Lake

[SY 978 908]

Introduction

This is one of only two sites still yielding fossil plants from lower Eocene beds traditionally called the 'Dorset Pipe Clays'. These deposits are of about the same age as the London Clay, but are fluvial rather than marine deposits and thus largely lack the mangrove-palm-dominated vegetation seen in the London Clay. Lake yields the most diverse of the Dorset Pipe Clay floras, containing 69 species of mainly angiosperms and ferns, 30 of which (and 3 genera) are unique to the site.

In the western part of the Hampshire Basin, the London Clay Formation *sensu stricto* is mostly missing, and is replaced by fluviatile sediments. These sediments have included a number of historically important palaeobotanical sites, including Alum Bay on the Isle of Wight (see La Harpe and Salter (in Bristow, 1862), Gardner (in Reid and Strahan, 1889) and Crane, 1977, 1978) and Corfe and Studland in Dorset (Brodie, 1853; Gardner, 1877, 1886a; Gardner and von Ettingshausen, 1879; Chandler, 1962). These leaf beds now yield very little material, but in recent years it has been discovered that there are also fruit and seed deposits, which are much more productive. The site at Lake, on the shore of Poole Harbour, was discovered in 1938 by E. St J. Burton and most of what we know about the flora here is based on his collection (now stored at the Natural History Museum, London). Chandler (1955, 1962) has described the fossils from here, and some were briefly mentioned by Collinson (1980a), who also illustrated a *Ficus* fruit (Collinson, 1989). Fruits of the dogwood family from here were also used in a chemical investigation of fossil resins (van Aarssen *et al.*, 1994).

Description

Stratigraphy

The low cliffs here (Figure 8.19) show fluviatile sands and muds of the Lower Eocene (Ypresian) (Plint, 1988). For recent correlations see Hooker and Collinson in Collinson (1996b). They were originally assigned to the Lower Bagshot Beds, but were renamed as they are older than the true Bagshot Formation in the Thames Valley (Curry *et al.,* 1978). Most of the section consists of poorly consolidated sands with bands of red and white mottled clay, traditionally known as the Dorset Pipe Clay 'Series'. These are sometimes now referred to as the 'Code Member' of the Poole Formation, but we have here continued to refer to them as the 'Dorset Pipe Clays'. In the sands are numerous lenses and thin bands of carbonaceous material, mainly consisting of woody tissue but also containing fruits and seeds.

Palaeobotany

Lake has yielded nearly 70 species of plant fossil, the full assemblage being shown in (Table 8.2).

The enigmatic '*Scirpus*' *lakensis* (see (Figure 8.20)), together with an extinct member of the caper family (*Palaecleome*) and pyrenes of *Ehretia* dominate the flora. There are also numerous seeds of lianas, especially of the icacina, moonseed and grape families. Most species are represented as carbonaceous fossils that have probably suffered significant shrinkage. They reveal no internal anatomical detail, although details of the sclerotic tissue are often preserved. Lake is the type locality for 44 species and 3 genera.

Interpretation

Lake has produced by far the most diverse and well-preserved fossil flora from the Dorset Pipe Clays. The only comparable site is Arne, but that has yielded only just over half the number of species. The Arne fossils also often suffer from the coarse overgrowth of pyrite crystals, which can mask the morphology of the fruits and seeds.

The dominant plant fossils at Lake are what Chandler (1962) identified as isolated fruits of *Scirpus.* However, essentially identical specimens in the Eocene strata at Messel occur within receptacular fruiting heads, showing that they are seeds and thus totally unlike *Scirpus* but more similar to modern Cyclanthaceae (Panama hat family) (Collinson, 1982b, 1988, 1996b). Collinson (1996b) showed that these fossils came from plants that grew along rivers and lakeshores. Further evidence of aquatic conditions is the presence of the water lily, *Palaeonymphaea* (Collinson, 1980a). The relatively high proportion of icacina, moonseed and grape family members probably reflects a dense swathe of lianas, growing on trees surrounding the rivers and lakes, whose fruits dropped directly into the water.

