DEGLACIAL HISTORY OF THE UPPER HUDSON REGION

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INTRODUCTION

The Hudson River descends from the Adirondack Mountains through a beautiful gorge and empties into the northern Hudson lowland onto a diverse complex of ice contact, glaciofluvial and glaciolacustrine sediments. Early workers such as Ogilvie (1902), Woodworth (1905), Miller (1914, 1925), Fairchild (1917), Stoller (1922), Chadwick (1928) and others posed early explanations and some interesting contrasts for the diverse suite of glacial deposits. All provided a solid context for future workers. Readvance hypotheses were a popular paradigm in the 1960's and 1970's when Connally & Sirkin (1969, 1971) hypothesized a major readvance of the Hudson-Champlain (H-C) ice lobe through much of the northern Hudson region. De Simone (2008) recently proposed this Luzerne readvance lacks strong evidence for its occurrence and should be abandoned. This trip will address concerns over the proposed Luzerne readvance hypothesis and present an alternative interpretation of the stratigraphy of the Luzerne Mountain gorge. The interpretation is based upon a synthesis of past descriptions of the Corinth Road exposures combined with insights from borehole data analyzed from a site in the western portion of the gorge.

The southern Champlain and northern Hudson lowlands contained a continuum of glaciolacustrine lakes that fronted the retreating H-C lobe as the ice front melted back during the late Wisconsinan. Woodworth (1905) recognized the shared Quaker Springs (QS), Coveville (CV) and Fort Ann (FA) water levels in the two lowlands. Rayburn (2004), Rayburn et al (2005, 2007) and Franzi et al (2007) developed a modern chronology of deglacial events in the Champlain lowland building upon the classical work of Chapman (1937). They provide a valuable time frame for deglaciation and the sequence of Coveville and Fort Ann lake levels. De Simone (2006) recently extended their 4ft/mi tilted water planes into the northern Hudson lowland and found good agreement with major deltas for the Fort Ann, Coveville and earlier Quaker Springs and Albany II (ABII) lake levels, the latter confined to the Hudson Valley. This correlation appears to solve the old problem of aberrantly low tilts on Hudson Valley water planes that were a feature of regional syntheses for many decades (Woodworth 1905, LaFleur 1979, De Simone and LaFleur 1985, 1986, Dineen et al 1992). We'll discuss these lake levels, their ice margins and their outlets as we tour the H-C divide region.

Most recently, De Simone et al (2008) present a summary of work in progress that adds to our understanding of the deglaciation of the H-C region. In this volume, Wall expands upon his earlier (Wall 1995) analysis of IroMohawk discharge; Miller discusses the implications of the Cohoes mastodon site for the Younger Dryas with new information based upon his earlier work (Miller and Griggs 2004); Rayburn contributed a revised water planes correlation and insights into QS in the southern Champlain Valley; and, Dineen presents data on the onset of Lake Quaker Springs incorporating earlier analysis (Dineen and Miller 2006).This trip will expand that synthesis to include the Lake George basin. We will visit some different sites than the FOP 2008 trip but will link our discussion thread into that synthesis.

NORTHERN HUDSON LOWLAND GLACIAL LAKES

The Lacustrine Link Between The Hudson And Champlain Lowlands. --- We'll consider the northern Hudson lowland to represent that portion of the Hudson Valley north of the Hudson-Mohawk confluence in Waterford, NY. On the 70th annual reunion of the Northeastern Friends of the Pleistocene, Dave Franzi and colleagues took us on a tour of the deglaciation of the northern Lake Champlain Valley (Franzi et al. 2007). They estimated ice margin retreat through the region of about 0.4 – 0.5 km/year. The cause for the CV-FA transition was a flood event related to the coalescence of Lake Coveville and Lake Iroquois when the ice margin reached the northern flank of the Adirondacks. Franzi and colleagues demonstrated evidence for this at Cobblestone Hill on Altona Flat Rock (Rayburn et al. 2005).

Lake Coveville dropped catastrophically to Lake Fort Ann during the Lake Iroquois flood that likely breached the Coveville threshold. Woodworth (1905) first named Lake Coveville and 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" (De Simone 1977, 1985) indicated it was formed by a portion of 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. Lake Coveville is the key link between the Hudson and Champlain lowlands as it was coeval across the divide region.

Lake Fort Ann. --- Lake Fort Ann lasted for approximately 200 years based upon varve chronology they analyzed before ice margin retreat opened the drainage route through the Gulf of St. Lawrence, FA drained, and the Champlain Sea (CS) entered the isostatically depressed valley. Varve chronology combined with radiocarbon ages (Rayburn et al., 2007) indicates that the CS began around 13,000 calibrated years BP. Lake Fort Ann did not extend into the Hudson lowland as a lake. The threshold of the lake in Fort Ann, NY, is bedrock controlled and the FA waters represented a high discharge fluvial period through the Hudson lowland that excavated the present valley occupied by the Hudson River southward from Fort Edward near Glens Falls.

Older Glacial Lakes. --- Lake Albany I (ABI) and Lake Albany II (ABII) had dropped to the next lower lake, Lake Quaker Springs (QS), while ice remained in the Hudson Lowland. Therefore, these two lakes have no extension into the Champlain Lowland. De Simone et al (2008) propose an ice margin where the drop from ABI to ABII occurred based in part upon overlooked insights provided by Schock (1963).

