DISCLAIMER

Before visiting any of the sites described in the New England Intercollegiate Geological Conference guidebooks, you must obtain permission from the current landowners.

Landowners only granted permission to visit these sites to the organizers of the original trips for the designated dates of the conference. It is your responsibility to obtain permission for your visit. Be aware that this permission may not be granted.

Especially when using older guidebooks in this collection, note that locations may have changed drastically. Likewise, geological interpretations may differ from current understandings.

Please respect any trip stops designated as “no hammers”, “no collecting” or the like.

Consider possible hazards and use appropriate caution and safety equipment.

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SECOND NOTICE

37th NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

October 10, 11, and 12, 1941
NORTHAMPTON, MASS.
****

SECOND NOTICE

HEADQUARTERS & REGISTRATION:- Basement of Department of Geology, Seelye Hall, Smith College. Please register there Friday p.m. or Saturday a.m., and receive detailed itineraries and information on trips.

ACCOMMODATIONS:-The largest hotel is Hotel Northampton, but its rooms are almost all taken for this week-end. If you wish accommodations there, write to the management for information.

The Northampton Chamber of Commerce is willing to provide accommodations for parties using the enclosed blank. Fill out and mail to Chamber of Commerce, Northampton, Mass. Care will be taken to accommodate parties as nearly in accordance with their wishes as possible. The reply from Northampton will enclose a map of the town and the location of your house will be marked.

RESTAURANTS:-There are several restaurants on Main Street, all within a few blocks of headquarters. Wiggins Old Tavern in the basement of Hotel Northampton is famous for good food; also Beckman's, on Main street, 4 blocks closer to headquarters. No annual dinner is planned, but both Wiggins Tavern and Beckman's have ample space for smaller parties. Advance reservation is advisable for larger groups.

TOPICS FOR DISCUSSION:-(1) Structure and age relations of pre-Triassic rocks near north end of Triassic area. TRIPS A, C.

(2) Types of Triassic rocks and their significance in the vicinity of Mount Toby. TRIP D.

(3) Quaternary deposits of the Connecticut valley in Massachusetts. TRIPS B, E.

LEADERS:- R.Balk, R.H.Jahns, C.Lochman, F.D.Reed, B.M.Shaub, M.E. Willard.

MAPS:-Participants are urged to supply themselves with maps in advance. As the trips will traverse a dozen quadrangles, it is impracticable for the inviting department to order stocks of all of these for sale at headquarters. Outline maps will be provided as far as possible with each trip.

NOTE:-Maps marked * are 7½-minute sheets; maps not marked are 15-minute sheets.

Maps for topic (1):-Greenfield, Mass.; Warwick, Mass., N.H., Vt. (out of print in Washington); Bernardston*, Mass.; Miller's Falls,*, Mass.; Northfield*Mass.; Belchertown, Mass.; Geologic maps: USGS Monograph 29, plate 34, 1898; USGS.Bull.597, plate 10, 1917.

Maps for topic (2):-Greenfield, Mass.; Greenfield*, Mass.; the advance sheet; Mount Toby*, Mass., the advance sheet; Warwick, Mass.) see note above); Geologic Maps: USGS Monograph 29, pl.34, 1898; USGS.Bull.597, plate 10.1917..

Maps for topic(3): Greenfield*, Mass; Mount Toby*, Mass.; Mount Holyoke,*Mass., the advance sheet; Springfield-North*, Mass.; Greenfield, Vt., Northampton, Mass. Geological Maps: USGS. Monograph 29, pl.55, sheets C, D. (Greenfield, should read-Mass.Vt.)

REMEMBER

Detailed itineraries will be distributed at headquarters. For additional advance detailed information write:

Dr.Robert Balk
Mount Holyoke
S.Hadley, Mass.

or Dr.Meyerhoff
Smith
Northampton.

For general information or for more copies of these advance sheets, write to:-
Lloyd W.Fisher, Bates College
LEWISTON--------MAINE

PROGRAM

Friday, October 10, 1941

2:00 p.m.:-Short trips in the vicinity of Northampton to show Triassic and Quaternary localities of spcial significance. (Diabase quarry at the Notch; Triassic footprints and plants on west side of Connecticut River; post-Pleistocene plant remains at Hadley, etc.)--Leave from Headquarters, return about 5.30 p.m.
Leaders: C.Lochman, F.D.Reed, M.E.Willard.

8:30-10:00 p.m.:-Informal gathering at Seelye Hall. Light refreshments.

Saturday, October 11, 1941

Two all-day trips. Bring box lunch

TRIP A.:Structure and age relations of pre-Triassic rocks near the north end of Triassic area. Leader: R. Balk.
Leave at 8.15 a.m. from traffic light at intersection of highways No.9 and 63 at Hadley, 4 miles east of Northampton. Take highway No.9 out of Northampton, and assemble on highway 63, facing north. Lunch at Northfield, about 12.30. Return about 6.00 p.m. Maps as indicated under Topic 1. References: USGS. Monogr. 29, pp. 201-203, 211-216, 253-299, 42-46.--USGS. Bull. 597, pp. 47-49, 72-76; 241-244, 248-253.

TRIP B:Quaternary deposits of the Connecticut Valley in Massachusetts. Leaders: R.H.Johns, M.E.Willard.
Leave at 8.15 a.m. from traffic light at intersection of highways No.9 and 63 at Hadley, 4 miles east of North-ampton. Take highway No.9 out of Northampton and assemble on Highway 63, facing south. Lunch stop of Montague station. Return about 5.45 p.m. Maps: Greenfield, 7½' sheet; Mount Toby, 7½' sheet; Mount Holyoke, 7½' sheet; or the old 15' sheet of Greenfield; and 15' Northampton quadrangle.
References:-USGS. Monograph 29, section on Pleistocene geology. Jefferson, M.S.W., The postglacial Connecticut at Turners Falls, Mass.: Jour. Geol., vol.6, pp.463-472, 1898.
Antevs, E., The recession of the last ice sheet in New England: Am. Geogr. Soc., res. ser. No.11, 1922.
Flint, R.F., Late-Pleistocene sequence in the Connecticut Valley; Bull. Geol. Soc. Am. Vol.44, pp. 965-988, 1933.

Neither trip involves strenuous bushwhacking or prolonged climbing. Greatest distance between cars and exposures on trip A is about one-half mile, and less than a quarter of a mile on trip B.

Trip A. starts at the fossil locality in Bernardston, and the relations of the Bernardston formation of Devonian age to the surrounding crystallines rocks are the chief points of interest.

Trip B is intended to demonstrate relations of varved-clay lake deposits to the adjacent deltas and to overlying fluvial deposits of post-Glacial age; relations of deltas to nearby ice-contact forms; structures of deltas and adjacent lake-bottom deposits; data bearing on mode of retreat of the valley ice lobe; and the post-glacial activity on the Connecticut River.

Saturday, October 11, 1941

8:30 - 11:00 p.m.

BUSINESS MEETING, followed by three 20-minute talks and discussion on the principal topics. Alumnae House of Smith College. Refreshments.

DO NOT WEAR HOB NAILS IN BUILDING

Sunday, October 12, 1941 Four half day trips

Trip C:-Geology of Quabbin Reservoir and Winsor(Quabbin)Dam.
Leader R.Balk Leave at 8.15 a.m. from traffic light at intersection highways No.9 and 63 at Hadley, 4 miles east of Northampton, and assemble on highway 9, facing east. Official trip will end at highway 9, 3 miles east of Belchertown.
Maps:Belchertown quad., Mass. References:-USGS.Mono.29, pp.208-214; 336-342; 243-248. USGS.Bull,597,pp.59-60,72-78.

Trip D:-Types of Triassic rocks and their significance in the vicinity of Mount Toby. Leader:-M. E. Willard.
Leave at 8.30 a.m. from traffic light at intersection of highways No.9 and 63 at Hadley, 4 miles east of Northampton. Take highway No.9 out of Northampton, and assemble on highway No.63 facing north. Official trip will end near intersection of highways No.63 and 2.
Maps:-Greenfield, 7½' sheet; Mount Toby, 7½' sheet, advance ed.
References:-USGS.Mon.29, section of Triassic rocks in Mt.Toby area. Bain, G.W., The northern area of Connecticut valley Triassic:Am.Jour.Sci., (5), vol.23, pp.57-77, 1932.
Reynolds, D.C. and Leavitt, P.H., Scree of Triassic age:Am.Jour.Sci., (5), vol.13, pp.161-171, 1927.