The Dorset Pipe Clay flora at Lake is important because it complements the more diverse London Clay flora, such as found at Sheppey, Bognor Regis and Herne Bay. Whereas the *Nypa–Ceriops* mangrove vegetation that fringed the coast dominates the London Clay flora, the Dorset Pipe Clay flora represents more inland vegetation. Only one example of a *Nypa* fruit has been recorded from the Dorset Pipe Clays, from a temporary exposure near Stoborough, Dorset (Collinson, 1993, 1996b). There are nevertheless many similarities between the floras, especially at the family level. Putting the dominant diagnostic elements of this interval aside (*Nypa* in the London Clay and '*Scirpus'* for the Dorset Pipe Clays — Collinson, 2000a), both assemblages include species of the dillenia, dogbane, dogwood, flacourtia, grape, icacina, moonseed, sapodilla, spurge, sumac, sweetleaf and tea families. There are groups present at Lake and not in the London Clay, including the caper, elder, ebony and styrax families. Nevertheless, it seems that behind the effects of the 'local' mangrove versus lake or river margin vegetation, both floras are representing basically similar, paratropical forests.

(Table 8.2) Composition of floras from the Dorset Pipe Clays, Hampshire Basin. Species descriptions, or references to them, can be found in Chandler (1962), unless otherwise referenced. Discussions on some of these species can also be found in Manchester (1994), Mai and Walther (1978, 1985), Mai (2000) and Collinson (1996b, in press a). The family classification used here is summarized in Chapter 1 of the present volume

Family	**Species**	**Lake**	**Arne**	**Studland**
Pteridaceae	*Acrostichum lanzaeanum* (Visiani) Chandler		×	×
Schizaeaceae	*Lygodium kaulfussii* Heer *emend.* Gardner and Ettingshausen			×
	L. poolensis Chandler	×		
	Anemia poolensis Chandler	×	×	
	Ruffordia subcretacea (Saporta) Barthel, 1976[1]		×	
Taxodiaceae	*Taxodium lakensis* Chandler	×	×	
	Sequoia couttsiae Heer[2]			×
Actinidiaceae	*Saurauia crassisperma* (Chandler) Mai[3]	×		
	S. poolensis (Chandler) Mai, 1970[4]	×		
Anacardiaceae	*Dracontocarya glandulosa* Chandler	×		
	?Lannea sp.	×		
	Rhus lakensis Chandler	×		
	R. spp.	×		

Apocynaceae	*Apocynospermum acutiforme* Chandler[5]	×		
	A. lakense Chandler[5]	×		
Arecaceae	*Calamus daemonorops* (Unger) Chandler	×		
	?cabal sp.		×	
Boraginaceae	*Ehretia lakensis* Chandler	×		
Burseraceae	*Palaeobursera lakensis* Chandler	×		
	Burtonella emarginata Chandler	×	×	×
Capparaceae	*Palaeocleome lakensis* Chandler	×		
	Capparidispermum eocenicum Chandler	×		
Caprifoliaceae	*Sambucus parvula* Chandler	×		
Cornaceae (including Mastixiaceae)	*Dunstania lakensis* Chandler[6]	×		
	Eomastixia rugosa (Zenker) Chandler (see Mai, 1993)	×	×	
	E. urceolata Chandler	×		
	?Mastixia cantiensis Reid and Chandler[7]		×	
	Mastixicarpum crassum Chandler (see Mai, 1993)	×		
	Swida quadrilocularis (Chandler) Mai, 1999[8]	×		
Cucurbitaceae	*Cucurbitospermum lakense* Chandler	×		
	C. obliquum Chandler	×		
Cyperaceae	*'Scirpus' lakensis* Chandler	×	×	
	?Scirpus sp.	×		
	Caricoidea arnei Chandler		×	
	C. obscura Chandler	×		
	?Caricoidea sp.	×		
	Cladiocarva minima (Chandler) Mai in Mai and Walther, 1978[9]		×	
Ebenaceae	*Diospyros headonensis* Chandler	×		

