
Felpham

[SZ 949 993]

Introduction

Felpham is the only known site to yield a diverse assemblage of fossil fruits and seeds from the middle part of the Palaeocene–Eocene transition beds in the Reading Formation of Britain. Four new genera and 16 new species have been found here. Felpham is the only available site where floras can be studied near the 'late Palaeocene' thermal maximum, and which provide an important contrast with the later Eocene floras. It is also the only known site where in-situ palms can be seen (see (Figure 7.10)).

The Reading Formation is best known for its leaf floras, such as that found at Cold Ash. However, these do not produce the variety of evidence on reproductive structures that is necessary for comparison with other floras. Some seeds have been reported from Cold Ash, but the only place where a reasonably diverse fruit and seed assemblage has been found is Felpham. Full details of the palaeobotany here have yet to be published, but Collinson (in Bone, 1986) has given a preliminary report and it is briefly referred to by Collinson and Hooker (1987), and Collinson (1990b, 1996a, 2000a). Van Bergen *et al.* (1993) include specimens from here in their study of *Salvinia* microspore massulae and megaspores.

Description

Stratigraphy

The foreshore exposures at Felpham, (Figure 7.7) whose geology was described by Bone (1986), are represented in (Figure 7.8). About 17 m of mainly mottled clays disconformably overlie Chalk deposits. Bone (1986) estimated that a further 12 m of mottled clays are obscured by alluvium, which are in turn overlain by brown clays probably of the London Clay Formation. There are no biostratigraphically useful animal macrofossils in the clays. However, lithostratigraphical correlation is with the Reading Formation, which indicates that they are in the Palaeocene–Eocene boundary interval and slightly post-dating a record of the carbon isotope excursion (CIE) that indicates the 'late Palaeocene' thermal maximum (Collinson, 2000a).

In the upper part of the exposed Reading Formation here is a 1.6-m thick lignite bed, which is one source of the plant fossils. There is also a channel deposit that cuts down into the lignite and has also yielded plant fossils.

Palaeobotany

Knowledge of the Felpham flora is mainly derived from 'a preliminary report' by Collinson (in Bone, 1986) and Collinson (2000a). From the clays in the lignite bed and from the channel deposit, she reports a diverse assemblage of fruits and seeds. The most abundant are from aquatic plants. In the clays associated with the lignite bed are the remains of the sedge *Caricoidea obovata* Chandler, a water lily *Sabrenia* sp. nov. and a water soldier *Stratiotes* sp. nov. (see Collinson, 1990a, pp. 50–1). This suggests shallow-water vegetation in a marsh setting. In contrast, the channel mainly yielded the water fern *Salvinia* sp. (see also van Bergen *et al.*, 1993) and the loosestrife *Decodon* sp. nov., which Collinson suggested as growing on water margins.

Less abundant, but more diverse, are the remains of forest trees and lianas, including the angiosperms of the frankincense, dogwood, squash, icacina, moonseed, rue, tea and grape families. The only named species were *Natsiatum eocenicum* Chandler, *Icacinicarya inornata* Chandler and *Vitis* sp.. However, Collinson mentioned that the elements of the frankincense, rue and grape families were probably conspecific with forms found in the early and middle Eocene deposits. In contrast, among the squash, moonseed and tea families, there are at least three new genera and several new species (Collinson, 2000a). In particular, a *Trichosanthes*-like seed, a new genus of Theaceae seed, (Figure 7.9) and a *Decodon*-like seed characterize the flora of the 'late Palaeocene thermal maximum' (LPTM). Also abundant

are *Rhamnospermum bilobatum* Chandler, whose affinities remain totally obscure. Also present here are fertile pinnules of the schizeaecean fern *Anemia poolensis* Chandler (Collinson, 1990a, 1996a, in press a). There are a number of other floral elements that have not yet been identified (Collinson, pers. obs.).

Sideritic nodules within the lignite bed have yielded leaf adpressions of probable lauralean affinities, small compound fruits, petrified fern rachises very similar to those of the London Clay, and coniferous (?redwood) cones. The lignite bed also contains in-situ petrified tree stumps yielding palm anatomy ((Figure 7.10); Collinson, 1990a) and large compressed logs as yet unidentified (Bone, 1986).

