THAMES RIVER TERRACES IN CONNECTICUT

BY F. P. GULLIVER

Dana classed the terraces on the sides of the drowned valley of the Thames river, Connecticut, as fluviatile deposits of the Champlain period, and thus considered that they were formed as floodplains in a greatly expanded river, their summits marking the greatest height reached by the floods from the fast melting ice-sheet. The writer has for some time considered the above hypothesis inadequate to account for the many forms assumed by the glacial waste at levels intermediate between the upper terrace and the present bed of the Thames river, particularly those typical eskers which today lie partly submerged in the waters of the estuary. Not until the recent cuts, made for the new line of the New York, New Haven and Hartford railroad in eastern Connecticut, along the east bank of the Thames river between Norwich and New London, had revealed the delta structure of these flat-topped deposits lying against the steep sides of this valley, which had been developed to adolescence before the depression of the land took place, was it possible to make out a more detailed history of the aggradation which occurred in this valley in Pleistocene time. The present paper outlines more in detail the method of this deposition.

The first question testing the flooded river hypothesis is whether these deposits form a uniform grade, rising gradually higher farther and farther upstream. Roughly, this is the fact. The terraces rise 10 to 15 feet above the river at New London and increase in height up the river until they are 90 to 100 feet above tide at Norwich. These level-topped deposits are not continuous, however, and a series of accurate levels run up the river might show that these deposits belong to more than one system and do not fall into one grade.*

At several points along the river there are typical eskers which do not rise to the level of the flat-topped deposits. These present to the eye the characteristic ridge, with steep sides and curving first to the right and then to the left, which has generally been recognized as a constructional form produced by glacial rivers at a late stage in the melting of the ice. A very good example is found about 3 miles below Norwich, on the east side of the river, opposite the little Indian village called Mohegan. The unsubmerged portion of this esker has been used by the railroad, as a part of its embankment, in crossing one of the numerous coves which resulted from the drowning of the Thames valley. The summit of this esker is in places more than 80 feet beneath the level of the gravel plain less than a mile to the north. This gravel ridge has the typical constructional esker form, as if the glacier had left it but a few weeks ago; therefore it is very difficult to conceive that a flooded river could have built a floodplain 80 feet above this deposit without obliterating its ridge-like form.

Two miles above the United States naval station there was another short esker, some 30 feet below the level of the terrace at this point on the river, which has been almost entirely removed by the engineers to fill in across one of the deep side valleys. The bottom at this place was found to be covered with very fine mud, which slid to one side when rock and gravel were piled on top, so that a great deal of material was used, thus nearly obliterating the little esker that played a most important part in the history of the deposits now to be discussed.

*See paper by F. B. Koons, Am. Jour. Sci., 1882, p. 425.

Another difficulty with the hypothesis of a flooded river is that these terraces have numerous depressions, 10 to 15 feet in depth, which are very similar in form to kettleholes seen in sandplains in other parts of New England. These kettleholes would suggest that ice was probably present when the deposits were being built up, the sand having been washed around ice blocks.

The cuts made at the navy yard will now be considered. In order that there should be no grade crossings at this point, the road leading from the highway toward the river was cut below the level of the track. At this point, therefore, the sections were exposed much deeper into the terrace than at any other place, and the writer was so fortunate as to obtain a number of photographs of these cuts before the banks were sloped back to make the sides of the road. Four of these are here reproduced. They all show delta structure.

Figure 1 of plate 53 is a general view looking south across the cut for the road. The granite blocks lie on the level where the railroad now runs, the cut for which through the overlying deposits may be seen to the right of the cart. These overlying deposits are some 10 feet thick and made up of coarse gravel and sand in nearly horizontal layers, and are typical top-set beds of a glacial delta. At the place where the view is taken they have been removed almost entirely, leaving the fore-set beds beneath them. This photograph is taken where the fore-set beds from one lobe merge into those of another lobe of the delta, the upper portions of all the layers being cut off by the succeeding top-set beds, a small portion of which had fortunately not been removed when the view was taken.

Figure 2 of plate 53 is taken in the cut looking north at southward-dipping fore-set beds, the water-laid character of which is evident from a glance at the structure as shown in the photograph. A few inches of the top-set beds are shown here also just beneath the small house.

Figure 1 of plate 54 is also taken in the cut, but looking eastward, and therefore at right angles to the general direction of water and ice flow down the valley. The connection of the top-set with the fore-set beds is here very clearly shown, in places continuous with them and in places cutting off the tops of the previously laid fore-sets. The delta character of this deposit is here unmistakable, and this is in a region where the flat-topped deposit laps up against the till-covered slopes of the sides of the valley in a manner strongly to suggest the terrace origin.

Figure 2, plate 54, is taken at the extreme eastern end of the cut and shows the better stratified deposits overlying the less stratified deposits at the edge of the delta-terrace, where the stratified drift ends and the unstratified drift begins. Less than 20 feet east of where this photograph is taken, there is unmistakable till. Along the margin of the terrace at this point the sections show, mixed with the less stratified water-worn material, some more angular rock waste that is morainal in character. This point would thus appear to have been an ice-margin at a time immediately preceding that of delta-building. This deposit would indicate that there was a tongue of ice extending down the valley with its margin at this point when the water from the melting glacier came out farther down the valley, perhaps at New London; and that a little later, when the tongue did not quite fill the valley, a glacial delta was built at this point, filling in completely the space between the ice and the valley side. The stream which supplied this waste was some 2 miles above the navy yard, as is indicated by the esker mentioned above. For the method of building up of this deposit the reader is referred to Professor Russell's account of the Malaspina glacier.*

* Nat. Geog. Mag., vol. iii, 1891, pp. 106-109.

