
Herne Bay

[TR 185 685]–[TR 224 693]

Introduction

Herne Bay is one of the most important Palaeogene sites in the London Basin and has been independently selected as a GCR site for its stratigraphical interest (Daley in Daley and Balson, 1999, p.34). It is also of considerable interest for palaeobotany, yielding the only significant flora from the Thanet Formation. It contains the only unequivocal Palaeocene flora known from Britain.

Plant fossils have been reported from several stratigraphical levels, the best documented being fruits and seeds from the A2 division of the London Clay Formation (see Herne Bay GCR site report in Chapter 8). However, the palaeobotany of the underlying Tertiary deposits has not been investigated to the same extent. Silicified pine cones (Prestwich, 1854; Gardner, 1883–1886a; Chandler, 1961a), fern stems (Carruthers, 1870b, 1872; Kidston and Gwynne-Vaughan, 1907; Chandler, 1961a, 1965) and angiosperm wood (Crawley, in press) have been described from the Thanet Formation. Ward (1978) lists other plants from the Thanet Formation and Upnor Formation, although none have yet been figured. Megaspores, both original and reworked, were described from the Thanet Formation by Collinson *et al.* (1985). Chandler (1961a, 1964) described fruits and seeds from the Oldhaven Beds.

Description

Stratigraphy

Daley (in Daley and Balson, 1999) gives an account of the geology at Herne Bay, including a review of the complexities of the lithostratigraphical nomenclature. Using the classification proposed by Ellison *et al.* (1994), the section here consists of 17.5 m of Thanet Formation, overlain by 5.6 m of Upnor Formation. This in turn is overlain unconformably by deposits of the Thames Group (Oldhaven Beds and London Clay Formation). The sequence is shown in (Figure 7.4), which also identifies the levels of the main plant beds.

Palaeobotany

Chandler (1961a) described from the Thanet Formation here two species of pinacean cone, *Pinus prestwichii* Gardner and *P macrocephalus* Gardner, and a silicified stem of the fern *Osmunda dowkeri* (Carruthers) Miller ((Figure 7.5); see also Carruthers 1870b, 1872; Kidston and Gwynne-Vaughan, 1907; Chandler, 1965; Collinson, in press a). From the *Astarte tenera* Bed in the middle Thanet Formation, Ward (1978) recorded *Canticocculus* sp. and *Iodes multireticulata* Reid and Chandler), together with a fragment of the pine cone *Pinus macrocephalus* Gardner. Later he reported (in Daley and Balson, 1999) that these beds have yielded a rich seed flora, and Collinson (pers. obs.) has found distinctive but so far unidentified fruits and seeds from here. There is clearly considerable research potential here.

Ward (1978) also recorded *Iodes multireticulata* from the *Corbula regulbiensis* Bed near the top of the Thanet Formation, while Brett (1960) described wood from this level. The overlying Upnor Formation (lowermost Palaeocene–Eocene transition interval) has yielded *I. multireticulata*, *P macrocephalus* and seeds of *Vitis* sp..

Collinson *et al.* (1985) described numerous megaspores from the Thanet Formation at Herne Bay. Many were reworked from Mesozoic and Palaeozoic strata, and suggested that the sediments of the Thanet Formation were derived by longshore drift from the eastern coast of Britain. However, there were also original Tertiary megaspores here, including *Minerisporites glossoferus* (Dijkstra) Tschudy emend. Batten and Collinson (in press) and *Erlansonisporites* sp. (both of lycophyte origin) and *Azolla* cf. *BeiträgeFlörschutz*. Following a revision of the type material, Batten and Collinson (in press) have shown the presence of both *M. glossoferus* and *M mirabilis* (Miner) Potonié emend. Batten and Collinson in the Thanet Formation Flora (Figure 7.6).

Chandler (1961a, 1964) described a number of species from the Oldhaven Beds at Herne Bay, some new to science. This flora comes from the latest part of the Palaeocene–Eocene transitional interval. For those species marked below with '*', Herne Bay is the type locality.

Icacinaceae

Natsiatum eocenicum Chandler (see footnote to (Table 8.1))

Lauraceae

Laurocarpum sp. (*Cinnamomum*?)

