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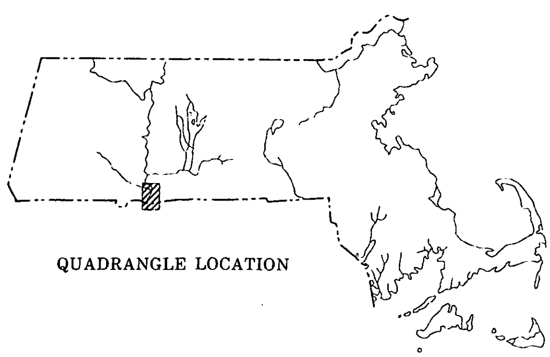
GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE SPRINGFIELD SOUTH QUADRANGLE HAMPDEN COUNTY, MASSACHUSETTS, AND HARTFORD AND TOLLAND COUNTIES CONNECTICUT

By
Joseph H. Hartshorn
and
Carl Koteff



QUADRANGLE LOCATION

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TO ACCOMPANY MAP GQ-678

GEOLOGIC MAP OF THE SPRINGFIELD SOUTH QUADRANGLE HAMPDEN COUNTY, MASSACHUSETTS, AND HARTFORD AND TOLLAND COUNTIES, CONNECTICUT

By

Joseph H. Hartshorn and Carl Koteff

The Springfield South quadrangle is entirely in the Connecticut Valley lowland, which is underlain by Triassic conglomerate, sandstone, shale, and both extrusive and intrusive basalts. The north-south lowland is about 95 miles long and 20 miles wide. The topography was a dominant factor in controlling the history of glacial retreat and formation of the proglacial lake that occupied the Triassic lowland.

BEDROCK GEOLOGY

The Portland Arkose, of Late Triassic age, is the only bedrock unit mapped in the Springfield South quadrangle. Emerson (1898, 1917) earlier recognized the Longmeadow Sandstone and the Chicopee Shale, both of Late Triassic age. The type area for the Longmeadow Sandstone is in the quarries in East Longmeadow; the type area for the Chicopee Shale is a short distance north of the quadrangle. Krynine (1950) applied the name Portland Arkose to rocks in central Connecticut that are stratigraphically equivalent to the Longmeadow Sandstone; Rodgers and others (1956) extended the Portland northward to the Springfield South quadrangle. The usage of Rodgers is followed in this report. Inasmuch as the Longmeadow Sandstone is no longer recognized in its type area and its constituent rocks are now included within the Portland Arkose, the Longmeadow is herein abandoned.

The Chicopee Shale was mapped by Emerson (1917) as occupying about the western one-third of the quadrangle, but it is not recognized by the authors. It appears that shaly beds called Chicopee Shale by Emerson at Agawam, Mass., and Thompsonville, Conn., are merely a finer grained facies of the Portland Arkose than that exposed in the eastern part of the quadrangle. The Chicopee, therefore, also is herein abandoned.

Lithology.—The Portland Arkose in this area is chiefly reddish-brown to grayish-red fine-grained sandstone, siltstone, shale, and minor amounts of conglomerate. The individual grains are angular to subangular and decrease in size from east to west. Abundant shale is exposed only in the western part of the quadrangle. A single lenticular 3-inch bed of conglomerate was found on the Osborn Prison Farm in Enfield, Conn.

The major constituents of the Portland Arkose, as seen in thin sections, are: strained quartz, 30-65 percent; microcline and plagioclase, 20-40 percent; ferruginous clay, 10-50 percent; and mica, 1-15 percent. Accessory minerals include hematite, magnetite, ilmenite, chlorite, epidote, apatite, zircon, tourmaline, garnet, and calcite. The calcite appears to be secondary in origin, and the magnetite is in part altered to hematite.

Sedimentary structures.—The sandstone and siltstone of the Portland Arkose are generally irregularly thin bedded, most beds being 1-3 feet thick; a few, as in East Longmeadow, are as much as 10 feet thick. Throughout the unit, ripple marks and raindrop impressions are very common, and mud cracks were observed along bedding planes in the shale. Concentrations of ferruginous material, called "fucoids" (Emerson, 1917, p. 94), also occur on the bedding planes. Dinosaur bones and tracks, as well as plant fossils, have been found previously in this area and in the Connecticut Valley lowland (Lull, 1953), but no fossils were found during the present investigation.

Structure.—The Triassic rocks are in a shallow syncline plunging to the east-southeast, although Emerson (1917) indicated a shallow syncline striking north in this area. No faults were observed, but it is highly probable that faults do occur in the Springfield South quadrangle.

