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BEECHES PIT: ARCHAEOLOGY, ASSEMBLAGE DYNAMICS AND EARLY FIRE HISTORY OF A MIDDLE PLEISTOCENE SITE IN EAST ANGLIA, UK

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Abstract

Beeches Pit in Suffolk, U. K. has been known as an artifact and faunal locality since the nineteenth century. We report here on archaeological excavations carried out by a Liverpool group over the period 1992 to present. Related paleoenvironmental studies have been carried out by Preece *et al.* (2000, in prep. a, b). The site lies in a forest to the northwest of Bury St. Edmunds, and preserves an interglacial sequence overlying glacial sediments. These sediments represent the Anglian glaciation (OIS 12) and the following interglacial (OIS 11) on the basis of stratigraphy, environmental indicators and TL dating reported here.

Excavations have uncovered archaeological sequences in two areas of the northwest part of the pit, where sections of up to five m in height are preserved. Sediments in the eastern trench, AH, are stratigraphically older. Here an artifact horizon has been exposed across excavations of approximately 75 m^2. It lies within interglacial lacustrine sediments and tufaceous material overlying cold period sediments. In 1999 artifacts were discovered about 0.5 m under the principal artifact horizon, indicating multiple occupations, probably by the side of a pool. The great majority of finds (several thousand knapped pieces) come from a gently sloping horizon of up to 30 cm thickness. Within this about 100 refitting pieces have been found. The largest set of refitting pieces is of a biface roughout, which was eventually abandoned probably because of a flaw. The horizon has yielded several other bifacial pieces, including a broken classic biface and "non-classic" specimens.

The western area, AF, records a later sequence within the same interglacial. Artifacts are stratified within clays overlying a channel bank of tufaceous clays. The site is notable for the variety of evidence of burning. Two localized burnt zones are under investigation, one in AH and one in AF. Burnt flints are common in the main excavations, but not in all areas. At higher levels in AF there is a widespread dark horizon that contains burnt material. The clays contain organic material including microfauna. The artifacts probably come from an occupation on the top of the channel bank in an area later erased by solifluction. Only the edge of the distribution is preserved. It includes very small pieces and microdebitage.

Two features of the archaeological evidence are of particular importance. One is the definite association of Acheulean artifacts, in multiple phases, with environmental evidence indicating a temperate environment, sometimes with closed vegetation. The other is the repeated association of fire events with archaeological evidence. The refit set documents human activity in relation to a particular hearth, which is one of a series. Burning in area AF represents a later similar event, with localized burning on a sloping bank adjacent to the pond. More extensive spreads of burnt material are evident at two levels. One can be related to the hearths of AH, the sediments of the other are truncated at the top, and its derivation is not clear. This level contained two small bifaces.

INTRODUCTION

Setting in East Anglia; history of earlier investigations; course of project

Beeches Pit is a Middle Pleistocene site in East Anglia, UK, combining a well-preserved Quaternary record and archaeological finds (Fig. 1). This paper describes, discusses and interprets archaeological excavations conducted by the University of Liverpool from 1992 to 2000, alongside wide-ranging Quaternary investigations reported elsewhere (Bridgland *et al.*, 1995; Preece *et al.*, 1991, 2000, in prep. a, b).

Most British Lower Paleolithic sites are in the southeast, either south of the Thames (e.g., Boxgrove, see Roberts and Parfitt, 1999), in the Thames Valley, or in East Anglia. In East Anglia there is rich record of Middle Pleistocene sites, investigated since the nineteenth century, and now combining to present one of the most detailed available pictures of the period (Fig. 2). Systematic research in the region began in the 1930s, but the modern picture has emerged through research programs carried out since the 1960s especially at High Lodge, Barnham, Elveden and Hoxne (Ashton *et al.* (eds.), 1992, 1998; Ashton *et al.*, 2000, in press; Lewis, 1998; Wymer, 1985, 1999; Roe, 1981; Singer *et al.*, 1993). Beeches Pit itself was studied geologically and faunally, but its archaeology was studied only in a preliminary way until the present work (Preece *et al.*, 1991, 2000; Andresen *et al.*, 1997; Gowlett *et al.*, 1998; Gowlett and Hallos, 2000; Hallos, 2004, 2005).

The region preserves an excellent geological record through parts of the Quaternary. Bedrock is generally Cretaceous chalk, which is directly or indirectly the prime source of flint for artifacts. The chalk dips gently toward the east. In eastern parts of East Anglia, it is capped by Pliocene and earlier Pleistocene sediments, visible especially near the coast (West, 1980; Gibbard *et al.*, 1991). Across the region a major geological benchmark is provided by the diamictons or tills of the Anglian glaciation (OIS 12) (cf. Bridgland *et al.*, 1995). The advance of the Anglian icesheets around 500–450 ka. destroyed a previously existing river system, now known as the Baginton/Bytham/Ingham river (Bridgland *et al.*, 1995; Rose, 1994; Rose *et al.*, 1999). The course of this former major river ran from the English midlands

Fig. 1. Beeches Pit: General view across the AF area as the excavation crew stands by for a crane (background) to start lifting sediment blocks

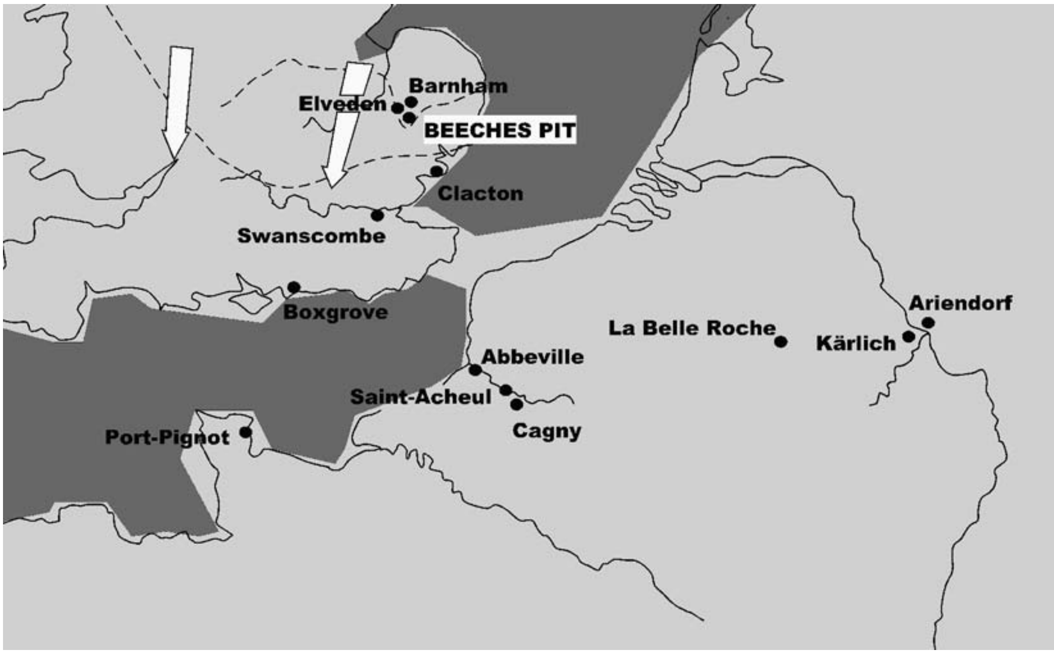

Fig. 2. Middle Pleistocene sites in southeast England and the adjacent area of northwest Europe, indicating the possible position of a land bridge in OIS11, and the main directions of ice flow in the preceding Anglian glaciation

through to the East Anglian coast. Its main channel lay within one km of Beeches Pit, presence of its north bank having been demonstrated by Wymer at nearby Ramparts Field (Bridgland *et al.*, 1999; Wymer, 1999). The Warren Hill and High Lodge sites about five km away relate to this earlier landscape (Wymer *et al.*, 1991; Bridgland *et al.*, 1995,1999), but most other localities postdate the Anglian (OI stage 12). In the region, Barnham, Elvden and Hoxne, amongst other sites, are generally accepted to belong to the succeeding interglacial, OI stage 11 (Bridgland 1996; Lewis 1998 Geol. Ref.; Ashton *et al.*, 1994; Ashton *et al.* (eds.), 1998; Lewis *et al.*, 2000, etc.). Among this group Beeches Pit is important for giving precise documentation to the presence of Acheulean industries in a temperate period, as well as to specific human activities and fire evidence.

SITE PROBLEMS IN CONTEXT

The present work has consisted of preliminary archaeological investigations followed by a series of full excavation seasons, and some minor completion investigations.

The sediments of the site were first exposed by a nineteenth century brickpit. Work on removing brickearth had stopped by 1860. This work left a pit approximately 70-x-50 m across, depressed below the surrounding landscape by up to 5 m, and relatively flat-bottomed. The north margin was investigated by geologists in the 1860s (Whitaker *et al.*, 1891; Skertchly, 1877). The dark organic horizons which characterize the site were first noticed at that stage; artifacts including hand axes and faunal remains were also recorded and a few finds were lodged in museums (Wymer in Preece *et al.*, 1991).

The nineteenth century pit offers a highly useful window for investigation. As far as archaeology is concerned, only the margins are now available for study, as the central sediments were removed to a depth that leaves only geological deposits. The archaeological research has been developed alongside a wider Quaternary investigation, which has paid extensive attention to the geology and paleoenvironment of the site (Bridgland *et al.*, 1995; Preece *et al.*, 2000, in prep. a, b).

The archaeological research program has been problem-orientated, in the sense that from the start, apart from questions of regional understanding, it was designed to make comparisons with African material in somewhat similar contexts. A major focus has been the study of the dynamics of human behavior in technology, in respect of a) stone artifacts and latterly, b) of fire interactions. Research goals are tabulated as below in a set of points that draw from Isaac (1972, 1989), Potts (1994), and other sources, and have been tailored especially to the project (Andresen *et al.*, 1997; Gowlett, 1996, 1997): 1) Location and density of sites: can we accumulate evidence for land-use and ecology, especially in relation to water and vegetation zones? 2) Site integrity: to what extent do the artifacts and bone remain as deposited by hominids? 3) Site sizes: how big were they, how long occupied, and at what season(s)? Does any evidence relate to community size and organization? 4) Internal structure: is there any evidence for structural features or separations of activities that can inform about social behavior? 5) Resource transport: how are the sites located in relation to material resources, and how far were these transported, for modification or use? 6) Artifact dynamics: can we disentangle threads or chains of activity, and in particular examine to what extent artifacts were made elsewhere or discarded elsewhere? 7) Faunal potential: what relationships or overlaps can be traced, with either carnivores or possible prey species?

In the course of the project all seven of these objectives have been met to some degree, but in all cases our knowledge is obviously partial, and in some instances knowledge falls away very abruptly at the margins.

Outline excavation methodology

The site was laid out in a continuous grid aligned to north, with 10 m squares identified by two letters (e.g., AF). Within this grid, individual meter squares were designated by numerical coordinates. Pilot work was carried out in meter squares and 10 cm sieving spits. Detailed work employed quadrants and 5 cm spits. Natural layers were followed in spit subdivisions wherever possible. Varyingly steep gradients between layers provide a methodological difficulty for excavation, but in general it is possible to refer sieve finds to particular units.

Soil samples were taken from every square and 10 cm spit. They were logged in a separate catalog amounting to some 700 bags. Excavated material was dry-sieved through a 5 mm mesh. Subsamples of sediment were water-sieved or retained for future analysis.

GENERAL STRATIGRAPHY AND CHRONOLOGY

The ice advance of the Anglian (OI stage 12) provides a benchmark for Middle Pleistocene studies across much of southern Britain. In East Anglia, Anglian diamicton forms an extensive blanket over chalk bedrock. At Beeches Pit diamicton overlies the chalk bedrock, which is rarely visible, and its hummocky surface forms the substrate over which a series of interglacial deposits has been laid (Preece *et al.*, 1991, 2000, in prep. a, b; Bridgland *et al.*, 1995; in Lewis *et al.*, 2000).

When the ice retreated there was left a hummocky dissected landscape of creeks and pools. Beeches Pit represents the interglacial infilling of one such feature. The interglacial sediments, which include extensive spring deposits (calcareous clay or tufa), were later covered by solifluction sediments and finally by Holocene coversands. The major units, as now recognized, are given in Table 1 (below), and here are equated exactly to those used by Preece *et al.* (in prep. a, b). The scheme represents a major revision of the units used in earlier publications. In this paper we always refer to the units as “layers” emphasizing archaeological significance, whereas our colleagues refer to them in geological terms as “beds” (Preece *et al.*, in prep. a, b).

Although all areas of the pit were inspected for archaeological potential by us, and extensively investigated geologically by D. Bridgland and S. Lewis, artifact-bearing sediments have been found only on the northwest of the Pit. Two areas were excavated, AF, and 20 m further east, AH (Fig. 3).

