The British
Palaeolithic
Human Societies at the Edge of the Pleistocene World

Paul Pettitt and Mark White

The British Palaeolithic

The British Palaeolithic provides the first academic synthesis of the entire British Palaeolithic, from the earliest occupation (currently understood to be around 980,000 years ago) to the end of the Ice Age. Landscape and ecology form the canvas for an explicitly interpretative approach aimed at understanding how different hominin societies addressed the issues of life at the edge of the Pleistocene world.

Commencing with a consideration of the earliest hominin settlement of Europe, the book goes on to examine the behavioural, cultural and adaptive repertoires of the first human occupants of Britain from an ecological perspective. These themes flow throughout the book as it explores subsequent occupational pulses across more than half a million years of Pleistocene prehistory, which saw *Homo heidelbergensis*, the Neanderthals and ultimately *Homo sapiens* walk these shores.

The British Palaeolithic fills a major gap in teaching resources as well as in research by providing a current synthesis of the latest research on the period. This book represents the culmination of 40 years combined research in this area by two well-known experts in the field, and is an important new text for students of British archaeology as well as for students and researchers of the continental Palaeolithic period.

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Hominin societies at the edge of the Pleistocene world

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One million years of the British Pleistocene

GREATER LONDON, NEARLY 12,000 YEARS AGO

At this point the waters of the Colne River ran through a wide floodplain, cutting a gravelly route due south towards its confluence with the mighty Thames barely 15 km downstream. The lower slopes leading to the river allowed access to the waters, to the flint and chert nodules glinting in its shallows that sufficed for knapping, and to fording points that could be used to trap fish and disadvantage prey in the hunt. The patchy stands of pine trees provided wood for fuel and for replenishing the hafts and shafts of tools and weapons. After several months of snow the region was greening up; although it was still cold, reindeer were passing through in number on the way to their spring calving grounds and, here and there, small herds of wild horse grazed on the grassy tundra. From the high ground above this place their numbers could be seen for a great distance across the floodplain and their movements studied. The familiar path of the Thames and Colne – preserved as folk knowledge despite infrequent visits to this edge of the world – had guided these people here.

They were present in small numbers – a task group you could count on one hand – charged with monitoring the reindeers' movements and beginning the hunt that would provide meat and fat, antler for tools and calfskin and sinew for clothing. A few days in the area should provide enough to take back to the remainder of the small band left behind where the two rivers meet. The day's hunt had been a success; an adult reindeer had been killed at the ford just downstream; its legs had been removed and carried to this place, a low slope overlooking the river. Fish traps set at this place had produced a freshwater fish and fallen pine wood had been gathered to set a hearth against the growing afternoon chill. While there was still enough light each person set to their tasks, huddling as close as they could to the hearth to benefit from its heat. Sometimes they sat,

sometimes they stood, each preoccupied with swiftly and efficiently executing the tasks on which they were dependent. When the hearth had been lit, two wiped dry the nodules of flint they had selected from the chilly waters and knapped them. After removing the chalky cortex they skilfully produced a small series of long, regular blades, using time-honoured techniques to shape the cores and control the flakes and blades knapped from them. Some of these were passed on to the two members busy with completing the dissection of the reindeer legs. In addition to the sinew, meat and marrow the foot-pads of the animal would be saved to make boot soles. A fifth individual – the last – set to descaling the fish for immediate consumption. After eating, as night fell, the group would set to repairing their javelins and nets before retiring under lightweight bivouacs tethered to the pines. Tomorrow they would rejoin their band, paddling downriver in the skin boats drawn up out of the water and now packed with reindeer antler and meat carefully wrapped in skins. They would leave offerings to placate the waters and the spirits of this place, ensuring a successful return next year, set their paddles in the water, and take one last look back before setting their minds on the brief journey south.

They would never return. They could not know it but their world was coming to an end. Soon, the reindeer and horse would be gone from here, and the grasslands would give way to woodland and forest. First, the boreal woodlands would thicken; later a thick mat of warmth-loving forest would cover the land. Although their hunter-fisher-gatherer way of life would continue for several thousand years more, the vast open lands that had been home to the large herds and their Palaeolithic predators would be no more. The world of gravelly rivers, hills and plains would disappear.

They could not know, but this little group – one of only several scattered about in this vast and untamed world at the northern edge of humanity's reach – had inherited the legacy of nearly one million years of intermittent visits into this land. Soon, with the reindeer, it would be completely gone.

