Humans in the Hoxnian: habitat, context and fire use at Beeches Pit, West Stow, Suffolk, UK

R. C. PREECE,1* J. A. J. GOWLETT,2 S. A. PARFITT,3,4 D. R. BRIDGLAND5 and S. G. LEWIS6

1 Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK
2 SACE, The Hartley Building, University of Liverpool, Liverpool L69 3GS, UK
3 Department of Palaeontology, The Natural History Museum, Cromwell Road, London SW7 5BD, UK
4 Institute of Archaeology, University College London, 31–34 Gordon Square, London WC1H 0PY, UK
5 Department of Geography, University of Durham, South Road, Durham DH1 3LE, UK
6 Department of Geography, Queen Mary, University of London, Mile End Road, London E1 4NS, UK


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ABSTRACT: A Lower Palaeolithic industry at Beeches Pit, West Stow, Suffolk, occurs within an interglacial sequence that immediately overlies glacial deposits, referable to the Anglian Lowestoft Formation. There is strong biostratigraphical evidence from both vertebrates and molluscs that the interglacial represented is the Hoxnian (MIS 11). This conclusion is supported by uranium series dates from carbonate nodules (>400 kyr), TL dates from burnt flint (414 ± 30 kyr) and a range of amino acid racemisation data. The archaeology consists of flint artefacts of Acheulian character, including many refitting examples. Charred material is abundant in three stratigraphical units and many bones and flints have been burnt, indicating repeated occurrence of fire. Several discrete areas of burnt sediment appear to be hearths. This interpretation is supported by: (1) the intensity of burning (600–800 °C) implied by the charred and calcined bones; (2) the intersection of two of the burnt areas, implying separate burning events at slightly different, overlapping locations; (3) the discovery of two burnt flakes that refit onto an adjacent group that are unburnt, indicating that the burning was highly localised; and (4) the spatial distribution of artefacts respects the features interpreted as hearths, suggesting fireside knapping. Fossils associated with the archaeology indicate occupation within closed deciduous forest in a fully temperate climate. Attractions to this unusual environment would have included the fresh water provided by springs, a rich supply of potential food and a prolific source of good quality flint for tool manufacture. The archaeological evidence therefore suggests that the site repeatedly served as an area of focused activities (perhaps a ‘home-base’) during much of the interglacial. The upper levels of the sequence provide clear faunal evidence of climatic deterioration during which human occupation and fire use persisted. Biostratigraphical correlations with other Lower Palaeolithic sites lend support to the suggestion that Acheulian and Clactonian industries occurred in Britain during the same substage of the Hoxnian, although not necessarily at precisely the same time. Copyright © 2006 John Wiley & Sons, Ltd.

KEYWORDS: Lower Palaeolithic; fire use, hearths; ‘home-base’; Hoxnian; Acheulian; Clactonian.

Introduction

It has been suggested that during interglacial forest phases in Europe, human activity became focused on the relatively restricted areas of open country that remained (e.g. Gamble, 1986). Not only would hunting game have been much harder in woodland (Bradley et al., 1989) but dispersal itself would have been particularly difficult in closed forest environments. Indeed, it is currently argued that most movement of human populations took place along the narrow open corridors provided by the floodplains of large rivers (Ashton et al., this issue, pp. 497–505). The concentration of artefacts in fluvial contexts might be seen to reinforce this view, even though most such archaeological sites have furnished little or no evidence of in situ occupation. Indeed, fluvial sediments provide one of very few opportunities for the preservation of artefacts and other evidence of Pleistocene human activity. Other parts of the landscape in which such people lived are largely unrepresented in the sedimentary record, nor are Pleistocene land surfaces commonly preserved. Thus the concentration of archaeological evidence in fluvial contexts (cf. Wymer, 1999) might give an entirely false impression of the distribution of early human populations and the range of their activities (but see Ashton et al., this issue, pp. 497–505). For this reason Beeches Pit is of particular value, since it provides a rare glimpse of an...
interglacial area of focused activities (perhaps a ‘home-base’ sensu Rolland, 2004) that was not in the bottom of a large river valley.