Almost all the finds from Beeches Pit belong within a single interglacial, which is attributed to OIS 11 by various lines of evidence, notably stratigraphy, molluscan fauna, vetebrate microfauna and macrofauna, a U-series date (Preece *et al.*, 1991, 2000, in prep. a, b; Bridgland *et al.*, 1995;

Table 1

Major stratigraphic units

Layer	**In excavation area**	**Area excavated**	**Nature of sediment**
Layer 7	AF	6 m^2	Pale brown loam
Layer 6	AF	8 m^2	Dark organic clay
Layer 5c Layer 5b Layer 5a	AF	8 m^2	Brown and gray mottled clays
Layer 4	AF AH	6 m^2	Calcareous clay (tufa)
Layer 3c Layer 3b Layer 3a	AH	~20 m^2	Dark silty clay
Layer 2	AH	75 m^2	Brown/dark brown clays
Layer 1	AH	2 m^2	Brown clays

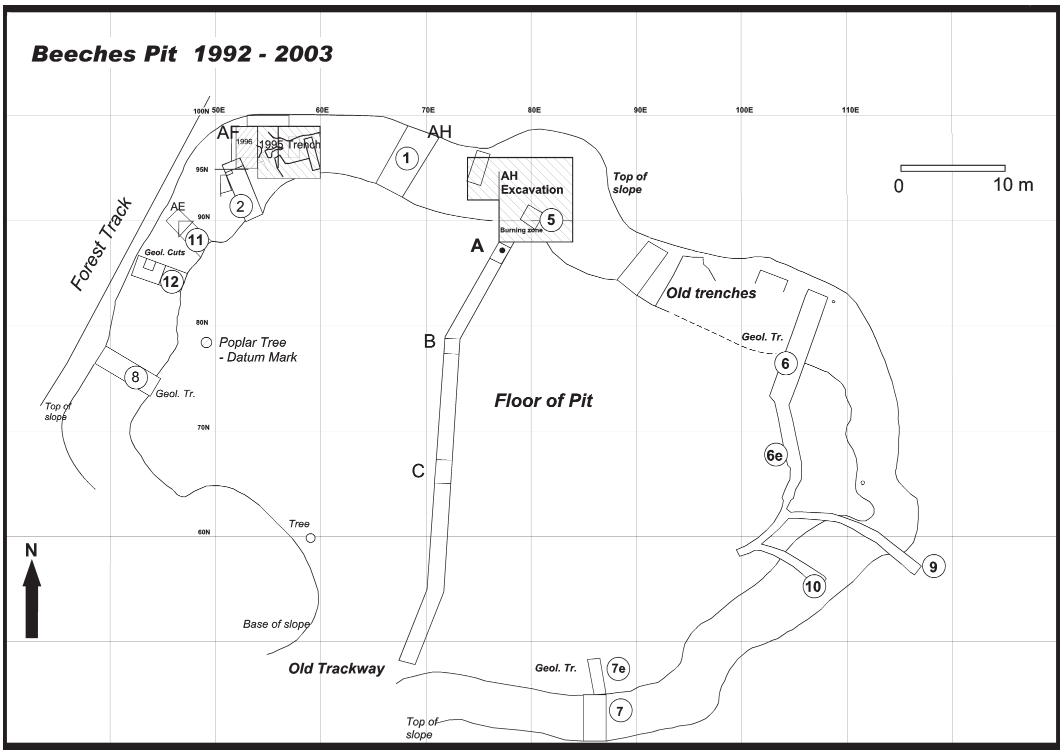

Fig. 3. General plan showing archaeological trenches and geological trenches after Preece *et al.* (2000)

Gowlett *et al.*, 1998) together with a series of TL dates of which more details are given here.

Following an initial thermoluminescence (TL) dating arranged by S. G. Lewis, funding was obtained by us for a series of dates with support from the British Academy/SBAC Applied Science fund. Samples for these were taken from exposures in areas AH, AF and AE (see below). All the dates reported here were based on burnt flint, in some cases taken directly from archaeological contexts. The dating has provided incidental information about temperatures of burning, and about variations in the radioactivity content of Beeches Pit sediments (see fire discussion below, also Preece *et al.*, 2000, in prep. a, b).

In total five flints were dated, three from the area of AF, and two from trench AE to the northwest of the pit. 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 ± 30 ka. The error limits represent the random and systematic uncertainties in environmental factors and laboratory measurements, and refer to the 68% confidence level. The dates are fully consistent with all other lines of dating evidence for the site. As the oxygen isotope scale limits for OIS 11 are approximately 360–420 ka., the older tail of values is effectively precluded by the upper limit of 420 ka. The dating methodology establishes the date of the last heating of the flint to a temperature in excess of 400°C (Debenham in Preece *et al.*, in prep. a, b). A fragment of burnt flint of particular archaeological interest was not dated specifically, but was tested and confirmed to be compatible in age with the dated specimens (see below).

DETAILED STRATIGRAPHY

AH excavation, AF excavation, other occurrences

Almost all finds from Beeches Pit can be attributed to a single interglacial sequence. Within this, the stratigraphy allows some subdivision of phases, and it is plain that archaeological occupations occur at a number of different levels.

The oldest finds come from Area AH. This lies on the northern edge of the Pit, at a point where a nineteenth century cart track left it (Fig. 3). Evidence of this was provided by a hollowed way, and a horseshoe – the only metal find of the excavations. Work started from a small sounding originally made in the 1960s by Kerney (Geological Cutting 5), which had uncovered tufa, and also flakes (Kerney, 1976; Preece *et al.*, 1991). Exploration of this sounding revealed a rich distribution of artifacts, in places almost touching the nineteenth century surface.

The initial trench was extended up to a final size of about 10-x-8 m (Figs. 4–5) so as to allow exploration of this distribution of natural flint and artifacts, which included many refitting pieces. Further extension was ruled out because of the need to preserve sections, and to leave areas for future study. The growth of trees since the nineteenth century is a threat to the site. Where two substantial trees were removed, it was evident that their roots had damaged the sediments.

BASAL LEVELS

The deepest view of levels with artifacts is seen where the north–south geological trench (TR5-A-B-C) intersected the AH area. It was hoped that this trench could be hand dug through to join the original sounding (Geological Cutting 5 – Kerney's trench), to make a connection through at about depth 26.50 (local datum approximating to OS datum). The density and importance of archaeological finds above these basal levels prevented this. Nevertheless, a bench 50 cm wide and 1 m long was excavated as an extension of the geological trench, revealing a lowest concentration of artifacts, which consists of flakes and cores. These overlie immediately clays that contain aquatic fauna (Parfitt, personal communication; Layer 2 of Preece *et al.*, in prep. a, b) and are the oldest artifacts from the site. These artifacts appear to be embedded in the top of Layer 3a, but given the aquatic nature of the fauna in this layer, it is possible that they straddle the interface between Layer 3b and Layer 3a.

From this point upwards a detailed archaeological record can be given of levels, which include artifacts through a vertical extent of about one m. Key factors in the discussion are: 1) vertical facies change; 2) the question of slope; 3) spatial relationships indicated by refits; 4) presence and distribution of large flint blocks; and 5) horizontal facies variation.

Facies relationships

In the main part of the artifact distribution AH can clearly be divided into two zones – a pale calcareous clay across the northern part (Layer

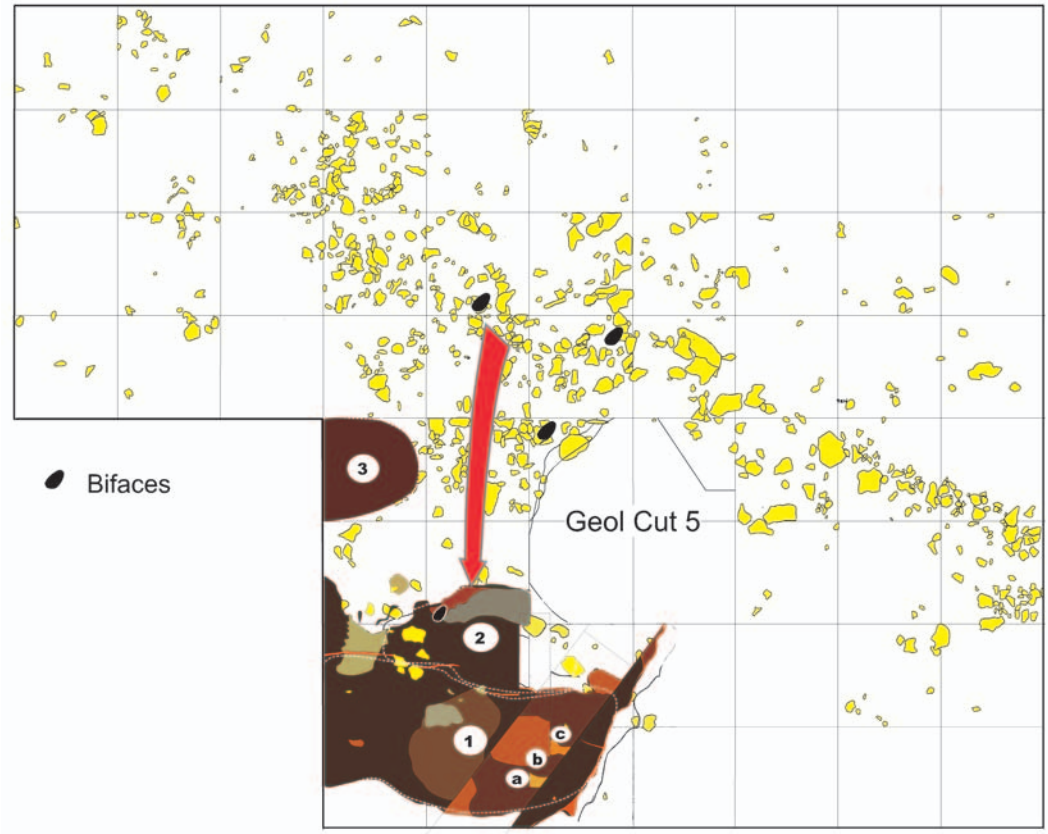

Fig. 4. Plan of area AH showing main features and artifacts greater than ca. 5 cm. Areas of burning are numbered. The arrow shows the main trend of refits (cf. Fig. 17)

3bii); and much darker silty clays across the front or southern part (Layer 3bi). Prominent bands of large flint cobbles give the appearance of dividing the two zones, especially on the eastern side of the excavation.

These units would probably be thought to form a stratigraphic series, were it not for the refits, which suggest strongly that the pale clay and the darker clay accumulated alongside one another (it seems likely that 3bii passes up into 3c, and detailed division may be arbitrary). There were evidently differences in the local environment of deposition. In interpretation, it can be suggested that the northern area or bank was washed clean by trickles of spring water, and that the southern area close to the pond or creek may have contained contributions of rotting vegetation and burnt material. Layer 3bii is described as lacustrine by Preece *et al.* (in prep. a, b).

Slope

The refit distributions (discussed further below) help to give the impression that there was a bank of clays that sloped down towards the creek/ponded area. Consistently the pieces to the north have higher elevations than those to the south. There may well be some element of post-depositional deformation, with sinking in the center of the Beeches Pit depression, but it is evident that the creek/pond lay to the south, and the units of sediment are thicker towards the north, giving support to the idea of an original slope.

The dark areas have been plotted, and can be seen to concentrate in the south and west corners of the trench, where there are areas of burning (Fig. 4).

The upper levels include "pipes" of solution, filled with dark clay and flint rubble.

Fig. 5. General view of area AH, overhead view looking south: pale sediments in foreground, darker areas further away. Burning area 3 is visible at top toward right

AREA AF

In Area AF, 20 m to the west of AH, the sequence starts with Anglian diamicton (Layer 0). Deep excavation below the pit floor revealed this to include large blocks of chalk. The diamicton is overlain on the northern side by a bench of tufa/calcareous clays, some 3 m thick (Fig. 9; bed 4 of Preece *et al.*, in prep. a, b). This tufa can be traced continuously from the upper levels of AH excavation to the east, demonstrating that all archaeological levels in AF are stratigraphically higher than all archaeological levels in AH.

In AF, the calcareous clay or tufas has a steeply sloping southern face, descending into a channel. In one place near the middle of its 8 m exposed length the lip of the tufa appears to have crumbled and collapsed, leading to formation of a small "table" on the slope. This becomes an important feature in interpretation (see below). A cut through the calcareous clays at this point showed them to be sterile of artifacts through a depth of more than two m, although there were artifacts embedded in the surface of its slope. The clay/tufa contains a rich molluscan fauna (Preece *et al.*, in prep. a, b).

As tufa normally forms at low angles, the steep slope is not easily explained (cf. Bridgland *et al.*, 1995; Lewis *et al.*, 2000). It may be that the water level in the creek dropped, leading to erosion, or that side-cutting of the channel led the bank to be cut. After the slope had formed, it became mantled by a series of clays and silty clays that contain the main archaeological finds (Figs. 6, 7, 9). Through a depth of more than one m they contain distributions of artifacts almost without break.

Layer 5a

The lowest layer (5a) is a gray clay, which appears to consist of reworked tufa (calcareous clay), and lies on the toe of the tufa slope. Conditions were favorable to the preservation of bone. Scattered bones are chiefly of large deer, possibly derived from a single carcase. Small artifacts occur throughout. The gray clays may be characteristic of a gleying environment, with a dark organic band within the sediment possibly representing a former leaf mould.

