Lower Upnor Sand Pit, Kent

[TQ 759 711]

Highlights

The site is one of the very few to show a complete succession of the Lambeth Group and the Oldhaven Beds. It is an important comparative section for the first of these units (formerly called the Woolwich and Reading Formation) and has helped geologists to understand its complicated stratigraphy.

Introduction

This large sand pit lies on the north bank of the River Medway, just north of Chatham, at grid reference [TQ 759 711]. Here, the strata exposed range from the upper part of the Thanet Sand Formation to the lower part of the 'London Clay'.

Interest in the site extends back for over 150 years. The early description by Morris (1837) was followed by others published by Prestwich (1854a) and Whitaker (1872) who both produced faunal lists. It also featured in a number of 19th century papers concerned with stratigraphical definition and nomenclature (Morris, 1837; Whitaker, 1862; Harris, 1887). Early palaeoenvironmental interpretations include that of Whitaker (1889) who alluded to the abundant yet low diversity fauna of the Woolwich Beds at Upnor compared with other localities around London including Charlton and Erith. Monckton (1904) referred to Upnor as providing examples of estuarine (Woolwich Beds), shallow marine (Oldhaven Beds) and relatively deep marine (Thanet Beds) deposits.

Visits to Upnor by the Geologists' Association have been recorded by Berdinner and Hutchings (1925), Searle (1947) and Stinton (1965a). The last of these authors included a detailed section, as did Kennedy and Sellwood (1970; see (Figure 3.14)) in their paper on the trace fossil *Ophiomorpha* which is particularly well developed in the Woolwich Beds at this locality.

Relatively brief descriptions of the strata present appear in the Sheet Memoir for the Chatham area (Dines *et al.,* 1954), together with combined faunal lists for this and other sections. References to the locality are also made in the reviews of the Woolwich and Reading Formation by Hester (1965) and Ellison (1983), both of whom alluded to the contribution that it makes to our understanding of the stratigraphy and depositional environments of this part of the Palaeogene succession. Recently, Ellison *et al.* (1994) have introduced lithostratigraphical nomenclatural changes as part of a wider study.

Description

Lower Upnor Sand Pit (Figure 3.15) is one of the very few localities where a continuous section from the Thanet Sand Formation through complete sequences of the Lambeth Group (formerly the Woolwich and Reading Formation) and the Oldhaven Beds to the 'London Clay' is exposed. The geographical location of the pit facilitates a comparison of what is known to occur to the west (e.g. at Charlton Sand Pit), with the succession of the more easterly exposures in the cliff sections of Pegwell Bay and Herne Bay.

Lithological succession

Below the London Clay, the succession comprises something in excess of 23 m of mainly unlithifled sands. The shelly clays of the Woolwich Shell Bed occur towards the centre of the Lambeth group and below this unit, some beds are lithified. Kennedy and Sellwood (1970, fig. 1) recorded the London Clay at about 4 m but King (pers. comm.) has indicated that it exceeds 15 m in thickness. The succession is summa rized in (Figure 3.16), whilst additional bed-by-bed details are given in (Figure 3.14) (after Kennedy and Sellwood, 1970).

Biostratigraphy

Recent work by Powell *et al.* (1996, p. 172) recognized five dinoflagellate cyst 'sequences' at Lower Upnor and that they can contribute to the recognition of breaks in the succession.

Thanet Sand Formation

Although only the upper part of the Thanet Sand Formation is visible here, the locality is located where this unit begins to approach its maximum thickness (see isopachyte map in Hester (1965, p. 130). The basal strata, including the Bullhead Bed are, however, exposed nearby and were sampled by Weir and Catt (1969) in their mineralogical study of the Palaeogene sediments of north-eastern Kent.

Lambeth Group

A complete sequence of the 'Woolwich Beds' of the Woolwich and Reading Formation of Ellison (1983) occurs in the pit. Of the six lithofacies into which he divided this formation, three are represented: the 'Glauconite sand', mainly near the bottom of the sequence; the 'Shelly clay' towards the centre (Woolwich Shell Beds of Kennedy and Sellwood (1970) and other authors); and below this, the 'Ferruginous sand' (see Beds 4 and 5, (Figure 3.14)). Ellison (1983, p. 315) considered that Lower Upnor Sand Pit contains the best extant exposure of the last of these three lithofacies. The sands contain a variety of sedimentary structures in addition to the well-developed *Ophiomorpha* burrows.

