
Harefield, Middlesex

[TQ 050 898]

Highlights

This site has contributed to an understanding of 'Reading Beds'-type Palaeocene deposits as well as being a rare occurrence in the western London Basin of where the latter is seen to rest unconformably on the Chalk. Harefield has also been the major source in the 20th century of fossils from the 'London Clay Basement Bed'.

Introduction

The 'Cement Works Pit' or 'Great Pit' at Harefield ([TQ 050 898]; (Figure 4.1)) has been of interest to geologists since the latter part of the 19th century. Whilst the thickness of the Palaeogene strata present is uncertain, up to 15 m of Palaeogene strata have been recorded, including the 'Reading Beds' development of the Woolwich and Reading Formation, the Oldhaven Formation and the London Clay. The first of these rests unconformably on the Upper Cretaceous Chalk.

In the latter part of the 19th century, Whitaker (1864, 1889) referred to the site in his extensive work on the London Basin, whilst in the Beaconsfield Sheet Memoir, Sherlock and Noble (1922) described it as an 'excellent section'. Since these early times, it has continued to be of both palaeontological and stratigraphical interest. Visits by the Geologists' Association include meetings reported by De Sales (1914), and Wooldridge and Wrigley (1929), whilst those by the Tertiary Research Group were recorded by Cooper and James (1975) and Cooper (1976a).

Both body fossil organisms and trace fossils have attracted the attention of palaeontologists over many years. Extensive fossil lists are given in Cooper and James (1975) and Cooper (1976a), whilst earlier palaeontological references include those by Wrigley (1929) and Curry (1959). Stratigraphical descriptions include the brief account in Sherlock and Noble (1922) and a description of the lower part of the Reading Beds by Cooper (1976a) and of the London Clay by the same author (1982, unpublished and produced for the Geologists' Association field meeting of 21 February 1982) and Cooper and James (1975). The stratigraphical significance of the site is further discussed in Hester (1965), Cooper (1976a) and King (1981), whilst more recently it was sampled by Townsend and Hailwood (1985) as part of their broader research into Palaeogene magnetostratigraphical correlation in south-eastern England. More recently, new lithostratigraphical terminology has been introduced by Ellison *et al.* (1994) (see below for details).

This site was also independently selected for its fossil plant content, a more detailed account of which can be found in the GCR series volume *Mesozoic to Tertiary Palaeobotany of Great Britain* (Cleal and Thomas, in prep.).

Description

The Harefield site is important for various reasons. One is that it is an example of the very few remaining localities in the western part of the London Basin where the Palaeogene may be seen resting on the Chalk. The burrowed surface of unconformity has interested palaeontologists since the 19th century, with the burrow (*Terebella harefieldensis*) named after this locality by White (1923).

Lithological succession

Flint gravel at the base is followed by a succession of muds, silts and sands, concretionary in places. Almost 15 m of Lambeth Group and succeeding Thames Group strata have been reported from this site, although relatively recent accounts do not confirm this and it is possible that the total thickness may be somewhat less ((Figure 4.2), after King, 1981; Cooper, 1976a).

Stratigraphy

Above the unconformity, around 1 m of flint gravel represents a particularly coarse development of the Bottom Bed of the Woolwich and Reading Formation, which, following Ellison *et al.* (1994), is now known as the Upnor Formation of the Lambeth Group. No modern accounts refer to the total thickness of the latter, though early reports (e.g. Sherlock and Noble, 1922, p. 28) indicated something over 10 m. Glauconitic sediments immediately above the basal gravel (Cooper, 1976a) should perhaps be assigned to the Upnor Formation, with the remainder of the Lambeth Group succession considered to be part of the Reading Formation of Ellison *et al.* (1994).

The succeeding strata have proved to be of considerable stratigraphical and palaeontological interest. Traditionally regarded as the 'London Clay Basement Bed', all but the uppermost part was redefined by Cooper (1976a) as the Harefield Member, with the northern part of this section as stratotype. Subsequently, King (1981, pp. 16–18) defined the Oldhaven Formation, subsuming most of the 'London Clay Basement Bed'. This formation is represented at Harefield by King's Tilehurst Member for which the section is one of two hypostratotypes (but see later discussion). The latter was considered by Ellison *et al.* (1994) to comprise part of their Harwich Formation.