Layers 5b and 5c

Above this comes a complex unit chiefly formed of grayish mottled clays, about 50 cm

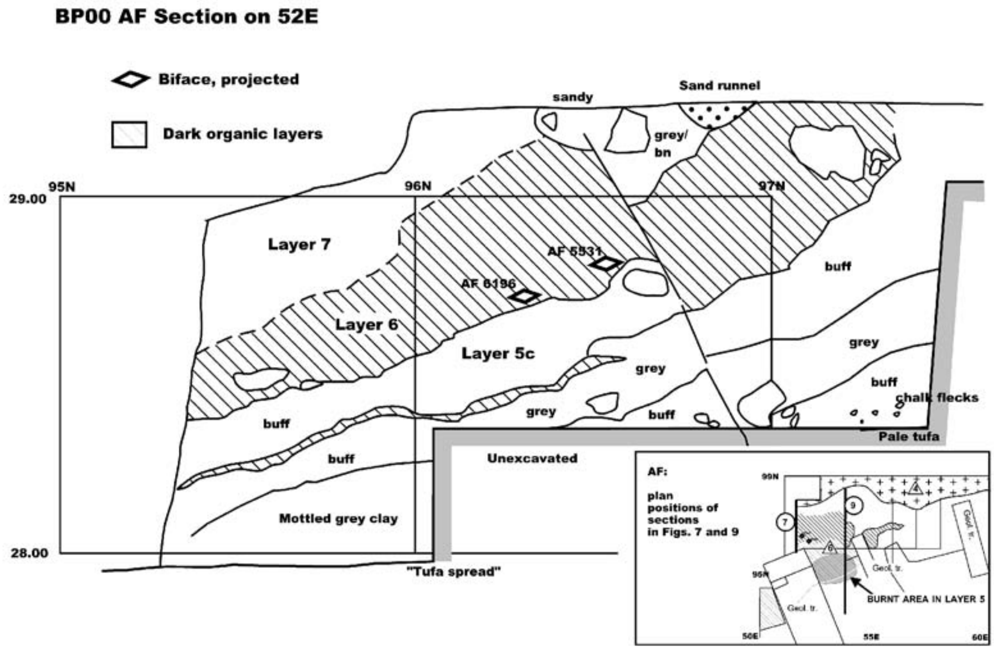

Fig. 6. Section of west face of AF showing main units and projected positions of two small bifaces, found near the base of Layer 6

Fig. 7. The sequence of AF, facing west. The bank of pale calcareous clay (tufa) dominates the picture on the right. Part of the burnt area in AF is visible left-center in distance

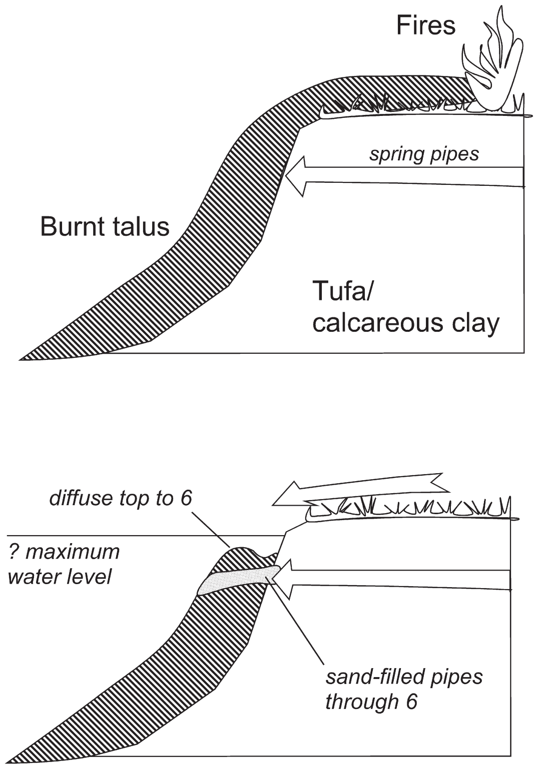

Fig. 8. Possible interpretation of formation of AF layer 6, suggesting how springs may have kept on flowing through the sediments after formation of Layer 6

thick. Where these rest against the tufa (Layer 5a) they are homogeneous and greenish gray, but further forward (downslope) they include a complex stratigraphy of organic lenses, tufaceous material, and burnt components (discussed in detail below). Artifact material occurs throughout Layer 5.

Layer 6

Layer 5 is overlain by a much darker organic layer which appears to have formed an apron over the whole area, to a depth of about 30 cm on average (Layer 6). It contains archaeological material, including two small bifaces found near to its base, and also further burnt material including both flint and bone. It lenses out and disappears to the east of these finds at 56E, but could have been more extensive before the nineteenth century clay extraction, and is still well represented at 54E (section in Fig, 9).

Layer 7

Layer 7 is a pale loam that completed the fill of the channel. It is decalcified in places (cf. Preece *et al.*, 2000, in prep. a, b). It contains some artifacts, but has yielded no major finds, and is interpreted by Preece *et al.* (in prep. a, b) as representing a cold period, probably at the end of the inter- glacial.

The interglacial sequence is capped by a thick layer of clay with flints, which appears to represent a later cold period, probably Wolstonian or Devensian. No further Paleolithic artifacts have been found, except one small biface in Area AG.

The section is completed at the top by about one m thickness of sand and silt (coversand) deposited during the Holocene. A few Neolithic flints have been found from these levels, with distinctive dark shiny patina. Such finds are ubiquitous in the region.

The overall conformation of this sequence is shown diagrammatically in Figs. 7–8.

The clays are interpreted as making up a channel infill. The base of the channel has been located in Area AE about 10 m away to the southwest, although this exposure probably represents an embayment rather than the true base of the channel.

The clay fills must have been deposited from sediments/surfaces standing higher than the present top of the calcareous clay bank, which was probably also the focus of human occupation – but unfortunately all material overlying the tufa has been planed off by later erosion/solifluction. This makes it difficult to determine which if any of the clay units were originally draped over the lip of the tufa from the higher level, and which were deposited entirely within the channel.

There is no clear top surface to the dark Layer 6, which is not evidently truncated at the top, and did not lie right up against the channel bank. It seems to have ended diffusely, at the end of a series of runnels that traverse the top of the tufa. Disturbance by erosion or solifluction does not appear to explain the observed conformation, since one of the runnels is filled with clean sand, and at its end tunnels through the upper part of Layer 6, with quite sharp edges.

Although uncertainty remains over interpreting the top edge of Layer 6, we can make a suggestion summarized in Fig. 8. This is that water level fluctuated within the channel, but was fed by springs that emerged locally at the top of the tufa, running through pipes (the runnels) that were covered by some thickness of channel bank. During or after the deposition of Layer 6, water from the springs made its way out either through Layer 6 (as recorded in one sand-filled pipe), or by washing away Layer 6 at the channel margin, thus separating it from any cover of the channel-side.

The nature of the slope deposits presents various questions. They front a steep face of tufa, or calcareous clay. Stream downcutting may have caused this steep face, which is unlikely to be depositional. The thickness of the succeeding clays varies from front to rear. Sometimes marker bands are close together at the rear (north), then become more deeply separated, coming together again towards the toe of the deposit. This could suggest slumping of deposits, but the distributions of artifacts favor an interpretation of fairly continuous deposition. The varying thicknesses may be a product of varying sediment inputs and water-levels. The artifact distributions assist in interpretation, and are discussed further below.

Artifacts

There were very few large artifacts in the deposits in AF. It is likely that the preserved occurrence on the channel bank is at the edge of a more extensive former occupation. Unfortunately, testing by JCB in the forest to the north of AF revealed no traces of preservation. Relatively few pieces came to rest on the slope. There are however a few large flakes and a number of large blocks of flint.

Other exceptions are two small bifaces found near the base of the dark Layer 6, and near the top of the slope. They were found alongside blocks of similar dark flint, which may have been blanks for other specimens.

As bifaces have been found in both areas AH and AF, there is little chance of concluding whether the nineteenth century biface find came from one locality or the other.

THE ARTIFACTS: CHARACTER AND GEOMETRY

Geometry of the artifact distributions

Coordinate plotting of the artifacts and other stones allows them to be considered as 3D swarms in the different localities. These provide useful additional evidence for the recognition of units.

In outline, we can say that the great majority of artifacts come from the AH locality, where they are inclined at a shallow angle through a vertical depth of *ca*. 50 cm–1 m (Fig. 10). In the area of AF, they are steeply inclined in layers mantling the channel bank (Fig. 9; cf. also Fig. 7).

AH Finds

The AH finds are localized in different respects both horizontally and vertically. Horizontally, finds are concentrated in a patch about 5–6 m across, trending NW–SE (Fig. 11). The density of distribution is lower towards the pond, towards

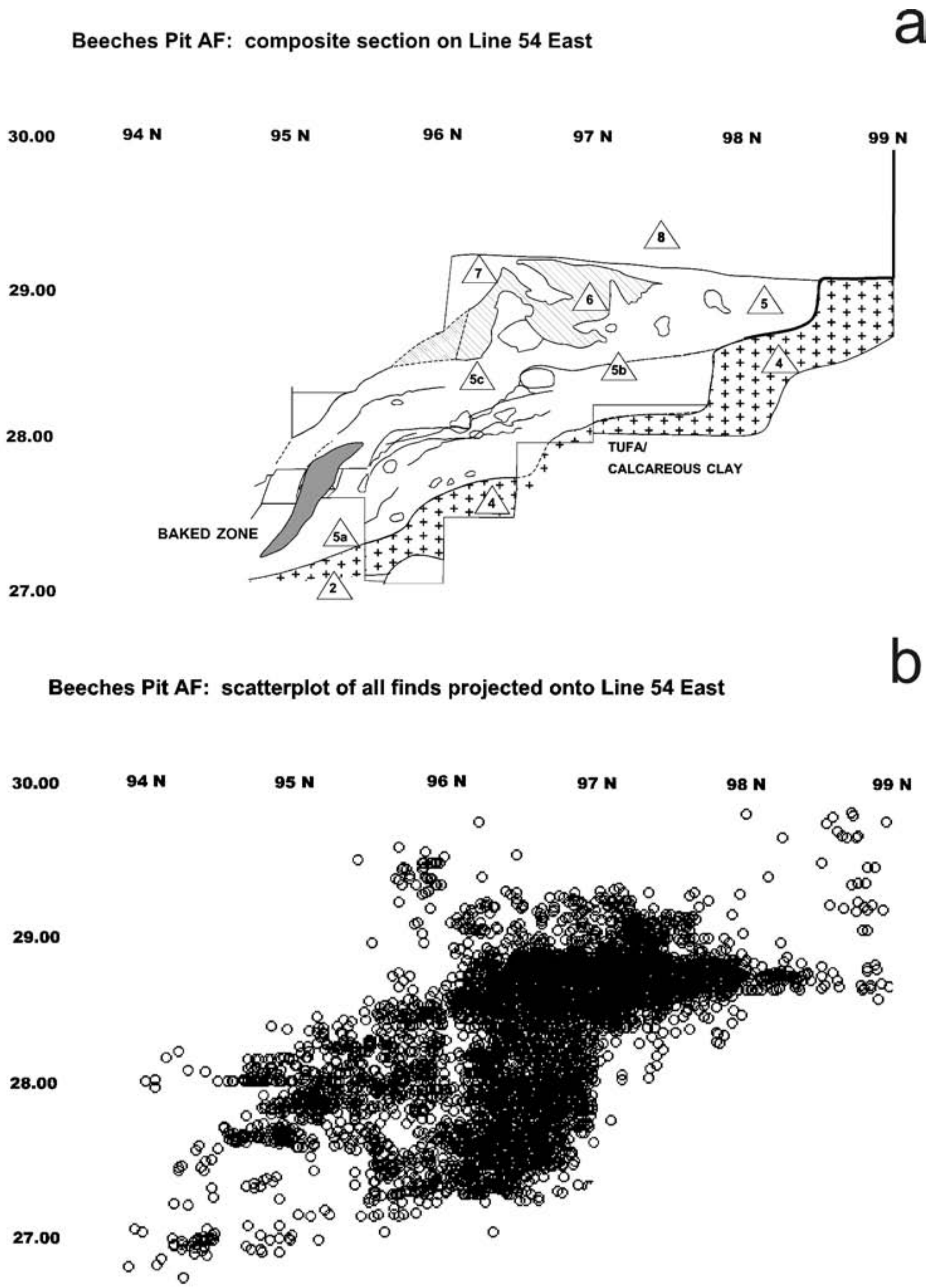

Fig. 9. Vertical distribution of all finds in AF, viewed facing to west (cf. Fig. 4)

the pale tufa to the north, to the east and to the west.

The vertical distribution is of the order of 60 cm. The refits demonstrate the presence of artifacts on a gentle slope down towards the pond (discussed in more detail below). On both AH and AF plots of artifacts suggest that formerly horizontal surfaces may have tilted post-depositionally with a slight dip to the north.