Recent changes to the lithostratigraphical subdivision of this part of the Palaeogene succession by Ellison *et al.* (1994) have introduced new nomenclature. The glauconitic sand which Kennedy and Sellwood (1970) called the 'Woolwich Bottom Bed' is now part of the Upnor Formation, and Lower Upnor has been designated the type locality for this formation. Up to the base of the Oldhaven Beds, the remainder of the Lambeth Group is assigned to the Woolwich Formation, whilst the Oldhaven Beds themselves are a component of the Harwich Formation.

Thames Group

The erosive relationship of the overlying Oldhaven Beds (Harwich Formation) with the underlying unit is clearly seen. This unit is thinner than further east. It has a basal shell bed (Bed 15, (Figure 3.14)) with *Corbicula* (disarticulated and reworked according to King, pers. comm.), *Glycymeris* and *Nemocardium,* whilst according to Stinton (1965a), lenses occurring higher up contain numerous ophiuroids. The succeeding 'London Clay' has a clearly erosive relationship with the underlying Oldhaven Beds.

Interpretation and evaluation

As a result of the dramatic facies changes which characterize the pre-'London Clay' Lower London Tertiaries', any exposure contributes to a better understanding and interpretation of Palaeocene times in this part of the British area. Lower Upnor Sand Pit is particularly important, for it provides a section including the whole of the critical Lambeth Group and Oldhaven Beds and is the only suitable extant exposure 'linking' what is known from the London area with more easterly developments represented by Pegwell Bay and, more particularly, Herne Bay.

Stratigraphical significance

This was first recognized in the 19th century. Morris (1837) grouped the Thanet, Woolwich and Oldhaven beds found here as part of his 'Woolwich and Upnor Strata', whilst Whitaker (1866) recognized Upnor as a key locality in his definition of a new formation, the Oldhaven Beds, in a review of the stratigraphical nomenclature of the 'Lower London Tertiaries' of Kent. Later, Harris (1887) made numerous references to Upnor in a review of the increasingly complex Tertiary nomenclature of the London Basin.

Depositional environments and palaeogeography

Interest in the site has particularly centred on the 'Woolwich and Reading Formation' (now the Lambeth Group) and the Oldhaven Beds. The former, as Whitaker (1872, p. 98) said, is 'as constant in its presence as it is changeful in its structure' and displays marked facies changes throughout its outcrop. Its succession here makes a major contribution to our understanding of these changes. The glauconitic 'Bottom Bed' (now the Upnor Formation) occurs here, as elsewhere, at the base. Further west in the London area, the 'Woolwich Beds' contain plant material and, above the 'Woolwich Shell Bed', comprise muds and sands representing a back barrier lagoon (Ellison, 1983, p. 314). At Lower Upnor, the greater development of sands is thought to represent a barrier sand complex (Ellison, 1983 p. 312). However, the fauna is still of low diversity, suggesting that salinities were less than fully marine. Furthermore, whilst the commonly occurring *Ophiomorpha* has been considered as a marine indicator (Kennedy and Sellwood, 1970), there is evidence that this ichnogenus also develops in brackish or even fresh water environments (Stewart, 1978).

The 'Ferruginous sand' facies, now best exposed at this locality, equates to ferruginous sandstone doggers, informally known as the Winterbourne Ironstone', and formerly visible at Winterbourne Sand Pit (grid reference [TR 065 571]) (Gamble, 1972). This facies is considered by Ellison (1983) to represent the culmination of the mid-Woolwich and Reading Formation regression when the barrier sands were modified following emergence or a lowering of the water table. Furthermore, he has speculated that this 'event' may be represented to the west in the 'Mottled clay' (typically 'Reading Beds') facies by a prominent soil profile.

