River Itchen near Knightcote, Warwickshire

[SP 404 558]

Highlights

The River Itchen at Knightcote represents an example of stream underfitness where the present channel cuts through the deposited alluvium of the former channel and is wholly contained within it. The site was the first of its kind to be distinguished.

Introduction

The Warwickshire Itchen was the first site to have been deliberately tested for the presence of a former channel, and has revealed more details than other sites. It is cut in impermeable alluvium underlain by impermeable solid rock, has not been extended or reduced by divide migration since the last glaciation, and is tectonically stable. The type features of winding valleys are well-developed throughout — large-scale sinuosity, steep slopes at the outside of valley bends, with gentle slopes on the inside, together with the small meanders of the existing stream.

Description

The Warwickshire Itchen is a tributary to the Leam which, in turn, flows into the Avon near Stratford. The valley was selected by Dury (1954) for investigation for its almost impermeable alluvium underlain by solid rock; for the fact that it has not been extended or reduced by divide separation since the last local glaciation; and because it is tectonically stable. In part the valley is incised and winding, while in part it is open and with low relief but still with valley windings (Figure 6.23).

The windings are best displayed where the valley is cut into a limestone shale series near the base of the Jurassic succession. The ribbon of alluvium that lines the valley bottom is for the most part sharply bounded by the valley walls. The type features of winding valleys are well-developed throughout; large-scale sinuosity, and steep slopes on the inside, together with the small meanders of the existing stream. The latter, as is commonly observed, are mostly not in contact with the valley walls at many points but instead are described in the alluvium.

It is important to note that three different reaches of the Itchen were investigated, necessarily at different distances from the present source of the stream. It was found that the dimensions of the mulled channel diminish headwards in about the same proportion as the dimensions of the existing channel. Hence the ratio between the respective widths of the two channels is the same throughout. The same ratio is given by a comparison of the radius of curvature of the valley bends and the existing stream meanders in a group of streams in the English Midlands.

First trial augurings in the valley of the Itchen revealed an abrupt transition from moist gleyed alluvium to dry shale or marl. The valley fills contain little material coarser than sand, consisting mainly of silt and clay, varied in places by peat, sapropel, tufa and maim (earthy, amorphous calcium carbonate).

On the Itchen, the sole consistent change in the vertical succession of alluvium is from dull-brown cloddy columnar or prismatic clayey silt at the top to moist, blue-grey, gleyed clayey silt in the lower part. When the first records were made, the significance of gleying was not fully taken into account, and the two types of deposit were recorded as distinct. Subsequently, it became clear that the difference is one between permanent waterlogging and seasonal waterlogging. In the absence of litho-logic change it is impossible to define the base of the present floodplain, although the base of the large channel lies well below the maximum depth of scour of present conditions. The bed is not scoured severely enough to permit the stream to reach the base of the underlying filled channel; nor does the present channel widen sufficiently to pro- vide the width to depth ratio which — on any reasonable view of channel form — would be needed if scour were to go down to the underlying bedrock.

Interpretation

The reduction of a stream to a manifestly underfit condition necessarily lengthens the trace and thus tends to reduce the slope. Lengthening must occur when stream meanders are added to the trace of valley meanders. To compensate fully for the lengthening, the vertical difference between source and mouth would need to increase in the same proportion. There is no scope for degradation at the downstream ends where levels are controlled by confluence or sea level, and all compensation would therefore need to be performed by infilling on the upper reaches. The depths of fill required by full compensation for lengthening of trace are great. However, no such deep fills are evident in the field. Indeed, the fills in some Cotswold head valleys are distinctly shallow. The fills on the Itchen increase in depth with distance downstream, and appear to do so regularly.

This stream was the first of a number which have been used to establish the widespread occurrence of underfit streams, to demonstrate that not all underfit streams need possess meandering channels at the present time, and to show that rearrangements of drainage do not constitute a general hypothesis to explain the facts of distribution and chronology of the stream shrinkage.

Subsurface exploration shows that manifestly underfit streams on the English Plain are characteristically underlain by large channels that wind round the bends of the valleys (e.g. (Figure 6.25)). They reach their greatest depths at or near the extremities of valley bends. The average ratio of width between the large channels and the present channels is 11.5: 1, (Dury, 1954).

Records for the Itchen River valley include this site and three other reaches that have been used to make a graphic comparison of bed width and drainage area. These indicate that the large channels can be traced far up the valleys. They also suggest that the disparity between bedwidth increases headwards, as the disparity between wavelengths will later be seen to do. The bedwidth ratio falls from 15 : 1 at 3 miles to 9 : 1 at 40 miles.

Three periods are critical for consideration of the development of underfit streams:

1. initiation of large meanders or large channels;
2. the onset of underfitness and the abandonment of large meanders or channels; and
3. the duration between times of initiation and abandonment.

