# River Axe at Axminster and Whitford, Devon

[SY 268 961] and [SY 287 979]

## Highlights

The River Axe provides an excellent example of contemporary river channel planform change for a lowland gravel-bedded river. Cartographic information and data from instrumented channel reaches illustrate how the downstream translation of meanders, changing sinuosity, and decreases in wavelength and in the radius of curvature can be observed.

## Introduction

Knowledge of the extent, nature and distribution of changes in channel pattern in Britain was particularly sparse 25 years ago, and the general impression amongst geomorphologists has probably been one of the stability of streams. Since that time much work on channel changes has been carried out in Britain, and this is one of the sites at which detailed documentation and measurement has been undertaken. The migration of meander bends is a characteristic feature of alluvial rivers and such downstream translation of meanders is one of the most conspicuous changes affecting fluvial landscapes. Local changes may occur whenever and wherever streamflow exceeds the threshold for erosion of the materials composing the banks of the channel. It is necessary to know exactly how meanders migrate and change in floodplains typically dominated by agriculture, and subject to capital works within and close to the channel.

## Description

From a study of over 400 bends on a number of rivers in Devon, Hooke (1977) found that 55% of the changes involved extension or translation, or their combination. In this study of the distribution and nature of changes in river channel patterns in Devon in a 100 year period, the River Axe illustrated types of distribution of channel movement. In (Figure 6.6), firstly, sections where the channel has simply translated downstream maintaining its planform or where the proportion of differential movement is very low, as at the Axminster site (see (Figure 6.8)) are shown; and secondly, sections where movement accompanied by change in the form and characteristics of the pattern has occurred, as at the Whitford site (see (Figure 6.7)): 40% of the channel length of the Axe has altered its course, while 17% has also changed in form. Many sections on the Axe have changed in character. If a river channel planform is translated by migration downstream, this autogenic change should maintain the exact size, shape and morphology of the channel pattern. However, there can be changes of size, shape or of composition of the planform, in contrast to the relatively stable pattern of lowland channels characteristic of many rivers in lowland Britain. The Axe is a relatively active river that demonstrates two particular types of mobility particularly well.

### Whitford Site

Here, the meanders are migrating down valley but lateral mobility of the river is constrained by the railway embankment (Figure 6.7). Meanders can be described as confined when they impinge against or are partly developed in media that alter the forms or rates of development from those found in local channel materials where such confinement is absent. In this case, maintenance and protection of the embankment prevents natural extension of the secondary lobe developed at the apex of the bend. Where confined, channel movements are typically dominated by down-valley migration. Bank erosion has been estimated as an average rate of 0.37 m $yr^{-1}$ over a two-year period and a maximum average rate of 0.96 m $yr^{-1}$; this compares with a cartographic estimate of 0.54 m $yr^{-1}$ for the same reach over a longer time period.

### Axminster Site

Near Axminster, individual meanders are developing *in situ* through lateral growth in an unconstrained situation (Figure 6.8). Unconfined meandering rivers display a degree of morphological regularity, e.g. meander wavelength is correlated with discharge, frequently being between 10 and 14 channel widths. Indeed, meander width, length, mean radius of curvature and channel width, from a wide variety of locations including alluvial rivers and supra-glacial streams, are closely interrelated. However, many meandering rivers are made up of a complex sequence of irregular and compound bends, such as the one at Whitford, and Ferguson (1976) concluded that whereas regularity reflects the dominance of hydrodynamic factors, irregularity reflects random topographical, sedimentological or artificial disturbances.