Euphorbiaceae	*Euphorbiotheca lakensis* Chandler	×		
	E. platysperma Chandler	×		
	E. tuberculata Chandler	×		
	E. digitata Chandler	×		
	Euphorbiospermum punctatum Chandler	×		
	Wetherellia variabilis Bowcrbank		×	
Flacourtiaceae	*Oncoba rugosa* Chandler		×	
Hamamelidaceae	*Steinhauera subglobosa* Presl[10]	×		
Icacinaceae	*Iodes acutifornzis* Chandler	×	×	
	Natsiatum eocenicum Chandler[11]	×		
	?Palaeophytocrene foveolata Reid and Chandler	×		
	kacinicarya inornata Chandler	×	×	
Lauraceae	*Laurocatpum* spp.	×		
Lythraceae	*Anzmannia lakensis* Chandler	×		
	Alatospermum lakense Chandler	×		
Menispermaceae	*Tinospora arnensis* Chandler	×	×	
	Palaeococculus lakensis Chandler	×	×	
	Wardensheppeya poolensis (Chandler) Eyde, 1970		×	
Moraceae	*Ficus lucidus* Chandler (see Collinson, 1989)	×		
	F. sp .			×
?Moraceae	*Ovicarpum reticulatum* Chandler (see Collinson, 1989)		×	
Nymphaeaceae	*Palaeonymphaea eocenica* Chandler (see Collinson 1980a)	×		
Nyssaceae	*Nyssoidea eocenicum* Chandler	×	×	
Rosaceae	*Rubus acutiformis* Chandler			×

	Phellodendron costatum Chandler		×
Rutaceae	*Rutaspermum excavatum* Chandler		×
	R. glabrum Chandler	×	
	R. magnificum Chandler		×
	R. striatum Chandler	×	
Sabiaceae	*?Meliosma sheppeyensis* Reid and Chandler	×	
Sapotaceae	*?Sapoticarpum* sp.		×
Solanaceae	*Solanunz arnense* Chandler		×
-	*Solanisperrnum reniforme* Chandler		×
Styracaceae	*Styrax elegans* Chandler	×	
Symplocaceae	*Symplocos headonensis* Chandler		×
	S. lakensis Chandler	×	×
Theaceae	*Cleyera? obliqua* Chandler	×	
	?Gordonia sp.	×	
Thymelaeaceae	*Thymelaeaspermum lakense* Chandler	×	×
	T? sulcatum Chandler	×	
Vitaceae	*Vitis ambigua* Chandler	×	
	V. arnensis Chandler		×
	V. cuneata Chandler	×	
	V. excavata Chandler	×	
	V. lakensis Chandler	×	
	V. lusatica Czeczott and Skirgiello[12]	×	×
	V. platysperma Chandler	×	×
	V. *poolensis* Chandler	×	
	V. pygmaea Chandler	×	×
	V. goodhartii Chandler	×	×
	V. symmetrica Chandler	×	
	V. triangularis Chandler		×
	Tetrastigma acuminata Chandler		×
	?T lobata Chandler	×	
Zingiberaceae	*Alpinia arnense* (Chandler) Mai in Mai and Walther, 1985[13]		×
Incertae sedis	*Rhamnospermum bilobatum* Chandler	×	×
	Carpolithus arnense Chandler		×

Footnotes to (Table 8.2)

[1] *Ruffordia subcretacea* (Saporta) Barthel (1976) is the name in current use for *Anemia subcretacea* (Saporta) Gardner and Ettingshausen. However, the fossil, known as an almost complete plant, is very similar to *Anemia* and certainly belongs in the Glade including *Anemia* (Collinson, in press a).