Hominins stretched to their limits: living on the edge of the Palaeolithic world

The fanciful reconstruction above is based on interpretation of Scatter A at the Terminal Pleistocene/Early Holocene Long Blade Industry site of Three Ways Wharf in Uxbridge, Greater London (see Chapter 8). It has a little of our imagination mixed in for sure but is otherwise based on analyses and interpretations of the site's excavators (Lewis and Rackham 2011). Here, at the Pleistocene/Holocene transition, a small group of terminal Palaeolithic hunter-gatherers camped, leaving several lithic scatters and bones of reindeer and horse. Long Blade Industry sites – which almost certainly are linked to the continental Ahrensburgian culture – are not common in Britain. It seems that there were few people of this cultural attribution in the country – probably for a very brief time – a small and barely perceptible dispersal into a vast landscape during a brief window of opportunity when climate and environment allowed. If we were to go back in time from this point to that of the earliest known hominin dispersal into Britain – currently ~750-980,000 years ago – we would find essentially the same thing; remarkably small groups

of humans, in this case a different species, engaged in similar social and economic tasks registered mainly through their involvement with stones and bones.

Our central aim in this book is a synthesis and interpretation of the entire British Palaeolithic record in terms of the occupation, behaviour and societies of the ancient hominins who once roamed these shores. Several of the elements touched upon in the opening vignette are constant themes in this book. Rivers are critical to Palaeolithic archaeology and their 'fluvial archive' contains by far the richest record of hominin presence. Equally, rivers were central to the lives of Palaeolithic hominins, forming a focus of critical resources (water, plants, animals and stone), as well as conduits for movement through the landscape. Since at least MIS12 the Thames has formed a main route of dispersal into Britain, being connected at times of low sea level to the Rhine–Meuse systems of Europe, while its many tributaries formed a network for incursions into large parts of the country. Prior to MIS12, the erstwhile Bytham River served a similar function.

The landscapes and environments of the Pleistocene are both alien and familiar. As we shall see in later chapters, during the warm interglacials the vegetation of Britain had a remarkably British feel, a mosaic of woodland and grassland in which most of the component species still occur today. The animals that walked this land, though, were often rather exotic, with mammoth, bison, reindeer, and rhinoceros forming key prey species for humans and non-human carnivores such as lion and hyaena. During colder periods, however, Britain was a truly alien place, its geography unrecognisable as low sea levels connected it to Europe across the vast plains of 'Doggerland' (Coles 1998). Ice sheets at times extended as far as the Thames Valley, beyond which existed polar deserts with frozen ground, biting winds and minimal tundra vegetation. During the 'non-analogue' environments of MIS3, though, Britain, like much of northern Europe, formed part of the so-called 'Mammoth-Steppe' (Guthrie 1982), a rich grassland populated by vast herds of megafauna, in which trees were a rare commodity.

Located at the north-western corner of North-western Europe, Britain formed the edge of the hominin range throughout most of the Palaeolithic. 'Here, at the very edge of their range, biological and cultural adaptations were stretched to their limits' (Roebroeks et al. 2011, 113). When combined with the frequency and amplitude of climatic and environmental change, this made Britain a very hard place to live. It is therefore not surprising that for much of the Pleistocene Britain appears to have been unoccupied, or occupied only very briefly by small groups of humans. To paraphrase a geological axiom: the Palaeolithic record of Britain is essentially a long series of hiatuses, interrupted by a few handaxes. While the same may be said of neighbouring regions of Europe, the occupational gaps in Britain are longer and more frequent (Roebroeks et al. 2011). As such, Britain may be considered a population sink, where regular abandonment and/or extirpation necessitated the constant influx of people originating from elsewhere; even during periods of occupation populations may have been reproducing below replacement levels and thus required 'topping-up' from outside. This has had a profound impact on the record we find here.

A VERY BRIEF HISTORY OF TIME: THREE CENTURIES OF PALAEOLITHIC ARCHAEOLOGY IN BRITAIN

This is not a book about the history of Palaeolithic archaeology in Britain. In order that we may present a coherent interpretation of the British Palaeolithic record we do not even seek to integrate discussion of the history of investigation of British Pleistocene deposits into the main text. Where we discuss key sites – usually in boxes – we note the major excavators and phases of investigation but this is not intended to constitute a comprehensive account of the history of the discipline. There are colleagues better suited to undertaking this and, indeed, excellent accounts of the British contribution to the development of Palaeolithic archaeology and of the historical investigation of British sites already exist. The reader is directed in particular to Grayson (1983) and O'Connor (2007) for general accounts contextualised in the wider scientific world; various papers in *Great Prehistorians: 150 Years of Palaeolithic Research, 1859–2009* (Volume 30 of *Lithics: the Journal of the Lithic Studies Society* for 2009) for accounts of specific individuals; Pettitt and White (2011), White and Pettitt (2009), Weston (2008) and particularly Sommer (2007) for discussion of the work of Buckland, MacEnery and their contemporaries in the first half of the nineteenth century; Gamble and Kruszynski 2009 for discussion of the British involvement in the shattering of the 'time barrier' at Amiens and acceptance of deep time in that *annus mirabilis* of 1859; McNabb (1996b, 2007) for the history of Lower Palaeolithic archaeology with particular reference to the Clactonian and Swanscombe; Scott (2010) for the investigation of what came to be defined as the Early Middle Palaeolithic and Campbell (1977) for the Upper Palaeolithic. A very brief survey, is nonetheless warranted.