Magnetostratigraphy

In relatively recent years, the stratigraphical significance of the site has been re-emphasized by Townsend and Hailwood (1985). They recognized that the Woolwich and Reading Formation and most of the overlying Oldhaven and London Clay strata accumulated during periods of reverse polarity. However, the basal unit of the Oldhaven Formation (Unit 2 of Cooper, 1976a, p. 35) shows normal polarity and has been referred to by Townsend and Hailwood (1985) as the Harefield normal magnetozone.

Palaeontology

The site has been a major source in the 20th century of 'London Clay Basement Bed' fossils (Cooper, 1982). Extensive lists compiled from various sources are given in Cooper and James (1975) and Cooper (1976a). Mollusca, both bivalves and gastropods, are most common, though also present are brachiopods (*Discinisca*, *Lingula*) ophiuroid ossicles, ostracods and fish remains (including otoliths, teeth and scales). A particularly palaeoecologically interesting occurrence comprises contemporaneously exposed early concretions bored by the bivalve *Martesia saxorum*, whilst also providing a substrate for the brachiopod *Discinisca* and button coral *Paracyathus*. The boring molluscs and others from different sites were described by Wrigley (1929).

Interpretation and evaluation

Although present-day exposures are not as good as they once were, this site retains its importance as one of the few remaining exposures in the western part of the London Basin.

The sub-Palaeogene unconformity

The section at Harefield 'Cement Works Pit' has long attracted those geologists interested in the development of the Chalk–Palaeogene surface. The age of the Chalk below the Palaeogene at Harefield demonstrates the magnitude of the unconformity. Since it is of *M. coranguinum* age, the Maastrichtian, Campanian and most Santonian Chalk is missing. Together with the absence of older Palaeogene strata, the unconformity therefore represents a time gap of some 30 Ma.

Over a period of years, the *T. harefieldensis* burrows that penetrate the Chalk have variously been described as the roots of marine plants (Hudleston, 1876), as having been formed by annelids (White, 1923; Hester, 1965), and now, with the recognition of characteristic scratch marks, are thought to have been produced by arthropods (Crane and Goldring, 1991, p. 151). As Palaeogene sedimentation began, the surface of the Chalk remained firm but uncemented; hence the structures are burrows not borings.

Origin of the Upnor Formation

The Harefield section was also one of four sampled to investigate the hypothesis that the Bottom Bed (now the Upnor Formation) might have developed entirely as a result of post-depositional weathering at the Chalk–Palaeogene interface (Bateman, 1988). His investigations proved conclusively that any in-situ weathering has been minimal. Major solution would have destroyed the *T. harefieldensis* burrows, whilst a 44 km thickness of Chalk would need to have been dissolved at Harefield to yield the quartz content of the basal conglomerate (Bateman, 1988)!

Hester (1965, p. 122) has demonstrated the very variable thickness of the Bottom Bed from the Cement Works and other pits in the Harefield area. It seems likely that this variation may reflect subsequent erosion in later 'Reading Beds' times and that this could have been a response to a fall in sea level (Crane and Goldring, 1991, p. 156).

Stratigraphy and correlation

The recognition of Harefield as a lithostratigraphical type section for the Tilehurst Member of King's (1981) Oldhaven Formation has already been referred to. However, since the latter is unlikely to comprise a separately mappable unit in this area, its formational status locally is probably invalid. As indicated above, recent work on the lithostratigraphy of the London Basin (Ellison *et al.*, 1994) assigns the Tilehurst Member to the Harwich Formation but the change of name does not validate it as a mappable formation.

The magnetostratigraphical work on the section led Townsend and Hailwood (1985) to the conclusion that the Harefield normal magneto-zone represents the end of the normal polarity chron whose start is recorded in the Oldhaven magnetozone at Herne Bay. The lower part of the latter is presumably not represented at Harefield due to the hiatus between the Lambeth Group and the overlying 'Tilehurst Member'. Aubry *et al.* (1986) have suggested that the Oldhaven magnetozone represents a short-period normal polarity interval during the reversed polarity Chron C24R. Such a date for the Harefield site is compatible with the occurrence of dinoflagellate assemblages representing the *Apectodinium hypercanthum* Zone found in the lower part of the Tilehurst Member here by Knox *et al.* (1983), although it should not be forgotten that recently the overall validity of the Oldhaven magnetozone has been questioned (Ali *et al.*, 1996).

