
Kennpier

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Highlights

Kennpier is of national importance because here the fossiliferous temperate-stage channel-fill and estuarine deposits of the Yew Tree Formation overlie the Kennpier and Nightingale members of the Kenn Formation. The latter comprises materials which have been interpreted as glacial outwash and till. Amino-acid ratios derived from fossil molluscs in the Yew Tree Formation suggest correlation with Oxygen Isotope Stage 15, and thus a pre-Anglian age for the underlying glacial deposits. Evidence for pre-Anglian glacial episodes is virtually unknown elsewhere in the British Isles. The site is the type-section of the Kenn Formation and of the Kennpier and Nightingale members.

Introduction

At Kennpier, exposures in deep drainage ditches and a borehole have shown a complex stratigraphy, with coversands of the Brean Member overlying estuarine sands of the Kenn Church Member and a richly fossiliferous channel-fill of the Yew Tree Formation. The latter can be correlated aminostratigraphically with Oxygen Isotope Stage 15. The channel-fill is incised into glaciogenic diamictons and gravels of the Kenn Formation.

Pleistocene gravels have been known in the Kenn area since the work of Woodward (1876) and Greenly (1921). Gilbertson (1974) and Gilbertson and Hawkins (1978a) described the stratigraphy of Quaternary deposits at Kennpier Footbridge. These authors also carried out detailed studies on the freshwater, estuarine and terrestrial molluscs from the site, and Beck (*in* Gilbertson and Hawkins, 1978a) described six very small pollen assemblages. They regarded the palaeobiology of the site as indicative of the late stages of an interglacial, probably the Ipswichian. Hunt (1981) described the stratigraphy and palynology of a borehole through the channel-fill. The pollen was comparable with Ipswichian II–III assemblages. The organic-walled microplankton included both marine and freshwater forms, suggesting estuarine conditions. Andrews *et al.* (1984) presented amino-acid ratios on *Corbicula* shells from the Yew Tree Formation at Kennpier Footbridge. These are suggestive of an age of around 400 to 600 ka BP and may therefore indicate a pre-Anglian age for the underlying glacial deposits. This age was supported by Bowen *et al.* (1989) and accepted by Campbell *et al.* (*in prep.*). Andrews *et al.* (1984) also obtained an amino-acid ratio of 0.2 on *Macoma* from the Kenn Church Member at this site. Kennpier is designated the type-section of the Kenn Formation and of the Kennpier and Nightingale members (Campbell *et al.*, *in prep.*).

Description

The stratigraphic relationships at Kennpier are shown in (Figure 10.5). Gilbertson (1974) recorded the following section at [ST 427 698], overlying Mercia Mudstones. Maximum bed thicknesses are shown in parentheses.

6. Grey estuarine silts of Holocene age. The bed has a sharp boundary with bed 5. (1.7 m)
5. Red silty fine sands (Brean Member). These overlie and are juxtaposed with beds 2, 3 and 4 in a series of involutions. (1.0 m)
4. Pockets of pebbly shelly sands (Kenn Church Member), for instance at [ST 425 708], containing marine molluscs and overlying beds 1 and 2. (0.5 m)
3. Greenish-grey, shelly silty sands (Yew Tree Formation), lying in a channel 30 m wide and of variable depth incised into bed 2. (2.0 m)

2. Pale brown to red silty and sandy diamictons (Kennpier Member), with striated boulders up to 1 m in diameter and weighing over 1 tonne. (1.7 m)