Britain was central to the development of Palaeolithic archaeology, along with its closest continental neighbours. The absence of an understanding of deep time until the mid-nineteenth century meant, however, that the earliest discoveries of what we now know to be Palaeolithic materials – the handaxes discovered at Gray's Inn Lane, London (1679) and Hoxne, Suffolk (1797) – passed largely unnoticed. Similarly, John MacEnery's discoveries of Middle and Upper Palaeolithic tools stratified under stalagmite floors in association with extinct animals at Kent's Cavern during the early 1820s remained unpublished during his lifetime, largely due to his deference to the 'antediluvian' theories of the Reverend William Buckland, his friend and mentor (White and Pettitt 2009; Pettitt and White 2011). Even Buckland's involvement with the discovery of an Upper Palaeolithic burial, fauna, stone and bone tools at Goat's Hole, Paviland, in 1823 and his excavation of a Pleistocene hyaena den at Kirkdale Cave in 1822, did little to shake his conviction. Although MacEnery's findings were adequately vindicated by the publication of his notes by Edward Vivian in 1845, this came after his and Buckland's death because Buckland's validation – which MacEnery was waiting for – never came (White and Pettitt 2009). The world, it seems, was not ready for such an epochal shift.

This would not occur for another 35 years, and then, sadly, not in Britain. At Amiens, in April 1859, Joseph Prestwich and John Evans gave their seal of approval to Jacques Boucher de Perthes' claims to having found early evidence of humans in association

with the bones of extinct animals. A frenzy of discovery occurred over the decades that followed, during which time several of the 'flagship' British sites were investigated, including the caves of Creswell Crags, Swanscombe on the North Kent terraces of the Thames, the Hyaena Den at Wookey, Gough's Cave in Cheddar, Clacton-on-Sea in Essex, and High Lodge in Suffolk, and more systematic investigations in Kent's Cavern. By the beginning of the twentieth century thousands of new sites and findspots had been identified, most of which still remained undated and poorly understood chronologically. As the number of sites grew, in Britain and especially in France, attempts were made to place some sense of order on the record. The most influential of the resulting chrono-cultural systems was that of Gabriel de Mortillet, who introduced terms such as Acheulean, Mousterian and Magdalenian; still in use today, for better or for worse. Culture history had begun, and from this time dominated British Palaeolithic archaeology until well into the 1960s. Developments during the early decades of the twentieth century also saw the birth of the Clactonian (Chapter 4), the infamous Piltdown hoax and the re-emergence of the pointless eolith debate, with Ray Lancaster and James Reid Moir picking up the reins from Benjamin Harrison and Joseph Prestwich in the quest to prove the existence of 'Tertiary Man' (O'Connor 2007). These latter controversies can be seen in the wider context of the 'scramble' for evidence of the development of humanity. At this time everything was up for grabs; it had not yet been recognised that Africa was the cradle of humanity and, therefore, it seemed plausible that humans may have originated in Europe. The embarrassing forgery of the Piltdown remains – a recent human cranium matched with the mandible of an orang-utan, both chemically stained to appear fossil and teeth filed clumsily to occlude together (Spencer 1991) – fooled scientists of the time but its authenticity had begun to be questioned by the 1950s.

Emphasis on fieldwork has been constant throughout the history of the British Palaeolithic. The large-scale excavation of caves was largely restricted to the nineteenth and early twentieth centuries. Sadly, this too often took the form of wholesale clearing of vast sedimentary deposits, archaeology and palaeontology from which were selectively retained, lost, distributed across the world and rarely published comprehensively. Cave and rockshelter excavations of the latter half of the twentieth century were typically smaller in scale and usually comprised very small trenches, in many cases thankfully, as they remain unpublished: certain British scholars put trenches through critically important deposits in a number of caves and failed to undertake even the most basic analysis and publication. In worst case scenarios we know they excavated in flagship caves such as Kent's Cavern but don't even know the location of their trenches.

