Hengistbury Head, Dorset

[SZ 167 907]–[SZ 181 906]

Highlights

Hengistbury is stratigraphically important since it facilitates correlation of the more westerly exposures of strata adjacent to the Bracklesham Group/Barton Group junction with those further to the east. Palaeoenvironmentally, the site has helped geologists to better understand lateral changes in the Boscombe Sand and it is also the best exposure of the marginal sandy facies of the Barton Clay.

Introduction

The site comprises a sea cliff on the southern side of the Hengistbury Head peninsula (grid reference [SZ 167 907] to [SZ 181 906]; (Figure 6.10)). Three lithostratigraphical units of Eocene age are present. Historically, they have been referred to, in ascending order, as the Boscombe Sand, Hengistbury Beds and Highcliffe Sands. The Boscombe Sand is now recognized as the lowest formation assigned by Edwards and Freshney (1987b) to their Barton Group. The others correlate with the lowermost strata of the Barton Clay, exposed in 'Barton Cliffs' further to the east (Hooker, 1975a; Curry, 1976). Recently (Bristow *et al.,* 1991), the highest of the three has been formally renamed the Warren Hill Sand Member of the Barton Clay (Figure 6.11).

The section has attracted the interest of geologists since the early part of the 19th century. A great deal of attention has been paid to the stratigraphical position and correlation of the succession since, although now resolved, this was a matter of considerable controversy over a number of years (see below). A good stratigraphical account is given in Hooker (1975a), whilst Curry (1976, fig. 1) also provides a useful summary of the sequence.

Palaeontological work on the section includes that of Reed (1913) who listed molluscs, fish, an echinoid and a crustacean; Chapman (1913) on the agglutinated foraminifera; Curry (1942), who made the significant discovery of *Nummulites prestwichianus;* and Chandler (1960), who described the plant macrofossils. Both Hooker (1975a) and Curry (1976) include useful palaeontological data, whilst Hooker (1977a) described the mammal *Lophiodon* from the Barton Clay at this site. Costa *et al.* (1976) worked here on the dinoflagellate microflora as part of a broader correlative study.

Although Tylor (1850) considered the economic importance of the sideritic nodules in the section, it is only in recent years that the broader sedimentological aspects have been investigated. Plint (1983c) made a detailed study of the Boscombe Sand, also referred to briefly in his more comprehensive paper (1983a) on middle Eocene environments and facies and that recently published on the Eocene strata between Poole Harbour and High Cliff (Plint, 1988b). The most up-to-date account of the Hengistbury sediments is that of Bristow *et a/.* (1991, pp. 66–7).

Description

The Hengistbury section is of considerable stratigraphical significance since it provides a valuable 'bridging' exposure between the more westerly sequences exposed around Bournemouth and beyond, and those further eastwards on the mainland and on the Isle of Wight.

Lithological succession

In ascending order, the succession (Figure 6.11) comprises the Boscombe Sand (about 8 m) and the Barton Clay, including what has historically been called the Hengistbury Beds (about 16 m) and the Warren Hill Sand Member (formerly the Highcliffe Sands; 9 m). The Boscombe Sand includes 'bitumen'-impregnated sands. Above, rolled flint pebbles are followed by muddy sands and sandy muds with a few flint pebble bands and ironstone nodules at four levels (Hengistbury Beds); these are succeeded by the light-coloured fine-grained sands of the Warren Hill Sand Member.

Stratigraphy

The first account of the succession was apparently that of Lyell (1827) who assigned the strata at Hengistbury to the 'plastic clay formation' (i.e. the Reading Formation), stratigraphically *below* the 'London Clay' (sic) of Barton (i.e. what is now the Barton Clay). Prestwich (1849a) took a contrary view, concluding that, on both lithological and palaeontological grounds, part of the succession represented a westerly reappearance of the Barton Clay. Over a period of years, Gardner (1879c), Reed (1913), White (1917) and Stamp (1921) expressed differing views and only relatively recently (see particularly Curry, 1976) has the matter been resolved, and the 'Hengistbury Beds' recognized as the lower part of the Barton Clay.