Trip E:Varved clays in vicinity of South Hadley. Leader C.Lochman.
Leave at 8.30 from point of assembly, highway no.116, just south of village green in S.Hadley, 12 miles east of Northampton. Take highway 9 out of Northampton, and turn right at the intersection with highway 63 at Hadley. Follow route 63 to intersection with route 116. Official trip will end on highway no.116 at Willimansett, 1½ miles sc.of Holyoke.
Maps:-Springfield-north, 7½' sheet; Mount Holyoke, 7½' sheet.
Reference:Antevs, E., The recession of the last ice sheet in New England:Am.Geogr.Soc.Res.ser.No.11, 1922.

Trip F:-Quarries in diabase and serpentine("Black Marble")near Westfield, Massachusetts, and their mineralogy.
Leader: B.M.Shaub Details to be announced later.

TRIPS C,D,E,F do not require much walking. Trip C touches only highway exposures. At one stop of Trip D there will be about ¼ mile of walk, partly through underbrush and slippery in places.
TRIP C. will show the impressive spillway and road cuts made for the recently completed Quabbin reservoir. On a clear day the party will also have a beautiful view of central Massachusetts from the new observation tower on Quabbin Hill. The rocks are crystalline schists, intruded by off-shoots of the Belchertown tonalite. Contact exposures are very good.
TRIP B. will show significant changes in rock types in the Triassic conglomerate where it is adjacent to older floor rocks. Contacts will be visited near the eastern border fault zone.
TRIP E. will demonstrate varve correlation in a few of Antevs' localities, recently re-examined in detail by Miss Lochman. IF IT RAINS, THIS TRIP WILL BE CANCELLED.
TRIP F:-is based on new work on the mineralogy of the Westfield diabase and serpentine quarries by Dr. Shaub. Details to be announced later.
(SEE AGAIN NOTE AT BOTTOM OF PAGE ONE)

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

Northampton, Massachusetts

Time -- Friday, October 10, 2:30 P.M.

Place of Meeting -- Seelye Hall, Smith College, Northampton

Leaders -- C. Lochman and Fredda D. Reed

This trip is designed to acquaint the visitors with some of the better Triassic fossil localities in the immediate area, and an interesting Post-Pleistocene plant locality.

Itinerary --

Drive south on Highway U.S. 5 toward Holyoke, five miles to opposite entrance to Mountain Park. Turn left on to secondary road and park.

Stop 1 -- On the outcrops just above the road may be seen some very large dinosaur tracks, many showing the length of stride. On the extensive ledges outcropping below the road along the bank of the Connecticut may be seen dinosaur footprints of various sizes and large quantities of Triassic drift wood.

Please do not bring your hammer as this is a state park, and numerous signs will ask you not to try to remove the footprints.

Proceed south on secondary road to intersection with Highway U.S. 5; continue one and one-half miles south to intersection with Highway U.S. 202; turn east on U.S. 202, drive through Holyoke and cross Connecticut River; continue one-half mile northeast on U.S. 202 to intersection with Mass. Highway 116; continue northeast on Mass. 116 two and one-half miles to South Hadley; continue north past village green to first street on right - Silver Street - turn right and drive for one mile to foot of low hill.

Stop 2 -- Collecting plant remains in fissile, carbonaceous shales of the Longmeadow sandstone.

Continue west on this road for two miles to the outskirts of Granby; park on secondary road back of "The Kings" fruit stand.

Stop 3 -- Collecting charcoal fragments in sandstone lenses of the Sugarloaf Conglomerate.

Stop 4 -- To be made if there is sufficient time --
The Museum of the Nash Bros. at Moody Corner. These young men have been quarrying dinosaur footprints for several years and have developed a growing business in the sale of these footprints. They have obtained a number of interesting small prints which they have kept in their home.

Return to South Hadley -

Stop 5 -- Botany Department, Clapp Hall --
Miss Fredda Reed will show the methods of preparation and study which are being made on the Post-Pleistocene plant remains from the Fort River flood plain.

Leave South Hadley on Highway Mass. 63; follow highway 7.3 miles to intersection with north-south road - (Ben Smith house on northeast corner); turn south and drive to end of road and park. Walk one-half mile south along bank of Connecticut River.

Stop 6 -- Collecting Post-Pleistocene plant remains

Return to intersection; turn left and drive one mile to intersection with Highway Mass. 9; turn left and cross Coolidge Bridge and proceed straight to center of Northampton.

References: B.K. Emerson, Geology of Old Hampshire County, Mass.
U.S.G.S. Monograph 29, 1898
Chapter XII - The Trias
Chapter XXI, p. 737 - the Post -Pleistocene of Fort River

Quadrangles: Mount Holyoke, Mass.
Springfield North, Mass.

TRIP A. Saturday, October 11, 1941

PRE-TRIASSIC ROCKS, THEIR CORRELATION AND STRUCTURE.
All-day Trip, about 100 Miles. Bring Box Lunch
Leader: R. Balk
Maps: 7 1/2-minute Greenfield; Northfield; Millers Falls, or the old 15-minute Greenfield and Warwick quadrangles.

NOTICE TO DRIVERS: Parking is difficult at most stops. Please try to park as far off the road as possible, and as close to car ahead as space and safety may permit.

Start at 8:15 a.m. at the intersection of highways 9 and 63 (traffic light) at Hadley, 4 miles east of Northampton. Take route 9 out of Northampton, turn left at traffic light, and assemble on highway 63, facing north.

Mileage

(Mt. Toby quadr., Mass.)

0.0 Hadley and North Hadley, five miles north on highway 63, are situated on silt plains along the Connecticut River. Tobacco, onions, asparagus, and other high-grade vegetables are grown in the fields. Most farmers are of Polish descent. Bed rock is not in evidence. Mount Warner, southeast of North Hadley, is underlain by mica schist (?Carboniferous Amherst schist), but Triassic sandstone crops out at North Hadley.

9.6 Sunderland. To the left (west), 1/2 mile across Connecticut River, is Sugarloaf Mountain, the southern end of the Deerfield Range. The diabase sheet which once covered the red sandstone and arkose, has been eroded from the south end of the ridge. The beds dip gently east. To the right (east) is Mount Toby, a great mass of Triassic conglomerate (trip D).

North of Sunderland the road passes ledges of conglomerate, and the eastern extension of the Deerfield diabase sheet is seen on the right, at a prominent curve 1 mile north of Sunderland. The road skirts Mount Toby on the west, and passes additional conglomerate outcrops south of

15.4 5.8 Montague.

(7 1/2' Greenfield quadr., Mass.)

Through post-Pleistocene delta sands to

21.2 5.8 Turners Falls, see outline map.

Bridge across Connecticut River. Turn left at junction with highway No.2. In bed of river famous section of Triassic sandstone and shale from which many dinosaur footprints and fish remains have been secured. Cut on right (north) side of highway displays upper contact of Deerfield trap sheet with Triassic sandstone.

22.0 0.8 Turn right on Lampblack Road. Soon ledges of red Triassic arkose (Sugarloaf arkose) and conglomerate come into view on both sides of the road.

(Bernardston quadr., Mass.)

23.3 1.3 Viewpoint on road affords good view to north. Forward to left is Wildcat Mountain, Bald Mountain is forward to the right. All the high ground is underlain by the Leyden argillite, older than Middle Devonian. Forward, in the valley, is the village of Bernardston, underlain by Triassic arkose, and between the argillite and arkose extend the outcrops of the Bernardston formation, in part of Middle Devonian (Onondaga) age. The Bernardston strata rest ?conformably on the Leyden argillite, and dip under the Triassic rocks.

