Whitecliff Bay

[SZ 638 858]–[SZ 652 871]

Introduction

Whitecliff Bay is the best exposure in western Europe of a long sequence through part of the Eocene Series, with potential for studying the vegetational succession. It is particularly important for allowing other isolated floras to be placed in their superpositional context. This site has been independently selected as a Tertiary stratigraphy GCR site (Daley in Daley and Balson, 1999).

The plant macrofossils from here are rather few, the only specimens having been reported by Chandler (1961b, 1963a) and Collinson (1978a, 1996b). However, the exposure has revealed an unrivalled sequence of palynological data through the Eocene Series (Collinson *et al.,* 1981), which has provided important evidence as to the pattern of vegetational and climatic change occurring at that time. Charophytes have been found in the upper Eocene strata of this section (Feist-Castel, 1977) and there is a rooted lignite in the middle Eocene (Plint, 1983).

Description

Stratigraphy

Daley (in Daley and Balson, 1999) reviews the stratigraphy of this site. The full Tertiary sequence here is *c.* 550 m thick and lies unconformably on the Chalk. The Tertiary beds have been assigned to the Lambeth, Thames, Bracklesham, Barton and Solent groups, and range in age from late Palaeocene (Thanetian) to early Oligocene (Rupelian).

Palaeobotany

Two specimens of fan palm leaf from the Bembridge Marls at Whitecliff Bay were described and figured by Reid and Chandler (1926) as *Palaeothrinax mantellii* Reid and Chandler. Chandler (1963a) did not revise these specimens but recorded a seed of *Sabrenia chandlerae* Collinson from the Bembridge Marls. From the middle muds within Bembridge Limestone, Allan Lawson has recovered seeds of *Stratiotes* (Collinson, pers. obs.). Singer (1993) undertook a detailed palynological study of this unit.

Limnocarpus forbesii (Heer) Chandler was figured by Chandler (1961b) from the basal Wittering Formation and is one of the earliest records of the genus (Collinson, 1982a, 1996b). '*Scirpus*' *lakensis* was recorded from the Fisher Bed V in the upper Wittering Formation (Collinson, 1996b). Also in Fisher's Bed V is a rooted lignite (Plint, 1983) that preserves thick, long roots, suggesting a rooted woody vegetation (Collinson, pers. obs. in foreshore exposures). Fungal remains from here are described by Collinson (1978a) in her unpublished thesis. There are plant remains from the London Clay exposed here, in the collections of the Natural History Museum, London (e.g. *Nypa*) and *Platycarya* occurs here (Collinson, pers. obs.) but they have never been described in the literature.

Groves (1926) and Feist-Castel (1977) described charophytes from the upper part of the Whitecliff Bay section. From the Osborne Beds (Solent Formation), Feist-Castel (1977) described *Gyrogona wrightii* (Salter ex Reid and Groves) Pia, *Harrisichara* sp., *Chara* sp. and *Sphaerochara* sp.. From the Bembridge Beds, she reported *Harrisichara tuberculata* (Lyell) Grambast, *Sphaerochara subglobosa* (Groves) Horn al Rantzien, *Rhabdochara stockmansii* Grambast, *Gyrogona wrightii* and *G. caelata.* Several of these species are of biostratigraphical value (see Collinson, 1992 and references therein).

Very significant palaeobotanical interest at this site is provided by the palynological record, which gives evidence of the vegetational changes taking place in the Eocene Epoch (Collinson *et al.,* 1981). The London Clay and Wittering Formations yield assemblages that reflect the mangrove and paratropical rain forests, including *Bombacacidites,*

Compositoipollenites and *Anacolosidites.* Also important here is *Spinizonocolpites,* which is the pollen produced by the mangrove palm *Nypa* that is such an important element of the floras of the Eocene Thames and Bracklesham Groups. Most of these taxa disappear in the upper Wittering Formation, to be replaced by conifer pollen such as *Tsugaepollenites* and *Sciadopityspollenites.* A second change follows in the upper Selsey Formation and basal Barton Group, with an increased proportion of fern spores and of bisaccate and inaperturate pollen originating from conifers. Also seen here is the first appearance of *Aglaoreidia,* the pollen associated with the Potamogetoneae tribe of the pondweed family (Collinson, 1982a), although this tribe occurs as macrofossils rather lower in the sequence. Boulter and Hubbard (1982) expanded this palynological study, recognizing four palynologically based floras reflecting changing climate through the Cainozoic Era in Britain. Their work was based largely on borehole material but it shows the research potential of long sequences such as that at Whitecliff Bay.

Interpretation

Whitecliff Bay has yielded the best succession of Eocene palynofloras in an exposed sequence in western Europe. There are other known palynological sequences through strata of this age, but only in boreholes such as at Ramnor near Bracklesham (Anon., 1978, Boulter and Hubbard, 1982). Although currently sparse and scattered, the macropalaeobotanical records from the London Clay, Wittering Formation, Bembridge Marls and Bembridge Limestone indicate that there is also considerable research potential here.

Combined with the complementary macrofossil record from sites such as Bracklesham Bay, Whitecliff Bay gives an unrivalled insight into the vegetational changes taking place at that time as a response to climatic cooling. Of particular interest is the evidence that there was not a single vegetational change in Eocene times, but a change that occurred in at least two steps. This in turn has consequences for understanding Palaeogene climatic changes, which have to be balanced against palaeotemperature curves obtained through physical measurements, which indicate an ultimate sharp cooling event at the Eocene–Oligocene boundary, within an overall cooling trend during late Palaeogene times.

The biostratigraphical significance of the charophytes from Whitecliff Bay is discussed in the Tertiary stratigraphy GCR volume (Daley in Daley and Balson, 1999).

Conclusions

Whitecliff Bay has yielded the best sequence of pollen and spores through the Eocene strata of Western Europe. It has also yielded a sparse macrofossil record and stratigraphically important charophyte floras. It is the only place to show clearly the pattern of vegetational changes that were occurring through a 20 Ma interval (55–35 Ma ago) as the climate gradually cooled from the Eocene 'greenhouse' conditions towards the onset of 'icehouse' conditions.

References