There is evidence at sites such as Highlands Farm Pit near Henley-on-Thames, in the so-called ‘Caversham Ancient Channel’ (Wymer, 1999) and knapping scatters in the upper solifluxion levels at Boxgrove (Roberts and Parfitt, 1999), for human occupation in southern England during the Anglian but the frequency of archaeological remains increases dramatically in early Hoxnian contexts (Fig. 1; Wymer, 1999). Based on annually laminated sediments at Marks Tey (Turner, 1970), the Hoxnian Stage would seem to be broadly equivalent to just the early part of MIS 11. Other Hoxnian localities, such as the cluster of archaeological sites near Hitchin, Hertfordshire (Wymer, 1985; Boreham and Gibbard, 1995), are associated with lakes that have formed on the surface of Anglian till. Such lacustrine archaeological contexts, perhaps originating as kettle-holes, are surprisingly rare and even the Palaeolithic industry at the Hoxne type-site has recently been shown to occur above, rather than within, the lake deposits at that site (Ashton et al., this issue, pp. 497–505). One possible explanation for the failure to find archaeological evidence from lacustrine contexts is that quarries exploiting lake deposits, and researchers studying them, will have tended to concentrate on the thicker sequences away from the lake edges, whereas any evidence for human activity would be concentrated near the former margins (but see Ashton et al., this issue, pp. 497–505).

At other sites, such as Barnham, Suffolk, the archaeology occurs in channels, rather than basins, the contexts being described as ‘fluvio-lacustrine’ (Ashton et al., 1998). This implies some flow, perhaps at times of flood, alternating with quieter periods of stagnation. Such conditions were probably widespread in the immediate aftermath of the Anglian glaciation, which obliterated earlier drainage systems, leading to the formation of many small lakes connected by a network of channels on the newly deglaciated terrain (cf. Preece and Penkman, 2005). Most archaeological sites of Hoxnian age, however, occur in valleys, usually in river terrace deposits. Examples include the famous sites at Swanscombe, Kent (Ovey, 1964; Bridgland, 1994; Conway et al., 1996), and Clacton-on-Sea, Essex (Warren, 1955; Bridgland, 1994; Bridgland et al., 1999), both of which are beyond the limits of the Anglian glaciation.

Despite the wealth of the archaeological record, only a small part of the Hoxnian landscape has been sampled. Virtually nothing is known about occupation of upland interfluve areas, coastal regions or indeed caves. This paper concerns a site representing another poorly known context, namely closed forest, which would have covered extensive tracts of the landscape during the early part of the interglacial. It draws on recent multidisciplinary investigations at Beeches Pit, integrating evidence so as to work towards a reconstruction of human ecology in the Hoxnian. A full account of the geology of the site will appear elsewhere (Preece et al., in preparation) and a detailed account of the archaeology has already been published (Gowlett et al., 2005), hence only a general review of these aspects is provided in order to give context to the environmental and socio-ecological issues.

Location and geological succession

Beeches Pit, in the parish of West Stow, Suffolk (TL 798 719), is a disused brickpit at the edge of Thetford Forest. It is 2.5 km from the larger village of Icklingham, with which name it has also been associated. It is one of a number of important Lower
Palaeolithic sites in this part of central East Anglia (Fig. 1; Lewis, 1998), the others including High Lodge (Ashton et al., 1992), Warren Hill (Bridgland et al., 1995; Wymer, 1999), Elveden (Ashton et al., 2005) and Barnham (Ashton et al., 1994, 1998). It is also one of several sites in East Anglia where Middle Pleistocene interglacial sediments overlie Anglian glacial deposits, a feature that it again shares with Barnham and Elveden, as well as the Hoxnian type locality at Hoxne, Suffolk (West, 1956), and the parastratotype at Marks Tey, Essex (Turner, 1970).

The sections at Beeches Pit were first described in the 1870s by S. B. J. Skertchly and reported in the Geological Survey Memoir (Whitaker et al., 1891). Recent excavations (Fig. 2) have re-exposed some of the sediments seen by Skertchly and, together with new borehole data, have added further information about the sequence (Fig. 3) and the threedimensional disposition of beds (Preece et al., 1991, 2000).

The bedrock at Beeches Pit is Middle Chalk, which can be observed at a few points at or near the ground surface along the southern margin of the pit. The Middle–Upper Chalk boundary occurs <100 m upslope to the north. The basal part of the Upper Chalk in this area contains prominent bands of flint nodules known as the Brandon Series (Bristow, 1990), highly regarded as a raw material for flint-knapping. The Pleistocene succession fills a depression in the Chalk, which is 100 m wide and at least 15 m in depth (Fig. 2(A)) and has been interpreted as a subglacial channel.