By contrast, the monitoring and excavation of productive pits and quarries has profitably continued for the best part of one 150 years. The rate of discovery of archaeological sites in these contexts has diminished over time, as extraction procedures have become increasingly mechanised and urban expansion has made many Pleistocene deposits inaccessible, although these sites continue to provide world-class information. During the second half of the twentieth century, the excavations of John Wymer, Mark Roberts, Francis Wenban-Smith, David Bridgland, Nick Barton, John Gowlett, Danielle Schreve, and the British Museum/AHOB (led by Nick Ashton, Simon Parfitt and Simon Lewis) have been

particularly important in drawing together the understanding of the British Quaternary discussed in Chapters 2, 3 and 4. With a few key exceptions, for example Pakefield and Happisburgh (Chapter 2), Lynford (Chapter 6), Glaston (Chapter 7), Three Ways Wharf at Uxbridge (Chapter 8), and to an extent Boxgrove (Chapter 4), most excavations of the past 50 years have concentrated on re-investigating old sites to answer specific chronological, environmental or cultural issues. Sadly, many of the very early discoveries at such sites were, with the best of contemporary intentions, poorly and sometimes completely excavated, meaning that they are now effectively lost to us (Roe 1981). Britain may have taken an early lead in the race to study the Palaeolithic but unfortunately quickly ran out of steam: now is an exciting time to be working in the British Palaeolithic, but we sorely need more new sites, something that only renewed and extensive survey will achieve.

Alongside fieldwork, more sophisticated methods of artefact analysis have been developed in Britain since the 1960s, resulting in classificatory schemes still in use today such as the handaxe classifications of Roe (1968a); and in considerable advances in our understanding of assemblage variation in the Lower Palaeolithic (e.g. McNabb 1992) and Early Middle Palaeolithic (White et al. 2006; Scott 2010) and the establishment of a chronology for the Late Middle and Upper Palaeolithic (e.g. Campbell 1977; Barton and Roberts 1996; Barton et al. 2003 and the numerous publications of Roger Jacobi). In recent years popular (but nevertheless weighty) accounts of the British Palaeolithic have been published (Barton 1997; Stringer 2006), although it is perhaps no surprise that the relatively brief coverage of the Palaeolithic in general accounts of British prehistory (e.g. Pryor 2004; Darvill 2010), however useful, fail to do justice to a period which represents 98.5–99% of British Prehistory.

THE SOMEWHAT LONGER (PRE)HISTORY OF TIME: SOME CONVENTIONS IN QUATERNARY SCIENCE

In the same way that this is not a book about the history of the British Palaeolithic, it is also not a book about Palaeolithic chronology, although we are, of course, entirely reliant upon the ability to hang sites as precisely in time as we can in order to make sense of the record. The host of relative and absolute dating techniques on which Quaternary specialists rely have been developed since the mid-twentieth century (Walker 2005), and it may be said that we have entered a period of maturity in which we can now place our confidence in the reliability of several techniques. We simply make some points here about our use of Quaternary time.

Rhythms of the planet: climate, environment and Pleistocene timescales

It is not a straightforward task to marshall the variety of complex relative and chronometric dating techniques and seriation schemes into one consistent whole for

the purposes of clarity, but that is what we have attempted here. Overall we refer to the Marine Isotope Stage (MIS, alternatively Oxygen Isotope Stage, OIS) system, which has become the global standard among Quaternary scientists (e.g. Shackleton 1987). If the recent dating of Happisburgh is upheld (see Chapter 2) then hominins have visited Britain intermittently over a period spanning at least 25 of such stages.

Marine Isotope Stages reflect relatively long periods of time – typically ~15,000 years (MIS2) to ~60,000 (MIS11). They are subsumed in or define the old units of 'glacials' and 'interglacials'. As such they form the largest definable units of the highly complex climatic and environmental instability of the Pleistocene. Within these, however, several nested scales of change are also observed, and it has become necessary to subdivide each Marine Isotope Stage further. The ice cores, deep sea cores, and terrestrial records preserve evidence of these climatic and environmental fluctuations on the millennial and sub-millennial scale. At the level of hominin dispersals and behavioural change it is probably these scales that provided the adaptive pressures that determined whether Palaeolithic societies survived and ultimately propagated the changes that are visible in the archaeological record.

Two conventions have been established for the naming of these isotopic substages. MIS 11, for example, has been divided into substages based on an alphanumeric system, that is, 11c, 11b and 11a (e.g. Tzedakis et al. 2001). In other records, however, (e.g. MD900963, Bassinot et al. 1994) a more complex pattern can be seen with additional warm–cold oscillations (Figure 2.5). Therefore, an alternative system identifies negative and positive isotopic events, which are numbered using a decimal system (Imbrie et al. 1984; Bassinot et al. 1994; Desprat et al. 2005). This has the advantage of allowing additional isotopic events to be incorporated as they are discovered. The two conventions differ because the first denotes *periods of time*, whereas the second identifies specific *isotopic events*, and therefore the terminology is not directly interchangable. We discuss issues where they appear in the text.