[2] *Sequoia couttsiae* Heer = *Athrotaxis couttsiae* (Heer) Gardner, both Taxodiaceae. The former name has been applied to British material but the latter is used currently in continental Europe. However, as both these genera are modern genera, more than a mere nomenclatural decision is involved here. For the British material, Chandler (1925–1926 p.13) initially rejected Gardner's assignment to *Athrotaxis.* She reconfirmed and re-instated the affinity with *Sequoia* in full and made detailed studies of leaves, leafy shoots, twigs, cones and seeds (Chandler, 1962, 1963b, 1964), noting a marked similarity to *Sequoia sempervirens* (Chandler, 1964, 1978, p. 40, under discussion of *Sequoiadendron fordit*) and rejecting affinity with *Sequoiadendron* (Chandler, 1964, p. 104, 1978 pp. 40 and 41). Fowler *et al.* (1973) emphasized the difficulties of determining isolated foliage of Taxodiaceae, noting that Chandler (1964) had stated that the leaves of *S. couttsiae* were not identical with either *Sequoia* or *Sequoiadendron.* Ruffle (1976) also treated the species as a member of genus *Sequoia.* Subsequently workers in continental Europe (Mai and Walther, 1978, 1985, 1991; Mai, 1998; Knobloch *et al.,* 1996) have assigned the species to *Athrotaxis* citing the work of Dorofeev and Sveshnikova (1963) as the basis for this assignment. However, Dorofeev and Sveshnikova (1963) combined a range of material into their recombination *Athrotaxis taxiformis* (Unger) Dorofeev and Sveshnikova (including *S. couttsiae* and *A. couttsiae). Athrotaxis taxiformis* in their sense included material later assigned to an extinct genus of Taxodiaceae *Doliostrobus* Marion by Kva■ek (1971). Mai (1998) expressed some reservations as to the use of the genus *Athrotaxis* for the remaining material. Furthermore, Dorofeev and Sveshnikova (1963) were apparently unaware of, and did not cite, the work of Chandler (1962, 1963, 1964) and, to the best of our knowledge, they had not been able to study the British material. There is considerable variation in Taxodiaceae leaves resulting in similarities between those of *Taxodium, Sequoia, Sequoiadendron* and *Glyptostrobus. S. couttsiae* is associated with tree stumps with wood of the *Glyptostroboxylon* type (Fowler *et al.,* 1973). It is therefore possible that, even though Chandler found a convincing affinity with *Sequoia* based on foliage, cones and seeds, a fully reconstructed plant bearing *S. couttsiae* foliage and cones might not resemble modern *Sequoia* in all features. Until such a plant can be reconstructed, ideally based on organic attachment, and included in a dadistic analysis of the Taxodiaceae, its relationships must remain slightly uncertain. Finally one must consider the relative unlikelihood of a relationship with modern *Athrotaxis,* which is endemic to Tasmania. There are numerous relationships between the Palaeogene floras of Europe, and those of the USA and Asia (Manchester, 1999). Numerous modern genera recorded in these Palaeogene floras now grow in south-eastern Asia and America (Manchester, 1999; Tiffney, 1994), some occur in Africa and South America (Tiffney, 1994) and a few occur in Australia (Tiffney, 1994). However, all those occurring in Australia also occur today in eastern Asia or in both eastern Asia and the New World; none are Australian endemics today. Some claims for records of Proteaceae and Cunoniaceae in the northern hemisphere Tertiary are all based on very old literature and all have been subsequently rejected (Mai, 1995). Thus, there is no evidence for floristic affinity between Australia and the European Palaeogene, and the occurrence of a modern Australian endemic in the European Palaeogene is judged to be extremely unlikely. For all these complex reasons we have retained the name in current use in Britain for British material i.e. *Sequoia couttsiae.* While this volume was in press, Kunzman (1999) reassessed the systematic affinity of *S. couttsiae* and judged that it represented an extinct member of the Taxodiaceae, which he assigned to the genus *Quasisequoia as Q. couttsiae* (Heer) Kunzman.

[3] Formerly *Hordwellia crassisperma* (Chandler) Chandler and thought to belong to the Theaceae (see Mai and Walther, 1985).

[4] Formerly *Actinidia poolensis* Chandler, 1963b.

[5] According to Manchester (1999, p. 476), the genus *Echitonium* Unger has priority for apocynaceous seeds for which the generic affinity is unclear.

[6] *Dunstania* has been assigned to *Cornus* by some authors (e.g. Eyde, 1988) (see discussion in Manchester, 1994, p. 42).

[7] Mai (1993) synonymized this with *Mastixiopsis* (Kirchheimer).

[8] Formerly *Cornus quadrilocularis* Chandler.

[9] Formerly *Caricoidea minima* (Chandler) Chandler.

[10] Includes *Protaltingia hantonensis* Chandler (see Mai and Walther, 1985).

[11] See footnote 8 to (Table 8.1). Kva■ek and Bužek (1995) treated the Lake and Hordle *N. eocenicum as Palaeobosiea bilinica* (Ettingshausen) Kva■ek and Bužek, whilst Mai and Walther (1978) used *Hosiea bilinica* (Ettingshausen) Holy.

[12] Includes *Vitis glabra* Chandler (see Mai and Walther, 1991).

[13] Formerly *Aracispermum arnense* Chandler, then included within the Araceae.