Lake Quaker Springs was first recognized 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. The Lake George basin was occupied by Lake Quaker Springs and features tentatively correlated to QS terminate near the northern end of the basin just south of Ticonderoga. This is consistent with Rayburn's (2004) observation that the Street Road delta approximately 6 mi north of Ticonderoga is the highest ice contact delta in Crown Point and is a CV delta. So, QS did not extend to Crown Point on the west side of the southern Champlain lowland. Thus, QS now also becomes a glacial lake coeval between the Hudson and Champlain lowlands.

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, and represents 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, 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 side of AB I. This indicates the H-C lobe position extended across the Hudson Valley near Saratoga Springs, NY, similar to where Chadwick (1928) placed the margin.

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. Much more work is needed to answer the question of where the ABI threshold was located.

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 well south 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 water level dropped some 50-60ft to establish Lake Quaker Springs. It is problematic if this drop was triggered by a high discharge event that would have come down the IroMohawk River. 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. Chadwick (1928) proposed a Lake Bolton as the final and lowest glacial lake in the Lake George basin. Connally and Sirkin (1969) suggested there was no need for a separate Lake Bolton and we concur. Numerous strand line features just above the present shore of Lake George fall onto the Quaker Springs projected water plane. Therefore, this is the main level of the glacial lake that occupied almost the entire basin until the ice retreated to near Ticonderoga.

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 (2008, pers. comm.) 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 a grounding line for the retreating glacier and established a condition similar to that where the proposed CV threshold developed. Further study is planned.

Lake Coveville (CV). --- The water level in the H-C lowlands dropped some 60ft to establish Lake Coveville. This occurred with the ice margin just south of Ticonderoga on the west side and just north of the Neshobe River near Fernville on the east side of the Champlain lowland. Lake Coveville fronted the retreating H-C ice lobe through the northern Champlain Valley as previously detailed by Chapman (1937) and discussed briefly already. The CV water plane projects into the lake bottom sediments south of Albany and Rensselaer, NY. However, it is possible that the CV waters were held back by a thick plug of ice marginal sediments composed of sand and gravel near Waterford, NY.

4.0FT/MI TILTED WATER PLANES THRU CHAMPLAIN TO HUDSON REGION

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. John Rayburn's 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.

Water Planes Tilt At 4.0ft/Mi +/- 0.2ft/Mi (0.75m/Km +/- 0.03). --- The plot by Rayburn illustrated in **Figure 1** represents an integration of the data assembled by De Simone with data from Rayburn for the entire Champlain Lowland. 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 by De Simone (2006) to attempt to rectify what appeared to be a long standing error in the plots of Hudson Valley strand line features. It is interesting to note that Miller (1914,1925) discussed Glacial Lake Warrensburg, a long lake that occupied the Schroon and Hudson River valleys in the southeastern Adirondacks. Miller determined the tilt for the Lake Warrensburg water plane to be 4.5ft/mi although he cautioned readers about the altitudes of the features he used due to the accuracy of the topographic maps. It would be very useful to re-map these areas and provide new data for Lake Warrensburg.

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. 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 along 4.0ft/mi tilted water planes that were identified as QS, AB II and AB I. The very minor deltas of small tributaries entering the lowlands are being added to this data set at the suggestion of Al Randall (2008, pers. comm.) and support the initial effort.

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 (Stoller 1922, Miller 1925, Chadwick 1928). 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.