From an environmental point of view, the Hoxnian Interglacial (MIS11) and the Ipswichian Interglacial (MIS5e) have been divided into pollen subzones, the identification of which has proved critical to our understanding of exactly when hominins were present in Britain. Alongside these, micro- and macro-faunal, coleopteran and molluscan biostratigraphy are critical to the division of time and correlation of sites. In chronometric terms, palaeomagnetism and amino-acid racemisation techniques have proven invaluable in the seriation of sites, but do not produce dates. Correlating such seriated sites with Marine Isotope Stages is nowadays possible with high degrees of confidence, but it is not without its problems, as will be seen, for example, in Chapter 2. Non-radiocarbon dating methods such as thermoluminescence (TL), optically-stimulated-luminescence (OSL) and Uranium-series underpin our chronology and, for the Middle Pleistocene and earlier stages of the Upper Pleistocene, are associated with measurement imprecision consistent with that of the other techniques. The powerful combination of all these methods has resulted in the impressive chronological control of British Middle Pleistocene sites we rely on in Chapters 2, 3, 4 and 5.

How old is a *Homotherium*? Radiocarbon chronology and the British Late Middle and Upper Palaeolithic

Non-radiocarbon dating techniques noted above, particularly Uranium-series, TL and OSL, while of critical use from MIS3 backwards, are associated with relatively large measurement errors (imprecision) which render them of limited use for structuring late MIS3 and MIS2 archaeology in time, at least where radiocarbon measurements are available. As a result we rely in Chapters 6, 7 and 8 almost entirely on radiocarbon for our chronological framework. We will not rehearse in detail here the usual issues relating to radiocarbon accuracy and precision, but make some simple points which, we hope, justify why we use calendrical (calibrated) radiocarbon dates in the way we do. Correction for radiocarbon inaccuracy has been available back to ~50 ka (^{14}C) BP for the last decade, notably in the form of the CALPAL curve (see below). INTCAL09 now calibrates back to a little beyond ~44.5–45 ka ^{14}C BP, that is ~48 ka BP in calendrical terms (Reimer et al. 2009). The result of calibrating measurements using these curves has revealed how considerably radiocarbon measurements underestimate real time in this period; the cause being the complex factors relating to the influx and production of ^{14}C in the Earth's atmosphere, itself, it seems, governed to a large extent by changes in the Earth's magnetic field. Here is one example of such age underestimation which we revisit in Chapter 7: a tooth of the scimitar-toothed cat *Homotherium latidens* dredged from the North Sea close to the Brown Bank that has been directly dated to 28100 ± 220 (^{14}C) BP (UtC-11000, tooth) and 27650 ± 280 (^{14}C) BP (UtC-11065, mandibular bone). These calibrate to ~31–32 ka BP, revealing that the uncalibrated radiocarbon measurements on the dentary underestimate its real age by four to five thousand years.

The ability of specialists to remove contaminating sources of carbon from dating samples and thus isolate only the carbon relevant to the actual age of the sample has also had a significant effect on chronometric accuracy. Recent improvements in pretreatment methods, notably ultrafiltration, seem to be far more efficient at removing contaminating sources of carbon and thus of producing more reliable (i.e. accurate) age estimations. Although the technique was not invented at Oxford – and was indeed practised in other laboratories before it was adopted there – it has perhaps become particularly associated with this laboratory's work on the chronology of the Late Middle and Upper Palaeolithic (e.g. Higham 2011). The redating of ultrafiltrated carbon from samples originally pretreated using non-ultrafiltration methods has often resulted in new (and one assumes more reliable) measurements that are either younger or older than the original results. It would be fair to say, however, that new results typically produce *older* ages. There is, therefore, a *strong tendency* for more recently produced measurements to be older, and thus shift back in time our chronologies for the Late Middle and Upper Palaeolithic, while at the same time eliminating chronometric noise.

All dates we use in the book may be considered to be 'calendrical', that is we present calibrated radiocarbon dates. In order to correct the uncalibrated radiocarbon measurements pertinent to Chapters 6, 7 and 8 we have used the CALPAL curve, a splined,