The difference between the Lambeth Group succession here and that at Herne Bay mainly reflects the pre-Oldhaven Beds unconformity, for the latter is markedly erosive and in general lies on progressively lower horizons of the 'Woolwich Beds' (Lambeth Group) from west to east (Hester, 1965, fig. 6). Whilst the Lambeth Group is thinner at Herne Bay than at this locality, the opposite applies to the Oldhaven Beds. The fossiliferous nature of the latter is unusual, since in most inland sections, it has been decalcified (Ward, 1978, p. 6). The Oldhaven Beds contains a mixed fauna, including brackish elements, suggesting an inshore situation, and are now agreed by Ellison *et al.* (1994) to be a proximal or nearshore facies of the Harwich Formation.

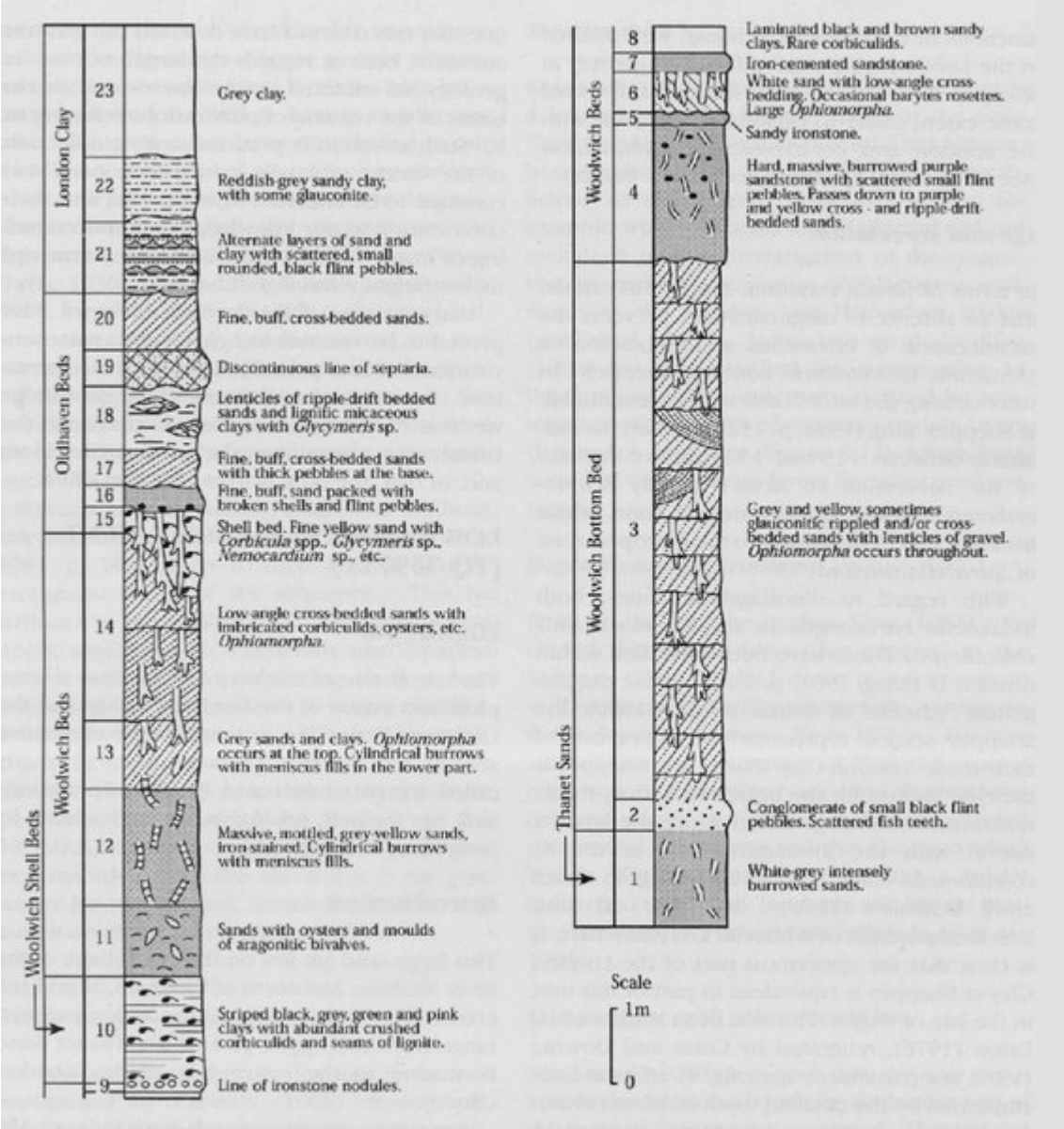
Conclusions

Lower Upnor Sand Pit is one of the very few remaining sections where a complete section of the Lambeth Group (formerly the Woolwich and Reading Formation) and Oldhaven Beds (Harwich Formation), together with the top of the Thanet Sand Formation and the lower