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INTRODUCTION

This field trip will examine glacial deposits in a section of the Androscoggin River valley from Peru west to Newry, and thence up the Bear River valley to Grafton Notch in the Mahoosuc Range. The sites visited during the trip have been selected to illustrate the style of deglaciation in this part of Maine, and the variety of meltwater deposits resulting from retreat of the late Wisconsinan ice sheet. Ongoing geologic mapping in the region has raised numerous questions concerning these deposits, which hopefully will stimulate discussion during the NEIGC conference.

The field trip area is located in the hilly to mountainous terrain of western Maine. Elevations are generally higher toward the northwest, culminating in the Mahoosuc Range where some mountains exceed 1,000 m. The Androscoggin River follows a peculiar zig-zag course as it flows eastward through the mountains. It is very narrow in this reach, and abruptly drops about 60 m at the falls in Rumford. Crosby (1922) discussed this "disarranged" drainage pattern. On the basis of geomorphic evidence, he proposed that the Androscoggin formerly flowed southward from Bethel along the present course of the Crooked River valley. Deposition of glacial sediments just south of Bethel supposedly blocked this course and diverted the river.

The products of deglaciation in the study area differ from those found in certain other parts of New England. The region is situated above the limit of late-glacial marine submergence, and lacks the abundant moraine ridges that occur in Maine's coastal lowland. Sand and gravel deposits formed by glacial meltwater are unevenly distributed along this section of the Androscoggin Valley, due in part to the valley's irregular east-west course. Esker systems enter the valley from tributary valleys to the northwest, follow the Androscoggin for a short distance, and then depart to resume their southward course through the hills in response to the former pressure gradient in subglacial tunnels.

Other meltwater deposits along the main Androscoggin Valley include glaciolacustrine deltas and fans, and glaciofluvial outwash. Base-level controls for the deltas and outwash are difficult to locate because of the erratic distribution of these deposits and scarcity of diagnostic exposures. The postglacial river has terraced the original deposits in some places and completely removed them in others. Deltas and subsurface records of lake-bottom sediments indicate that a glacial lake existed in Bethel (just upvalley from the area covered by this trip). Data are being collected to learn the extent of this lake and others that probably formed in the Rumford area. Some of these lakes were dammed by ice and/or drift barriers in constricted parts of the Androscoggin Valley.

Positions of the retreating glacier margin are likewise poorly defined. There are few, if any, end moraines in the field trip area; and distinct ice-contact deltas or other deposits showing heads-of-outwash (like those which occur abundantly in southern New England) are relatively uncommon in this part of the Androscoggin River basin. However, the mapped deposits and meltwater channels indicate northward to westward ice recession over most of the area. Possible evidence for northeastward retreat of an ice mass in the vicinity of Rumford will be discussed during the trip. The timing of deglaciation in Maine is constrained by only a few key radiocarbon dates (e.g. Davis and Jacobson, 1985), from which it is inferred that the mountains in western Maine were uncovered between 14,000 and 13,000 yr B.P. (Thompson and Fowler, in press).

The topography of the study area is believed to have strongly influenced the pattern and mode of deglaciation. Southeast of this area, the stratigraphy and structure of end moraines indicate the presence of an active ice margin in the coastal lowland. To the west, the Androscoggin Moraine and other features provide evidence of active ice in the upper Androscoggin basin following emergence of the Presidential, Carter, and Mahoosuc Ranges from the ice sheet (Thompson and Fowler, in press). However, it is likely that large masses of ice were cut off from the thinning ice sheet in the lee of the Mahoosucs, in the central Androscoggin Valley and its tributaries. This local stagnation may account for the small volume of meltwater deposits generated in the latter region. The size and continuity of residual ice masses, and the extent to which they maintained some activity, are being investigated in conjunction with mapping studies in this area.

DESCRIPTION OF STOPS

STOP 1: West Peru Sections

This is a two-part stop. Stop 1-A is the large pit close to Route 108; Stop 1-B includes the small pit and washout gully along the logging trail leading to the south (other side of small intermittent stream) (Fig. 1).

STOP 1-A presently exposes about 3 m of section. Three stratigraphic units occur in this pit. From oldest to youngest, they are as follows:

(1) The lowest exposed unit is a sandy diamicton that is interpreted as glacial till, though its depositional environment is uncertain. The till is light olive-gray (5Y-6/2), non-oxidized, and variably stony. It contains assorted bedrock lithologies as angular to sub-rounded clasts to 1 m in diameter. Only a small percentage of these clasts are striated and faceted. Unit 1 closely resembles the typical surface till deposited by the late Wisconsinan ice sheet in southwestern Maine (Stratford Mountain Till of Koteff and Pessl, 1985). However, at this locality it shows an unusual degree of stratification in the form of silt-sand lenses. Perhaps it is a water-lain

