Trip B-5

INITIAL DEGLACIATION OF THE ADIRONDACK MOUNTAINS AND DEVELOPMENT OF THE FULTON CHAIN LAKES

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INTRODUCTION

The Adirondack Mountains, located in northern New York State, offer a textbook example of radial drainage. The Black River and its tributaries drain the west and southwest region of the Adirondacks (Figure 1). The Moose River is the largest tributary of the Black River and drains most of the southwest Adirondacks. The Fulton Chain is a series of eight lakes that lie along the Middle Branch of the Moose River.

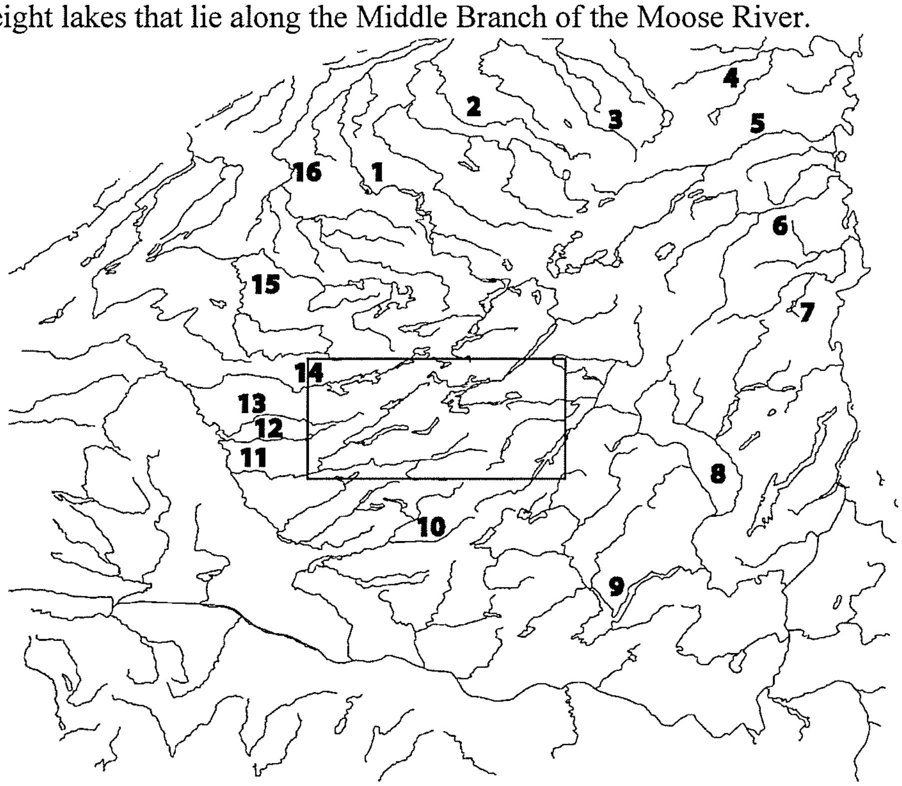

Figure 1. Radial drainage of the Adirondacks accomplished by the: 1) Raquette, 2) St. Regis, 3) Salmon, 4) Great Chezy, 5) Saranac, 6) Ausable, 7) Bouquet 8) Hudson, and 9) Sacandaga Rivers, 10) West Canada Creek, and the 11) Moose, 12) Independence, 13) Beaver, 14) Black, 15) Oswagatchie, and Grasse Rivers. The box outlines the area covered by Figure 2.

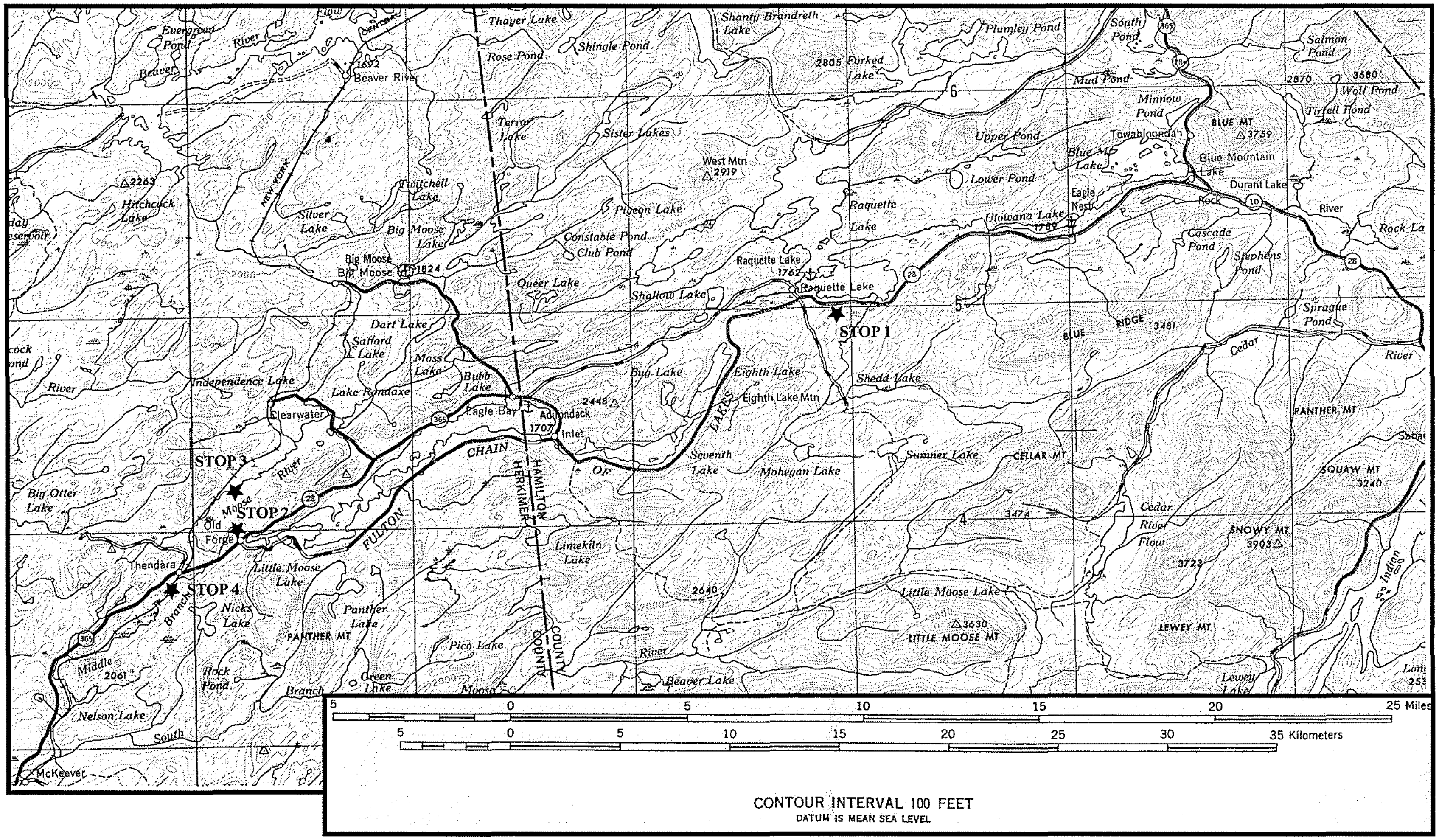

Figure 2. The location of the four fieldtrip STOPS, from Raquette Lake to First Lake, along the Fulton Chain of Lakes.