Microfaunal discoveries at the site helped to resolve the controversy. Curry (1942) found *Nummulites prestwichianus* 4.6 m above the base of the 'Hengistbury Beds'. In a study of the dinoflagellate flora, Costa *et al.* (1976) found that the zone fossil *Wetzeliella draco* first appears immediately above the *N. prestwichianus* band, with their *Heteraulacacysta?* sp. *A.* (*H. porosa*) about 1.5 m above. These two species define the base of Zone Bar-1 of Bujak *et al.* (1980), the oldest of the five 'Barton Beds Zones' defined by these workers.

Sedimentology

The Barton Clay below the Warren Hill Sand Member comprises some 16 m of sandy muds to muddy sands, its base being marked by a layer of well-rounded flint pebbles. The lowest 3–5 m are highly bioturbated and glauconitic. The remainder of the sequence includes five nodule bands of intermittent persistence. These are mainly sideritic ironstones, although the third set from the bottom comprises ball and pillow structures.

Lateral variation in the Barton Beds at Hengistbury Head has been referred to by Hooker (1975a, p. 118 and fig. 5). Whilst the nodule bands are less well-developed to the west, an increase in the sand and silt content in this direction is accompanied by an increase in the frequency of pebble bands within the sequence.

Good exposures of the Boscombe Sand occur at Hengistbury and comprise cross-bedded quartzose sands with flint pebbles, either scattered or in bands. The uppermost part of the Boscombe Sand comprises a clean, very well-sorted, fine-grained sand, up to 1.25 m thick, with a pebble bed locally developed at its base (Bristow *et al.,* 1991, p. 66) and which Flint (1983c) considered to mark the base of his T5 transgression. Body fossils are absent from the Boscombe Sand here, but Plint (1983c) recognized the trace fossils *ophiomorpha* and *Thalassinoides.*

A spectacular feature of the Boscombe Sand at Hengistbury is the development of what appear to be 'bitumen'-impregnated sands which have been contemporaneously deformed and eroded, thereby demonstrating the synsedimentary origin of the 'bitumen'. The bituminous sands are mainly developed in the banks and eastern flank of a mud-filled channel in the Boscombe Sand, where they reach a maximum thickness of 2.5 m. According to Plint (1983c), the bitumen has 'the characteristics of a 'type 2' bitumen, probably derived, in large part from the waxy cuticular coatings of plant leaves'. An unusual feature is the occurrence of contemporaneously eroded sand (not sandstone) pebbles, rendered cohesive by their bitumen 'cement'. These, together with fluidization and water-escape structures, have been described by Plint (1983c) in some detail. He also noted the interesting point that unlined *Thalassinoides* burrows in the bituminous sands pass into lined *Ophiomorpha* burrows in the clean sand (Plint 1988b, p. 131); an excellent illustration of how burrowing animals respond to changing circumstances.

Interpretation and evaluation

The prime importance of this site has centred around the relationship of the beds here to those further east, and secondly that it provides a link between the contrasting successions both to the west and the east.

Stratigraphical affinity of the Hengistbury Beds

Much of the interest in the section over many years has centred on the stratigraphical position and correlation of the succession. In particular, the disputes that arose concerned the question of the relationship of the 'Hengistbury Beds' to

the Barton Clay succession exposed to the east of Christchurch Harbour. Was the Hengistbury Head succession, as implied by Lyell (1827), older than the Barton Beds to the east or was it, as Prestwich (1849a) suggested, that at least part of the succession represented a westerly reappearance of the Barton Clay?

Lyell (1827) was undoubtedly influenced by the apparently constant and gentle easterly dip on both sides of Christchurch Harbour, from which he assumed that the succession at Hengistbury dips below that found at Friars Cliff to the east. Gardner (1879c) supported Lyell's view and assigned all the strata at Hengistbury to the 'Bracklesham Series'. To the lowest sands he gave the name the Boscombe Sand. The clays and silts above he called the Hengistbury Head Beds (subsequently the Hengistbury Beds), whilst the sands higher up were correlated with those *below* the Barton Clay at Friars Cliff which he had called the Highcliff Sands and which we now know as the Boscombe Sand (see separate site review).

