Chapter 8 Early and early middle Eocene (Ypresian–Lutetian) Palaeobotany of Great Britain

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Introduction

The early and middle part of the Eocene Epoch included a thermal maximum and prolonged warmth (greenhouse world') when vegetation across southern England was similar to modern tropical rain forests bordered by a coastal *Nypa*-dominated mangrove ((Figure 8.1); Collinson, 1996b, 2000 a,b). These floras are represented in the London Clay Formation and associated deposits, the Poole Formation (traditionally known as the 'Dorset Pipe Clay') and the Bracklesham Group, and are among the best-known early Tertiary floras in the world. The apparent presence of a 'tropical rain forest' in Britain, combined with the abundance of the fossils at coastal exposures, has meant that sites such as Sheppey have attracted collectors since at least the 18th century. The Poole Formation and Bracklesham Group sites have not yielded such diverse assemblages and have not therefore been as extensively studied. However, they represent different sedimentary facies to the London Clay and thus complement the fossil floras found in the latter deposits.

History of research

Plant fossils have been noticed in the London Clay for over 300 years, especially in coastal exposures such as Sheppey, where the large *Nypa* fruits are difficult to ignore. The early research on the London Clay floras was very much concentrated at Sheppey and an outline of the work is given in the introduction to that site report later in this chapter (see also Reid and Chandler, 1933; Chandler, 1961a; Andrews, 1980). The first extensive study was by Reid and Chandler (1933), who described nearly 300 species, mainly from Sheppey, and placed the London Clay firmly on the palaeobotanical map. Additions to this work were made by Chandler (1961a, 1964, 1978) and an identification guide to the fossils has been prepared by Collinson (1983b). The 'twig' floras have been reviewed and studied by Wilkinson (1981, 1984, 1988) and Poole (1992, 1993a,b).

Being so near to large centres of population and having such extensive coastal exposure, it is not surprising that the London Clay attracted considerable attention from collectors, especially after Reid and Chandler (1933) had drawn attention to the diversity of the floras that it contains. For instance, a local collector, D.J. Jenkins, was largely responsible for uncovering the palaeobotanical interest at Herne Bay. Another local collector, E.M. Venables, discovered the plant beds at Bognor. In more recent years, the Tertiary Research Group has focused much of the attention on the London Clay palaeobotany and their journal (*Tertiary Times,* later renamed *Tertiary Research*) has contained many useful papers on the subject. In most cases, the fossils found by these collectors have found their way into museums and have been incorporated into the body of knowledge on the early Eocene vegetation of southern Britain, as presented by Chandler (1961a, 1964) and Collinson (1983b), among others.

In the eastern Hampshire Basin, the London Clay is succeeded by the Bracklesham Group. Dixon (1850) first reported the presence of plant fossils in these beds and Carruthers (in Dixon, 1878) published a summary of the flora. Gardner (1884), Rendle (1894) and Reid (1897) described individual specimens from these deposits and Chandler (1961b) reviewed the then-available information. The most recent account has been by Collinson (1996b), who described new material from Bracklesham, documented the stratigraphical distribution of the different species, and reconstructed the vegetation and palaeoecology.

The Poole Formation (traditionally referred to as the 'Dorset Pipe Clays') in the western part of the Hampshire Basin is a fluviatile succession that is at least partly time-equivalent to the Bracklesham Group. Sites such as Studland and Corfe yielded numerous leaf fossils, such as the well-known remains of the fan-palm named *Trachycarpus* (Brodie, 1853; Gardner, 1877, 1886a; Gardner and von Ettingshausen, 1879; Chandler, 1962). The Alum Bay plant beds on the Isle of

Wight also attracted some attention (see La Harpe and Salter (in Bristow, 1862), Gardner (in Reid and Strahan, 1889) and Crane, 1977, 1978). The less obvious fruit and seed flora, first discovered in the Poole Formation in the 1930s, has proved to be of considerable scientific interest, providing a complement to the London Clay flora (Chandler, 1962; Collinson, 1996b). Fragmentary fern fossils have also attracted some interest (Chandler, 1955; Collinson, 1996a, in press a).

Palaeogeographical setting

The palaeogeography of early Eocene times was generally similar to that of the Palaeocene (Figure 8.2). The most notable difference in the region near the British Isles is the separation of Greenland from Europe, which broke the land connection between Europe and North America that allowed plant migration.