multi-component curve based on high-precision U/Th and radiocarbon data from Hulu Cave synchronised with palaeoclimatic data from the Greenland ice cores (Weninger and Jöris 2004, 2008). The reason we use this rather than the INTCAL09 curve is familiarity and loyalty: the effort expended into developing CALPAL over the last 15 years or more made this available long before INTCAL was extended back beyond ~25 ka BP although the two datasets are very similar. Reimer et al. (2009, 1112) suggest that where calibrated dates are used original radiocarbon measurements on which they are based should also be cited. We do this where we think it is necessary, but in the interests of space do not make a habit of it. We cite references to the publications in which the original radiocarbon measurements were presented and thus, where we do not present original measurements in tables or text, readers, should they wish, may follow a trail back to original sources and check the accuracy of our calibration. In any case we do not attempt any correlations of dated material (between sites, or with climate, for example) that require high degrees of precision, and even towards the end of the Pleistocene there is still a large degree of imprecision; *single* radiocarbon measurements around 12,000 BP produced in recent years using ultrafiltration pretreatment methods – which may be considered to be the most precise currently available – typically have errors in the order of 50 (^{14}C) years (see for example the results on samples from Gough's Cave – Jacobi and Higham 2009); *sets* of such measurements from contexts that one might assume to be chronometrically contemporary (e.g. assemblages such as Gough's) typically produce age ranges of three to four centuries, and even Bayesian analyses – which perhaps specialists put a little too much faith in – result in modelled ranges of around two centuries *for samples that are assumed to be contemporary or which reflect single events.* This is some achievement for which the radiocarbon community should be justifiably proud, but also a degree of imprecision with which we are probably stuck and thus that, in our opinion, merits our use of calibrated dates. When we quote a date '~14.5 ka BP' it should be assumed that there is a spread of uncertainty of around a century either side at 2σ. Where a set of dates have been produced for a given assemblage we state the range over which measurements overlap at 2σ; it will be seen in the text that, for the Late Glacial, this typically results in ranges of two, three, four or more centuries (Chapter 8). Needless to say, the further one goes back the greater the imprecision; measurements at around five half lives of radiocarbon, for example ~30 ka (^{14}C) BP – pertinent to the arrival in Britain of the first *Homo sapiens* groups – typically possess age ranges of some seven centuries (Chapter 7), and at around seven half lives/~42 ka (^{14}C) BP – pertinent to late Neanderthals – around two millennia.

Pioneers at the edge of the Pleistocene world

The earliest hominin visitors to Britain, ~1ma–700 ka BP

INTRODUCTION

Little more than a decade ago, most European Pleistocene specialists would have denied the presence of humans in Europe prior to ~600–500 ka BP (e.g. Roebroeks and van Kolfschoten 1994; papers in Roebroeks and Van Kolfschoten 1995; cf. Roebroeks 2001; Roebroeks 2006: see Text Box 2.1). Today, however, there is incontrovertible and ever-increasing evidence – in the form of both hominin fossils and genuine humanly modified lithics – that humans arrived in some areas of Europe by at least ~1.2 ma BP, and probably earlier. Until very recently these earliest incursions were also understood to be restricted to familiar semi-arid (savannah-like) grassland habitats and to warmer southern latitudes below 40˚ N (Dennell and Roebroeks 1996, 2005; Dennell 2003). This proposition must now be called into question, at least on the basis of the earliest evidence on hominin presence in Britain. In this chapter we review this earliest evidence of human settlement during the Early and early Middle Pleistocene, relating to the first demonstrable dispersal of humans into Europe.

The record of human occupation between ~1.6 ma–700 ka BP is very different from that found ~600–500 ka BP onwards, in terms of both technological character and quantity of evidence (Roebroeks 2006). The earliest occupation appears to be one of patchy, short-lived and modest settlement (Dennell 2003), whereas from ~600 ka BP onwards far more substantial and continuous occupation is evident (Roebroeks 2001; 2006). Some have seen this as suggestive of a two-phased sequence of colonisation – the first before ~1.2 ma BP and the second ~700–600 ka BP – although in reality these phases are more likely to have been a stochastic series of multiple dispersals and local extinction events at a continental scale, rather than linear and directed waves of migration (Carbonell et al. 1999a, 2010; Moncel 2010; Dennell et al. 2011).

A SHORT CHRONOLOGY FOR EUROPE, OR THERE AND BACK AGAIN

The quest to identify the earliest Europeans is a perennial and often divided pursuit. By the beginning of the 1990s, many workers were ready to accept an age of ~1 ma BP for hominin dispersals into the continent (e.g. Rolland 1992; cf. Roebroeks and van Kolfschoten 1994) with some specialists accepting sites of up to ~2 ma BP in age (Bonifay and Vandermeersch 1991). In a reversal of the normal trend in origins research, however, where things simply get pushed back earlier in time the more they are researched, the outcome of the 1993 European Science Foundation Workshop at Tautavel, France (Roebroeks and van Kolfschoten 1995) promoted a much shorter chronology for Europe, arguing that no convincing evidence of hominin presence existed prior to ~0.5 ma BP.

In a critical review of a number of claimed early sites, Roebroeks and van Kolfschoten (ibid.) concluded that most contained only pseudo-artefacts, were poorly dated and/or contained fossils thought to be hominin that on critical inspection belonged to other species. Qualitative and quantitative differences between sites before and after ~0.5 ma BP, provided a number of falsifiable propositions: (Table 1).

Table 1 Qualitative and quantitative differences between sites before and after 500 ka BP. (After Roebroeks and Van Kolfschoten 1994.)