Detailed studies of fossil pollen in southern England not only serve to confirm that reduction to underfitness post-dates the last glacial maximum but also show that channelling and filling went on long after 10 000–11 000 BP. Infilling of some channels in southern England during Zone V is referable to increasing dryness. As the floristic record demonstrates, this was a time of increasing cold which necessarily reduced evapotranspiration. Therefore the reduction of precipitation was great enough not merely to compensate for the influence on runoff of reduced temperatures, but also to promote stream shrinkage.

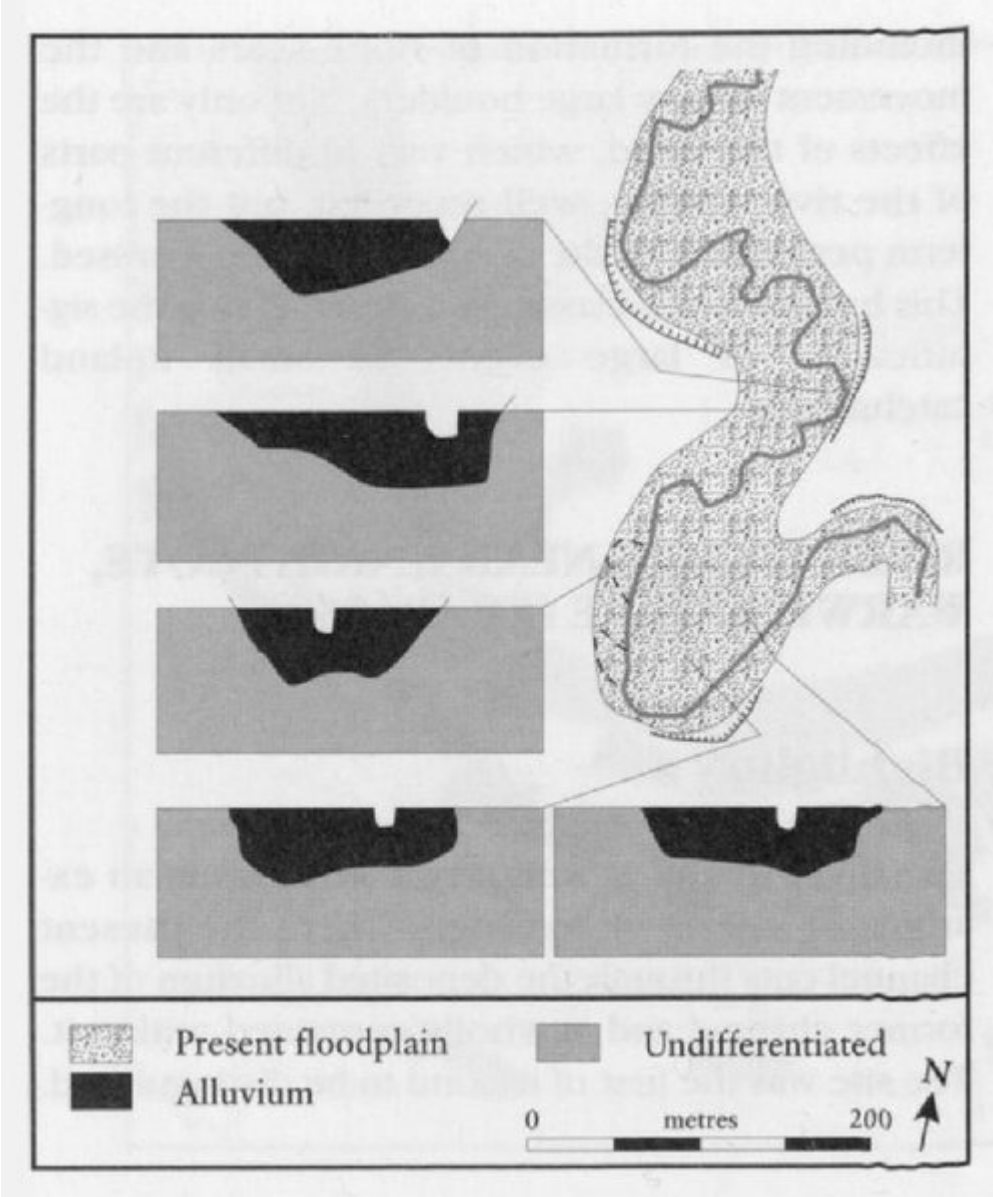
Data confirm that wavelength varies with the square root of discharge and support the contention that bankfull discharge of manifestly underfit streams has been reduced in proportion to the square of the reduction shown by meander wavelengths.