L. spp.

Menispermaceae

**Cocculus cooperi* (Chandler) Mai 1987

**C.? serratus* (Chandler) Chandler

Tinospora excavata Reid and Chandler

Potamogetonaceae

**Limnocarpus cooperi* Chandler (see Collinson, 1982a)

**L.? magnus* Chandler

L. sp.

Symplocaceae

?*Symplocos* sp.

Rutaceae

Zanthoxylon sp.

Theaceae

**Cleyera? cooperi* (Chandler) Chandler

C.? variable (Ludwig) Chandler

Vitaceae

Vitis spp.

In addition, there were generically unattributable examples of ?palm, epacris, spurge and buckthorn families.

Brett (1966) described a wood of the cashew nut family from a loose beach specimen judged, on the basis of sediment infillings of *Teredo* borings, to have come from the Woolwich Formation (Palaeocene–Eocene transition) at Herne Bay.

Interpretation

Herne Bay is of outstanding palaeobotanical interest for yielding plant fossils from the Palaeocene and early Eocene strata, providing insight into the stratigraphical changes in the plant fossil record through this interval. However, it is significant that each of the three main plant-bearing units (Thanet Formation, Oldhaven Beds and the A2 division of the London Clay Formation) yields significant floras and each is worthy of selection as a GCR site on its own merit. The last is dealt with in the next chapter.

Herne Bay is the only known site to yield plant macrofossils from the Thanet and Upnor formations, making them the oldest known Tertiary plant fossils in Britain. The best documented are the silicified osmundacean fern stem (Figure 7.5) and two pine cones (Carruthers 1870b, 1872; Kidston and Gwynne-Vaughan, 1907; Chandler, 1961a, 1965).

Herne Bay is the type locality for *Osmunda dowkeri*. Two silicified pieces of stem have been found here, one described by Carruthers (1870b, 1872), the other by Chandler (1961a). The detailed anatomy was very finely preserved, including starch grains within the cells, and there is no doubt as to its osmundacean affinities (Miller, 1967, 1971). The stem is important for confirming the presence in the Tertiary deposits of Europe of the subgenus *Plenasium*, which today is restricted to East and Southeast Asia (Collinson, in press a). Other fossil evidence of this subgenus in Europe comes from sterile and fertile fronds known as *Osmunda lignitum* (Giebel) Stur from the Eocene to Miocene deposits of Europe (Barthel, 1976; Collinson, in press a).

The pine cones are known from both silica petrifications and carbonaceous fossils. Two species have been distinguished on size and shape of the cone and on the form of swellings on the cone scale; for one of these species (*P. prestwichii*) Herne Bay is the type locality. The anatomy of both species is well preserved and unequivocally shows that they belong to the genus of living pines, *Pinus*.

Ward (1978) stated that the *Astarte tenera* Bed in the Thanet Formation yields abundant fossilized seeds. They are of considerable potential significance, being the oldest known Tertiary seed-flora in Britain, but they have yet to be described in the literature. Collinson (pers. obs.) has also found determinable wood in the Upnor Formation here but it has yet to be described. The megaspores from this horizon described by Collinson *et al.* (1985) provide some of the best evidence of lycophytes from the Tertiary rocks of Britain, including isoetalean forms and *Selaginella*-like forms. They confirm the importance of heterosporous lycophytes and water ferns in the British Palaeocene record, as in the floras of the same age in continental Europe (Collinson and Hooker, 1987; Batten and Collinson, in press).

From the Oldhaven Beds flora at Herne Bay, Chandler (1961a) described three types of seed thought to belong to the pondweed family, and which she assigned to the genus *Limnocarpus* Reid. Collinson (1982a) reviewed this genus and argued that it should be restricted to those species known to have had paired fruits. The Herne Bay species have endocarps with straight ventral margins and so may have originally been paired, but they have never been found preserved in pairs. Collinson thus argued that they can only be regarded as tentatively assigned to *Limnocarpus*. They are nevertheless of interest as the only known examples of this aquatic family from the Thames Group, and the oldest known from Britain.