Before 0.5 ma BP	After 0.5 ma BP
Small series of isolated pieces selected from a natural pebble background	Large collections of obvious artefacts from excavated knapping floors with conjoinable material
Secondarily (disturbed) context (coarse matrix)	Primary context sites (fine-grained matrix)
Contested primitive assemblages	Uncontested Acheulean and non-Acheulean industries
No hominin remains	Hominin remains 'common'

This original 'Short Chronology' was itself shortlived. New discoveries at Orce, Spain, the redating of TD6 at Atapuerca to below the Brunhes-Matuyama palaeomagnetic boundary (Carbonell et al. 1995; it had originally been dated to ~MIS13 on the basis of palaeomagnetism and biostratigraphy, cf. Carbonell and Rodriguez 1994) and the announcement of the discovery of *Homo antecessor* (Bermudez de Castro et al. 1997), falsified almost all of its original tenets. Dennell and Roebroeks subsequently forwarded a 'modified Short Chronology', which accepted that hominins had occasionally and temporarily dispersed into southern Europe prior to ~0.5 ma BP, as and when conditions allowed, but were

Text Box 2.1

still confined by winter foraging requirements and minimum daylight tolerance to areas south of latitude 35º N. Thus, while southern Europe occasionally threw up surprises (due to a closer environmental match and its much shorter and less intensive research history) Dennell and Roebroeks maintained that a 'quantum leap' in adaptive abilities was required to take humans into northern and central Europe, where their absence prior to ~0.5 ma BP was 'beyond reasonable doubt' (Dennell and Roebroeks 1996, 535). Dispersals into the north, and more permanent occupation of southern latitudes, therefore occurred only after ~0.5 ma BP.

This modified position was upheld in the face of growing evidence for more continuous and widespread occupation of southern Europe as early as perhaps ~1.6 ma BP (see main text), and discovery of ~0.75 ma BP occupation at Pakefield, Suffolk (Roebroeks 2005; 2006). In this case, it was suggested that the warm Mediterranean climate underlined the ecological signal of the Short Chronology, with pioneer hominin groups dispersing as integral parts of their familiar habitats. In this way, Pakefield did not contradict the assertion that humans only spread into colder latitudes from about ~0.5 ma BP because at this time Britain was not part of the cold north but apparently an extension of the Mediterranean zone (although we dispute this – see main text). The discovery of Happisburgh, if accepted (see Text Box 2.4) must be seen as finally falsifying and signalling the last death throes of the Short Chronology.

Situated at the northwest tip of Eurasia – a cul-de-sac at the edge of the Pleistocene world – Britain is sometimes considered a 'good laboratory' for studying the ebb and flow of human colonisation and adaptation (Roebroeks 2006; Figure 2.1). This is only partly true. While Europe may be largely a political construct (ibid.), several countries – including Britain – are geographically defined. When not isolated from Europe as an island, Britain formed an upland peninsula surrounded by two deep basins (the Channel and the North Sea) through which flowed wide, deep and possibly impassable rivers (White and Schreve 2000; papers in Preece 1995; Pettitt 2008). The British 'laboratory' was thus only periodically open for experiments and we should therefore expect it to show different settlement patterns from the European mainland. These issues are taken up further in the following chapters.

FAMILIAR SETTINGS IN UNFAMILIAR LANDSCAPES: THE EARLIEST OCCUPATION OF EURASIA

The earliest artefactual and/or fossil evidence for human presence outside the 'cradle of Africa' dates to the Early Pleistocene. The oldest artefactual claims come from the ~2.4–1.9 ma BP deposits at Riwat, Pakistan (Dennell et al. 1988) and the Pabbi Hills,

FIGURE 2.1
Major British sites pertinent to the earliest hominin occupation of Britain.

Pakistan, where a series of poorly contextualised artefacts have been argued to originate from deposits ~2.2ma BP in age (Dennell 2004). The earliest uncontested human remains are slightly younger: the ~1.77 ma BP fossils and associated artefacts from Dmanisi, Georgia (Gabunia et al. 2000; Rightmire et al. 2006; Mgeladze et al. 2010) and ~1.8 ma BP material from Mojokerto and Sangiran, Java (Swisher et al. 1994; Antón and Swisher 2004).

The earliest European sites are all situated within the Mediterranean belt. The two oldest claimed sites are currently Lézignan-le-Cébe, Hérault, France, which has been dated