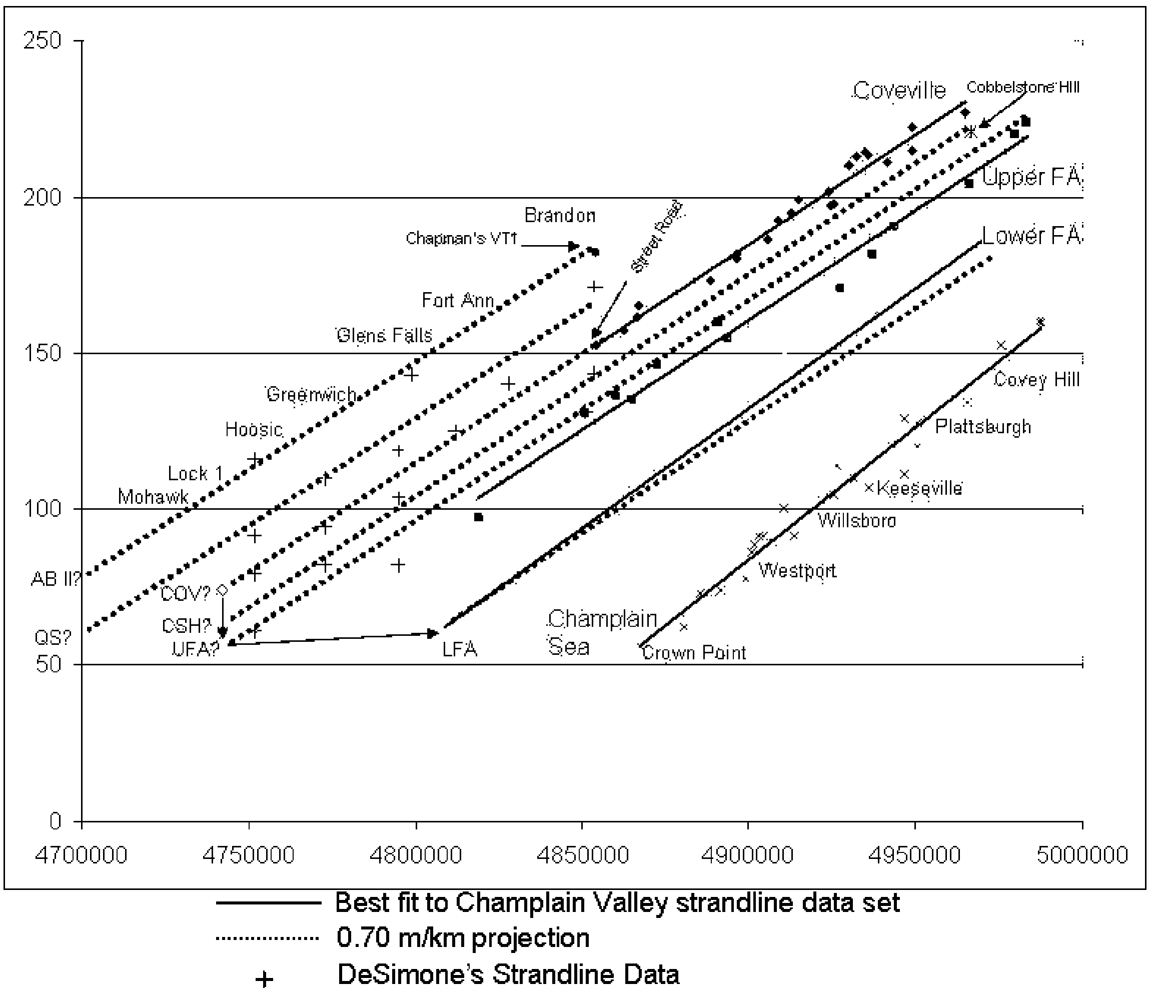

Figure 1: A plot of some of the northern Hudson through southern Champlain Lowland's strandline data combined with Chapman's data from the entire Champlain Valley completed by Rayburn and first seen in De Simone et al (2008).

LAKE COVEVILLE HALFMOON THRESHOLD HYPOTHESIS

Multiple data sources indicate there was 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 have exceptionally extensive kame moraine deposits. This 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 or even a surge of the H-C ice lobe.

A plausible reason for an extended still stand lies with the longitudinal profile of the Hudson-Battenkill channel near Lock #1 where there is a buried nick point (Dineen 2008, pers. comm.). 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 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 duration of Lake Coveville.

Dave Barclay (2008 pers. comm.) notes that the lowered base level and grounding of the H-C lobe at the proposed Halfmoon threshold would likely have resulted in a surge or readvance of the ice. The basal lacustrines exposed at Lock #1 within the proposed threshold offer some support for this surge. There, thick basal varves contain numerous chunks of lodgement till that dropped, presumably in a frozen state from the ice into the accumulating lake bottom sediments. The sediments are very compacted and exhibit a “leaned upon” structure as described by LaFleur. Thus, there may be evidence the ice responded to the lowered lake level from ABI to ABII by surging slightly over the basal lacustrines at the proposed threshold.

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 – 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. 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 (Waterford) and at Lock #1 but the river was deeper in between these two sections. This might reflect the buried step in the river profile or even a buried plunge pool at the step. The long history of the name Halfmoon indicates this is the most appropriate name for the hypothesized threshold for Lake Coveville.

DEGLACIATION OF LAKE GEORGE BASIN

Early Local Lakes. --- Chadwick (1928) discussed the retreat of the Lake George ice and most of the story he presented seems to hold true with the addition of a few details. Early ice retreat is marked by the series of kame terraces southwest of Lake George Village at 780ft, 740ft and finally at 590ft. Initially, drainage was probably across the divide above present Lake Vanare and into Glacial Lake Corinth (early Glacial Lake Warrensburg). Later, drainage was back against the ice front and southward against the H-C ice and the accumulating Glen Lake kame moraine. It is likely that during this interval of Lake George ice retreat, the H-C ice retreated from Corinth into the Luzerne Mountain gorge. As the H-C ice retreated from Corinth, the level of Lake Corinth/Lake Warrensburg would have dropped as the ponded water found a lower route along and/or under the H-C ice in the gorge. This would have abandoned the Corinth col and ended the Kayderosseras-Hudson flow. At some point in the H-C ice retreat, the 670ft Hartman terrace was deposited at the lower end of the Luzerne Mountain gorge. The Hartman terrace likely accumulated just prior to Lake George ice retreating enough to deposit the 590ft kame terrace that Chadwick attributed to a local Lake Caldwell.

Glacial Lake Caldwell And Subsequent Falling Waters To Glacial Lake Fort George. --- Continued retreat of the Lake George ice was probably accompanied by a falling water level as there are no kame terraces between 590ft and 420ft. Drainage had to be across the Glen Lake kame moraine and into the local Queensbury lake where the Queensbury kame delta accumulated. Meltwater from both the Adirondack-Hudson River and from Lake George ice likely contributed to the Queensbury delta at 470ft. Continued retreat of the H-C ice allowed the local Queensbury lake to become confluent with ABII and the Adirondack-Hudson River deposited the West Glens Falls delta. This last 440-420ft Lake Fort George of Chadwick was the last separate glacial lake in that basin.

