Creechbarrow, Dorset

[SY 922 824]

Potential GCR site

Highlights

Interest in Creechbarrow is centred on the Creechbarrow Limestone, the sole remnant of non-marine limestones of early late Eocene age in the Hampshire Basin. Its land and non-marine gastropods, together with a rich mammalian fauna, provide a prime source of information on the contemporary palaeogeography.

Introduction

The conical form and height (193 m) of Creechbarrow (grid reference [SY 922 824]; see (Figure 7.1)) is a striking physical feature of the Dorset landscape (Figure 7.3). It is capped by the Creechbarrow Limestone (Creechbarrow Limestone Formation of Hooker, 1977b) which is underlain by a complex of fine to coarse elastics. Both the nature of the succession and its relationship to the underlying Chalk have significant stratigraphical, palaeogeographical and tectonic implications.

Geological interest in Creechbarrow began at the beginning of the 20th century with the pioneer work of Hudleston (1901, 1902a,b, 1903). He was initially concerned to explain its anomalous physical features and age, but in the course of this work discovered the capping of limestone which has provided the focus of interest for subsequent work including that of recent years.

Excavation is necessary to expose the limestone and this has proceeded at intervals up to the present day. Much of the interest has centred on the fossils from the limestone and their use for dating the Creechbarrow strata and for palaeogeographical interpretation. Work by Hudleston and others (Keeping, 1910, 1912; Bury, 1934; Arkell, 1947) led to the recognition of a mainly molluscan fauna and a long-lasting debate on the age of the 'Creechbarrow Beds'.

More recently, excavations by field parties from the Natural History Museum in 1975, 1976 and 1978 have led to the discovery of a rich vertebrate fauna (see Hooker, 1977b, 1986, 1992; Hooker and Insole, 1980), whilst a modern review of the mollusca from the Creechbarrow Limestone has been undertaken by Preece (1980).

Originally the sequence was mapped by the Geological Survey as 'Bagshot Beds', whilst the disparity of the dip of these strata and the nearby Chalk led to early speculation about the age of the local folds (Arkell, 1947; see also Jones, 1981).

This site is a confirmed GCR site for its fossil mammal content, a more detailed account of which can be found in the GCR series volume *Fossil Mammals and Birds of Great Britain* (Benton *et al.,* in prep).

Description

Creechbarrow is a conical hill immediately north of the Chalk ridge of the Purbeck Hills and comprises an outlier, the sole remnant of the 'Creechbarrow Beds', resting on what used to be called the 'Pipe-clay Series' (Arkell, 1947, pp. 233–41). At 194 m in height, it is higher than the summit ridge of the Chalk except for Ridgeway Hill and Nine Barrow Down, and rises above the supposed Miocene planation surface (House, 1993, p. 129).

Lithological succession

Altogether, the 'Creechbarrow Beds' are some 52–64 m thick. The youngest unit comprises2–3 m of limestone, which rests on a sequence of elastic strata comprising brick-clays, sands, grits and bands of flint pebbles (Figure 7.4).

The present fossil mammal GCR site includes both the limestone and the immediately underlying 'Sand with hands of flints' (Arkell, 1947, p. 237) which forms the lower part of the 'Upper Creechbarrow Beds', but it is exclusively the nature of the former (the Creechbarrow Limestone) that justifies independent GCR/SSSI status on stratigraphical grounds.

Stratigraphy

The 'Lower Creechbarrow Beds' of Arkell (thought to be the equivalent of the Agglestone Grit) occur within the Poole Formation of Curry *et al.* (1978, table 1) whilst the 'Middle and Upper Creechbarrow Beds' were assigned to their Bournemouth Formation. The application of the more recent stratigraphical terminology of Edwards and Freshney (1987b), as amended by Bristow *et al.* (1991), is not totally clear, but it seems possible that the 'Creechbarrow Beds' occur across the boundary between the Poole Formation and the Branksome Sand of the former authors. The Creechbarrow Limestone of Hudleston (1902a) has recently been formally described by Hooker (1977b), to conform with Hedberg (1976), and named the Creechbarrow Limestone Formation.