One purpose of this paper is to describe five proglacial lakes that preceded the present day Fulton Chain, and neighboring Raquette Lake. A second purpose is to relate the formation of those glacier-dammed lakes to the inception of ice withdrawal from the Adirondack Mountains. The third purpose is to correct misrepresentations on the Surficial Geologic Map of New York, Adirondack Sheet (Cadwell and Pair, 1991) for which the senior author of this paper was responsible.

Fieldwork for this study was completed during the 1989 through 1992 field seasons. Fieldwork in the Adirondacks always has been frustrating because of 1) the large area, 2) the great topographic relief, 3) the limited road access, and 4) the paucity of exposures. During 1989 and 1990, under the aegis of the New York State Geological Survey, the existing road networks were covered and all major accessible exposures were examined. Most time was spent packing into wilderness areas during 2-day and 3-day trips – often finding no surficial materials exposed. Under those conditions, an implicit response model was adapted from nearby areas of New York State where almost all level features adjacent to ice-contact deposits are observed to be outwash.

It was not until preparation for oral presentations summarizing the field mapping (Connally and Cadwell, 1991; Fleisher et al., 1991) that Connally began to suspect a consistent error. Fieldwork later in 1991 confirmed the error. In the few places where Connally had observed exposures beneath horizontal topographic features, he had mapped lacustrine deposits. Yet, he inferred outwash beneath similar landforms lacking visible exposures. Each new exposure confirmed lacustrine deposition. When he realized that it was likely that he had systematically misinterpreted those features, the Adirondack Sheet was in final production. It was too late to revise the submitted work.

GEOGRAPHIC SETTING

The Moose River is the master stream draining the southwest Adirondack Mountains (Figure 2). The Beaver and Independence Rivers drain smaller basins immediately west and north of the Moose River basin. To the east, West Canada Creek and smaller streams drain directly south to the Mohawk River. Most of the rest of the Adirondacks is drained by north flowing master streams; the Oswegatchie, Grass, Raquette, St. Regis, and Salmon Rivers, or southeast by the Rock, Cedar, and Indian Rivers in the southeast draining Hudson River system. The northeast corner of the Adirondacks is drained by tributaries to Lake Champlain.

The Moose River

The Moose River funnels waters from the southwest Adirondacks into the Black River. To the north, the Moose River drainage basin shares a divide with the north-draining Raquette River basin. The lowland of the Fulton Chain is continuous, over the low divide of lacustrine sand, with the depression in the headwaters of the Raquette River containing Raquette Lake. East of Raquette Lake, the divide between its tributary, the Marion River, and the east-flowing Rock River, separates the Hudson River that drains east from the Raquette River that drains north.

The Moose River divides into three branches. The South Branch splits off to the east at the hamlet of McKeever, 15 km upstream from the Black River. Events in the South Branch have no bearing on the present study. The North Branch splits off to the north at the village of Old Forge, 13 km upstream from McKeever, draining a large sub-basin that includes Safford Pond and Big Moose Lake. The Middle Branch continues eastward from Old Forge to the low drainage divide with Raquette River drainage, about 3 km southwest of the hamlet of Raquette Lake. The eight lakes of the Fulton Chain are located along the Middle Branch, between Old Forge and the hamlet of Raquette Lake. All horizontal distances are reported in metric units. However, vertical distances are reported in English units to closely match available topographic maps.

The Fulton Chain

The lakes of the Fulton Chain are named for their position east of Old Forge. First Lake is the closest and Eighth Lake is the farthest. The present elevation of First through Fifth Lakes is 1707 ft. The uniform elevation is due to a dam at Old Forge, first constructed in 1810 at ±12 ft to operate an iron forge, namely Brown's Tract Forge. In 1880-81, the Old Forge dam was raised another 2 ft, to ±14 ft, to merge all five lower lakes. The original elevation of Fifth Lake probably was close to the present 1707 ft; Fourth Lake probably was at ±1705 ft. From the dam height, it appears that the original elevation of First Lake was 14 ft lower at ±1693 ft. Second and Third Lakes had original elevations between 1693 and 1705 ft.

Sixth and Seventh Lake share a present day elevation of 1786 ft, but a dam was built at Sixth Lake in 1879 to gain additional water storage needed to compensate the Black River system for waters diverted to the Erie Canal. I have measured that dam at ±13 ft, so the original elevation of Sixth Lake probably was ±1773 ft, with Seventh Lake at its present 1786 ft. Eighth Lake has a present day elevation of 1791 ft that was never modified. The elevations are summarized in Table 1.

TABLE 1

Fulton Chain Lake	Natural Elevation	Present Elevation
Eighth Lake	1791 ft	1791 ft
Seventh Lake	1786 ft	1786 ft
Sixth Lake	1773 ft	1786 ft
Fifth Lake	1707 ft	1707 ft
Fourth Lake	1705 ft	1707 ft
Third Lake	~1701 ft	1707 ft
Second Lake	~1697 ft	1707 ft
First Lake	1693 ft	1707 ft

The Moose River drainage basin is an area of significant relief. The highest point is Little Moose Mountain at ±3640 ft, in the South Branch. The lowest point is ±1200 ft where the river enters the Black River Valley. Most of the divide for the North and Middle Branches varies from 2300 to 2500 ft. The highest point is West Mountain at 2902 ft on the North Branch divide. The divide between the South Branch and the Hudson River basin to the east, has many peaks between 3000 and 3500 ft. The lowland of the North Branch drops from 2001 ft above Big Moose Lake to 1702 ft at its confluence with the Middle Branch at Old Forge, over a distance of 35 km. The South Branch drops from 2144 ft at Little Moose Lake to 1525 ft at its confluence with the Middle Branch at McKeever, over a distance of 47 km. The Middle Branch drops from 1791 ft at Eighth Lake to ±1200 ft at its confluence with the Black River, over a distance of 62 km.

LACUSTRINE SEDIMENTS

The Sedimentary deposits discussed here originally were interpreted as proglacial outwash by Connally (1990), reported as such by Connally and Cadwell (1991), and published as such by Cadwell and Pair (1991). These sediments have not changed and their degree of exposure has increased very little. It is only our understanding that has changed. Upon re-examination and remapping, we now infer almost all previously inferred outwash deposits in the vicinity of the Fulton Chain to be lacustrine in origin.

We have observed very little sediment finer than sand in the southwest Adirondacks. During the 1991 field season, extensive highway reconstruction between Raquette Lake and the hamlet of Blue Mountain Lake exposed several roadsides for lengths of 100 m or more. Subglacial and superglacial meltout till, and stratified drift, all are dominated by sand. Pebbles, cobbles, and boulders were present in many exposures, in varying proportions. The sandy matrix material is the presumed source for lacustrine sediment. Therefore, the absence of finer material in the lacustrine sediments is not surprising.

There are only four localities where more than 2 m of sediment was exposed. A vertical face was maintained only after heavy rain. When the sandy sediments dry out, the faces collapse almost immediately. A fresh face remains exposed only where rare silty sediments are interbedded with sand.

At many exposures there are current structures in the sands. Most exposures were adjacent to paleoshorelines where currents from either shoreline or fluvial processes would have been normal. Deltaic deposits were exposed only at Blue Mountain Lake and at Burke's Cabins, shown in Figure 3.