Lake Bolton Confluent With Lake Quaker Springs. --- Eventually, Lake Fort George found an outlet through the Glen Lake kame moraine and deposited the sandy Patten Mills delta into Lake Quaker Springs. At this time, Chadwick's Lake Bolton is actually confluent with Lake Quaker Springs in the Hudson Valley. Lake George ice then fronted Lake Quaker Springs as the ice retreated northward through the basin to just south of Ticonderoga. Lake Quaker Springs dropped to Lake Coveville with the ice in the northern end of the Lake George basin. Lake Coveville dropped to Lake Fort Ann and the waters in the Lake George basin became isolated from Lake Fort Ann. This scenario is only slightly different from the well illustrated story of Chadwick and owes much to Chadwick's thoughtful analysis of the sequence of events.

LUZERNE MOUNTAIN GORGE STRATIGRAPHY AND DISCUSSION OF THE LUZERNE READVANCE HYPOTHESIS

The Luzerne Hypothesis. --- 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.

Connally and Sirkin (1969, 1971) described an upper till overlying lacustrine sediments with a lower till deformed till in 2 exposures. 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 3 described sections span an approximate horizontal distance of 3000ft and elevations are provided. Connally and Sirkin proposed the upper brown till in their western and eastern sections represented a late Wisconsinan readvance they termed the Luzerne readvance.

In a search for exposures that may aid in understanding the Corinth Road stratigraphy, no new exposures were observed. Further, the old Corinth Road exposures are vegetated over but still reasonably accessible.

Prior Workers Did Not Interpret The Sections As From A Readvance. --- Previous workers did not attribute the observed sediments as representing a readvance (Chadwick 1928, Hansen et al 1961) and Woodworth (1905) dismissed the notion of a readvance in the stratigraphy of the Hartman terrace kamic gravels exposed a short distance to the west at considerably higher elevation and stratigraphically above the proposed readvance till. Woodworth also discussed a thick sequence of glaciofluvial gravel and sand with no apparent tills but the location of this exposure has never been reconciled with current exposures along the lower Luzerne Mountain gorge.

Hansen et al (1961) did not measure sections because the focus of their study was the decollement structure present between the lower lacustrine unit and the overlying till. They observed this at 3 exposures along Corinth Road and provided a cross section with exposure locations and elevations along a 2000ft stretch of Corinth Road. Hansen et al observed the basal lacustrines were rhythmically bedded and composed of dark gray clayey laminae alternating with light gray silty laminae. Several beds of moderately sorted medium to very fine sand occur within the rhythmites and ice rafted clasts were "plentiful." Above the lacustrines, they describe a compact, gray stony till with rounded to sub rounded clasts that grades upward to a yellowish brown, compact till at their outcrop #1. In their outcrop #2, they describe the upper part of the till as becoming loose and sandy, easily disaggregated. In their outcrop #3, the upper part of the till is described as silty, hard and compact. It should not be overlooked that Hansen et al consistently report their lower gray till as grading upward to a brown facies in all 3 exposures. The upper brown till facies is compact and silty in 2 sites but loose and sandy in their middle outcrop.

One problem emerges with Connally and Sirkin's correlation of their 3 exposures with those of Hansen et al. Connally and Sirkin compare the till fabrics of their proposed upper readvance till with the brown facies fabrics examined by Hansen et al. The problem here is that we do not believe Hansen et al observed the true upper diamicton facies that Connally and Sirkin propose as their readvance. The readvance diamictons are stratigraphically above a lacustrine sand unit that separates the lower and upper diamictons. Hansen et al did not discuss any interbedded lacustrine sand unit between their lower gray till and upper brown till. Hansen et al never looked high enough in the exposure to observe the sand unit and the overlying diamicton. This was not their focus. They reported fabrics in the lower gray facies and upper brown facies all within the same lower till unit observed by Connally and Sirkin. So, the comparison of till fabrics reported by Connally and Sirkin is invalid. Further adding to the problem is it is not clear these workers observed the same 3 exposures as there are at least 6 exposures along Corinth road and the location data for both Connally and Sirkin and Hansen et al are inadequate to verify which exposures match each other.

Subsequent Workers Suggest Alternative Interpretations. --- Bob La Fleur took students to the site to measure, describe and interpret the Corinth Road sections as part of a field lab in glacial stratigraphy. I was among those students as were some 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 best efforts of these students have been synthesized here to offer a more complete picture of the entire Corinth Road stratigraphy. Cro (1984) examined the stratigraphy, texture, fabric and mineralogy of 3 exposures as part of a thesis project. Both LaFleur and De Simone assisted Cro during the early stages of his field project in the summer of 1983. Cro dismisses any comparison of fabrics in the brown till facies as invalid due to the alteration of till fabric in the ablation environment. Thus, Connally and Sirkin's assertion that the E-W oriented fabric in their brown proposed readvance till is not valid if this till is an ablation till or sediment flow deposit. However, Cro compared the gray lower and brown upper facies that Hansen et al described in their outcrop #3 and did not observe the same upper diamicton of the proposed readvance. So, there is no direct comparison of textures possible.

Both Schuster (ca 1986) and Hixon (1988) carefully measured the same easternmost exposure observed by Hansen et al and by Connally and Sirkin. The difference between the observations of the earlier workers and the later workers is that the later workers could not observe the lower portion of the lower gray till of Hansen et al nor the underlying deformed lacustrines. This is likely due to slumping and cover of the lower portion of these exposures. The descriptions of Schuster and Hixon are in close agreement. This adds confidence to the more complete study of Hixon who measured and described 5 sections along Corinth Road. LaFleur's notes on the location of these 5 sections further aids in their map location and in the correlation of Hixon's 5 exposures with the exposures observed by all earlier workers. **Figure 2** presents a synthesis of the 6 total stratigraphic sections described by Hixon, Schuster, Cro, Connally and Sirkin, and Hansen et al. Connally and Sirkin's middle exposure is not shown as there is some uncertainty as to exactly where it fits with the other measured exposures.