Dury began research involving subsurface exploration of the bottoms of valleys occupied by former manifest underfits. The first stream selected was the Warwickshire Itchen, which is very suitable, being on impermeable alluvium and impermeable solid rock, tectonically stable and not extended or reduced by divide migration. Discharge of meltwater cannot adequately explain the valley meanders of the Itchen. Not only does the stream flow towards the direction of the local ice front, but the valley meanders were still being shaped after the last local ice had disappeared, and after a whole interglacial and succeeding glacial had intervened. These conditions make the Itchen a classic representative of underfitness.

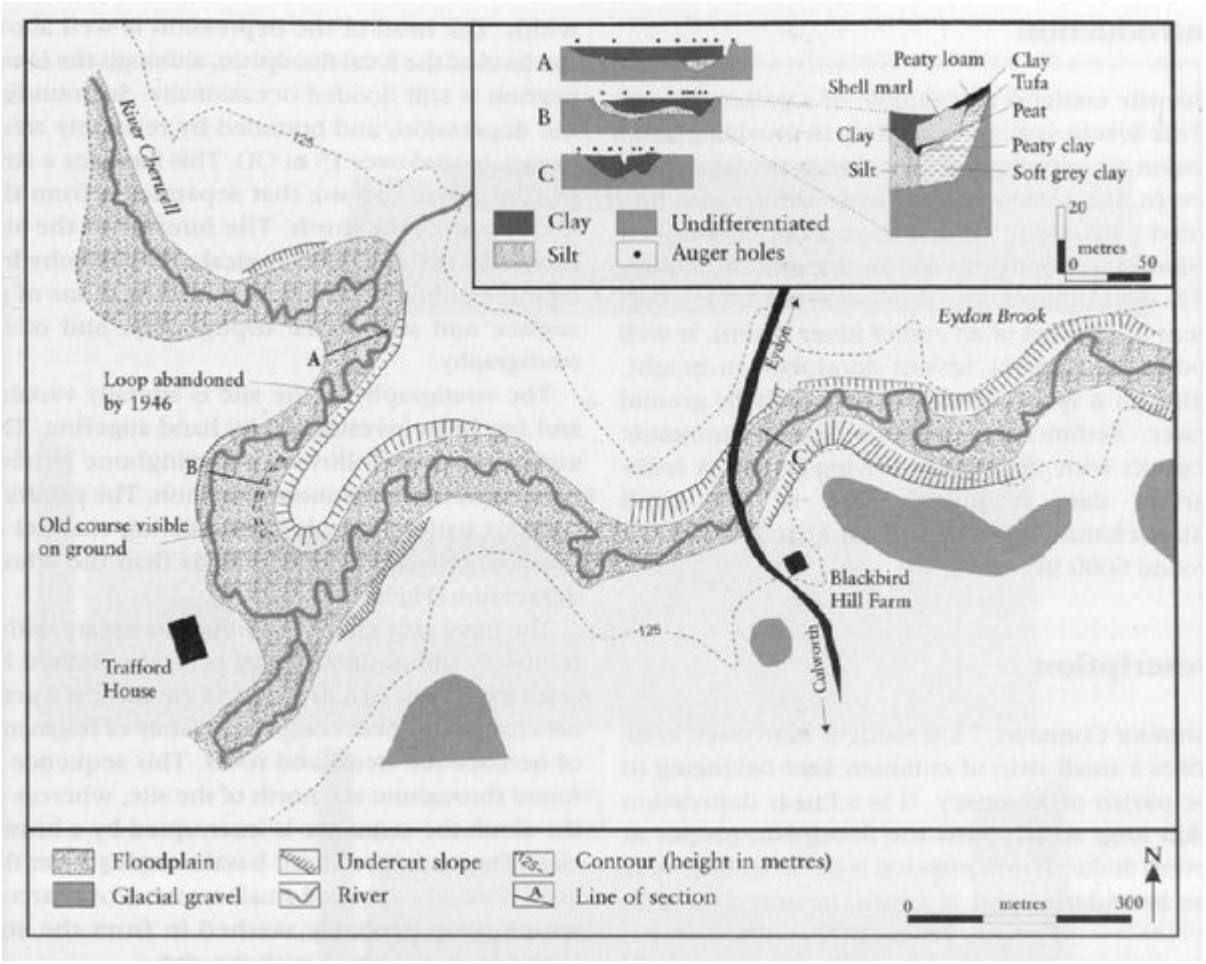
Conclusion

Many examples exist in southern England where the present stream and its meanders are disproportionately small compared with the size of the valley. The valleys themselves exhibit meandering. The Itchen is a classic example of this underfitness and was the first to be investigated in the 1950s.

References



(Figure 6.23) Alluvium-filled palaeochannels on the River Itchen, Warwickshire. (After Dury, 1954.)



(Figure 6.25) Palaeohydrological features of the River Cherwell and Eydon Brook. (After Dury, 1953.)