Conclusions

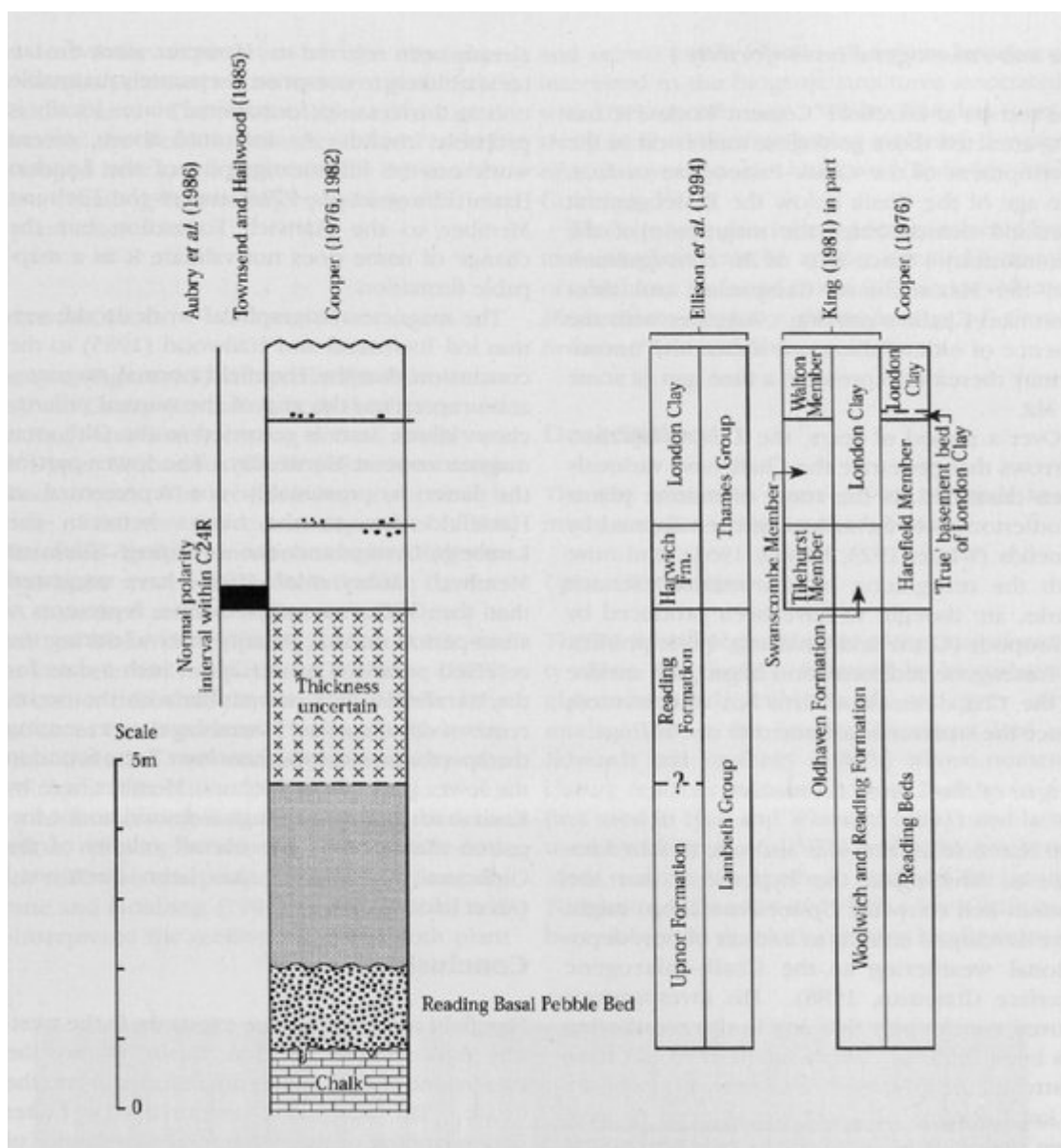
Harefield represents a rare exposure in the western part of the London Basin where the Palaeogene is seen to rest unconformably on the Chalk. The site has contributed to a better understanding of the nature and significance of this surface and our appreciation of the variable nature of the overlying Lambeth Group.

The site formerly attained lithostratigraphical significance through being a type locality for the Tilehurst Member of King's (1981) Oldhaven Formation, whilst it remains probably the most important site palaeontologically for this part of the Palaeogene sequence in the London Basin.

References



(Figure 4.1) Harefield, Middlesex. Lambeth Group, showing flint gravel of the Upnor Formation resting uncon-formably on the Upper Cretaceous Chalk. Photograph (courtesy of English Nature) taken in 1974.



(Figure 4.2) Generalized succession of the Woolwich and Reading Formation and London Clay at Harefield, Middlesex (mainly after Cooper, 1976a, 1982).