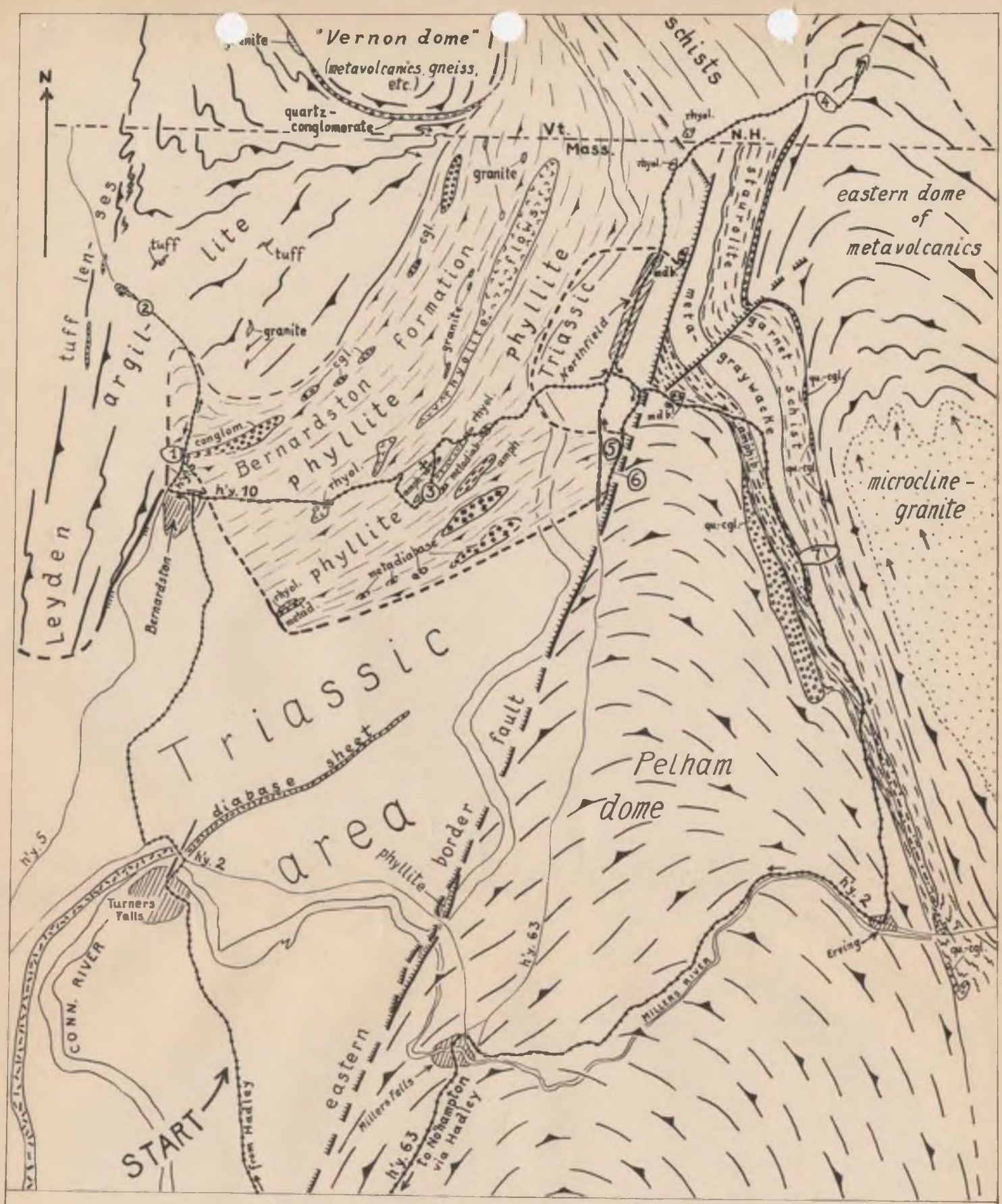
26.4 3.1 Turn left on highway No. 10 -- Bernardston.

26.6 0.2 Turn right on highway No. 5 at Bernardston Inn.

27.0 0.4 Northernmost ledge of Triassic arkose on west side of highway, at Perry Farm.

27.5 0.5 Stop 1, Fossil Locality Bernardston. Park off the highway near gravel pit, 3/10 mile NW of the Old Cemetery, north of Bernardston.

Walk west, up the hillside, to the fossil locality ("Williams Farm", USGS Monogr. 29, pp. 253-299). In gravel pit a ledge of the basal quartzitic beds of the Bernardston formation. Through kame gravel higher up to ledge of gray, conglomeratic quartzite that rests locally on phyllite. Immediately above the quartzite is the impure, fossiliferous marble, mineralized at the top, with magnetite, hematite, chlorite, and garnet. Several old pits expose the formation. Large crinoid columnals in the westernmost pit. All the beds dip at low angles southeast, the easternmost outcrops of quartzite are somewhat folded and warped.



TRIPA-OUTLINE MAP

Walk 900 feet west to brook. In its bed basal conglomerate layer of the Triassic, and Bernardston phyllite and quartz-schist below. In woods north of the marble pits are ledges of basal quartzitic Bernardston beds, contact with the older Leyden argillite concealed. Outcrop of fine-grained spotty ?metatuff, 40 feet NE of easternmost iron pit.

29.1 1.6 Stop 2. Ledge of Leyden argillite, on southwest (left) side of highway No. 5, at northeast base of Wildcat Mountain. See black phyllite with small gray metacrysts of leucoxene, folds, flow cleavage, and quartz-feldspar veins.

29.6 0.5 Turn back south, just in front of Couch Brook bridge. Follow highway No. 5 back to Bernardston Inn.

32.5 2.9 Turn left on highway 10, at Bernardston Inn. Follow highway 10. The bedrock, mostly Bernardston phyllite, is concealed for some distance under kame gravels. A small knob, to the right, about a mile east of Bernardston, is Bernardston rhyolite.

35.2 2.7 Turn right after passing railroad bridge. Follow paved road for 3/10 mile, then turn left on first gravel road. Turn left on first junction with another gravel road.

(Northfield quadr., Mass.)

36.3 1.1 Stop 3, 1/2 mile SW of Shadow Lake, and 8/10 mile west of Mount Hermon School, on west border of Northfield quadrangle.

Walk 1000 feet west-northwest through open forest. A cliff shows the base of a rhyolite flow in the Bernardston formation, resting conformably on black Bernardston phyllite with small metacrysts of biotite. The base of the rhyolite is sharp, but thin lenses of rhyolite, or metamorphosed rhyolite tuff, appear in the phyllite below. Quartz and feldspar phenocrysts in rhyolite, 20 feet above base of flow.

Walk back, cross the road, and see cliff of medium-grained metadiabase of the Bernardston formation, 100 feet east of the road. It too rests on black phyllite. The metadiabase, now composed of hornblende, clinozoisite, sericite, chlorite, small ramnants of plagioclase, and quartz, is cut by quartz-albite-sericite veinlets.

37.0 0.7 Turn right on highway No. 10. Just south of junction, an abandoned quarry in Bernardston amphibolite, to the left of the road.

37.4 0.4 Pass entrance to Mount Hermon School. A few hundred feet beyond are road cuts of Bernardston metadiabase. From top of hill a good view is had of the mountains east of Connecticut River. Those forward to the right are underlain by the dome of Pelham granitic gneiss, which begins 1 1/2 mile south of Northfield, and extends south to Belchertown, a distance of about 22 miles. The summits straight ahead are along the outcrop of the "Gulf series" (see stop 7), a group of steeply dipping sedimentary rocks lying to the east and north of the Pelham gneiss dome, and the summits farther to the left are composed of amphibolitic and other metavolcanic, highly metamorphosed rocks that seem to constitute another gneiss dome ("eastern dome" on outline map). Notch Mountain with a gentle dip slope to the north, and a steep southern scarp, is prominent on the skyline. It is a large mass of amphibolite, crescentic in plan.

The bedrock west of Connecticut River, concealed along the route of the excursion, is Bernardston phyllite, with many lenses and sheets of rhyolite, amphibolite, and metadiabase, all dipping at moderate angles southeast or south. These formations are believed to extend eastward beyond the Connecticut River. An outcrop will be seen at Stop 5.

39.0 1.6 Directly behind railroad underpass, on the left, road cut in coarse Triassic conglomerate. Boulders measure up to 4 feet in diameter. Many are of Bernardston phyllite and metadiabase.

39.1 0.1 Turn left on highway 63, south entrance of Northfield. Several outcrops of Triassic conglomerate along the road in village.