Invertebrate macrofauna

For many years, the limestone comprising the uppermost2–3 m of Arkell's (1947) 'Upper Creechbarrow Beds' has provided the main focus of interest, predominantly as a result of its fossils (although in part too as a result of its locally unique lithological nature and the conse quent stratigraphical implications to which this gives rise).

From Hudleston's time onwards, both freshwater molluscs (mainly gastropods) and land gastropods have been obtained from the Creechbarrow Limestone. L.R. Cox (in Arkell, 1947, p. 240) listed nine gastropods and the bivalve *Unio* and concluded that 'the fauna is undoubtedly a Bembridge Limestone one'. More recently, the molluscan fauna was reviewed by Preece (1980) who recognized, in addition to *Unio,* 15 gastropod species representing 12 families. Preece (1980, p. 178) pointed out that 13 of the 15 may also be found within the Bembridge Limestone (see Pain and Preece, 1968) but conceded that only three are not known from other stratigraphical horizons elsewhere. The most common fossil he assigned tentatively to *Coptostylus brevis* (Thiaridae). Hooker (1986) referred to the presence of slug plates and snail opercula.

Mammalian remains

Early workers such as Keeping (1910, 1912) found some mammalian material, but the importance of the site for mammalian fossils was not realised until much later. Hooker (1977b) listed some thirty species and indeterminate material from nine orders. These are considered in more detail in the GCR volume *Fossil Mammals and Birds of Great Britain* (Benton *et al.,* in prep.) but see later discussion regarding their stratigraphical and palaeoenvironmental significance.

Other fossils

Hooker (1977b) also mentioned the presence of fish and crocodile material, fossil blue-green algae (Cyanophyta), including those encrusting shells, silicified bryozoa derived from the Cretaceous, and small ovoid structures originally thought to be the eggs of land gastropods. However, such structures are similar to cocoon-like trace fossils recently described from the Bembridge Limestone (Edwards *et al.,* 1998) that are considered to have been formed by insects for pupation or by an unknown organism for hibernation or aestivation.

Sedimentology

The Creechbarrow Limestone is a white to cream, largely pisolitic and tufaceous, sandy limestone (Hooker, 1977b). Lithification varies, with both soft manly material and well-lithified limestone present (Arkell, 1947). Much of the shell material present is encrusted by calcium carbonate, thought to be produced by cyanophyte algae, whilst cylindrical hollows may be rhizoconcretions (Hooker, 1977b). Diagenesis has left little original shell material, with many specimens represented by internal casts. In a later account, Hooker (1986) described the Creechbarrow Limestone as comprising 'a buff marl containing variable sized limestone clasts'. Near the summit, the latter were a mass of limestone boulders with

marl filling narrow gaps between them. From this, Hooker (1986) concluded that the marls might represent in-situ limestone decomposition but conceded that an alternative might be lateral lithological variation (p. 210).

Interpretation and evaluation

As the sole remnant in Dorset of a facies having some palaeontological and lithological similarity to freshwater limestones from the Headon Hill Formation and Bembridge Limestone further east, the Creechbarrow Limestone provides a valuable contribution to our understanding of the local Palaeogene palaeogeography.

Correlation with other localities

The palaeogeographical significance of the Creechbarrow Limestone quite naturally depends on its being accurately dated and this has been a matter of some interest from its earliest discovery to the present day (see discussion in Hooker, 1977b).