The total excavated AH area is 75 m^2, giving

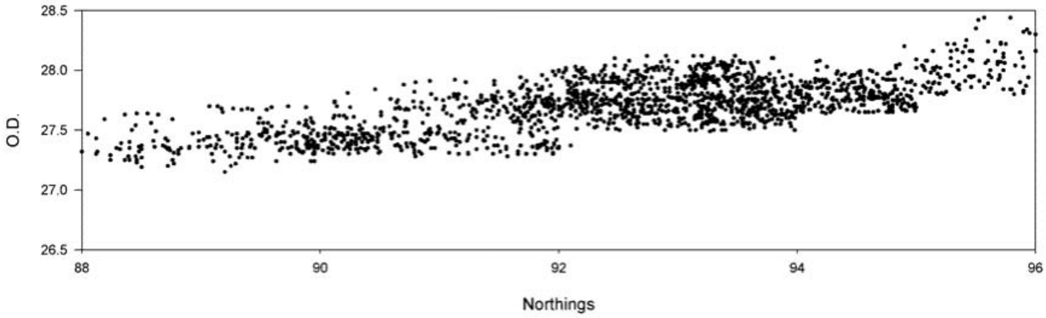

Fig. 10. Vertical distribution of all identified artifact finds in Area AH, viewed facing to west

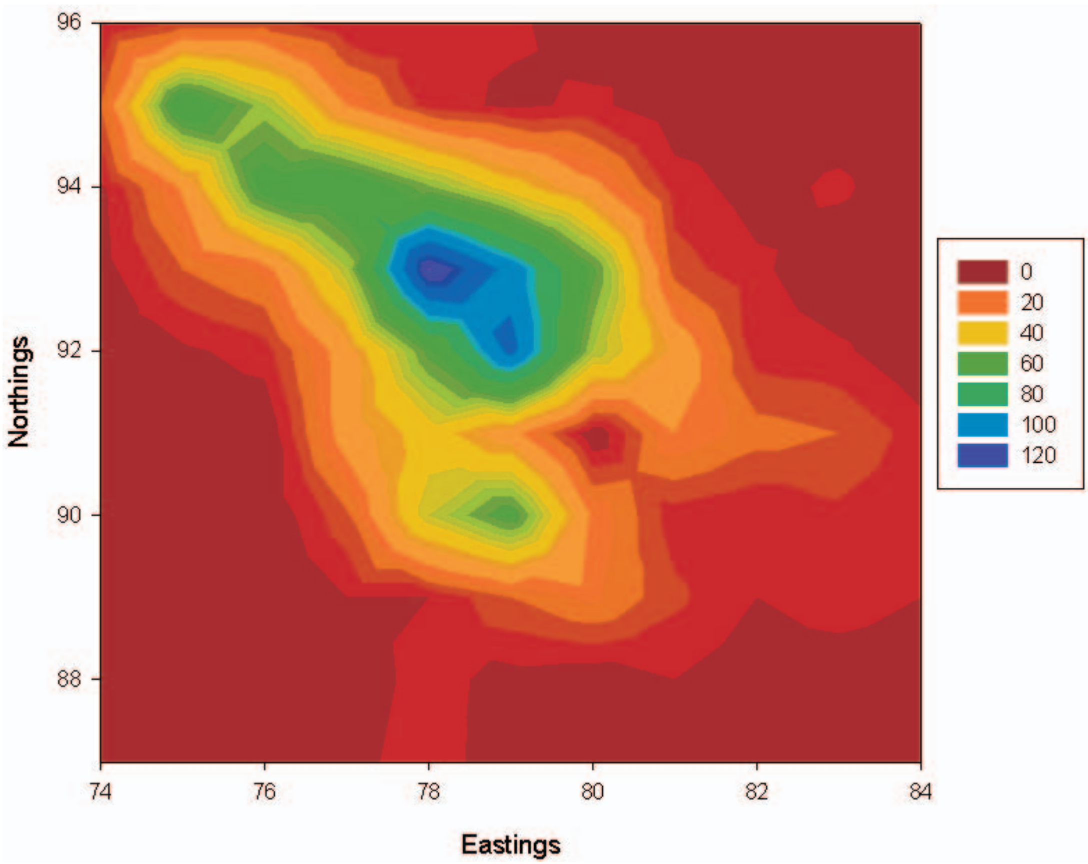

Fig. 11. Plan of density distribution of all identified artifacts in Area AH. The small void area right of center represents the Geological Cut 5 originally made many years before excavations began

an average artifact density of 24 per m^2 although it is evident that certain areas are more artifact-rich than others (Fig. 11; Fig. 4). The area to the northeast of the trench corresponds to a deposit of pale, tuffaceous sediment, and is a zone of low artifact density (averaging 2.5 artifacts per m^2, range 0–12). An area at the front of the trench (77–80E / 88–90N) represents an area of discrete

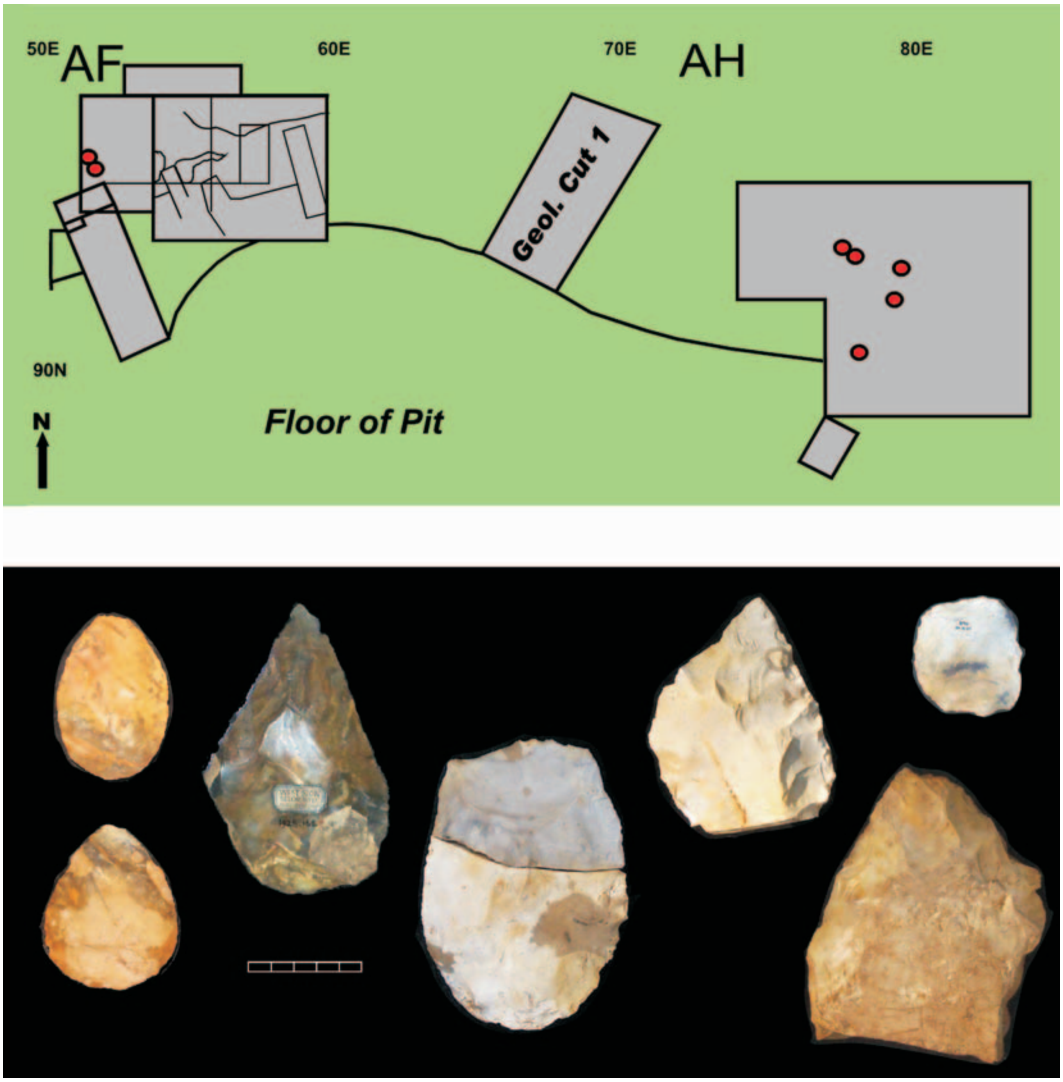

Fig. 12. The bifaces of Beeches Pit: Photoviews to common scale seen in relation to findspots. The specimen above the scale is the nineteenth century "Trigg" find, photographed courtesy of the Ashmolean Museum

burning, interpreted below as a series of hearth positions, one of which can be related to the refitting biface roughout (see below; Gowlett and Hallos, 2000). The zones of most dense artifact concentrations, 77–80E / 90–94N (averaging 77.25 artifacts per m^2, range 11–160) and 74–77E / 93–95N (averaging 52 artifacts per m^2, range 14–89), correspond to the zones where refitting pieces are most abundant. The refits and density plots reveal one main locus for knapping activities within the excavated area.

AF Finds

The AF finds are predominantly distributed on a slope, the channel bank. This was so steep that all or almost all are likely to have migrated downslope during and perhaps after initial deposition. They are distributed through a thickness of about 1.5 m at least, running through Layers 5–7. It seems likely that most of the finds have spilled over from the flat channel bank above (now vanished) on which there could have been an extensive occupation. Within Layer 5, however, a hearth feature has been isolated, and it may be that some artifacts are related to this.

THE ARTIFACTS IN OUTLINE: GENERAL ASSEMBLAGE CHARACTERISTICS

A total of nearly 2,000 artifacts > 2 cm was recovered from the AH excavation, along with several thousand fragments of microdébitage. A much smaller assemblage of several hundred pieces was found on the steeper slope of the AF locality, among some 5,000 stone finds of all kinds, largely natural. The raw material for tool manufacture is exclusively flint, which is available in the immediate vicinity of the site. Artifacts are found amongst an abundance of unworked flint nodules, which in area AH outnumber the knapped pieces by approximately ten to one.

Although the exact source of the flint raw material is not established, the state of the cortex is predominantly fresh or slightly weathered suggesting that the cobbles eroded out of a nearby chalk exposure, perhaps beside a tributary runnel of the main creek. The cobbles have not undergone extensive fluvial transport and redeposition. The weathering of the cortex probably occurred *in situ* as the nodules were exposed upon the surface for a considerable length of time. This interpretation is supported by the heavy patination of the majority of pieces, which may also be indicative of surface exposure (Stapert, 1976). The size range of the nodules available for exploitation varies considerably, from small pebbles under 10 cm in maximum dimension up to very large nodules over 0.5 m in length. The flint is generally of a good quality, although there are many small fossils and inclusions that sometimes cause it to break in an uncharacteristic way, creating an abundance of shatter and fragments.

The majority of artifacts are in a very fresh or fresh condition, compatible with other indications of limited taphonomic disturbance. Cores and tools make up just 3–5% of the total assemblage, with débitage accounting for the majority of artifactual material. These proportions are typical of on-site knapping behavior, confirming that the local manufacture of stone tools was a principal factor in the accumulation of lithic material at this location.

The knapping can be characterized as involving four main reduction sequences: 1) production of bifaces from nodules; 2) production of large flakes (> 8 cm) for use as biface blanks; 3) core and flake working unrelated to biface manufacture; and 4) modification of natural pieces into retouched tools. There are no signs of Levallois working, as discussed for example by White and Ashton (2003).

As a matter of convention only, we start with a description of the relatively small number of shaped artifacts. These consist of about eight bifacial pieces, and about 30 retouched pieces, out of a number of several thousands of flakes/flaking debris. Other pieces appear to have been utilized.

Bifaces

Bifaces occur at all levels, confirming the Acheulean designation for the industry. They can be tabulated as follows (Tab. 2).

Those bifaces and flakes found in the nineteenth century are most likely, following the published description, to have come from the organic bands in the AF area (Whitaker *et al.*, 1891), but it is not impossible that they came from the front of AH, where construction of a nineteenth century cart entrance to the pit also certainly exposed a dark organic lens. As further bifaces have been found in each locality, there is no independent means of evaluation at present. Searches of catalogs have confirmed one well-shaped pointed biface at Oxford (measurements in table 3). Several other specimens are recorded in collections at Cambridge, but they do not include bifaces.

A further nineteenth century specimen may have been located in the Shotton collection at Birmingham. This is either (possibly) a burnt hand axe, or one with solifluction damage, clearly resembling Beeches Pit material in patina. There is no proof (as yet) that this specimen comes from the site, but arguably Beeches Pit is the only British site with burnt material that would have been open to nineteenth century collection – this find remains "in suspense account" for the moment.

Together the excavated specimens are just sufficient to "characterize" the assemblage, and to allow comparisons with other Acheulean biface assemblages (the extent to which such individual products can represent a notional parent population is discussed by Gowlett, in press).