Follow highway No. 10 north of Northfield. At junction of highways 10 and 63, Wanamaker Pond, with ledge of brown Bernardston rhyolite at head. The eastern border fault of the Triassic area runs a short distance east of

pond, and a thick clay gouge is exposed in a local brook.

(Warwick quadrangle, Mass., N.H..,Vt.)

About 1/2 mile north of the State line, ledges of staurolite-garnet-mica schist of the "Gulf series" on right side of road.

47.6 8.5 Turn back on highway No. 10 at single farm, 8/10 mile north of the road cuts.

48.4 0.8 Stop 4, highway cuts on route No. 10, 1/2 mile north of Hogback Mtn.

The rocks vary in composition from quartz schists to chloritic amphibolites, are impregnated with pyrite and, locally, with tourmaline, and are regarded as a series of metavolcanic rocks. This complex of rocks constitutes a large mass of dome-like structure east of the syncline of the "Gulf series". In the core of this dome a large mass of medium-gray microcline granite is exposed. The metavolcanics are older than the rocks of the Gulf series.

The highway cuts display several sharp folds in the metavolcanics the axes of which pitch north. This is the prevailing orientation of all folds in this district. Significant for this type of metavolcanics are the large aggregates and single crystals of chlorite that penetrate certain zones. Pegmatites and aplitic dikes of irregular shape are in part later than the folding.

How far south this complex of metavolcanics extends is not yet known. It may, or may not, be continuous with Emerson's Monson gneiss, a term that includes a great variety of rocks. The age relation to the Pelham granitic gneiss, likewise, is as yet unknown.

(Northfield quadr., Mass.)

52.4 4.0 LUNCH STOP AT NORTHFIELD, 1 hour.

52.8 0.4 Turn left on local road leaving Northfield eastward. Take next road right, and follow it southward.

54.0 1.2 Stop 5. Ledges of ?Bernardston phyllite and amphibolite, 150 feet west of road, in bed of brook at north end of Beers Plain. This phyllite is 1 1/10 mile due east of the easternmost outcrop of Bernardston phyllite west of Connecticut River. Specimens from both localities are indistinguishable, mega- and microscopically. The fine-grained, thin-bedded rocks are composed of the usual quartz-sericite groundmass, with many small metacrysts of leucoxene and, more rarely, biotite. Small garnets (less than 1 mm) are seen microscopically in places. The phyllite is interbedded with lenses of amphibolite, similar to those west of the river. The strike on both sides of Connecticut River is east-west.

The outcrop is significant as it lies close to typical gneiss of the Pelham dome (stop 6).

54.5 0.5 Stop 6, 1/2 mile south of stop 5. Walk 500 feet east to see ledge of Pelham granitic gneiss in pasture. This outcrop is 2/5 mile southeast of the phyllite of stop 5. The rock is an oligoclase- orthoclase-quartz-biotite gneiss. According to Emerson (USGS Bull. 597), the Pelham granitic gneiss is of Carboniferous age. As the phyllite at stop 5 has obviously not been injected, there are two interpretations of the age of the Pelham gneiss (Am. Jour. Sci., vol. 238, pp. 354-365, 1940): (1) The gneiss existed as such before Bernardston (early or middle Devonian) time. (2) The phyllite formation lay on top of a sufficiently thick series of early or pre-Carboniferous rocks to remain protected from the emanations given off by the gneiss when it intruded its roof rocks. Post-Triassic erosion has removed all traces of these rocks on the east side, whereas the great throw on the eastern Triassic border fault has brought this low-grade rock down to the same level as the gneiss. Difficulties in the second interpretation arise because on the east flank of the Pelham gneiss dome, 1 1/10 mile away, is an entirely different series of more highly metamorphosed, but not injected, rocks ("Gulf series"), younger than the gneiss. Balk regards the first interpretation as the more probable one.

Turn right on highway 63, drive to Northfield, and turn right on same local road as before, but continue on Gulf Road. A quarter mile out of Northfield, on left side, where gravel road goes off, ledge of typical Bernardston

metadiabase. As Gulf Road enters the mountains, it skirts the north end of the Pelham gneiss dome and then traverses rocks of the Gulf series. These are, in ascending stratigraphic order (1) a basal quartzite, locally conglomeratic; (2) a staurolite-garnet-mica schist; (3) a metagraywacke, and (4) a finely laminated epidotic amphibolite. The rocks of the Gulf series are thrown into a tightly compressed, northward-pitching syncline (Emerson's "Northfield semisyncline", USGS Monogr. 29, pp. 212-216), flanked by the Pelham dome on the west, and the "eastern dome" on the east. The rocks of the Gulf series are not known to be injected by any granitic gneisses, although member (2) contains abundant pegmatites in places. They differ from all pegmatites in the two domes in that they carry semi-precious minerals (spodumene, beryl, apatite, cleavelandite, etc.).

Quartz-conglomerate also flanks parts of another gneiss dome, in southeastern Vermont ("Vernon dome" on outline map). On the south flank of this dome, the quartzite is visibly interbedded with basal beds of the Leyden argillite. Thus there is an entirely different stratigraphic sequence west of Connecticut River, if it is maintained that the two basal quartzites are equivalents. One might correlate the basal quartzite of the Gulf series with the Clough conglomerate (early or middle Silurian) of western New Hampshire, but several stratigraphic and structural questions will have to be studied before this correlation can beestablished.

Most of the cliffs along Gulf Road are amphibolite. From the car one can see the thin laminae, and the many films of quartz-albite, as well as lenses and chunks of epidote.

59.2 4.7 Stop 7, highest point on Gulf Road. Park cars carefully so as not to block traffic on this narrow mountain road.

Walk east into pasture, and see section of "Gulf series" (unofficial term, used for convenience of discussion only). First outcrops are amphibolite, the youngest member of the series. The beds dip east, in overturned position, as are all other members seen on this walk. Basal beds of next older metagraywacke, interbedded with the amphibolite, about 40 feet east of road. Gray, compact quartzitic beds with small pink garnets are characteristic of this rock. Between them are thinner chloritic layers. Higher up on the hill are ledges of staurolite-garnet-mica schist, with good staurolites in places. Continue east over crest of hill, to see ledge of basal quartzite on the east flank of the syncline. In forest east of this ledge are metavolcanics like those of stop 4.

After returning to the cars, the excursion continues south on Gulf Road, towards Erving. To the right (west) is the high crest of Brush and Crag Mountains, formed by a thick mass of Gulf series quartzite (west limb of the syncline). Where the quartzite lenses out, the eastern border of the Pelham dome advances eastward into the valley, and the other members of the syncline are greatly thinned except for the mica schist on the east limb. It forms the First Bald Hills to the left of the road, crowned by pegmatite knobs.

(Millers Falls quadr., Mass.)

A mile north of Erving, the Pelham gneiss advances beyond the road. Two small outcrops to the right, near the first houses of Erving.

64.9 5.7 Turn right on highway No. 2 at Erving. Trip follows highway 2 for 6 miles to Millers Falls. ~~One stop will be made to see the Pelham gneiss,~~ but location of stop will depend on size of party and parking facilities.

The route from Erving to Millers Falls affords a fine cross-section through the Pelham gneiss dome which here is about 7 miles wide. The gneiss includes an older sedimentary component, mostly injected mica schist and quartzite in this section, and a younger, granitic gneiss somewhat deficient in potash feldspar, but detailed microscopic work in this quadrangle is still in progress. The dome structure is remarkably symmetric and regular. Dip angles rarely exceed 35°. All rocks exhibit lineation pitching north, or north-northeast.

The valley of Millers River follows the broad outcrop of a "dome shell" of injected mica schist or mixed gneiss, which accounts for its semicircular course. High ridges to the right (north) are crowned by a sheet of pink orthogneiss on top of the mixed gneiss. In addition the valley is determined by structural weakness of the gneiss along a slight shift in the position of the axis of the dome. North of the highway, the axis lies about 2 miles farther east than south of it (see outline map).

Along the road, only the injected biotite-rich gneiss is exposed. Adjacent layers differ in the proportions of biotite, and crystalloblasts of microcline are conspicuous. Some attain a diameter of 6 inches. Epidote, magnetite, chlorite, and tourmaline are common accessories of the gneiss. The intrusive phase contains also microcline crystalloblasts, as well as long drawn-out films and lenses of the biotitic gneiss and quartzite.