Three species of the form-genus *Myrtospermum* were recognized by Chandler (1961a). One was later provisionally transferred to the palms (Chandler, 1964), while the other two (*M. cooperi* and *M. variabile*) were placed in the tea family. Chandler (1964) suggested that the latter two species might belong to the living genus *Cleyera* although Collinson (1983b) stated that they could equally belong to *Eurya*.

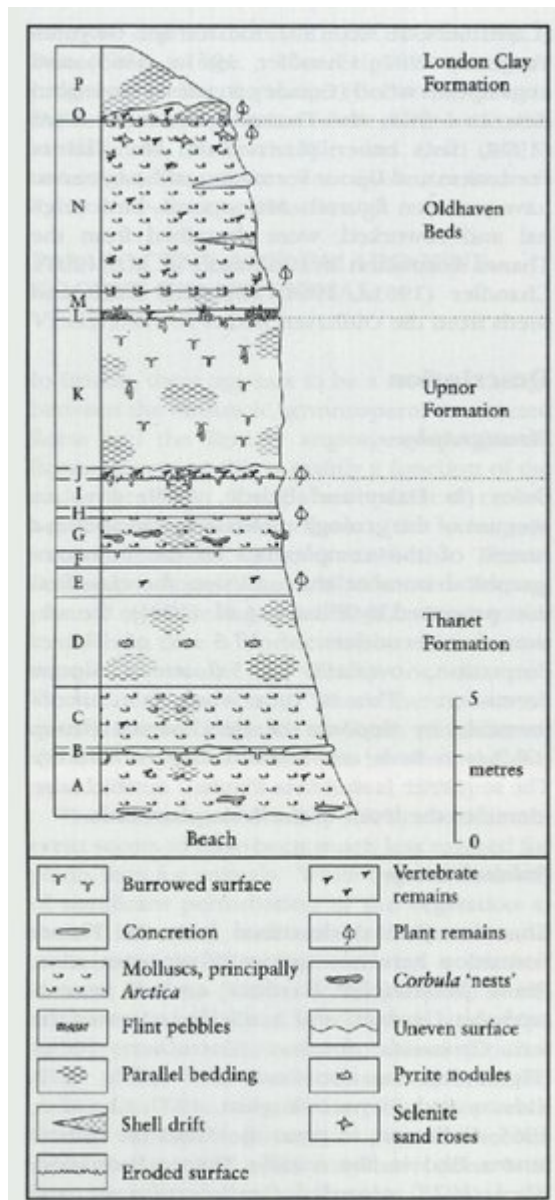
Chandler (1961a) assigned a seed of the moonseed family with a prominent serrated ornamentation to *Menispermicarpum serratum*. However, she subsequently discovered that the living *Cocculus* can also have such ornamentation and so provisionally transferred the Herne Bay species to this genus (Chandler, 1964). Mai (1987) also transferred Chandler's *Canticocculus cooperi* to the genus *Cocculus*.

