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# THE LATE QUATERNARY GEOLOGY OF THE HOUSATONIC RIVER BASIN IN SOUTHWESTERN MASSACHUSETTS AND ADJACENT CONNECTICUT

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## INTRODUCTION

The latest (Woodfordian) glaciation enveloped the entire region after 25,000-30,000 years ago and stripped the area of most of the weathered mantle left from previous interglacials and the pre-Woodfordian interstade. Directional indicators (whalebacks, drumlins, striations, grooves, boulder fans, and till fabrics) record glacial movement from the northwest quadrant; this direction diverges appreciably from the generally north-striking belted metamorphic terrane. Emerson (1899) noted this divergence and suggested that glacier movement in southwestern Massachusetts radiated southeast from the axis of the Hudson-Champlain lowland. Kelley (1975) found similar ice-flow directions in northwestern Connecticut and concluded that at least in the latter part of Woodfordian time, glacier movement was out of the Hudson Basin southeastward into the Housatonic Basin. The bedrock thalweg of the Housatonic Valley was overdeepened by glacial scour. Borings reveal more than 100 feet of bedrock closure northwest of South Canaan, Connecticut (Melvin, 1970; Holmes and others, 1971).

Deglaciation by downwasting and stagnation appears to have been rapid, and the area was probably ice free by 13,000 B.P. (Before Present). The pattern of deglaciation resulted in major derangement of drainage. Examples include diversion of the main stem of the Housatonic River from its pre-Woodfordian valley to an adjacent tributary valley immediately to the west. The diversion was caused by the deltaic apron and outwash constructed by the proglacial Konkapot River, which joins the Housatonic Valley from the east near Ashley Falls, north of Canaan, Connecticut. In addition, Warren (1971) has trenchantly argued that Great Falls, near Falls Village, Connecticut, the southernmost stop on this field trip, is almost certainly a postglacial landscape feature that resulted from the diversion of the Housatonic River from an unknown earlier course.

The Great Falls bedrock threshold, at an elevation of about 625-630 feet, dammed a lake in the Housatonic Valley that extended north for about 20 miles from Great Falls to the village of Housatonic, north of Great Barrington (Fig. 1). Data from borings (Norvitch and Lamb, 1966; Melvin, 1970) disclose the presence of more than 100 feet of fine-grained lake-bottom sediment at several localities near Sheffield, Massachusetts. The considerable volume of fine-grained sediment indicates that the Great Falls-Sheffield glacial lake endured for at least several hundred years. The demise of glacial Lake Sheffield (formerly called the Falls Village lake; Holmes and Newman, 1971) was due to three factors: 1) minor erosion at the Great Falls threshold; 2) filling of the basin by lake sediments and valley-