The Pleistocene sequence has been divided into eight beds (Fig. 3). In places, the upper surface of the Chalk is strongly brecciated, which appears to represent periglacial weathering in situ, although some disturbance is apparent towards the top of this unit (Bed 1). A silty diamicton-rich unit (Bed 2) represents the most extensive deposit surviving at Beeches Pit. It is generally olive yellow (Munsell colour 2.5Y 6/6) to brownish yellow (10YR 6/6) and contains chalk clasts of all sizes, as well as flints and exotic rocks, including a striated clast of Carboniferous Limestone. Two lithologically distinct subunits are also recognised: a gravel (Bed 2a) that occurs in the northeast part of the pit and laminated silts and fine sands (Bed 2b) that rarely exceed 0.5 m in thickness. Bed 2 is interpreted as a glacial, probably subglacial deposit. The composition of the gravel provides a clear indication of a glacial origin; it contains non-durable material derived far from the catchments of any local rivers as well as Rhaxella chert, a notable durable rock that was brought from north of the Humber by the Pleistocene glaciations (Bridgland et al., 1995). This gravel reinforces the interpretation of the glacial sequence as filling a channel; similar glacial gravel, with characteristic ‘exotic’ clasts, occurs

Figure 2 (A) Generalised geological section across the Lark valley showing the geomorphological context of Beeches Pit. (B) Plan of Beeches Pit showing the locations of archaeological excavations (shaded), cuttings, trenches and the borehole.
at sites to the west, including Weatherhill Farm Pit (Bridgland et al., 1995). The alignment of these sites is suggestive of a channel that may well have been part of the local subglacial drainage, which was centred on a ‘tunnel valley’ now drained by the Lark (Bridgland and Lewis, 1991), but which originated as the course of the Bytham-Ingham River (Rose, 1989, 1994; Rose et al., 2001).

The interglacial sediments (Beds 3–7) have been defined as the West Stow Formation (Lewis, 1999) and are restricted to the northwest corner of the pit, where they appear to occupy a depression in the top of the glacial sequence. The glacial deposits pass upwards into Bed 3, which consists of light grey (2.5Y 7/2) silts and clays, rich in aquatic molluscs and ostracods, indicating deposition in shallow pools. In places this bed is separated into lower (3a) and upper (3c) units by a prominent very dark brown (10YR 2/2) horizon (3b) that is less calcareous but nevertheless contains land snails and small vertebrate remains, as well as aquatic molluscs indicative of stagnant water. Above these shallow lacustrine sediments is the Icklingham Tufa (Bed 4), which is separated from them by the products of slope erosion, in the form of a colluvial diamicton (Bed 3d). The Icklingham Tufa, first discovered by Kerney (1976), consists of light yellowish brown (2.5Y 6/4) to olive yellow (2.5Y 6/6) silts and clays with a concretionary tufaceous component. Notwithstanding previous descriptions, it is not a pure homogeneous tufa, as it contains a significant clastic component (small flints and belemnite fragments). Moreover, stable isotope analyses suggest that many of the carbonate concretions were formed as the result of post-depositional groundwater processes (I. Candy, unpublished data). Bed 4 is extremely fossiliferous and has yielded a diverse molluscan fauna dominated by land snails.

The upper levels of the sequence (Beds 5–8) are best exposed in the western faces of the pit (cuttings 2 and 11; Area AF; Fig. 2B)). Bed 5 consists of grey/brown silts and clays that in places rest on a surface sloping to the southwest. The occurrence of large flint clasts (up to 20 cm) in an otherwise fine-grained sediment, together with faults and folds resulting from slumping, all suggest emplacement by colluvial processes. Shells are rare in this bed but vertebrate remains are frequent. Overlying Bed 5 is a prominent black (10YR 2/1) organic clay, up to 0.75 m thick, rich in charcoal and bone fragments, including those of the rhinoceros Stephanorhinus hemitoechus. It has also yielded a few aquatic molluscs, suggesting deposition in a shallow body of water. The yellowish brown (10YR 5/4) clayey sands of Bed 7, rich in ostracods and freshwater molluscs in their lower part (the upper part is decalcified), also indicates subaqueous deposition. Mantling the entire sequence is a poorly sorted and decalcified clayey gravel (Bed 8), which has clearly been strongly affected by
periglacial disturbance (cf. vertical orientation of clasts). It is this bed that earlier authors might have regarded as a possible glacial ‘boulder clay’ or till (Whitaker et al., 1891).

**Dating**

Several biostratigraphically important species occur at Beeches Pit. The molluscan fauna of the Icklingham Tufa (Bed 4) contains *Lyrodiscus* (indeed it is the type locality for *Retinella (Lyrodiscus) sketchlyi*) and other taxa typical of the ‘*Lyrodiscus* biome’, thought to characterise MIS 11 (Rousseau et al., 1992). Likewise, the mammalian fauna from the interglacial horizons (Beds 3–5) includes the voles *Arvicola terrestris cantiana* and *Microtus (Terricola) subterraneus*, the extinct mole *Talpa minor*, extinct beaver *Trogontherium cuvieri*, aurochs *Bos primigenius* and rabbit *Oryctolagus cf. cuniculus*, a combination also indicative of a Hoxnian (MIS 11) age (Parfitt, 1998; Schreve, 2001).