Corinth Road Stratigraphic Units of Figure 2. ---
<u>Hartman Gravel:</u> Glaciofluvial sand and gravel of the 670ft Hartman terrace as originally discussed by Woodworth (1905) and later by Chadwick (1928). The sediments are horizontally bedded brown sands and gravels coeval with the lower level of Glacial Lake Corinth. These deposits represent a fluvial gravel and sand unit that accumulated in a kame terrace setting. Exposures are now insufficient to confirm if the gravel is predominantly sourced from the H-C ice or is inwash from the Adirondack-Hudson River. The Hudson-Champlain lobe dammed the lake at this level (Chadwick 1928).

<u>Hartman Till:</u> Brown, highly compacted silty diamicton with approximately 10% clasts ranging from angular to rounded but less well rounded than the clasts in lower till units. Cro counted clasts and determined their lithologies. Adirondack gneiss in the brown tills average 56% of the clasts versus 30% in the gray tills. Shale derived from the Hudson-Champlain lowland averages 27% in the brown tills versus 49% in the gray tills. The matrix contains abundant frosted quartz grains with minor garnet, micas and mafic minerals. The lower contact of this till with the lacustrines shows no deformation, only a truncation surface.

This till is interpreted to represent the late Wisconsinan lodgement till. An alternative interpretation is that this till could be from a readvance of the H-C lobe. If this was a readvance till and not the lower diamictons proposed by Connally & Sirkin, then the Hidden Valley moraine could be the limit of the readvance in the southeastern Adirondacks. However, in view of the lack of evidence elsewhere for the proposed readvance of Connally & Sirkin as discussed below and by De Simone (2008) and De Simone et al (2008), it is *not* preferred to consider a readvance as the best interpretation.

<u>Luzerne Lacustrines:</u> Below the Hartman till both Hixon and Cro measured sections composed of interbedded silty clay, silt and sand, horizontally bedded, brown in color, and undeformed. In the 2 nearby sections measured, there was a brown, compact, sandy silt matrix diamicton interbedded with the finer grained lacustrines. The nearly 5 foot thick diamicton does not incorporate any of the underlying lacustrine sediment into its base and there is no deformation at the lower contact. This diamicton is interpreted to represent a sediment flow deposit that originated on the steep upper slopes above the site. The lateral extent of the diamicton is unknown but is shown on the cross section as a discontinuous lens.

<u>Hixon Till:</u> This is the till measured by Hixon in his exposure #3 and is correlated to be the same section seen by Hansen et al as their outcrop #1. Hansen et al describe this till as a dense, compact, gray stony till that grades upward into a dense, compact brown stony till. Clasts range from rounded to angular. Hixon notes the base of the till appears to incorporate gray silt and clay from the underlying lacustrine unit. Hansen et al discuss the folding and thrusting observed along the contact between the till and the underlying lacustrine sediments. The gradational contact between the lower gray facies and the upper brown facies as described by Hansen et al and shown by Hixon indicates the gray and brown portions are facies of a single till unit. Rounded clasts are more abundant in the gray till facies while angular clasts are more abundant in the brown till facies as noted by Cro at other sections. Cro also observed the fabric differences between the gray and brown till facies and decided they were the result of the ablation process

altering the brown till fabric during deposition. The brown facies incorporates more Adirondack lithologies and angular clasts as the sediment comprising the upper till facies is derived from sediment within and on the surface of the glacier. In contrast, the lower gray till facies contains more rounded clasts and more Hudson Valley lithologies as the sediment comprising the lower till facies is primarily derived from at or near the base of the glacier.

The age of this middle till unit is problematic. Its extent along Corinth Road is also unknown. The unit was observed and measured at only one section but clearly lies at a very different elevation from the till units above and below it. The Hixon till is nearly 25 ft thick where measured and the underlying lacustrine sediments are sheared along the contact with the till. Further, the underlying lacustrines are highly compacted. It is inferred the Hixon till may be middle Wisconsinan or older in age but this based solely upon stratigraphic considerations and no other supporting data.

Cro Lacustrines: Cro's exposure #2 contains no till, only a thick sequence of interbedded silt, clay and sand that is highly compacted and brown in color. The clays display incipient fissility and the sands support undercutting as evidence of their dense structure. These are correlated to exposures to the east based upon stratigraphic position and elevation and similar sediment textures. Hixon's exposure #2 and his exposure #1, the latter examined in even greater detail by Schuster, both contain a diamicton unit in addition to lacustrine sediments. Schuster described graded bedding in the interbedded sands of the deep water Cro lacustrines and noted the presence of flutes or load casts on the undersides of sand beds. Thus, the graded sand beds represent turbidites deposited in very deep water.