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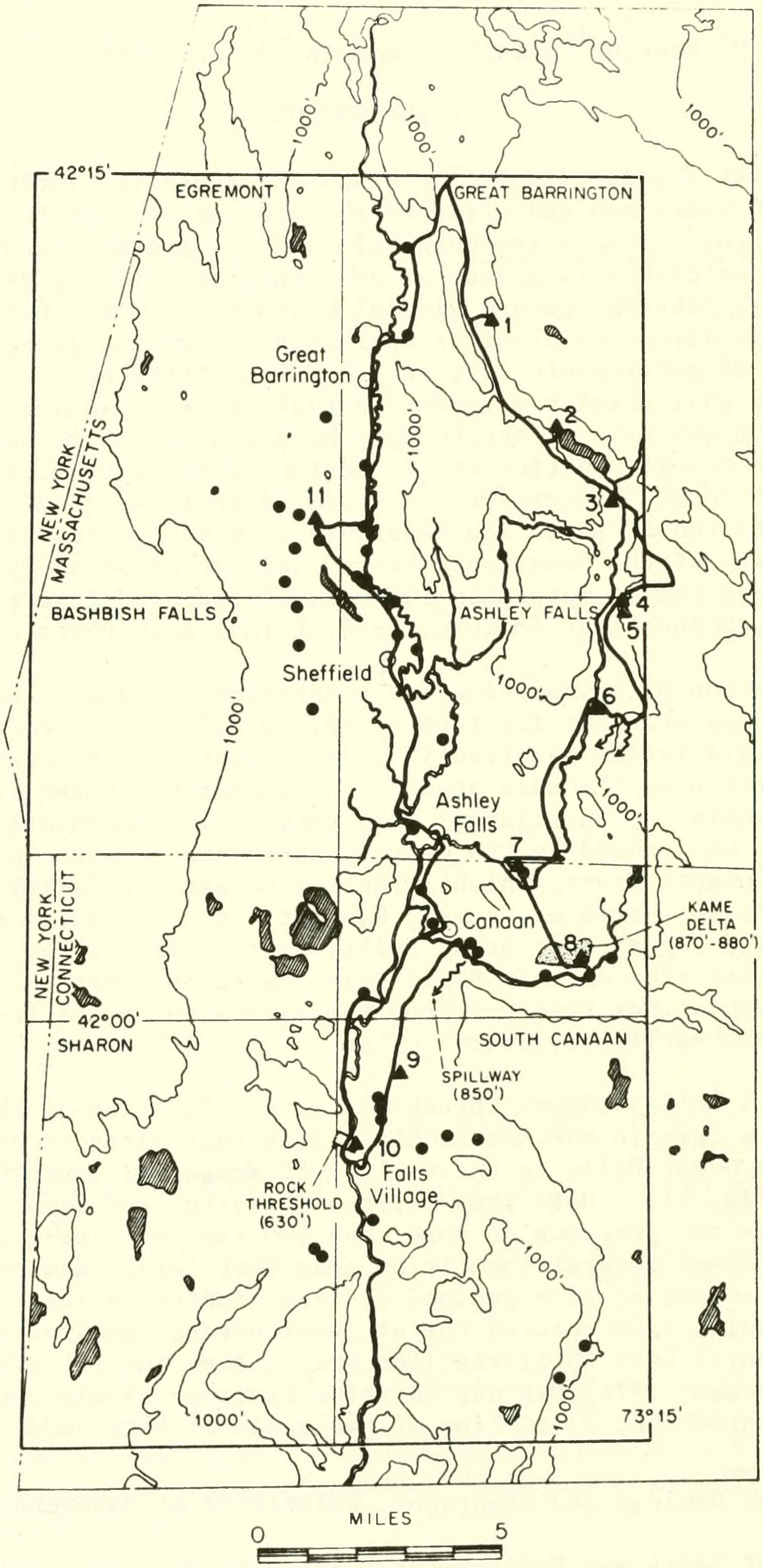
42°15'
EGREMONT
GREAT BARRINGTON
Great Barrington
NEW YORK
MASSACHUSETTS
1
2
3
4
5
6
7
8
9
10
11
BASHBISH FALLS
ASHLEY FALLS
Sheffield
Ashley Falls
Canaan
KAME DELTA (870'-880')
NEW YORK
CONNECTICUT
42°00'
SHARON
SOUTH CANAAN
SPILLWAY (850')
ROCK THRESHOLD (630')
Falls Village
1000'
73°15'
MILES
0
5

train deposits and early postglacial alluvium grading to the Great Falls threshold; and 3) perhaps differential late-glacial/postglacial isostatic rebound, higher to the north, causing at least partial decanting of the lake basin. The filling of the basin by outwash and alluvium probably buried many proglacial landforms, which may account for the paucity of ice-contact stratified drift in that reach of the Housatonic Valley extending from Great Falls to Great Barrington.

The past 13,000 years witnessed the migration of vegetation into the region, beginning with tundra flora (Whitehead and others, 1973), which was followed by predominantly coniferous forest and then by a mixed conifer-deciduous forest (Whiting, 1974). European Man entered the area during the middle of the 18th century and radically altered the floral composition of the area, while his forest-clearing and agricultural activities increased erosional rates several-fold and perhaps by as much as an order of magnitude.

We find little evidence of pre-Woodfordian Quaternary history in the area. Occasionally, exposures of weathering-profile mantles ("saprolite") are found; the weathered bedrock commonly has a thin cover of relatively unweathered glacial drift. Warren (1971) has attempted to construct an erosional sequence of buried, exhumed, and recently excavated valley segments on a reach of the Housatonic River south of Great Falls. However, without either stratigraphic or chronological controls, it is difficult to accept even his most tentative suggestions.

## GLACIAL DEPOSITS

### Till

Till forms a fairly continuous mantle over most of the area, except at higher elevations, on steep slopes, and on the summits of some lower hills. Most of the exposed till is sandy, nonindurated, and similar to the upper or younger till elsewhere in southern New England. The clasts are composed of marble, schist, quartzite, quartz, and small quantities of gneiss and granitic rocks. Except for a very low percentage of exotic

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Figure 1. Index map of the Housatonic Valley area in southwestern Massachusetts and adjacent Connecticut. The 1000 foot contour line is shown.