Table 2

Biface descriptions

Ref. Number	Description	Context
BP AF5331	Small biface	within Layer 6 in AF
BP AF6196	Small biface	within Layer 6 in AF
BP AH229	“Other” biface on tabular flint, irregular	main horizon in AH
BP AH411	“Other” biface, irregular, part-worked	main horizon in AH
BP AH1300	“Classic” biface found in two pieces	main horizon in AH
BP AH2105	Small discoid biface	main horizon in AH
BP	Biface roughout and refit set	main horizon in AH
BP AG1	Small biface	Found by D. Bridgland in later Cold period deposits in AG
BP?? Birm	Lanceolate	Possibly from Beeches Pit
BP-Ashmolean	“Classic” pointed biface	19^{th} C find from north of pit

Table 3

Biface dimensions

Ref Number	Description	Weight	Length	Breadth	Thickness	East	North	Level
BP AF5331	Small biface	55	72	49	19	52.29	96.54	28.81
BP AF6196	Small biface	85	73	60	20	52.5	96.31	28.72
BP AH229	“Other” biface	510	117	100	35	79.8	92.74	28.12
BP AH411	“Other” biface	265	99	75	42	79.19	91.79	27.7
BP AH1300	Biface	435	123	87	48	78.55	93.15	28.03
BP AH2105	Disc	45	52	48	26	78.17	90.04	27.53
?BP Birm	Lanceolate	400	145	93	35	-	-	-
BP-Ashmolean	Pointed	288	125	81	40	-	-	-

It is strikingly obvious that the bifaces occur in a range of sizes, and do not form a classic homogeneous set. They result from differing manufacturing strategies, and probably had varied functions. Sampling bias has possibly given this impression – it could be that a further random selection from this industry would produce mainly classic specimens. At any rate, the range of specimens shows clearly that the makers were engaged in making very small and quite large bifaces; and that sometimes obtaining a good working edge seems to have been more of a consideration than achieving a “finished” symmetrical piece.

Biface descriptions

Five biface specimens came from AH (Fig. 12). They include a biface with a tranchet tip (AH 1300), somewhat intermediate between a cleaver and hand-axe in form (i.e., chisel ended). It is broken, with the two halves found about one m apart. It may have broken in use, or in retrimming. Its user was evidently sufficiently unfazed by this event that neither part was thrown away in disgust.

A biface made from a tabular piece of flint (AH 229) is one of the heaviest biface finds; it is somewhat irregular in form, but less so than

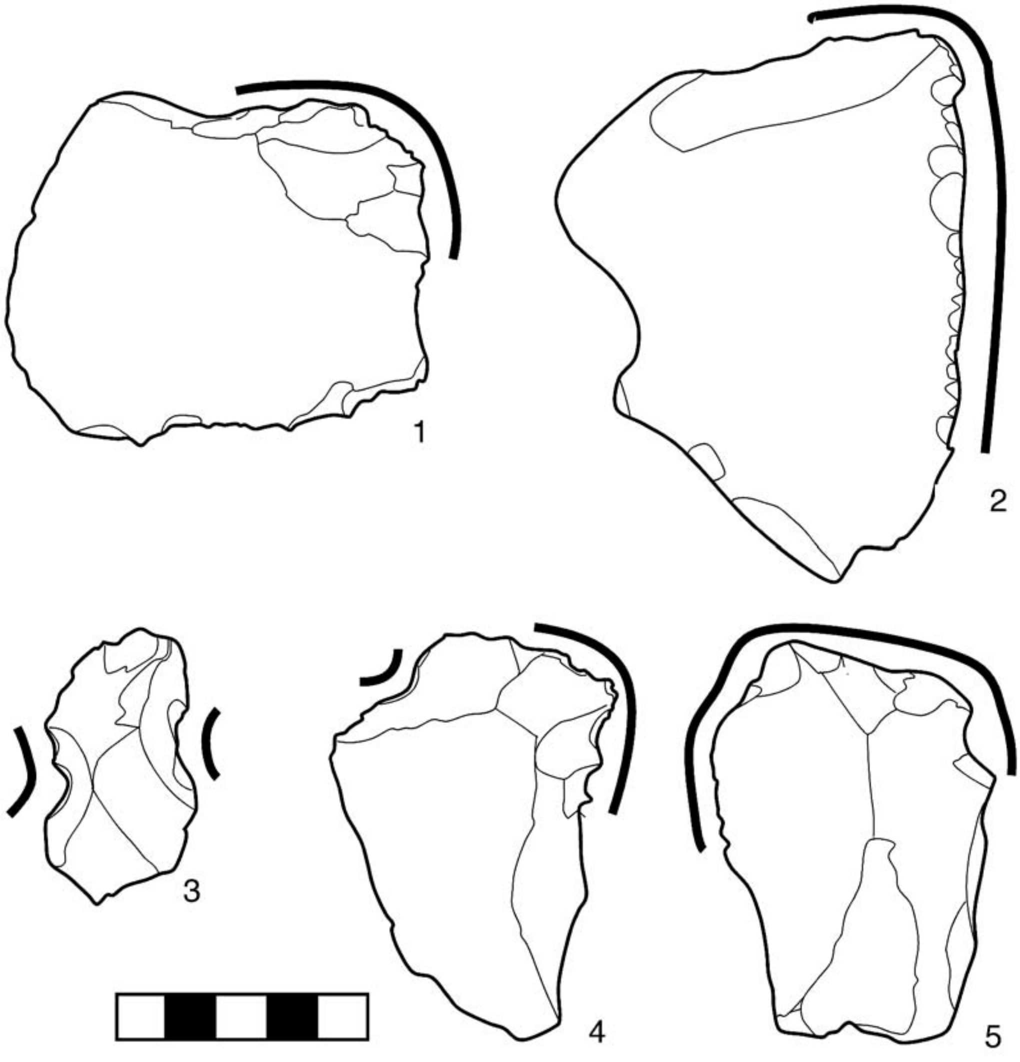

Fig. 13. Selected flake tools. 1-2: Flake scrapers; 3: Double notch; 4-5: Denticulates. The dark bars indicate the extent of retouch/edge damage

another “non classic” piece (AH 411). A small discoid is the smallest bifacially-worked piece (AH 2105). Comparisons can be drawn with generally somewhat later finds from southern Britain, especially perhaps with the discoid flaking technology from Oldbury (Cook and Jacobi, 1998), but apart from its shape, the worked edge resembles biface edges more than a typical discoid core.

The two specimens from Area AF, both found near the top of Layer 6, are relatively small, just over 70 mm in length. One is relatively broad (AF 6196), the other quite slender (AF 5331). They are made from similar flint, perhaps from large flake blanks, and could conceivably have been made by the same individual.

Retouched pieces

Retouched tools make up only a very small proportion of the total assemblage, *ca*. 2% of pieces > 2 cm long. The majority are made upon flakes or broken flakes, although there are a low

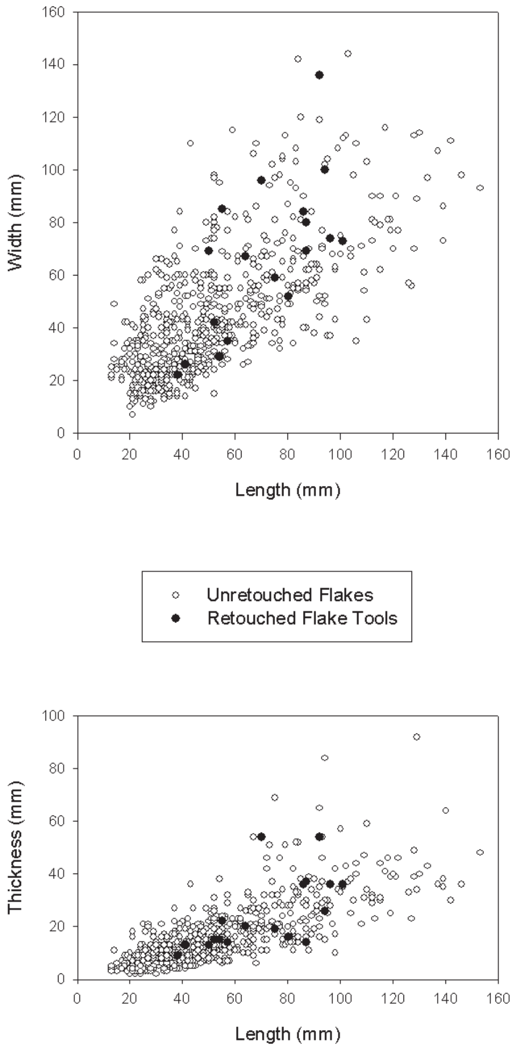

Fig. 14. AH retouched flake size distribution

number made upon naturally fractured pieces of flint. In this respect, the assemblage is similar to the well-known Acheulean site of Cagny L'Epinette, which records the presence of retouch on naturally fractured pieces of flint (Tuffreau *et al.*, 1995). There does not appear to be any preferred edge on the flakes for retouch. Retouch occurs on distal, lateral and proximal edges, although the retouched edge is usually the longest edge. The majority of retouch is direct (occurring upon the dorsal side of the flake) and unifacial; bifacial retouch on flake tools is very rare.

Notches and denticulates are the most frequently occurring tool types. The notched pieces can be subdivided into three categories: notches created by multiple removals, notches created by a single removal (so-called "flaked flakes": Ashton *et al.* 1991), and notches created by edge modification characteristic of utilization damage. Several of the notches in the assemblage are made on very large flakes, exceeding 100 mm in maximum dimension.

Scrapers and composite tools are rare. Only three scrapers were identified, all from area AH. In all cases, the retouch is limited to one edge, forming a series of continuous, semi-invasive removals. In one example, a large flake (94 x 100 mm) has retouch along the right lateral edge on the ventral surface, creating an inverse scraper with a straight edge profile. The other two pieces in this category are more irregular, with slightly denticulated edges (Fig. 13, 1–5).

The small number of retouched pieces does not allow for extensive statistical comparisons to be made between assemblages from the different areas of the site. However, in Area AH, there are enough retouched flakes to allow comparison with the unretouched flake population, giving an insight into the presence of any selective preferences. The size frequency of the retouched flake tools displays a very different size distribution to the core reduction and biface manufacture flakes. The average flake length for retouched flakes is 71 mm, although the size frequency distribution has a bimodal profile, with peaks at 50–60 mm and 80–90 mm in length (Fig. 15). The retouched flakes are 20 mm wider and 10 mm thicker on average than the unretouched flakes. Plotting the length against width and thickness for retouched and unretouched flakes (Fig. 14) shows the retouched flakes have an overlapping distribution with the unretouched pieces, suggesting selection of the larger flakes for retouch from the available flakes. The distributions also show that flakes that are wider and thicker in relation to length were chosen for retouch. Within the retouched flakes, comparison of the mean size by tool category shows that the scrapers are made on the largest flake blanks. Although the number of retouched pieces in the assemblage is low preventing statistical comparison, the results are in agreement with other metrical studies of flake tools that suggest

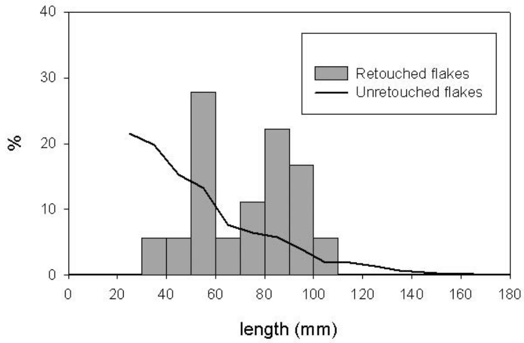

Fig. 15. Area AH comparison of retouched and unretouched flakes by size

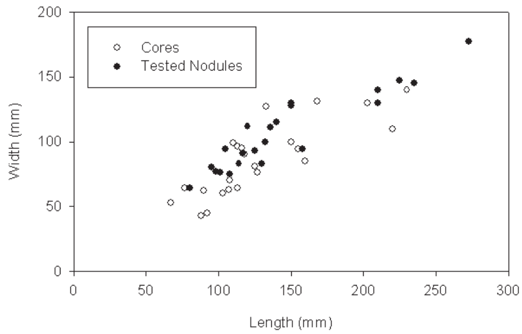

Fig. 16. Area AH core length versus width

scrapers are typically larger than notches and denticulates (Geneste, 1985; Meignen, 1988; Roth and Dibble, 1998; Gowlett, 1999).

Cores

The cores can all be described as globular, showing no evidence of predetermination of flake removals. Many of the cores have fewer than three flake removals, and due to their limited reduction have been classified as "tested nodules". These pieces retain a high percentage of cortex on their outer surface, and may indicate testing of flint quality. Other cores in the assemblage show more intensive reduction, as evidenced by a greater number of flake removals and a reduction in cortex.

The cores range in size from small pieces < 70 mm in diameter, up to very large nodules over 250 mm in maximum dimension. The wide range of core sizes appears to be due to selection of a wide range of different original nodule sizes from the raw material available. The minimally flaked pieces show a similar size distribution to the more heavily flaked pieces, suggesting that smaller cores are not the product of more intensive flaking (Fig. 16). There is not a continuum from large, minimally flaked cores to small, heavily reduced pieces, and in fact tested nodules are on average smaller in all dimensions than the more heavily flaked cores (Table 4). This possibly indicates a separate strategy of flake production aimed at producing only one or two flakes from these pieces.

The cores vary in shape, from rod-like to more spherical in morphology. The differences in shape probably reflect differences in the shape of the original nodules selected for reduction. The predominance of rod-shaped pieces among tested nodules may partly explain why these pieces were not more intensively flaked. If the original nodules were long and thin, it would have been more difficult to maintain a suitable platform for extensive flake removal upon these pieces compared to more spherical-shaped nodules. Many of the tested nodules are rod-shaped pieces that have one or two removals at one end. These pieces are morphologically similar to the "salami-slice" technique of producing flakes documented in Mousterian assemblages (Mellars, 1996:75), and the resulting flakes retain a strip of cortex around a large part of their edge.