1. Grey-brown, poorly bedded cobbly gravels (Nightingale Member). (4.0 m)

The Kenn gravels (bed 1) and Kennpier till (bed 2) contain numerous non-local rock types, and occasional very large striated clasts. The Yew Tree Formation channel-fill (bed 3) contains a diverse mollusc assemblage, with 30 taxa recorded (Gilbertson and Hawkins, 1978a; Table 10.1). The fauna is dominated by the opercula of *B. tentaculata*, with some *Agrolimax* spp. and *V. piscinalis*. Other taxa are comparatively rare. Estuarine molluscs are present but decrease in abundance up-section. The pollen assemblage (Hunt, 1981) contains abundant tree pollen, including *Pinus*, *Quercus*, *Alnus*, coryloid, *Carpinus*, *Betula*, *Picea* and *Tilia*, together with pollen of herbs, marsh plants and aquatics, and cryptogam spores. The algal microfossil assemblage (Hunt, 1981) is species-poor and includes the marine dinoflagellate cysts *Operculodinium centrocarpum*, *Achomosphaera andalusiense* (= *Spiniferites septentrionalis*; (Figure 10.6)), the prasinophyte *Cymatiosphaera* sp. and spores of the zygnemataceous alga *Spirogyra* sp. Molluscs from the Yew Tree Formation at Kennpier have yielded amino-acid ratios of 0.385 and 0.405 (Andrews *et al.*, 1984).

In the pebbly shelly sand pockets of the Kenn Church Member (bed 4), restricted molluscan faunas are dominated by *M. balthica* and *Littorina* spp. Freshwater species are occasionally present. Fossil material from this bed yielded an amino-acid ratio of 0.2 (Andrews *et al.*, 1984).

Interpretation

The stratigraphy and palaeobiology of the site have been interpreted by Gilbertson (1974), Gilbertson and Hawkins (1978a) and Hunt (1981). Andrews *et al.* (1984) reassessed the stratigraphical significance of the Yew Tree Formation and their model has been accepted by later workers.

The grey silts (bed 6) at the top of the section were laid down during the later Holocene (Gilbertson and Hawkins, 1978a; Butler, 1987). The red silty sands of the Brean Member (bed 5) were interpreted by Gilbertson and Hawkins (1978a) as coversands of aeolian origin. The pockets of pebbly shelly sand of the Kenn Church Member (bed 4) are most likely of estuarine origin. This bed can be correlated aminostratigraphically with Oxygen Isotope Stage 7 (Andrews *et al.*, 1984; Campbell *et al.*, in prep.).

In the Yew Tree Formation (bed 3), several of the mollusc taxa, especially *B. marginata* and *C. fluminalis*, require interglacial conditions. Declining counts of thermophilous taxa in the higher levels of the deposit led Gilbertson and Hawkins (1978a) to suggest that the sediments were laid down during an episode of deteriorating climate. The Yew Tree Formation at Kennpier was regarded as of fluvial origin, because most of the Mollusca are freshwater taxa, with the most abundant environmental group being taxa typical of moving water such as *B. tentaculata* and *V. piscinalis*. They suggested that the estuarine taxa in the channel-fill were recycled from nearby estuarine gravels. This interpretation was challenged by Hunt (1981) who described palynological evidence — high counts for Chenopodiaceae — and the presence of marine microfossils as evidence for marine influence: a depositional environment in the backwaters of an estuary was suggested. High counts for Poaceae and herbaceous taxa point to a relatively 'open' coastland environment, but the presence of a variety of broad-leaved tree species is evidence for interglacial conditions (Figure 10.7). Similarly 'open' environments have been noted from other coastal interglacial sites, for instance at Morston (Gale *et al.*, 1988). Marine taxa and broad-leaved tree species decrease in importance up-section, suggesting lessening marine influence and an opening of the landscape through time. The palynological evidence is thus consistent with the molluscan evidence for deteriorating climate and suggests that the Yew Tree Formation at Kennpier was laid down as climate started to deteriorate towards the end of an interglacial. The amino-acid ratios may indicate correlation with Oxygen Isotope Stage 15 (Bowen *et al.*, 1989), though Bowen (pers. comet., 1995), while accepting this correlation, suggested that ratios on *Corbicula* should be treated with some caution.