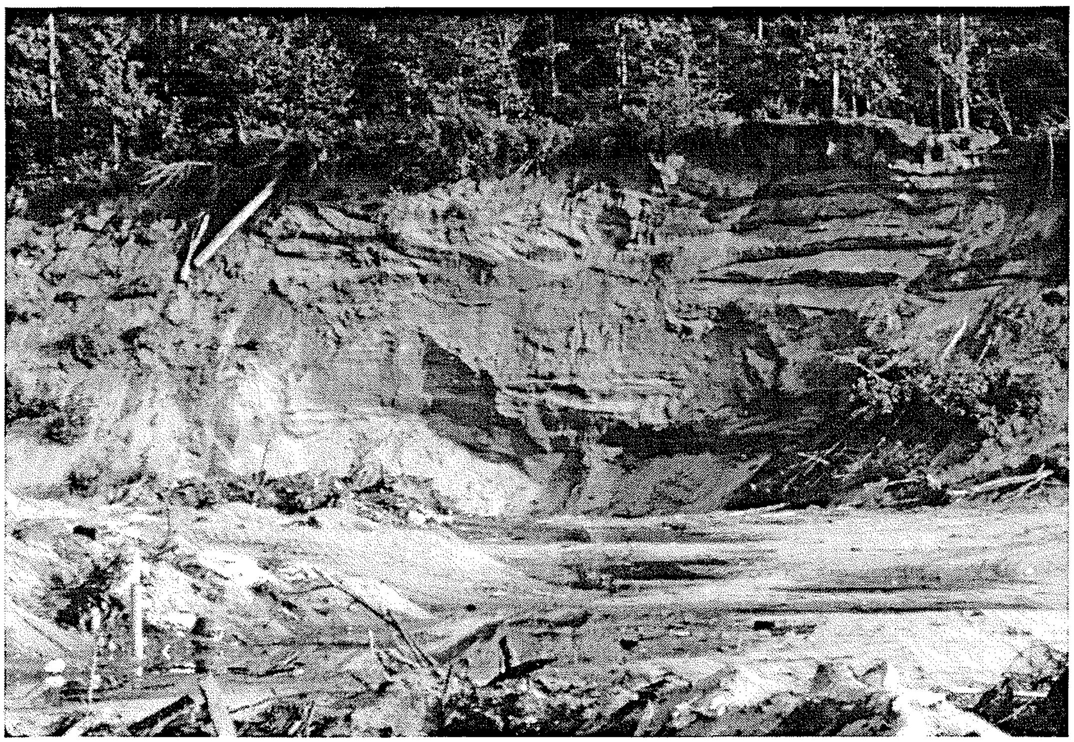

Figure 3. A 1991 view of the ice contact delta sediments south of and behind Burke's Marina. The 1840 ft delta top helps to define the level of Glacial Lake Raquette. Foreset beds are dipping northward toward the viewer.

Most exposures are in roadside ditches where oxidation in the B_2 or B_{2ir} soil horizons produces a distinct reddish color. In the few deep exposures, such as that at Burke's Cabins, the sand is typically light tan (5YR 6/4 to 10YR 4/2). The sediments comprise fine- to very-coarse-sand. The composition is dominated by quartz with dark amphibolitic layers present near Eighth Lake. Neither varves, nor any simple rythmites, have been observed to date. However, the level upper surfaces with matching elevations are best interpreted as the result of lacustrine deposition, rather than as proglacial outwash.

Glacial Lake Raquette

The initial high level lake, at ±1840 ft, straddled the divide between upper Moose River and upper Raquette River drainage. It was centered on the present day Raquette Lake depression and is here named Glacial Lake Raquette (hereafter GLR). GLR spread southwest, up the Sucker Brook valley to beyond Shallow Lake; south into northern Eighth Lake, via Browns Tract Creek; and eastward up the Marion River to the Utowana Lake basin, as illustrated in Figure 4. The ±1840 ft delta at Blue Mountain suggests a long extension of GLR to the east, down the Rock River valley, where it must have been dammed by Hudson River ice.

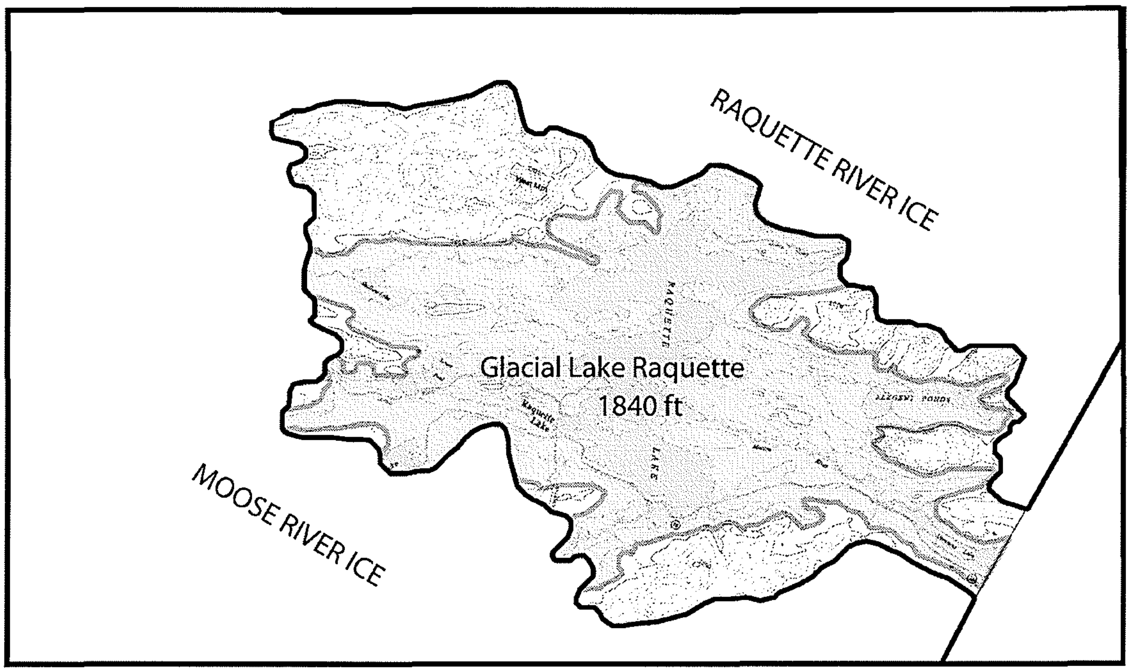

Figure 4. A sketch map of 1840 ft Glacial Lake Raquette, centered above present day Raquette Lake. The outlet is eastward into Hudson River Ice.

Glacier ice in the northern Adirondack drainage basins became the northern border of GLR. South-graded outwash near Grass Pond, above Sargent Ponds, documents the former ice margin. The Forked Lake depression shows no evidence of GLR. Inversion ridges between Outlet Bay of Raquette Lake and western Forked Lake might have resulted from the drainage of GLR northward through or under the ice into Raquette River drainage. The ice margin probably remained banked against the eastern mountains north of the Marion River, anchored to the east at Blue Mountain. At least initially, ice remained along Blue Ridge, south of the Marion River valley.

