THE DRAINAGE PATTERN IN WEST DORSET AND EAST DEVON AND ITS RELATIONSHIP TO THE SUB-CRETACEOUS

HUGH C. PRUDDEN

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There appears to be a correlation between the present-day drainage pattern and the contours representing the unconformity at the base of the Gault/Upper Greensand. The unconformity surface is an elongated dome approximately over what is now Marshwood Vale. Present-day streams radiate from this centre whilst Beaminster Down marks the watershed between the Bristol and English Channels. Arguably, the west Dorset-east Devon hilltops are the remnants of an extensive plateau which was subjected to prolonged sub-tropical weathering with the formation of solution pipes, silcretes and the clay-with flints i.e. an etchplain of low relief. There are extensive spreads of gravels in the eastern parts. It would appear that this plain was warped, possibly during Tertiary compression, and the present drainage pattern initiated.

2 Yeovil Road, Montacute, Somerset, TA15 6XG, U.K.
(E-mail: hugh@hughprudden.wanadoo.co.uk).

INTRODUCTION

Some 6 km north of the west Dorset coast lies an important WNW-ESE watershed: on the south side streams drain to the English Channel whilst on the north side they flow to the Bristol Channel. In addition, the River Frome drains to the south-east and the River Axe to the south west. Together, these rivers form a radial pattern around Beaminster. Attention was drawn to this radial pattern by Wilson *et al.* (1958) as shown in Figure 1. Gibbard and Lewin (2003) have recently reviewed the evidence for the history of major rivers of southern Britain during the Tertiary and it seems an appropriate time to draw attention to the development of the drainage pattern in this part of Britain.

THE ASSOCIATION OF THE SUB-CRETACEOUS SURFACE AND DRAINAGE PATTERN

The contours shown in Figure 1 on the base of the Cretaceous, where the Gault/Upper Greensand overlie the Jurassic strata, show the Marshwood Dome which has an oval shape. The unconformity has clearly been faulted and deformed. It is difficult to be certain as to the original form of the unconformity but here it is assumed that it was planar with low relief. The implication of the association of unconformity and drainage pattern is that a *topographic* surface of low relief was warped after the manner of the unconformity and that streams *consequently* flowed off the dome in the broad radial pattern that we see today.

FEATURES OF THE PLATEAU SURFACE

Small (1980) has described this upland plain as "…arguably the finest example of an upraised and dissected 'peneplain' in lowland Britain". The view westward from Golden Cap on the Dorset coast presents a remarkably planar plateau surface. Its preservation is due to the relative hardness of the Upper Greensand and Chalk that cap the hilltops. However, the plateau surface varies in altitude and rises to its highest point at Pilsdon Pen (270 m O. D.). Embleton (1992) has shown that generalised contours drawn across the hill tops to the south of Pilsdon Pen slope down to the south in sympathy with the slope of the unconformity.

The deep quarry at Beer when in work showed solution pipes extending down over 15 m into the underlying Chalk. These appear to be mainly relics of past intense chemical weathering. Isaac (1981, 1983) has reported tropical weathering profiles in east Devon. It would appear therefore that the plateau surface has experienced a long period of semi-tropical weathering which resulted in subdued relief and a deep weathering mantle. These are the characteristics of an etchplain produced by chemical weathering. There are extensive deposits of clay-with-flints.

There is also a liberal spread of rounded gravels on many of the hilltops east of a NNW-SSE line drawn from the south of Taunton to Lyme Regis (Waters, 1960). The gravels are a mix of flint, cherts, vein quartz, quartzite and other resistant Palaeozoic rocks. At Hill Clump west of Crewkerne (NGR ST 401 092) a silage pit exposed masses of rounded gravel, silts and sands plus what appeared to be fragments of Purbeck Limestone (late Michael House pers. comm.). At Staple Hill south of Taunton some 3 m of very coarse gravels cap the Blackdown escarpment (NGR ST 259 154). Chert boulders up to 0.3 m in length have been found near Combe St Nicholas. The blue-grey flint cobbles are rounded and have oval chatter marks that suggest that there was a period of marine trimming. The gravels overlie the clay-with-flints on Beaminster Down and elsewhere. Most of the gravels appear to have been derived from sources outside the area and could only have arrived before the initiation of the present-day river and valley system. They resemble the gravels found in the Poole Formation.