Hudleston (1902b) considered the possibility that the Creechbarrow Limestone might equate to the Bembridge Limestone, but concluded tentatively that it represented a local facies of the Bagshot Beds and in part the lateral equivalent of the Pipe-clay Series. By contrast, Keeping (1910) had no doubt, on the evidence of the fauna, in identifying the Creechbarrow Limestone with the Bembridge Limestone. Bury (1934) felt that the Creechbarrow Limestone was probably of Oligocene age, but, in recognizing that the fauna was facies controlled, considered that a direct correlation with the Bembridge Limestone was unwarranted. However, Cox (in Arkell, 1947) considered the fauna as 'undoubtedly a Bembridge Limestone one'. Curry (1965a, p. 170) reiterated this view by referring to the Creechbarrow Limestone as 'an outlier of what is believed to be Bembridge Limestone, which rests unconformably on Bagshot Beds'.

Within recent years, such a correlation has been disputed. Hooker (1977b) has pointed out that as the most rapidly evolving group found as fossils within the Creechbarrow Limestone, the Mammalia are the most suitable for relative dating. Hooker (1977b) considered that on the basis of the mammalian fauna it may be dated as early late–Eocene, Bartonian (late Auversian or early Marinesian). In a further discussion, Hooker and Insole (1980) suggested that it could be equivalent to the lower part of the Barton Clay (early Marinesian). Earlier, Hooker (1977b) had argued that it might represent a marginal regressive facies preceding the Barton transgression and perhaps be equivalent to the Bournemouth Marine Beds (now part of the Branksome Sand).

In a recent paper on the Creechbarrow Mollusca, Preece (1980), whilst conceding that little is known about the stratigraphical ranges of most species of Tertiary non-marine molluscs, referred specifically to the presence of *Filholia laevolonga* and its possible stratigraphical significance. In the Toulouse Basin, it characterizes the lower to upper Ludian, considerably younger than the age for the Creechbarrow Limestone suggested by Hooker (1977b). Preece concluded that if Hooker was correct, the known stratigraphical ranges of several molluscs have been considerably extended.

Depositional environment

As far as palaeoenvironmental interpretation is concerned, both Hudleston (1902a) and Arkell (1947) supported a lacustrine origin, whilst Bury (1934), who drew attention both to the tufaceous nature of the Creechbarrow Limestone and the frequency of land snails, concluded that it was 'not formed in a lake, but in a swamp, the water in which was highly charged with lime, and was liable to rather rapid evaporation'.

Recent work has enhanced our understanding, the molluscs provide information on the depositional environment itself, with the mammals used to elucidate the nature of the hinterland. Preece (1980) has referred to the scarcity of Lymnaeidae and the absence of Planorbidae, in contrast with the Palaeogene limestones on the Isle of Wight, and has suggested a substrate of poorly vegetated or even bare lime mud. Preece (1980) considered that the presence of *Unio,* with united valves, indicates a fairly large body of shallow water. The importance of *Coptostylus* (found elsewhere by Paul (1989) with the slightly brackish *Potamomya* and other rare brackish water snails) and the absence of planorbids, even less tolerant of raised salinities than Lymnaeids (Paul, 1989), might be construed as suggesting slight brackishness.

Preece (1980) pointed out that land shells are absent or very rare in lake sediments. The rhizoconcretions, if representing the former presence of roots, suggest very shallow water, whilst the pisolitic and other structures resembling the pedogenic (calcrete) facies of the Bembridge Limestone (Armenteros *et al.,* 1997) may indicate subaerial exposure. The Creechbarrow Limestone is probably a composite reflection of different phases of subaqueous and subaerial development in a marginal (palustrine) situation.

The land snails, particularly the *Clausiliidae* and *Cochlostoma,* are shade-demanding and indicate the proximity of forest (Preece, 1980, p. 178). Such a conclusion is supported by data from the fossil mammals present. Hooker (1992) found that a significant percentage of the Creechbarrow mammals were arboreal and that the overall mammalian spectrum indicated a lowland tropical forest with glades.

Intra-Palaeogene tectonism

It is now accepted that in both Dorset and other parts of southern England, folding, which began in the Late Cretaceous, continued into the Palaeogene and beyond into the Neogene (see summary in Jones, 1981, pp. 76–85). That there had been deep dissection of such structures by mid Eocene times in the Dorset area is clear from the presence of Upper Greensand and Purbeck pebbles in the local 'Bagshot Beds' (Phillips, 1964; see also site descriptions for Bincombe Down and Blackdown in this volume).