part of the 'London Clay' may be examined. As a geographically intermediate exposure between sites such as Charlton Sand Pit in the London area and the coastal localities of Pegwell Bay and Herne Bay, it is especially significant.

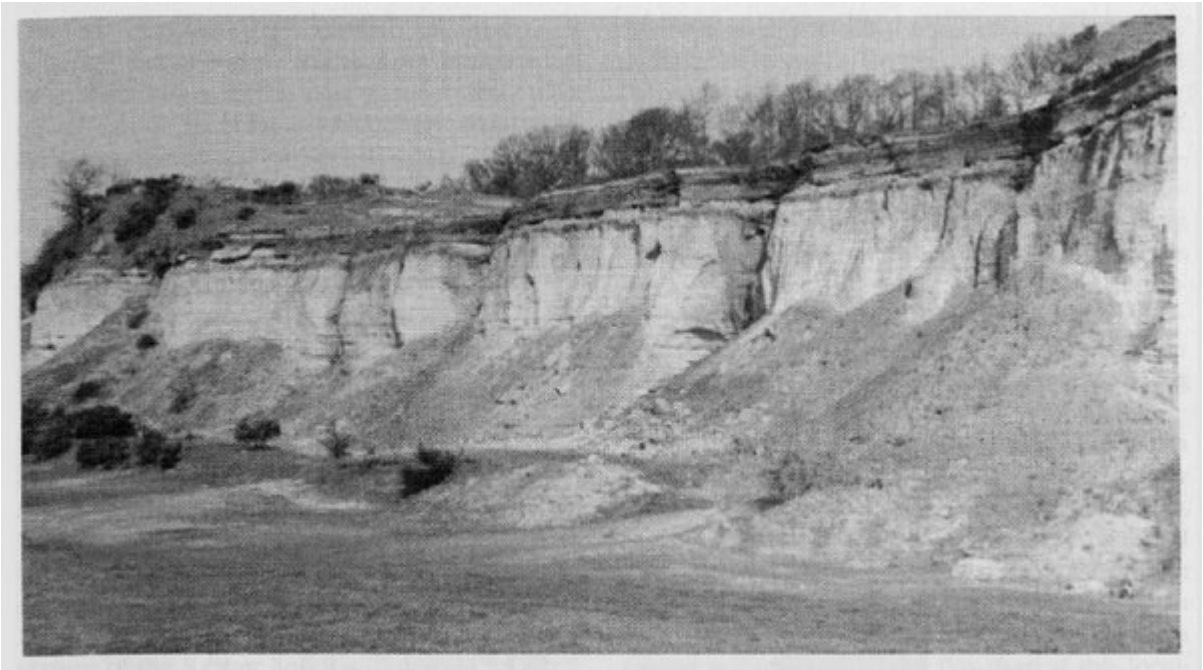
For the Lambeth Group in particular, it has proved to be an important comparative section that has facilitated our understanding of its complex stratigraphy and hence an appreciation of the contemporary palaeogeography. The best stratigraphical 'marker' in the formation (the 'Woolwich Shell Beds') and the underlying 'Ferruginous' sand is clearly seen here, whilst the barrier sand facies is also well developed.

The relationship with the overlying Oldhaven Beds here, together with that apparent at localities such as Herne Bay, clearly demonstrates the development of intra-Palaeocene tectonism towards the eastern end of what is now the London Basin, when uplift was followed by differential erosion of the Lambeth Group, an event now represented by the sub-Oldhaven Beds unconformity.