The Nightingale Member (bed 1) was regarded as glacial outwash and the Kennpier Member (bed 2) as till by Gilbertson and Hawkins (1978a). They correlated these deposits with the high-level drifts in the Bath area, on the Failland Ridge and at Court Hill and argued that together these provided evidence for a glacial incursion into the Avon coastlands. This

interpretation was accepted by Campbell *et al.* (in prep.).

Conclusion

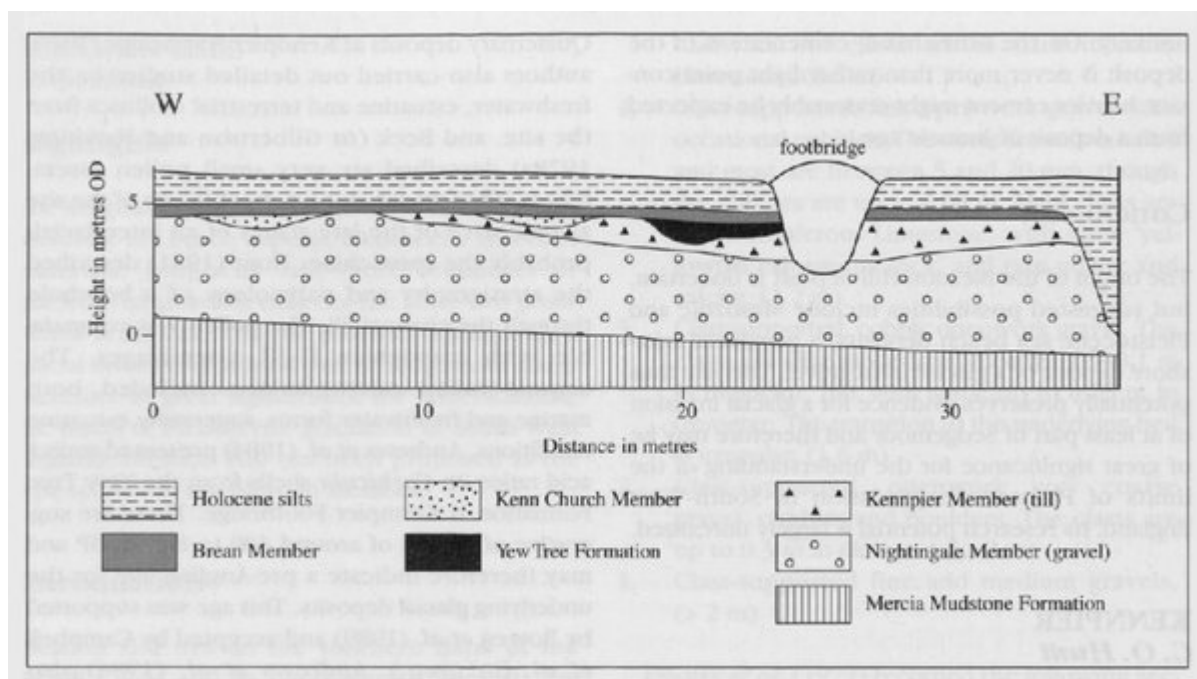
Kennpier is a key site for studies of the Pleistocene stratigraphy and palaeobiology of the British Isles. The sequence here contains a temperate-stage channel-fill, estuarine deposits also indicative of temperate conditions, gravels which have been interpreted as glacial outwash and diamictons that have been interpreted as glacial till. In the temperate-stage deposits of the Yew Tree Formation, molluscs, pollen, dinoflagellate cysts and foraminifera suggest interglacial conditions. Two amino-acid ratios have been determined from molluscs in this bed, which ostensibly suggest correlation with the Purfleet interglacial deposits in the Thames Estuary and Oxygen Isotope Stage 15. (This date would seem to be at conflict with Purfleet's position in the post-Anglian course of the Thames, which the river only assumed in Stage 11 (Bridgland, 1994).) The fossil remains from the Yew Tree Formation at Kennpier Footbridge offer considerable potential for future investigation, since the palaeobiology of the temperate stage which they reflect is as yet very poorly known. Further research potential is offered by the 'temperate' estuarine deposits of the Kenn Church Member. The interglacial deposits at Kennpier Footbridge rest on diamictons of the Kenn Formation suggested by Gilbertson and Hawkins (1978a) to be of glacial origin. These represent an ancient glacial episode which is very poorly known elsewhere in the British Isles.

