River Dane near Swettenham, Cheshire

[SJ 790 673], [SJ 800 665], [SJ 810 662] and [SJ 819 652]

Highlights

This reach includes mobile meanders and a Holocene river terrace sequence. Historical analysis and recent monitoring has shown bank erosion and deposition rates are high, and that the meanders tend to exhibit a sequence of development from simple to complex forms. The Holocene terraces indicate distinct phases of stability, aggradation and incision.

Introduction

The Dane is a piedmont river (*sensu* Newson, 1981) with a mixed gravel/sand/silt sediment load, the upper reaches of which are fed by a gritstone catchment in the south-west Pennines and the middle reaches of which have, since the decay of the Devensian Ice, become trenched through the glacial deposits of the Cheshire Plain into the underlying Triassic bedrock. The middle reaches of the river exhibit a well-developed modern· meander belt and a complex postglacial terrace sequence (Figure 4.17). There had been no major study of the fluvial landforms until Johnson (1969) attempted to correlate the terrace sequence with that of the Mersey. More recently, a series of studies, dominated by Hooke, have focused on meander geometry and channel change (Hooke and Harvey, 1983; Hooke, 1984a, 1985, 1986, 1987, 1996; Hooke and Redmond, 1992), and to a lesser extent on the Holocene terrace sequence (Harvey, 1985a; Hooke *et al.,* 1990). Work on the terrace sequence continues and Hooke continues to monitor contemporary meandering processes.

Description

Within the Dane valley between Somerford Hall and Pigeon Howe Clough, four sub-reaches of particular importance can be identified (Figure 4.17):

1. Downstream from Swettenham bridge. This reach includes a well-developed Late Pleistocene to Holocene terrace sequence, with some small sections exposed in the upper terrace sediments and excellent river bank exposures of the youngest terrace, including two sites from which three radiocarbon dates have been obtained (Hooke *et al.,* 1990). In the part of this reach between Swettenham Bridge and a point *c.* 700 m to the north-west is a complex series of bends, where development over the past 140 years demonstrates 'double-heading' and the initiation of new meander bends.
2. From Dane Edge upstream for *c.* 700 m. This reach includes the most rapidly changing bends and a major 20th century bend cutoff.
3. From Swettenham Hall upstream to Holly Banks (Figure 4.18). This reach is one of the rapidly migrating bends, but its real value lies in the lack of human interference. Undisturbed wetland habitat occurs in areas of recent channel migration.
4. Somerford Hall Reach. This reach includes active meander bends with very recent and historical cutoffs (Hooke, 1996; (Figure 4.19)). There are also good terrace sections, demonstrating the stratigraphic relationships between the main and lower terraces. Bend development to double-heading has been monitored in this reach (Hooke and Harvey, 1983; Hooke, 1996).

Interpretation

The middle reaches of the Dane valley have developed wholly during the Late Pleistocene and the Holocene. The river course was probably initiated as a meltwater channel during the recession of the main Devensian ice sheet, perhaps at *c. 16* 000 BP (Worsley, 1985; Harvey, 1985a). Since then it has trenched through the Devensian glacially-related sediments of this part of the Cheshire Plain into the underlying Triassic bedrock. This incision has been marked by the development

of a series of river terraces, an upper group of Late Pleistocene age correlating with the main terrace of the Mersey (Johnson, 1969).

There are two groups of younger terraces: the main terrace (Harvey, 1985a; Hooke *et al.,* 1990), composed largely of gravels and sands, apparently derived in part from the gritstone bedrock in the Dane headwater valley in the western part of the Peak District; and the extensive, youngest terrace which differs from the others in that it is composed dominantly of finer material, presumably related to soil erosion in the central part of the catchment, and clearly represents a major phase of recent aggradation. Mineral magnetic analyses (Hooke *et al.,* 1990) indicate a totally different sediment source than for the main terrace, and suggest a source area on Triassic derived material. Four radiocarbon dates from these deposits (Hooke *et al.,* 1990) indicate that dissection of the main terrace had taken place prior to *c.* 4000 BP and aggradation of the youngest terrace occurred post-1200 BP. Dissection of this youngest terrace has taken place only recently. Inset below the terrace is the modern floodplain, a first-generation floodplain, almost all of which postdates 1840 AD (Hooke and Harvey, 1983; Harvey, 1985a). The implication is that dissection of the terrace occurred not very long before this date. There are excellent sections in the terrace deposits at a number of locations within the area. Soil development differentiates between these two terraces and the floodplain surfaces (Hooke *et al.,* 1990).