Occurrence and thickness.—The Portland Arkose underlies the entire quadrangle but only about 40 separate exposures were found, 2 of these temporary. Most of the exposures are along the east side of the map in quarries, which, for the most part, are now either nearly covered over or filled with water. The best exposure is in the large quarry between Main and Pleasant Streets, about 2,000 feet southeast of the center of East Longmeadow.

Krynine (1950) gives the thickness of the Portland Arkose at Portland, Conn., as about 4,000 feet, but neither the top nor bottom of the unit is exposed in the map area. Assuming no extreme structural complications, a minimum of 8,000 feet of Portland Arkose is estimated to underlie the quadrangle.

SURFICIAL GEOLOGY

About 20,000 years ago, ice of the last great continental sheet moved south to Long Island (Schafer and Hartshorn, 1965), depositing over the bedrock a nearly continuous layer of till, a reddish-brown unsorted to poorly sorted mixture of sand, silt, and clay-sized particles, and numerous stones many feet across. Most of the till consists of fragments of Triassic sandstone, shale, and conglomerate, but some fragments of igneous and metamorphic rocks from the uplands on either side of the Connecticut Valley are included. In many places the till is only a few feet thick; in some areas, where it was molded into streamline hills or drumlins that are elongated parallel to the direction of ice movement, it may be tens of feet thick. The drumlins on the west side of the map, which are more or less in the center of the Connecticut Valley, reflect the topographic control of the lowland on the movement of the glacier and trend nearly south. In the southeastern corner of the map, the drumlins are oriented south to southeast and show that in places the basal ice moved up out of the Connecticut Valley trough. The few striations on bedrock also trend from south to southeast.

When the ice retreated to the vicinity of Rocky Hill, Conn., more than 14,000 years ago, a dam of stratified drift across the valley created a lake between the receding ice front and the dam. The lake steadily increased in length as the ice retreated north and eventually may have extended from Rocky Hill, about 23 miles south of the Springfield South quadrangle, to Lyme, N. H., about 117 miles north of the quadrangle. The deposits of this glacial lake, named Lake Hitchcock (Lougee, 1939), and the postglacial terraces of the Connecticut River that were cut in these deposits dominate the surficial geology of the quadrangle.

Before the margin of the glacier ice in the lake basin reached the Springfield South area, numerous ice-contact stratified drift deposits (Qcd and Qkd) were laid down in depressions in the ice, as shown by their height above surrounding deposits and by collapsed slopes on all sides. The ice-contact drift forms a line of low hills from 215 feet in altitude at the kame delta to about 270 feet near East Longmeadow, too high to be associated with Lake Hitchcock. The alinement of these ice-contact deposits may reflect the nearby margin of the ice, which abutted against the till uplands to the southeast, or may merely show the position of a series of isolated depressions in the glacier, as do the many kames projecting through the delta (Qdo_2) to the north. Flowtill, a concentration of superglacial debris that moved laterally and down from the glacier surface to these deposits, is found at a number of localities and provides proof of higher ice in contact with the sediments.

The kame delta (Qkd) is 10 to 15 feet higher than the projected water level of Lake Hitchcock, but it may be a proglacial kame delta built into Lake Hitchcock.

If the alinement of ice-contact deposits is representative of the ice margin here, it indicates that the northward-retreating margin of the glacier in the Lake Hitchcock basin lingered behind the retreating ice on the upland; it was a tongue of ice extending an unknown distance south of the main part of the glacier. Better evidence of a Connecticut Valley lobe is seen where glacial melt waters flowed from the lake-basin ice over the ice-free land southeast and northeast of Crescent Lake and deposited outwash in the valleys. The glaciofluvial deposits (Qgf) on the uplands begin at altitudes of 230 to 345 feet and indicate that the glacial streams came from valleys on the surface of the ice or possibly from englacial tunnels. The edge of the ice occupying the lake basin at this time was thus at least 450 feet thick in the center of the basin, measured from the till basement to the highest glaciofluvial deposit.

As the ice retreated northward across the quadrangle, the glacial lake washed directly against the glacier. Numerous melt-water streams must have discharged from the melting ice front directly into the lake. Those that were below the ice and below the water level may have formed eskers and incomplete sublacustrine deltas that were buried by later lake deposits. Sedimentation ranged from sand and gravel near the mouths of the subglacial streams to fine sand, silt, and varved clay away from the ice margin. Iceberg-rafted stones are found in the clay. The base of the varved clay, resting on till, is exposed in the valley of Deep Brook in the southwestern corner of the map. Here the reddish-brown sandy to silty summer layers, 2½-3 inches thick, contrast with the ½-¾ inch thick reddish-gray clayey winter layers.