Conclusions

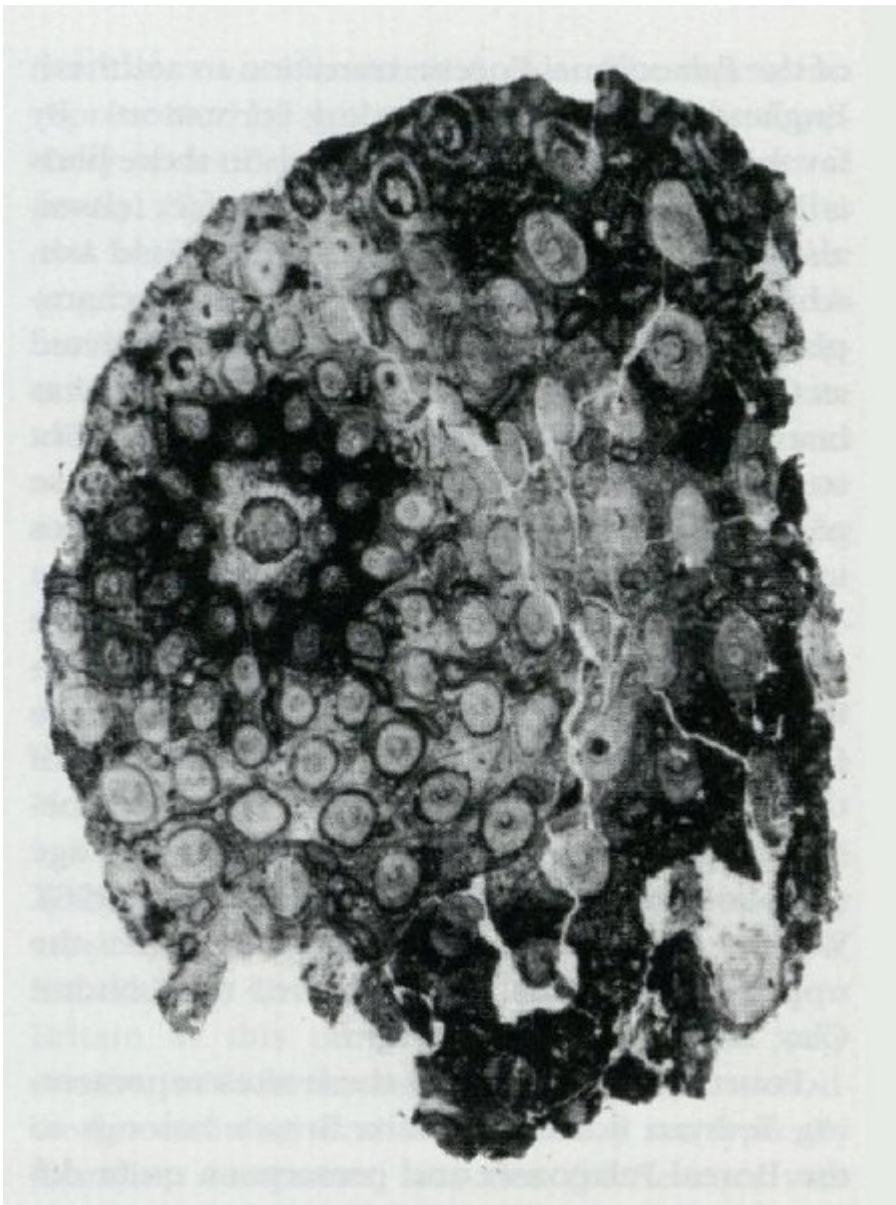
The Thanet Formation at Herne Bay yields the oldest known flora from Britain containing angiosperm fruits and seeds, and heterosporous plants, c. 55 Ma old. It has also yielded petrified fern stems and conifer cones, which show details of

their anatomy. Herne Bay is the only site to have yielded a fossil flora from the Oldhaven Beds, a distinctive lithology that is essentially coeval with the division A1 of the London Clay at Walton-on-the-Naze and Harwich, and with the Harefield Member at Harefield.

