Challenges to the Occupation of North-West Europe during the late Middle Pleistocene: Discussion and summary

This series of papers have set out to investigate the nature and timing of the human occupation of northern Europe during the late Middle Pleistocene and to examine the specific challenges and barriers to colonisation. The study centres on Britain because this area, sometimes a peninsula and sometimes an island of Europe, provides a good set of data to examine specific questions. As such, it is a case study that provides answers to much broader questions about the behaviour and capabilities of early humans. Three modules were identified within this region. These were: 1. the habitat choices made by humans during MIS 11; 2. the demography of the late Middle Pleistocene; and 3. the reasons for the long-identified absence of humans in Britain. The evidence from each of these modules is discussed below.

Module 1: Human habitats and environments in MIS 11

Three papers have been presented that contribute to the debate about the human habitat choice during MIS 11 (Ashton *et al.* 2005, 2006, 2008). The first paper is a site report of the British Museum excavations from 1995-1999 at Elveden, Suffolk (Ashton *et al*. 2005). The site occurred within a small disused clay pit and was first subject to excavations by Paterson and Fagg (1940) and later fieldwork by Sieveking and Turner (Turner 1973). The recent work has concluded that a small lake formed in a kettle hole within Anglian till. When the lake basin became choked with fine-grained sediments a small river formed, laying down further silts and clays, but also creating a lag gravel on the fringes of the basin. As the river dried up, a palaeosol formed across the basin, which was then covered by a series of colluvial sandy clays. The lacustrine and fluvial sequence dates from the late Anglian through to Hoxnian pollen zone HoII. The artefact assemblages, which include handaxes, are associated with the lag gravel and immediately underlie the palaeosol. There is no evidence of human occupation during the lacustrine phase of the site, nor is there evidence after the palaeosol formed across the basin.

Unfortunately, other than pollen, there is comparatively little environmental evidence preserved; only fragmentary molluscs, ostracods and occasional vertebrate remains were recovered. However, they generally support the evidence from the pollen of a fully temperate environment during the use of the site by humans. Of perhaps greater value is the evidence from Barnham (Ashton *et al.* 1998). This site is situated 7km to the east of Elveden. At Barnham a remarkably similar sequence was recorded, with the same lacustrine sediments in a kettle hole cut into Anglian till, overlain by fluvial sediments including a lag gravel on the fringes, followed by a palaeosol and colluvial sediments at the top. The archaeology was also primarily associated with the lag gravel. It has been suggested that the sequence at Barnham is contemporary with that at Elveden and they formed part of the same river network. It has also been suggested that the similarity in the sequences is due to both sites being subject to the same climatic forcing. This could be reflected in an increase in precipitation leading to the creation of a fluvial system followed by either a warming in climate or a decrease in precipitation leading to the drying out of the river basins and the formation of the soils.

Unlike Elveden, Barnham has a very rich environmental record, including pollen, molluscs and vertebrate remains. These were associated with the fine-grained fluvial sediments in the centre of the basin. Although the main archaeological assemblages were recovered from the lag gravel on the edge of the basin, importantly there were occasional artefacts and a cut-marked bone found in association with the environmental evidence. Here the recovery of amphibians such as tree frogs (*Hyla arborea*) and European pond terrapin (*Emys obicularis*) indicate summer temperatures of at least 18°C, which is warmer than British summers today. The pollen suggested deciduous woodland together with more open, grassy areas within the vicinity of the site. The mix of vegetation was supported by the vertebrates.

A second site that has been investigated is that of Hoxne from 2000 to 2003 (Ashton *et al*. 2008). Previous work had described the long lacustrine sequence at the site together with the overlying fluvial sediments (Evans 1896; West and McBurney 1954; West 1956; Singer *et al*. 1993). However, there were different interpretations from these studies as to when the human use of the site occurred and what sort of habitats they were occupying. The recent investigations concluded that there was a major hiatus within the lacustrine sequence between Stratum D (pollen zone HoIIc) and the overlying 'Arctic Bed' of Stratum C. The latter contained dwarf birch (*Betula nana*) and three species of dwarf willow

(*Salix myrsinites*, *S. herbacea* and *S. polaris*) together with beetle remains suggestive of cold climate (Coope in Ashton *et al*. 2008). The overlying fluvial sediments of Stratum B also contained environmental data of vertebrates, molluscs and ostracods, but suggested a more temperate climate. It is this unit that contained the primary context artefact assemblage from the site ('the lower industry' of Wymer and Singer 1993).

The environmental data from Stratum B is still being studied, but evidence from the University of Chicago excavations in the 1970s indicated that the mammalian faunal assemblage was dominated by horse and included Norway lemming (*Lemmus lemmus*) (Stuart 1993). Cutmarks on the horse teeth indicate the association with the human presence at the site. Pollen was also recovered from the Stratum B sediments, which had been interpreted as fluvial (Mullenders 1993). This interpretation was strongly critisised by Turner and West (1994) on the basis of the problems of reworking in fluvial sediments. These issues notwithstanding, the dominance of the pollen spectra by birch and pine does require explanation, in particular from which sediments was it being reworked? There are no obvious sources for this reworking at the site.

Further clues to the environment of Stratum B lie in the suggested dating of the sequence. This has been constrained by Anglian till at the base (Stratum G), attributed to MIS 12, and by amino acid racemisation (AAR), U-series dates and by the biostratigraphy of the Stratum B sediments. The recent AAR ratios suggest that Stratum B is probably late MIS 11 in age (Penkman in Ashton *et al*. 2008). An MIS 11 age is supported by U-series dates of 404 ± 33/42 and 437 ± 38 ka (Grün and Schwarcz, 2000). Three mammalian species also support an MIS 11 age with *Microtus (Terricola)* cf. *subterraneus*, *Trongontherium cuvieri* and *Talpa minor* apparently being absent in Britain after MIS 11 (Parfitt 1998). The main part of the sequence at Hoxne (Strata F to B) therefore falls within MIS 11. The structure of MIS 11 has been discussed in the introduction and consists of a sustained temperate phase (MIS 11e) followed by a series of climatic oscillations (MIS 11d-11a). It is suggested here that the truncated part of the Hoxnian sequence at Hoxne (pollen zones Ho I to Ho IIc) correlates with the first part of MIS 11e, and therefore that the entire Hoxnian sequence (as represented at Marks Tey; Turner 1970) is attributed to MIS 11e. It is also suggested that the cold episode of Stratum C correlates with either MIS 11d or MIS 11b. Furthermore, this implies that the more temperate climate of Stratum B correlates with either MIS 11c or MIS 11a.