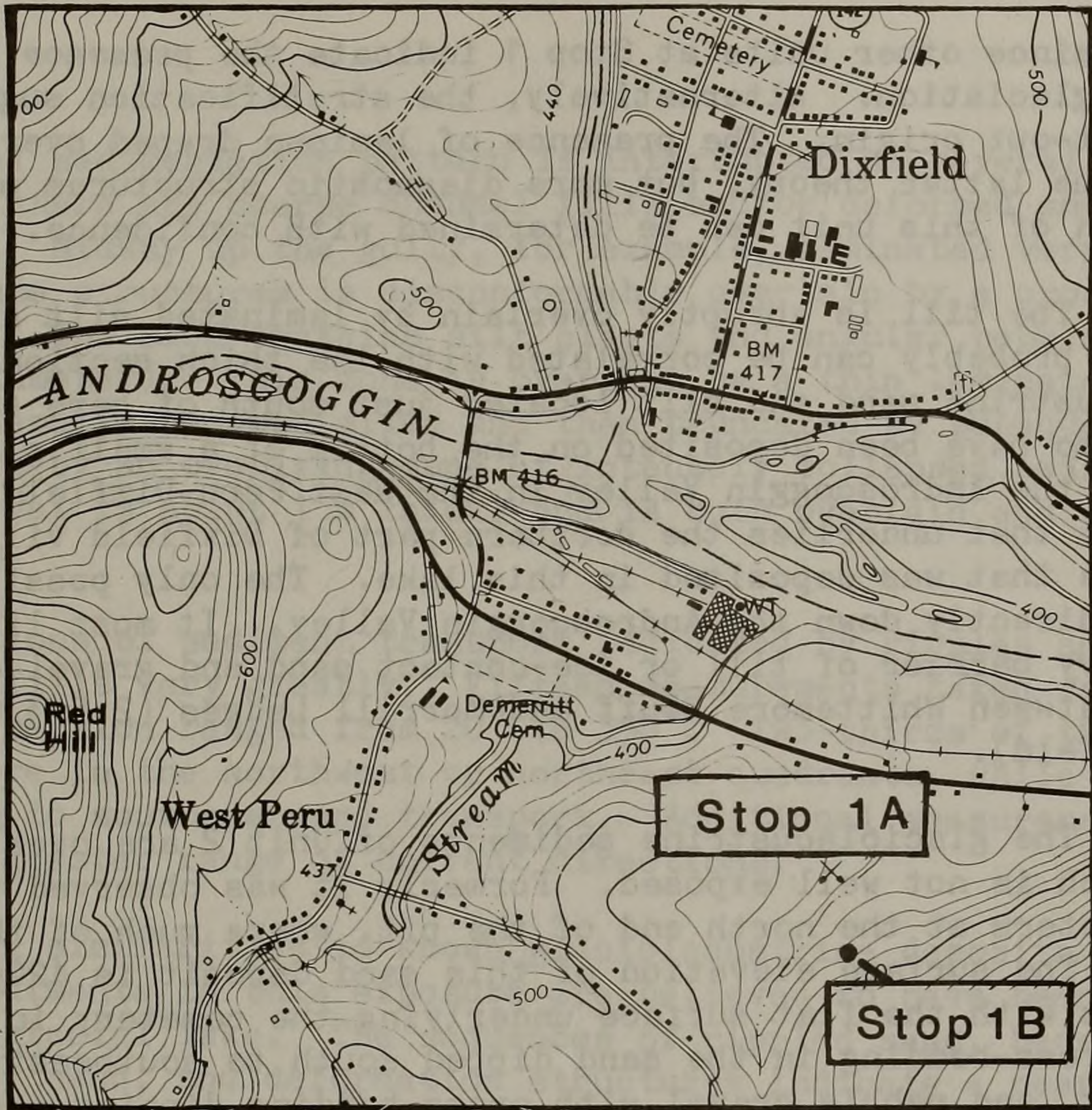

Figure 1. Location map for stops 1-A and 1-B

Figure 2. Location map for stops 2-A and 2-B. Chevrons indicate ice-channel filling.

deposit, since other units at Stop 1 indicate the presence of ponded water during deglaciation. Alternatively, the stratification suggests a possible basal melt-out origin. The presence of laminae draped over stones in the till support the latter theory, but more diagnostic structures must be found before the origin of this unit can be determined with confidence.

(2) The till is abruptly overlain by laminated silt and very fine sand. This unit probably can be correlated with the thick section of glaciolacustrine sand and silt located just south of here (Stop 1-B). It is believed to have been deposited on the bottom of a small glacial lake that was dammed in the Androscoggin Valley in the West Peru-Dixfield area. The outwash at 460+ ft that underlies the northern part of Dixfield village (Fig. 1) may be a delta that was deposited in this lake. The only possible outlet for the lake was directly down the Androscoggin Valley. It most likely was dammed by a temporary barrier of till or ice-contact sand and gravel deposits in the narrows between Whittemore Bluff and Morrill Ledges (2.5-3.0 km downstream from Dixfield).

(3) The glaciolacustrine sediments of Unit 2 are overlain by pebbly sand, which is not well exposed. Formerly it was observed to thicken to several meters at the north end of the pit, where much of the section has been removed. The surface elevation of this sand deposit is 420-440 ft; it correlates with the flat surface underlying the cemetery in West Peru. Fluvial cross-bedding in the sand dipped south to southeast in the north end of the pit, and pebble gravel with cross-bedding dipping east was noted in a railroad cut in the same unit just northeast of here.

Unit 3 is interpreted as glacial outwash or a postglacial stream terrace. In either case, it postdates the downcutting of the barrier that impounded the lake. Elevations of glaciofluvial deposits a short distance upriver (between Dixfield and Mexico) are in the 460-500 ft range, and probably are on-grade with the sand plain at West Peru. Therefore, Unit 3 is considered more likely to be glacial outwash. This kind of interpretive problem is common in narrow segments of the Androscoggin Valley, where Holocene erosion by the river has left only fragments of terraces. Given the 20-ft contour interval of the topographic maps and frequent lack of genetic criteria, it is difficult to determine the origin and age of some of the waterlaid units, or to correlate them along the valley.

Stop 1-B is the long washout gully in the logging road that leads across the brook and uphill to the south from Stop 1-A. This washout and the adjacent pit expose a total of at least 14 m of glaciolacustrine sediments. The deposit consists of well-stratified, subhorizontal sand and silt beds. The following characteristics were noted in these exposures:

-- Dark-colored finer-grained sets of thinly laminated silt and silty very fine sand beds occur throughout the section, indicating episodic low-energy conditions. These silty units are best exposed in the upper part of the gully, where they have a somewhat regular spacing of up to a few decimeters.

-- Ripple-drift lamination (current ripples) occur throughout the section in the sandy intervals. "Type A" and "Type B" ripples are present, as well as silt drapes (Ashley and others, 1985). Medium to very coarse sand seems to be more abundant higher in the section, suggesting higher-energy conditions with time.

-- The typical sedimentation pattern is interrupted at several levels in the section, where there are coarse channel fills and/or deformed and brecciated silt-sand beds. Midway up the gully, for example, laminated very fine sand with water-escape structures is disconformably overlain by a cross-bedded lens of coarse sand. The sand contains silt clasts and angular pebbles (the latter to 4.5 cm in diameter). This zone is overlain by a thin laminated silt-sand unit, which laterally becomes mixed and then truncated by subaqueous slumping, followed in turn by an overlying zone of intensely collapsed beds. The entire disturbed interval is about 1 m thick, and is both overlain and underlain by undeformed beds.

-- The directions of sediment transport indicated by ripples and cross-bedded channel fills vary greatly. Fifteen measurements taken randomly throughout the section ranged from 20^{o} to 350^{o}. Two-thirds of these measurements were in the northwest or northeast quadrants, while the remainder indicated south to southeastward transport. Additional measurements might reveal an even greater range of current directions.