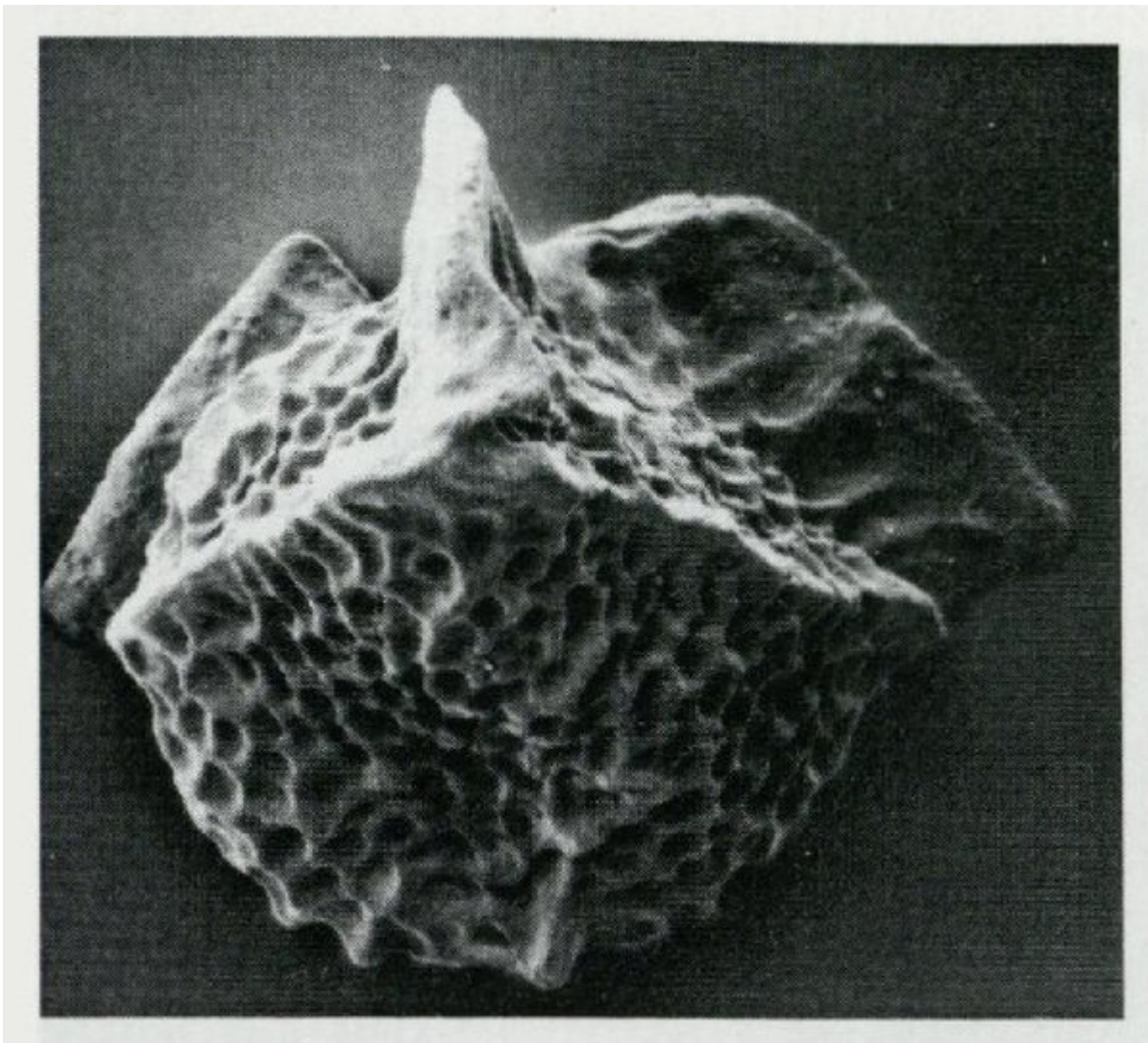
References



(Figure 7.4) Sequence exposed in the cliffs and foreshore at Herne Bay. (After Ward, 1978).



(Figure 7.5) Stem of the fern *Osmunda dowkeri* permineralized by silica, hence showing anatomical detail, $\times 1.8$ (see Chandler, 1965) (specimen number BMNH V.29629c). The specimen was found at Herne Bay and judged to have been derived from the Thanet Formation. The specimen is the holotype of this species. (Photo: Natural History Museum, London.)



(Figure 7.6) Megaspore of *Minerisporites mirabilis*, an early member of the species tending towards *M. glossoferus* morphology, x 120 (see Batten and Collinson, in press). From the Thanet Formation, Herne Bay. (Photo: M.E. Collinson.)

Family	Species	Strat.	Reid	Chandler	Family	Species	Strat.	Reid	Chandler	Family	Species	Strat.	Reid	Chandler	
Rosaceae	<i>Amelanchier canadensis</i> (Mill.) B.S.P.				Rosaceae	<i>Amelanchier canadensis</i> (Mill.) B.S.P.				Rosaceae	<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
	<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.					<i>Amelanchier canadensis</i> (Mill.) B.S.P.				
<i>Amelanchier canadensis</i> (Mill.) B.S.P.				<i>Amelanchier canadensis</i> (Mill.) B.S.P.				<i>Amelanchier canadensis</i> (Mill.) B.S.P.							

(Table 8.1) Angiosperm fruit, seed, wood and twig fossils from the Eocene London Clay GCR sites. Species and details from Reid and Chandler (1933) and Chandler (1961a), unless otherwise referenced. The family classification used here is summarized in Chapter 1 of the present volume.