Knapping of large nodules over 300 mm in maximum dimension does not appear to have taken place, although nodules over this size are present at the site. Some of these large nodules may have been divided into more manageable sized pieces in order to be worked, and some of

Table 4

Area AH: Average core dimensions in mm (means and sds)

Size (mm)	Tested nodules	Cores	All
Length	129 ± 42	147 ± 50	138 ± 47
Width	86 ± 28	107 ± 28	97 ± 30
Thickness	63 ± 25	82 ± 33	73 ± 30
N	23	23	46

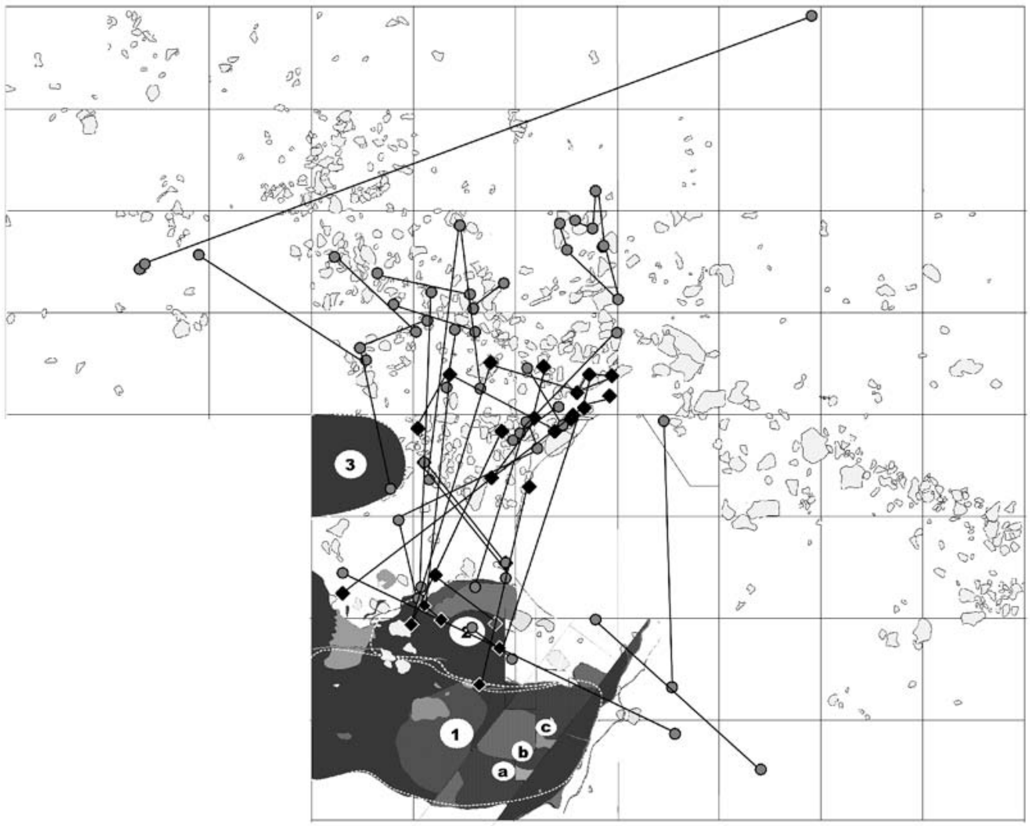

Fig. 17. The distribution of refits within Area AH

the largest nodules found have break surfaces that may have been intentionally created, although the anthropogenic nature of these breaks cannot be confidently established at present.

Débitage products

Débitage products consisting of flakes, broken flakes and shatter fragments are the most abundant category of artifact, accounting for *ca*. 95% of all pieces. Within the flake category, three types can be identified which are indicative of different reduction strategies. Flakes that are typical core reduction, having a wide platform and prominent bulb of percussion are the most abundant type of flake in the assemblage. This type of flake also accounts for the majority of broken flakes. Flakes with a narrow platform and diffuse bulb of percussion, characteristic of the middle and later stages of biface manufacture are present, although they only account for *ca*. 2% of the total whole flake population. Biface manufacture flakes are also scarce in the broken flake category, although proportionally more of these flakes are broken. The proportions of the flake types suggest that the early stages of biface manufacture and core working were the main knapping activities carried out at this location, as biface thinning and finishing flakes are rare. The occurrence of flakes with two ventral surfaces (Janus flakes) signifies that some large flakes are used as cores to produce further flakes from their ventral surfaces.

The flake platforms are predominantly plain or cortical, and none of the flakes show any evidence of platform preparation or faceting. These platform types are consistent with the flaking patterns observed on the cores. The proportions of cortical, semi-cortical and non-cortical flakes in the assemblage are indicative of core reduction sequences that were not exhaustive, terminating soon after decortication of the nodule had taken place.

DISCUSSION OF ASSEMBLAGE DYNAMICS

The "windows" of activity exposed at Beeches Pit, particularly in AH are large enough to allow meaningful comparisons with the growing body of data from across Europe. As on many sites, the presence of refitting material allows fuller understanding of technological practice, as well as some index to disturbance.

The lithic artifacts from the Beeches Pit assemblage have been analysed for the presence of refits, in order to answer questions about site formation, technology and artifact dynamics (cf. Villa, 1982; Cziesla, 1990; Gowlett *et al.*, 1998). Area AH has produced all the refits so far: 31 refitting sets, totalling 102 individual artifacts have been recovered to date (Fig. 17). These represent 6% of the total excavated artifacts > 20 mm to be incorporated into a refitting sequence. The refitting groups have been classified in accordance with the categories established by Cziesla (1990): twenty-one groups are dorsal-ventral refits; nine groups are broken artifacts; as yet none of the refitting groups relate to artifact modification.

Broken artifacts

The refitting groups of broken artifacts comprise five core reduction flakes, three biface manufacture flakes and a broken ovate biface. Examination of the break surfaces shows that they are patinated to the same degree as the rest of the artifacts, demonstrating that the breaks are ancient and occurred at or soon after the time of manufacture. The broken flakes were most likely damaged at the time of manufacture. Flint is a natural material, with each nodule containing internal flaws and weaknesses that cause flakes to shatter spontaneously as they are detached from the core. The spatial distribution of the broken refits also supports this interpretation, since the broken artifacts are within close proximity to each other. The fragments of biface manufacture flakes were found lying directly adjacent to each other, implying they were broken by pressure as they lay on the ground, possibly by trampling or sediment loading. The relative thinness of these artifacts, being only a few millimeters, makes them particularly susceptible to this type of damage.

The broken biface was found in two halves approximately 90 cm apart, indicating that it was broken on-site and therefore discarded. The break is characteristic of "end-shock", a phenomenon that occurs in the final stages of biface manufacture, particularly common in novice flint-knappers (Bradley and Sampson, 1978). A large scar removed from the tip of the biface is visible, and its removal may have been the cause of the break. However, no conjoining flakes have been recovered relating to this biface, suggesting the piece was not made in the immediate vicinity, and was possibly imported from another area of the site. Therefore, subsequent use or resharpening in the area it was discarded seems to be the most likely explanation of the breakage and abandonment of the piece.

TECHNOLOGICAL REFITS

The technological refit groups reconstruct parts of reduction sequences, and as such are useful for understanding technology, site formation and artifact transport. The majority of these refits consist of two or three flakes in a sequence of parallel flaking. Only five of the groups conjoin flakes to cores. None of the refit groups conjoin sets of biface manufacture flakes to each other or to bifaces, and none of the retouched flake tools are part of a refitting sequence. It is acknowledged that the number of refits in an archaeological assemblage is as much a factor of time spent searching for refits as it is a reflection of hominid behavior. A concerted effort was made to find refits conjoining the biface thinning flakes to the bifaces present in the assemblage, although this did not yield any positive results. It is therefore concluded upon present evidence that the bifaces discarded in Area AH were not manufactured "on the spot" and were brought into the area and abandoned in their final form. Although it is unlikely that these pieces were transported long distances, nevertheless the assemblage shows spatial separation of the manufacturing area for these particular bifaces and their area of final discard. Similarly, the retouched flake tools may have been made upon blanks not produced in the excavated area, or conversely other artifacts belonging to the same reduction sequences as the retouch flakes were removed from the area after manufacture.

It is clear from the number and types of refits present that primary manufacture of bifaces and core reduction unrelated to biface manufacture was carried out at this location. The largest refitting group consists of a biface roughout and the flakes of production, totalling 27 individual artifacts, although reconstruction of the nodule is far from complete. The nodule has been reduced by parallel and alternate flaking, creating a roughout with a partially bifacial edge. The final series of flake removals reveal a large flaw in the raw material, and the penultimate removal was an extremely large, thick flake taken from the tip of the emerging biface. These factors may have contributed to the abandonment of the piece at this unfinished stage.

The production of large flakes, possibly for use as biface blanks, can be observed in one of the refit groups. Two large flakes (160 mm in length) in a sequence of parallel flaking were found less than one m apart, although these flakes appear to be isolated from the rest of their reduction sequence.

Another group of refitting flakes provides evidence of parallel and alternate knapping of flint nodules that is unrelated to biface manufacture. This group consists of eight flakes in a sequence of parallel and simple alternate reduction (Gowlett and Hallos, 2000). The flakes represent the initial opening of a flint nodule. The first four flake removals retain more than 50% cortex on their dorsal side, and partially reconstruct the outer surface of the original flint nodule. The core relating to these flakes is not present in the assemblage, suggesting it may have been removed from the area after initial decortication.

A small number of refit groups relate flakes to cores. The majority of these are cortical or semi-cortical flakes refitting to large, minimally flaked cores retaining some cortex on their outer surface. However, the number of flakes refitting to cores in the assemblage is low, suggesting that some of the flakes detached from cores in this area were exported. Alternatively, some cores may have been initially flaked in the excavated area then removed, leaving behind débitage that is unrelated to the cores discarded at this location.

The overall pattern of refitting in the assemblage is one of segmented reduction sequences rather than complete nodule reconstruction. Where mainly complete sequences are present, this appears to indicate very limited core reduction, perhaps testing of flint nodules accounting for the high number of cores with less than three flake removals. The more complete reduction sequences are also associated with abandonment of pieces during the manufacturing process e.g., the refitting biface roughout. If this attempt at biface manufacture had been successful, it is highly likely that the piece would not have fallen out of the technological system at this location. Other bifaces in the assemblage appear to be isolated from their debitage, suggesting manufacture and transport from another location. Refitting cortical flakes demonstrate that decortication of flint nodules was an activity carried out in the area, followed by export of some of the partially reduced cores.

The spatial distribution of the dorsal-ventral refits demonstrates discrete patterns of scatter, indicating limited disturbance and that the artifacts are lying in approximately the positions in which they were abandoned. The majority of pair distances between refits are less than three m, and the maximum distance between conjoining pieces is seven m. The horizontal spatial distribution of refit groups is consistent with those produced under experimental conditions (Newcomer and Sieveking, 1980; Schick, 1986). The refits map out surfaces descending gently about 50 cm towards the channel bank, but local vertical displacements are up to +/- 25 cm. These suggest up and down movement possibly due to trampling, bioturbation or freeze-thaw action during periglacial conditions. As edge damage on the artifacts appears minimal, the vertical movement are most likely due to post-depositional forces, since extensive trampling creates characteristic micro-damage (Gifford-Gonzales *et al.*, 1985).

SUMMARY OF ASSEMBLAGE DYNAMICS

The abundance of lithic debitage and the presence of several reduction sequences relating to separate episodes of core reduction and biface manufacture suggest that on-site knapping behavior was a principal factor in the accumulation of artifacts at this location. The refitting sequences are incomplete, and generally record segments of the reduction process, suggesting spatial and temporal disengagement of the *chaînes opératoires.*

For core and flake production, knapping activities took place at the site of raw material procurement, since flint nodules are abundant in the excavated area. The flake population is consistent with complete sequences of reduction, with an abundance of semi- and non-cortical flakes. However, over 50% of cores in the assemblage have fewer than three flake removals, suggesting very limited core reduction sequences. This suggests that many of the cores knapped in this area were exported after initial decortication. High numbers of cortical flakes and refitting groups of cortical flakes without cores supports this interpretation. Very few of the cores discarded at this location are incorporated into refit groups, further implicating the separation of cores and debitage products from this area.

The retouched flake tools display similar attributes to flakes knapped at this location, suggesting they were selected from the background population. However, none of the retouched flakes belong within refitting groups, raising the possibility that they were imported to the site from another location.

The dynamics relating to biface manufacture suggest that the *chaînes opératoires* were highly fragmented in time and space. The bifaces discarded in area AH appear to have been shaped elsewhere and imported, since they are isolated from their manufacturing debitage, and there are low numbers of thinning and finishing flakes in the assemblage. These pieces may have been used in various activities before discard. Primary production of bifaces was, however, carried out in this area, as evidenced by the refitting biface roughout, abandoned at a premature stage due to a large flaw in the flint. The presence of bifaces without evidence of their manufacture indicates that this area was not simply a primary manufacturing location or quarry site, as also shown by the fire evidence (below). The finished tools may have been imported into this area to carry out activities unrelated to stone tool manufacture, although the lack of organic materials and heavy patination of the flint artifacts ruling out reliable microwear analysis make this hypothesis difficult to test.