Much of south-eastern England was under shallow sea during early Eocene times, which resulted in the deposition of the Thames and Bracklesham Groups (Figure 8.3). Lower Eocene deposits mainly occur in two areas known as the 'London Basin' and 'Hampshire Basin'. These are purely structural basins, and these two areas were originally part of the same depositional basin that covered much of the present-day North Sea, north-east France, and south-east England (Figure 8.3). It was mainly a shallow marine basin with mainly mud deposition, but with alluvial-plain deposits forming on the western margins, the latter represented by the Poole Formation.

Stratigraphical background

There has been much disagreement about the lithostratigraphical classification and correlation of these deposits in southern England, at least partly because of the difficulties in relating the marine and non-marine sequences that occur in different parts of the area. Terms such as the 'London Clay', 'Bracklesham Beds' and 'Dorset Pipe Clay' have been widely used in the literature, but often with very loose definitions.

The most comprehensive revision of the London Clay part of the sequence was by King (1981), who attempted detailed correlations of the sequences in different parts of south-eastern England. He referred to all of the London Clay (*sensu lato*) as the Thames Group. Below the classic London Clay sequences are more sandy beds sometimes referred to as the Basement Beds, which were formally identified as the Oldhaven Formation. The London Clay proper was divided into five informal divisions, termed 'A' to 'E', with divisions 'A ' and 'B' being further subdivided into two and three subunits, respectively. He also recognized members within his London Clay Formation, defined on local developments of distinctive facies. However, the informal divisions were defined by discontinuities within the sequence, which he claimed to be able to recognize throughout most of southeastern England, and these have tended to be most widely used by subsequent authors. The only significant alteration to King's scheme has been by Ellison *et al.* (1994), who combined the Oldhaven Formation and King's A1 subdivision to form the Harwich Formation. These strata fall within the interval of the Palaeocene–Eocene transition and the floras within them have been described in Chapter 7.

The beds overlying the Thames Group are more arenaceous and represent shallow marine or alluvial deposits. In the London Basin they are alluvial deposits known as the Virginia Water Formation. These have not yielded any significant plant macrofossils. In the eastern part of the Hampshire Basin, they are shallow marine or marginal deposits referred to as the Bracklesham Group. Following Edwards and Freshney (1987), these are divided into the Wittering, Earnley, Marsh Farm and Selsey Formations. Further west are alluvial sequences that are referred to as the 'Poole Formation' (formerly the 'Dorset Pipe Clays'). Detailed correlations between these higher beds in the Hampshire Basin have always been problematic but a scheme recently established by Hooker and Collinson (in Collinson, 1996b) is shown in (Figure 8.4).

Early and early middle Eocene vegetation

The four major palaeofloristic zones recognized in the Palaeocene Epoch continued to be present in early Eocene times (Figure 8.2). The British floras all belong to the Tethyan Palaeoarea of the Holarctic Palaeokingdom. In early Eocene times, a zone of lush vegetation had developed in Britain, strongly reminiscent of today's tropical rain forests, dominated by evergreen trees of the sumac, custard apple, dillenia, dogbane, frankincense, flacourtia, icacina, laurel, palm, sabia,

soap berry and tea families, and mastic trees of the dogwood family. There were also abundant lianas of the icacina, grape vine and moonseed families. The coastal areas were fringed by dense stands of mangrove palms (*Nypa*) with rare true mangroves (*Ceriops*) (Collinson, 1993, 1996b, 2000a,b). The vegetation has been compared with the modern para-tropical rain forests of lowland Asia, although there are some clear differences, such as the extreme rarity of dipterocarps and the apparent absence of flowering plant epiphytes (Collinson, 1983b, 2000b, in press b).