Three geochronological techniques have been used to date the sequence from Beeches Pit. Full details are given elsewhere, so only brief summaries are presented here. All techniques give support to the view that the interglacial sediments at Beeches Pit accumulated during MIS 11.

Uranium series dating (by Dr P. Rowe and Professor T.C. Atkinson) of carbonate concretions from the base of Bed 4 in Cutting 1 have yielded data with a mean age of ca. 455 kyr, which is very close to the limit of Th230/U method and, as a consequence, carries a very large uncertainty. The stable isotope data suggest that the carbonate precipitated during an interglacial period. Since it postdates its host sediment, it is theoretically possible that it might relate to a later interglacial period than the site as a whole. This seems unlikely because it would require the maintenance of a high water table on the margins of an actively eroding valley through at least one cold stage. From detailed statistical arguments, it is estimated that the probability of the deposit being of MIS 7 age or younger is <5%, of MIS 9 age 19–25% and of MIS 11 age 20–32%. An older age, which would imply a pre-Anglian interglacial, is equally compatible with the U/Th data, although it can be ruled out from other evidence.

Thermoluminescence dating has been undertaken by Dr N. C. Debenham on five burnt flints from the archaeological horizons in Bed 6 in Cutting 2 and Area AF and in Cutting 11 (Fig. 2(B)). Within their uncertainties, the TL dates of the five flints are not significantly different. If it is assumed that all the samples were heated contemporaneously, the best estimate for the date of the event is $414 \pm 30$ kyr (Gowlett et al., 2005). This is fully compatible with attributions to MIS 11 made on the basis of other lines of evidence.

Finally amino acid dating has been undertaken by Dr K. Penkman on the calcitic opercula of *Bithynia*, which were chosen because they have been found to provide good quality data and therefore have potential for comparison with the large database being assembled from such material (Penkman, 2005). The opercula analysed were recovered from Bed 7 in Cutting 2. The data fall within a large cluster that represents MIS 11 sites (Penkman, 2005), corroborating that age attribution.

**Evidence of human occupation**

Archaeological excavations have been undertaken in two areas of the pit, Area AF, in the west, and Area AH, about 20 m to the east (Fig. 2(B); Gowlett et al., 1998, 2005). Most of the artefacts in Area AH came from Bed 3b and in sediments immediately overlying it. Whether this flint, which would have provided a ready supply of good quality raw material for tool manufacture, was derived from a chalk cliff to the north, now buried, or from glacial deposits such as were revealed in the trial pits to the northwest remains to be determined. The rich lithic assemblage suggests that...
knapping of locally obtained flint nodules was one of the activities carried out at the site. The nodules were first tested for suitability, then reduced to produce handaxes and flakes (including simple flake tools). This interpretation is supported by the recovery of many cores with fewer than three flake removals and by the refitting of several flakes onto the roughout, and other instances of conjoint material. The occurrence of refits indicates that this is a primary-context locality that preserves an in situ knapping site. Other handaxes in the assemblage appear to be isolated from their manufacturing debitage, however, raising the possibility that they were imported and then discarded in their final form. The low numbers of flakes from the latter stages of handaxe manufacture, and the absence of refits relating to resharpening and retouching, supports this interpretation (Gowlett and Hallos, 2000; Hallos, 2005). The lack of long sequences of flaking, other than in one key specimen mentioned below, suggests that humans were also removing partly reduced cores from the site for use at other locations (Hallos, 2004, 2005).

Human occupation persisted into the ensuing cold phase represented by Beds 6 and 7. Bed 6 was uncovered over a restricted area of several square metres, as it is on a steep slope and also lenses out to the east. Its archaeological assemblage, however, includes two small handaxes found towards the base. They are in fresh condition and do not have the appearance of being burnt. Nearby, at the edge of some sand-filled ‘pipes’, small debitage was found. These finds may represent the fringe of a larger occupation on a flatter area beyond the channel bank, but this cannot be verified as soundings showed that the Pleistocene sediments do not continue in this direction. The small assemblage is sufficient, however, to indicate that knapping took place in the area during formation of Bed 6, and to show that it was of Acheulean character. The two handaxes (lengths 72 and 73 mm) are smaller than others from the site, and may hint that relatively delicate tasks were being performed nearby, but the sample is far too small to suggest that smaller handaxes were preferred in general.