If these correlations are correct, then a more reliable environmental reconstruction can be suggested by the more complete pollen sequences in Europe. These include the Velay sites (Reille and de Beaulieu 1995; de Beaulieu *et al.* 2001) and that from Ossowka (Nitychoruk *et al.* 2005). In combination these suggest that the later more temperate substages of MIS 11 were considerably cooler than MIS 11e and in northern Europe are likely to have been dominated by boreal forest. This conclusion supports the original interpretation of the pollen from Stratum B by Mullenders (1993). This suggests that the humans at Hoxne were inhabiting a boreal environment on the edge of a river, surviving on the hunting of horse. The environmental indicators from Hoxne are similar to those from the Channel II (level 4b) deposits at Schöningen with the pollen suggesting pine forest and the fauna dominated by horse (van Kolfschoten 1993; Thieme 1997; Urban 2007). It is quite possible that Hoxne and Schöningen date to the same sub-stage of MIS 11.

The third paper draws the evidence from Elveden, Barnham together with other Hoxnian sites (Ashton *et al*. 2006). These include the sites of Beeches Pit (Preece *et al.* 2006, 2008), Hitchin (Reid 1897; Boreham and Gibbard 1995) and Foxhall Road, Ipswich (Layard 1904, 1906; White and Plunkett 2005). Most of these sites had previously been interpreted as lake-edge occupations (Wymer 1999). Reanalysis of the data, suggests that human occupation is only associated with the fluvial sequences at the sites, which generally overly lacustrine sediments. To test this pattern, other non-archaeological lacustrine sites were examined, to see if reasonable opportunities had been provided for the recovery of archaeology if it had been present. Of a list of 17 sites, only four had good exposures of the sediments and a long history of collection, to provide convincing evidence of human absence. It was further suggested that fluvial sites were more likely to be visible and discovered because of the lithic resources and consequent knapping at these sites. However it should also be noted that at least two sites have been discovered in fluvial situations but away from the raw material resources, namely Hoxne (Ashton *et al.* 2008) and High Lodge (Ashton *et al.* 1992). Other means of testing human habitation of lacustrine sites were discussed, such as looking for the presence or absence of small knapping waste or chips, cut-marks on bones, or indications of anthropogenically produced charcoal. To provide convincing evidence, these lacustrine locations need to be investigated more thoroughly.

Despite these problems of visibility, it was deduced that fluvial habitats were being extensively used during the Hoxnian. The reasons suggested were the array of resources that these habitats provided; lithic raw material was exposed through the erosive processes of rivers, while other animal and plant resources were likely to be more abundant in the variety of ecological niches found within a river valley location. It was also suggested that the river valleys were kept open by the foraging and trampling of large herbivores such as elephant and rhino, in contrast to the interfluves, which from the pollen evidence were likely to have been surrounded by dense deciduous forest. As such, the valleys would have provided routeways through the landscape. If this reconstruction is correct, then it is not surprising that small lake locations, such as Elveden, Barnham and Hoxne show no evidence of human habitation during that phase of their histories. Such locations would have been off the beaten track, particularly Barnham and Elveden, which were little more than ponds of less than 100m across.

Evidence that the interfluves were exploited at some point during the Palaeolithic is clear from the recovery of hill-top locations, such as Caddington, Bedfordshire (Bradley and Sampson 1978), Whipsnade (White *et al*. 1999) and West Cliff, Kent (White pers. comm..). It was suggested that these locations were occupied in cooler conditions, when more open landscapes would have allowed easier access, and when more erosive processes would have exposed raw material sources in these locations. However, due to the lack of environmental or secure dating evidence for these sites, this interpretation remains to be properly tested.

In conclusion, a variety of habitats seem to have been exploited during MIS 11, varying from fully temperate, densely forested conditions at sites such as Elveden, Barnham and Beeches Pit, to cooler, more boreal environments at Hoxne. What most of these sites have in common is the fluvial context, river-edge in the cases of Elveden, Barnham and Hoxne, or on the edges of a valley next to a spring-line in the case of Beeches Pit.

The suggestion of a boreal environment for Hoxne is not unique. It has also been suggested for several sites that probably date to MIS 13, such as High Lodge (Ashton *et al*. 1992), Boxgrove (Roberts and Parfitt 1999) and Happisburgh Site 1 (Ashton *et al*. 2008). This reconstruction is supported to some extent by the beetle evidence (Coope 2006). What is not clear is how humans coped in these difficult environments, where there is little edible plant material, animal resources are generally dispersed and more likely to have seasonal migration patterns, and with cold winter temperatures. One clue might still lie in the river valley locations. The valleys again would have been open and a focus for watering game. A further clue might come from the sites of High Lodge and Hoxne, where some of the assemblages have an unusually high proportion of well-made scrapers. Although there is no direct evidence of how these tools were used, it is reasonable to suggest that hide processing was an important activity at these sites, and therefore that clothing and shelters were being produced. That the controlled use of fire was also a possibility during MIS 11 is shown by the reasonably strong evidence from Beeches Pit (Preece *et al*. 2006). There is clearly, however, much more work required to understand better how humans coped with boreal environments during MIS 13 and 11.

Module 2: Population change from MIS 13 – MIS 5e

Two papers have been presented for Module 2, which deal with the pattern of demographic change in Britain during the late Middle Pleistocene based on the fluvial archives from the Middle Thames and the former Solent rivers (Ashton and Lewis 2002; Ashton and Hosfield in press). The study of the fluvial archive from the post-diversion Middle Thames (Ashton and Lewis 2002) examined in detail the number of handaxes and Levallois artefacts recorded from within each terrace, using the data presented in the English Rivers Palaeolithic Project (TERPS; Wessex Archaeology 1996). The study also took into account the mapped areas of the terraces, and thus provided artefact density figures for each terrace. For the Middle Thames the highest (Black Park) terrace formed towards the end of the Anglian Glaciation in MIS 12 and the formation of subsequent terraces (Boyn Hill, Lynch Hill, Taplow and Kempton Park) can be related to the major glacial-interglacial cycles (Bridgland 1994). The rationale behind using simply handaxes and Levallois artefacts in the analysis was to overcome in part the biases introduced through selective collecting. It was recognised that further biases could be introduced through greater urban development or quarrying over some terrace areas, thus enhancing the chances of artefact discovery by collectors. These factors were assessed for the Middle Thames area and the density figures adjusted to accommodate their possible effect. In addition, each terrace formed over slightly different lengths of time (most over approximately 100,000 years), and this again was factored into the analysis.

Despite these issues a clear pattern emerged of changes in artefact density through time with a marked decrease from the Boyn Hill Gravel to the Lynch Hill Gravel and a virtual absence of artefacts in the Taplow and Kempton Park gravels. The artefact densities were argued to be a proxy for relative levels of human population and therefore the pattern suggested a drop in population from MIS 11 to a virtual absence of humans from the end of MIS 7 to after MIS 5e. It was suggested that the apparent decline in population might be due to the progressive adaptation of Neanderthals to open steppe environments and that they only reached Britain as this biome expanded from the east. It was further suggested that the apparent absence of humans after MIS 7 might indicate a comparatively late breach of the Chalk of the Weald-Artois Anticline, perhaps towards the end of MIS 8 or MIS 6, rather than the more widely accepted timing in MIS 12 (Smith 1985; Gibbard 1995). This is discussed further below.