Considering similarities to known glaciolacustrine deposits in New England, the sediments in this exposure are believed to have been deposited on the floor of a glacial lake. The sequences of rippled sand, beds/lenses of coarse to pebbly sand, and deformation structures indicate a nearby sediment source and dynamic environment. This site may have been located upon or close to a delta front. The remnant of an inferred delta is preserved across the river in Dixfield, as noted above. Since there are no dropstones in the lake sediments at Stop 1-B, the delta probably blocked the valley in front of the glacier margin and thus inhibited the development of icebergs.

The origin of the erosion features and coarse sand units, especially the fluvial-looking channel fills with pebbles and brecciated silt clasts, is uncertain. These features suggest the occurrence of sediment gravity flows from the nearby delta. The flows would have been triggered by slope failures on the unstable delta front. Perhaps dewatering of the lake-bottom sediments (indicated by water-escape structures) caused fluidization of beds in some cases. The frequency of northward sediment transport is another problem, since the alleged delta lies to the north of Stop 1-B, and there is only a till-mantled hillside to the south.

STOP 2: Glass Face Mountain, Rumford

This is a two-part stop, located north of U. S. Route 2 on the lower slope of Glass Face Mountain. The large parking lot next to the highway is the former site of the drive-in theater shown on the Rumford Quadrangle (Fig. 2). This parking lot is situated on the surface of an alluvial fan deposited by the unnamed brook that flows down the hillside into the Androscoggin River.

Stop 2-A is the steep-sided ridge in the woods northwest of the parking lot (Fig. 2). Pit exposures show that the ridge is composed of gravel. Together with the morphology, this indicates that the deposit is an esker (or at least an ice-channel filling). There are numerous boulders on the ridge crest near the uphill end of the esker, as would be expected if meltwater flowed southward toward the valley and dropped the heaviest part of its load in the upper end of the ice tunnel.

This esker is one of several types of glacial features that typically occur on the distal (lee, or down-ice) sides of bedrock hills in the high-relief terrain of southwestern Maine. These features chiefly comprise meltwater channels (generally trending downhill, normal to contours) and various forms of hummocky moraine consisting of ablation till and/or sand and gravel. Less common are short, distinct ice-channel fillings like the one seen here. G. H. Stone described similar features, which he called "hillside kames" (Stone, 1890) and "hillside osars or eskers" (Stone, 1899). He noted their abundance in the hills of western Maine, and their restricted distribution on south-facing slopes.

The questions raised by Stone concerning hillside eskers are relevant to the Glass Face Mountain deposit. He discussed the meltwater paths leading to these eskers, and the absence of similar features on proximal slopes. Stone concluded that they formed during a late stage of deglaciation, when "the ice north of the hills was still high enough to enable its drainage waters to flow southward over the hills" (Stone, 1899, p. 366). It is curious that the esker on Glass Face Mountain simply terminates against the hillside. It is slightly offset from the adjacent ravine, and there is no meltwater channel leading to its upper end. Glacial debris presumably was carried to this site through an englacial tunnel higher in the ice to the north or west. No continuation of the esker has been found down the valley. However, there is another ice-contact gravel deposit on the hillside just west of here, consisting of irregular hummocks that extend up to similar elevations (over 800 ft).

The genesis of lee-side channels and associated deposits needs more work in this part of Maine. These features may have been initiated subglacially in sites of reduced stress on the distal sides of hills as the ice was thinning. Accelerated melting and development of tunnel networks could have occurred in these locations as hills emerged and ice masses stagnated in valleys. However, the timing and formation of lee-side channels, eskers, and hummocky moraine deposits within this broad framework are not well understood.

At Stop 2-B, we will examine the ravine along the brook just east and northeast of the esker. This ravine is bedrock-floored along much of its length, and shows deep erosion of glacial sediments by a small, high-gradient intermittent stream during Holocene time. There are several waterfalls along the brook, including the one at Stop 2-B. The steeply dipping foliation of the metamorphic bedrock, striking transverse to the brook, provides structural control for this waterfall. Note that the upturned edges of the foliation layers have not been incised or greatly abraded, as we might expect if a debris-laden glacial stream had carved the ravine. On the other hand, many of the boulders along the brook can be moved on this steep slope during major floods (J. S. Kite, pers. comm.).

A small exposure of lodgement till occurs in the stream bank at Stop 2-B. The limited outcrop, and rusty mottling produced by near-surface weathering, preclude easy identification of this till as late Wisconsinan Stratford Mountain Till vs. the earlier Nash Stream Till (see Koteff and Pessl, 1985). The sheltered location in the lee of the mountain would be a likely site in which to find a remnant of pre-late Wisconsinan till.

When walking back to the highway, notice the narrow alluvial surface that occurs locally along the brook. It terminates at the alluvial fan next to Route 2. Many such fans have been deposited at the mouths of steep tributary streams in the upper Androscoggin River basin.

STOP 3: Weston Pit, Rumford

The Weston Pit (Fig. 3) exposes up to 18 m of well stratified sand. Part of the pit face was freshly excavated in 1983. The material exposed at that time consisted of planar beds of fine to very coarse sand. The lower part of the section contained thin interbeds of pebble-cobble gravel and minor silt. "Starved ripples" have been noted, and boundaries between sets of beds are locally unconformable. The dip direction of bedding varies between east-northeast and south. No ice-contact deformation has been found here.

Internally, this deposit has the foreset bedding characteristics of a delta. It shows one or more foreset lobes built in an eastward (downvalley) direction. However, a delta topset unit is lacking, and the upper surface of the deposit slopes 8-10^{o} eastward in conformity with the foresets. The Weston deposit is interpreted as a subaqueous glaciolacustrine fan, based on its close similarity to submarine fans of coastal Maine and lacustrine fans in other New England localities. The fan radiates from an apex located at the 780-800 ft col west of here, between the mountain to the north and a small bedrock knob to the south. A meltwater channel, with a boulder lag on its floor, traverses this col (Fig. 3).

Much sand also occurs around the south side of the rock knob, along the broad curve in Route 2. Though not apparent on the topographic map, a distinct terrace wraps around the hillside approximately 50 ft above the road, and there is possibly a higher terrace as well. These terraces resulted from the lowering of the lake in which the fan had been deposited. The original lake level is unknown, since deltas or shorelines have not been found. It presumably was impounded by glacial ice remaining in this narrow part of the Androscoggin Valley, and may have been a very local, ephemeral water body.