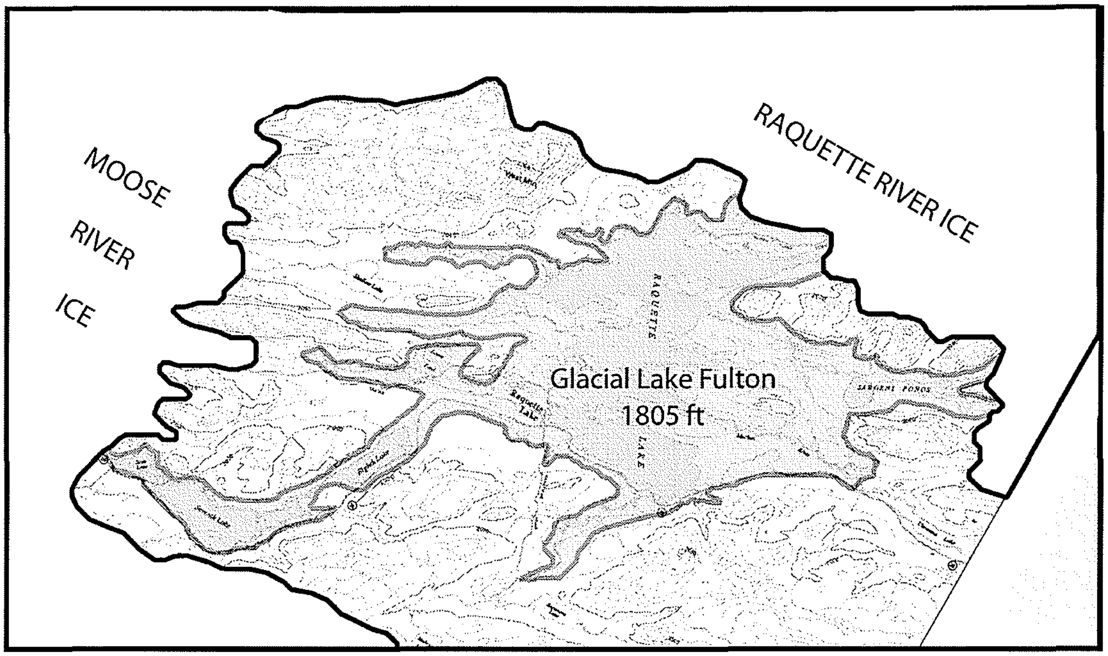

Figure 5. Sketch map of 1805 ft Glacial Lake Fulton, extending into the basins of Seventh and Sixth Lakes. Drainage for Lake Fulton also is to the east, down the Rock River into the Hudson River drainage basin.

There is sedimentary evidence of a small lake at ±1920 ft between Blue Ridge and Eighth Lake Mountain in the vicinity of Sagamore Lake. That lake might have been contemporary, but probably developed after GLR and its successor had drained. Moose River ice evidently established a margin at the south end of Eighth Lake and in the North Branch between present day Big Moose Lake and GLR. The Hudson-Champlain Lobe ice remained in the upper Hudson River drainage basin at Lake Durant, immediately east of Blue Mountain. Thus, GLR must have been completely surrounded by thick glacier ice.

Although it had a very irregular shoreline, and was barely 0.6 km wide in the Marion River valley, GLR had maximum dimensions of 28 km east-to-west and 12 km north-to-south. The eastward extension is documented by the hanging delta on Blue Mountain northeast of the hamlet of Blue Mountain Lake (Figure 2). Other deposits were observed along Sucker Brook to the west and south of Eighth Lake Mountain from Eighth Lake to the Raquette Lake Reservoir. More are concentrated near Inlet Creek, south of the Marion River, and along Boulder Brook, a second eastern tributary to Raquette Lake. Esker ridges (?) near Eldon Lake, at the east side of Raquette Lake, and ice-contact structures in the Blue Mountain Lake delta, suggest that remnant ice remained in GLR, at least initially.

Where was the outlet for GLR? Ice stood in the Lake Durant depression blocking eastern drainage and in the Forked Lake depression blocking northern drainage. Ice probably remained in Inlet Creek, up to the elevation of Sagamore Pond at 1904 ft. Inversion ridges suggest that this ice did not melt until GLR and its successor had drained. And there are no GLR features south of Eighth Lake. This leaves northward or eastward drainage into the ice; or southwestward drainage via either Eagle Creek or Sucker Brook.

Ice-contact stratified drift appears to have filled Eagle Creek up to ±1900 ft along Uncas Road. Indeed, the drift may mark the edge of Moose River ice that dammed GLR Although there may have been an early level of ±1960 ft in upper Sucker Brook, that may have drained southwest via the Cascade Lake channel, the thresholds are well above 1840 ft. Thus, it is not now possible to pinpoint a drainage threshold responsible for the level of GLR. The most likely possibility is somewhere eastward within the blocking Hudson River basin ice. It is proposed here that GLR drained eastward into or under leaky Hudson-Champlain Lobe ice where a topographic barrier served as an 1840 ft threshold. The most likely candidate is the channel south of the Stark Hills, 3 km east of Lake Durant. There is a possible threshold at ±1840 ft on Ledge Mountain south of the Stark Hills that overlooks what may be an abandoned plunge pool. Perhaps GLR waters were on their way to the subglacial Indian River channel.

Glacial Lake Fulton

Glacial Lake Raquette was succeeded by a more extensive lake at ±1805 ft. The release of 35 ft of water caused lake waters to withdraw almost entirely from Sucker Brook in the northwest. A dense concentration of boulders at Eagles Nest, north of Eagle Lake, probably represents a lag deposit formed during drainage of GLR. The new lake, here named Glacial Lake Fulton (hereafter GLF), spread eastward in the valley of Lake Durant, in the Rock River drainage basin. Inversion ridges west of Stark Hills, near Rock Lake on the Rock River, and between Ledge Mountain and Sawyer Mountain, suggest that this lake drained east like its predecessor into or beneath ice of the withdrawing Hudson-Champlain Lobe. To the south, the lake extended into the Fulton Chain, for which it is named, as far as Sixth Lake. The maximum extent is illustrated in Figure 5.

The dimensions for GLF shrank from 28 to 22 km east-to-west, but increased from 12 to 17.5 km north-to-south, compared to GLR. Stratified sand and silt deposits surround Raquette Lake at ±1805 ft. Those deposits extend eastward to the head of Utowana Lake and were observed adjacent to eastern Blue Mountain Lake. In the Fulton Chain, 1805 ft terraces were mapped between Eighth and Seventh Lakes and immediately south of Sixth Lake. They extend to the ice-margin deposits in Eagle Creek that probably bounded GLR. Similar deposits at Lake Durant Camp and surrounding O'Neil Flow east of Blue Mountain document extension into the Rock River valley and upper Hudson drainage.

The northern ice border for GLF probably remained unchanged. Outwash south of Forked Lake is graded to ±1800 and ±1780 ft. Evidently it was deposited by active northern ice still in place after the demise of GLF. Ice-contact structures in deltas at "Burke's Cabins" and at the former landfill for the village of Inlet document the presence of remnant ice during establishment of this lake. To the east, Hudson-Champlain ice was beginning to withdraw and probably to disintegrate at its western margin. The withdrawal probably initiated the drawdown of 1840 ft GLR to 1805 ft resulting in GLF. To the west, ice still occupied the North Branch of the Moose River in the vicinity of Big Moose Lake. However, in the Middle Branch the ice margin withdrew southwestward through Eighth, Seventh, and Sixth Lakes. A small terrace remnant south of Fifth Lake also may represent this level. GLF waters may have been present in northern Fourth Lake, but we conclude that Fourth Lake deposits near 1805 ft probably represent southwest-flowing drainage that ended GLF. Late in the history of GLF it probably drained into stagnant ice in the Fourth Lake basin.

Glacial Lake Inlet

A ±1760 ft level is documented in the northern part of Fourth Lake and south of Fifth Lake. It is here named Glacial Lake Inlet (hereafter GLI) for the hamlet of Inlet just north of Fourth Lake. Although GLI was a relatively minor lake at 6 km by 10 km, it was an important step in the overall sequence.