Schuster did not observe the diamicton at the top of the easternmost exposure, #1 of Hixon. Hixon described the diamicton as a poorly sorted brown sandy and gravelly unit, consistent with the upper or readvance till of Connally & Sirkin's exposure #3. Neither Hixon nor Connally & Sirkin reported any deformation at the contact between this diamicton and the underlying turbidite sands. Hixon's exposure #2 is correlated with Connally & Sirkin's exposure #1. The upper diamicton above a thin but similar deep water sand unit shows no deformation at the lower contact. Here, however, the diamicton is comparatively compact, brown in color and more silty than to the east. These two upper diamictons are the proposed late Wisconsinan readvance tills of Connally & Sirkin. However, their stratigraphic position, elevation and the nature of the sediment and lack of lower contact deformation suggests an alternative explanation. It is inferred here that both these diamictons are sediment flow deposits composed of reworked till and lacustrines from higher up on the slopes that were carried into the deeper lake waters contemporaneous with deposition of the Cro lacustrines. It is also possible the easternmost relatively uncompacted diamicton represents the youngest unit along the entire Corinth Road section and that it was deposited during the Holocene by sediment flow or slump processes. The lateral extent and thickness of both of Connally & Sirkin's proposed readvance deposits is unknown. It is certain, however, that they occur at an elevation that may best place them into the Cro lacustrine unit.

Hansen Till: This is the lower till observed most frequently by past workers. It was visible at Hixon's exposures #2 and #1, Hansen et al's outcrop #2 and #3, and Connally & Sirkin's #1 and #3. Connally & Sirkin's exposure #2 cannot be matched to others along the Corinth Road section. Thus, it is left out of this discussion but its possible location is indicated on the cross section.

The Hansen till consists of a lower gray facies and an upper brown facies, similar overall to the Hixon till discussed above. Cro discussed these as his upper till C and lower till D. The lower gray facies is dense, compact and enriched in rounded shale clasts. Cro determined this gray till facies contained 49% shale clasts and 30% gneiss clasts. X-ray diffraction analysis of the clay fraction by Cro determined that the gray facies contained more illite than the other amphibole enriched brown till facies.

The lower contact between the Hansen till and the underlying basal lacustrine unit shows shear deformation with folding and thrust faulting consistent with emplacement of the till as a lodgement facies. Hixon noted the lower gray facies appeared to incorporate gray clay and silt from the underlying lacustrine unit.

The contact between the lower gray facies and the upper brown facies was noted as gradational by both Hansen et al and Hixon. Overall, the lodgement gray facies contains approximately 30% clasts while the upper brown ablation facies contains approximately 15% clasts. Cro interpreted the gray and brown facies to represent a lodgement-ablation till couplet. Indeed, as discussed for the Hixon till above, the differences in clast lithologies, clay mineralogy, clast angularity and fabric of the gray and brown units is best explained by them representing a facies change. A basal lodgement till composed predominantly of more rounded clasts of more valley shale lithology with high illite content changes in a gradational manner to an upper facies predominated by more angular clasts with more Adirondack gneiss lithology and a higher amphibole content versus illite.

Basal Lacustrines: Only a thin layer of these black and gray horizontally bedded silt and clay rhythmites was discussed by Hansen et al beneath their decollement structures at the 2 easternmost and lowest elevation exposures along Corinth Road. Hixon did not observe the basal lacustrines as they were likely covered by slumping during the years between their observations. Hansen et al describe the rhythmites as composed of dark gray clay rich laminae alternating with yellowish gray silt rich laminae. Some interbeds of medium to very fine sand also were noted. Ice rafted clasts were cited as plentiful and there was deformation around the clasts due to their emplacement into the deep waters of the lake. The upper portion of the basal lacustrines showed evidence of shear deformation due to ice override and deposition of the overlying Hansen till.

Correlation Of Western and Eastern Luzerne Mountain Gorge Stratigraphic Units. --- LaFleur (1990-91, private files) examined data from numerous borings drilled to evaluate a site in Corinth, NY, at the western end of the Luzerne Mountain gorge. His interpretation of the stratigraphy in Corinth is summarized in **Figure 3.** LaFleur recognized 3 tills and interbedded lacustrines with a basal fluvial gravel unit over an elevation range of more than 200ft. We propose the multiple till sequences along the western and eastern ends of the Luzerne Mountain gorge are correlative and consistent in their preservation of 3 tills. The uppermost till in both locations is interpreted to be the late Wisconsinan till. Wider correlations may be possible as the underlying gray till and "black & white" lacustrines along the Luzerne Mountain gorge are similar in character to the Hell Hollow till and related lacustrines at West Milton, NY (LaFleur 1975, 1979). At West Milton, an erosional unconformity separates the older Hell Hollow till from the upper late Wisconsinan or Mohawk till.

Additional Data Does Not Support The Luzerne Readvance. ---
Detailed surficial geologic mapping reveals no evidence of a readvance throughout the area where it is proposed; A readvance of 30 miles is proposed but no evidence of overridden sediment has been cited. Detailed surficial geologic mapping over the entire area of the proposed readvance in southern Washington County revealed no observed evidence to support a readvance. 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 (De Simone 2006, 1992, 1985, 1977; De Simone & La Fleur 1986, 1985; De Simone & Newton 1994; 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 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.