Coarse gravel is absent or rare in the section exposed at the Weston Pit. Most of the gravel derived from melting ice in this area was channeled into the esker system that comes down the Ellis River valley and crosses the Androscoggin about 2.5 km west of here. It is unclear why a large quantity of sand was diverted eastward to build the fan seen at this stop. The fan probably was deposited from the mouth of an ice tunnel where the glacier margin lay against the 780-800 ft col mentioned above.

STOP 4: Red Hill Meltwater Channels, Rumford

Some of the most spectacular meltwater channels in this part of Maine are located on the west side of Red Hill (Fig. 4). The longest of these channels are plainly visible in the pastures belonging to the Kimball farm. They are up to 10 m or more in depth, and all terminate at the base of Red Hill. The channels are incised in thick bouldery till; no bedrock outcrops were seen on their floors. Unlike other types of meltwater channels, which slope obliquely across hillsides and follow the gradients of former ice margins, the Red Hill

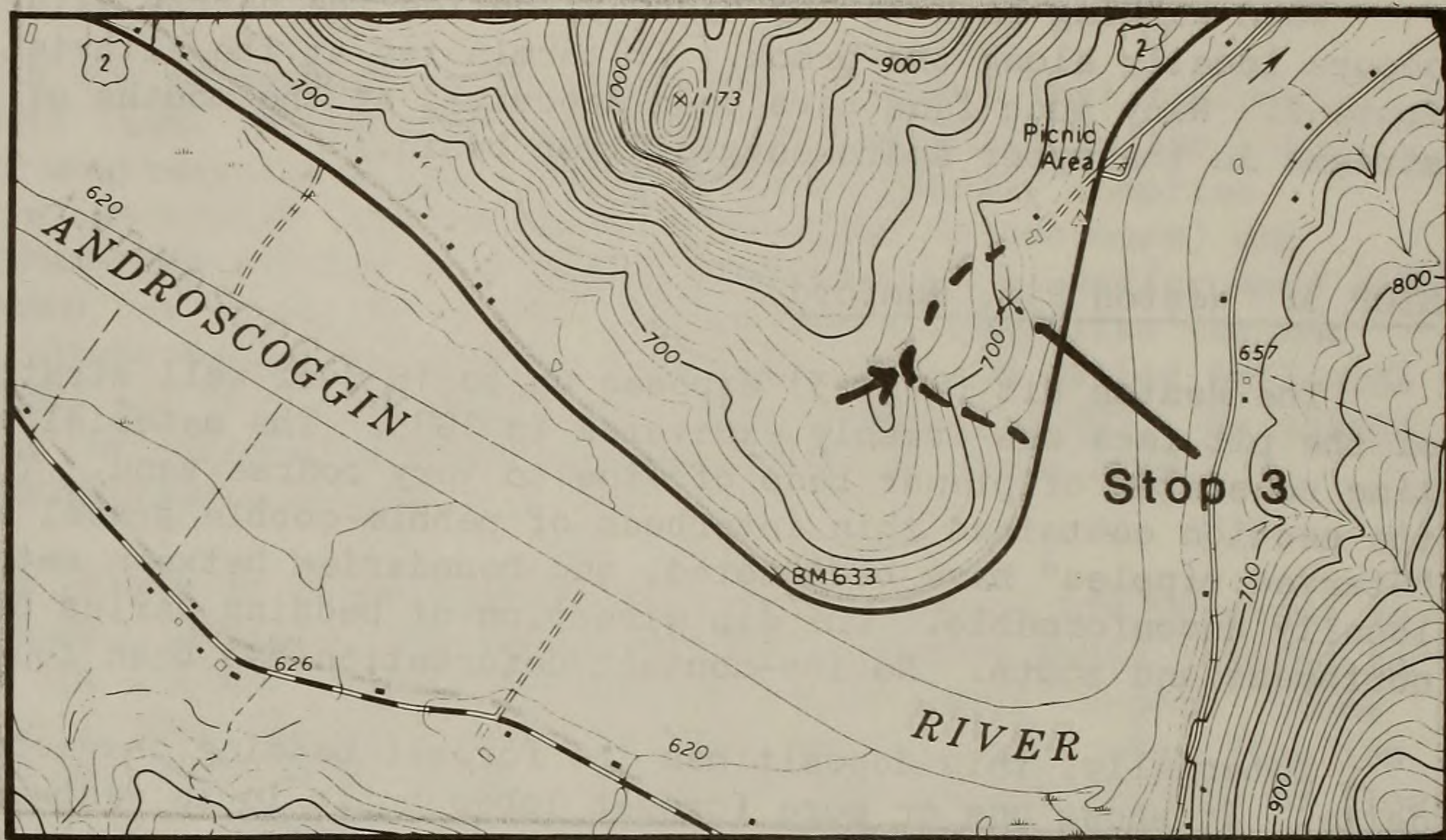

Figure 3. Location map for stop 3. Dashed line shows approximate boundary for glaciolacustrine fan seen at Weston Pit. Arrow indicates feeder channel.