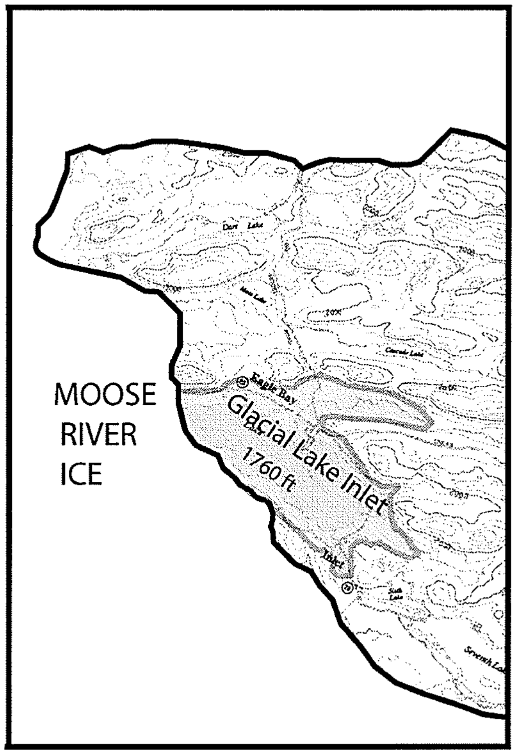

Figure 6. A sketch map of 1760 ft Glacial Lake Inlet which extended over Fifth and Fourth Lakes. Drainage is southwest into the Moose River ice.

East of the Raquette River/Hudson River drainage divide, the Hudson-Champlain ice withdrew farther eastward. GLF waters fell to a new threshold elevation at ±1790 ft and then drained altogether down the Rock River. No distinct features were observed at that elevation surrounding Raquette Lake. Thus, northern drainage of GLF to the Raquette River probably followed immediately via the Outlet Bay inversion ridge channels. That would have lowered the water level in the Raquette Lake depression to its present level of 1762 ft. South of the Raquette River/Moose River drainage divide, southwestward drainage must have commenced into or onto Moose River ice.

The north portion of the Middle Branch became ice-free enabling Eighth Lake to reach its stable level at 1791 ft, Seventh Lake to reach 1786 ft, and Sixth Lake to reach ±1773 ft. Miller (1917, p. 70) stated that "From ... Raquette Lake ... preglacial drainage was almost certainly southwestward by way of ... the Fulton Chain ...". Evidently, just the reverse was true. Seventh and Eighth Lakes, without Lake Fulton lacustrine deposits at ±1805 ft at their northern ends, probably were tributaries to the Raquette River, via the Raquette Lake depression.

In the Moose River basin, ice evidently remained in the South Branch. But a lake developed at ±1800 ft across the Dart Lake and Moss Lake depressions in the upper North Branch. It is marked by very thick deposits of lacustrine sand. The lake extended to the vicinity of Safford Pond and we here name that lake Glacial Lake Safford. The northern margin of Fourth Lake ice must have been just west of Bubb Lake, then north of Lake Rondaxe to southeast of Safford Pond. It acted as a dam for both Lake Safford in the North Branch and GLI in the Middle Branch as illustrated in Figure 6. We posit that Lake Safford gradually emptied into the Middle Branch at the hamlet of Thendara, either into the ice or over it, bypassing GLI.

Above Glacial Lake Safford another lake developed at ±1900 ft from Lake Big Moose northeastward to the drainage divide. That lake, here named Glacial Lake Big Moose, might have developed prior to Lake Safford or contemporaneously. But because overflow deposits from Big Moose Lake appear to be graded to previously deposited Lake Safford sands, we infer that it was subsequent. In any case, the combined waters of Lakes Big Moose and Safford eventually extended Lake Safford down the North Branch to a threshold at Thendara. Drainage into Moose River ice probably caused retreat of the Fourth Lake ice margin to the North Branch/Middle Branch confluence, initiating the succeeding lake.

Because of the lack of sediment downstream in the Moose River, we conclude that superglacial drainage sluiced water and sediment from the central Adirondacks into the Black River Valley. The draining of Glacial Lake Safford and Glacial Lake Inlet initiated large scale sediment bypassing as a process in the Moose River drainage basin. Bypassing was previously proposed by Connally and Cadwell (1991).

Glacial Lake Old Forge

The retreat of Moose River ice to Thendara was accompanied by a lowering water level along the Middle Branch from ±1760 to ±1740 ft. Lake Safford and Lake Inlet drained completely. The 1740 ft level is here named Glacial Lake Old Forge (hereafter GLO) for the former Browns Tract Forge and the village of Old Forge. GLO extended 20 km from Fifth Lake to the ice dam at Thendara as illustrated in Figure 7. GLO and it successor were only ±1 km wide in the Middle Branch of the Moose River and even narrower in the North Branch. Boulder deposits immediately above GLO deposits south of Fourth Lake suggest that the lowering from GLI to GLO was accomplished by strong current action. It might have been catastrophic.

Ice must have remained in the valley of Nicks Creek, to the southeast, because no 1740 ft features were observed there. However, GLO did extend up the North Branch to the vicinity of Rondaxe Lake. GLO terraces are the dominant features surrounding all of the lower lakes of the Fulton Chain. They were particularly well exposed in 1990 at the Old Forge airport. Again, drainage must have escaped southward, sluicing water and sediment through superglacial channels to the Black River Valley.

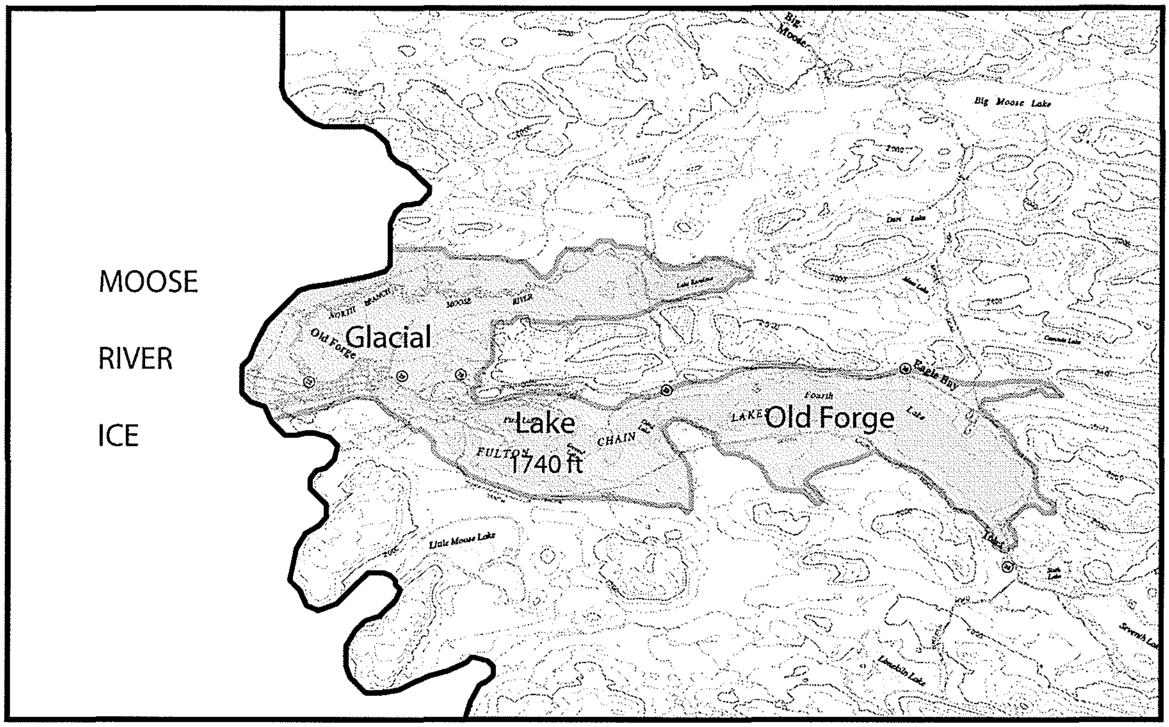

Figure 7. A sketch map of 1740 ft Glacial Lake Old Forge which extended over First through Fourth Lakes. The outlet is to the west over disintegrating Moose Ricer Ice.