The idea that human population declined from MIS 11 through to MIS 7 has received a number of specific criticisms. Collecting bias was suggested as a major contributing factor to the observed pattern of declining artefact densities whereby particular sites and terraces would be targeted as they became better known by the collecting fraternity, having a snowball effect on particular locations, creating in effect 'super-sites' (Hosfield 2005; McNabb 2007). Hosfield further argued that regional differences might be playing a role, as it was difficult to discern a similar pattern in selected terraces of the Solent region (Hosfield 2001). A further criticism concerned the use of the quantities of handaxes and Levallois artefacts. White *et al.* (2006) argued that one handaxe does not equate to one Levallois artefact as they may have had different functions and therefore may have been discarded at different rates. It was also suggested that the organisation of technology in the landscape was different during the Middle Palaeolithic, where discard locations reflected a broader, more logistical pattern of landscape use and that this would also have an effect on the artefact record in the fluvial archive (Scott 2006; White *et al.* 2006). If correct, this would create difficulties for examining the record during the Middle Palaeolithic, when handaxes were scarce.

In order to test the data from the Middle Thames and also to examine some of the potential problems of using the fluvial archive as a means of assessing human population, a new study has been undertaken on the Solent River basin and its tributaries based on the Southern Rivers Palaeolithic Project (SRPP; Wessex Archaeology 1993; Ashton and Hosfield in press). This river system presents particular difficulties partly because there are different terrace schemes used in the different tributary valleys of the Frome, Stour, Avon, Test and western Solent, and therefore correlation between these valleys is problematic. There is also disagreement about the mapping of the terraces in some of the valleys, so that in the western Solent, for example, the scheme proposed by Allen and Gibbard (1993) has been extensively modified by Westaway *et al.* (2006). A further difficulty is the lack of chronological constraint on the terraces, in part due to the dearth of biostratigraphic data. However, recent OSL work is beginning to provide some age control for some of the lower terraces in the western Solent (Briant *et al.* 2006). The above problems are compounded by the nature of the archaeological record, which often lacks contextual detail and where the rolled condition of many of the artefacts suggests that reworking might be a major issue.

Despite these difficulties the study has assessed the different tributary areas and attempted to find ways of overcoming the problems. Each area has been taken independently and a relative scheme provided of changes in artefact density over time. A broad dating and correlation scheme has been applied, largely based on the few OSL dates and also on how the terraces correlate in the confluence areas. Unfortunately, assumptions have been made about the context of many of the collections, although the condition of nearly all the artefacts did suggest that they originated from fluvial gravels. To overcome the difficulties of using Levallois artefacts (see above) only handaxes were used as a proxy, and the date range considered was limited to their earliest occurrence (MIS 13 or 15) up to MIS 8, when Levallois is widely regarded to have been first used in Britain. This also overcame a particular problem for the Solent basin where only 63 Levallois artefacts are recorded; where their stratigraphic context is known, they always occur in sediments overlying terrace gravels. The issue of collecting bias was also examined to assess the effect of particularly large assemblages (or 'super-sites') on the artefact densities, and some tributary areas were treated with caution as a result.

A summary of the raw artefact density figures has shown some patterning in the different areas with all the peak densities occurring in terraces that are probably MIS 10 or earlier, followed by a drop in densities thereafter. However, three of the tributary areas have been treated with great caution as they are dominated by 'super-sites' and have had a large effect on the results. For example, the Frome valley is totally dominated by the Moreton gravel pits. The Avon and western Solent are also regarded as problematic. However, the Test Valley and the Stour Valley seem to provide more robust data. Although the dating of the terraces is not clear, the peak densities probably occur between MIS 13 and MIS 10. If Britain was abandoned during MIS 10, this implies peak populations in MIS 11 or earlier. The data from the Stour (and part of the main Solent) were examined in more detail in the Bournemouth area, taking into consideration urbanisation, quarrying and also the effect of reworking from higher into lower terraces. All the data suggested that peak populations still occurred in MIS 11 or earlier.

The conclusions from the new research in the Solent therefore broadly support the original analysis from the Middle Thames Valley that population based on artefact densities declined from approximately MIS 11 through to the introduction of Levallois at around MIS 8. What neither study has adequately addressed are the issues of using Levallois as equivalent to handaxes and thereby assessing population change from the Lower to Middle Palaeolithic and during the Middle Palaeolithic itself. These problems are addressed in Module 3, together with possible explanations for population decline and eventually absence between MIS 6 and MIS 4.

Module 3: Low or absent populations between MIS 6 and MIS 4

Two papers examine the early Middle Palaeolithic in Britain and the possible period of absence in comparison to the record from north-west France (Ashton 2002; Ashton and Scott submitted). Most of this record for Britain occurs in the Thames Valley, where there are contrasts in the context of Levallois artefacts between the Middle and Lower parts of the valley. In the Middle Thames the major Levallois sites, such as Creffield Road and Yiewsley/West Drayton are all found in sediments overlying the Lynch Hill Gravel (Ashton *et al.* 2003; Scott 2006), which was deposited during MIS 9-8 according to the model of Bridgland (1994) . Where recorded, the artefacts seem to be lying on the surface of this gravel (Brown 1887, 1895), which has led to the suggestion that they are likely to date to the end of MIS 8 or early MIS 7, after the down-cutting of the river to the level of the Taplow Terrace aggradation. It is notable that there are only 11 Levallois artefacts recorded as being found in areas mapped as Taplow Terrace, but in most cases the context is not clear.

By contrast, in the Lower Thames the only significant Levallois assemblage associated with the Corbett's Tey Gravel (equivalent to the Lynch Hill Gravel in the Middle Thames) is that described as 'proto-Levallois' from the Botany Pit, Purfleet (White and Ashton 2003). However, there are several major Levallois sites that come from sediments that have been attributed to the later Taplow/Mucking Gravel (Bridgland 1994). These include Baker's Hole/Ebbsfleet (Wenban-Smith 1995; Scott *et al.* submitted), West Thurrock (Schreve *et al*. 2006) and Crayford. Ebbsfleet and West Thurrock have been attributed to late MIS 8 or early MIS 7. There is more disagreement about the dating of Crayford where the mix of cold and warm-adapted mammalian fauna has led to suggestions of a late MIS 7 or early MIS 6 date (Currant 1986; Schreve 2001), whereas its stratigraphic position has led to the interpretation of an early MIS 7 age (Bridgland 1994). However, the mammalian fauna is clearly derived from several contexts and cannot be used to assign an age to the site. Better clues are provided by the molluscan fauna, which has shells of *Corbicula fluminalis* recovered in life position from sediments associated with and above the artefact assemblage (Kennard 1944). A temperate episode within MIS 7 therefore seems more plausible.