## Interpretation

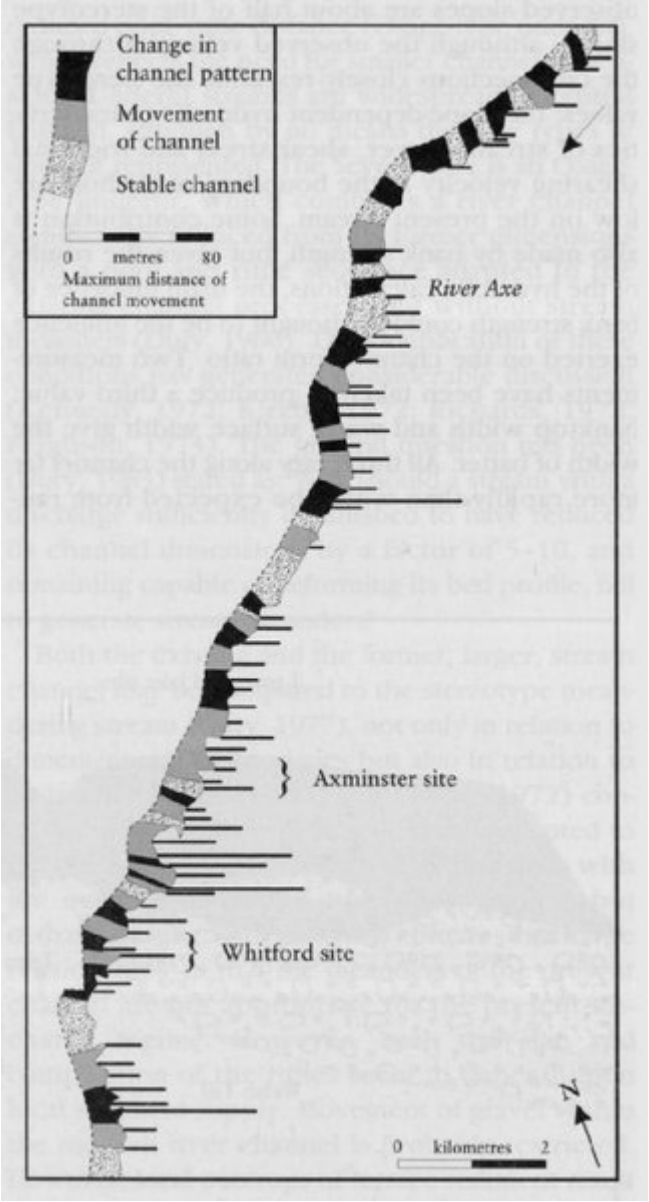
A distinction can be made between straight and meandering streams in that the latter are actively migrating as a result of selective bank erosion and point bar development. Their sinuosity is the product of this activity. Meandering requires relatively high stream power, which is usually intensified by secondary circulation to initiate selective bank erosion, although the detailed pattern will be distorted by topographical and sedimentary constraints. The creation of meander bends reduces channel gradient and lessens the rate of energy loss. A meander attains a more uniform rate of energy loss by the introduction of a form of energy loss not present in a straight channel, since along a curved path work is required to change the direction of flowing water.

Comparison of these two reaches — one confined and one unconfined — in both of which rates of erosion are relatively high and pattern changes over the past 150 years are quite large, allows variation in the mode and mechanisms of meander change to be examined. Together, the two sites clearly exemplify important features of lowland stream mobility and the effects of one fundamental control on river planform changes. Some examples of the impact of direct interference have been demonstrated on this river, but much of the channel is naturally mobile. The rivers in Devon are generally becoming more sinuous, moving by extension of bends, and decreasing in wavelength and radius of curvature, and sites such as these are of significance in understanding the effects of this development on the landscape, much of which is dominated by agriculture.