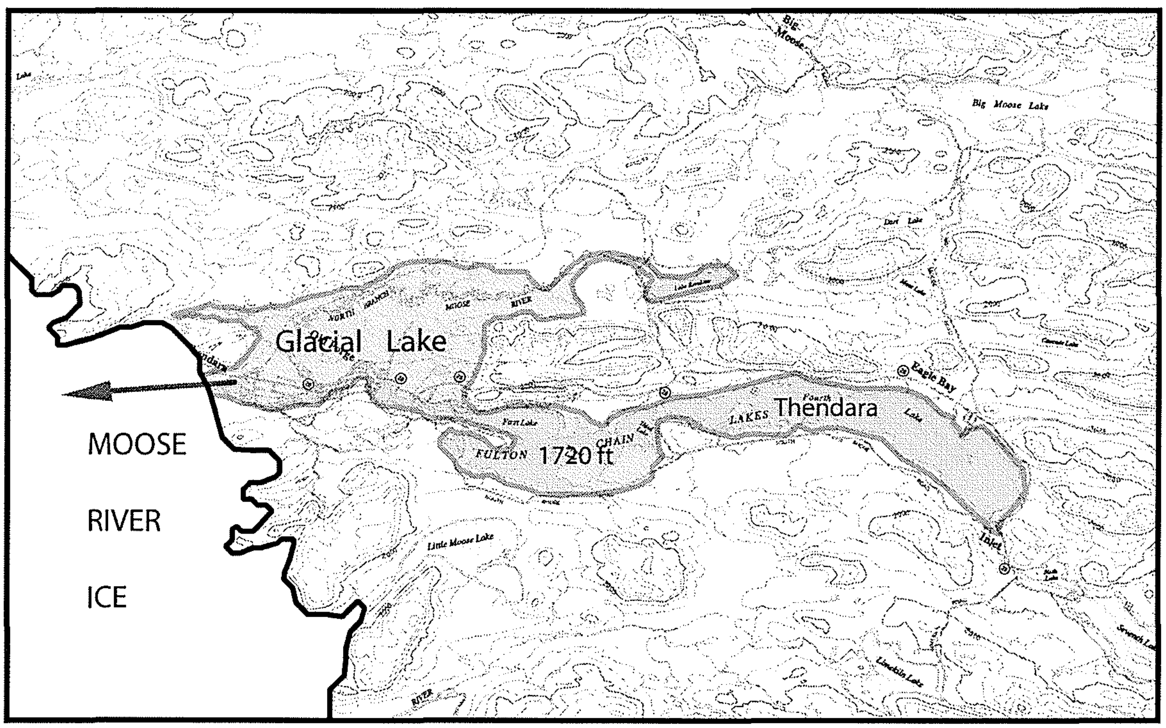

Figure 8. A sketch map of 1720 ft Glacial Lake Thendara that also extended over First through Fourth Lakes. Drainage is southwest into the Moose River ice. The outlet channel deposits are shown in Figure 9.

Glacial Lake Thendara

Evidence for the final pre-Fulton Chain lake is preserved at ±1720 ft. The Moose River ice margin retreated 1 km southwest and later another 6 km to Flatrock Mountain. The lowest level is here named Glacial Lake Thendara (hereafter GLT) for the hamlet of Thendara. It was ±27 km long from Fifth Lake to the ice dam as illustrated in Figure 8. GLT left low terraces from 10 to 14 ft high at many points along the lower Fulton Chain. However, GLT deposits are much more prominent along the Moose River southwest of Old Forge and in the valley of Nicks Creek. At the mouth of the North Branch, west of Old Forge, the Thendara Flats were deposited.

Drainage from GLT, like its predecessors, must have been southwest over decaying Moose River ice. Connally was able to identify the probable outlet channel, at least for GLT, in a gravel pit southwest of Thendara. A linear concentration of huge boulders that strongly suggests catastrophic drainage by very swift currents was uncovered in the autumn of 2002. These boulders are illustrated in Figure 9.

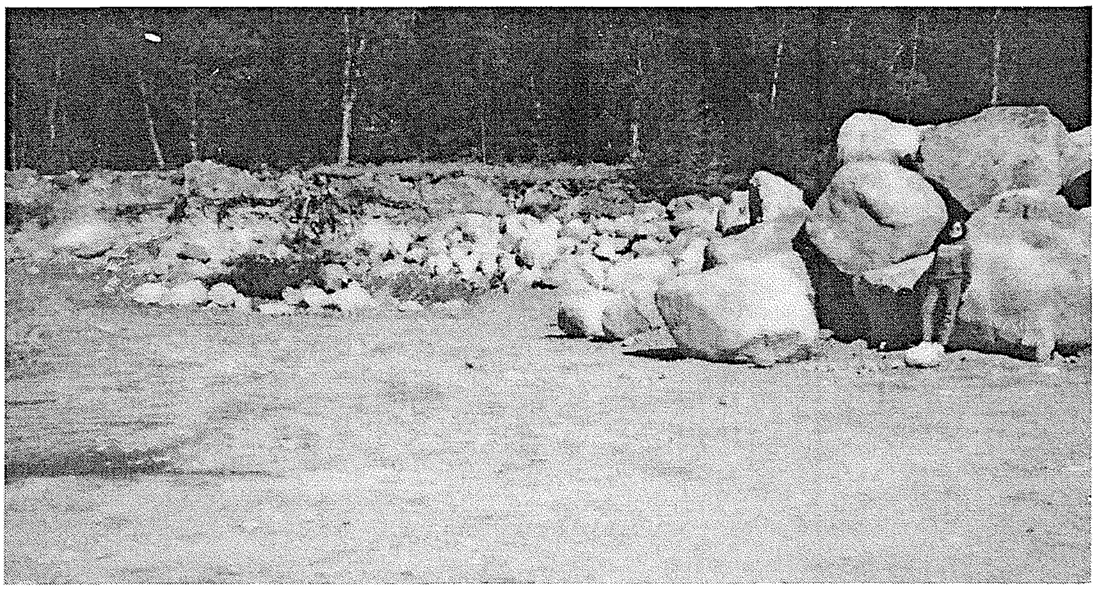

Figure 9. Boulders in the Heroux Construction Co. pit, deposited during drainage of Glacial Lake Thendara, as observed in 2002. The wife of the senior author appears at right for scale.

The relationship between the five proglacial lakes of the Fulton Chain, and Raquette Lake, and the natural elevations of the nine lakes are illustrated in Figure 10. The elevations, dimensions, and boundaries for those lakes are summarized in Table 2.