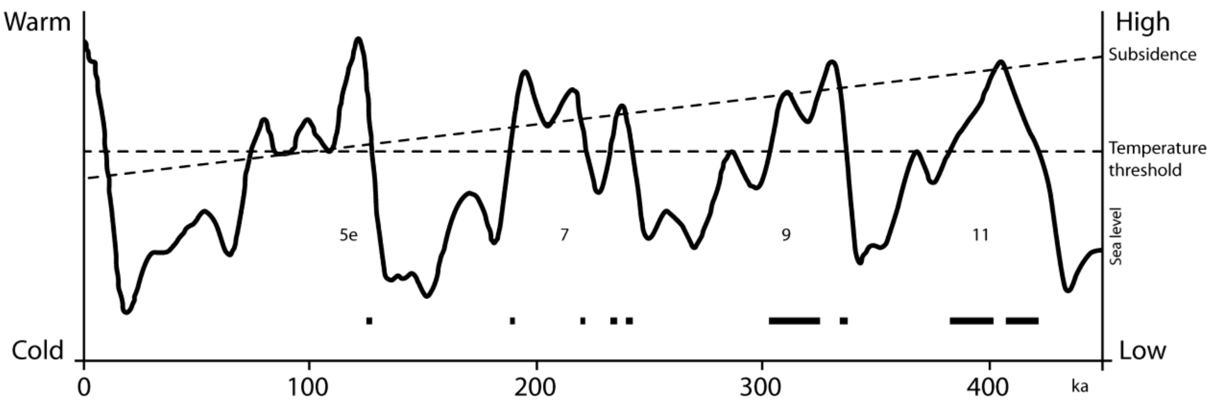
Therefore in the Thames there is no convincing evidence for human occupation from after early MIS 7. Elsewhere in Britain there is also a lack of sites that can be firmly attributed to later in MIS 7 or MIS 6. The small lithic assemblages from the sites of Aveley, Stoke Tunnel/Maidenhall and Selsey have all been suggested to date to late MIS 7 on the basis of the associated open-landscape mammalian fauna (Schreve 2001). However, a similar open-landscape fauna is associated with the Levallois archaeology at Ebbsfleet which on stratigraphic and aminostratigraphic grounds is attributable to early MIS 7 (Scott *et al*. in press). A more plausible exception is the cave site of Pontnewydd, where TL and U-series dating suggest a minimum age of 220 ka for the handaxes and associated Levallois archaeology. The cool-adapted fauna probably suggests a date in substage MIS 7b (Green 1984; Aldhouse-Green 1995). There are no other major assemblages with secure dating.

This record has been compared to that from north-west Europe (Ashton and Scott submitted). Here the pattern is very different with sites spanning the entire period from MIS 8 through to MIS 5e and later. A selection of the key assemblages are the probable MIS 8 sites of Mesvin IV, Belgium (Ryssaert 2006) and Gentelles (Tuffreau *et al*. 1999) and the late MIS 8 and MIS 7 sites of Le Pucheuil (Series A/C), France (Ropars *et al*. 1996), Maastricht-Belvedere, Netherlands (Roebroeks 1985) and Tourville-la-Rivière, France (Guilbaud and Carpentier 1995). Sites that have been attributed to late MIS 7 through to MIS 6 include Biache, France (Tuffreau and Sommé 1988), Therdonne, France (Locht *et al*. 2000) and La Cotte de St. Brelade, Jersey, (Callow and Cornford 1986), while MIS 5e occupation is demonstrated by the site of Caours (Antoine *et al.* 2006)

Several explanations have been put forward for the apparent decline in sites and artefact numbers from Britain. The first was posited by Ashton (2002) who suggested that Neanderthal populations were progressively becoming adapted to and part of the biota of the mammoth-steppe, and that it was only when this type of environment expanded into western Europe that sites are evident. There is good evidence to support Neanderthal adaptation to open, often cool, environments and the increased specialisation in hunting (e.g. Gamble 1995; Gaudzinski 1996, 1999; Gaudzinski and Roebroeks 2000), but the data from north-west Europe indicates that this explanation cannot account for the decline of artefacts in Britain. The north-west European data also provides problems for other explanations. This includes the idea that it is the shortage of lithic raw material later on in MIS 7 in Britain caused by finer-grained sedimentation covering the lithic resources and therefore more economic use of the raw material (White *et al.* 2006). However, if this was the case, why was the same problem not encountered in the very similar landscapes of northern France, Belgium and the Netherlands. A further explanation has been that during the Middle Palaeolithic human mobility increased with broader landscape use and that this is reflected in increased transport and more dispersed discard patterns of Levallois technology (White *et al.* 2006; Scott 2006; see also Geneste 1985; Féblot-Augustins 1999). This again would have an affect on the rate of artefact accumulation in the river valleys. This explanation for lower artefact numbers in Britain again does not tally well with the evidence from north-west Europe.

Although these factors might have contributed to the archaeological record, they do not explain the marked difference between the records from Britain and mainland Europe. A different explanation, which accommodates the European data, lies in the changing palaeogeography of Britain. It is now widely accepted that Britain first became an island when British and Scandinavian ice blocked the North Sea Basin creating a pro-glacial lake that forced its way through the Chalk of the Weald-Artois Anticline (Smith 1985). It was also widely accepted that this occurred at the end of MIS 12 (Gibbard 1995), although an MIS 6 breach was put forward on the basis of molluscan evidence by Meijer and Preece (1995). Ashton (2002; Ashton and Lewis 2002) also suggested a later breach on the basis of the apparent absence of humans in MIS 5e. Since then there has been growing evidence of a major breach and 'mega-flood' in MIS 12, but also a second mega-flood perhaps in MIS 6 (Gupta *et al.* 2007; Gibbard 2007; Toucanne *et al*. 2009). Gibbard has suggested that a similar mechanism was involved at this time, but that the pro-glacial lake was perhaps dammed against pre-existing glacial moraines in the North Sea basin. These events certainly explain the difficulty of crossing from mainland Europe to Britain in the area of the Channel after MIS 12 with perhaps increased difficulties after MIS 6, but consideration also needs to be given to the lowering of the southern North Sea Basin through both subsidence and erosion (Busschers *et al.* 2008).

It seems evident that the floor of the southern North Sea Basin must have been close to the height of present-day sea-level during MIS 11. This is clear from the records at Swanscombe, Clacton and Tillingham (Roe 2001; Preece and Penkman 2005; Ashton *et al.* 2008) where a slight fall in sea-level during fully temperate climate led to a reconnection of the Thames and north-west European rivers and allowed molluscan faunas from these rivers to colonise the Thames river system, creating the distinctive 'Rhenish fauna' (Kerney 1971). It is apparent from this data that large areas of the floor of the southern North Sea basin would have been dry land for much of MIS 11, allowing easy access to Britain.