(Table 10.1) Fossil molluscs from three profiles through the interglacial channel-fill at Kennpier Footbridge (after Gilbertson and Hawkins, 1978a)

Species	KPA	Profiles KPB	KPD
Marine			
<i>Littorina littorea</i> (Linné)	3	—	1
<i>Littorina saxatilis</i> (Olivi)	1	—	—
<i>Littorina littoralis</i> (Linné)	5	1	■
<i>Littorina</i> spp.	13	1	2
<i>Retusa</i> sp.	—	—	1
<i>Nucella lapillus</i> (Linné)	3	—	—
<i>Ostrea</i> sp.	1	—	2
<i>Cerastoderma</i> spp.	2	—	frags
<i>Macoma balthica</i> (Linné)	36	1	16
Land and freshwater			
<i>Valvata piscinalis</i> (Müller)	127	72	423
<i>Belgrandia marginata</i> (Michaud)	14	—	13
<i>Bithynia tentaculata</i> (Linné) shells	3	—	4
<i>Bithynia tentaculata</i> (Linn) opercula	1092	3579	5619
<i>Lymnaea peregra</i> (Müller)	12	—	65
<i>Anisus leucostoma</i> Müller	—	—	1
<i>Gyraulus laevis</i> Alder	4	—	1
<i>Armiger crista</i> (Linné)	1	—	1
<i>Planorbis</i> spp.	—	—	1
<i>Ancylus fluviatilis</i> Müller	2	—	—
<i>Trichla htspida</i> (Linné)	—	—	15
<i>Zonitoides nitidus</i> (Müller)	—	—	1
<i>Agrolimax</i> cf. <i>agrestis</i> (Linné)	70	70	128
<i>Agrolimax</i> cf. <i>reticulatus</i> (Müller)	30	43	35
<i>Agrolimax</i> cf. <i>laevis</i> (Müller)	6	—	22

<i>Agrolimax</i> spp.	65	56	162
<i>Corbicula fluminalis</i> (Müller)	—	20	24
<i>Pisidium amnicum</i> (Müller)	4	6	7
<i>Pisidium obtusale</i> (Lamarck)	—	—	1
<i>Pisidium subtruncatum</i> Malm	5	—	1
<i>Pisidium henslowanum</i> (Sheppard)	1	—	—
<i>Pisidium nitidum</i> Jenyns	5	—	1
<i>Pisidium moitessierianum</i>	—	—	1
Paladilhe	—	—	1
<i>Pisidium</i> spp.	13	4	13
Total	1560	3854	6564