Reed (1913) supported Prestwich (1849a), for he found fossils in the 'Upper Hengistbury Beds' that had Barton Beds affinities. White (1917), however, was dismissive of Reed's view, maintaining that the molluscs listed by the latter ranged down into the Bracklesham Beds. Stamp (1921, pp. 153–4, fig. 3) followed Lyell and Gardner, regarding the Hengistbury Beds as a westerly continuation of the marine beds of the 'Upper Bracklesham Beds' cyclothem.

Curry's (1942) discovery of *N. prestwichianus* 4.6 m above the base led to a suggested correlation of this unit with the lowest Barton Beds. In 1958, he repeated this view and suggested that the sands above the Hengistbury Beds might equate to Burton's (1933) horizon A_3 of the Barton Beds at Highcliffe, i.e. the 'High Cliff clays and sands' of Wright (1851), and that the underlying Boscombe Sand at Hengistbury correlates with the 'Highcliff Sands' of Gardner (1879c). In a more recent review of the Hengistbury dispute, Curry (1976) reiterated his earlier conclusion, whilst in the same year, Costa *et al.* (1976) found dinoflagellate evidence confirming Curry's interpretation. Recent mapping by the British Geological Survey has suggested the presence of a fault, the Christchurch Fault, which provides a mechanism for the repetition of the Barton Clay at Hengistbury.

Palaeogeographical significance and depositional environment

With the resolution of the correlation 'problem', the importance of Hengistbury in helping us to understand the palaeogeography of Barton Beds 'times' is apparent. It appears that the Hengistbury Beds represent a sandy 'marginal marine' facies compared with the contemporaneous muddy 'offshore' facies found further to the east. Chapman (1913) suggested a tidal estuarine origin from the agglutinated foraminifera that he had found. Murray and Wright (1974, p. 50) concurred with the possibility of hyposaline conditions and suggested a marsh regime (p. 63), but Curry (1976) preferred to interpret the fauna as representing the open sea whilst conceding that the land was not far away.

Although, over the years, a great deal of attention was paid to the Ilengistbury Beds', the importance of the Boscombe Sand at this site cannot be ignored. Apart from the extremely unusual bituminous sand development and associated erosional and deformational structures, the nature of the Boscombe Sand here has implications for our understanding of the palaeogeography.

Plint (1983a,c) considered that at Hengistbury, the Boscombe Sand comprises a 'lower' estuarine tidal channel facies which correlates westwards towards Bournemouth with more upriver estuarine sediments and with what he considers to be 'distributary mouth bar' facies to the east at Friars Cliff. The channel facies at Hengistbury is in part exceptional because of the development of a bituminous cement which has exercised a unique influence on both physical and biological syndepositional processes. In addition to its influence on structures already discussed, it has produced a 'elastic firm ground'. This bituminous subfacies alone merits further geochemical and sedimentological investigation.