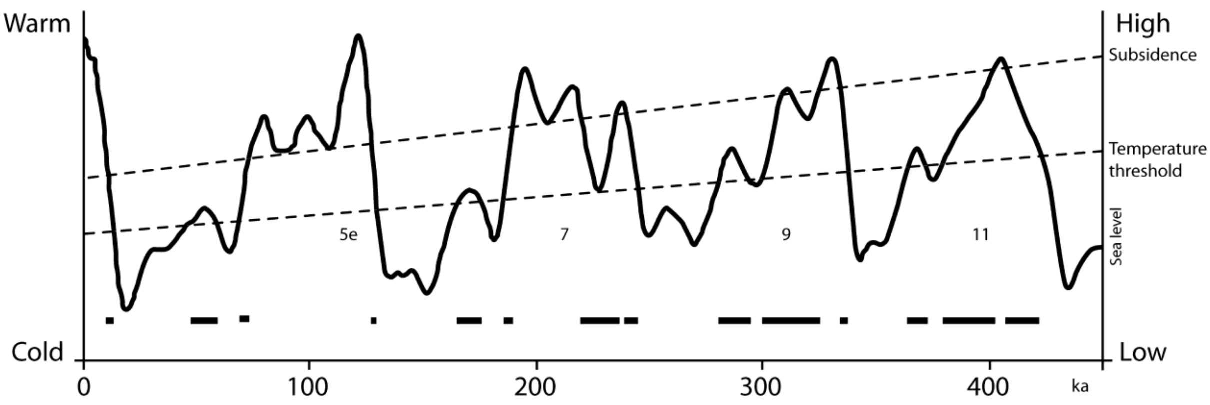


Figure 1. Models of how the human colonisation of Britain from mainland Europe may have been affected by the constraints of the temperature tolerance of humans and the subsidence of the North Sea Basin. The marine isotope curve is based on Specmap (Imbrie, J., et al, 1990). The lines of subsidence and temperature threshold are shown as examples of how these two parameters might affect colonisation. a) assumes a constant temperature threshold through time, and b) assumes that human tolerance for cold improves through time. The best opportunities for colonisation are shown by the horizontal bars at the base of each figure and are defined by parts of the marine isotope curve that occur between the two parameters.

However, subsidence and erosion of the North Sea Basin (Busschers *et al.* 2008) has resulted in depths of up to 40m today. Access to Britain was therefore controlled by progressive lowering of the floor of the basin over time and by climatically-driven lowering of sea-level. As a consequence in MIS 9 only a comparatively small drop in sea-level would have been needed to open up the North Sea Basin, whereas in MIS 7 a more significant drop would have been required. By MIS 5e the floor of the North Sea basin was probably approaching modern depths, and therefore without a major sea-level drop, access across the basin would have been difficult. Is this increased difficulty of getting to Britain across the North Sea Basin reflected therefore in the suggested decline in population from MIS 11?

A model can be constructed of the possible effect this might have on human access to Britain over time using the Specmap marine isotope curve (Figure 1). The figure is constructed using the interpretation that the floor of the North Sea basin has dropped from 0 to -40mOD since MIS 11. Although assumptions are made concerning the constant rate of subsidence and the minimum temperatures for human survival, the model does provide a mechanism for investigating their effects. With the assumption that technology did not change and therefore that there was no change in human ability to cope with cold conditions or sea-faring capabilities, it can be seen that there were fewer opportunities for gaining access to Britain after MIS 11, and virtually none after early MIS 7. The model can be altered slightly to account for possible technological improvements in clothing, shelter and control of fire, so that lower temperatures are increasingly tolerated through time. These adjustments show that opportunities for access to Britain would appear to reflect the archaeological pattern not only for the later Middle Pleistocene, but also for the Upper Pleistocene. If this model is correct, then it indicates that access to Britain was difficult between late MIS 7 and late MIS 4, but that there were opportunities for easier colonisation during MIS 3.

There are hints that colonisation during late MIS 8 and earlier MIS 7 might have stemmed from different sources. It is suggested in Ashton and Scott (submitted) that both in western Britain and north-west France, assemblages contain significant quantities of handaxes, compared to the assemblages from south-east England, northern France, Belgium and the Netherlands which only contain Levallois. It is further suggested that there may have been two major routeways into Britain, one by crossing the Channel river and into southern England by it's tributary the Solent river, the other by an eastern route via the Thames. Currently the evidence for this is slim, but it is a pattern that needs to be investigated in the future.

Conclusions

North-west Europe provides one of the richest archaeological records to examine questions about the habitats used by humans during the late Middle Pleistocene at the known limits of their range. Due to the succession of climatic cycles questions can also be asked about the nature of depopulation and subsequent recolonisation. The record from Britain forms a unique case study within the region due to its changing geographical status as a peninsular and island of Europe. The large water bodies of the North Sea and the English Channel can be viewed as filters to occupation. As such, the record from Britain has the potential to isolate distinct colonisation events. It also holds the potential to examine the technological ability of early humans in overcoming large sea barriers.

The foregoing papers have begun to answer some of these questions. It is now clear that humans occupied a range of vegetational and climatic habitats in areas of both deciduous and coniferous forest and at times surviving winter temperatures significantly cooler than Britain today. A common link between these different habitats is the human association with locally open conditions, particularly marked by the occupation of open river valley locations. Modern analogues for these locations are probably lacking due to the differences in the large mammal faunas. All the large herbivores are likely to have been destructive elements in these landscapes and kept open large areas, particularly in the river valleys and other significant bodies of water. The challenge for the future is a better understanding of how humans adapted to the cooler boreal environments. Seasonal movement and physical adaptation perhaps played a role, but are also difficult to ascertain from the archaeological record. In contrast, technological innovation can be identified and understanding of this should be a focus of research in the future. A further challenge is understanding the nature of colonisation in being able to distinguish between pioneering populations and groups with more sustained occupation (Roebroeks 2006).

A better understanding of the island status of Britain provides the opportunity to address very specific questions. In terms of the large sea barriers, changes in palaeogeography appear to have become a major factor in human colonisation by late MIS 7. Although Britain was undoubtedly a part of mainland Europe during MIS 6, occupation was hindered by extreme cold. The apparent absence of humans during MIS 5e probably relates to the very rapid rise of sea-level at the end of MIS 6 and the lack of potential colonising populations in mainland Europe. It seems likely that the first evidence of the re-appearance of humans at the end of MIS 4 at sites such as Lynford (Boismier 2003) relates either to significant improvements in technology or an increase in seasonal movement, which itself demands important changes in technology, social organisation and behaviour.

Britain is also an arena where individual human groups can be studied. In the Late Middle Palaeolithic and Upper Palaeolithic due to the resolution of recent radiocarbon dating it now seems possible to isolate specific colonisation events (Jacobi *et al*. 2006; Jacobi 2007). With increasing understanding of the late Middle Pleistocene chronology, in particular the progressive isolation from mainland Europe, future work should be able to focus on distinct population movements into and out of Britain, and how this relates to changes in technology and more generally in material culture. Although presently far from clear, is the phenomenon of the Clactonian simply a matter of an early incursion of humans without handaxe technology entering Britain in early MIS 11, as suggested by White and Schreve (2000)? If correct, similar population movements ought to be discernable in the British record. If the models put forward in the foregoing papers are correct, then such population movements should be increasingly more recognisable through time. Furthermore, distinct routes into Britain from different areas of Europe might be discernable, as suggested for the Early Middle Palaeolithic in the contrast between the sites apparently dominated by handaxe technology in the west and those composed of Levallois technology in the east.