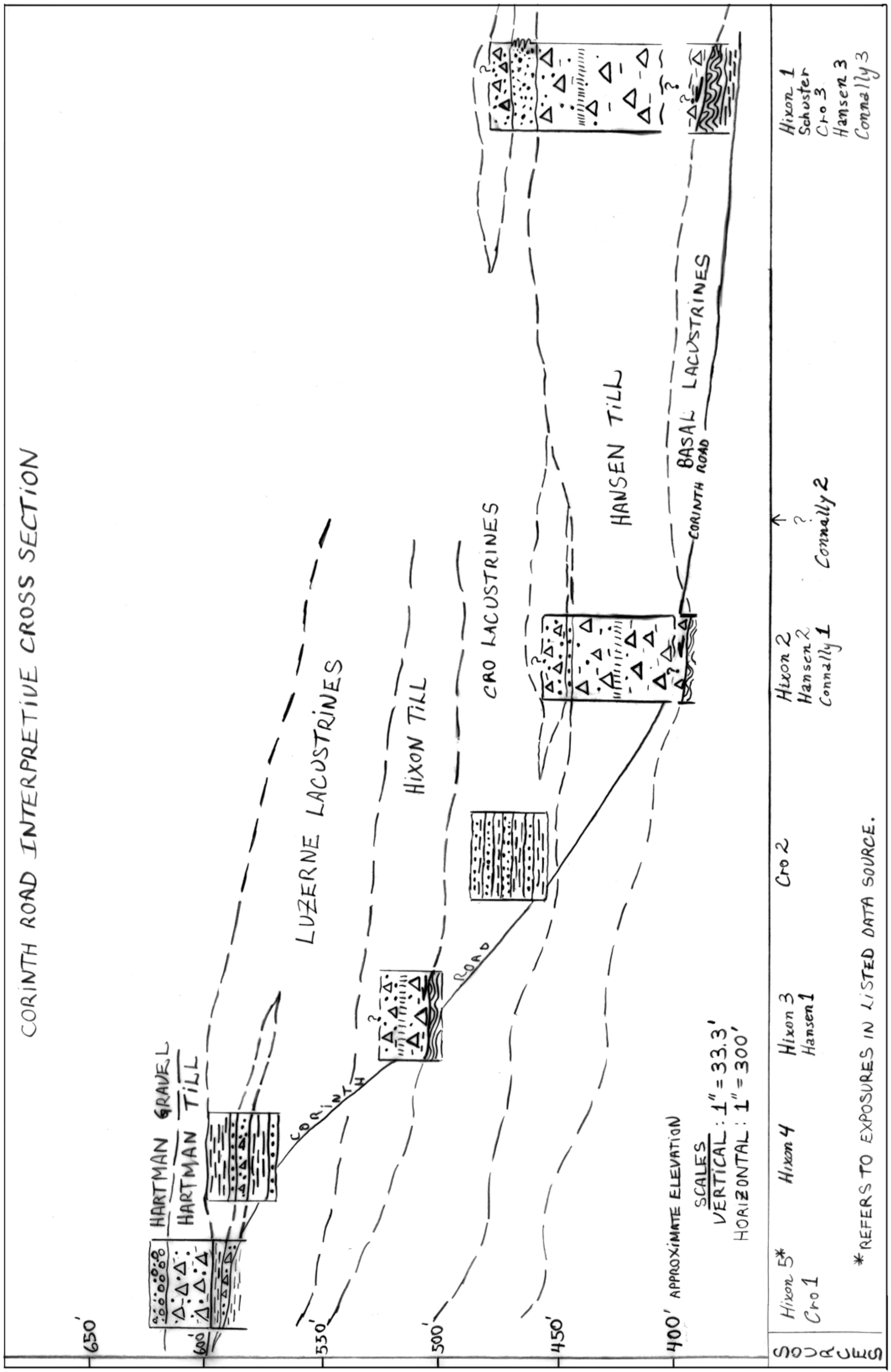

Figure 2: A stratigraphic synthesis of the Corinth Road exposures indicates there may be as many as 3 tills separated by lacustrines over an elevation range of nearly 300ft. The uppermost or Hartman till is inferred to be late Wisconsinan and is not interpreted to represent a readvance or surge of the H-C lobe. The lacustrine units contain diamictons interpreted to represent sediment flows or slumps.

Luzerne Mountain Gorge

W Corinth Section	Corinth Road Section E
SG-S-C Unit III	Hartman Gravel
Till III	Hartman Till
Clay-Silt Unit II	Luzerne Lacustrines
Till II	Hixon Till
Clay-Silt Unit I	Cro Lacustrines
Till I	Hansen Till
Basal Gravel	Basal Lacustrines
LaFleur, 1990-91, private files	De Simone & LaFleur, this volume

Figure 3: Proposed correlation of the Luzerne Mountain gorge stratigraphy along Corinth Road on the east with the borings data from Corinth on the west. The agreement between the west and east ends of the gorge suggests this region of the Adirondack Hudson Valley may sporadically preserve evidence of older glaciations.

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, De Simone and Baldivieso 2001) , VT, does not support a Luzerne readvance.

Summary of Arguments Against The Luzerne Readvance

*The type sections do not expose an acceptable readvance diamicton. The readvance diamictons have here been interpreted to be sediment flow or slump deposits within lacustrine units in a thick 3 till sequence.

*The proposed extent of the readvance is not supported by mapped evidence.

*The proposed extent of the readvance leaves out areas that would have been covered by advancing ice; These areas reveal no evidence to support a readvance.

*The timing of the proposed readvance has not been matched to the paleoclimatic record.

The hypothesis should be abandoned.