Evidence of fire use

Clear evidence of burning was present in both archaeological areas. There are scatters of burnt flints, sometimes deeply reddened and crazed (Figs. 4(b) and 6), across the AH excavation and at more than one level in Area AF. In addition, there are sharply delimited features (about 1 m²) interpreted as hearths (Gowlett et al., 2005; Gowlett, 2006). These generally have dark fills and are characterised by reddening of adjacent sediments (Figs. 4(a) and 5). Moreover, the most striking aspect of the vertebrate assemblage is that many of the bones are charred or calcined by burning (Fig. 6); about 13% of the small mammal teeth from Cutting 1 show unequivocal evidence, together with 9.2% of the amphibian bones. The bones from Beeches Pit and burnt modern bones show identical patterns of modification, notably splitting and mosaic cracking, as well as exhibiting similarities in colour, ranging from red to blue-black and grey-white, individual bones often showing variegated hues (Fig. 6). The colours reflect the degree of burning, which is a function of the prior state of the bone (weathered or ‘green’), exposure (whether lying on the surface or buried) and the intensity and duration of the fire (Shipman et al., 1984). Burning is also indicated by calcined shell, charcoal (some up to 2 cm across), ‘clinker’ (Fig. 6), and heat-fused sediment, which, with fire-crazed flint, are dispersed throughout Bed 3b in Area AH, Cutting 1 and Trench 5e.

A priori, these burnt remains could represent either natural forest fires or human occupation and fire use. In recent years, general arguments have inclined towards earlier human fire use in the light of new general models about diet in the Plio-Pleistocene, particularly the human digestive requirements for cooking in preparation of roots and tubers (Wrangham et al., 1999; O’Connell et al., 1999), and the need for high-grade foods as required by the expensive tissue hypothesis (Aiello and Wheeler, 1995; Wrangham and Conklin-Brittain, 2003). Supporting evidence for early fire comes mainly from Africa, at Swartkrans (>1 Ma), Chesowanja (ca. 1.5 Ma) and Koobi Fora (ca. 1.6 Ma), and remains controversial for some of the reasons explained below (Brain and Sillen, 1988; Gowlett et al., 1981; Bellomo and Kean, 1997; Clark and Harris, 1985). Additional archaeological discoveries, however, as at Gesher Benot Ya’aqov in Israel, give further indications of a long timescale for fire use (Goren-Inbar et al., 2004).

At Beeches Pit, evidence in favour of natural fires is the fact that large numbers of small rodent, insectivore and amphibian bones are burnt, an assortment suggestive of random burning. Burnt patches and ‘depressions’ representing burnt-out roots of trees have been observed in the aftermath of modern forest fires (Connor et al., 1989). Bellomo has also noted that in rare cases where stump fires burn back into the roots they follow the distinctive root shapes (Bellomo, 1993). Alternative anthropogenic explanations are plausible but human use of fire during the Lower and Middle Palaeolithic is difficult to demonstrate for the simple reason that fire itself is transient (Perles, 1975). James (1989) examined the claims for fire use in the Lower Palaeolithic and concluded that, although evidence of burning was present at many sites, it could not be securely linked to a human origin. Furthermore he found no evidence for definite hearth structures before the appearance of Neanderthals towards the end of the Middle Palaeolithic. Roebroeks and Tuffreau (1999: 129) came to a similar conclusion, noting that ‘although burnt flints are very common at Middle Palaeolithic sites (yet more striking, in view of their virtual absence in Lower Palaeolithic contexts), hearth structures are conspicuously absent’. It has even been argued that the apparent absence of fire use in the early Middle Pleistocene, at sites such as Boxgrove, may be linked to a major advance in human social and intellectual capabilities, which did not take effect in northern Europe until about 400 kyr (cf. Dunbar, 1998; Rolland, 2004).
Despite these arguments, there is compelling evidence for controlled use of fire at Beeches Pit (Hallos, 2004; Gowlett et al., 2005; Gowlett, 2006). First, the stratigraphical coincidence of burning with the greatest concentrations of artefacts is highly suggestive. Moreover, the first evidence of burning (in Bed 3b) coincides with the earliest archaeology at the site. Second, careful excavation has shown that areas of intense burning are restricted to shallow depressions, two of which appear to intersect (Fig. 5). This implies a sequence of burning at discrete locations but with overlapping ‘footprints’. Third, the spatial disposition of artefacts appears to respect the burnt areas (Fig. 5), interpreted as hearths. In particular, one refit series of almost 30 pieces, probably representing roughing out of a biface, is unburnt, except for two reddened flakes that moved forwards into the hearth area (Figs. 4b and 5). They both confirm that burning was highly localised and appear to imply fireside knapping. Fourth, burning events have been recognised in three Beds (3b, 5 and 6), indicating

Figure 6 Photographs of burnt material: (A) burnt flint (Bed 3b); (B) ‘clinker’ (Bed 5); (C) burnt large mammal bone (Bed 3b); (D) burnt tooth fragment of large mammal (Bed 6); (E) comparison of calcined (left) and unburnt (right) molar of Clethrionomys glareolus (both Bed 3b); (F) burnt premolar of Talpa minor (Bed 6); (G) burnt vertebra of small mammal (Bed 5); (H) experimentally burnt vertebra of brown rat showing characteristic ‘mosaic’ cracking.