Many of the research agendas for the future are very clear, and it is remarkable how over the past 20 years, new sites in north-west Europe, coupled with better resolution of the chronology have provided improved understanding and generated new research questions. It is also now clear how detailed lithic analyses and behavioural studies can be integrated with environmental and palaeogeographic data to understand better the large-scale questions of our early human past.

References

Aldhouse Green, S. 1995. Pontnewydd Cave, Wales, a later Middle Pleistocene hominid and archaeological site: a review of stratigraphy, dating, taphonomy and interpretation. In J.M. Bermudez, J.L. Asuarga and E. Carbonell (eds) *Human Evolution in Europe and the Atapuerca Evidence*. Junta de Castilla y León. pp. 37-55.

Allen, L.G. and Gibbard, P.L. 1993. Pleistocene evolution of the Solent River of southern England. *Quaternary Science Reviews* 12, 503-528.

Antoine, P., Limondin-Lozouet, N., Auguste, P., Locht, J-L., Galheb, B., Reyss, J-L., Escudé, E., Carbonel, P., Mercier, N., Bahain, J-J. Falguères, C. and Voinchet, P. 2006. Le tuf de Caours (Somme, France) : mise en évidence d'une séquence eemienne et d'un site paléolithique associé, *Quaternaire* 17(4).

Ashton, N.M. 2002. Absence of humans in Britain during the last interglacial (Oxygen Isotope Stage 5e). In A. Tuffreau and W. Roebroeks (Eds). *Le Dernier Interglaciaire et les Occupations Humaines du Paléolithique Moyen*. Lille: Publications du CERP. 93-103.

Ashton, N.M., Cook, J. Lewis, S.G. and Rose, J. (eds) 1992. *High Lodge: Excavationsby G. de G. Sieveking 1962-68 and J. Cook 1988.* London: British Museum Press.

Ashton, N.M. and Hosfield, R. 2009. Mapping the human record in the British early Palaeolithic: evidence from the Solent River system. *Journal of Quaternary Science* doi 10.1002/jqs.1350.

Ashton, N. and Lewis, S. 2002. Deserted Britain: declining populations in the British late Middle Pleistocene. *Antiquity* 76, 388-396.

Ashton, N.M., Jacobi, R.M. and White, M. 2003. The dating of Levallois sites in west London. *Quaternary Newsletter* 99, 25-32.

Ashton, N.M., Lewis, S.G. and Parfitt, S.A. (eds) 1998. *Excavations at Barnham 1989-94.* London: British Museum Occasional Paper 125.

Ashton, N.M., Lewis, S.G., Parfitt, S.A., Penkman, K.E.H. and Coope, G.R. 2008. New evidence for complex climate change in MIS 11 from Hoxne, UK. *Quaternary Science Reviews* 27, 652–668

Ashton, N.M., Lewis, S.G., Parfitt, S.A., White, M., 2006. Riparian landscapes and human habitat preferences during the Hoxnian (MIS 11) Interglacial. *Journal of Quaternary Science* 21, 497–505.

Ashton, N.M. and Scott, B. submitted to *Bulletin de la Société Préhistorique Française* Dec 2008. The relationship between Britain and mainland Europe during the early Middle Palaeolithic (MIS 8-6)

de Beaulieu, J.-L., Andrieu-Ponel, V., Reille, M., Grüger, E., Tzedakis, C., Svobodova, H. 2001. An attempt at correlation between the Velay sequence and the Middle Pleistocene stratigraphy from central Europe. Quaternary Science Reviews 20, 1593-1602.

Boismier, W.A. 2003. A Middle Palaeolithic site at Lynford Quarry, Mundford, Norfolk: Interim Statement. *Proceedings of the Prehistoric Society* 69, 315-324.

Boreham, S. and Gibbard, P.L. 1995. Middle Pleistocene Hoxnian Stage deposits at Hitchin, Hertfordshire. *Proceedings of the Geologists' Association* 106, 259-270.

Bradley, B. and Sampson, C.G. 1978. In C.G. Sampson (ed.) *Paleoecology and Archaeology of an Acheulian Site at Caddington, England*. Dallas: Department of Anthropology, Southern Methodist University. 83-137.

Briant, R.M., Bates, M.R., Schwenninger, J-L. and Wenban-Smith, F. 2006. An optically stimulated luminescence dated Middle to Late Pleistocene fluvial sequence from the western Solent Basin, southern England. *Journal of Quaternary Science* 21(5), 507-523.

Bridgland, D.R. 1994. *The Quaternary of the Thames*. London: Chapman and Hall.

Brown,, J.A. 1887. *Palaeolithic Man in North West Middlesex*. London: Macmillan.

Brown, A.J. 1995. Notes on the high-level River Drift between Hanwell and Iver. *Proceedings of the Geologists' Association* 14, 153-173.

Busschers, F.S., van Balen, R.T., Cohen, K.M., Kasse, C., Weerts, H.J.T., Wallinga, J. and Bunnik F.P.M. 2008. Response of the Rhine-Meuse fluvial system to Saalian ice-sheet dynamics. *Boreas* **37:** 377–398.

Callow, P. and Cornford, J.M. 1986. *La Cotte de St. Brelade, 1961-1978: Excavations by CBM McBurney*. Norwich: Geobooks.

Coope, G.R. 2006. Insect faunas associated with Palaeolithic industries from five sites of pre-Anglian age in central England). *Quaternary Science Reviews* 25, 1738-1754.

Currant, A.P. 1986. Man and Quaternary interglacial faunas of Britain. In S.N. Collcutt (ed.) *The Palaeolithic of Britain and its nearest neighbours.* Sheffield: University of Sheffield. 50-52.

Evans, J., Morse, E., Reid, C., Ridley, E.P. and Ridley, H.N. 1896. The relation of Palaeolithic man to the glacial epoch. *Report of the British Association*, *Liverpool*. 400–416.

Feblot-Augustins J. 1999. Raw material transport patterns and settlement systems in the European Lower and Middle Palaeolithic: continuity, change and variability. In *The Middle Palaeolithic Occupation of Europe,* Roebroeks W, Gamble C (eds). Leiden: University of Leiden. 193–214.

Gamble, C.S. 1995. The earliest occupation of Europe: the environmental background. In W. Roebroeks and T. van Kolfschoten (eds), *The Earliest Occupation of Europe*. Leiden: University of Leiden. 279-295.

Gaudzinski, S. 1996. On bovid assemblages and their consequences for the knowledge of subsistence patterns in the Middle Palaeolithic. *Proceedings of the Prehistoric Society* 62:19-39.

Gaudzinski, S. 1999. On the variability of Middle Palaeolithic procurement tactics: the case of Salzgitter Lebestedt, Northern Germany. *International Journal of Osteoarchaeology* 10:396-406.