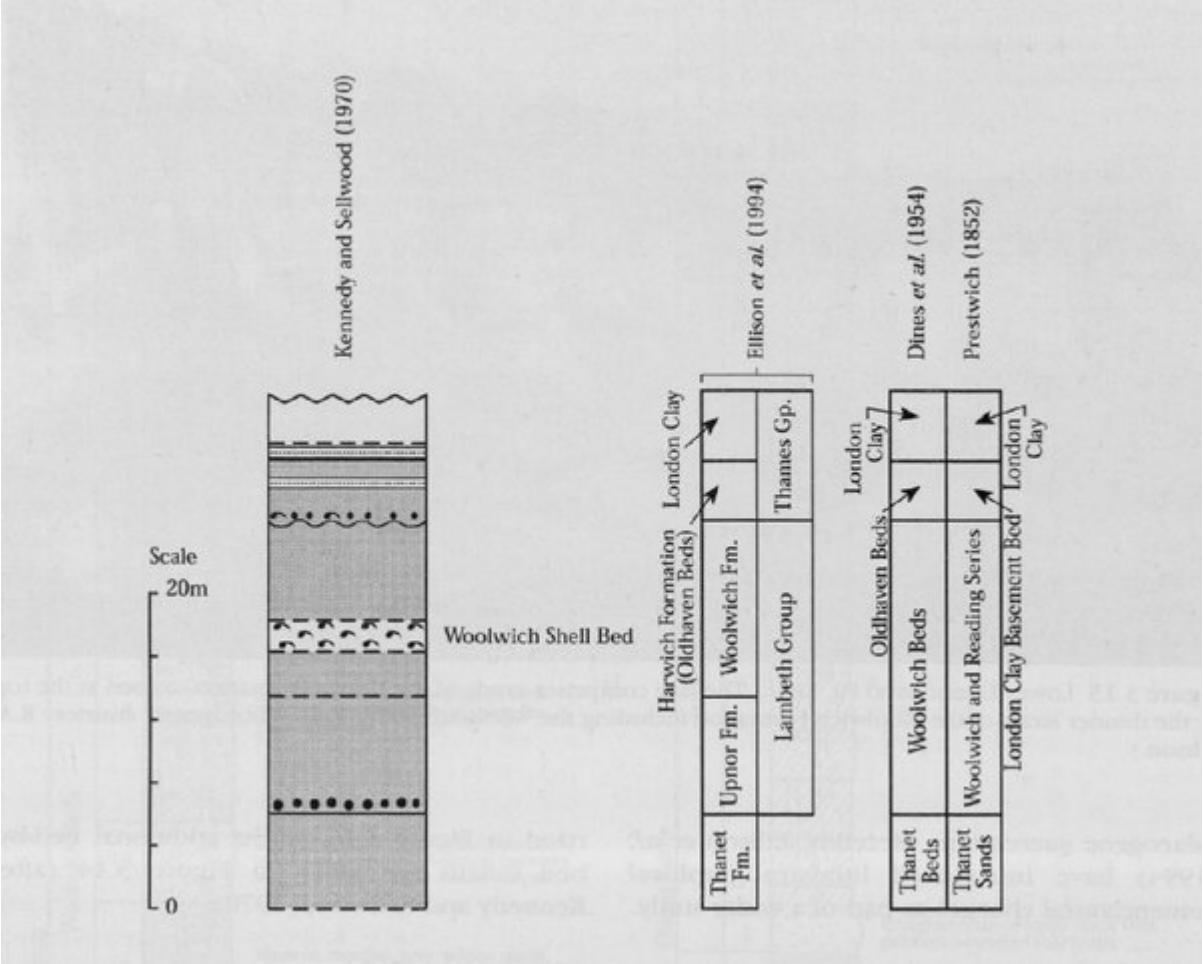
References



(Figure 3.14) Lithostratigraphical succession of the Thanet Formation to London Clay strata in Lower Upnor Sand Pit, Kent (after Kennedy and Sellwood, 1970, fig. 1).



(Figure 3.15) Lower Upnor Sand Pit, Kent. The face comprises sands of the Upnor Formation capped at the top by the thinner strata of the Woolwich Formation including the Woolwich Shell Beds. (Photograph: courtesy R.A. Ellison.)



(Figure 3.16) Generalized succession at Lower Upnor Sand Pit, Kent, including current and earlier lithostratigraphical terminology.