... recurrent fire use over prolonged periods of the interglacial and into the ensuing cold period (Fig. 3). Fifth, various lines of evidence indicate burning of flint at temperatures of several hundred degrees. Crazed pieces indicate heating in excess of 350°C (Purdy and Brooks, 1971; Douglas-Price et al., 1982) and the TL measurements show that some flakes from Bed 6 were heated to a temperature above 400°C (Gowlett et al., 2005). Moreover, X-ray diffraction (XRD) analysis of three bones has confirmed that the charred and calcined bones from Bed 6 had been intensely heated at temperatures of between 600°C and 800°C (J. G. Francis, pers. comm.). This intensity of burning is never attained in grassland fires, which generally burn for only relatively short periods with temperatures exceeding 65°C for less than about 10 minutes (Shipman et al., 1984). Grassland fires do not generate sufficient heat for a long enough time to alter bone colour beyond scorching (Seabloom et al., 1991). Likewise forest or bush fires seldom reach temperatures above 300°C and burning tree stumps produce a prolonged soft glow but only at relatively low temperatures (Bellomo, 1993). Major forest fires can generate very high temperatures, but generally occur in interfluvie situations where there is a long return time between fires (Johnson, 1992). Conversely, several authors have reported temperatures from camp-fires between 400 and 800°C; a maximum temperature of 900°C has even been measured from the oak coals of one camp-fire (Shipman et al., 1984). At Beeches Pit, the occurrence of bones burned to grey or white (Fig. 6) implies more intense combustion than is usual for a natural fire, which often results in only partial and superficial burning (David, 1990). However, none of the large mammal bones from Beeches Pit bear cut-marks and it is not clear whether those that were burned were done so intentionally during cooking or disposal of food waste, or as a fuel for the fire.

Notwithstanding previous assertions, there are nevertheless several European sites where evidence for human use of fire in the Middle and Late Pleistocene is indicated (Fig. 1; cf. Gowlett, 2006). These include both hearths and charred artefacts from Schöningen (Thieme, 2005), the central German travertine sites of Bilzingsleben II (Mania, 1991) (all also attributed to MIS 11), Weimar-Ehringsdorf (Kahlke et al., 2002), of probable MIS 7 age and Taubach (Bratlund, 1999), probably attributable to MIS 5e. In addition, the rock fissure of La Cotte de St Brelade, Jersey, is another MIS 7 locality with evidence for hearths (Callow et al., 1986), whereas Grotte du Lazaret (archaeological unit UA25), near Nice, has been attributed to MIS 6 (de Lumley et al., 2005). Much earlier evidence has recently come from the Acheulian site of Gesher Benot Ya’aqov, Israel, where localised burning in sediments near 790 kyr old has been attributed to the controlled use of fire by humans, including possible hearths (Goren-Inbar et al., 2004). Deep caves, such as Tabun, also preserve hearths back into the Middle Pleistocene (Ronen and Tsatskin, 1995).

The extreme rarity of Lower Palaeolithic hearths may be due to taphonomic factors, in that burnt bones are susceptible to leaching in acidic environments (Lyman, 1994) and ash and charcoal are readily dispersed by water and wind. Sergant et al. (2006) have argued that non-structured hearths may be “invisible” in the archaeological record. In the absence of discrete hearth structures, diagnosis of fire use is frequently based on the patterning of burnt material, such as microdebitage at Gesher Benot Ya’aqov, Israel (Goren-Inbar et al., 2004). However, this evidence is often ambiguous as it may be difficult to eliminate the possibility that the burning resulted from natural fires ignited by lightning strikes or spontaneous combustion. Therefore unless special factors have favoured the preservation and recognition of hearths, such as incorporation in an actively forming travertine (as at the German sites listed above), it is unlikely that anything other than a few burnt stones will survive in place. Beeches Pit, which also has calcareous precipitation and exceptional preservation of archaeological remains, is thus one of the rare sites in northern Europe that has the potential to preserve Middle Pleistocene hearths. The fact that hearths have not been found in fluvial contexts at Hoxnian sites such as Swanscombe and Clacton is entirely to be expected; humans might have procured food and other resources in fluvial environments, perhaps even engaging in tool-making on the gravel bars from which they obtained raw materials, but such locations are unlikely to have been favoured as home-bases. They are too exposed, would attract the attention of predators and would be liable to flooding. At Beeches Pit, the recurrent nature of the fire record, the flint knapping and range of tool types suggest that the woodland habitat (with its source of fresh water from the spring), served as a ‘home-base’. Possibly fire was sustainable only in such favoured local environments (Gowlett, 2006).