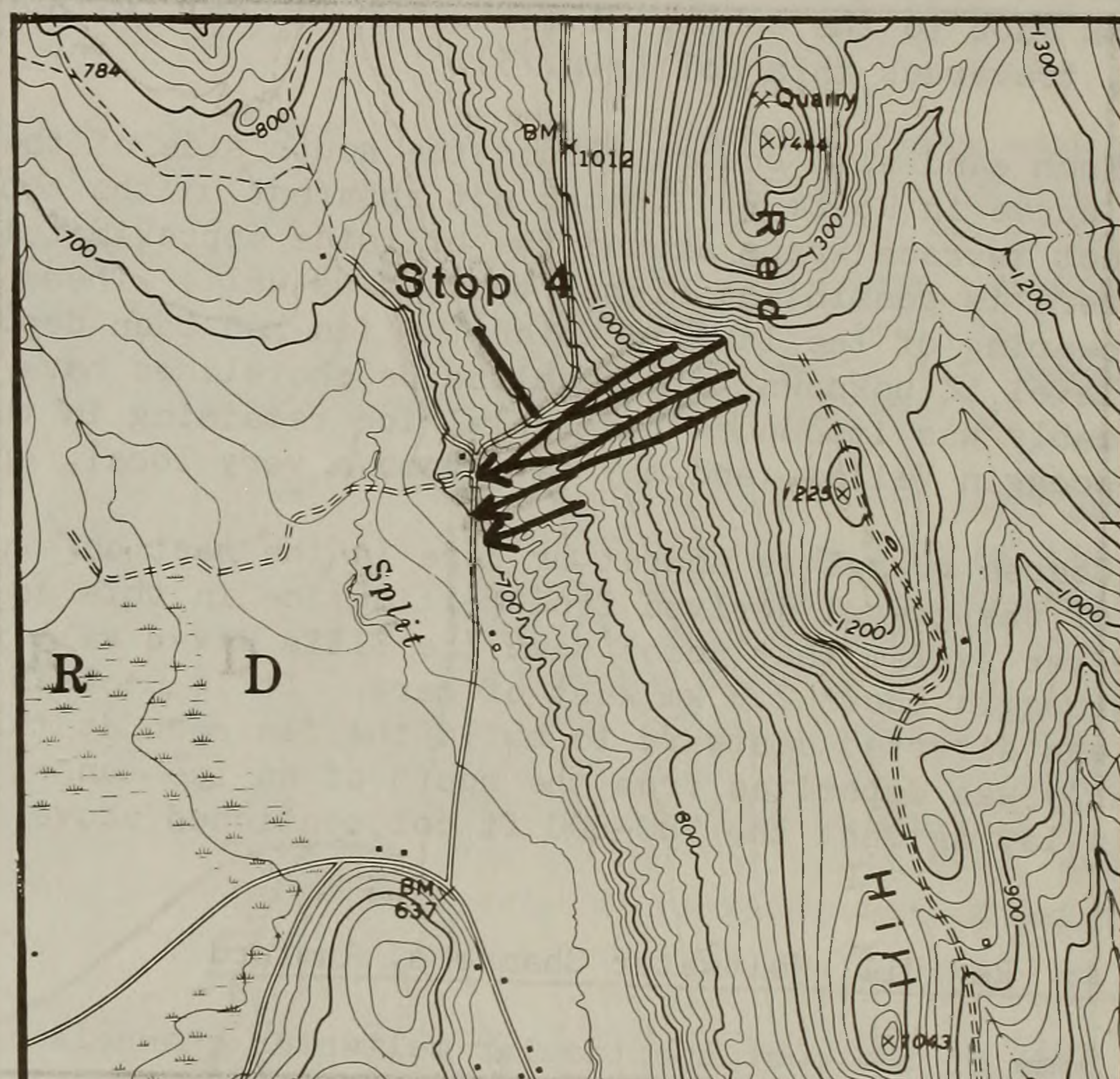

Figure 4. Location map for stop 4. Arrows indicate meltwater channels seen in open field. Other channels occur in woods to south.

channels plunge directly downhill, normal to the topographic contours. They are parallel and straight to slightly sinuous. In some places the divides remaining between channels are only a few meters across. Two channel junctions occur uphill from the Kimball farm, one of which is very near the bottom of the hill (Fig. 4). All observed junctions are accordant.

The upper ends of the central and southern channels become shallower and terminate before reaching the ridge crest. The northern channels extend farther uphill and end beneath a steep bedrock slope on the north peak of Red Hill. The full length of the ridge crest has not been explored, but observations to date have not revealed any channels that cross the top of the ridge.

The lower ends of the channels terminate at the eastern margin of a broad, gently sloping valley floor. This surface is underlain by Holocene alluvium deposited partly along a former course of the Ellis River, and partly by alluvial fans at the mouths of steep upland streams to the north. On air photos, it can be seen that small, poorly defined channels extend out onto this alluvial plain from the lower end of the Red Hill channels. There may be considerable runoff from the Red Hill channels during periods of heavy rainfall, during which sediment washes onto an alluvial fan west of Kimball Road. However, it is unlikely that postglacial erosion by meteoric streams has been sufficient to carve the deep, closely spaced channels seen on Red Hill.

Several questions concerning these channels remain to be answered:

- Assuming a glacial origin, what was the meltwater drainage path above and below the Red Hill channels?
- Were the channels cut subaerially or subglacially?
- Were they cut simultaneously or in sequence?
- Is their topographic setting in the lee of the north peak of Red Hill significant in terms of glacial drainage processes?

Since the central and southern channels do not straddle the ridge crest, it is likely that meltwater descended onto the hillside from a higher position in the glacier, thus requiring an ice cover on Red Hill. If so, we can infer that the channels formed subglacially. Meltwater drainage was focused on the lee side of the north peak when the northern channels were cut, but the absence of lateral channels on the hillside to the northwest suggests that meltwater continued to plunge down into the subglacial channels from higher within the glacier.

The systematic close spacing of the channels, and the relative timing of channel cutting, are problematic. Perhaps the pattern of subglacial tunnels was initiated along parallel crevasses in the ice? The subsequent path of the meltwater and debris exiting the channels is equally uncertain. No other glacial drainage indicators occur in the immediate vicinity, unless they are buried under the valley alluvium. It is possible that the meltwater streams connected with the esker sytem in the nearby Ellis River valley to the west.

STOP 5: Chadbourne Pit, Newry

The Chadbourne Pit is located next to the confluence of the Bear River and Stony Brook with the Androscoggin. A complex deglacial history is recorded in this pit and the surrounding area shown in Figure 5. The reconstruction of this history is still in progress, but a tentative sequence of events is listed below. Some of these events probably overlapped in time.

(1) An esker system developed in the Bear River valley (along Route 26). It extends eastward down the Androscoggin Valley, though the discontinuous esker segments may not have been deposited simultaneously. The topographic map (Fig. 5) shows two segments in the area of the Chadbourne Pit. The ridge of the southeastern segment has been obliterated by expansion of the pit, while the segment to the northwest has recently been cleared of trees and shows excellent esker morphology (as of 1989).

Remnants of esker deposits comprise the oldest stratigraphic unit seen in the pit. An exposure of this unit in the northwest end of the pit consists of poorly sorted, non-stratified, locally openwork pebble-boulder gravel. Minor sand beds in this section are steeply collapsed. Other exposures of collapsed sand and gravel presently occur along the northeast wall of the pit. In the latter sections, the deformed unit extends up to 5 m above the pit floor. It is unconformably overlain and incised by fan gravel (discussed below), and probably is an eroded remnant of an esker.