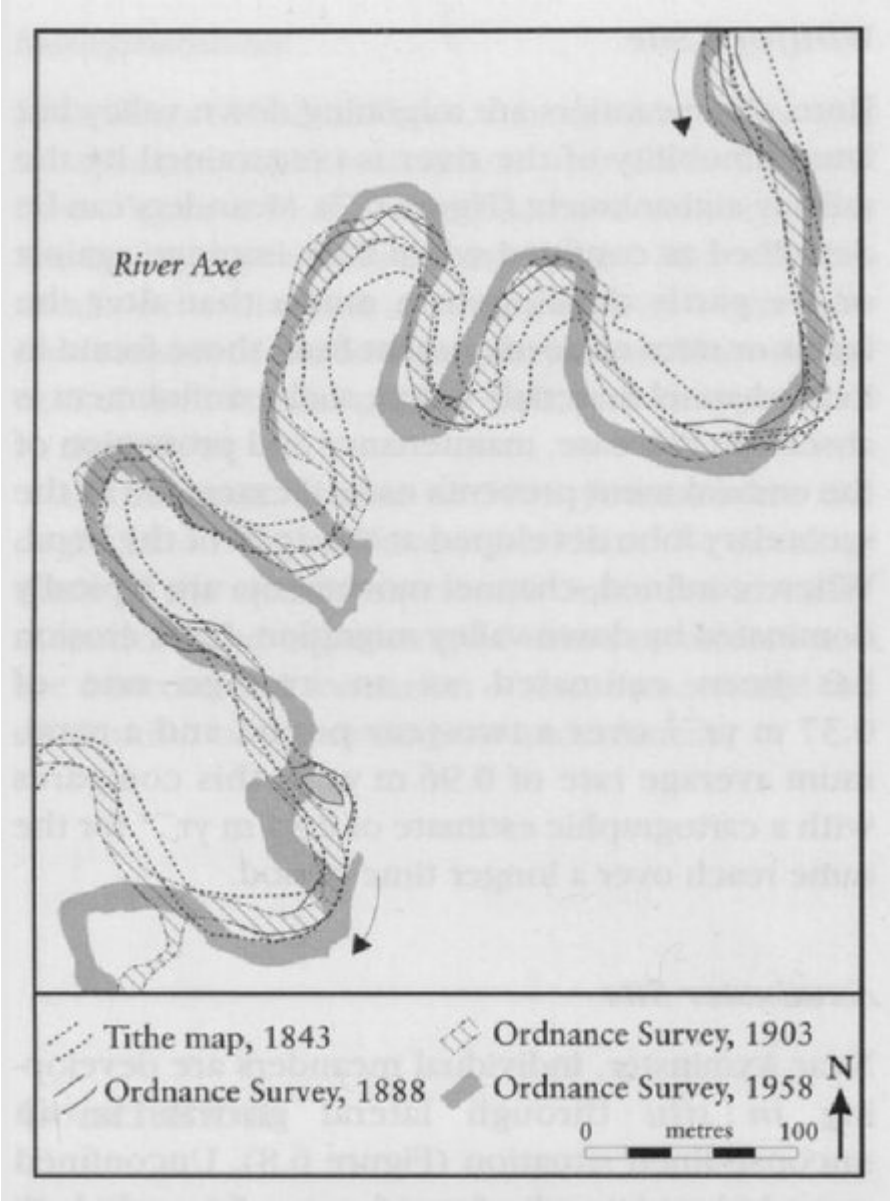
## Conclusion

This is a site on an active and mobile, lowland meandering river in which historical changes have been documented and processes of bank erosion measured. Two reaches within the site show contrasts in degree of confinement and in change in meander characteristics.

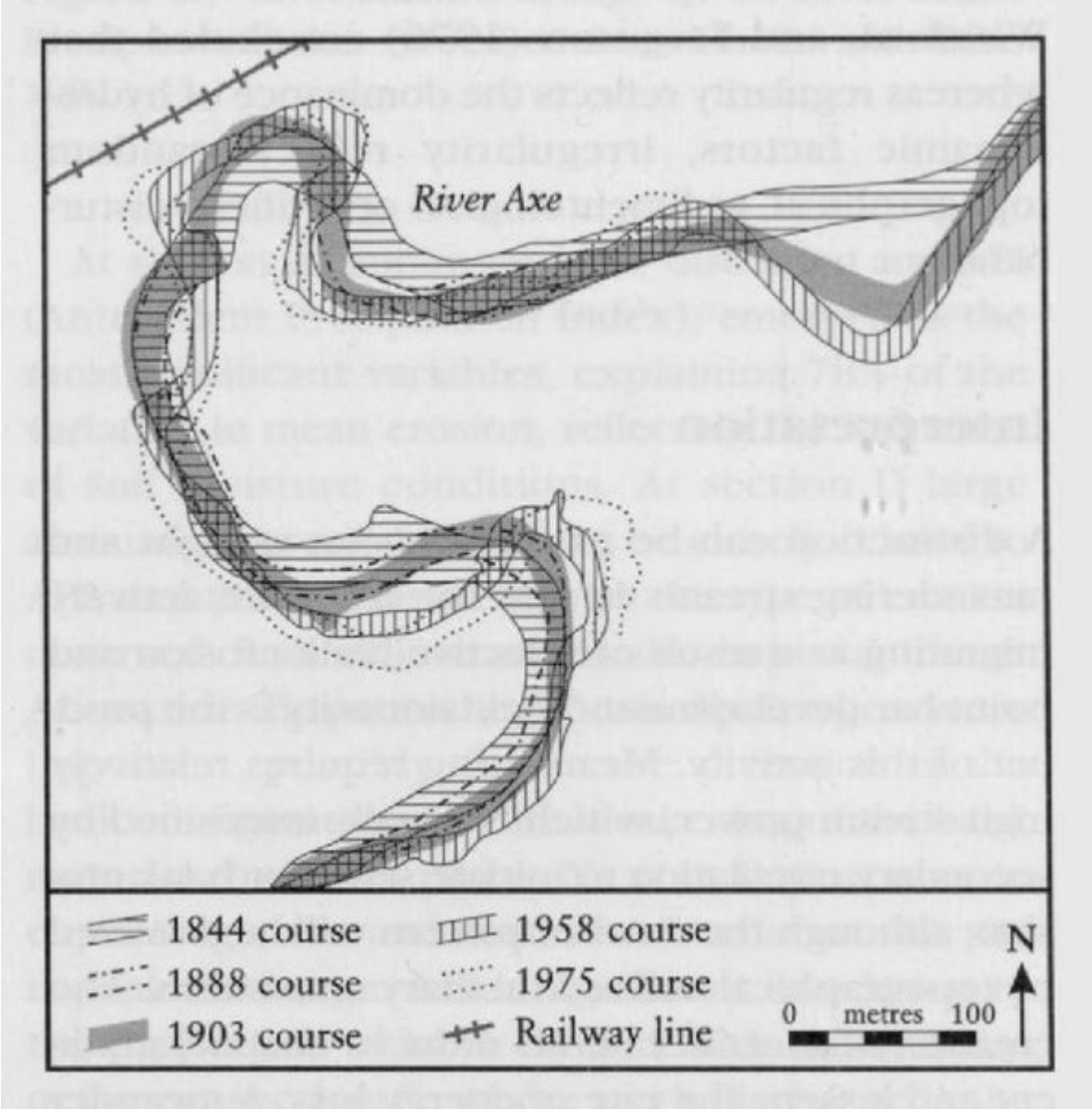
**References**




*(Figure 6.6) The distribution of channel movement along the River Axe. (After Hooke, 1977.)*




*(Figure 6.8) The changing channel pattern along the River Axe, near Axminster. (After Hooke, 1977.)*




*(Figure 6.7) The changing channel pattern along the River Axe, near Whitford. (After Hooke, 1977).*