Environmental context

Beeches Pit is a rare example of a European Lower Palaeolithic site where human occupation can be related to the local environment and to changes in that environment during different parts of an interglacial/glacial cycle. Since the sediments are strongly oxidised and so lack pollen, most of the environmental evidence at the site comes from faunal data, especially from molluscs, vertebrates and ostracods. The earliest evidence for occupation, from Bed 3b, coincides with an open environment at the edge of a small pool, surrounded by marsh. Drier areas of calcareous grassland existed, as did patches of open woodland. Subsequent archaeological activity (Beds 4 and 5) was located close to tufta-forming springs that would have represented a reliable source of clean fresh water. Areas of deeper, more permanent water existed, supporting aquatic molluscs such as Valvata cristata. The molluscan fauna (‘the Lyrodiscus biome’ sensu Rousseau et al. (1992)) associated with the artefacts in the base of the tufta shows that the humans were active at the height of the interglacial in a local environment dominated by closed deciduous woodland. The land snail fauna is dominated by woodland taxa (ca. 60%), including species (e.g. Platylina polita, Helicodonta obvoluta and Zonitoidea excavatus) with the most shade-demanding preferences. Components of the vertebrate fauna, such as squirrel (Sciurus sp.), garden dormouse (Eliomys quercinus) and wood mouse (Aperodemus sylvaticus) also attest to the presence of forest. Molluscan evidence suggests a slight opening of the woodland canopy in the upper levels of the tufta but otherwise similar conditions appear to have persisted into Bed 5, which yielded a small mammal assemblage dominated by woodland taxa (especially Aperodemus spp.). A major environmental change is registered in Bed 6 by a shift in the composition of the small mammal assemblage towards species characteristic of open country (especially Microtus spp.). The presence of the bivalve Pisidium obtusale laponicum in Bed 6 indicates that the sediments accumulated in a shallow, near stagnant waterbody, during a cold climate episode. Further evidence for cold conditions comes from Bed 7, in which P. obtusale laponicum persists, but is joined by several ostracods species (e.g. Amphocypris tonnensis) and lemming (Lemmus/Meglys) indicative of cold climate. The overlying Bed 8, which is devoid of fossils, has been affected by periglacial disturbance. There is therefore unambiguous evidence of human occupation of a relatively open landscape during an episode of temperate
climate (Bed 3b) and in full interglacial closed forest (Beds 4 and 5). Refitting flint clusters and evidence of fire use attest to in situ occupation during these periods. Flint artefacts and burnt bone have also been recovered from the overlying cold-climate deposits (Beds 6 and 7), implying human persistence at the site under these dramatically different conditions.

Some authors, in particular Gamble (1986, 1987), have argued that early humans in Europe were primarily adapted to open situations, being less able to survive in extreme environments, such as glacial maxima and dense interglacial forest, before the development of extensive ‘alliance networks’. Gamble (1986) suggested that the main obstacle to long-term occupation of such ‘high-risk environments’ is not so much a lack of technology as the absence of appropriate social structures. Others, however, have argued (Roebroeks et al., 1992) that European Middle Pleistocene humans were present in northwestern Europe during interglacial optima, albeit only in ‘relatively open areas within interglacial forested environments’ (Roebroeks and Tuffreau, 1999: 127). They have also argued that the shorter length of interglacials reduces the chances of sampling sites in a given phase.

Evidence for occupation of dense woodland is nevertheless exceptional. An explanation may perhaps be found in relation to the supply of raw material for tool making. Wenban-Smith (1998) has suggested that availability of raw material diminished during interglacials as slopes became vegetated and stable, leading to concealment and scarcity of flint sources. Thus a readily accessible source of flint from what is now Area AH might have led to frequent and repeated visits to the locality even at a time when it was within dense deciduous woodland.