Creechbarrow contributes evidence for local tectonic activity during early Palaeogene times. Various workers had noted the marked disparity in dip between the 'Creechbarrow Beds' (10° N) and the nearby Chalk (up to 85° N) (Arkell, 1947, fig. 46). Jones (1981, fig. 4.8) interpreted this as an unconformity, with the Chalk of the Purbeck Downs originally overlain by 'Creechbarrow Beds'. Since the Creechbarrow Limestone has been dated as early late-Eocene (Hooker, 1977b), the inference which may be drawn from Jones' (1981) interpretation is that considerable folding had developed in this area by mid Eocene times.

Although changes in dip over a short distance do not unequivocally prove an unconformable relationship (cf. dip changes at the northern ends of Alum and Whitecliff Bays, Isle of Wight), Creechbarrow supplies other evidence to support the view that by early Palaeogene times both the Chalk and older Mesozoic strata were being actively eroded. Large, unworn flints found within the 'Creechbarrow Beds' by Hudleston must have been locally derived from the Chalk, whilst Hooker (1977b, p. 142) considered that the derived silicified bryozoa in the Creechbarrow Limestone are most likely from the Upper Greensand. Plint (1982) concluded that the Chalk had been exposed locally in the late Lutetian.

Conclusions

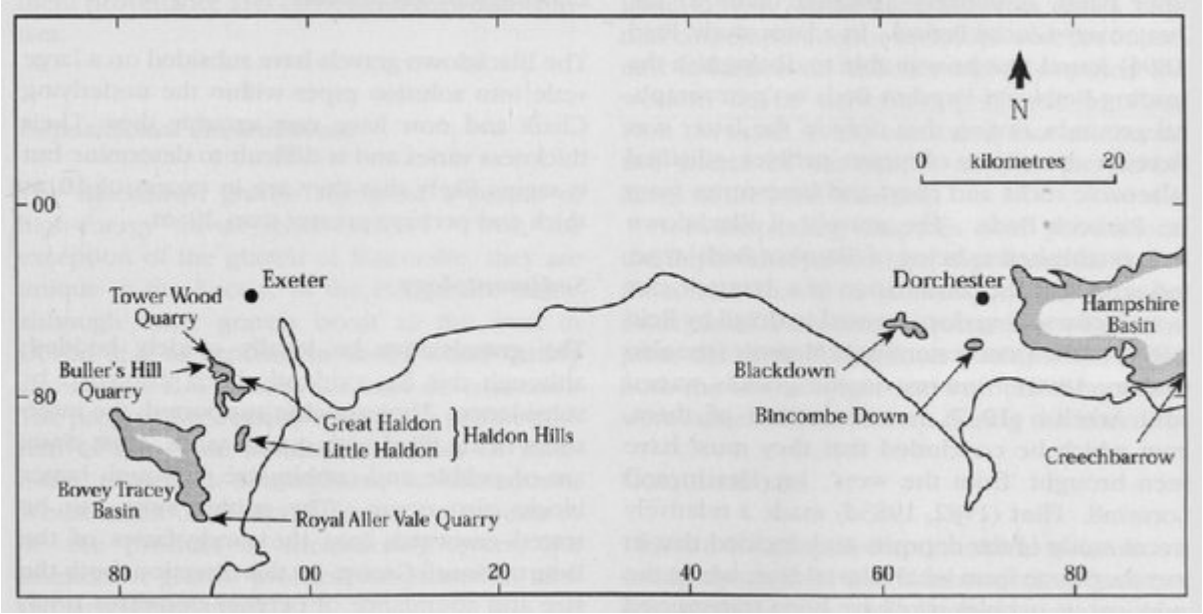
Of the 'Creechbarrow Beds', the uppermost unit, the Creechbarrow Limestone, is the most significant both stratigraphically and palaeogeographically.