● - Well containing lake-bottom deposits

9 ▲ - Field-trip stop

⊙ - Town or village

- Lake or pond

- Spillway in rock or till

specimens glacially transported from the north and east, the clasts appear to be of local derivation. The till usually ranges from 5 to 10 feet in thickness, although logs of borings document thicknesses greater than 100 feet. These appreciable till thicknesses raise the possibility that till of more than one age may be present.

## Stratified Drift

Wastage of the ice in the Housatonic Basin took place in several stages, as recorded by a series of stagnant ice features in tributary valleys. Melting of the ice in the main stem of the Housatonic Valley did not form ice-contact deposits on the valley sides, or, if these features were formed, they were eroded or buried by lake sediments and alluvium. Shortly after the higher elevations became ice free, stratified drift was deposited in glacial lakes and streams adjacent to and in front of the ablating ice. These deposits may be divided into chronological groups on the basis of geographic position and altitude. These chronologic groups of sequencies are successively younger northward and mark retreatal positions of the edge of the ice sheet. In our area, most of the retreatal positions probably were determined by the relation between deposition and topography and very likely do not represent climatically controlled stillstands. The altitudes of deposits generally were controlled by local and temporary base levels, such as glacial ice, bedrock spillways, or glacial lakes. Deposits laid down in association with a stagnant ice margin include such morphological forms as ice-channel fillings, kames, kame terraces, and kame deltas.

Evidence on the relationship of a valley ice tongue in the Housatonic Valley to the uplands and tributary valleys on each side is contradictory.

Perhaps the best evidence that the tributary valleys were deglaciated prior to the disappearance of ice in the Housatonic Valley is found in the Blackberry Valley, east of Canaan. Near East Canaan on the north side of the Blackberry Valley (STOP 8), a huge kame delta was bult into a proglacial lake impounded by an ice tongue in the Housatonic Valley to the west. The topset-foreset interface in the East Canaan kame delta has a reported elevation of 883 feet (Holmes and Newman, 1971), but the delta topography suggests a lower level, perhaps 870-875 feet. The threshold of the lake may have been over the bedrock notch just south of Church Hill, 1 mile south-southeast of Canaan. The present elevation of the Church Hill threshold is about 855 feet.

On the other hand, the Konkapot River valley train seems to show that the ice was gone from the main valley before it left the adjacent tributaries. A well-marked head of outwash (that is, the place where proglacial deposits first become a continuous feature) starts south of Konkapot at an elevation of about 725-730 feet. The valley train declines southward to 690 feet at Clayton, turns westward, and grades into the presumable lake-bottom deposits, or perhaps even post-lake alluvium, at an altitude of about 685 feet. Thus it seems that a body of ice remained near Konkapot after the glacier left the adjacent Housatonic Valley.

## RADIOCARBON CHRONOLOGY

We have few data as to duration of the latest glacial interval within the area under consideration. R.L. Melvin (U.S. Geological Survey, Hartford) secured two $^{14}C$ dates on peat balls from kames near Norfolk, Connecticut, 8 miles east of Canaan. These dates are 28,000±100 years B.P. (W-2043) and greater than 33,000 years B.P. (W-2174) (Sullivan and others, 1970). Newman secured a peat ball from the East Canaan kame delta, which dated at greater than 40,000 years B.P. (W-2615). The East Canaan peat ball yielded no pollen. These three dates suggest that the advancing last Wisconsin glacier incorporated frozen peat during its advance and that these peat balls were deposited in ice-contact deposits. Perhaps the dates indicate an interstade that lasted from about 40,000 to more than 28,000 years B.P. The one finite date in the sequence might indicate that the last glacial ice invaded the area after 28,000 years B.P.

We know of only two early postglacial $^{14}C$ dates adjacent to our area. Both are basal peat dates from bedrock basins and indicate a minimum age of deglaciation. One of these dates is on material collected by Kelley (1975) in the Ellsworth quadrangle south of our area and was dated at 12,750±230 years B.P. (RL-245). The second date was secured by Whitehead and others (1973) from Berry Pond, west of Pittsfield, Massachusetts, and 20 miles north of Great Barrington. The date at the base of the Spruce Zone was 12,680±480 years B.P. (OWU-481). How long before these dates deglaciation actually took place is moot: we guess about 13,000 B.P.