Position within the interglacial cycle

The Hoxnian is one of the few intervals in the European Middle Pleistocene for which it is possible to assign archaeological contexts (e.g. at Swanscombe, Clacton-on-Sea and Barnham) to relatively short time-slices. At some of these sites, palynology can be used to place the contexts within the substages of the interglacial cycle (cf. Turner, 1970). Where pollen data are equivocal or unavailable, molluscan biostratigraphy has been used to correlate critical archaeological sites and to link them to the Hoxnian pollen stratigraphy (e.g. Kerney, 1971; Fig. 4). It is now possible to adopt a similar approach to the Hoxnian sequence at Beeches Pit and to suggest correlations with other sites (Fig. 7), and so to make first steps towards building a regional human ecology.

The pattern of occurrence of the land snails *Discus ruderatus* and *D. rotundatus* are important in this discussion. During the early Holocene (ca. 9500–8500 yr BP) in southern Britain only *D. ruderatus* (now extinct in Britain) occurs but this species is subsequently replaced by its southern congener *D. rotundatus* after ca. 8500 yr BP with only a brief period of overlap (cf. Preece and Bridgland, 1999). However, during several earlier interglacial periods, *D. ruderatus* was not restricted just to the early substage but appears to have persisted far later, resulting in a greater temporal overlap with *D. rotundatus*. During the early Hoxnian, it appears that, as in the early Holocene, *D. rotundatus* was absent or relatively scarce, whereas *D. ruderatus* was the only (or more dominant) species of *Discus* present (Kerney, 1971, 1977; Preece and Penkman, 2005).

The suggested correlations provide a chronological framework relevant to a discussion about the relation of the Clactonian (flake-and-core) industry to the Acheulian (handaxe) industry. The Clactonian has long been regarded as preceding the Acheulian within the Hoxnian, based originally on their superposition at Swanscombe (Kerney, 1971; Wymer, 1974). The Clactonian is found in southeast England from the late Anglian through to the middle of the early temperate substage of the Hoxnian (Ho II), when handaxes became prevalent (Wymer, 1974; Wenban-Smith, 1998; White, 2000; Wenban-Smith et al., this issue, pp. 471–483). In addition to the Swanscombe area, evidence for this is based on the Clactonian type locality; both sites can be related to the terrace sequence...
of the River Thames (Bridgegland, 1994; Bridgegland et al., 1999).

The Clactonian has also been recognised in sediments forming a lower terrace of the Thames at sites like Little Thurrock and Purfleet, which have been correlated with late MIS 10/early MIS 9 (Bridgegland, 1994; Schreve et al., 2002; White, 2000), suggesting at least two sequential Clactonian migrations in consecutive climatic cycles (White and Schreve, 2000).

If the suggested correlations in Fig. 7 are correct and Bed 3b is broadly coeval with the Lower Loam at Swanscombe, the implication is that the Acheulian facies appeared earlier at Beeches Pit than at Swanscombe. At Barnham, 11 km to the northeast of Beeches Pit, the earliest evidence of handaxe manufacture is found within sediments (Unit 5c) yielding Discus ruderatus and those immediately above (Preece and Penkman, 2005), with early temperate pollen (Ho II). The molluscan evidence suggests that these sediments can be correlated with Bed 3b (from the later part of Ho II) at Beeches Pit (Fig. 7), which would therefore imply that handaxes occur earlier in the Hoxnian at both these East Anglian sites than in the Thames valley. It is also apparent that the Clactonian and Acheulian occur within the same stage (Ho II) of the Hoxnian (cf. Ashton et al., 1994, 1998). However, the temporal resolution is insufficient to establish whether they overlapped chronologically or whether there was extremely rapid replacement of the Clactonian by the Acheulian (cf. White and Schreve, 2000).

Conclusions

The Beeches Pit site provides a rare record of human occupation of a land surface during a Middle Pleistocene interglacial, identified as the Hoxnian (= early part of MIS 11, onset about 424 kyr). The occurrence of conjoinable artefacts, which indicate primary context archaeology, within sediments containing evidence for a temperate deciduous woodland, establishes that humans were able to live in fully interglacial closed forests, despite earlier suggestions to the contrary. Discrete areas of burnt sediment are interpreted as hearths, which are thus amongst the oldest in northwest Europe. It is perhaps no coincidence that these features are preserved at a location where calcareous precipitation from a spring has led to exceptional preservation of terrestrial surfaces, something that Beeches Pit has in common with the travertine sites of central Germany, where hearths are also reported. Molluscan assemblages can be used to attribute the archaeological evidence to particular time-slices within the Hoxnian Stage, raising questions about the long-established notion that Clactonian knappers reached Britain earlier within that interglacial than those with an Acheulian (handaxe-making) tradition. The British variability needs to be assessed in relation to the patterns of tool manufacture seen elsewhere in continental Europe.

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References