The Creechbarrow Limestone at Creechbarrow is the sole remnant of a non-marine limestone of early late Eocene age in the Hampshire Basin and may represent a marginal facies equivalent to more marine strata further east. It bears some resemblance to the Bembridge Limestone and other freshwater limestones of the Isle of Wight, although there are considerable faunal differences.

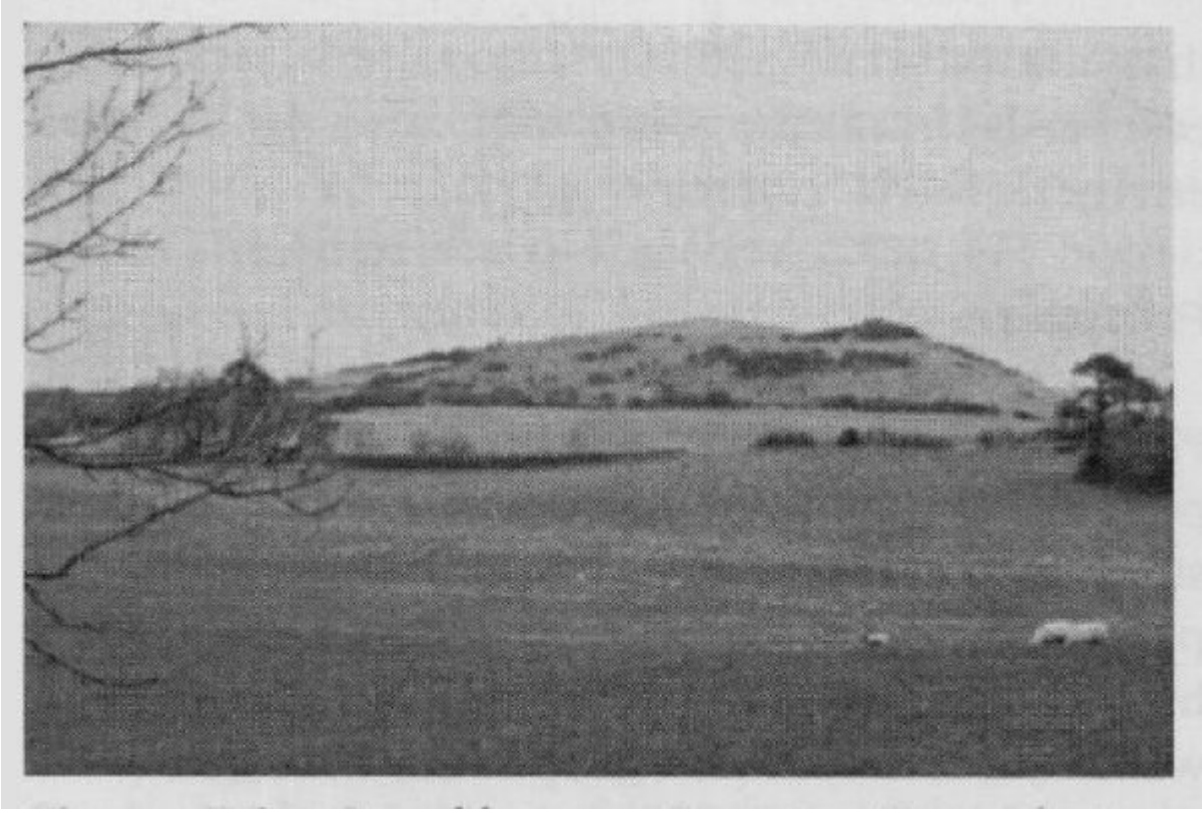
The presence of terrestrial as well as non-marine gastropods, together with a rich mammalian fauna, including a significant arboreal element, suggests a possible palustrine environment adjacent to a tropical wooded hinterland.