Interpretation

This is the only site in Britain to yield a diverse suite of fruit and seed fossils from the Palaeocene–Eocene boundary beds, and it provides the only opportunity to compare the vegetation of this time with the later Eocene floras (see Chapter 8). The bulk of the flora represents palm-dominated swamp vegetation, quite different from the London Clay floras, such as from Sheppey. A number of essentially tropical families found in the London Clay also occur here, including the frankincense, dogwood, squash, icacina, moonseed, rue, tea and grape families. However, most of the tropical families that characterize the Ypresian floras do not occur at Felpham, suggesting that the paratropical rain forests had not yet fully developed in southern England.

The aquatic vegetation, whose remains dominate the Felpham flora, also differs from that represented in the Ypresian and Lutetian. The commonest species here, *Carcoidea obovata*, is unknown from horizons above the Reading Formation, and the new species of *Sabrenia* and *Stratiotes* are not known from anywhere else in Britain. '*Scirpus*' *lakensis*, which is a diagnostic element of the Ypresian and Lutetian aquatic floras, is unknown from Felpham, or from any other Reading Formation locality.

Felpham has yielded the only example of the water fern *Salvinia* from a conservable site in Britain and is one of the few early records of this genus in Europe. The chemistry of these fossils has been studied by van Bergen *et al.* (1993).

There appears to be a marked contrast with the adpression floras from other Reading Formation sites, such as Cold Ash, where the remains of plants such as *Palaeocarpinus* and *Cercidiphyllum*-like plants dominate. However, this is probably because the Felpham deposits represent a marsh setting, which was unsuited to those two plants (see Collinson, in Bone, 1986).

This is the only known site in Britain to have yielded palm stumps (Bone, 1986; Collinson, 1990a; (Figure 7.10)). Their identity was confirmed through observations on the anatomy of the trunk. Collinson (in Bone, 1986) reported that they occur at intervals of 1–4 m, suggesting they were dominant elements in the swamp vegetation, which was thus similar to some areas of the Florida Everglades of today.

Fruit and seed floras from the Palaeocene–Eocene transition are extremely rare worldwide, making Felpham a site of international importance. Detailed comparisons are difficult because, although known for well over a decade, the flora has not been fully described in the literature. However, Collinson (in Bone, 1986) remarked that for several genera, Felpham represented the earliest known occurrence and was thus potentially important for understanding the early evolution of the relevant groups.

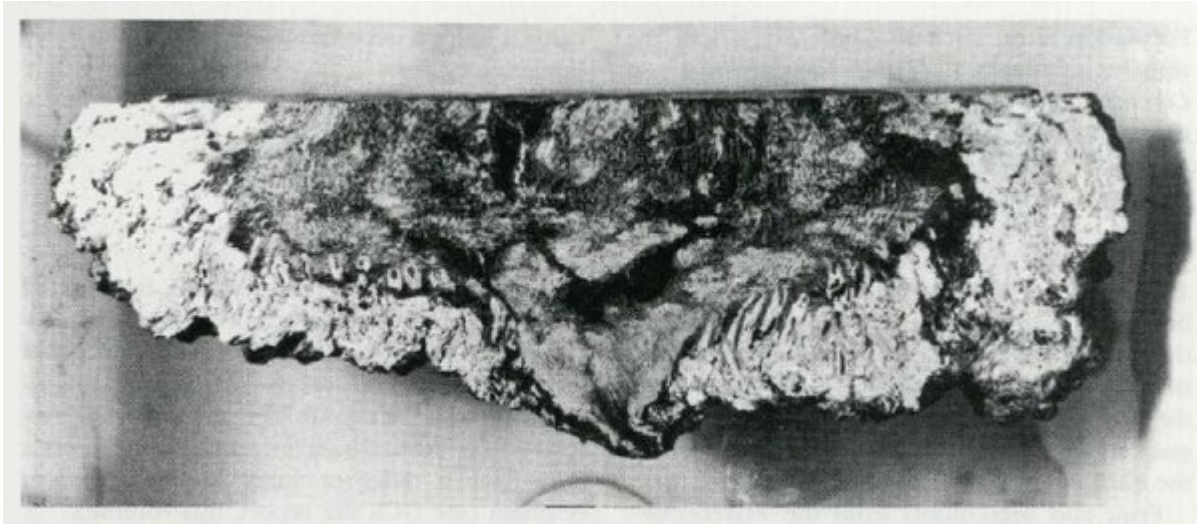
Collinson (2000a) has recognized that the distinctive flora at Felpham characterizes the interval near, or at, the 'late Palaeocene thermal maximum' (LPTM). Comparable floras were also identified from temporary exposures at St Pancras and Croydon, but Felpham is the only conservable site to yield the assemblage. The site is therefore of international importance for understanding global climatic change near the Palaeocene–Eocene boundary.