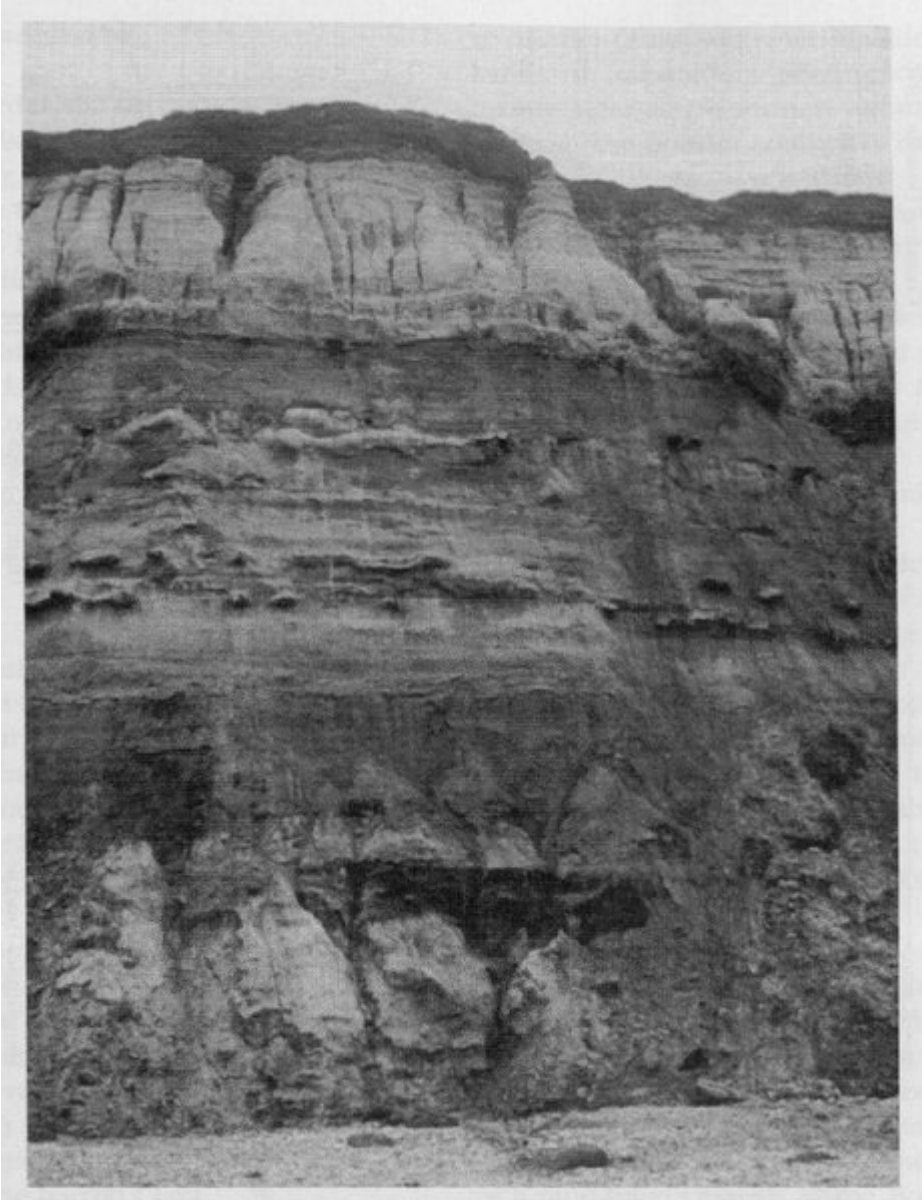
Conclusions

The stratigraphical position and age of the strata exposed in the Hengistbury Head section emphasizes the national importance of this site in the correlation of the western sections of Bournemouth and beyond with those to the east on the mainland and the Isle of Wight. In this regard, the recognition that the 'Hengistbury Beds' are actually part of the Barton Clay has been of primary importance.