The Connecticut Valley glacial lake occupied a trough that ranged from 3 to 10 miles wide between Hartford, Conn., and the Holyoke Range, about 28 miles north of the Massachusetts-Connecticut border. Three large deltas, the Farmington River delta (Bradley Field delta of Colton, 1961), the Westfield River delta, and the Chicopee River delta, extended several miles into the lake at the mouths of major streams and now form large sand plains. Smaller deltas at the mouths of streams that drained smaller areas during late-glacial time are more difficult to recognize. The Scantic River, about 1½ miles south of this map area in the Broad Brook quadrangle (Colton, 1965), may have built a delta that extended into the Springfield South quadrangle from the eastern uplands, but it has not been interpreted as such by Colton.

When the glacier margin outside the valley lay northeast of Bass Pond, a melt-water stream began to discharge from the glacier at a well-defined head of outwash southwest down a narrow valley between till hills on the east and the ice tongue in the Connecticut Valley, which then lay against the western side of the outwash deposits northeast of Redstone Lake. The debris was deposited over and around scattered ice blocks for about 2 miles, then as proglacial outwash for another 2 miles; it finally debouched into glacial Lake Hitchcock at a present altitude of about 180 feet. The delta thus built southward into the lake is mapped as Qdo_1. When the glacier melted back from the head of outwash east of the quadrangle, this delta was abandoned, and the main flow of melt water began to come down the major westward drainageway of the Chicopee River.

The eroded flat around Freshwater Brook and south of Osborn Prison Farm is too high to be bottom deposits of Lake Hitchcock, and it is too flat to be part of the southward-sloping subaerial part of Qdo_1. One possible explanation is that the flat area is part of the northern half of a delta from the Scantic River that merged with the southern extension of Qdo_1.

Less than a third of the huge delta of the glacial Chicopee River (Qdo_2) is shown on this map. It was deposited from the east and northeast by melt waters and later nonglacial drainage that flowed from areas almost as far north as the Millers River (30 miles north) and as much as 35 miles east of the Connecticut River. The delta probably extended nearly to the western edge of the quadrangle, and at least some distance south of Porter Lake. The surface of the delta, whose outer edge was trimmed and terraced by the postglacial Connecticut River, slopes southwest.

Lake-bottom sedimentation apparently continued as the lake stretched northward to Lyme, N. H., until the varved clay deposits became as much as 230 feet thick. The present altitude of the clay ranges from approximately 170 feet above sea level beneath the delta at the north edge of the quadrangle to 155 feet southwest of Osborn Prison Farm at the south edge of the map. Here sediments include lake-bottom deposits of very fine sand, fine sand, and clay occurring as varves, some of which are much contorted. Varved clay nearer the center of the basin, about 2 miles west of this locality, is 115 feet above sea level and has probably been eroded in post-lake time.

Reddish-brown to brown varved clay, reflecting predominantly Triassic provenance, is found at altitudes ranging from 25 feet below sea level near the Connecticut River to 35 feet above sea level 2 miles east of the river. The reddish-brown clay is overlain by blue-gray to gray-brown varved clay, reflecting predominantly igneous and metamorphic provenance, with numerous laminae of reddish-brown clay and sand.

This change in provenance can be traced to changes in drainage history when the retreating glacier tongue in Lake Hitchcock withdrew past the mouths of the Westfield and Chicopee Rivers. Prior to this event, the sediment in the lake was derived primarily from melt-water streams draining about a 12-mile sector of the glacier margin in the Triassic lowland, with minor contributions from the uplands to the east.

When the glacier margin retreated northward past the mouths of the Westfield River on the west and the Chicopee River on the east, melt-water streams then drained about 20 miles of glacier margin underlain by Triassic rocks, but the Westfield and Chicopee Rivers together drained a 45-mile glacier margin in the igneous and metamorphic uplands. When the retreating glacier reached Mt. Holyoke, the ratio changed to 55 miles of upland ice front and only 10 miles in the Triassic basin. The amount of Triassic debris delivered to Lake Hitchcock diminished steadily and finally ceased as the glacier retreated north past the Millers and Deerfield Rivers.

The discussion of lake altitudes is complicated by upwarp of the land, which took place after deglaciation. If there had been no postglacial tilt, the lakeshores and deltas graded to the same water plane from Rocky Hill to at least New Hampshire would be horizontal. However, after ice left the area, and presumably after the lake was drained, postglacial upwarp or tilt of 4.2 feet per mile (Jahns and Willard, 1942) took place. Thus, once-level shorelines, such as those found in the Mt. Toby (Jahns, 1951) and Greenfield (Jahns, 1966) quadrangles, now rise about 4 feet per mile to the north.