Early and early middle Eocene palaeobotanical sites in Britain

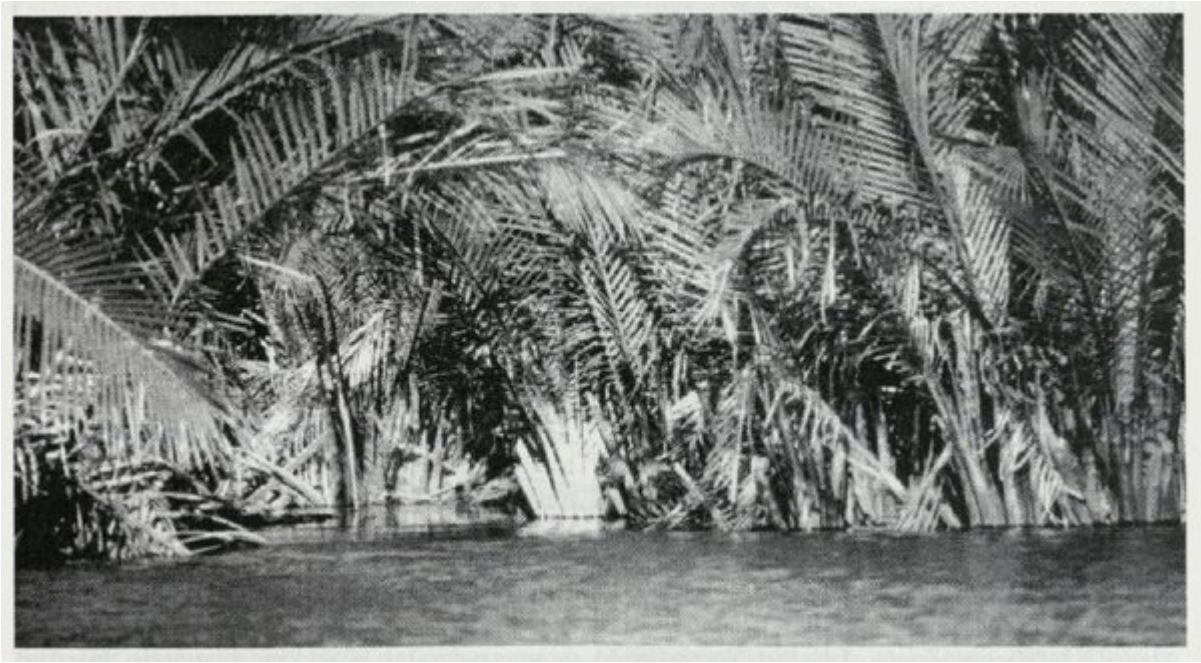
These palaeobotanical sites can be divided into three categories. The first group yields the classic Tethyan floras of division A2 and above of the London Clay. There are four principal British sites that have this flora, Sheppey, Bognor Regis, Herne Bay and Wrabness. Although all four yield broadly similar assemblages, each has its own particular strengths and each occurs at a different stratigraphical level (Collinson, 1983b), so that all must be included in the GCR network.

The second category is sites for the Poole Formation floras. These are contemporaneous with the London Clay but represent a more inland type of vegetation. Only two sites are currently known to yield significant numbers of plant fossils, Lake and Arne. Because each of these sites yields a somewhat different assemblage, they have both been selected for inclusion in the GCR network.

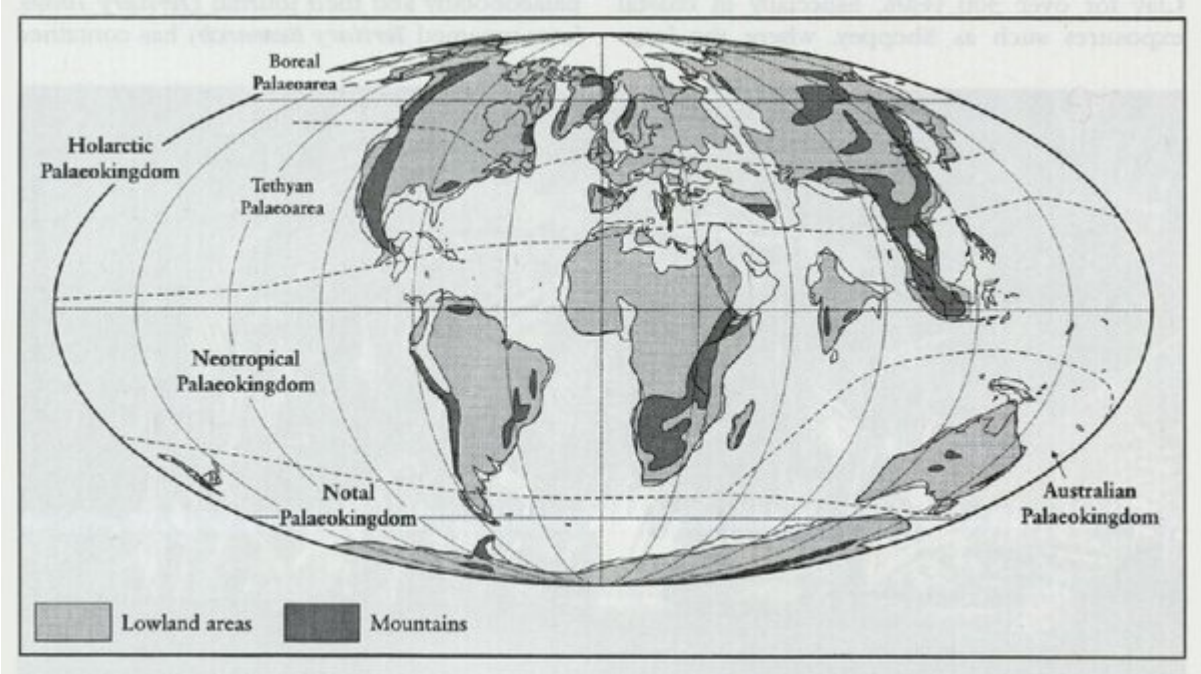
In the Bracklesham Group, the only place to have yielded any quantity of plant macrofossils is Bracklesham Bay, which has therefore been selected as a GCR site. Whitecliff Bay has yielded some plant macrofossils, as well as making a major contribution to the palynological record. Normally, sites with dominant palynological interest are not included within the relevant GCR palaeobotany network, but the palynological evidence from Whitecliff Bay is so important for enhancing the understanding of vegetational change in the Eocene Epoch of Britain, that an exception has been made. Other palaeobotanical sites in the Bracklesham Group, such as those mentioned by Collinson (1996b), have yet to be studied in detail and some were temporary exposures.

