Bolter End, Buckinghamshire

[SU 799 919]

Highlights

The Reading Formation at this site is distinguished by the presence of exotic pebbles in addition to the flints found commonly elsewhere in the Palaeogene. The existence of such pebbles reflects the presence of a marginal fluvial facies and probably originated from the erosion of Lower Cretaceous and Upper Jurassic rocks outcropping to the north-west.

Introduction

The site at Bolter End (grid reference [SU 799 919]; (Figure 3.2), (Figure 4.4)) occurs within the Lane End Outlier (Wooldridge and Gill, 1925, fig. 10), one of a number of small outliers of Palaeogene age which rest unconformably on the dip slope of the Chalk forming the Chiltern Hills (see sheet 254 (Drift): Henley on Thames, published 1905).

Whilst some of these outliers, such as that at Lane End, include London Clay strata, most comprise 'Reading Beds' type sediments of the Woolwich and Reading Beds Formation, now renamed the Lambeth Group. The particular significance of Bolter End (and the Lane End Outlier as a whole) is that the succession has an atypical petrology (particularly with regard to pebble composition) which provides an insight into the provenance and environment of deposition of the formation in this area.

The Lane End Outlier has attracted the interest of geologists since the 19th century. Although small in size, its significance has been discussed in some detail over the years. Sections noted by Whitaker (1872) revealed nothing abnormal in the 'Reading Beds', but the discovery of an unusual pebble suite (Jukes-Browne and White, 1908) led in time to some controversy. According to Wooldridge and Gill (1925), the outlier 'long enjoyed a certain notoriety'. Certainly it has provided a focus of interest continuing to the present day.

Early references to Lane End and the pebble suite include White (1906), Woodward (1909), Barrow (1919) and Sherlock (1924). A detailed early description was published in Jukes-Browne and White (1908). Wooldridge and Gill's (1925) comprehensive paper, following new excavations at a number of localities in the outlier, went a considerable way towards resolving outstanding disputes. Later, with the development of a number of further pits and other exposures, Wooldridge and Ewing (1935) were generally able to confirm earlier conclusions, whilst introducing extensions and corrections to their 1925 account. In recent years, detailed work on the Lane End Outlier has been limited by lack of exposures. Reference to it is, however, made by Bateman and Moffat (1987) whose broader mineralogical investigations of the Woolwich and Reading Formations continues the interest in the detrital mineralogy of Lane End discussed at some length in both Wooldridge and Gill (1925) and Wooldridge and Ewing (1935).

Description

The most useful map of the Lane End Outlier and its stratigraphical composition remains that of Wooldridge and Gill (1925, fig. 1). A complete sequence of 'Reading Beds' occurs between the Chalk and the overlying London Clay. The base of the Palaeogene dips southeastwards at a low angle and the junction with the Chalk was formerly visible on both sides of the Fingest Road at Bolter End. The Bolter End site itself appears to correspond to the 'new sand pit' described by Wooldridge and Gill (1925, figs 13 and 14) just to the south of Bolter End Common.

Wooldridge and Gill (1925) considered the local 'Reading Beds' to be some 15–18 m thick and roughly divisible stratigraphically into two parts. A lower mottled clay, considered by Wooldridge and Ewing (1935) to be marine and unlike the 'normal' mottled clay from the formation elsewhere, reaches some 9+ m around Lane End itself, but thins to the north-west of the outlier. This may reflect overlap by, or passage into, the upper part of the formation, comprising cross-bedded sands with gravels and intraformational mud–clast breccias which provide the focus of interest and

characterize the unusual nature of the outlier.

Lithology

At Boulter End, the sediments are typical of the 'upper division' of the local Reading Beds. The rudites within these comprise predominantly intraformational mud–clast breccias with some exotic pebbles or, higher up, lenticular gravels with more exotic pebbles. These pebbles, which represent the main attraction of the site, include quartz pebbles and black, polished chert/sil-iceous rock pebbles which earlier workers referred to as lydite'. From elsewhere in the outlier, (Jukes-Browne and White, 1908) had also noted quartzite and sandstone pebbles. They also referred to the variations in wear of the flints. Whilst true flint pebbles occurred, they were markedly outnumbered by subangular, little-worn flint nodules.