The artifact dynamics observable in the AH assemblage suggest repeated, sporadic hominid visits to the same location within the landscape over a relatively brief period of time. The high numbers of refitting pieces forming discrete patterns of scatter show high levels of temporal resolution are present between artifacts within the same refitting groups. The spatial overlap of several refit groups, the high levels of technological coherency and the fresh conditions of the artifacts suggests knapping activities are likely to have been carried out over the same period of time, suggesting occupational contemporaneity (Conard and Adler, 1997). However, it is extremely difficult to determine if these activities were carried out in one continuous period of occupation or several episodes. The AH assemblage suggests a complex and dynamic technological system in which artifacts were not always made, used and discarded in an expedient or opportunistic manner. On-site knapping of local raw material, import and discard of bifaces, and export of knapped components – in particular cores – are responsible for the composition and build-up of lithic material at this location.

FAUNAL EVIDENCE

Faunal remains within the archaeological levels are confined chiefly to specimens within the lower levels of AF and within Layer 6, and to fragments within the excavations of AH. They have been identified by S. Parfitt (Preece *et al.*, 2000, in prep. a, b). The list from Beeches Pit includes notably cervids and bovids (*Dama dama*, *Cervus elaphus*, *Bos primigenius*, *Bos* or *Bison* sp.), an equid (*Equus ferus*), and other large mammals including bear (*Ursus* sp.) and rhinoceros (*Stephanorhinus hemitoechus*). Fragments of bone are fairly widespread in area AH, but rarely exceed five cm in length. Bone fragments occur within the hearth areas, but the distribution outside this restricted zone has not yet been related to the hearths.

THE FIRE EVIDENCE

The archaeological record at Beeches Pit provides much evidence of burnt material. From first

Fig. 18. Hearths in area AH. The raised strip in the background was raised as a sediment block.

discovery of this, various hypotheses have been considered very carefully. These were influenced much by the actual course of discoveries. This account does not follow the sequence of discovery and thinking, but presents the evidence as we now feel it can best be interpreted. Even with careful recourse to "neutral" terms such as "combustion patch" it is not truly possible to lay out first the evidence and then an interpretation. We have come to the final conclusion, and indicate below, that there are several occurrences at Beeches Pit of humanly-controlled fire (hearths or fire places), and that there is one later locality where fire evidence is more widespread, and of unknown cause. This interpretation now fits well with a pattern of comparable evidence from sites across Europe dating to approximately the same time interval (Rolland, 2004), from sites such as Bilzingsleben, Schoningen, Menez Dregan and Terra Amata (Mania, 1996, Mania and Mania, 2005; Thieme, 1996, 1999; de Lumley, 1969) and possibly represented similarly at the site of Gesher Benot Ya-aqov (Goren-Inbar *et al.*, 2004). Finally, however, we make a particular effort to generate and consider alternative hypotheses. The question of fire use in the Middle Pleistocene remains of great importance, considering that this was a period of increase in brain size, change in technology, and probably of major developments in social behavior perhaps involving language (Aiello, 1996; Dunbar, 1996; Gamble, 1999; Gowlett, 1996; Ronen, 1998; Wrangham *et al.*, 1999; Wrangham and Conklin-Brittain, 2003).

Burning is attested at Beeches Pit in each locality (AH and AF), and at different levels. Firing is indicated by numerous finds of burnt flint, by charred bone (cf. Preece *et al.*, in prep. a, b), and by darkened and red-oxidized sediments. It is defined and characterized by the form of localized features (hearths) and by the relations of artifacts (a refit set).

Strongly burnt flints are clearly recognisable by eye. They are reddened and sometimes pockmarked or even shattered. However, some flints

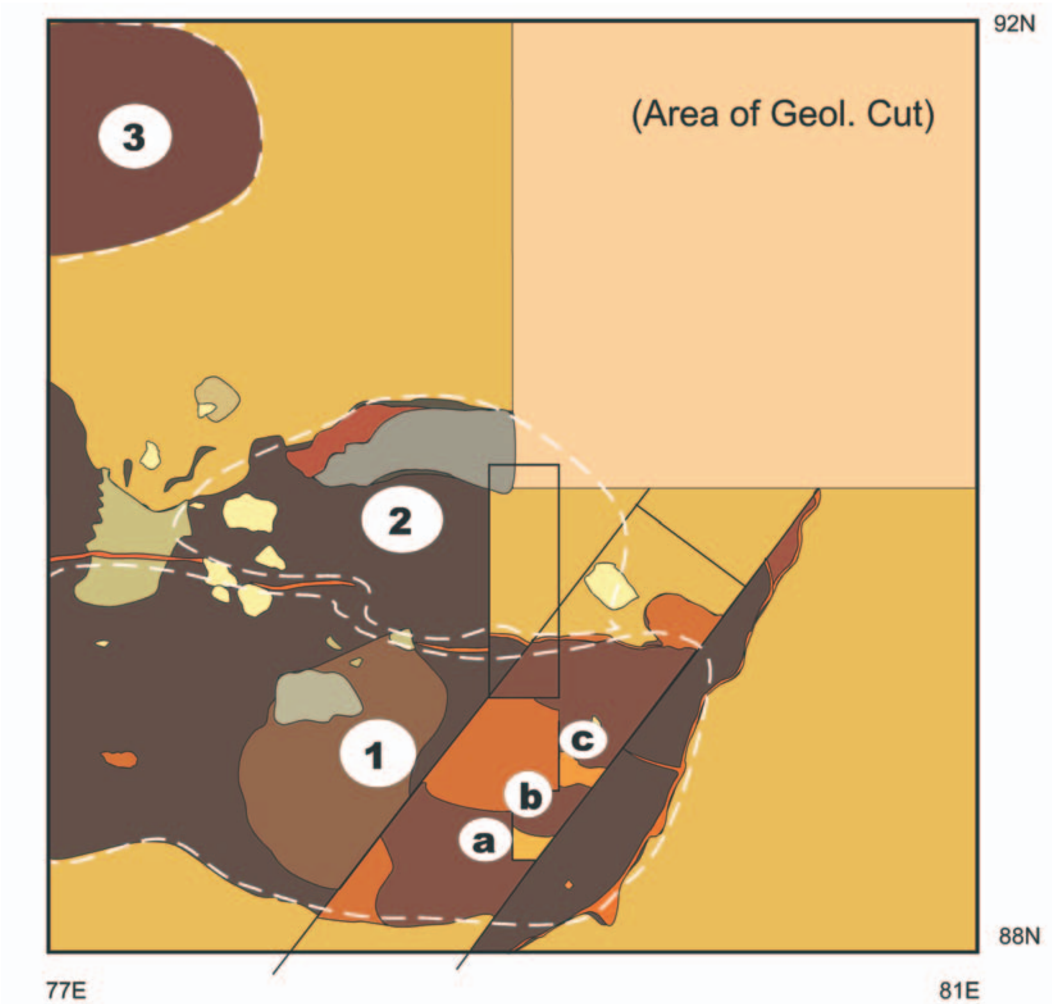

Fig. 19. Detail plan of hearths in Area AH. This area is viewed from the left (west) in fig. 18. Dashed white lines represent delineations of the main hearth complexes. Brown lines indicate thin oxidised layers.

heated to a temperature in excess of 400 degrees C do not have traces of alteration visible to the eye.

Burnt flints are quite widespread in Area AH, but occur chiefly in the darker areas towards the front of the excavation. The main evidence from Area AH consists of localized patches of burnt material in the front of the excavation in the squares (77–80E, 88–91N; Figs. 18–19). Under excavation, the edges of these patches could be localized clearly, so as to appear on a photograph as a darkened area, with defined edges to the east, to the north, and to the south (Fig. 19). On the west side some features have not been closed-off within the excavation, but their profiles have been preserved in the section.

It was found that the dark material lies in shallow depressions some of which intersect others. At the base, there is oxidation in places of the light brown clay in which they lie. In other places, thin bands of oxidation give the outline of newer features intersecting older ones. From the lowest level (*ca*. 27.10) the features move slightly in a northwest direction, so that the final feature in the first series (2) is displaced by about two m horizontally from the first one (Fig. 21). The lowest

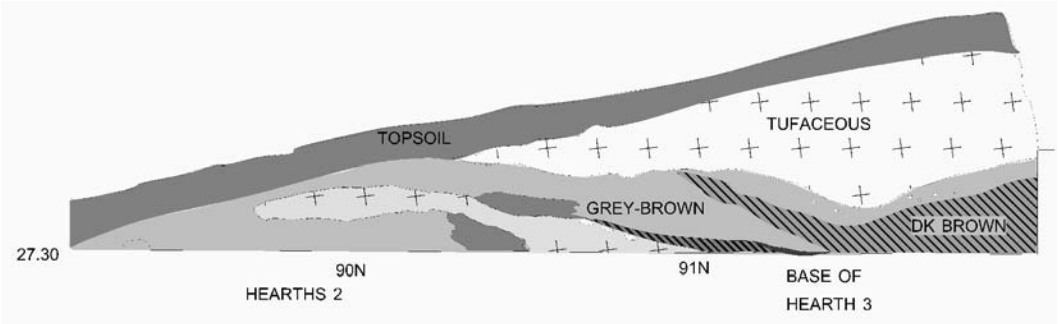

Fig. 20. Stratigraphy of AH hearths, viewed facing west (cf. view in Fig. 21)

Fig. 21. View of west section of AH showing Hearth 3

hearth comprises subunits a, b, c, and possibly others, and has produced fragments of charred bone. A further hearth (3) is visible in the section on line 77E, with its base at 27.30 (Figs. 20–21). It is stratigraphically slightly higher than the series 1a–c and 2 and displaced northwest a further 1.5 m from (2).

The features just mentioned are sufficiently sharply defined to appear clearly on photographs, and to be mapped with some confidence (Figs. 19–20). They have been partly-excavated, with the aim of elucidating stratigraphic relationships. The wandering strong brown lines were at first a puzzling feature. In final investigation of the site (2003), we were able to establish that most of them bounded the edges of one elongated shallow bowl-shaped depression (hearth 2). It appears that on at least one occasion a renewed focus of burning oxidized a thin layer of material at the top of the underlying sediments, even when these were themselves quite dark.

Key evidence for interpreting these features comes from the main refitting artifact set. As described above, this represents the fashioning of

Fig. 22. The lens of burning in area AF, seen at an early stage of excavation. A thin dark organic band can be seen in the foreground

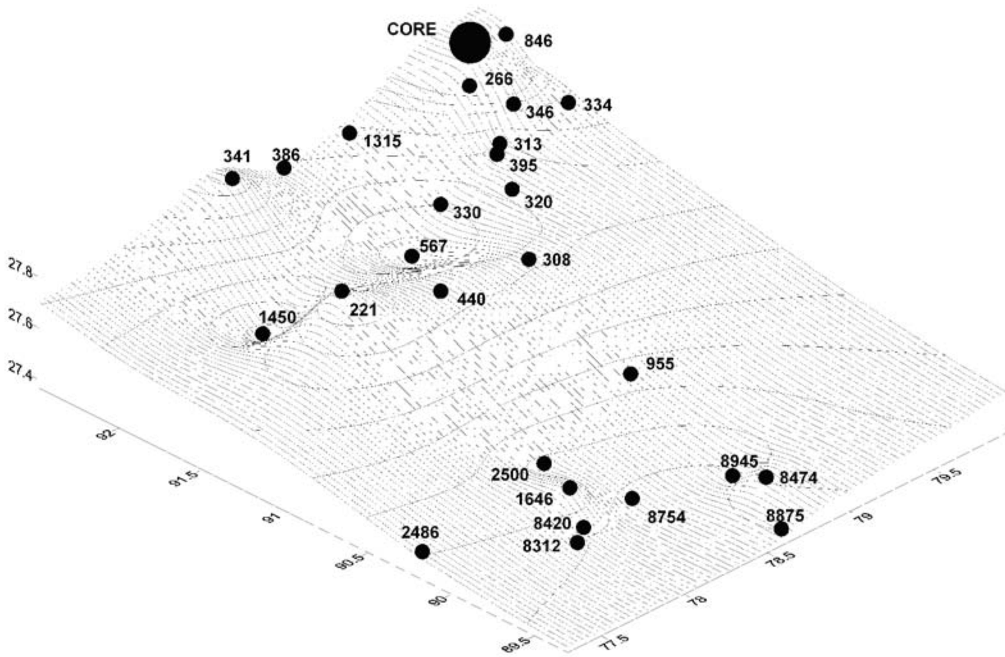

Fig. 23. 3D Spatial distribution of refitting biface rough-out. The surface fitted to the finds by Surfer picks out the bowl shape of a hearth (foreground-right) independently of all mapping of excavation units (as shown in Figs. 4 and 19)

Fig. 24. The rejoined refit set indicated in Fig. 23, showing the burnt flake. The inset shows the whole group including the main piece of the biface roughout

a biface roughout from a large flint nodule. The refitting pieces are a set of 27 flakes and core pieces. The discarded core is likely to give the approximate sitting position of the knapper, about 2.5 meters from hearth 2. The refit distances are in the range of approximately one to three m. Three pieces from the core travelled forward by about two m. These three pieces alone lie within the perimeter of the hearth features (Fig. 24). These alone are burnt red, as is strikingly demonstrated when they are refitted to the core. A measurement was made by TL methodology on a small detached fragment of one of the burnt flakes, confirming the Middle Pleistocene date of the burning, which for this and the other dated samples took place at temperatures of greater than 400 degrees C.