Gaudzinski, S. and Roebroeks, W. 2000. Adults only. Reindeer hunting at the Middle Palaeolithic site of Salzgitter-Lebenstedt, Northern Germany. *Journal of Human Evolution* 38, 497-521.

Geneste JM. 1985. Analyse lithique des industries Moustériennes du Périgord: une approche technologique du comportement des groups au Paléolithique moyen. Thesis, Université de Bordeaux.

Gibbard, P.L. 1995. The formation of the Strait of Dover. In R.C. Preece (ed.) *Island Britain: a Quaternary Perspective*. London: Geological Society Special Publication 96. 15-26.

Gibbard, P.L. 2007. Palaeogeography: Europe cut adrift. *Nature* 448, 259-260.

Green, H.S. 1984. *Pontnewydd Cave; A Lower Palaeolithic Hominid Site in Wales*. Cardiff: National Museum of Wales.

Grün, R. and Schwarcz, H.P. 2000. Revised open system U-series/ESR age calculations for teeth from Stratum C at the Hoxnian Interglacial type locality, England. *Quaternary Science Reviews* 19, 1151-1154.

Guilbaud, M. and Carpentier, G. 1995. Un remontage exceptionnel à Tourville-la-Rivière(Seine-Maritime). *Bulletin de la Société Préhistorique Française* 92:289-295.

Gupta, S., Collier, J.S., Palmer-Felgate, A. and Potter, G. 2007. Catastrophic flooding origin of shelf valley systems in the English Channel. *Nature* 448, 342-345

Hosfield, R.T. 2001. The Lower Palaeolithic of the Solent: 'site' formation and interpretive frameworks. In F.F. Wenban-Smith and R.T. Hosfield (eds). *Palaeolithic Archaeology of the Solent River*. Southampton: Lithic Studies Occasional Paper No. 7. 85-97.

Hosfield, R.T. 2005. Individuals among palimpsest data. Fluvial landscapes in southern England. In C.B. Gamble and M. Porr (eds) *The Hominid Individual in Context*. Routledge, London. 220-243.

Imbrie, J., McIntyre, A. and Mix, A.C. 1990. Oceanic Response to Orbital Forcing in the Late Quaternary: Observational and Experimental Strategies. In A. Berger, S.H. Schneider and J.-C. Duplessy (eds) *Climate and Geosciences, A Challenge for Science and Society in the 21st Century*. D. Reidel Publishing Company.

Jacobi, R.M. 2007. A collection of Early Upper Palaeolithic artifacts from Beedings, near Pulborough, West Sussex and the context of similar finds from the British Isles. *Proceedings of the Prehistoric Society* 73, 229-325.

Jacobi, R.M., Higham, T.F.C, Bronk-Ramsey, C. 2006. AMS radiocarbon dating of Middle and Upper Palaeolithic bone in the British Isles: improved reliability using ultrafiltration. *Journal of Quaternary Science* 21(5), 557-573.

Kennard, A.S. 1944. The Crayford Brickearths. *Proceedings of the Geologists' Association* 55, 121-169.

Kerney, M.R. 1971. Interglacial deposits at Barnfield Pit, Swanscombe, and their molluscan fauna. *Quarterly Journal of the Geological Society of London* 127, 69-93.

Kolfschoten, T. van. 1993. Die Vertebraten des Interglazials von Schöningen 12B. *Ethnographisch-Archäologische Zeitschrift* 34, 623–628.

Layard, N.F. 1904. Further excavations on a Palaeolithic site in Ipswich. *Journal of the Royal Anthropological Institute* 34, 306–310.

Layard, N.F. 1906. A winter's work on the Ipswich Palaeolithic site. *Journal of the Royal Anthropological Institute* 36, 233–236.

Locht, J-L., Guerlin, O., Antoine, P. and Debenham, N. 2000. *Therdonne. "Le Mont de Bourguillemont"*. SRA Picardie 5

McNabb, J. 2007. *The British Lower Palaeolithic: Stones in Contention*. London: Routledge.

Meijer, T. and Preece, R.C. 1995. Malacological evidence for insularity of the British Isles during the Quaternary. In R.C. Preece (ed.) *Island Britain: A Quaternary Perspective*. Geological Society Special Publication No. 96. London: The Geological Society. 89-110.

Mullenders, W.W., 1993. New palynological studies at Hoxne. In R. Singer, B.G. Gladfelter and J.J. Wymer (eds.), *The Lower Paleolithic Site at Hoxne, England*. Chicago: University of Chicago Press. 150–155.

Nitychoruk, J., Bińka, K., Hoefs, J., Ruppert, H. and Schneider, J., 2005. Climate reconstruction for the Holsteinian Interglacial in eastern Poland and its comparison with isotopic data from Marine Isotope Stage 11. *Quaternary Science Reviews* 24, 631–644

Parfitt, S., 1998. The interglacial mammalian fauna from Barnham. In N.M. Ashton, S.G. Lewis and S.A. Parfitt, S. (eds), *Excavations at the Lower Palaeolithic site at East Farm, Barnham, Suffolk 1989–94.* London: British Museum Press. 111–147.