Conspicuous in the scenery is the great cliff of Don Mountain to the right, about half-way between Erving and Millers Falls. The upper half of the cliff is pink orthogneiss, with many lenses and sheets of the dark gneiss incorporated near the base and at the top. Opposite Don Mountain, about 3 miles away, is the highest topographic and structural point of the dome, Dry Hill. It is a horizontal plate of orthogneiss that rests on quartzite and injected schist.

70.9 6.0 Turn right just beyond Texaco station at Millers Falls, and join highway No. 63. Return on highway 63 to Hadley, thence to Northampton.

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

Northampton, Massachusetts

Trip B: Saturday, October 11, 1941

QUATERNARY DEPOSITS OF THE CONNECTICUT VALLEY, MASSACHUSETTS
(with special reference to the area north of the Holyoke Range)

Leaders:
R. H. Jahns, M. E. Willard.

General Instructions:

Trip will begin from the intersection of State Routes 9 and 63, Hadley (Old Hadley), at 8:15 A.M. Starting point is about 4 miles east of Northampton: From Northampton take State Route 9, driving northeastward; cross the Connecticut River and continue on to Hadley; at the traffic light turn right (south) and park; this is the starting point, at which maps, itinerary, and other data will be distributed. Mileage figures in the itinerary refer to distances by road, not air-line. The appropriate topographic sheets are enumerated for each stop, and for any other point where the route of travel passes from one quadrangle to another.

Be sure to bring a lunch.

STOP A: 1.0 mile south of starting point. Mt. Holyoke or 15' Northampton quadrangle. Bank of Connecticut River.

Section of varved clays is overlain unconformably by Connecticut River deposits of Recent age. Clays locally distinctly reddish, presumably because of high content of attrite Triassic material, and have several contorted zones. The eroded surface of the clays is overlain by coarse river-bottom sands, which give way upward to bar sands and silts, then to typical floodplain material, and finally to fine silt that is in large part loessial. ----- This is one of the two places in Massachusetts where the river is rapidly eroding its bank; the bank at this point has been cut back more than 100 feet since 1938. The opposite bank, a sandy beach, has been built eastward at least 70 feet in the same period of time. The Fort River, to the east, appears to be in great danger of intercision by the Connecticut in the near geological future.

± 0.6 mile north of Stop A; State Route 63.

Scarp west of highway trends parallel to it; Connecticut River terrace (averages 31 feet above present mean river level) to east, and high floodplain (av. 21 feet above m.r.l.) west of scarp. The high floodplain was inundated during the great flood of March, 1936, and the Hurricane Flood of September, 1938, with great damage to fields and buildings.

± State Route 63, 2.1 miles north of Stop A.

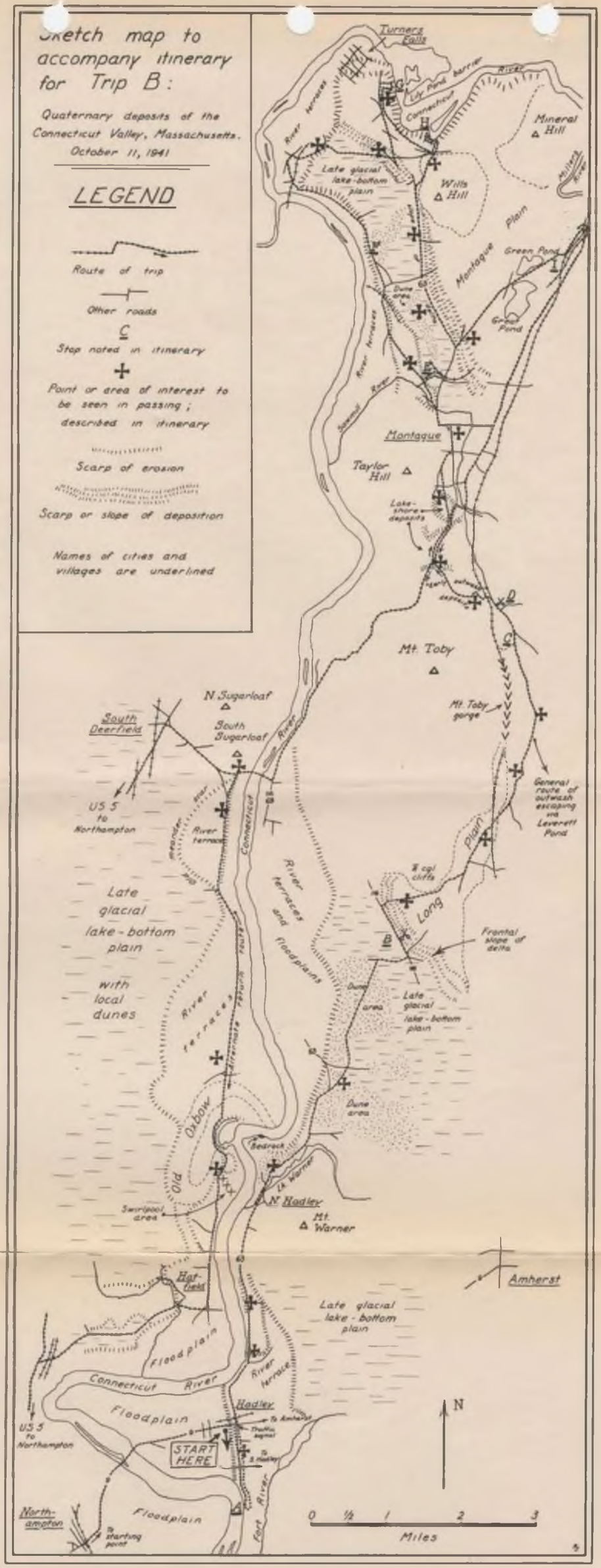
Highway descends low scarp separating a Connecticut River terrace from a high floodplain. Thick woods to east mark a west-facing river-cut scarp; this 20-foot scarp is the edge of the bottom plain of the late glacial Connecticut Valley lake.

± State Route 63, 2.8 miles north of Stop A.

Scarp on left (west) side of road separates floodplain from higher river terrace.

± State Route 63, 4.6 miles north of Stop A. 0.4 mile northeast of North Hadley. Mt. Toby quad. or old 15' Northampton quad.

Road is here on the bottom plain of the late glacial Connecticut Valley lake (here Emerson's "Lake Hadley"). When the lake was drained, prevailing westerly winds formed dunes, in large part derived from the relatively fine-grained bottom sediments of the lake. Several of these dunes lie to the west of the road.


Sketch map to accompany itinerary for Trip B:
Quaternary deposits of the Connecticut Valley, Massachusetts.
October 11, 1941
LEGEND
Route of trip
Other roads
Stop noted in itinerary
Point or area of interest to be seen in passing; described in itinerary
Scarp of erosion
Scarp or slope of deposition
Names of cities and villages are underlined
Turners Falls
Mineral Hill
Wills Hill
Late glacial lake-bottom plain
Montague Plain
Green Pond
Montague
Taylor Hill
Mt. Toby
Mt. Toby gorge
N. Sugarloaf
South Deerfield
South Sugarloaf
US 5 to Northampton
River terrace
Late glacial lake-bottom plain with local dunes
River terraces and floodplains
Old Oxbow
Bedrock
Mt. Warner
N. Hadley
Amherst
Hatfield
Floodplain
Connecticut River
Hadley
START HERE
Northampton
Miles

* - 6.0 miles north of Stop A; 1.8 miles north-northeast of N. Hadley.

Small dune beside the road on the left (west). To the east is an excellent view of the bottom plain of the late glacial valley lake. ----- Many dunes can be seen on the west side of the road from this point northward to the edge of the woods. The entire wooded area contains many dunes.

STOP B: 8.5 miles from Stop A; frontal slope of Long Plain. Mt. Toby quadrangle or 15' Northampton quadrangle.

Excellent section exposed in recently worked gravel pit. Deltaic structure of marginal part of Long Plain demonstrated; topset beds of pebble to cobble gravel overlie foresets of pebbly sand. Long Plain is a delta built into the late glacial valley lake, whose waters in this vicinity probably stood about 300 feet above present sea level. The outer part of the delta probably overlies varved-clay bottom deposits of the lake, but such a relation cannot be demonstrated here.