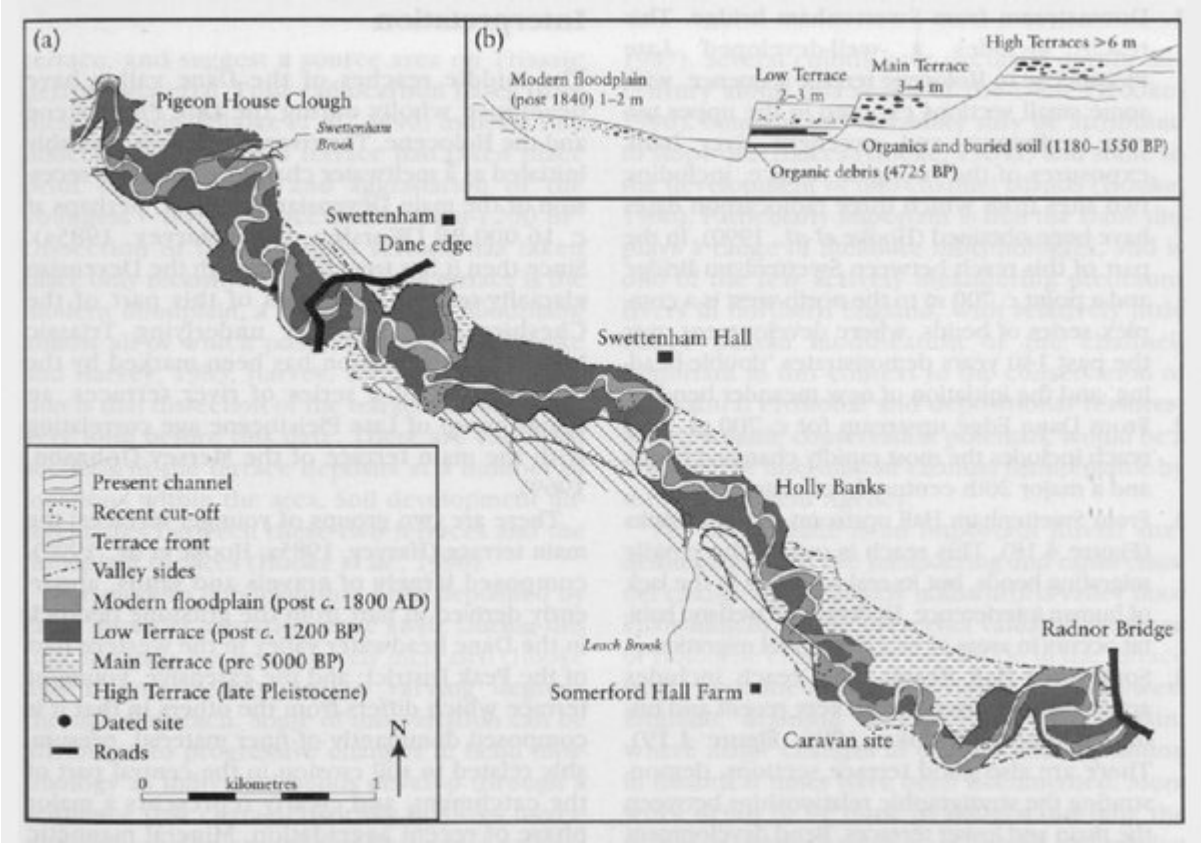
The modern floodplain has been deposited by rapid meander migration since 1840. During this time sinuosity has progressively increased (Hooke and Harvey, 1983), but to varying degrees through the reach. Some of this variation can be attributed to progressive changes in bend morphology as individual bends develop through a sequence that characteristically involves migration, followed by growth and finally by a process of double-heading whereby new bends are formed (Hooke and Harvey, 1983; Hooke, 1985, 1987). Several cutoffs have occurred during this century along this reach of the Dane (Hooke, 1996). Some of the variability may be attributed to slope differences (Hooke, 1984a) and some to the development of mid-channel islands (Hooke, 1986). Particularly important is that the Dane displays a range of meander morphologies, and is one of the few actively meandering piedmont rivers in northern England, with relatively little direct human modification of the channel. Important in this context to the conservation of the natural erosional and depositional features, and to wildlife conservation potential, would be a cessation of intermittent channel maintenance by the Environment Agency.