## ACKNOWLEDGEMENTS

Many geologists from the U.S. Geological Survey, both present and former members, have tried in recent years to decipher the complex glacial and deglacial history of southwestern Massachusetts. J.H. Hartshorn and the late G.W. Holmes started reconnaissance mapping in 1962, and Holmes later produced many open-file maps. Detailed mapping in the area covered by this field trip was done by Holmes and W.S. Newman, the latter assisted by R.M. Newton in 1971. We still disagree among ourselves about landforms, sedimentary history, and chronology, and obviously more detailed work of many kinds is necessary before we can decipher a coherent story.

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## ROAD LOG

<u>Mileage</u>

0.0 Assemble in parking area of Monument High School at intersection of Route 7 and Monument Valley Road, 3.8 miles north of Great Barrington. Exit left from parking area (enter Great Barrington quadrangle).

0.2 Turn left on Monument Valley Road.

0.9 The road is high on the side of a mined-out kame and kettle complex on right. Konkapot Brook valley to the left.

1.4 Madden Farm, view of ice-contact slope on the left.

2.2 Intersection with Stony Brook Road.

3.1 Turn left on Blue Hill Road.

3.3 Cross Muddy Brook

3.6 <u>STOP</u> 1 - BLUE HILL ROAD KAME TERRACE. Short walk down dirt road on right to exposure in kame terrace. Section exposes colluvium (?)/ eolian/fluvial sediments/lacustrine sediments/gravel. Farther down road is small pit showing the eolian mantle (with ventifacts?)/ channeled fine to medium sand. Note the topography of the kame terrace.

4.1 Return to Muddy Brook Road and turn left (south).

4.8 Kames on left; bedrock and till with boulders on right. Three Mile

Hill directly to the west (right) strikes north-northwest and striations at its summit more or less parallel that same direction, suggesting bedrock control of latest ice-flow directions.

5.8 Intersection with Route 23. STOP! CAREFULLY cross Route 23 (slight jog to the right) and continue south on Lake Buel Road. Note bedrock on right.

6.5 Turn left at Deerwood Camp Road.

7.0 Park along road.

STOP 2 - LAKE BUEL ICE-CHANNEL FILLINGS. This morphological feature is one of several ice-channel fillings found near the shore of Lake Buel. Exposures of the interior of these landforms disclose stratified coarse sand, gravel, cobbles, and boulders. Evidence of collapse is conspicuous.

7.5 Return to Lake Buel Road and turn left. Note till above the break in slope, and many boulders on surface.

8.4 Left on gravel road. Ridge on right is ice-channel filling. Road curves right, crossing through the esker, then swings left and right along the east side of the esker. Lake Buel on left. Bear left along lake.

9.3 Large cut in ice-channel filling on right. Note width and flattish top.

9.7 Rejoin Lake Buel Road and turn left.

10.1 Bear slightly left on Adsit Road. Note channel on right.

10.5 Bear right on dirt road.

10.7 Straight on Crosby Road. Note kettles on right and gravel in roadcuts.

10.8 STOP 3 - CROSBY ROAD ICE-CONTACT DEPOSITS. Park as close to the right shoulder of road as possible. Here we find a large kame immediately to the north; stratified drift containing a large boulder (12 ft x 8 ft x 7 ft) is exposed on the south side of road. A large kettle is present just west of the small pit.

11.0 Cross Konkapot River.

11.3 Intersection. Turn right on Rt. 57. Briefly leave Great Barrington quadrangle and enter Monterey quadrangle.

13.1 Right on New Marlborough Hill Road (dirt road). Reenter Great Barrington quadrangle.

14.6 Join Hartsville Road on right. Leave Great Barrington quadrangle and enter Ashley Falls quadrangle. Here we drive along the base of a high and complex kame terrace.

14.7 STOP 4 - HARTSVILLE ROAD TILL. Till at base of kame terrace is loose, sandy, and light colored, and has some medium to fine sand laminations within the matrix. Clasts are dominantly quartzite and include some well-weathered gneiss. Note flood plain of Konkapot River on right side of road.