There is also a wide spread of sarsens some of which are still on the plateau although many have been soliflucted down to lower ground. The formation of silcretes is generally associated with surfaces of low relief and they are indicative of subaerial denudation under hot and at least seasonally humid conditions (Waters, 1960).

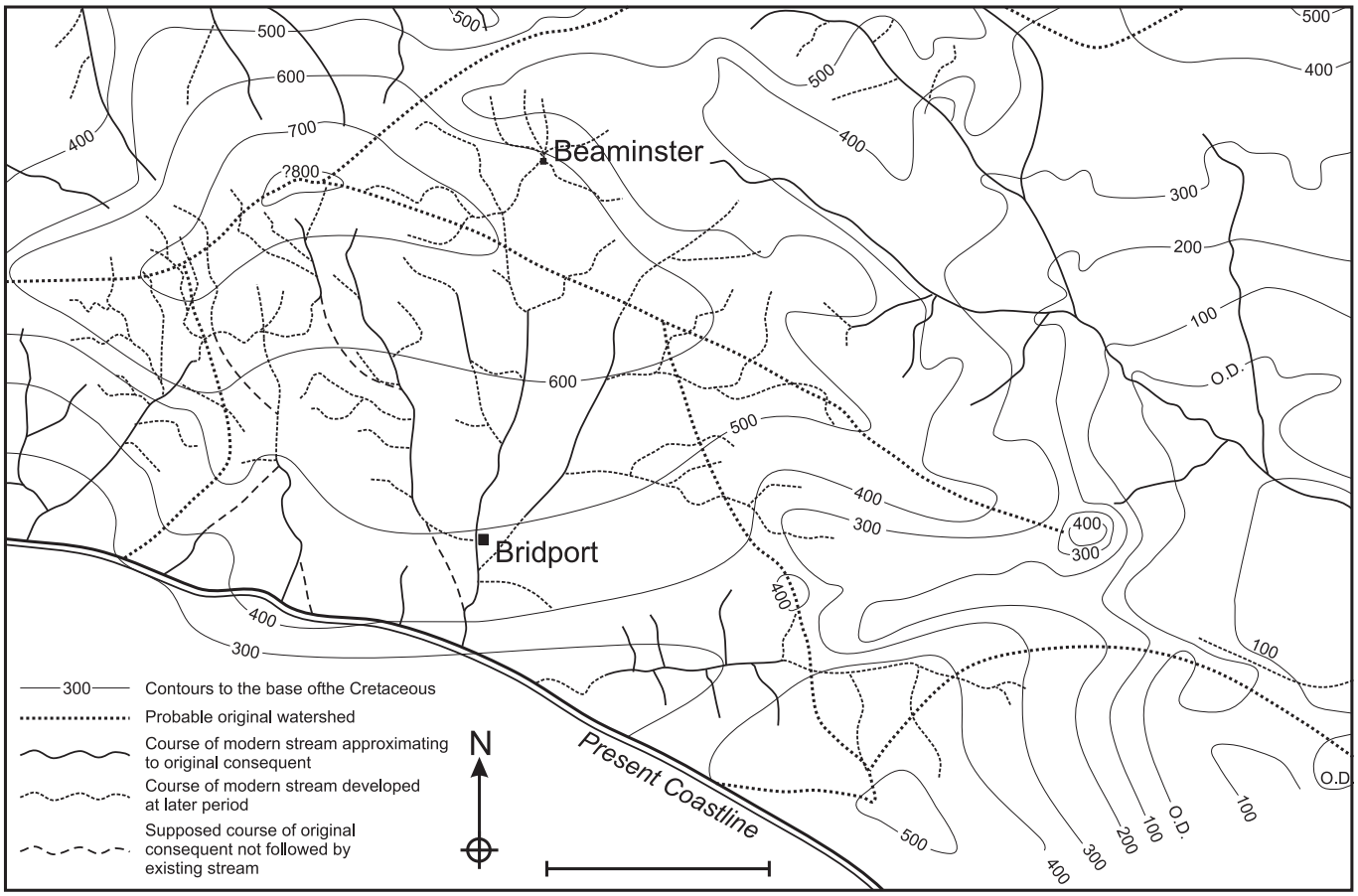

Figure 1. *Sketch map of the Bridport area, showing the relationship between the structure as seen by the base of the Gault and the present day drainage system (after Wilson et al., 1958, fig. 27)*

THE INITIATIOON OF THE DRAINAGE PATTERN

The features outlined above suggest that what is now the east Devon-west Dorset Plateau surface developed as a plain of low-relief close to base level. This would have been a necessary precursor for the initiation of a new drainage pattern. The present-day summit surface, which culminates at Pilsdon Pen, appears to conform broadly to the contours on the sub-Cretaceous unconformity that demarcate the Marshwood Dome. It would seem, therefore, that suitable conditions existed for the eventual initiation of a new drainage pattern following differential uplift that would have raised what is now the plateau surface.

The Marshwood Dome is situated to the west of the Hampshire Basin, north of the Channel Basin and south of the Bristol Channel-central Somerset Basin. The timing of the uplift of the Marshwood Dome is uncertain. There was a long period of intermittent tectonic activity from the early Tertiary culminating in the Miocene (Small, 1980). However, uplift may have been after the deposition of Eocene plateau deposits as these are shown to be faulted in several places on the 1:50,000 Sidmouth sheet (1974 edition) as, for example, to the west of Gittisham Hill and this was confirmed by examination of temporary exposures in a gas main trench at NGR ST 144 968 where Tertiary deposits have been displaced by some 30 m. Also the coarse cobble gravels at the Hardy Monument west of Dorchester are very similar to the plateau gravels mentioned above; Arkell (1953) ascribes the latter to the Eocene