TABLE 2

Major Proglacial Lakes of the Fulton Chain Region

Glacial Lake	Elevation	NS x EW	SW boundary	NE boundary
Lake Raquette	1840 ft	12 x 28 km	Moose River ice	Hudson River ice
Lake Fulton	1805 ft	18 x 22 km	Moose River ice	Hudson River Ice
Lake Inlet	1760 ft	10 x 6 km	Moose River ice	5^{th} Lake/6^{th} Lake upland
Lake Old Forge	1740 ft	20 x 1 km	Moose River Ice	5^{th} Lake/6^{th} Lake upland
Lake Thendara	1720 ft	27 x 1 km	Moose Rover ice	5^{th} Lake/6^{th} Lake upland

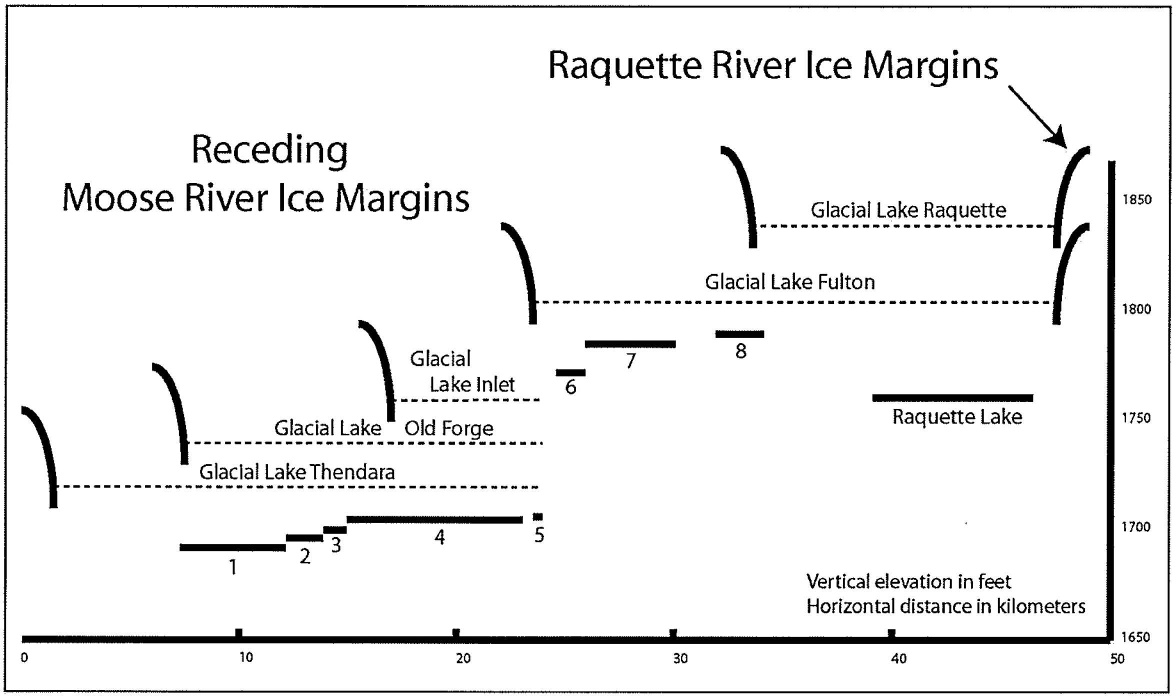

Figure 10. This diagram suggests the association of retreating glacier ice in the Raquette and Moose River valleys, with the elevation and position of both the proglacial and present-day lakes. The eight Fulton Chain lakes are represented by number.

ADIRONDACK DEGLACIATION

The Events outlined above probably initiated deglaciation of the entire Adirondack region. When deglaciation began, the Raquette Lake depression was critically located between northern sublobes, the Hudson-Champlain Lobe to the east, and glacier ice that was south and west of the major drainage divides. If the Raquette Lake area is not the place where deglaciation began, it is one of very few candidates.

At some time during general deglaciation of western and central New York, continental ice had shrunk back to the Adirondack Mountains. The last time that Adirondack ice, and probably Black River ice, contributed to the Mohawk Valley was during the West Canada Advance (Ridge and others, 1991) prior to the Shed Brook Discontinuity (Ridge, 1997). To the north, Adirondack ice was continuous with the continental glacier that covered central Canada and the Maritime Provinces. According to Connally and Cadwell (2004) free drainage that created the Shed Brook discontinuity commenced at 19,500 yBP. Note here that all dates have been translated into calendar years (yBP) using Calib 4.3 (Stuiver et al., 1998). Actual ^{14}C dates (ka) are quoted in parentheses where appropriate.

Following the erosion that created the Shed Brook Discontinuity, presumed active ice furnished sediment to deltas on the northeastern shore of proglacial lakes in the Black River Valley (Connally and Cadwell, 1991). According to Connally and Cadwell (2004), the free drainage had ceased by 17,800 yBP. At the southern edge, presumed active ice furnished sediment to Lake Miller deltas in the Mohawk Valley (Fullerton, 1971). To the southeast, the

Hudson-Champlain Lobe still was active, re-blocking the lower Mohawk Valley and extending south into the mid-Hudson Valley as the Rosendale Readvance.

At the next geological instant, downwasting in the Adirondacks reached a critical threshold where new ice could no longer replenish the ablating ice to the south. The glacier was no longer thick enough to maintain flow over the high, mountainous divides. Once the critical threshold was reached, ice in the Independence River and Moose River basins, and probably the West Canada Creek basin as well, stagnated in place (Fleisher and others, 1991). Ice north of the divides remained active, thus maintaining the ice margin in the Forked Lake depression that dammed Glacial Lakes Raquette and Fulton. At first, the Hudson-Champlain Lobe continued to supply active ice in the Lake Durant depression to the east. But this ice began to stagnate and disintegrate causing the demise of GLR. Perhaps Moose River ice was large enough and thick enough to maintain independent flow for a brief time, but there is no confirming evidence. This then was the beginning of Adirondack Mountain deglaciation.

Why should the Raquette depression be first? As soon as peaks such as West Mountain and Blue Mountain cut off ice supply from the north, ablation must have accelerated south of the divide. In the Beaver River basin to the west there is abundant evidence of large quantities of meltwater beneath the ice. Connally and Cadwell (1991) reported sandy, laminated, subglacial meltout till in many lowlands in both the Beaver River and Moose River basins. Thus, we suggest that meltwater, having nowhere to go, began accumulating subglacially in the Raquette Lake depression.

During initiation of Glacial Lake Raquette, the Hudson-Champlain Lobe remained firmly in place in the Lake Durant depression. Raquette River ice also stayed firm in the Forked Lake depression. Moose River ice melted back only marginally, to the Eighth Lake depression. We suggest that large quantities of subglacial water at or near its melting point promoted rapid melting of ice overlying the Raquette Lake depression, initiating GLR at 1840 ft. A similar situation may have existed at the divide between the north-draining Oswagatchie River and the west-draining Bear River basins. However, it is reasonable to conclude that ice overlying the Moose River-Raquette River divide melted first. That is where the mountains are highest and so that is where the Adirondack ice probably was thinnest.

TIMING

It is impossible to establish an exact time when deglaciation began. However, it must have begun between 19,500 and 15,500 yBP (16.35 and 12.86 ka) and was completed in the Moose River basin by 15,500 yBP.

Deglaciation of the Adirondacks did not occur until after retreat of the last Valley Heads readvance into the western Mohawk Valley. The maximum extent of Valley Heads glaciation in south-central New York occurred at about 16,010 yBP (13.32 ka) according to Coates et al. (1971). However, the equivalent Kent Moraine ice in western New York had begun recession by 16,800 yBP (14.00 ka) according to White et al. (1969). The last readvances of the Ontario Lobe in the western Mohawk Valley were the Hinckley Readvance that deposited the Norway till and Barneveld Readvance that deposited the Holland Patent till of Ridge (1985, Fig. 21) followed by the final Rome Readvance (Muller and Calkin, 1993). There was no involvement of either Adirondack or Black River ice during these readvances.