SUGGESTED CRITERIA FOR A READVANCE PROPOSAL

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 be made in the hypothesis between a surge confined to a valley and likely the result of local glaciological conditions and not driven by significant climatic changes versus a larger scale readvance. The larger 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.

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TRIP STOPS

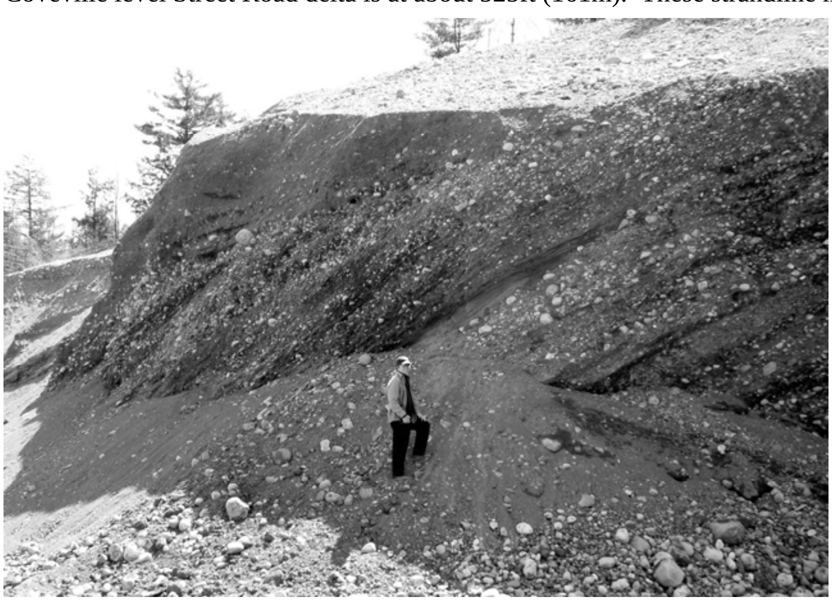
1. Crown Point CV Delta:

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.



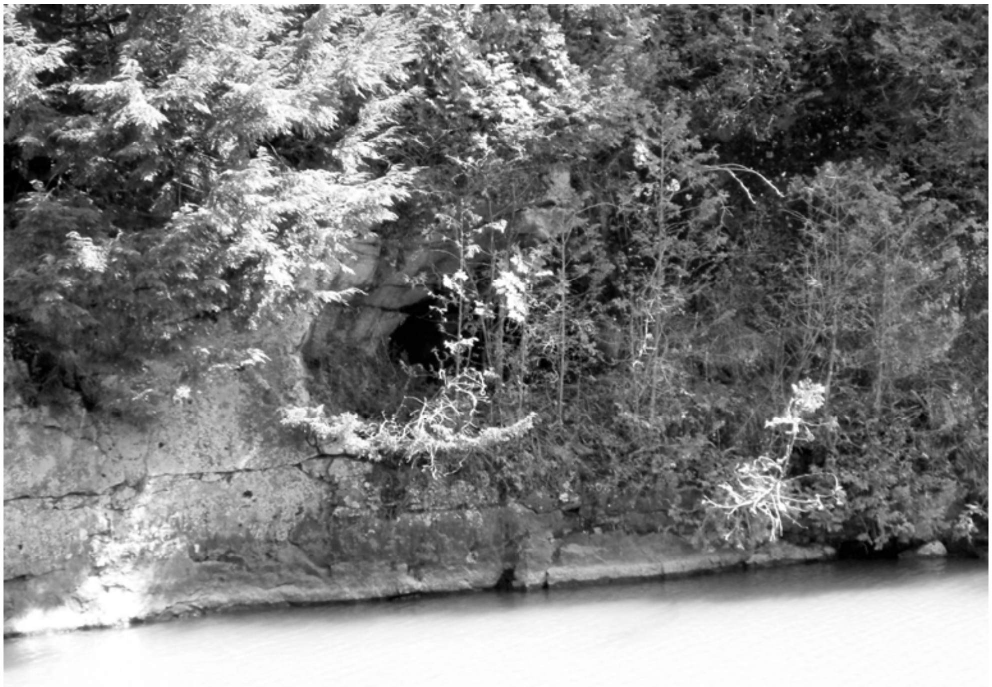
Topsets over Foresets in Street Road Delta.

Bottomsets of Street Road Delta.

2. 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.

3. 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. CAUTION ! Poison ivy and oak present.
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.
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* 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 on Flank of Battle Hill in Gneiss



Pothole in Canal Wall

4. 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).

5. Corinth Road Multiple Till Exposures:

Location; Proceed west along Corinth Road from Exit 18 of I-87 approximately 3 miles, past the Queensbury sewage treatment plant on the south side of the road. Continue another ½ mile past roadside outcrops of bedrock at the foot of the Luzerne and Palmertown Mountains. As the road grade begins to rise, look for any of several parking areas along the north side of the road where the overburden exposures are visible. It’s a good idea to drive all the way to the top of the hill, past the house on the bluff and note the highest exposure below the house. This is the Hartman terrace. You can turn around and return to a convenient pullout and park to examine the exposures.

Parking; The best parking area is about ½ of the way up the hill where there is a large pullout that still has crumbly asphalt and plenty of room.

Ownership and permission; You only require permission to access the bluff exposure below the house at the elevation of the Hartman terrace.

Description and Discussion; Please see the text for a thorough analysis of this site. Note that the exposures have been overgrown for many years and may not be in good shape at the time of your – or our – visit.