Bagshot Beds and so the doming would appear to be of a later date. Green (1985) has provided a useful overview of the pre-Quaternary weathering residues, sediments and landform development of the adjacent areas. The contours on the unconformity surface therefore suggest that the present drainage pattern began as a response to crustal warping. The west Dorset-east Devon plateau may be unique in that an association between drainage pattern and crustal warping can be demonstrated. Rivers have subsequently been superimposed upon the underlying geological structures as, for example, where the River Yeo flows northward against the dip of the strata south of Yeovil.

What can be inferred concerning drainage development in areas where there is no sub-Cretaceous surface to indicate crustal warping? To the east of Dorchester, on the Chalk dip slope, there are a number of NNW-SSE-trending sub-parallel streams. Were the Dorset streams a result of a tilt of the Chalk/Tertiary surface? However, the recent BGS 1:50,000 Shaftesbury sheet shows a number of NNW-SSE strike slip faults to the north of the Chalk escarpment. Therefore it is possible that associated rock fractures may have influenced the *alignment* of the valleys. Straw (1995) has suggested that Tertiary movements influenced the stream pattern in Exmoor where the watershed is very close to the Bristol Channel. Might it be inferred that the superimposed drainage pattern of the Bristol Avon and Wye is the result of derivation from a Tertiary surface? Donovan (1995) has summarised the strange range of exotic stones found on the plateau near Bath. Might these be Tertiary material? Should we begin to think of the Mendip plateau as a Tertiary etchplain? Further north the papers in the *Proceedings of the Cotteswolde Field Club* contain accounts of strange exotics on the Cotswold plateau e.g. Cleeve Common.

To sum up, the east Devon-west Dorset plateau contains evidence for a major restructuring of the drainage pattern. This was a major event in the evolution of the landforms of southern Britain.

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