According to Ridge (1997 and 2003), the Hinckley and Barneveld Readvances occurred at 14.5 and 13.5 ka, respectively. Thus, it is possible that deglaciation of the Moose River drainage basin began with the recession of the Oneida sublobe prior to the Hinkley Readvance.

Deglaciation of the central Adirondacks began with recession of Hudson River ice to the east, down the Rock River valley, prior to 15,500 yBP. That is the revised date reported by Connally and Cadwell (2004) for retreat of the Hudson-Champlain Lobe from the east edge of the Adirondacks. It is based on the date of Clark et al. (2001) for re-establishing Great Lakes drainage down the Mohawk Valley and out the Hudson Valley to the Atlantic. By that time the upper Hudson Valley drainage basin almost certainly was free of active ice, though areas of stagnant ice may have remained in protected areas (Fleisher et al., 1991).

Thus, at this time we conclude that initial deglaciation of the southwest Adirondack Mountains began by 16,800 yBP. Deglaciation began with the inception of Glacial Lake Raquette that straddled the divide between the Moose River and Hudson River drainage basins. It probably did not take long for the Moose River basin to become ice-free but 15,500 yBP seems to be the youngest limit.

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ROAD LOG

For the 93 miles to Stop #1, this trip follows the path of the Raquette River upstream to its origin at Raquette Lake. The route crosses the river several times; three times in the first 10 miles. There are many bedrock outcrops along the way. Although not the subject of this trip, it is interesting to notice that almost all exhibit a set of joints that dip toward the road, parallel to the rock surface.

At Blue Mountain Lake, mile 81.2, the road log starts to mention features pertaining to this fieldtrip.

Total Miles	Miles From Last Stop	
00.0	00.0	Proceed west on Barrington Drive toward Rout 56.
00.2	00.2	STOP SIGN Turn left (south) on Route 56. Follow Route 56 for 32 miles.
32.2	32.2	STOP SIGN Turn left (east) on Route 3. Follow Route 3 for 17 miles.
49.7	49.7	2 TRAFFIC LIGHTS Turn left, then right onto Route 30 at the top of the hill.
49.9	49.9	3rd TRAFFIC LIGHT Turn left (south) following Route 30. Follow Route 30 for 33 miles.
71.2	71.2	Cross bridge into hamlet of Long Lake.
71.9	71.9	YIELD SIGN Follow Rt. 30 to right; Rt. 28N joins from left.
81.2	81.2	Start down steep hill into hamlet of Blue Mountain Lake.
81.5	81.5	Adirondack Museum entrance on is on the right.
82.4	82.4	**Blue Mt. Lake** is on the right; 1840 ft Blue Mountain delta in the woods at left.
82.6	82.6	INTERSECTION Continue straight (west) on Route 28; Route 30 leaves to left and passes Lake Durant, at 1,769 ft, the lowest of the lakes on the Marion River.
84.3	84.3	Look for an arête on the right.
90.6	90.6	Delta terrace sediments exposed.
92.9	92.9	**Raquette Lake** is on the right; 4.5 x 3.4 mi (7.3 x 5.6 km), present elevation of 1,762 ft.
93.2	93.2	Cross small bridge over South Inlet for Raquette Lake
93.8	93.8	**STOP #1** Burke's Cabins are on the right; Burke's Marina on

		the left. Park where you can but, NOT in the restaurant parking lot. We will look at the sediment behind the marina buildings and then find an open space to discuss Glacial Lakes Raquette and Fulton.
	00.0	Continue west on Route 28
94.3	00.5	Delta foreset beds may be exposed on the left.
95.7	01.9	INTERSECTION Continue straight ahead on Route 28. Historic Sagamore is to the left; to the right is the hamlet of Raquette Lake.
99.0	05.2	**Eighth Lake**, the highest of the Fulton chain, is on the right; 1.8 mi (2.6 km) long, present elevation 1,791 ft.
102.3	08.5	Cross an inlet to **Seventh Lake**; 3.1 mi (5.0 km) long, present elevation 1,789 ft.
104.5	10.7	Pryor's Sea Plane rides on right are on Seventh Lake. **Sixth Lake** is the next lake seen through the trees; 0.9 mi (1.5 km) long, present elevation 1,789 ft.
105.8	12.0	Sixth Lake Road is on the right.
106.0	12.2	**Fifth Lake** is on the left, only 0.3 mi (0.5 km) long, present elevation 1,707 ft.
106.2	12.4	Enter the hamlet of Inlet.
106.4	12.6	Inlet public parking lot on the left at the head of Fourth Lake.
106.5	12.7	**Fourth Lake** is on the left; 6.0 mi (8.6 km) long, present elevation 1,707 ft.
108.4	14.6	Enter the hamlet of Eagle Bay
111.3	17.5	Fourth Lake still is on the left.
113.9	20.1	**Third Lake** is now on the left, but is not visible; 1.0 mi (1.6 km) long, present elevation 1,707 ft.
115.0	21.2	**Second Lake** now is on the left, but it also is not visible; 0.8 (1.4 km) long, present elevation 1,707 ft.
115.4	21.6	A new rock fall in 2004 was added to the talus on the right.
117.3	23.5	**First Lake** is visible on the left; 2.7 mi (4.4 km) long, present elevation 1,707 ft.
117.6	23.8	INTERSECTION immediately before right turn. Turn left (east)

		between buildings.
117.7	23.9	**STOP #2** Here we will discuss the present day Fulton chain and their predecessors Glacial Lakes Inlet, Old Forge, and Thendara.
	00.0	Return to Route 28.
117.8	00.1	STOP SIGN Turn right (north) onto Route 28.
117.9	00.2	INTERSECTION Turn left (west) onto North Street and traverse a 1720 ft terrace of Glacial Lake Thendara lacustrine sand.
119.5	01.8	Rise up the scarp to the l740 ft lake terrace of Glacial Lake Old Forge lacustrine sand.
120.1	02.4	**STOP #3** Park where you can, then cross the bridge over the Moose River to view the sands of Lake Thendara.
	00.0	Return east to Route 28.
122.3	02.2	STOP SIGN Turn right (south) on Route 28.
122.5	02.4	The hamlet of Old Forge is constructed on the 1740 ft terrace deposited in Lake Old Forge.
123.0	02.9	Descend to the 1720 ft terrace deposited in Lake Thendara.
123.3	03.2	Cross the Middle Branch of the Moose River.
124.1	04.0	Passing through the hamlet of Thendara
125.6	05.5	INTERSECTION Turn left (east)
125.7 LEFT	05.6	Exposure of channel deposit of boulders on the left. STAY to the active gravel pit of Heroux Construction Co.
125.8	05.7	**STOP #4** Park where you can. We will look at ice-contact lacustrine sediments, and extremely coarse channel deposits. Then we will discuss the history recorded here. On the way out, visit the outlet channel deposits for Glacial Lake Thendara (and perhaps Lake Old Forge, and even Lake Inlet before it) in the original sand pit on the left. Note the size of the "sediment" and speculate on the rate of flow as the lake(s) drained.

This is the last stop. Vehicles traveling back north will reverse the route. Those traveling east, west, or south will continue south (left) on Route 28, which will become Route 12 before intersecting with the New York State Thruway at Exit 31.