The River Dane is an important fluvial site, demonstrating active meandering and rapid channel change in a relatively undisturbed valley floor environment. It also preserves valuable evidence of Holocene erosion and deposition in the terrace suite. It is one of the few rivers in north-west England, draining an essentially rural basin, where major changes in erosion and deposition in historical times have been documented. More work needs to be done to understand fully the causes of these changes or to model and predict future meander development. The Dane forms an interesting comparison with neighbouring rivers where channel changes have been identified, but in drainage basins more directly affected by urban and industrial development (Knighton, 1972; Mosley, 1975a,b; Hooke, 1996).

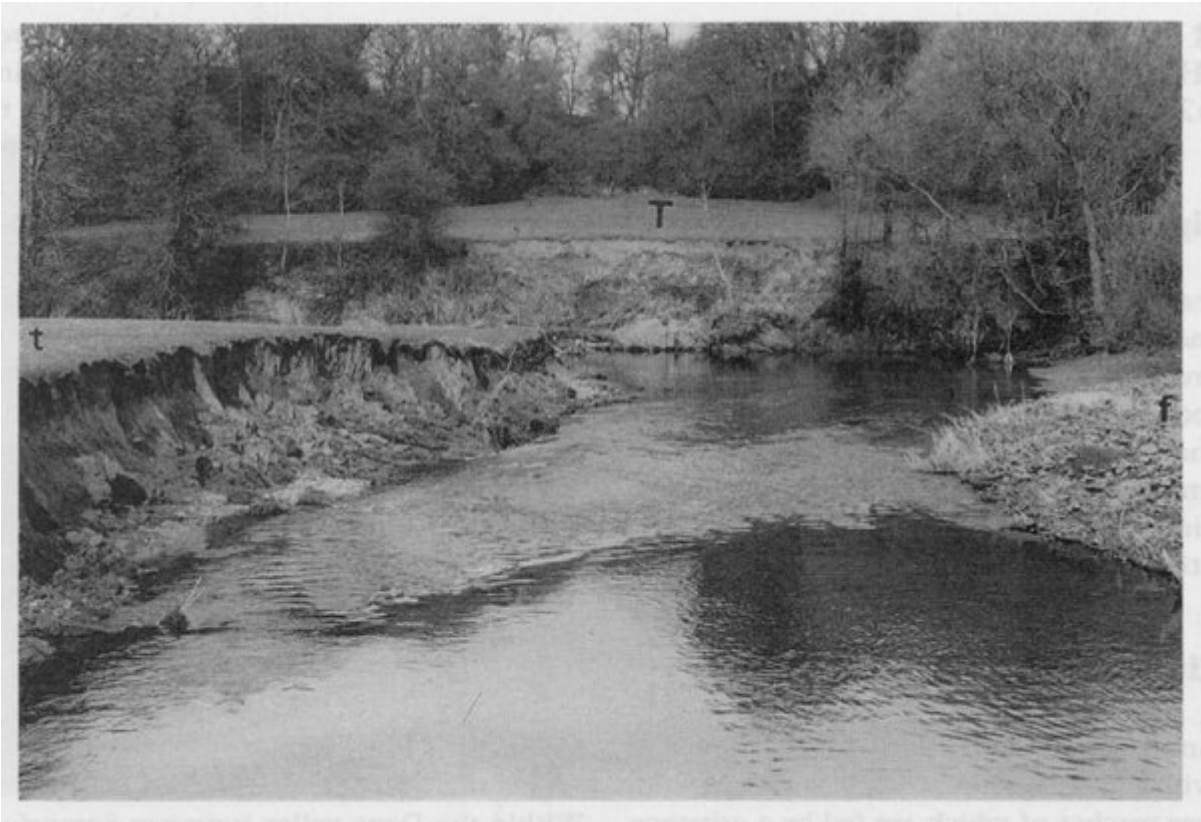
Conclusion

The middle Dane exhibits an excellent suite of active meanders, including a range of meander types at various stages of development. They have developed progressively since *c.* 1840 as the river dissected the low terrace and formed the modern floodplain. There is a well-preserved terrace sequence that contains an excellent record, in the sediments, of Late Pleistocene to modem fluvial development.

References



(Figure 4.17) River Dane: (a) geomorphological map. (From mapping by J.M. Hooke and A.M. Harvey.) (b) Stratigraphic relationships of dated site downstream Swettenham Bridge. (After Hooke et al., 1990.)



(Figure 4.18) The River Dane near Holly Banks, showing the main terrace (I), the low terrace (t), the modern flood-plain (f) and the meandering channel with a well developed pool-riffle sequence. (Photo: A.M. Harvey.)

(Figure 4.19) The River Dane near Somerford Hall, showing a very tight meander bend that has since developed into a cutoff. (Photo: A.M. Harvey.)