The historically important site of Bournemouth Cliffs (Daley in Daley and Balson, 1999) is no longer accessible (Collinson, pers. obs.). The palaeobotanical interest (using museum collections) was summarized by Collinson (1996b, p. 195) and McElwain (1998) used leaves to deduce elevated CO_2 levels during the Eocene 'greenhouse world'.

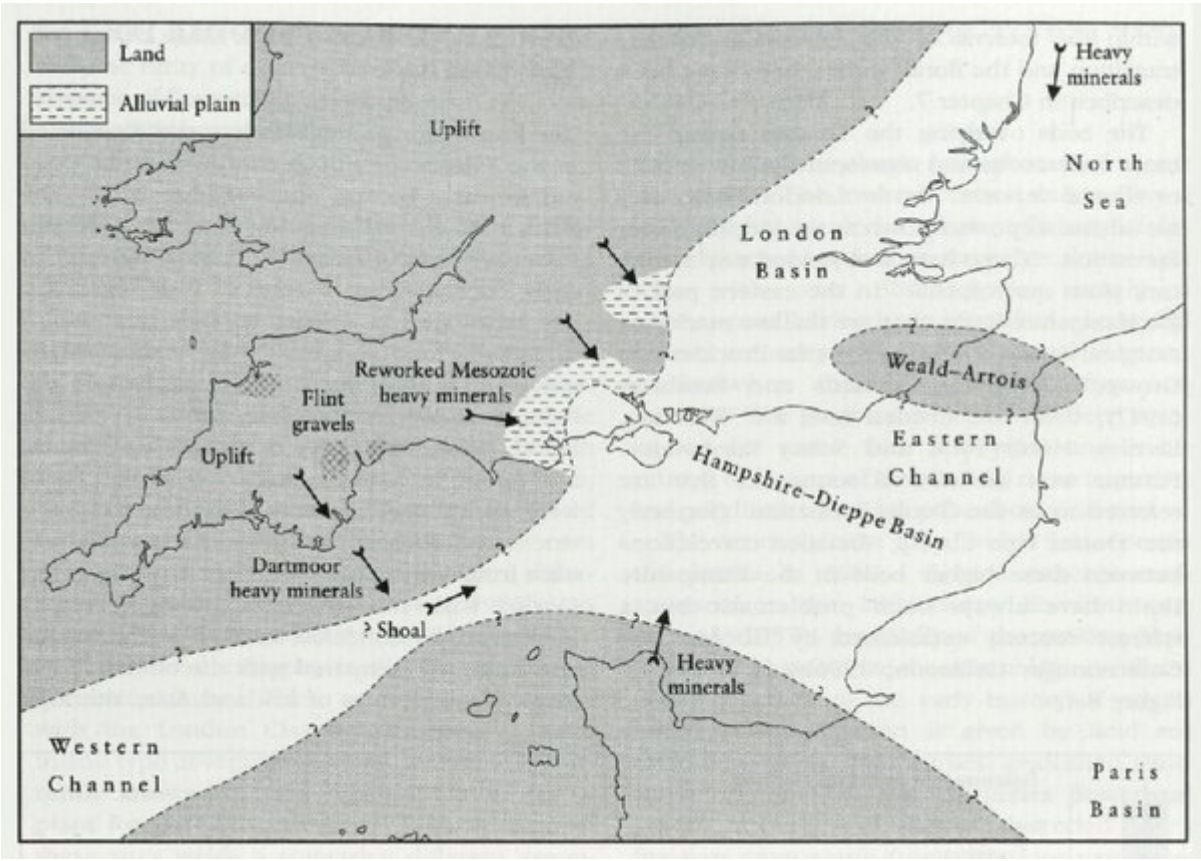
References



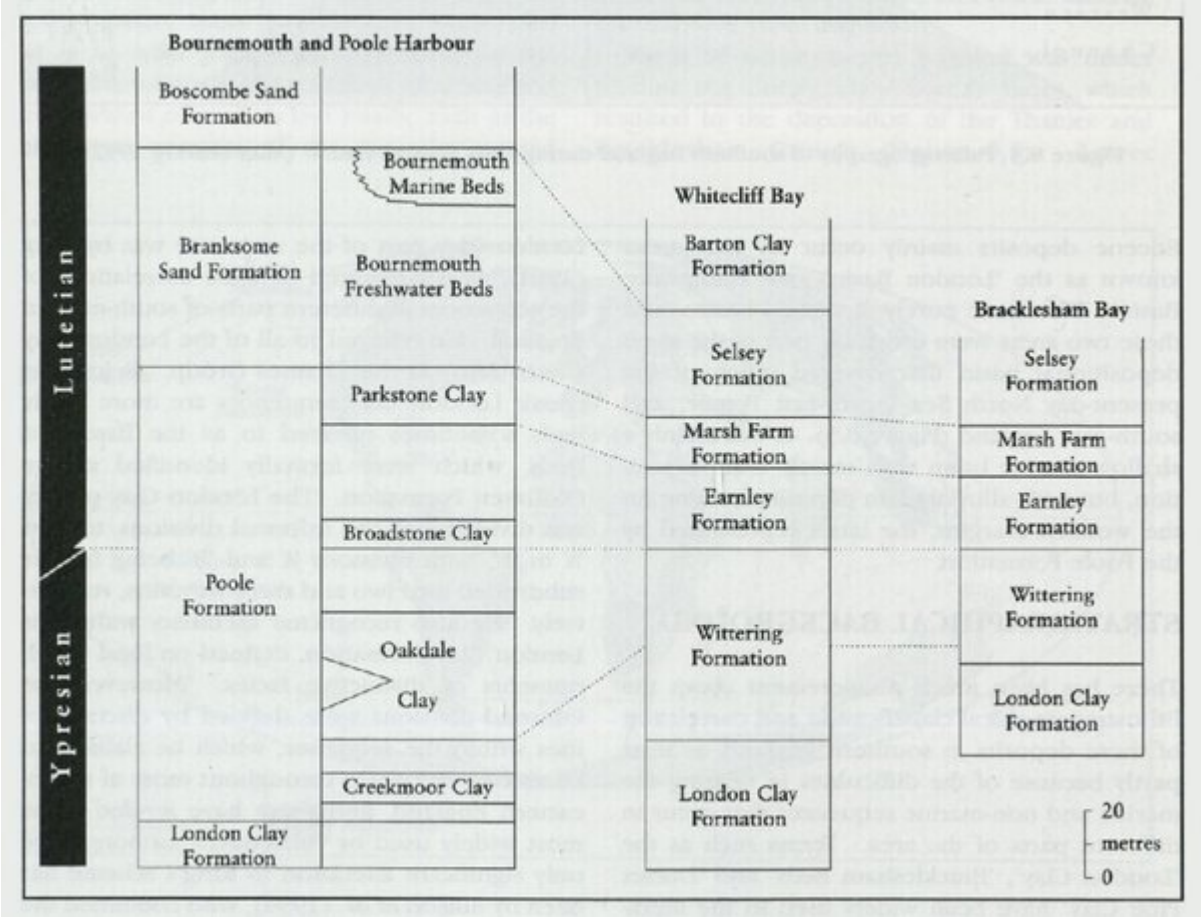
(Figure 8.1) Modem Nypa mangrove, Kapuas delta, Kalimantan, Indonesia. (Photo: M.E. Collinson.)



(Figure 8.2) Palaeogeography of the Early Eocene world, showing main areas of land and mountains. Based on Smith et al., 1994. Also shown are the main palaeofloristic areas, based on Akhmetyev (1987).



(Figure 8.3) Palaeogeography of southern England during early Eocene times. (After Murray, 1992.)



(Figure 8.4) Correlation of the Bracklesham Group and Poole Formation in the Hampshire Basin. (After Hooker and Collinson, in Collinson, 1996h.)