Conclusions

The foreshore at Felpham is the only site in Britain to yield a diverse assemblage of fruits and seeds from the Palaeocene–Eocene transition beds, c. 54 Ma old. It is one of the very few such floras of this age known worldwide and

is thus of international importance for understanding the global climatic and vegetational changes taking place at this time. It represents a mainly marsh community dominated by aquatic plants (e.g. sedge-like plants), but also includes remains of paratropical rain forest trees and lianas. Of additional interest is the presence of in-situ stumps of palm trees, the first such stumps found in Britain. Although still to be fully studied, Felpham seems to represent the earliest known occurrences of several genera of flowering plants.

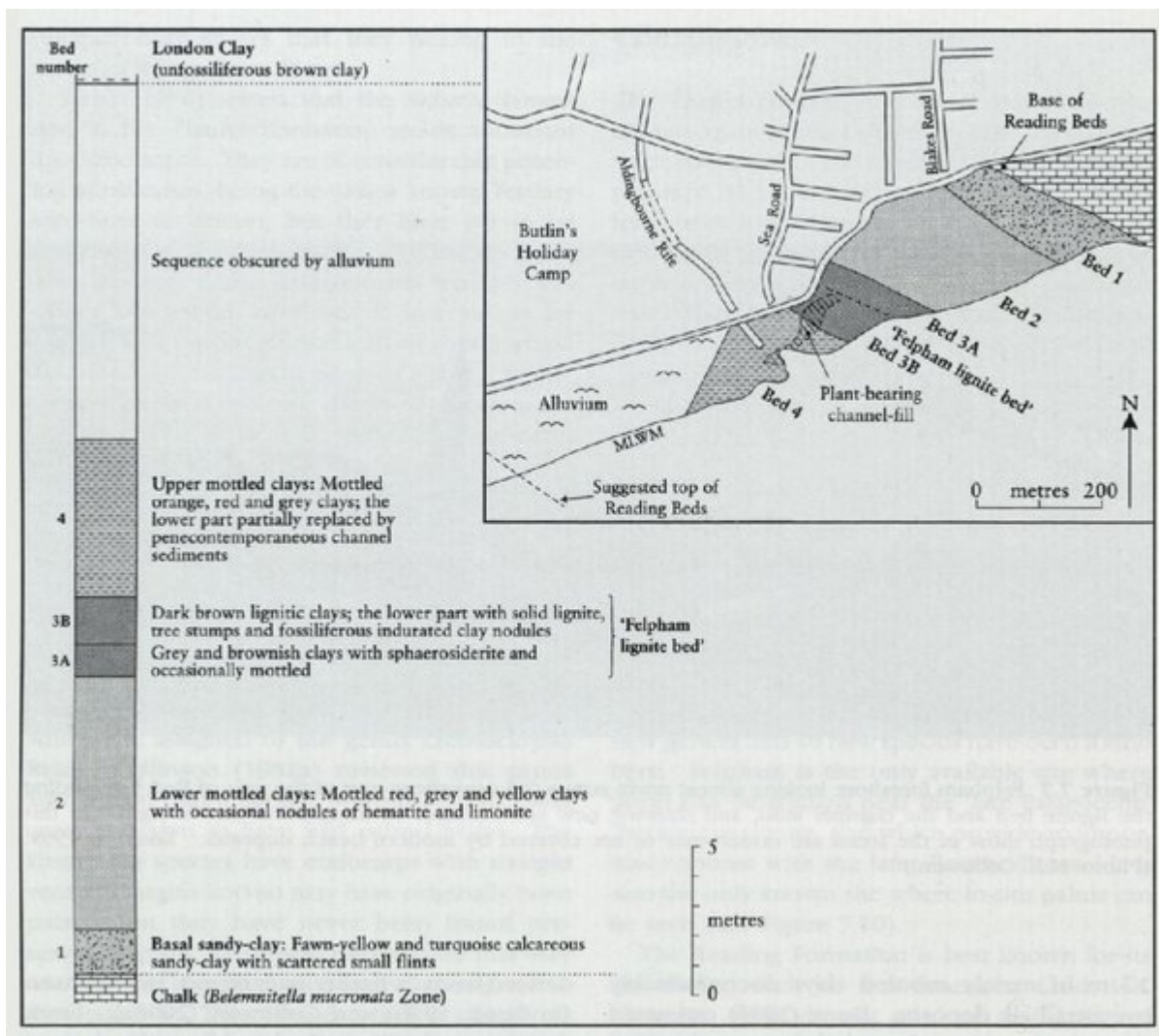
References



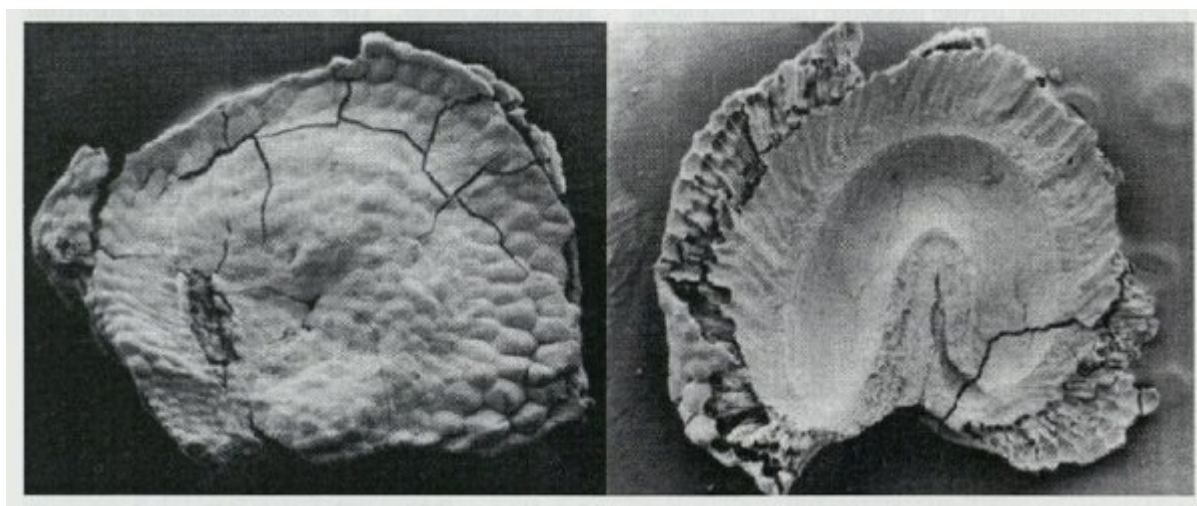
(Figure 7.10) Longitudinal polished cut surface of lower part of a partly pyritized palm stump, collected in situ at Felpham, $\times 0.3$ (see Collinson in Bone, 1986; Collinson, 1990a). (Photo: Natural History Museum, London.)



(Figure 7.7) Felpham foreshore looking almost north across the near-shore part of the area of Bed 3, including the lignite bed and the channel infill, and showing new sea defences in foreground and at right. In this photograph most of the strata are underwater or are covered by modern beach deposits. Taken in 1999. (Photo: M.E. Collinson.)



(Figure 7.8) Reading Formation exposed on the shore at Felpham, near Bognor Regis, including the Telpham Lignite Bed'. (After Bone, 1986.)



(Figure 7.9) A new genus of *Theaceae* seed from Felpham. On the left is a complete specimen, on the right a longitudinal fracture showing the internal anatomy of half the seed; both $\times 15$. (Photos: M.E. Collinson.)