A profile drawn from the original data (Jahns and Willard, 1942, p. 273) and projected south to the New Britain spillway west of Rocky Hill indicates a lake level 202 feet above present sea level at the north edge of the quadrangle and 166 feet at the south. Such a gradient shows that the outlet stream flowing over the present divide in the New Britain channel was 10 or more feet deep. The figures are consistent with a few beaches found in other quadrangles, such as the one at Kings Corner in the Broad Brook quadrangle (Colton, 1965), but apparently not with others in the West Springfield quadrangle. Other authors feel that the lake level was much higher, from 135 feet at Hartford to 220 feet at the Massachusetts border (Cushman, 1964, p. 57), or that shorelines were level at an altitude of 150 feet from south of Rocky Hill at least to Hartford (R. E. Deane, oral commun., 1962). These different interpretations may be the result of misinterpretation of shoreline features, a complex lake history south of the Farmington delta, or both.

When the glacial lake was drained by breaching of the drift dam south of Rocky Hill, Conn., probably between 10,710 B.P. and 10,650 B.P. (Flint, 1956, p. 277), the first concentrated thread of through current was the Connecticut River. The river at first flowed on the clay and sand of the former lake bottom, but soon, in conjunction with its many small tributaries, it began to cut laterally and downward and to remove the lacustrine material. The Connecticut River has cut vertically at least 160 feet into the lake deposits in the northern part of the quadrangle and has cut more than 2 miles laterally both east and west of the present river.

The numerous postglacial tributaries brought in sand and gravel that the Connecticut River distributed widely on its many stream terraces. Some areas were stripped completely of lacustrine and stream-terrace materials, as in the southwestern corner of the map, leaving till at the surface well below lake level, and some drumlins have been exhumed from their cover of lake sediments. Stream-terrace deposits are at least as high as 180 feet on a tributary near Porter Lake and may reach 165 feet near Freshwater Brook.

The postglacial Connecticut River occupies a channel that is bordered by Triassic bedrock west of Porter Lake, and flows on or near a bedrock floor from near the Connecticut State Line southward. The preglacial channel of the Connecticut is about 2 miles east of the present river at the south edge of the quadrangle.

In postglacial time, after the Connecticut River left the high terraces, vegetation was scarce enough on the dry sands to allow winds from the north to produce complex transverse and longitudinal sand dunes. Some dunes are well developed on the older delta, but most of the massive dunes, as much as 55 feet high and 1½ miles long, are on the upper stream terrace. The dune forms are less distinct at some places near the south edge of the quadrangle, and they grade into a sandy eolian cover (Colton, 1965) difficult to distinguish from the terrace sands.

Ventifacts occur on the stratified drift where crystalline pebbles are found; they are generally small, well polished, slightly pitted and fluted, but rarely faceted. Numerous ventifacts were found in the base of the transverse dune just south of Brainard Road.

The lowest and youngest geologic features in the area are the flood plains of the Westfield and Connecticut Rivers and numerous small streams. The greatest recorded flood in this area was in March 1936, when the water flooded over almost all the area mapped as alluvium; the crest of that flood was recorded as 64.5 feet above sea level at South End Bridge.

ECONOMIC RESOURCES

Portland Arkose.—Sixteen known abandoned quarries in the Portland Arkose (formerly called the Longmeadow Sandstone) are evidence of the decline of the popularity of "brownstone" as an architectural material. Few Connecticut Valley quarries are working today, but two in the quadrangle have recently become more active; one long-abandoned quarry, Redstone Lake, was reopened in 1966. The other operating quarry is between Pleasant and Main Streets, East Longmeadow.

Till.—Till, locally called hardpan or boulder clay, is relatively thin except in drumlins and is useful as fill for general construction. Commonly the upper few feet of till are less compact. The more compact till is impermeable and is suitable for cores for earthfill dams. Boulders are common in both varieties.

Clay deposits.—Varved clay suitable for brick making, and probably for lightweight aggregate, is widespread over the central part of the quadrangle but is difficult to work, except where erosion has cut through the lateglacial and postglacial sand and exposed the clay along valley walls.

Old clay pits, which include several small ones on Porter Lake and one in the J. L. Sullivan Playground in Springfield, have long been abandoned.

Sand and gravel deposits.—Sand, with minor amounts of gravel, consitutes the most important available mineral resource. The upper layers of the terraces and the deltas are composed of sand more than 75 feet thick in places. The sediments are coarser upstream and contain more pebbles and some cobbles.

The ice-contact stratified drift is generally coarser than the deltas and stream terraces.

Sand dunes are the largest single source of sand. They contain very well sorted (poorly graded), mostly medium sand.

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