LETTERS TO THE EDITORS

GEOMORPHOLOGY

Bedrock Corrosion and Drainage Initiation by Seepage Moisture on a Gritstone Escarpment in Derbyshire

A SURVEY has been made of the podsolized soils, the morphology and the drainage of the areas known as Matlock Moor, Farley Moor, Tower Moor and Blackbrook Moor, which together form the larger part of the upper reaches or 'source basin' of the Bentley Brook, a tributary of the Derbyshire Derwent[1].

Observations have been made which show the corrosive action upon the underlying bedrock of water seeping through a 2-ft. deep layer of sandy colluvial material occupying a seepage hollow at the head of the brook. Such water, slow-moving, and with an appreciable content of humus, seeping vertically on to the bedrock, has corroded it to depths of 18–22 in. The layers below 18 in. in the whole profile are permanently wet and have been so even in the dry summer of 1959. The upper mineral layers of the profile are lacking in particles finer than 0·06 mm.; but it is not yet certain whether such particles are removed by normal vertical seepage to be redeposited at lower levels, or are removed by lateral movement of soil water, near the surface, in the wettest periods of the year.

Other observations provide evidence of the processes associated with the initiation of a semi-dendritic drainage pattern on a dip-slope, of less than 5°, adjacent to the hollow, and on the scarp slope to the west, overlooking the Sydnope valley. Integrated narrow seepage lines express themselves as over-deepenings of the solum upon such slopes, though there is no surface indication of their presence. A close grid of augerings across and along them shows significant changes of soil profile morphology both within the seepage lines and on the areas between them. These seepage lines link up with visible surface drainage at lower levels.

These two types of seepage action which affect the bedrock on the watershed between opposing dip and scarp streams do not suffice to break the crest of the escarpment. As a result of their headward extension, the seepage catchment of the watershed area becomes so small that the processes of corrosion and overdeepening can no longer continue except at some point downslope where enough moisture can assemble. Hence the crest is exhumed to form a rock platform on which tors may develop wherever the wide spacing of the master joints permits their survival.

The observation that a rock platform on the watershed between two opposing drainage systems may not only be preserved, but may actually broaden by exhumation, calls for a reappraisal of the current ideas on col-formation in the normal cycle of erosion, at least on uniformly hard rocks. It also leads to a hypothesis of tor formation applicable to some of the tors of the southern Pennines. The tors in question are formed during the gradual emergence of crestal rock platforms from adjacent bands of corroded bedrock and colluvial material. These successive bands form Penck's convex and intermediate slopes[2], although they are produced by seepage, not by drainage in visible channels.

The colluvium merges into a band of thin soils which then merges downslope into a mass of valley-head peat wherein the permanent source of integrated drainage is found. The peat often rests upon the rock identical with that of the tor. The rock is pierced in a pronounced knickpoint by the stream, which flows down over lower gritstone beds and intervening partings of shale before entering the wide main valley which is cut in the dominantly shaly rocks below the lowest grit and above the limestone

There exists a possibility of assessing the period of time necessary to exhume these tor features. Most of them are 14–16 ft. in height. Young's estimate of surface lowering of the whole area of a small drainage basin, 17 miles to the north of the area considered here, is 0·005 in. per annum[3]. If one assumes a height of 15 ft. and that the tops of the tor features have not been lowered by weathering, then the time at which they began to be exhumed should be 36,000 years ago—a date which closely corresponds to the waning of the York glacier[4].

A more detailed account of this work will appear elsewhere. My thanks are due to Dr. G. Dury and Mr. R. A. G. Savigear for their comments and advice. This work has been supported in part by a grant from the Central Research Fund of the University of London.

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[1] Ordnance Survey, 1-inch map, 7th edit., Sheet 111, Buxton and Matlock (*SK*/3063).

[2] Penck, W., "Morphological Analysis of Landforms", 211 (Macmillan, 1953).

[3] Young, Anthony, *Proc. Yorks. Geol. Soc.*, **31**, 2, 149 (1957).

[4] Flint, R. F., "Glacial and Pleistocene Geology", 395 (Wiley, New York, 1957).

GEOLOGY

Mid-Tertiary Stratigraphical Palæontology

IN the course of extensive economic palæontological researches based on world-wide investigations, it has been found necessary to review and re-assess the bases of mid-Tertiary correlation and dating. We confirm the validity of the five-fold subdivision of the Oligocene and Lower Miocene as represented by the faunas of the type localities of the Lattorfian, Rupelian, Chattian, Aquitanian and Burdigalian. These five faunal assemblages can readily be correlated through to Southern Europe, the Mediterranean, the Middle East, East Africa, Pakistan and India, and the Far East as a whole.

Although the classical type assemblages are mainly developed in a molluscan–echinoid facies we confirm that it is possible to correlate these facies with beds in Southern Europe, which also contain important and characteristic foraminiferal faunas which can readily be followed through to the Far East, notwith-