As suggested by Collinson (1983b), a superficial appraisal of the London Clay and Dorset Pipe Clay fruit and seed assemblages (compare Tables 8.1 and 8.2) suggests marked differences at the rank of species. This may, however, be as much to do with the differences in preservation as with differences in the composition of the original vegetation (Collinson, 1983b). For instance, *Dunstania glandulosa, Iodes acutiformis, Icacinicarya inornata* and *Palaeobursera lakensis* from the Dorset Pipe Clay may well be the same as *D. multilocularis, I. comiculata, I. platycarpa* and *P bognorensis* from the London Clay, respectively (Chandler, 1962). The classic London Clay palaeobotanical sites (e.g. Sheppey) produce pyrite petrifactions that often yield the type of anatomical detail not seen in the Lake fossils. Furthermore, they are less vulnerable to shrinkage during fossilization, which can produce apparently dramatic differences in size and morphology Work on the sites that yield carbonaceous London Clay-type fruits and seeds (e.g. Walton-on-the-Naze) might help resolve this problem (Collinson, 1983b).

Another difference between the floras is the apparently greater abundance of smaller fossils at Lake, such as *Ficus lucidus, Ebretia lakensis, Palaeocleome lakense, Capparidispermum eocenicum* and *Alatospermum lakense.* However, this is probably mainly because of tidal winnowing of the seeds at Sheppey removing the smaller fraction rather than any significant difference in the original vegetation. Collinson (1983b, p. 16) noted a comparable difference between surface-picked larger fruits and smaller fruits in sieved concentrates at Sheppey.

Associated with the angiosperm fruits are very small fragments of fern foliage. They show extremely fine preservation of the reproductive structures, from which Chandler (1955) was able to establish that they all belong to the now mainly tropical family, the Schizaeaceae. They demonstrate that *Lygodium, Anemia* and the *Anemialike Ruffordia* had a much wider geographical range during the Eocene Epoch than they have today (Collinson, 1996a, in press a), a situation similar to that which we observe in the angiosperms.

Conclusions

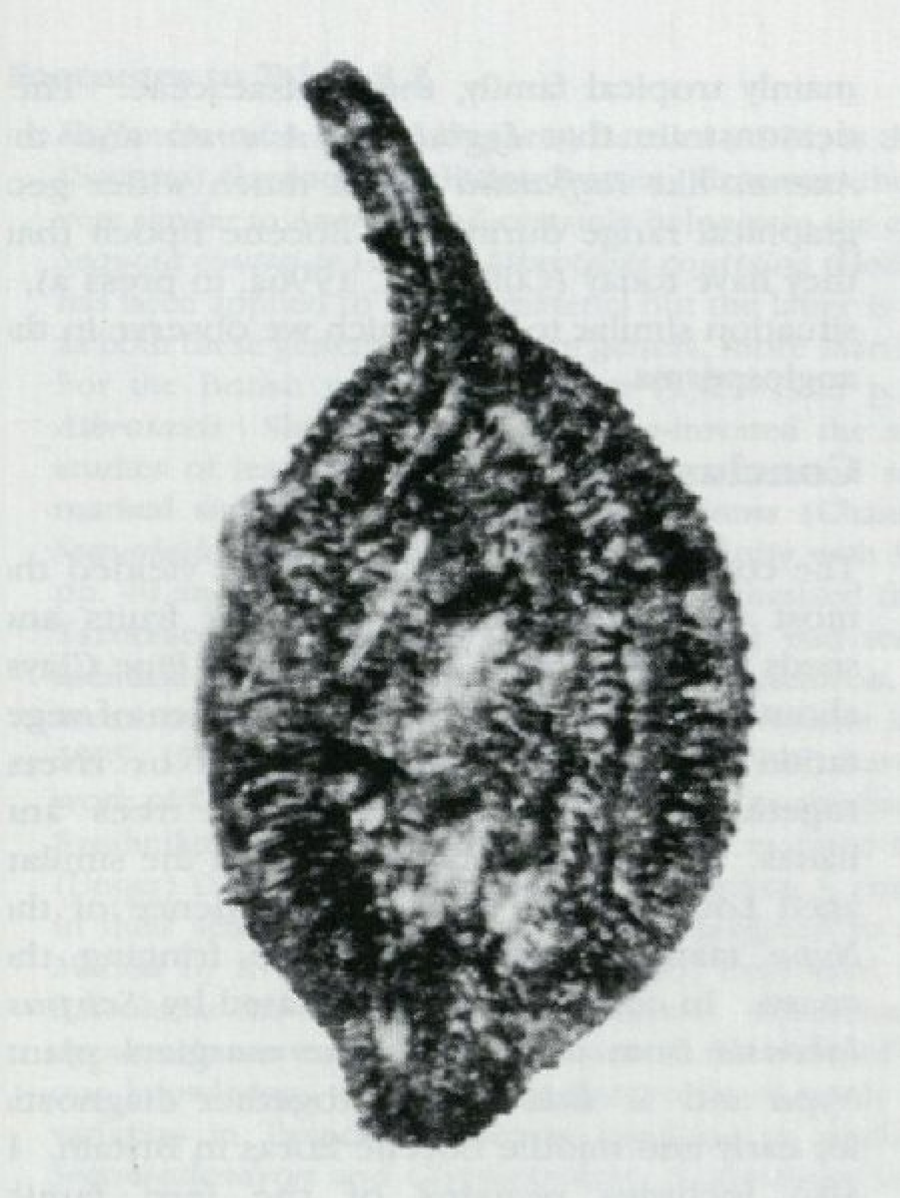
The coastal exposures at Lake have yielded the most diverse assemblages of fossil fruits and seeds from the Lower Eocene Dorset Pipe Clays, about 50 Ma old. It preserves evidence of vegetation probably surrounding lakes or rivers, together with paratropical forest trees and lianas. It complements the floras of the similar-aged London Clay, as it lacks evidence of the *Nypa* mangrove-palm vegetation fringing the coasts. In contrast, it is dominated by '*Scirpus' lakensis* from a river or lake marginal plant. *Nypa* and *'S.' lakensis* are together diagnostic for early and middle Eocene floras in Britain. It also includes remains of the fern family Schizaeaceae, far outside the geographical range of their living relatives.