15.0 Left on gravel road up past houses and barns.

STOP 5 - HARTSVILLE ROAD KAME TERRACE. Large pit at base of kame terrace. At southern end of pit slumping is prominent along the ice-contact face of the terrace. Material is predominantly medium to fine sand. Climbing ripple cross-laminations indicating south-flowing currents occur in the upper part of the exposure. Also present are several beds of pebble to cobble gravel in which low-angle crossbedding dips south. Pebbles are mostly quartzite, marble, and gneiss.

15.3 Return to Hartsville Road.

15.6 Intersection with Great Barrington Road.

15.8 Intersection with Hayes Hill Road.

16.0 Left on Mill River Road.

17.1 Intersection with Lumbert Cross Road. Bear left onto Lumbert Cross Road.

17.8 Intersection. Cross onto Rhodes and Bailey Road.

17.9 Thick eolian mantle in roadcut on right.

18.2 Bear right onto Cagney Road.

18.6 Note gorge, an ice-marginal channel, on left just before sharp right turn in road. Entrance to gorge is 1030+ feet.

18.8 A second lower gorge is down the steep slope to the left between road and next hill. Small pond may be seen within the gorge.

18.9 Intersection with Southfield Road. The intersection is at the upstream end of the lower Cagney Road gorge, whose elevation is 890+ feet.

19.0 Turn sharp right over bridge, then sharp left on Hadsell St.

19.5 Left turn into New Marlborough Township Park. Park at far end of parking area. Bring lunch!

STOP 6 - UMPACHENE FALLS. The stratigraphic section here at the falls is reversed; the younger Cheshire Quartzite crops out beneath the older Cambrian Dalton Formation. As you ascend the falls, you go down section stratigraphically.

UMPACHENE FALLS SAPROLITE. Proceed to north end of parking area adjacent to Konkapot River. Outcrop of deeply weathered Stockbridge Formation. Approximately 10 percent of all observed bedrock exposures in the field-trip area show deep weathering profiles.

19.6 Left on Hadsell Road. Cross Konkapot River on rickety single-lane bridge.

19.7 Left on Clayton Mill River Road.

20.5 Bedrock outcrop on left. Distorted marble. Note resemblance to kame on the topographic map.

21.0 Rise onto bedrock-cored hill. Note knobs of bedrock off in fields to left. Descend towards Konkapot.

21.2 Right turn at Konkapot and continue on Clayton Mill River Road. Note head of outwash to left at 720+ feet. Continue south on Clayton Mill River Road on small kame terrace that is part of the head of outwash.

21.9 Kettle on left in head of outwash. The meltwater streams coursing down the valley, in part over and around isolated blocks of ice in its northern part (note kettles and swell and swale topography), built a valley train between the hills on either side and surrounded a kame (present elevation 759 ft; possible original height 80 ft or more). The surface of the outwash declines to 690 feet at Clayton, and the gradient flattens as the outwash turns the corner toward Ashley Falls.

22.3 Intersection with Alum Hill Road. Note coarse gravel in fields on right.

23.0 High kame belonging to earlier sequence on left.

23.4 Intersection with Canaan-Southfield Road. Continue south.

23.6 Village of Clayton. Turn right on Old Turnpike North. As we go west, note the small terrace at 700+ feet, which is higher than the Konkapot valley train. The road goes up on to the terrace for a distance and descends again to the valley-train level.

24.7 Turn left on Allyndale Road.

25.2 Left turn into gravel pit.

<u>STOP</u> 7 - SODOM GRAVEL PITS. These pits in pebble and cobble gravel are approximately 2 miles south of the head of outwash north of Clayton. This alluvial and/or deltaic complex deposited sediment completely across the Housatonic Valley and is still responsible for

the impingement of the Housatonic River against the marble on the west side of the valley. Indeed, the outwash apron probably completely buried the bedrock highs in and about the village of Ashley Falls and the sediment completely surrounded several other bedrock knobs in the vicinity. After deglaciation, the Konkapot cut through the outwash sediment and into the underlying bedrock, creating Ashley Falls. Note eolian filling in shallow swale in gravels. Ventifacts (?) are rare. Exit from gravel pit and turn left on Allyndale Road.

26.0 Sodom! Continue south on Allyndale Road. Cross Konkapot River and Squabble Brook; note fine-grained alluvium. Note alluvium/till contact at base of hill.

27.2 Enter onto surface of East Canaan kame delta.

27.4 Left turn onto dirt road just beyond entrance into O'Connor Bros. gravel pit.

STOP 8 - EAST CANAAN KAME DELTA. Topset beds of gravel and foreset beds of fine to medium sand are exposed in the many pits. Kettles and ice-contact stratified drift occur at the north end of these pits. Peat balls are occasionally found in the foreset beds. The delta was built into an ice-dammed lake having its level at about 870-880 feet. The lake was presumably held in by ice blocking the valley to the west.