(2) Ice-contact sand and gravel was deposited on the north side of the Androscoggin Valley. This episode is recorded by the high 740-780 ft terrace east of Stony Brook (Fig. 5). The terrace probably formed in contact with stagnant ice remaining on the south side of the valley. At least part of this deposit is deltaic. A pit on the Newry-Hanover town line (now a condominium development) exposed topset/foreset/bottomset beds in a delta graded to a lake level at about 740 ft. (location "d" on Figure 5). Lake-bottom sand and silt occurs in the gully just east of here.

A lacustrine unit that overlies esker sediments in the Chadbourne Pit may have been deposited in the same water body as the delta mentioned above. As seen in various sections during recent years, this unit consists of at least 4-5 m of well stratified sandy foreset beds, and sandy to silty, laminated lake-bottom sediments. The latter contain ripple-drift lamination, water-escape structures, and rare dropstones. Faulting locally occurs in the lacustrine unit, especially near the esker segments. Like the esker unit, the lacustrine sediments are disconformably overlain by fluvial gravel of the Stony Brook fan.

(3) Lowering of base level occurred as residual ice dissipated in the Androscoggin Valley. As this lowering was in progress, the channel at 720-740 ft on the southeast side of the valley (Fig. 5) probably was carved by meltwater from an ice mass to the south. Failure of the ice-dammed lake in the area of the Chadbourne Pit was followed by deposition of fluvial gravels at elevations in the 650-700 ft range. The channel cut in till southwest of Newry would have formed during this period -- see Figure 5).

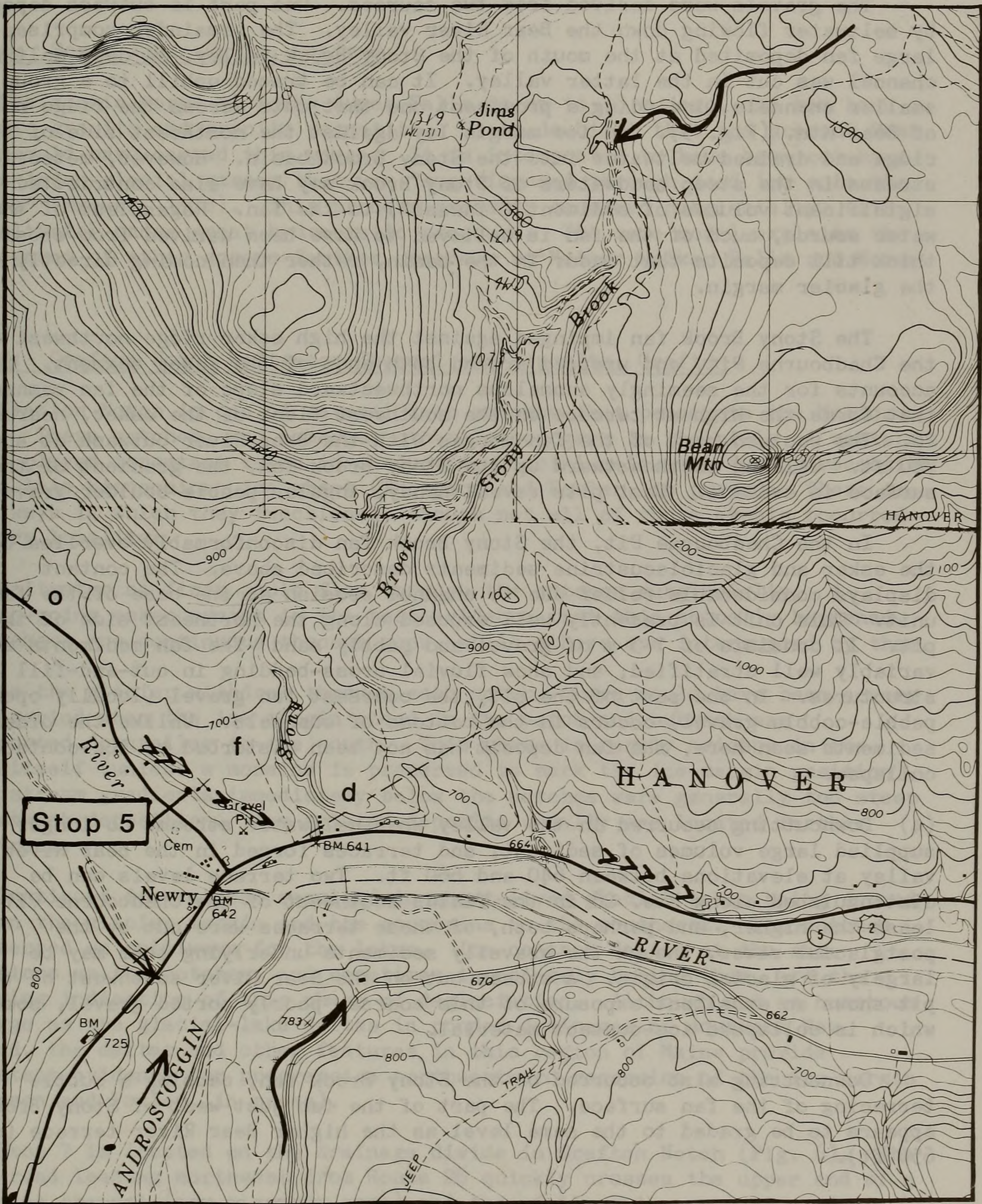

Figure 5. Location map for stop 5. Symbols are as follows: arrows - meltwater drainage routes; chevrons - esker segments; d - ice-contact delta; f - outwash fan; 0 - outwash surface in Bear River valley.

The gravels were derived from two sources. One part is outwash deposited by meltwater flowing down the Bear River valley. The remainder comprises a large fan deposited at the mouth of the Stony Brook valley. A deep meltwater channel was cut in the latter valley. It can be traced uphill to a group of smaller channels, including a prominent one that cuts across the ridge north of Bear Mtn. (Fig. 5). An ice margin lay against the northeast side of this ridge and drained meltwater into the Stony Brook basin. However, meteoric streams in the steep headwaters of Stony Brook may have also contributed siginificant volumes of sediment ("inwash") to the fan. Regardless of the water source, much of the fan is believed to have been derived from erosion of thick till deposits that occur in the basin, rather than coming directly from the glacier margin.