* - 0.7 mile from Stop B; northwest part of Long Plain.

Road, after ascending frontal slope of the delta, runs along its gently sloping (to S.W.) top. Note cliffs of Triassic conglomerate and arkose to the left (north).

* - 1.9 miles from Stop B; near crossing of Central Vermont RR.

Terrace remnant of earlier gravel plain on left (northwest); material in this terrace is very coarse. The plain was incised by the waters that dropped detritus into the valley lake to form Long Plain; thus the earlier plain, now a series of terrace remnants, must have been graded to a level slightly above that of the valley lake.

* - 2.7 miles from Stop B.

Note the narrowing of the outwash-bottomed valley. The swampy, flat-bottomed channel feeds south-southwestward onto Long Plain; the flanking gravel terraces are correlatives of the terrace remnant noted at the preceding observation point.

* - 3.5 miles from Stop B; west base of Joshua Hill.

Pit on right (east) in gravels laid down by meltwaters escaping to the south-southeast (via Leverett Pond). Similar gravels, in pitted terraces and subdued kame-like forms, may be seen on the west side of the road between here and Stop C; they are earlier than the sediments of Long Plain, so far as the outwash sequence of this area is concerned, and were deposited from meltwaters flowing over a bedrock spillway (to SSE) at an altitude of approximately 420 feet.

STOP C: 4.5 miles from Stop B; near Neighborhood Cemetery. Mt. Toby quadrangle or 15' Northampton quadrangle.

The outwash deposits, here fairly thin veneers over bedrock, may be correlatives of the Leverett Pond spillway mentioned above. On the other hand, they may have been deposited from waters leaking sidewise into the Mt. Toby gorge to the south. (See sketch map)

Walk 0.2 mile west to railroad. This is the lip of the Mt. Toby spillway (approximately 395 feet above sea level); meltwaters discharging through this spillway were responsible for the construction of Long Plain and of the slightly earlier-formed terraces that flank its narrow northeastward end. The spillway is entirely in bedrock, and throughout most of its length coincides with the boundary between Triassic sedimentary rocks and pre-Triassic igneous and metamorphic rocks.

STOP D: 0.6 mile north of Stop C; east of Cranberry Pond. Mt. Toby quadrangle or 15' Northampton quadrangle.

Pit in coarse gravel that lies directly on pegmatitic granite. The terrace in which the pit is dug is clearly graded to the lip of the Mt. Toby spillway; this may be the result of original deposition, or of the regrading of an

earlier-formed, higher terrace. The latter alternative is probably less likely. ---- This terrace lies immediately east of a kame-kettle-crevasse filling area of coarse gravel.

* - 0.4 mile northwest of Stop D. 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

Immediately beyond railroad crossing is an area of kames, kettles, kame terraces, and crevasse fillings. This ice-contact outwash is very coarse and ill sorted, as can be seen in road cuts near the sawmill.

* - 1.3 miles from Stop D; junction of trip route with State Route 63. 2 miles south of Montague.

The descent at this point is from the level of the ice-contact deposits just traversed to that of shore deposits (including deltas) associated with the late glacial Connecticut Valley lake (here Emerson's "Lake Montague"). The pits on both sides of the road immediately to the north are dug in pebbly sand and gravel of a shore terrace.

* - 2.2 miles from Stop D; secondary road 1.1 mile south of Montague.

The descent here is from a deltaic plain of sand and gravel to a local area of old lake bottom, underlain by varved clays. The deltaic plain may have been an ice-contact form, but features indicative of such an origin have been obliterated (if ever present), presumably by the waters of the valley lake.

* - Village of Montague.

Most of the village is built on the bottom plain of the late glacial valley lake. Varved clays underlie the area, and are capped by four to six feet of silt and sand.

STOP E: 0.8 mile from Montague; 0.3 mile west of Montague Station. 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

Pit in sediments of the valley lake bottom. Excellent detailed sections are exposed, showing the upward transition of varved clay into silt and sand. The sand-silt capping and the transition zone are well exposed, but the pit is not deep enough to show the normal varves. (These are seen at Stop F)

LUNCH STOP: Montague Station, just off State Route 63, 0.7 mile north of Montague.

* - 0.5 mile from Montague Station; 1.0 mile south-southeast of Fish Hatchery.

Scarp to right (east) of road is the eroded front of the lake-bottom plain. The road lies on a Connecticut River terrace of post-lake age.

STOP F: 2.2 miles from Montague Station; road cut. 0.7 mile north of Fish Hatchery. 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

Section of lake-bottom deposits resting on Triassic shale. Transition from normal varved clay into sand and silt well shown. -------- River-terrace area west of road. The fluvial deposits in this area overlie varved clays with an erosional unconformity.

* - 2.3 miles from Stop F; 0.7 mile from Montague City.

The high scarp ascended by the road is the eroded front of the bottom deposits of the late glacial valley lake (Emerson's "Lake Montague" in this part of the valley). The lower terraces west of the scarp are of fluvial origin and post-lake in age. ----- The pit to the left (north) of the road exposes varved clays.

* 3.1 miles from Stop F; 1.2 miles south-southeast of Turners Falls.

This scarp, distinctly less steep than the erosional scarp just seen 0.8 mile to the west, is the normal frontal slope of a great delta built into the Connecticut Valley lake by the pro-glacial Millers River. The apex of this large plain (which includes Montague Plain -- see sketch map) is at Millers Falls, almost three miles east-southeast of this point. ---- The frontal slope is locally veneered with dunes, as seen on the north side of the road. ----- From this point the route follows the top surface of the delta.

STOP G: West bank of Connecticut River at the Narrows; 0.8 mile southeast of Turners Falls (center of town). 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

The Connecticut River, in cutting down through the delta of the pro-glacial Millers River, has here exposed an excellent section. Topset and foreset sands and gravels (not well shown at this stop) overlie varved-clay bottomset beds. Beneath this delta section are several feet of tough till (rich in fragments of Triassic rocks) and finally, near the river itself, Triassic shale and sandstone.

* 0.2 mile from Stop G.

The road cuts expose sand and pebble gravel topset and foreset beds of the delta. The scarp ascended by the road is one cut by the post-lake Connecticut River.

STOP H: South bank of the Connecticut River 0.5 mile southeast of the Narrows; Turners Falls Rod and Gun Club. 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

A strong spring horizon in a deep tributary ravine marks the contact of varved-clay bottomset beds with the overlying foreset sands.

The bank of the Connecticut itself, 0.1 mile north-northwest, contains an excellent section of delta sediments on bedrock. The transition between varved clays and foreset sands can be seen. -- Immediately east is the Keith's Spring locality of Jefferson (see bibliography), where varved clays were once dug for brick making. The old pits have been flooded by the river since construction of the dam at Turners Falls.

Across the river to the north is the Lily Pond barrier, a ridge of Triassic sandstone that played an interesting part in the history of the post-lake Connecticut River. For a considerable period of time following drainage of the valley lake, the river flowed over this barrier, on which the lips, plunge pools, and short recessional canyons of two large waterfalls are clearly preserved. During this time, extensive terraces were formed upstream for many miles; these were left "high and dry" when the river, in its gradual eroding of the delta deposits in this area, uncovered a lower path around the southwest end of the barrier. This lower path is the present Narrows.

* 0.5 mile from Stop H; immediately south of crossroads with State Route 2A.

Dunes, seen on both sides of the road, lie on surface of bedrock and till.

* 1.9 miles from Stop H; southwest of Wills Hill.

Road lies at the base of the frontal slope of the Millers River delta. Lake-bottom plain lies to the right (west).

* 2.8 miles from Stop H; State Route 63, 0.6 mile southeast of Fish Hatchery.

Large dune on lake-bottom plain to right (west) of road. Parts of this dune are active at the present time; the fresh sand from one "blowout" can be seen from the road.

* 3.7 miles from Stop H; 0.4 mile northeast of Montague Station.

Road ascends the frontal slope of the delta of pro-glacial Millers River, and continues along its flat upper surface.

STOP I: 0.4 mile east-northeast of Green Pond. 7 1/2' Greenfield quadrangle or 15' Greenfield quadrangle.