28.6 Turn 180° to right onto Canaan Valley Road. Face of delta on right; flood plain of Whiting River on left.

29.5 Right turn on Route 44 West.

30.1 Village of East Canaan. Turn left onto Lower Road.

30.5 Intersection.

31.9 Limestone quarry on left.

32.2 View left of possible spillway of the glacial lake associated with the East Canaan kame delta. Elevation of Church Hill spillway is 850 feet (too low for lake outlet?).

32.8 Turn left (south) on Route 7.

33.3 Right on Sand Road.

33.5 Railroad crossing.

34.6 Bear left at intersection.

35.6 STOP 9 - SAND ROAD SAND DUNES. This exposure of fine sand with little internal structure suggests eolian deposition. Springs and drainage nearby seem to emerge from beneath a crust on saprolite.

36.7 Join Route 126. Continue straight on across railroad tracks.

38.3 Sharp 120° right turn under railroad overpass past electrical powerhouse.

38.6 Bridge over Housatonic River.

38.7 Bear slightly right.

38.8 Right turn onto Housatonic River Road.

39.3 <u>STOP</u> 10 - GREAT FALLS. Before construction of the dam in the early 20th century, the cataract possessed a clear fall of approximately 60 feet. Warren (1971) stated that the Housatonic was diverted across this bedrock sill sometime during the Wisconsinan Stage. This sill exerted a powerful influence on the late-glacial and postglacial landscapes. First, the Great Falls sill ponded a lake that ultimately extended north about 20 miles to the vicinity of Great Barrington, Massacusetts. Second, the Housatonic south of the falls is generally confined to a narrow gorge, but towards the north it is a meandering stream in a rather wide valley. Here we have a classic example of a local base level controlling the regime and grade of a segment of a major river. Look for "meteorite."

39.4 Road passes through short ice-marginal channel.

40.9 Alluvial-fan complex.

41.8 Leave South Canaan quadrangle; enter Ashley Falls quadrangle.

42.1 Turn right on Route 44.

42.7 Note oxbow lake on right.

42.9 Cross Housatonic River and bear left on Route 44.

45.2 Village of Canaan. Turn left toward North Canaan Town Hall.

46.9 Canaan Town dump.

48.0 Intersection with Route 7A. Turn left.

48.2 Village of Ashley Falls. Turn left at red light on Andrus Road.

49.3 Cross Housatonic River. Note outcrops exposed where Housatonic impinges against bedrock knob known as Bartholomew's Cobble. The Cobble is a small bedrock "island" surrounded by alluvium. Also note meanders on right.

49.4 Turn right on Andrus Road.

51.0 Dangerous intersection, cross railroad tracks. CAUTION. Turn left on Route 7A.

51.5 STOP. Left turn on Route 7.

53.5 Sheffield. The sediments of glacial Lake Sheffield achieve their greatest thickness in the vicinity of this village. These lacustrine sediments are overlain by valley-train sands and finer alluvial sand. Continue north on Route 7.

54.9 Leave Ashley Falls quadrangle and enter Great Barrington quadrangle. Prepare to make left turn.

55.1 Left turn onto Egremont Road.

55.2 Cross railroad tracks.

56.0 Road leaves alluvium.

56.2 Leave Great Barrington quadrangle and enter Egremont quadrangle.

56.9 Intersection with Limekiln Road.

57.2 Right turn onto gravel road. Park on right shoulder of road.

STOP 11 - SHAY'S REBELLION (1786-1787) THE LAST BATTLE. The site of the end of Shay's Rebellion. Visit Monument. Small kames suggest ablating ice whose meltwater may have passed through the gap to the east. Continue east through gap.

57.6 Limekiln Gap.

57.8 Leave Egremont quadrangle and reenter Great Barrington quadrangle. Cross high-level terrace and descend to modern alluvium.

58.3 Intersection with Route 7. STOP! Left turn on Route 7.

61.3 Intersection with Route 23. Continue north through Great Barrington.

62.2 Right turn on Route 7 on bridge over Housatonic River.

62.7 Bear left (north) on Route 7.

66.4 Right turn into Monument Mountain High School parking area.

END OF TRIP