Paterson, T.T. and Fagg, B.E.B. 1940. Studies on the Palaeolithic succession in England No. II. The Upper Brecklandian Acheul (Elveden). *Proceedings of the Prehistoric Society* 6, 1-29.
Preece, R.C., Gowlett, J.A.J., Parfitt, S.A., Bridgland, D.R. & Lewis, S.G. 2006. Humans in the Hoxnian: habitat, context and fire use at Beeches Pit, West Stow, Suffolk, UK. *Journal of Quaternary Science* 21(5), 485-496.
Preece, R.C., Parfitt, S.A., Bridgland, D.R., Lewis, S.G., Rowe, P.J., Atkinson, T.C. Candy, I., Debenham, N.C., Penkman, K.E.H., Rhodes, E.J., Schwenninger, J-L., Griffiths, H.I., Whittaker, J.E., and Gleed-Owen, C. 2007. Terrestrial environments during MIS 11: evidence from the Palaeolithic site at West Stow, Suffolk, UK. *Quaternary Science Reviews* 26, 1236-1300.
Preece, R.C. and Penkman, K.E.H. 2005. New faunal analyses and amino acid dating of the Lower Palaeolithic site at East Farm, Barnham, Suffolk. *Proceedings of the Geologists' Association* 116, 363–377.
Reid, C. 1897. The Palaeolithic deposits at Hitchin and their relation to the glacial epoch. *Proceedings of the Royal Society of London* 61, 40-49.
Reille, M., de Beaulieu, J.-L. 1995. Long Pleistocene pollen records from the Praclaux Crater, south-central France. Quaternary Research 44, 205-215.
Roberts, M.B. and Parfitt, S.A. 1999. *Boxgrove. A Middle Pleistocene Hominid Site at Eartham Quarry, Boxgrove, West Sussex*. London: English Heritage.
Roe, H.M., 2001. The Late Middle Pleistocene biostratigraphy of the Thames Valley, England: new data from eastern Essex. *Quaternary Science Reviews* 20, 1603–1619.
Roebroeks, W. 1985. Archaeological Research at the Maastricht-Belvédere Pit: A Review. *Mededlingen Rijks Geologische Dienst* 39, 109–118.
Roebroeks, W. 2006. The human colonisation of Europe. Where are we? *Journal of Quaternary Science* 21(5), 425-435.
Ropars, A., Billard, C. and Delagnes, A. 1996. 2.1 Présentation généerale de l'opération et des données archéologiques. In: Delagnes A, Ropars A, (eds). *Paléolithique moyen en pays de Caux (Haute-Normandie)*. Éditions de la Maison des Sciences de l'Homme: Paris; 28-49.
Ryssaert, C. 2006. Lithische technologie te Mesvin IV: selecticriteria voor geretoucheerde werktuigen en hum relatie met Levalloiseinproducten. *Anthropologica et Praehistorica* 117, 13-34.
Schreve, D.C., 2001. Differentiation of the British late Middle Pleistocene interglacials: the evidence from mammalian biostratigraphy. *Quaternary Science Reviews* 20, 1693–1705.
Schreve, D.C., Harding, P., White, M.J., Bridgland, D.R., Allen, P., Clayton, F. and Keen, D.H. 2006. A Levallois knapping site at West Thurrock, Lower Thames, UK: its Quaternary context, environment and age. *Proceedings of the Prehistoric Society* 72, 21-52.
Scott, R. 2006. *The Early Middle Palaeolithic of Britain; Origins, Technology and Landscape*. Unpublished Ph.D. Thesis, University of Durham.
Scott, B, Ashton, N.M., Penkman, K., Preece, R. and White, M. in press. The position and context of Middle Palaeolithic industries from the Ebbsfleet Valley, Kent, UK. *Journal of Quaternary Science*
Singer, R., Gladfelter, B.G. and Wymer, J.J. (eds) 1993. *The Lower Paleolithic Site at Hoxne, England.* Chicago: University of Chicago Press.
Smith, A.J. 1985. A catastrophic origin for the palaeovalley system of the eastern English Channel. *Marine Geology* 64, 65-75.
Stuart, A.J., Wolff, R.G., Lister, A.M., Singer, R. and Egginton, J.M., 1993. Fossil vertebrates. In R. Singer, B.G. Gladfelter and J.J. Wymer (eds.), *The Lower Paleolithic Site at Hoxne, England*. Chicago: University of Chicago Press. 163–206.
Thieme, H. 1997. Lower Palaeolithic hunting spears from Germany. *Nature* 385, 807-810.
Toucanne, S., Zaragosi, S., Bourillet, J.F., Cremer, M., Eynaud, F., Van Vliet-Lanoe, B., Penaud, A., Fontanier, C., Turon, J.L., Cortijo, E. and Gibbard, P.L. 2009. Timing of massive 'Fleuve Manche' discharges over the last 350 kyr: insights into the European ice-sheet oscillations and the European drainage network from MIS 10 to 2. *Quaternary Science Reviews* 28, 1238-1256.
Tuffreau, A., and Sommé, J. (eds) 1988. *Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais)*. Mémoires de la Société Préhistorique Française.
Tuffreau, A., Antoine, P., Marcy, J-L. and Segard, N. 1999. Les industries paléolithiques à nombreux bifaces du Mont de l'Evangile à Gentelles (Somme). *Les industries à outils bifaciaux du Paléolithique moyen dEurope occidentale.-Actes de la table-ronde internationale organisée à Caen (Basse-Normandie, France)–14 et* 15, 29-43.
Turner, C. 1970. Middle Pleistocene deposits at Marks Tey, Essex. *Philosophical Transactions of the Royal Society of London* B 257, 373–437.
Turner, C. 1973. Elveden, TL 809804, Warren Wood brick-pit. In J. Rose and C. Turner (eds), *Clacton. Field Guide*. Cambridge: Quaternary Research Association.
Turner, C. and West, R. 1994. Mixed signals from Hoxne. Review of Singer *et al.* The Lower Paleolithic site at Hoxne, England. *Antiquity* 68, 870–873.
Urban, B., 2007. Interglacial pollen records from Scho¨ ningen, north Germany. In: F. Sirocko, T. Litt, M. Claussen and M.F. Sanchez-Goni (eds), *The Climate of Past Interglacials*. New York: Springer. 417–444.
Wenban-Smith FF. 1995. The Ebbsfleet Valley, Northfleet (Baker's Hole). In: Bridgland DR, Allen P, Haggart BA, (eds). *The Quaternary of the Lower Reaches of the Thames*. Durham: Quaternary Research Association. 147-164.

Wessex Archaeology 1993. *The Southern Rivers Palaeolithic Project Report No. 1. 1991-1992, The Upper Thames Valley, the Kennet Valley and the Solent Drainage System*. Salisbury: Wessex Archaeology.

Wessex Archaeology 1996. *The English Rivers Palaeolithic Project. Regions 7 and 10: North of Thames and Warwickshire Avon*. Salisbury: Wessex Archaeology.

Westaway, R., Bridgland, D.R. and White M.J. 2006. The Quaternary uplift history of central southern England: evidence from the terraces of the Solent River system and nearby raised beaches. *Quaternary Science Reviews* 25, 2212-2250.

West, R.G. 1956. The Quaternary deposits at Hoxne, Suffolk. *Philosophical Transactions of the Royal Society of London* B 239, 265–356.

West, R.G. and McBurney, C.M.B., 1954. The Quaternary deposits at Hoxne, Suffolk and their archaeology. *Proceedings of the Prehistoric Society* 20, 131–154

White, M.J. 2006. Things to do in Doggerland When You're Dead: Surviving OIS 3 at the northwestern-most fringe of Middle Palaeolithic Europe. *World Archaeology* 38 (4): 54

White, M.J. and Ashton, N.M., 2003. Lower Palaeolithic core technology and the origins of the Levallois method in north-western Europe. *Current Anthropology* 44, 598–609.

White, M.J., Lewis, S.G. and McNabb, J. 1999. Excavations at the Lower Palaeolithic site of Whipsnade, Bedfordshire 1992-1994. *Proceedings of the Geologists' Association* 110, 241-255.

White, M..J. and Plunkett, S. 2005. *Miss Layard Excavates: the Palaeolithic Site at Foxhall Road, Ipswich, 1903-1905*. Bristol: WASP.

White, M. and Schreve, D. 2000. Island Britain – peninsula Britain: palaeogeography, colonisation, and the Lower Palaeolithic settlement of the British Isles. *Proceedings of the Prehistoric Society* 66, 1-28.

White, M.J., Scott, B. and Ashton, N.M. 2006. The Early Middle Palaeolithic in Britain: archaeology, settlement history and human behaviour. *Journal of Quaternary Science* 21(5), 525-541.

Wymer, J.J. 1999. *The Lower Palaeolithic Occupation of Britain*. Salisbury: Wessex Archaeology.