This is the kettled part of the Millers River outwash. The surface here is continuous with that of the deltaic part of the deposits to the west. In addition to kettles, kames and crevasse fillings are present in this part of the deposits; the materials are sands and gravels, with no varved clays. The ice-contact outwash rests directly on bedrock and till. ---- The relations over the entire area suggest that the debris-laden waters of the pro-glacial Millers River discharged over an area containing large masses of ice before reaching the open waters of the Connecticut Valley lake farther to the west.

Stop I is the last scheduled stop on the trip. Party will be led back to Montague, and from there to Sunderland via State Route 63. At Sunderland, those who are anxious to return to Northampton as soon as possible should drive west on State Route 116 for 2.8 miles, turning left (south) on US 5 at South Deerfield. Continue on US 5 to Northampton; the highway lies on the bottom plain of the valley lake (here Emerson's "Lake Hadley") for almost the whole distance.

An alternative, but slightly longer route will be taken by the leaders, and the following notes will serve to indicate the features of chief interest. Distances are given from the Connecticut River bridge at Sunderland.

* - 0.3 mile. Route junction. South Sugarloaf Mtn. (Triassic arkose) to northwest, lake-bottom plain to west, and Connecticut River terraces to south and southwest.

* - 0.8 mile. Excellent scarp between river terraces on left (east) side of road. Old meander scar in wooded area to west (see especially Mt. Toby quadrangle). The terrace on the east side of the road was inundated during the floods of 1936 and 1939, a situation exceedingly rare. The 1936 flood, however, was by far the greatest along this part of the river during the last 300 years.

* - 4.3 miles. Heavily scoured river terrace in vicinity of Bradstreet. Immediately south, the road drops into an old oxbow area, in which the river has been forced into peculiar bends during post-glacial time by a large mass of Triassic rock north of North Hadley (see sketch map).

* - 6.0 miles; recently constructed causeway. The pitted area on the left (east) is the well known swirlpool area north of Hatfield. During March, 1936, Connecticut River floodwaters piled up in the old oxbow area and broke across the fields in this area to flow eastward and southeastward into the normal channel. In so doing, the waters cut the great holes and trenches seen; in at least two places, the holes were cut deep enough to expose the varved clays that unconformably underlie the river deposits.

Continue through Hatfield, then turn west to join US 5 about three miles north of Northampton.

Sunday, October 12, 1941.

TRIP C: GEOLOGY OF QUABBIN RESERVOIR AND WINSOR (QUABBIN) DAM.
Leader: R. Balk.
Maps: Belchertown 15-minute quadrangle, Mass.

Start at 8:15 a.m. on highway No. 9, at intersection of highways No. 9 and 63, traffic light, at Hadley, 4 miles east of Northampton. Assemble on highway 9, facing east. -- Official trip ends at noon at highway 9, about 3 miles E of Belchertown.

General Information. Quabbin reservoir is located about 15 miles east of Northampton, and 5 miles east of the Connecticut valley. It is the newest, and by far the largest, water reservoir of Boston. Three branches of Swift River have been damned at a point 3 miles east of Belchertown, and the construction of this dam, Winsor Dam (originally named Quabbin Dam, in reference to Quabbin Hill, a prominent summit 2 miles northeast of it), has produced some excellent and instructive cuts that give much information on the geology of a small but geologically important area east of the Pelham dome of granite gneiss.

Apart from the geological features, the vicinity of the dam is a scenically interesting area as a system of new highways has given access to several high hills, and from the observation tower on top of Quabbin Hill one can enjoy one of the finest views over central Massachusetts. The large dam, and the growing lake in front of it, present many other features of general interest.

Mileage

0.0 From Hadley to Amherst the highway runs over late Pleistocene clays, silt and sand deposits, and no bedrock is exposed.

4.1 Amherst. Continue on highway No. 9 straight ahead.

After leaving Amherst, a good view is had of the ridges forward to the east. They are underlain by the Pelham granitic gneiss, a medium-grained rock that builds up a dome, 22 miles long and up to 8 miles wide. The hills in view are near the southern end of the dome. The slopes facing the valley are dip slopes, and along the flat crest the foliation lies more or less horizontal. The highest point is Mount Lincoln (fire tower). In the dome are found also sedimentary rocks, notably actinolite-bearing quartzites, injected biotite schists, and amphibolites. They occur as concordant lenses in the granitic gneiss.

5.2 Good view of the east end of the Holyoke Range on the right. The range is capped by a sheet of diabase that rests on Triassic sandstone. The layers dip south and as the resistant diabase is undercut by the less resistant sandstones, the range breaks off on the north with a steep scarp. Several notches in the skyline are caused by crush zones and steep normal faults that traverse the range (G.W. Bain, Am.Jour.Sci., vol. 239, pp. 261-275, 1941).

6.5 Large pit in kame gravel on right.

11.2 Ledges of pegmatite on both sides of the road. They cut folded quartz-biotite schist and amphibolite that belong to the western border of the Pelham gneiss dome.

13.2 Intersection with highway No. 202 (Daniel Shay's highway). Continue straight ahead.

On the right is Belchertown, on top of a large drumlin. The highway here follows a topographic depression along the south end of the Pelham gneiss dome. On the right, the higher ground is underlain by the Belchertown tonalite, a mass about 7 miles in diameter that seems to be younger than the Pelham gneiss. An offshoot of this intrusive is well displayed in the extensive cuts at the spillway, just east of Winsor Dam.

14.2 Junction with highway No. 21. Bear left.

16.3 Turn left to Winsor Dam. Drive slowly over dam.

On the left is the western portion of Quabbin Reservoir, flanked on the left (west) by the eastern border of the Pelham gneiss dome, and on the right by eastward dipping amphibolites, chloritic schists, and granitic

sills. Although the bedrock along this valley is nowhere exposed, it may be a slightly calcareous amphibolitic series, to judge from ledges at the west abutment of the dam (now concealed). All the rocks have a north-south strike.

Statistics: Winsor Dam

length	2,640 feet
width at bottom	1,100 feet
height above former stream	170 feet
height above bedrock	295 feet
volume of earth fill in dam, above stream level	4 million cu. yards

second largest dam in eastern United States

Quabbin Reservoir

length	18 miles
water surface	38.6 sq. miles
shore line	118 miles
average depth	51 feet
maximum depth	150 feet
capacity	415 billion gallons
area of watershed	185.9 sq. miles

Quabbin reservoir is connected with the older Wachusett reservoir through an aqueduct that starts at a point on the east shore, 7 miles northeast of Winsor Dam. This aqueduct is 24.6 miles long, 1/2 mile shorter than the Hetch-Hetchy tunnel in California. It is 11 feet wide, and 12 feet 9 inches high.

17.4 Turn left on road fork at south end of spillway, park in spillway, and assemble at south end of it.

On the east side of the road fork is a good contact exposure of an offshoot of the Belchertown tonalite with overlying chloritic schists. The latter are thrown into several folds, and the contact follows them concordantly. All rocks are cut by a variety of dikes ranging from quartz-diorite to aplite in composition, and pegmatites and quartz veins are also common. In places, more than 8 generations of dikes can be distinguished. The dikes are fractured, and epidote, quartz, tourmaline and, locally, purple fluorite veneer the fractures.

The tongue of tonalite is about 150 feet wide, and the western wall rocks are exposed in the cliff by the road connecting the east end of the dam with the south end of the spillway.

As seen in the spillway near its northern end, the contact relations on the north and northwest differ from those seen before in that the tonalite grows darker towards the chloritic schists, and a sharp boundary between intrusive and wall rock is not everywhere present. Many clots and ill-defined "ghosts" of xenoliths are seen on both sides of the road. Mineralogically, the darker masses contain larger proportions of chlorite and hornblende, or both, and epidote may also be enriched in them. The same mineral seems to be a primary constituent in the tonalite in this particular area. Although no new chemical analysis of the tonalite has yet been prepared, the petrographic name appears to be correct; andesine feldspar, hornblende, biotite, epidote, and small amounts of quartz are the principal constituents. Chlorite, although common, is an alteration product of hornblende or biotite. Albitic feldspar and orthoclase are sporadically present in small amounts.