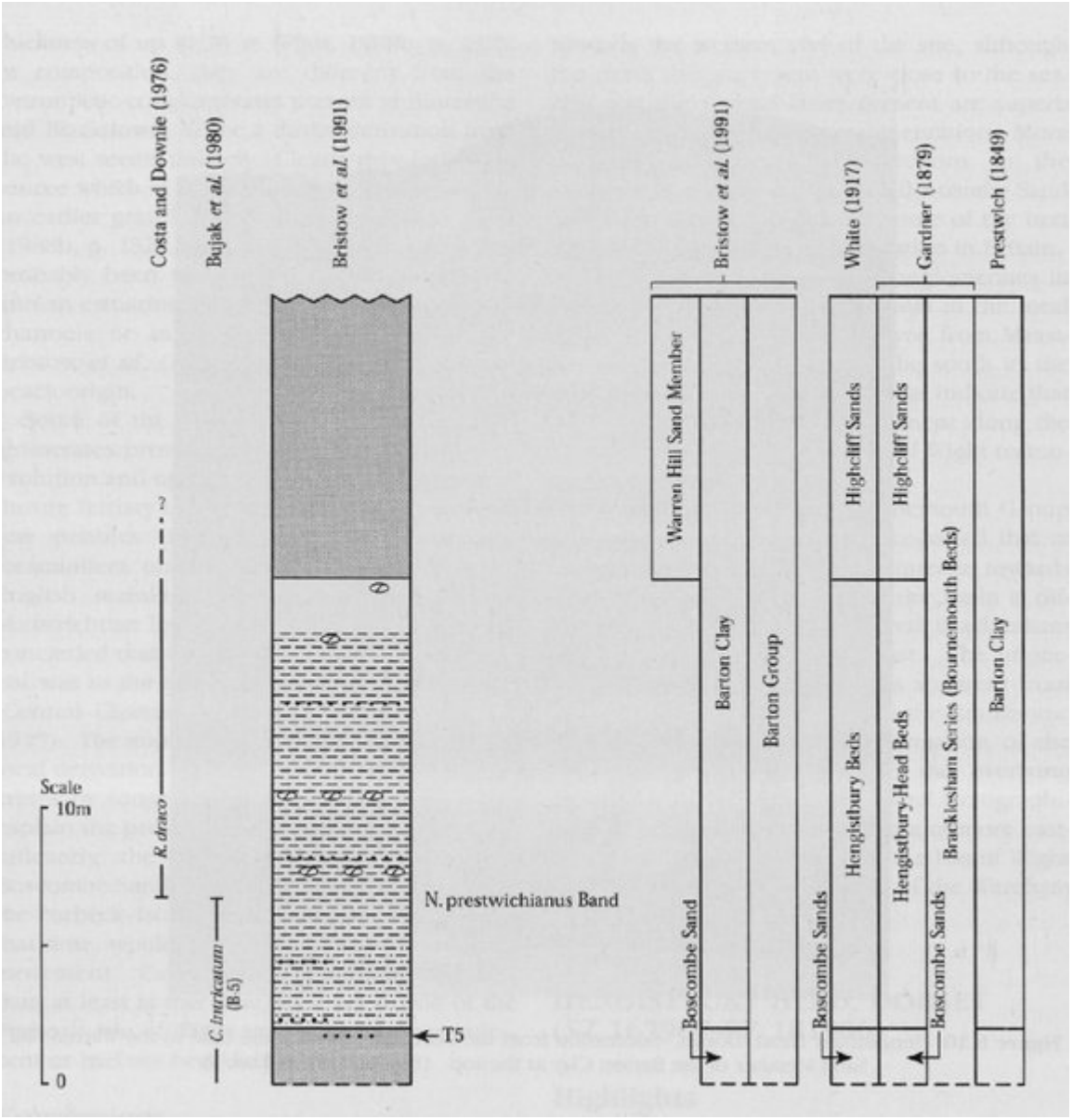
Hengistbury has proved to be a key site palaeoenvironmentally, for it has contributed to our understanding of the lateral facies changes that characterize the Palaeogene rocks in this area. The Boscombe Sand at Hengistbury comprises a 'lower' estuarine facies, linking the 'upper' estuarine facies found near Bournemouth with the 'distributary mouth bar' facies of Friars Cliff. The section also provides the best exposure of the sandy 'marginal marine' facies of the Barton Clay.

The bituminous sands in the Boscombe Sand render this site of considerable significance, since they are unique in the British Palaeogene succession and indeed exceptional in a more universal context. These sands, apparently impregnated contemporaneously by plant-derived bitumen, produced a 'elastic firm-ground' on the sea floor and influenced a quite unusual development of erosional and deformational structures.

References



(Figure 6.10) Hengistbury Head, Dorset. Succession from the Boscombe Sand at the base to the Warren Hill Sand Member of the Barton Clay at the top. (Photograph: B. Daley.)



(Figure 6.11) Generalized succession of the Barton Clay at the western end of Hengistbury Head, Dorset (mainly after Bristow et al., 1991, fig. 18). T5 refers to the 15 transgression of Plint (1983a).