There are no lobes pointing downstream in the direction of ice and water movement, as one would be led to expect from a study of New England sandplains; * but the position of all the eskers at the side of the valley indicates that the ice was in the center of the valley, and if the waste was sufficient to fill in all the space between the ice and the valley sides, as the deposit at the navy yard seems to show, there would have been no chance for the formation of lobes.

Although there are no lobes at the navy yard, the writer found several places along the river where tributaries enter, which were not completely filled in by waste from the ice-tongue to valley margin, and here the typical lobe form was found. One of the best examples is seen at Poquetannock cove, on the east side of the river, where there is a large amount of washed drift, on the eastern margin of which there are a number of well developed lobes which point eastward, as if formed by streams flowing from an ice tongue in the center of the river.

The ice-contact slope or moraine terrace is the steep slope of these flat-topped deposits which now faces the Thames river, if the above outlined delta hypothesis is to replace the floodplain hypothesis. It would then follow that the washed drift in this valley had been very slightly altered in form since the last retreat of the ice. In all points where man has not materially changed the aspect of these terrace slopes the form seems to the writer to be better explained as an ice-contact slope than in any other way. In a number of places boulders are found on these steep slopes facing the river, the position of which is easy to explain if we conceive a contiguous ice-margin from which they might have fallen; but it is impossible to see how they could stand where they do if the edge of this deposit is the result of erosion.

There are many other interesting features about these Thames River deposits, such as the rock hill at Montville, around which the ice flowed in two streams, forming two sets of terraces, the sandplain at Montville, or the extensive plains at Norwich, which should all be described in making out the history of this region in the way it has been done for Narragansett bay.† The field survey for this work has not been completed yet, so the details of the history of these deposits is not here given. Enough facts have been mentioned to show that these delta-terraces were formed when the ice was present in the drowned valley, and the suggestion is made that the structure of other so-called glacial terraces be examined to see if they were not similarly formed. There are undoubted fluviatile terraces,‡ and these should be discriminated from such delta-terraces as are here described.

A most interesting question is the water level shown by these delta deposits. It may be the sealevel, in which case a tilting of the land is shown by these Thames River deposits, the greater elevation being inland; it may be a series of lakes, as has been suggested by Mr Robert Chalmers, § or it may be that there was a blocking up of the valley at New London by ice or rock waste or both, and that as the ice melted first from the sides of the valley it left water bodies on each side of an ice-tongue, and that the streams from this tongue built out their deltas into this water on either side. From the facts known at present it is not possible to say just which condition prevailed in the Thames valley.

* W. M. Davis, in Bull. Geol. Soc. Am., vol. i, 188-, pp. 195-202. F. P. Gulliver, in Chicago Jour. of Geol., vol. i, 1893, pp. 803-812.

† J. B. Woodworth, in Am. Geologist, vol. xviii, 1896, pp. 150-168.

‡ See paper by R. E. Dodge, in Proc. Boston Soc. Nat. Hist., vol. xxvi, 1894, pp. 257-273.

§ Ann. Rep. Geol. and Nat. Hist. Survey of Canada, vol. iv, 1888, p. 61.

FIGURE 1.—GENERAL VIEW OF CUT AT NAVY YARD, LOOKING SOUTH

FIGURE 2.—VIEW AT NAVY YARD CUT, LOOKING NORTH

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FIGURE 1.—NAVY YARD CUT, LOOKING EAST

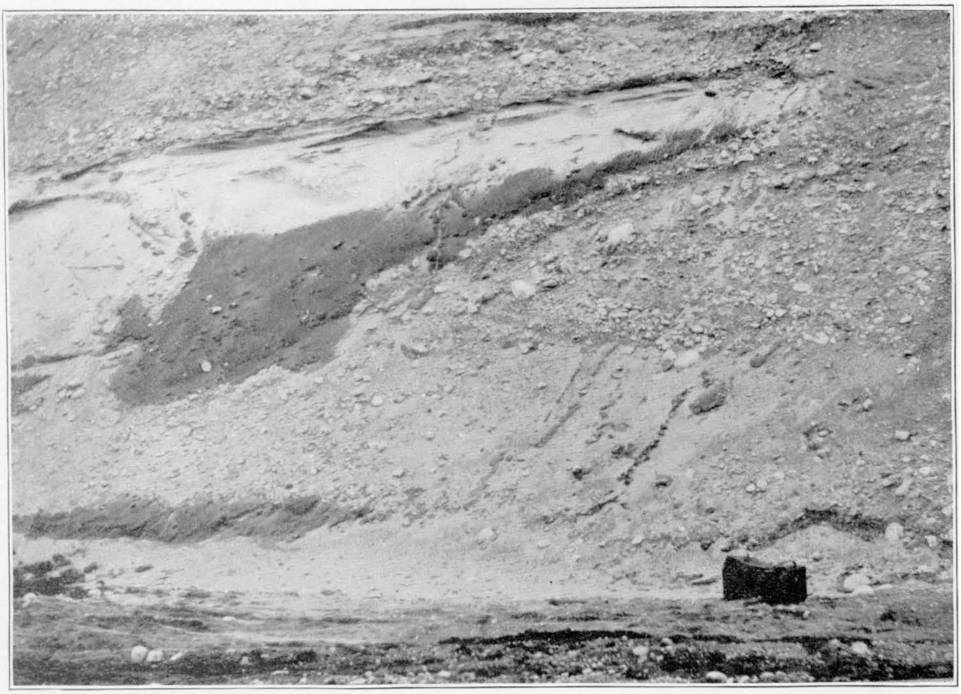

FIGURE 2.—EASTERN END OF NAVY YARD CUT, LOOKING NORTHEAST

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