The Stony Brook fan impinged against the high esker ridge northwest of the Chadbourne Pit, and wrapped around both ends of the esker segment. This accounts for the seemingly anomalous northwestward slope of the fan remnant that forms the highest terrace on the southwest flank of the esker, near Route 26. The western part of the fan merges with the Bear River outwash at about 780 ft. Walking northeastward up the Stony Brook fan, the gradient of the fan surface is evident. Test pits reveal sandy, angular pebble-boulder gravel.

In the Chadbourne Pit, the Stony Brook fan disconformably overlies both the esker and glaciolacustrine sediments described above. The contact displays considerable relief due to channel erosion at the base of the fan unit. This unit is presently well exposed along the northeast side of the pit. It consists of 1-3 m of gravel and pebbly sand The fan sediments are variably well stratified, and show fluvial cross-bedding in cut-and-fill structures. In one part of the pit, the coarsest fan gravel (locally openwork pebble-cobble gravel) occurs in the bottoms of channels. Unlike the older sediments seen here, the fan deposit has not been disturbed by ice-contact collapse.

(4) Downcutting occurred in the valley when meltwater streams no longer supplied large volumes of sediment, and terraces formed in the Bear River valley at elevations between 640 and 660 ft. Two terrace levels can be distinguished along Rte. 26 in the fields southwest of the Chadbourne Pit. At least the higher, and perhaps both, of these terraces were cut by the postglacial river, though the gravelly sediments underlying them may be largely of glacial origin. A stream cut on the Bear River southwest of the pit shows an excellent exposure of this coarse, poorly sorted gravel, some of which is collapsed ice-contact material.

Downcutting also occurred on the Stony Brook fan, causing a subtle terracing of the fan surface. The part of the fan just west of Stony Brook appears to be graded to the same level as the higher Bear River terrace (about 650 ft).

(5) Beginning in late-glacial time, the Androscoggin River cut through a till barrier at the narrows just south of Newry (Fig. 5). This gap may have been the final spillway for glacial Lake Bethel (Thompson and Fowler, in press). Lake Bethel emptied as the spillway was eroded and the modern river drainage was established. The present flood plain of the Bear and Androscoggin Rivers is at 620-640 ft near the junction of Routes 2 and 26.

STOP 6: Screw Auger Falls, Grafton

The scenic gorge at Screw Auger Falls is up to 13 m deep, and has been cut into granite and granite pegmatite. It is doubtful that the present Bear River could have carved this gorge. It is interpreted to have been cut by a debris-laden glacial stream that was "superimposed through dead ice onto the outcrop" (Brewer, 1978). This process probably occurred subglacially, with the meltwater under great hydrostatic pressure. The same model explains the development of other gorges farther upstream at Mother Walker Falls and Moose Cave.

STOP 7: Grafton Notch Meltwater Channel and Deposits, Grafton

Grafton Notch is one of several deep notches that penetrate the Mahoosuc Range. These notches, and numerous other lesser gaps in the hills of western Maine, played important roles in conducting glacial meltwater during recession of the late Wisconsinan ice sheet (Thompson and Fowler, in press). There are three ways in which they functioned, though not all of these events occurred at every locality:

-- Meltwater at first could flow through the notches subglacially. A through-going esker system is the best evidence that this actually happened. Some eskers are continuous through gaps, while others are interrupted by them.

-- As the glacier withdrew through each notch, there would have been a very brief period when the ice margin stood in the notch and outwash was transported downvalley to the south. This phase is rarely evident in the notch itself (unless a moraine is preserved to mark the ice-margin position), since stream gradients immediately below the notches were generally too steep for outwash deposition. Any related deposits usually are located farther downstream.

-- Continued ice retreat resulted in short-lived glacial lakes being dammed between the glacier margin and the mountains to the southeast. The notches then served as spillways for the lakes. Ice-contact deltas at the same elevations as the notches, and sometimes immediately behind them, are the surviving indication of this phase of deglaciation. Although not as numerous or large as the glacial-lake deltas in ponded drainages of southern New England, the deltas and other features in this region of Maine provide consistent evidence for progressive northwestward recession of the ice margin (Thompson and Fowler, in press).

Stop 7 is located on the drainage divide in Grafton Notch (Fig. 6). The woods road leading northwest from Route 26 quickly crosses the upper end of a meltwater channel (now a swampy area) and then follows the west side of it. This channel can be traced southward for about 0.7 km. It is not deeply incised, and may have carried meltwater for only a brief time. At the north end of the channel, and bisected by a brook that crosses the woods road, there is a small, flat-topped, kettled sand and gravel deposit. This feature is tentatively identified as an ice-contact delta ("d" on Fig. 6). It is graded to the head of the channel, and connects with an esker ridge to the north. A