This is a quality of refit evidence that occurs more frequently in the Upper Paleolithic, but even then rarely. The evidence represents a specific phase of activity, probably extending through a few minutes at most. We interpret the finds as indicating that a person sat close to a hearth, knapping an intended biface, and that three flakes of the debitage entered the fire. Given the multiple nature of knapping events, and the multiple use of hearths, it is conceivable that the knapping took place just before or after a particular fire was lit, but if that was so, then there was limited disturbance to the finds.

When plotted in three dimensions, the refit set maps out a relatively smooth surface, with only small vertical shifts of individual pieces. A contour-fitting program is able to reconstruct this surface on the basis of the whole refit series. Although entirely independent of all our photography and visual interpretation of features, it is striking that this reconstruction picks out the bowl-shaped form of a hearth (Fig. 23).

Thus the refitting pieces provide an excellent guide to the topography of the surface at the time of the burning. They descend in a slope from the back of the excavation towards the hearth (and the pond). Given the depth of sediments through which artifacts occur in total, and the general conformation of the deposits, it seems likely that this was a real slope, rather than one created by later distortion of sediments.

In Area AF, there are two levels with indications of burning, separated stratigraphically. The first in Layer 5, is restricted to an area about 1.2 m long, by 0.8 wide, and occurs in the form of a lozenge or pastille, with its shorter axis extending downslope at an angle of about 40 degrees. The oxidized zone is up to 30 cm thick, and includes heavily burnt flint that is red and shattered. The oxidized layer immediately overlies one of the thin organic layers within Layer 5. Parts of this feature have been preserved in large sediment blocks.

The second layer with burnt material is Layer 6, which extends across most of the upper part of AF excavation, and originally covered the slope of previously deposited clays as a thin mantle of material. The layer is dark and organic throughout; its nature and content are discussed in detail by Preece *et al.*, in prep.. Two hypotheses are available to explain its origin: 1) that it represents washed out material, the detritus from a regional forest fire; 2) that it represents a spread of ash and other organic material derived from repeated fires made on the channel bank, in an area where the sediments have now eroded away.

There is something to commend each hypothe- sis. First, any regional forest fire, anywhere within the drainage area, could generate a huge amount of burnt material, which could wash down to choke up local streams or creeks. A modern example is given by twentieth century forest fires within Mount Rainier National Park, Washington State (cf. Hemstrom and Franklin, 1982).

The second hypothesis can be supported by reference to other evidence at Beeches Pit, and from other early fire sites. A tail of dark material appears to extend downslope from the earlier set of hearths in AH (Layer 3b), and is recorded in Geological Cut 1. Human presence is attested near the top of Layer 6, where two bifaces in fresh condition were found close together alongside other flint finds. These are not evidently burnt. These findings may indicate no more than that the unit was reworked by water as its deposition ended, and that humans were in the area at that time. Burnt bone occurring within Layer 6 (Preece *et al.*, in prep. a, b) is compatible with either hypothesis. The matter is most likely to be resolved through microstratigraphic studies.

All the individual hearths at Beeches Pit appear to be of the order of one m across, round or ovoid in shape, and on AH at least filled to a depth of > 20 cm with burned materials. Our own experiments with campfires suggest that although this size is within the range of modern hearths, such a pattern can only arise through repeated burning, over a period of time. Modern campfires are often somewhat smaller, with *ca*. 60 cm diameter being typical. It may take several burnings to generate ash thickness of 10 cm. Some hearths belonging to the last glaciation at Abric Romani are of similar large size and depth (Carbonell, personal communication; Vaquero *et al.*, 2001), but it can only be hypothesized that this conformation will prove typical of the Middle Pleistocene.

HYPOTHESES

We came to the view that the burnt features represent hearths, because of their localized forms, their intersecting repeating nature, temperature indications, and above all because of their relationship with refitting lithic evidence, demonstrated dramatically in color changes. The form of the hearths is compatible with those on other sites, and there is no suggestion of the branching shapes that can occur when a fire follows roots, as in a stump fire (Bellomo, 1993, 1994).

Nevertheless, the variety of the evidence may suggest that more than one hypothesis of explanation will be needed for Beeches Pit as a whole. There are three immediate hypotheses, as stated previously (Gowlett *et al.*, 1998): 1) that the concentrated patches represent hearth features, indicating controlled fire-use; 2) that burnt patches and scattered burnt flints are incidental features of hominid fire-use; and 3) that the broader concentrations of burnt material (Layer 6) may be essentially natural features stemming from forest fires.

There have been relatively few ethnographic investigations of fire use in temperate zones (Johnson, 1992; Lewis, 1977; Vale, 2002; Parker, 2002). Research reviewed by Johnson (1992) in Canada is interesting in indicating that within the boreal forests repeated fires are very unusual in a single area. It appears that each area of forest will burn eventually, but that once burnt an area is unlikely to burn again for hundreds of years. Work by Lewis in Canada also suggests that human-generated fires tend to occur at different seasons and in different areas from natural fires – and that they are often made in low-lying valleys and along creeks, in areas where natural fires are not common (Lewis, 1977). In the Rainier forests too, "fire frequency varies with topographic position. Alluvial terraces, valley bottoms, and protected north-facing slopes are often forested with old stands", and "Nearly every major river valley contains a streamside old-growth corridor" (Hemstrom and Franklin, 1982:47). Among the Yurok of northern California most occupation was restricted to settlements along major watercourses (Vale, 2002). In most of these contexts fire return intervals, though variable, are considerable, of the order of 50–400 years. Elsewhere, it seems that fire return periods can be more frequent (Parker, 2002), but are still usually in the range > 10 years.

The very fact of repeated fire occurrences at Beeches Pit, as well as their localization and form, make it difficult to generate a hypothesis that the majority of fire occurrences at Beeches Pit could be owing to forest fires, but they do not rule this out for Layer 6, which need not necessarily imply a local fire by the pond side.

Evidence for humanly-controlled fire in or around OIS 11 is available from several sites, so that there begins to be a pattern of evidence arguing for a "regional hypothesis" (Gowlett, 2003: 201; cf. Bilzingsleben, Menez Dregan, Terra Amata: Mania, 1995; Mania and Mania, 2005; Hallegouët *et al.*, 1992; Monnier *et al.*, 1996; de Lumley, 1969). It remains a puzzle that controlled fire seems to occur at isotope Stage 11 (360,000–410,000 years ago) in Europe, but that earlier evidence is so lacking. Why is there no evidence of fire at the extensive site of Boxgrove, for example, or in the older sites on the Somme? Fire is present at the contemporary site of Zhoukoudian in China, but a pattern of human use has often been doubted (James, 1989; Binford and Stone, 1986; Weiner *et al.*, 1998). One clue may come from the findings of Tuffreau *et al.* (1997) on the Somme, that the same sites are used for similar specific tasks over very long periods – sometimes many thousands of years. These are tasks such as butchery, or raw material collection. Similarly, perhaps it was the practice to control fires in very specific environments that are not usually preserved on open sites. The emerging pattern is of repeated fire-use within caves, and on the edge of water bodies. Cave records do tend to give documentation to the recurrent nature of fire use (e.g., Kebara, Bar-Yosef *et al.*, 1992; The Haua Fteah, McBurney 1967).

GENERAL COMPARISONS

Beeches Pit should be seen within the general context of Middle Pleistocene sites in northwest Europe (Gowlett *et al.*, 1998). Several able surveys have been made of the broader record in this area where early settlement may date back to 600,000 years or more (Roebroeks, 2001; Roberts, *et al.* 1995; Gamble, 1986, 1999). With the likelihood of a land bridge between Britain and the mainland (Preece, 1995; cf. Meijer and Preece, 1995; Turner, 1995), there may often have been a single culture province, but the local variations in lithic industries have presented puzzles for interpretation over a long period, particularly in terms of presence or absence of bifaces, and size and form of other formal tools.

The presence of typical bifaces in both main Beeches Pit localities allows designation within the Acheulean tradition, which was widespread in western Europe from about 500,000 to 150,000 years ago, but which leaves archaeology to deal with facies problems in various periods and areas. There can be no doubt that at Beeches Pit the artifacts, including bifaces, represent occupations in temperate conditions, probably in an area dominated by closed vegetation. This association is important in the light of earlier discussions about habitats of occupation (Gamble, 1986; Roebroeks *et al.*, 1992; Roebroeks, 1996). Following the correlations proposed by Preece *et al.*, (2000, in prep. a, b) the earlier occupations are likely to have occurred in an early phase of the interglacial of OIS 11, and may equate with localities in the Thames valley which preserve Clactonian industries. The Clactonian has long been known as a facies or tradition comprising flake and chopping tool industries. Much debate has been give to considering its status and what it represents (e.g., Roe, 1981, 1996; White, 2000; Ashton, 1998; Ashton and McNabb, 1994, 1996; McNabb, 1992, 1996; Wymer, 1968, 1999). It does seem plain that there are facies of material in Britain in which bifaces are nearly or completely absent. This is also true for mainland Europe, especially towards the east (e.g., Mania and Mania, 2005; Svoboda, 1987). Locally within Britain, the Beeches Pit finds and dating indicate the presence of classic Acheulean at a time when the Clactonian facies is often thought to be dominant. The evidence may tip the balance towards interpreting the Acheulean and Clactonian as functional or ecological variants, rather than cultural facies, but it does not rule out the latter possibility. We can say definitely, however, that Acheulean is represented at each of the Beeches Pit localities, even though these represent different periods in the OIS 11 interglacial.

The Beeches Pit finds do much more to illustrate and illuminate aspects of the nature of behavioral flexibility and rigidity in the Middle Pleistocene, and the nature of a socialized human adaptation. They tally with the evidence of the Somme, Schöningen, and Boxgrove in indicating that there could be patterns of large repeated occupations in a single area, generally given over to the same or similar activities. Fires may have been made in particular situations, on banks, close to both water and fuel – in the settings where they do not often occur in nature. They may have been placed adjacent to rather than in main campsites. They may have been kept burning for long enough that they produced tails or spreads of burnt material downslope. We set forward as hypothesis that this was the only way in which fire could be satisfactorily controlled and managed.

If such patterns are proved to exist, do they show behavioral flexibility, or rather rigidity? There may well be elements of both, as in the "variable sameness" that is characteristic of the Acheulean. It may be reasonable to talk of people *mapped onto their landscape*.

THE ARCHAEOLOGY: SUMMARY

The archaeological evidence from Beeches Pit shows multiple Acheulean occupations from a temperate stage of the Middle Pleistocene that is judged from several lines of evidence to be isotope stage11.

The archaeology gives some evidence of internal chronology, complementary to that of the geological/paleoenvironmental evidence. As there are two stratigraphically separate localities, each with artifacts through considerable depth, it is evident that the site location represented a favored place, which attracted occupation through a long period, probably through varying environmental conditions. In this it resembles other such localities on the Somme, at Boxgrove, or perhaps particularly such as Bilzingsleben where there were similar springs.

People were probably drawn by a combination of factors, including fresh water, presence of animals, local raw material source, and probably the presence of a water's edge that gave protection on one side.

The interglacial nature of the occupation cannot be doubted, given the integrity of occurrence demonstrated by the refits, and the extent of the co-occurrence of artifacts and warm-period microfauna and macrofauna, as well as molluscan fauna (Preece *et al.*, 2000, in prep. a, b; cf. Meijer and Preece, 1995; Rousseau, 1992).

The fire history is complex, but in two separate instances, at different levels, there are sharply delimited burning features, associated particularly with the channel edge and with some burnt artifacts – in which the refit evidence offers a very precise record of events. These features are stratigraphically distinct from the dark Layer 6, which incorporates burnt material over a wider area, and may have a different mode of origin. We have concluded that the sharply delimited patches represent hearth positions. There may have been other fire phenomena on the site, with Layer 6 suggesting either a more widespread fire, or a large "tail" of burnt material derived from other hearths that have now vanished.

Fire-use may be long established in human prehistory (cf. Wrangham *et al.*, 1999), but its detailed documentation remains a major exercise. We hope to present further analyses in due course, and to discuss dietary, social, technical and cognitive implications in greater detail (e.g., Gowlett, 2005, 2006; Hallos, 2005).

Overall, Beeches Pit presents a coherent body of behavioral evidence adding to our knowledge of the Acheulean repertoire, particularly in terms of artifact dynamics and fire-use practices. For the latter, it provides major documentation suggesting that by 400,000 years ago, in Europe humans were well-established in the basic technical and social patterns of fire use which would continue for long ages, seemingly tightly bound to repeated practices and to their landscape.

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