Stratigraphy

The nature of the strata at Boulter End (traditionally considered as 'Reading Beds') suggests that they be assigned to the Reading Formation (Lambeth Group) of Ellison *et al.* (1994).

Interpretation and evaluation

This site represents, for the Lambeth Group, a unique facies not found at any of the remaining sections of this age. However, a few years after the discovery of quartz and other exotic pebbles in the Reading Beds of the Lane End Outlier, such workers as Barrow (1919) disputed the age of the gravels in which these pebbles were found, implying a Pliocene age. Subsequently, work by Wooldridge and Gill (1925) proved beyond doubt that such pebbles occurred *in situ* in a conformable sequence below a capping of London Clay and were consequently of Reading Beds age. That quartz pebbles also occur in younger gravels locally (the 'Pebble Gravel' of the Henley-on-Thames sheet; see discussion in Wooldridge and Ewing, 1935, pp. 305–11) indicates perhaps how the earlier controversy arose.

Pebble provenance

The significance of the exotic pebbles in the Reading Formation at Bolter End is considerable since there is a clear implication that by this time the extensive Chalk cover landward of the Palaeogene basin must have been breached to facilitate the erosion of older strata. Wooldridge and Gill (1925) held the view that the Lane End exotics were derived from the Lower Cretaceous and Upper Jurassic rocks exposed to the northwest. They pointed out that White considered the 'lydites' to be identical with those occurring in the Portland Beds and that northerly outcrops of the Lower Greensand contained both 'lydites' and quartz pebbles. H.B. Milner (in discussion of Wooldridge and Gill's (1925) paper, pp. 171–2) considered that the kyanites, staurolites and garnets from Lane End were like those from the Lower Greensand. That the latter might have been the source of the pebbles was supported by Wooldridge and Ewing's (1935) conclusion that the Faringdon Greensand could have provided some material. Recent work by Bateman and Moffat (1987), whilst conceding that the English Midlands provides a likely source for the exotic pebbles, concluded that the provenance of the Woolwich and Reading Formation as a whole based on detrital minerals is as yet speculative and unresolved.

Pebbles other than flint have been recorded from various outcrops on the western margins of the Palaeogene depositional basin. A variety occur, e.g. at Blackdown and Bincombe Down in Dorset, although the strata in which these are found are somewhat younger than the Lambeth Group (see separate accounts of these sites). Hester (1965, p. 123), in fact, recorded the presence of various exotic pebbles in the formerly named Bottom Bed of the latter, but at most localities, particularly those further east, at this level and in the stratigraphically higher pebble beds referred to by Ellison (1983; cf. Blackheath Beds), the pebbles in this group are exclusively flint.

Depositional environment

The petrological distinctiveness of the Reading Formation at Bolter End, together with the mud–clast breccias which occur in a number of fluvial sequences (cf. the Wessex Formation (Wealden) of the Isle of Wight) suggests that it represents a fluvial facies of northern or northwestern provenance, which does not fit comfortably into any of the six

lithofacies described from the Woolwich and Reading Formation as a whole by Ellison (1983). Wooldridge and Ewing (1935, p. 302) considered it to represent a channel facies laid down by a river, which in their words was one of the 'effluents of the so-called Eocene Amazon'. Clearly, this facies contrasts with the much lower energy 'mottled clay' deposits found elsewhere.

Comparison with other localities

Although Bolter End is the only locality at which this 'marginal' fluvial facies may now be examined, an important matter for consideration is its former areal extent. Wooldridge and Gill (1925) attempted to determine this at some length. They recognized it to the west in the Nettlebed Outlier [SU 705 873], but found it absent in most localities further east, including the classic Harefield site (see separate account). They did, however, refer (Wooldridge and Gill, 1925, pp. 162–3) to mud–clast breccias at a former pit at Denham (Dew's Pit) where rare 'lydites' and quartz pebbles have also been found. Following the later development of new pits, Wooldridge and Ewing (1935) reported the development of the facies from a wider area including localities such as Ayot, near Hatfield, and further west near Newbury. These authors made the point that the mud–clast aspect of the facies is more widespread than the quartzose gravels, but interestingly reported the latter from further south, near Basingstoke.