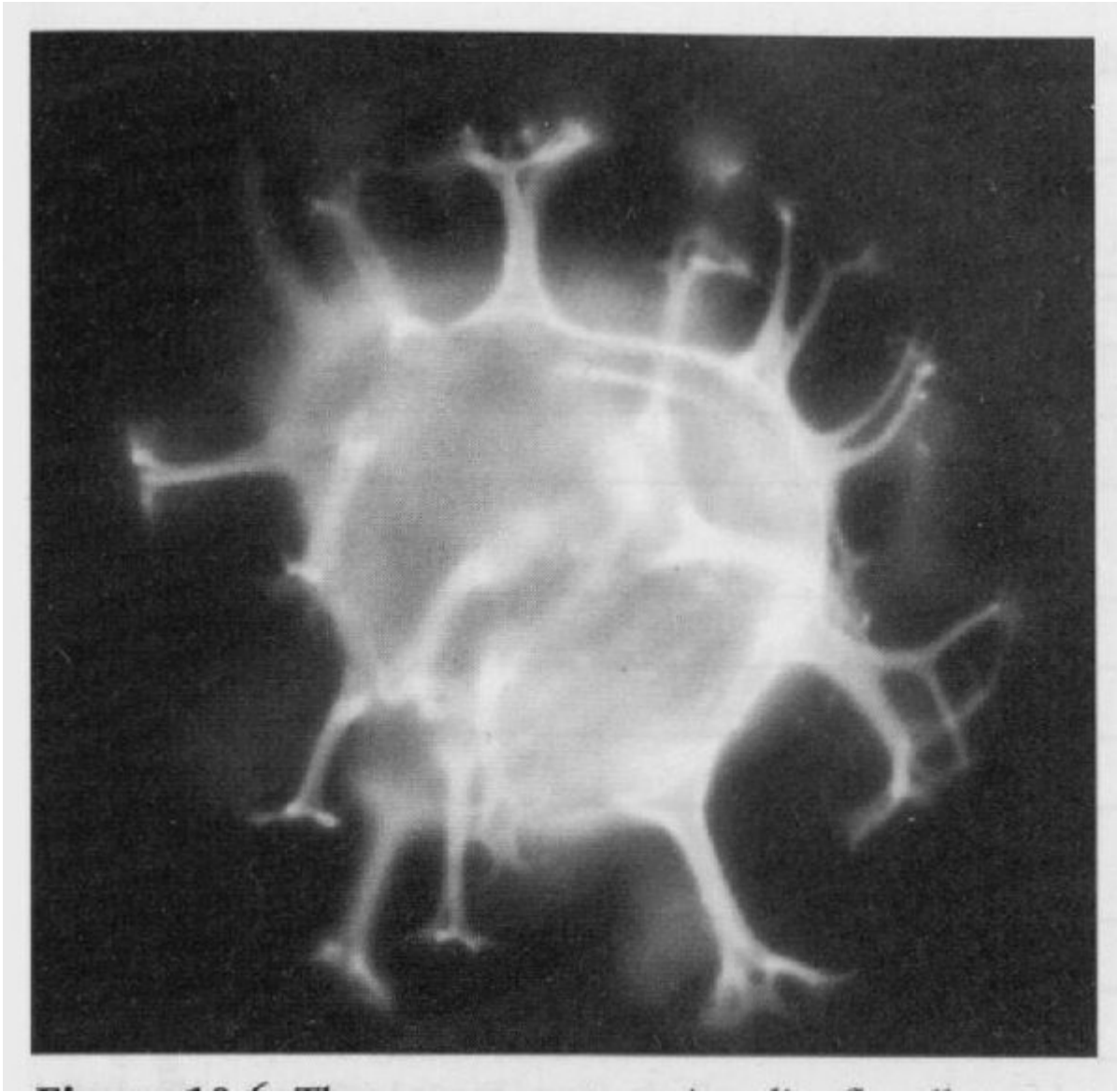
References



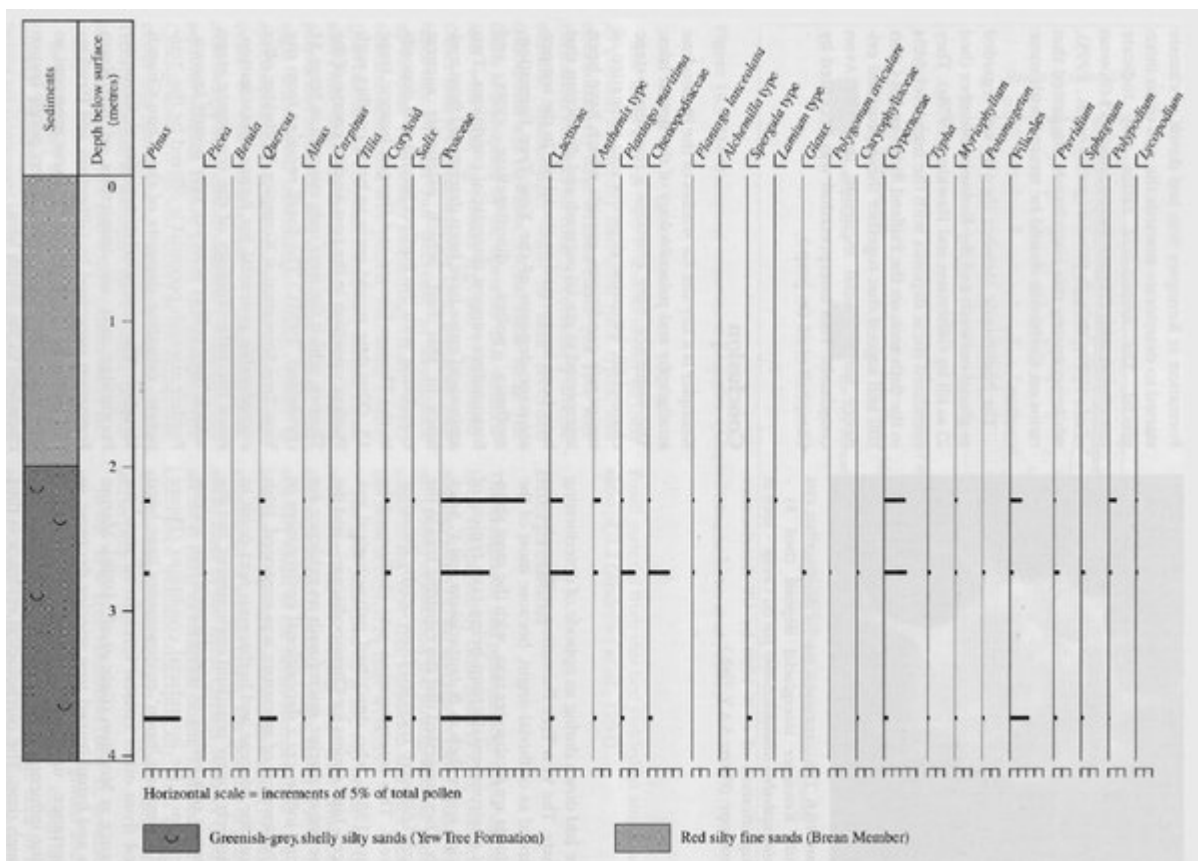
(Figure 10.5) The Quaternary sequence at Kennpier. (Adapted from Andrews et al., 1984.)

Species	Profiles		
	KPA	KPB	KPD
Marine			
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<i>Littorina saxatilis</i> (Olivi)	1	-	-
<i>Littorina littoralis</i> (Linné)	5	1	-
<i>Littorina</i> spp.	13	1	2
<i>Retusa</i> sp.	-	-	1
<i>Nucella lapillus</i> (Linné)	3	-	-
<i>Ostrea</i> sp.	1	-	2
<i>Cerastoderma</i> spp.	2	-	frags
<i>Macoma balthica</i> (Linné)	36	1	16
Land and freshwater			
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<i>Belgrandia marginata</i> (Michaud)	14	-	13
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<i>Pisidium subtruncatum</i> Malm	5	-	1
<i>Pisidium henslowanum</i> (Sheppard)	1	-	-
<i>Pisidium nitidum</i> Jcnyns	5	-	1
<i>Pisidium moltessierianum</i> Paladilhe	-	-	1
<i>Pisidium</i> spp.	13	4	13
Total	1560	3854	6564

(Table 10.1) Fossil molluscs from three profiles through the interglacial channel-fill at Kennpier Footbridge (after Gilbertson and Hawkins, 1978a).



(Figure 10.6) The commonest marine dinoflagellate cyst in the Kennpier interglacial deposit (bed 3) - *Achomosphaera andalusiense* Jan du Chene — seen at a magnification of c. x 1000 by UV fluorescence microscopy. (Photo: S.A.V. Hall.)



(Figure 10.7) Pollen diagram for Kennpier. (Adapted from Hunt, 1981.)