The structural relationship between the 'Creechbarrow Beds' and the underlying Chalk, together with the presence of derived Mesozoic fossils and pebbles, supports the view that by mid Eocene times, folds and other tectonic structures which had developed in the early Palaeogene had already been considerably dissected by erosion.

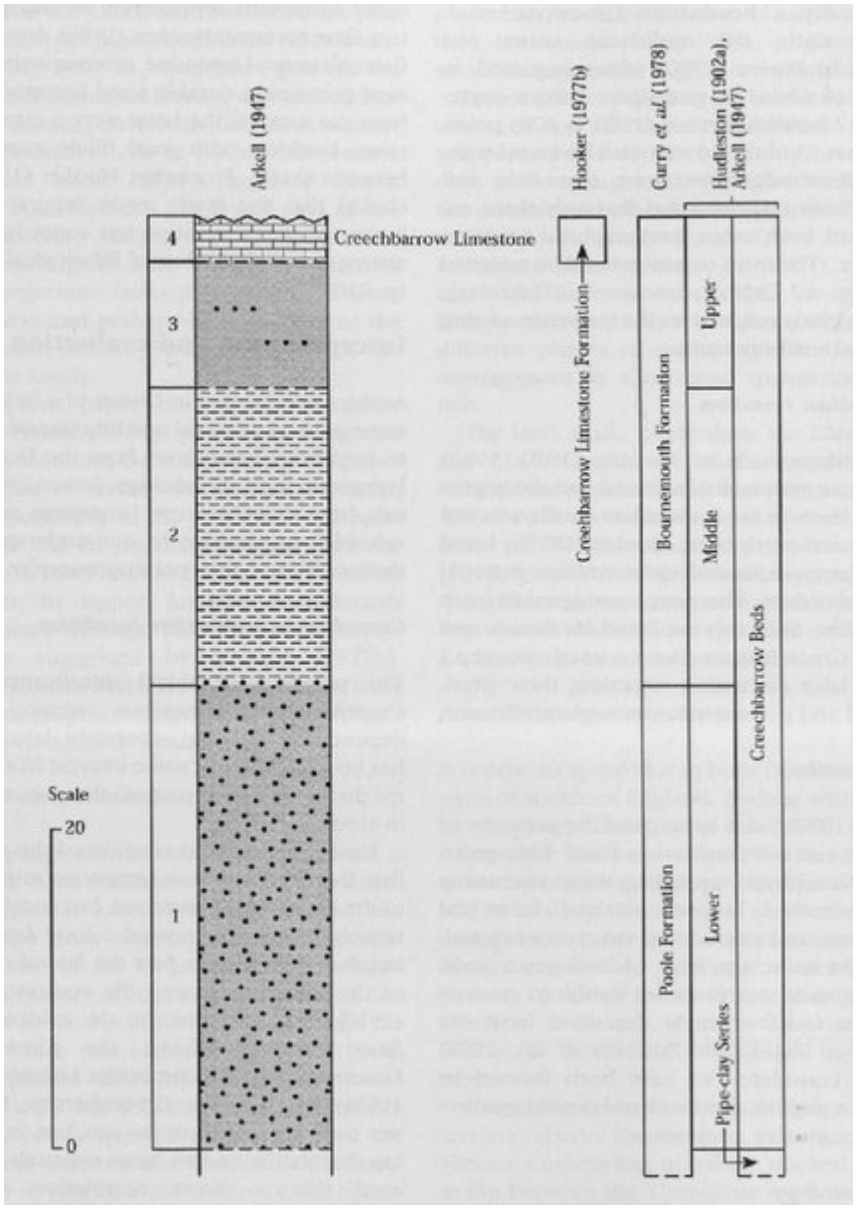
References



(Figure 7.1) Map to show the distribution of Palaeogene outliers in Dorset and Devon.



(Figure 7.3) Creechbarrow, Dorset. General view



(Figure 7.4) Succession at Creechbarrow (after Arkell, 1947, p. 237).