198°. Finally, there is a remarkable patch of *Calluna* on the embankment itself, the slope being 33° and the compass bearing 203°; the slope must have been steeper when this embankment was built out of chalk rubble.

It seems, therefore, that chalk heaths may arise not merely on plateaux but also on slopes, especially those facing the prevailing south-west winds, and that they may be found on places which must have been under cultivation about two thousand years ago, or about fifteen hundred years ago, or even more recently. The shallow undisturbed soils would be porous through the growth and decay of plant roots and through the activities of burrowing insects and other small animals. If the calcium ions have moved down through the soil in solution by the rain, is it not possible also that the finer soil particles, less than 0·03 mm. in diameter, may have moved down in suspension? May not the physical composition of the soil, as well as its chemical composition, be due to leaching rather than to deposition? Is sorting and deposition by water ruled out? Did solifluxion (as this term is now generally used) cease at the end of the Pleistocene?

It is hoped to write an account of the relict heath patches on the South Downs and in other chalk areas of south England, for the *Calluna* is now becoming obvious in places where formerly it was closely grazed by rabbits.

A. S. Thomas

Nature Conservancy,
19 Belgrave Square,
London, S.W.1.

[1] Perrin, R. M. S., *Nature*, **178**, 31 (1956).
[2] Curwen, E. C., "The Archæology of Sussex", 212 (1954).

The object of the work reported in my previous communication was simply to determine whether the soils on some well-developed chalk heaths could have been formed purely by solution of chalk. The areas chosen were Old Winchester Hill, Butser Hill, Manor Farm Down and Lullington Heath, since they appeared to conform to Tansley's original definition of chalk heath and in each case the association was well established in spite of heavy rabbit-grazing.

Since all the soils that have so far been examined lie on sharp crests or gentle slopes adjacent to steep slopes, it is very probable that they would have been left as bare chalk surfaces at the end of the Pleistocene. Now combination of analyses of chalk drainage waters with percolation data can give a rough estimate of the maximum probable rate of accumulation of chalk residues since that time. It is found that, although on some sites the depth of soil is fortuitously consistent with the calculated rate of formation, in other areas (for example, Old Winchester Hill) it appears to be too great. If, as suggested by Dr. Thomas, solifluxion did not cease at the end of the Pleistocene, it is even less likely that chalk residues would have accumulated to the observed soil-depth.

Consideration of the relief of these sites and of the geomorphological history of the South Downs shows that deposition by water is very unlikely to have occurred since Upper Pliocene or Lower Pleistocene times. Such deposits, if they ever existed, would have been very susceptible in these exposed situations to the subsequent peri-glacial conditions.

Apart from the mineralogical composition of the sand fractions, which seems to show conclusively that the soils are not derived from chalk, it is difficult to see how the observed degree of mechanical sorting could be caused by leaching of chalk residues. There is no reason why movement should commence with particles of 30μ diameter, and the eluviation of fine sand and silt particles, which are not even of colloidal dimensions, is scarcely to be compared with that of calcium ions in true solution. Mechanical eluviation in soil profiles is probably confined to dispersed colloids of less than 0·1μ equivalent settling diameter. Even this type of movement does not appear to occur in chalk heath soils, since there is no textural *B* horizon in either the solum or the underlying chalk. Analogy with other leached soils overlying chalk or calcareous drifts indicates that if such a horizon existed it would be found resting sharply on the calcareous surface.

The simplest explanation that fits all the facts is that the development of acidity in these soils has been facilitated by blanketing with wind-borne dusts carrying relatively small amounts of $CaCO_3$. This hypothesis is supported by the close resemblance of the mechanical composition curves to those of typical loesses in, for example, France, Belgium, Germany and the United States. Material of this type was certainly deposited in Britain early in Post-Glacial time, and preliminary analyses of soils from earth-works on the Chalk suggest that deposition continued even after the Bronze Age. It might perhaps still occur to-day in exceptionally dry, windy seasons. It is, of course, quite possible that an originally wind-sorted material may later have been locally re-deposited by water as hill-wash.

Cultivation clearly could not significantly affect the mechanical and mineralogical compositions of the sand fractions. Apart from turning up chalk, and so locally delaying the onset of acidity, its main effect would be to accentuate colluviation and thus lead to the deepening of the soils on the lower sides of fields. It is quite likely that on such soils chalk heath might develop more easily, as suggested by Dr. Thomas. The fact remains, however, that these soils cannot be considered to result from the solution of chalk.

R. M. S. Perrin

School of Agriculture,
Cambridge.

Identification of Coffinite in Radioactive Rocks of the Buller Gorge Region, New Zealand

Coffinite, the recently discovered hydroxy-uranous silicate, $U(SiO_4)_{1-x}(OH)_{4x}$[1], has been identified as an essential primary constituent of radioactive arkosic grits and siltstones of the lower Cretaceous Ohika Group[2] in the Buller Gorge region of the South Island of New Zealand. The identification is based on the characteristic X-ray pattern with lines at 4·68, 3·48, 2·66 and 1·78, and on the absence of thorium[1,3]. Fuller details will be published elsewhere.

J. J. Reed
N.Z. Geological Survey,
Wellington, New Zealand.

G. G. Claridge
Soil Bureau,
Wellington, New Zealand.

Dec. 12.

[1] Steiff, L. R., Stern, T. W., and Sherwood, A. M., *Science*, **121**, 608 (1955).
[2] Wellman, H. W., *N. Z. J. Sci. Tech.*, **32**, B (No. 3), 11 (1950).
[3] Weeks, A. D., and Thompson, M. E., *U.S. Geol. Surv. Bull.*, **1009** B, 31 (1954). Gruner, J. W., U.S. Atomic Energy Comm. Tech. Inf. Service, Oak Ridge, Tenn., *RME*-3020, 16 (1955).