References

(Figure 8.19) Low cliff exposure at Lake, beneath the caravan site, on the eastern side of Poole Harbour, as seen in the mid 1970s. The section is now largely obscured by sea defence work. (Photo: M.E. Collinson.)

Family	Species	Lake	Arne	Studland
Pteridaceae	Acrostichum lanzaeanum (Visiani) Chandler		×	×
Schizaeaceae	Lygodium kaulfussii Heer emend. Gardner and Ettingshausen			×
	L. poolensis Chandler	×		
	Anemia poolensis Chandler	×	×	
	Ruffordia subcretacea (Saporta) Barthel, 1976[1]		×	
Taxodiaceae	Taxodium lakensis Chandler	×	×	
	Sequoia couttsiae Heer[2]			×
Actinidiaceae	Saurauia crassisperma (Chandler) Mai[3]	×		
	S. poolensis (Chandler) Mai, 1970[4]	×		
Anacardiaceae	Dracontocarya glandulosa Chandler	×		
	?Lannea sp.	×		
	Rhus lakensis Chandler	×		
	R. spp.	×		
Apocynaceae	Apocynospermum acutiforme Chandler[5]	×		
	A. lakense Chandler[5]	×		
Arecaceae	Calamus daemonorops (Unger) Chandler	×		
	?Sabal sp.		×	
Boraginaceae	Ehretia lakensis Chandler	×		
Burseraceae	Palaeobursera lakensis Chandler	×		
Capparaceae	Bartonella emarginata Chandler	×	×	×
	Palaeocleome lakensis Chandler	×		
	Capparidispermum eocenicum Chandler	×		
Caprifoliaceae	Sambucus parvula Chandler	×		
Cornaceae (including Mastixiaceae)	Dunstania lakensis Chandler[6]	×		
	Eomastixia rugosa (Zenker) Chandler (see Mai, 1993)	×	×	
	E. urceolata Chandler	×		
	?Mastixia cantiensis Reid and Chandler[7]		×	
	Mastixicarpum crassum Chandler (see Mai, 1993)	×		
	Swida quadrilocularis (Chandler) Mai, 1999[8]	×		
Cucurbitaceae	Cucurbitospermum lakense Chandler	×		
	C. obliquum Chandler	×		
Cyperaceae	'Scirpus' lakensis Chandler	×	×	
	?Scirpus sp.	×		
	Caricoidea arnei Chandler		×	
	C. obscura Chandler	×		
	?Caricoidea sp.	×		
	Cladiocarya minima (Chandler) Mai in Mai and Walther, 1978[9]		×	
Ebenaceae	Diospyros headonensis Chandler	×		
Euphorbiaceae	Euphorbiotheca lakensis Chandler	×		
	E. platysperma Chandler	×		
	E. tuberculata Chandler	×		
	E. digitata Chandler	×		
	Euphorbiospermum punctatum Chandler	×		
	Wetherellia variabilis Bowerbank		×	
Flacourtiaceae	Oncoba rugosa Chandler		×	
Hamamelidaceae	Steinhauera subglobosa Presl[10]	×		
Icacinaceae	Iodes acutiformis Chandler	×	×	
	Natsiatum eocenicum Chandler[11]	×		
	?Palaeophytocrene foveolata Reid and Chandler	×		
	Icacinicarya inornata Chandler	×	×	
Lauraceae	Laurocarpum spp.	×		