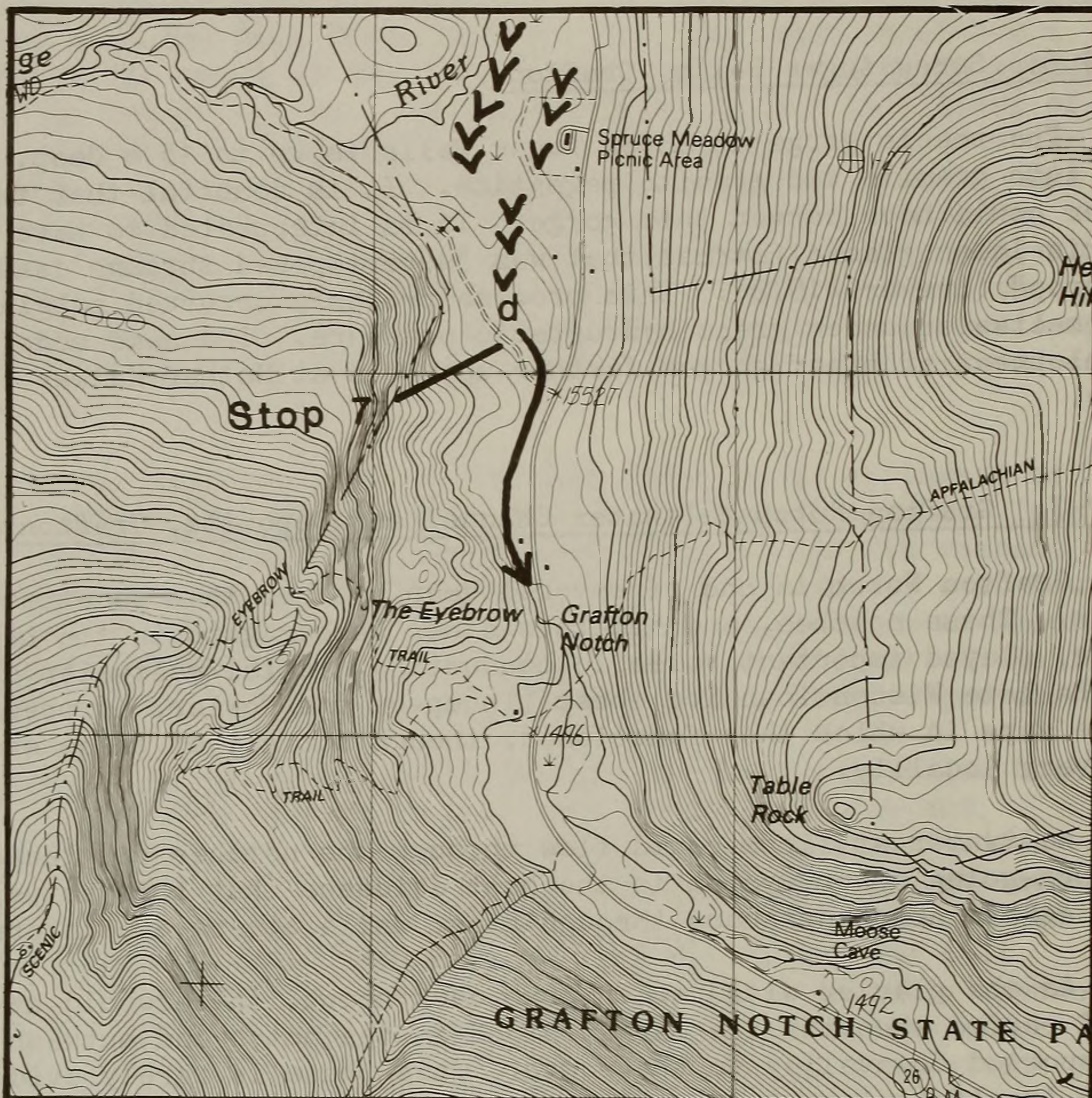

Figure 6. Location map for stop 7. Symbols are as follows: arrow - meltwater channel; chevrons - esker segments, d - ice contact delta (?).

bedrock knob protrudes above the floor of Grafton Notch on the east side of the delta. The esker that fed the delta is part of a multi-segment esker system that leads southward to the notch from the Swift Cambridge River valley. A bouldery ridge -- possibly a moraine -- begins in the woods across the road from the delta and extends uphill to the southwest.

The Grafton Notch channel was the highest and earliest spillway for glacial Lake Cambridge. This lake was named by Leavitt and Perkins (1935). Glacial recession from the proximal side of the Mahoosuc Range uncovered successively lower outlets for Lake Cambridge until it finally emptied into the upper end of the Androscoggin Valley in New Hampshire (Thompson and Fowler, in press).

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ITINERARY

Assembly point: South side of Route 108, next to cemetery in village of West Peru. The itinerary is covered by Maps 18, 19, and 10 in the Maine Atlas. Topographic map coverage for the field trip stops is provided by the Dixfield, Rumford, East Andover, Bryant Pond, Bethel, Puzzle Mountain, and Old Speck Mountain 7.5-minute quadrangles.

Total Mileage	Mileage from Previous Point	
0.00	0.00	Four-way jct. in West Peru village. Go east on Rte. 108.
0.55	0.55	Turn R onto dirt road and drive 0.1 mi south into sand pit.
		STOP 1: West Peru Sections (Dixfield Quadrangle)
		STOP 1-A: Till exposure in southwest corner of pit area. STOP 1-B: From south end of large pit, walk south on logging road, cross brook, and proceed to smaller sand pit and long gully resulting from erosion of road bed on hillside.
0.75	0.20	Return to Rte. 108. Turn L and drive west to Rumford.
6.30	5.55	Cross Androscoggin River at Rumford. Merge with U.S. Rte. 2 just past bridge, and continue straight (W) on Rte. 2.
10.45	4.15	Park on R shoulder of Rte. 2.
		STOP 2: Glass Face Mountain (Rumford Quadrangle)
		STOP 2-A: Walk north to back side of parking lot, then cross to west side of small brook and walk steeply uphill onto ridge crest (ice-channel filling) in woods.
		STOP 2-B: Walk up brook a short distance past upper end of ice-channel filling, until reaching waterfall and small till exposure.
		Continue west on Rte. 2.
13.90	3.45	Park on R shoulder of Rte. 2, and walk into sand pit on north side of road.
		STOP 3: Weston Pit (Bryant Pond Quadrangle)
		Continue west on Rte. 2.
16.25	2.35	Just past village of Rumford Point, note outstanding point bars to L, on opposite side of sharp bend in Androscoggin River.

16.40	0.15	Turn R (N) onto Jed Martin Rd. (sign obscured by bushes).
17.90	1.50	Note Meadow Bk. valley to west of road -- former course of Ellis River?
19.00	1.10	Turn R (E) onto Andover Rd. (no sign).
19.15	0.15	Turn L (N) onto Kimball Rd., and proceed north to Kimball Farm.
19.65	0.50	Park on R. Walk uphill through gate, into pasture on hillside. Be sure to close gate; and do not use shovels in cow pasture!
		STOP 4: Red Hill Channels (East Andover Quadrangle)
		Turn around at Kimball Farm and return by same roads to Rte. 2.
23.05	3.40	Rejoin Rte. 2. Turn R and continue west.
29.50	6.45	Just past Newry town line, turn R onto gravel road and drive north into large pit.
		STOP 5: Chadbourne Pit (Bethel Quadrangle)
29.90	0.40	(Mileages will vary after driving around in the Chadbourne Pit.) Enter Rte. 26 from west side of pit. Turn R and drive north on Rte. 26.
39.50	9.60	Turn L into State parking lot for Screw Auger Falls.
		STOP 6: Screw Auger Falls (Old Speck Mtn. Quadrangle) **No hammers or shovels at Stops 6 and 7!**
39.60	0.10	Return to highway. Continue north on Rte. 26.
42.85	3.25	Park on R shoulder of Rte. 26, as far off road as possible. Walk west on woods road about 430 paces to ice-contact deposits at head of meltwater channel (in woods to R -- see location map).
		STOP 7: Grafton Notch (Old Speck Mtn. Quadrangle)

END OF TRIP