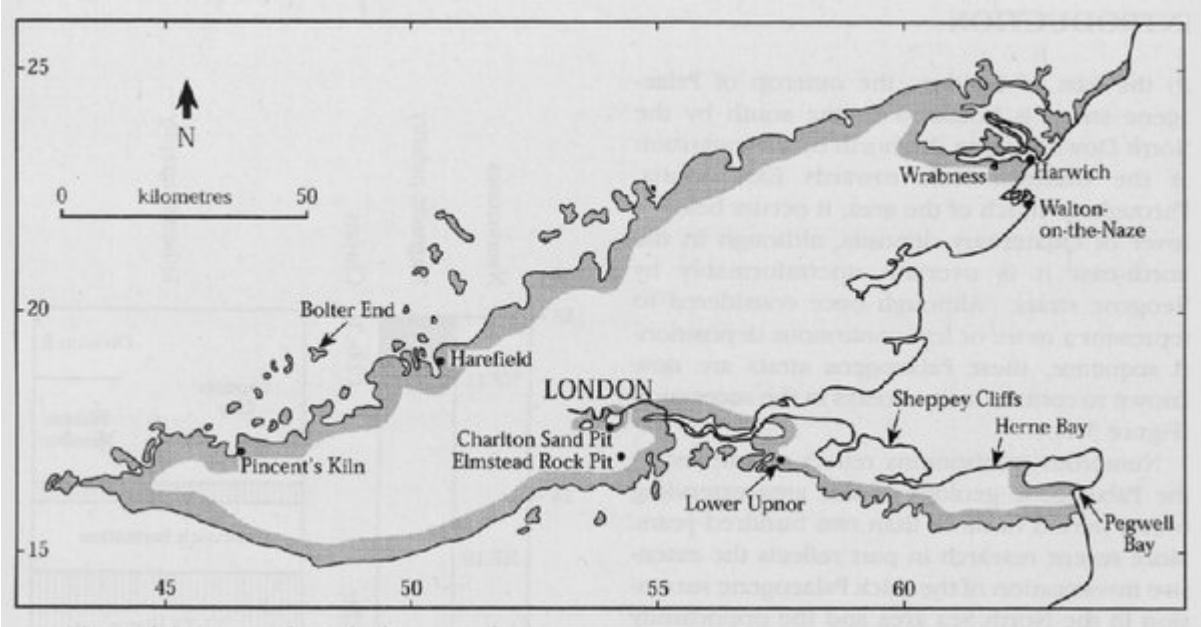
Maybe such localities represent separate channels developed on the western margins of the Lambeth Group basin of deposition. Resolving the palaeogeographical extent of the Lane End facies is inevitably diminished by the limited outcrops of the formation in such areas as the Chilterns. A possible way forward according to Wooldridge and Gill (1925) would be to map the scattered conglomeratic sarsens and quartz-bearing conglomeratic ironstones which both May and White (Jukes-Browne and White, 1908) considered might be erosional remnants of the 'Lane End facies'. To date, this has apparently not been attempted and in view of the uncertainty of their easy diagnosis, will probably not be undertaken.

Conclusions

A distinctive facies of the Woolwich and Reading Formation comprising sands with mud–clast breccias and gravels with exotic pebbles, called here the 'Lane End facies', is represented at Bolter End. This facies provides an important insight into the palaeogeographical conditions that existed towards the western margins of the basin of deposition, which extended over southeastern England during the period of time represented by the Lambeth Group.

This facies has been recognized from some other, but unfortunately no longer exposed, sites in this part of the London Basin. It is, however, not present at all localities in this area and is absent further to the east. It appears to represent a fluvial channel development deriving material from a hinterland to the west and/or north. Whilst the presence of flint in the pebble beds indicates a predominantly Chalk provenance, the exotic pebbles clearly demonstrate that by Reading Formation times, material from below the original Chalk cover was being eroded. The possibility exists that Lower Cretaceous or even Upper Jurassic rocks were the source of such pebbles.

References



(Figure 3.2) Map to show the location of Palaeogene stratigtaphy GCR sites in the London Basin area (shading shows limit of Paleogene together with outliers).

(Figure 4.4) Bolter End, Buckinghamshire. A view of the overgrown pit in 1982. (Photograph courtesy of English Nature)