Lythraceae	Ammannia lakensis Chandler	×		
	Alatospermum lakense Chandler	×		
Menispermaceae	Tinospora arnensis Chandler	×	×	
	Palaeococculus lakensis Chandler	×	×	
	Wardensheppeya poolensis (Chandler) Eyde, 1970		×	
Moraceae	Ficus lucidus Chandler (see Collinson, 1989)	×		
	F. sp.			×
?Moraceae	Ovicarpum reticulatum Chandler (see Collinson, 1989)		×	
Nymphaeaceae	Palaeonymphaea eocenica Chandler (see Collinson 1980a)	×		
Nyssaceae	Nyssoidea eocenicum Chandler	×	×	
Rosaceae	Rubus acutiformis Chandler			×
Rutaceae	Phellodendron costatum Chandler		×	
	Rutaspermum excavatum Chandler		×	
	R. glabrum Chandler	×		
	R. magnificum Chandler		×	
	R. striatum Chandler	×		
Sabiaceae	?Meliosma sheppeyensis Reid and Chandler	×		
Sapotaceae	?Sapoticarpum sp.		×	
Solanaceae	Solanum arnense Chandler		×	
	Solanispermum reniforme Chandler		×	
Styracaceae	Styrax elegans Chandler	×		
Symplocaceae	Symplocos headonensis Chandler		×	
	S. lakensis Chandler	×	×	
Theaceae	Cleyera? obliqua Chandler	×		
	?Gordonia sp.	×		
Thymelaeaceae	Thymelaeaspermum lakense Chandler	×	×	
	T.? sulcatum Chandler	×		
Vitaceae	Vitis ambigua Chandler	×		
	V. arnensis Chandler		×	
	V. cuneata Chandler	×		
	V. excavata Chandler	×		
	V. lakensis Chandler	×		
	V. lusatica Czeczott and Skirgiełło[12]	×	×	
	V. platysperma Chandler	×	×	
	V. poolensis Chandler	×		
	V. pygmaea Chandler	×	×	
	V. goodhartii Chandler	×	×	
	V. symmetrica Chandler	×		
	V. triangularis Chandler		×	
	Tetrastigma acuminata Chandler		×	
	?T. lobata Chandler	×		
Zingiberaceae	Alpinia arnense (Chandler) Mai in Mai and Walther, 1985[13]		×	
Incertae sedis	Rhamnospermum bilobatum Chandler	×	×	
	Carpolithus arnense Chandler		×	

(Table 8.2) Composition of floras from the Dorset Pipe Clays, Hampshire Basin. Species descriptions, or references to them, can be found in Chandler (1962), unless otherwise referenced. Discussions on some of these species can also be found in Manchester (1994), Mai and Walther (1978, 1985), Mai (2000) and Collinson (1996b, in press a). The family classification used here is summarized in Chapter 1 of the present volume



(Figure 8.20) Scirpus lakensis in carbonaceous preservation (specimen number BMNH V40396), found at Arne, × 50 (see Chandler, 1962; Collinson, 1996b). (Photo: M.E. Collinson.)

[illegible]

(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.