CYLINDRICAL TAPERING STRUCTURES IN THE ALLUVIAL SANDS OF THE TRENT VALLEY

by

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Summary

Some structures produced by growth and decay of plants, and modified by percolating groundwater, are described. These structures provide a further method by which the way up of deformed strata may be determined.

Introduction

During the summer of 1968, examination of the gravel pits at Holme Pierrepont, Nottinghamshire (SK 625395) revealed that, overlying the gravels, there are 2-4 metres of loose friable sand, in turn overlain by silt up to 1 metre thick. At a number of localities in the sands, bright red, iron stained and cemented vertical cylindrical tapering structures are developed. These structures are absent from the overlying silts and also from the gravels below.

Description and Origin of the Structures

In all the exposures examined, the cylindrical structures were discontinuous. The observed sections are 2-8 c.m. long, but several short lengths are frequently seen to be aligned vertically through the sand faces; it is evident that they are parts of once continuous structures up to a maximum of 3 metres long.

The thickness of the structures is very variable. The maximum diameter observed was 14 mm. and the minimum was 4 mm. In all cases, the structures taper downwards, and they terminated with a conical point (Plate 19). In many cases, the structures are solid and are made up of the normal sandy deposit of the area, which has been cemented by a secondary iron oxide cement, giving rise to the bright red. colour. The iron oxide is present as a coating to the grains and does not render the material non-porous by filling in spaces between the grains. In fact, the structures at present exposed are extremely friable and it is very difficult to extract them from the sand. In other cases, the iron cemented structures have a central hollow core, which tapers downwards in the same way as the external form of the structure does. When there is a central hollow, it often contains traces of black carbonaceous material. The structures do not branch in any way.

The tubular structures are not evident in the silt above the clay; however, in these silts there are often dead roots of thistles and these are, in many cases, in alignment with the tubular structures developed in the sands below. The roots have not been observed extending into the tubular structures, though living roots can be seen at several localities extending down into the sands. The black carbonaceous material inside some of the hollow tubes is considered to be the decay products of long-dead roots.

The origin of the tubular structures is considered to begin with downward penetration of a major root, probably of the thistle (Cirsium lanceolatus), which is the plant around the gravel pits that produces the deepest-penetrating observable roots. During growth, this root structure produces and fills a hole, but after death of the plant, the root first shrinks and contracts away from the hole that it has forced in the sand, and then decays to give the black organic residue observed. As the root contracts, the sides of the progressively fall in after it; and at the same time, iron-bearing ground waters can enter the hole. Where decay of the root is rapid after shrinking, the hole becomes filled with sand before cementation. However, if the root shrinks and then persists without immediate decay, iron cementation from the percolating ground waters may sufficiently consolidate the sand to prevent further collapse into the hole after the root does decay, thus producing the structures with a central hollow. It is considered that the biochemical action of the decaying plant root is a possible factor which causes the precipitation of iron materials from the ground water: this is perhaps combined with evaporation due to the fact that the intergranular water of the sands is entering comparatively large open spaces around the roots, which may be in free access with the air when the root decays. Iron oxide deposition extends outwards for several millimetres beyond the original limit of the root. The tubular iron cemented structures are absent from the silts above the sands because these sediments are above the general level of the water table in this area; they are absent from the gravels below because the original roots did not penetrate to the gravels.

Conclusions

Fossilised roots and stems have long been used as way up criteria in areas of deformed sedimentary rocks and descriptions of in situ fossil trees with root systems are common. A selected bibliography of occurrence of this type from rocks of widely different ages is given by Shrock (1948, p.293). Almost exclusively these examples involve fossil remains in which the original botanical features are preserved by carbonisation or silicification, or by the formation of a cast after the original material disappears. Barrell (1913, p.462) has described and illustrated (op.cit. p.462, fig. 4) rootlet impressions on fracture surfaces in Upper Devonian argillaceous sandstones from the Appalachian Mountains. In this example, no trace of the original material is preserved but very clear impressions are present. Jenkins (1925, p.241) has described carbonaceous rootlets with calcareous linings, from lacustrine sands in the valley of the Pende Oreille River in Washington: he concludes that the dead rootlets acted as open channelways along which lime changed waters passed, precipitation of calcium carbonate taking place by evaporation during the drier season. There is no clear indication of the precise form of the structures, but in all of them the original rootlet is still present as a solid central core, and the calcite lining is a thin marginal structure.

In the example described here from the Trent Valley, a structure is developed which is dissimilar from the examples quoted above; it is larger than a cast or mould of the rootlet would have been, and it is not a thin sheath down the side of where the rootlet was originally, nor is it an impression. None of the structures of the roots are preserved, except for their tapering nature, and it is this latter factor which is of significance because it means that both the hole produced by the root, and the subsequent area of secondary iron cementation both taper downwards. This might be used in determining the way up of deformed strata in which similar structures are present.

PLATE 19 Cylindrical tapering structures from the alluvium of Holme Pierrepont, near Nottingham.

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