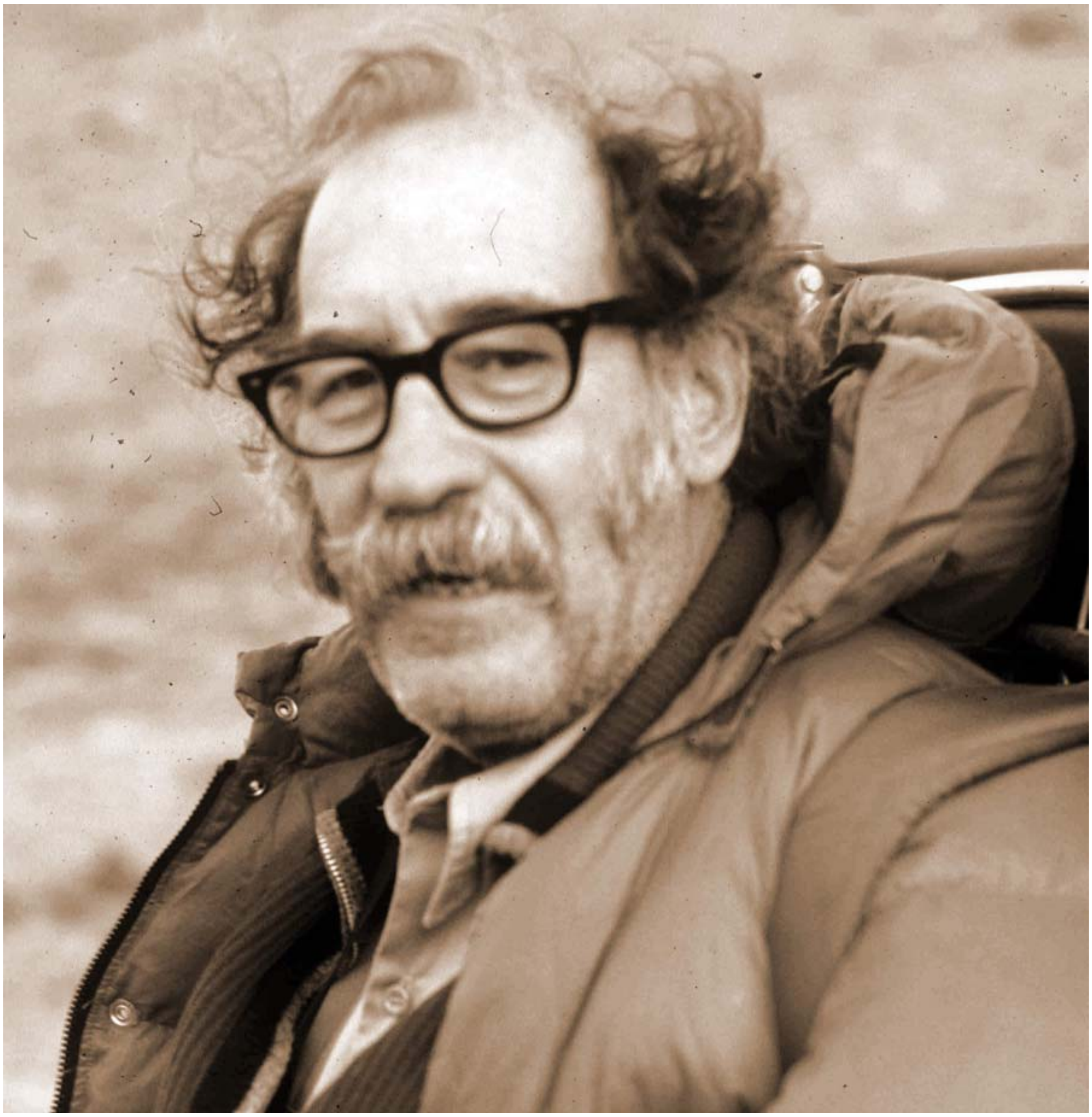
In Respectful Memory of a Missing Friend



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