At the north end of the spillway the dark clots are all aligned as ellipsoids pitching at about 30° north, and soon the roof of the intrusive sinks below the level of the road. The roof rock here is mostly a quartzose garnet-chlorite-biotite schist, in which light gray quartzitic interbeds with pink garnets are surrounded by more micaceous layers. Preliminary field work suggests that this rock is the prolongation of the "Gulf series" metagraywacke seen on trip A, southeast of Northfield. The same rock crops out over the stripped area next to the north from which the till has been removed to furnish the earth fill for the dam. Farther east and north, however, the metagraywacke disappears, and epidotic amphibolite makes its appearance. The same rock underlies most of Quabbin Hill.

18.6 Top of Quabbin Hill. Summit ledges of amphibolite, with small, coarse-grained apophyses of basic tonalite. Perhaps Quabbin Hill is something like an old volcanic center. At any rate the amphibolites attain a much larger area of outcrop here than farther north and south. That most, if not all, of the amphibolite series is metamorphosed volcanic material is seen at the next stop, on the north slope of the hill. Here a highway cut displays what appears to be metamorphosed pyroclastics, composed of numerous angular and round fragments of various rocks (quartz-sericite schist, gneiss, chloritic phyllite, chlorite schist, etc.), surrounded by a groundmass of chlorite, sericitic muscovite, biotite, and quartz. Feldspar and actinolitic hornblende are also common. Nearby is a ledge of snow-white quartz-sericite schist.. Highway cuts farther down the northeast slope exhibit many other varieties of the amphibolite series.

At the east base of Quabbin Hill, the highway crosses an important geological boundary, probably a recrystallized fault zone. East of the amphibolite series are outcrops of an entirely different formation, named Monson granodiorite gneiss by Emerson (USGS Mono. 29, p.41). This formation constitutes a large dome-like mass in central Massachusetts. Its western border, at Quabbin Hill, is vertical, but in the eastern reservoir area dips decrease more and more in steepness. Thus the reservoir, as a whole, is situated between two large gneiss domes. The wedge-shaped belt between them, that constitutes the large peninsula directly in front of Quabbin Hill, is composed of the amphibolite series seen at Quabbin Hill, and several schist and phyllite formations, not seen on this trip.

20.8 Quabbin Dike. This dam was built to terminate the reservoir on the southeast. The natural drainage here is towards the south. On the eastern abutment is a ledge of amphibolite that belongs to a series of crystalline schists within the Monson gneiss. Higher up on the slope are outcrops of sillimanite-bearing mica schist. These two rock types have been extensively injected by a granodioritic intrusive component, which is exposed at the western abutment. All stages of incipient and advanced assimilation can be seen within a few hundred feet, also several recrystallized shear zones in the gneiss.

The isolated, steep hill, 2 miles north of the dike, is Mount Lizzie, underlain by the same gneiss as on the western abutment of Quabbin Dike. Farther north, almost in line with it, is Mount Pomeroy.

Join the main reservoir road, 800 feet west of the dike, and turn left. Road joins highway No. 9 about a mile south of the dike.

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

Northampton, Massachusetts

Trip D:

Sunday, October 12, 1941

TRIASSIC ROCKS IN THE AREA OF MOUNT TOBY AND THEIR SIGNIFICANCE

Leader:

M. E. Willard

Maps:

7 1/2' Mount Toby and 7 1/2' Greenfield quadrangles.

General Information:

The trip will start at the intersection of highways 9 and 63 east of Northampton at 8:30 A.M. The party will assemble facing North on State Route 63.

One set of maps will be furnished each car at the start. The roads to be followed will be in solid red on these maps.

Numbered descriptions below are of actual stops all others are of points of interest that can be seen enroute.

The trip ends at approximately 12:00 noon two miles east of Turners Falls on State Route 2.

7 1/2' MOUNT TOBY QUADRANGLE

*Mount Warner east of North Hadley:

This mountain is largely of pre-Triassic schist. Its occurrence several miles west of the general eastern limits of the Triassic in this area makes its location of interest.

*Bull Hill Road south of Mount Toby:

The high cliffs to the left of the road are of red conglomerate overlain by the Deerfield diabase sheet. This conglomerate seems to grade westward into the Sugarloaf arkose.

Stop 1: North end of the Mount Toby gorge:

The east side of the gorge is of pre-Triassic rock. On the west is the steep front of Mount Toby made of coarse Triassic sediments. The exposures show the Triassic to be of large angular to slightly rounded fragments of phyllite and granite, with smaller amounts of other material.

7 1/2' GREENFIELD QUADRANGLE

Stop 2: Whitmore Pond above North Sunderland:

The Triassic section here includes shale, sandstone, conglomerate and an angular breccia. All blocks in the breccia are of one rock type.

Stop 3: Taylor Hill west of Montague:

An exposure of Triassic talus breccia. All blocks in the breccia are of granite gneiss.

*Mineral Hill:

East Mineral Hill is of pre-Triassic gneiss and schist; the rocks of West Mineral Hill are Triassic. The contact between these two follows the road and is marked by exposures of a large quartz vein, one of these can be seen east of the road at the crest of the hill.

Stop 4: Bank of the Connecticut River north of Mineral Hill:

Relations of coarse Triassic, early talus breccia and the underlying phyllite are well shown.

Stop 5: Lilly Pond barrier south of Barton Island:

Intraformational breccia in the Triassic sandstone.

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

Northampton, Massachusetts

TRIP E
(Not run in case of rain)

Time -- Sunday, October 12, 8:30 A.M.

Place of Meeting -- Hadley Bookshop, just south of intersection of highways Mass. 116 and 63 in South Hadley center (12 miles east of Northampton).

Leader -- C. Lochman

This trip is planned for Sunday morning only. It is designed to show the sites of several of Antev's clay pit localities; to make a detailed study of five sections which have been recently measured in the well exposed pits of the Hampshire Brick Co., Willimansett and to discuss the correlation of the varves in these five sections with each other and with Antev's section from the nearby Locality 10.

Itinerary:

Drive one mile south on Highway Mass. 116, cross Stony Brook and park on first side road to right.

Stop 1 -- To examine Antev's locality 15. In locality 16 which may also be visited and which is 3/4 mile up Stony Brook, Antev's records two feet of till at the top of the section, but no exposure can be found at this site which will duplicate his description.

Return to Highway Mass. 116, drive .7 mile south and turn left on Lyman Street; proceed directly across intersection at 1.6 miles and continue south and southwest to stop light beyond underpass at 4.6; turn left and continue south to fork in road at 5.3 at Gulf Gas Station; take left fork (Mass. 141) and at 5.6 miles turn left on Grattan street; proceed .1 mile just beyond overpass and turn sharply onto road into clay pit: drive down to shed and park.

Stop 2 -- In the junkyard on the opposite side of Grattan Street is the site of Antev's locality 10, in the Holyoke Brick Co. pits, but the whole area has been removed. The recent operations in the Hampshire Brick Co. pits expose the clays which must be continuous with those which Antev's measured and appear to go deeper in the section as over 100 more varves have been measured. In the five sections studied in this pit the method of study will be explained and such features as erosion in the top varve sands; the relation of river to varve sands; color changes in varves and varve sands; details of the varves; crumpled zones; and oxidation of the sands may be examined. The sections recently measured here will be compared with Antev's graph for locality 10.

If there is time one or two more stops will be made.
Leave pit and return to intersection of Grattan and Meadow Streets. Turn south on Meadow Street and drive 2.4 miles to Granby Road (just before crossing bridge at Chicopee); turn left and drive up road .25 miles and park in large excavation on right-hand side of road.

Stop 3 -- This excavation was made during 1940 for fill for the dike being built along the Connecticut. It exposed a section of 7 feet of till at a maximum overlying well-washed sands and sandy varves. This section will be illustrated by photographs taken at the time of exposure. This till mass abuts against varve clays at the north end of the excavation, and the contact shows both crumpling of the varves and interfingering of the till and varves. The till is overlain by the varves as well. The till was clearly introduced into the water of the lake at the same time that it was receiving deposits of varve clays.

Return to Chicopee bridge, turn left through Chicopee on highway Mass. 116 for 1 mile. A few cars may cross and park in clay pit; others will have to park along road.

Stop 4 -- Chicopee section, Antev's locality 9; Examination of a recently measured section and comparison of this chart with Antev's graph for the same section.