by Ar-Ar on overlying basalts to at least ~1.57 ma BP (Crochet et al. 2009), and Pirro-Nord, Italy, dated to ~1.6–1.3 ma BP on biostratigraphical grounds (Arzarello et al. 2007, 2009).[1] Other sites dated to >1 ma BP include Fuente Nueva 3 and Barranco León 5 at Orce, Spain (~1.4–1.2 ma BP; Oms et al. 2000); Sima de Elefante TE9, Atapuerca, Spain (~1.2 ma BP; Carbonell et al. 2008) and Pont-de-Lavaud in the Creuse Valley (~1.1 ma BP; Despriée et al. 2006). Continued, if not necessarily continuous, occupation of these Mediterranean and southern European landscapes is further attested by a series of sites dating to between ~1 ma BP and ~800 ka BP, including the Trinchera Dolina Levels 6 and 4 at Atapuerca, Spain (~960 ka BP; Berger et al. 2008); Vallparadis, Barcelona, Spain (a newly excavated site dated to ~830 ka BP; Martinez et al. 2010); Ca' Belvedere di Monte Poggiolo, Italy (~1 ma BP; Gagnepain et al. 1992, 1998; Peretto et al. 1998); Lunery-Rosières, Cher Valley and Pont-de-la-Hulauderie, Loire Valley, France (~930 ka BP and ~980 ka BP respectively; Despriée et al. 2010)[2].

The last of these, as well as the British sites that form the principal subject of this chapter, show that the common assumption that evidence for Early Pleistocene human occupation is limited to sites below 40˚ N latitude with little or no evidence north of the Alps (e.g., Doronichev and Golovanova 2010) is no longer sustainable (although see note 1). The notion that the very earliest occupation – between ~1.6 and 1.2 ma BP – was restricted to these low latitudes still holds true, however, with incursions beyond 45˚N taking a further ~300,000 years to achieve. Even then, any human presence seems to have been so sparse as to remain archaeologically undetected or undetectable in most regions of Europe – if any is actually out there to be found. There is presently absolutely no evidence of human settlement in Central Europe until ~600 ka BP (Marine Isotope Stage [MIS] 15) (Haidle and Pawlik 2010), Eastern Europe saw only insignificant incursions before this date (Doronichev and Golovanova 2010) and the same may be true of much of southwest France (Turq et al. 2010 – see note 1). After ~600 ka BP, this situation was very different, as we shall see in Chapter 3.

Technical systems

While human occupation by at least ~1.6–1.2 ma BP is now well attested in Europe, the lithic assemblages from sites of this age are generally poor in quality and quantity. They are without exception core and flake industries lacking handaxes (Clark's [1969] Mode 1). Débitage was based around a number of simple flaking systems, described in European terms as orthogonal (i.e. with flaking angles close to 90˚), unipolar and multidirectional (Arzarello and Peretto 2010; Carbonell et al. 1999b). In Britain most lithic technologists would probably subsume these under the heading of migrating platform cores (Ashton 1992; Ashton and McNabb 1996; Ashton 1998a), involving a number of simple flaking episodes (single, alternate or parallel sequences, the latter sometimes forming part of an alternate episode) that proceeded from a number of different (migrating) platforms. While this is neither random nor unskilled, knapping operated in a varied and organic fashion that was minimally planned or controlled. The raw materials used at the earliest sites were, regardless of rock type, usually cobbles and pebbles (Arzarello and

Peretto 2010). Sequences were initially dictated by the size and shape of these blanks, and subsequently by the evolving morphology of the core, each removal influencing the location and character of the next. The resulting cores are morphologically diverse and show varying degrees of working (White and Ashton 2003; White and Plunkett 2004). Selection of such materials may reflect the exploitation of familiar settings (i.e. fluvial corridors) in otherwise unfamiliar landscapes. On a number of early European sites the use of an anvil has also been noted, resulting in a 'pseudo' bipolar technique with flakes showing two opposing bulbs (Martinez et al. 2010; Peretto et al. 1998; Carbonell et al. 1999b; Despriée et al. 2010); these have also been claimed for Britain, particularly in the Clactonian (Wymer 1968) although their presence has been questioned (McNabb 1992).

Façonnage ('shaped' tools) in these assemblages is limited to simple 'choppers', a typological category plagued by controversy and variously interpreted as either tools or cores and of course in reality probably functioning as both (Warren 1922; Breuil 1932; Leakey 1971; Toth, 1985; Ashton et al. 1992a). At Monte Poggiolo, Italy, use-wear analyses showed no evidence of utilisation, suggesting that here, at least, they were simply by-products of flake production, although given a million years and the whole of Europe it is unwise to generalise these conclusions too widely. Retouched tools are also extremely rare in these assemblages, the only reported examples >1 ma BP presently coming from Pont-de-Lavaud (Despriée et al. 2006) and perhaps Barranco León 5 and Fuente Nueva 3 (Palmqvist et al. 2005), although the irregular retouch seen on many small flakes in the latter two assemblages may not be intentional but rather edge damage and crushing (Barsky et al. 2010). Retouch may be more common among sites within the ~1 ma–700 ka BP time range, although this appears to be regionally or functionally specific: retouched tools are abundant at Vallparadis, Barcelona (Martinez et al. 2010) and Atapeurca TD6 (Carbonell et al. 1999b) but are very rare from Lunery-Rosières (n = 2; Despriée et al. 2010) and absent from Monte Poggiolo (Arzarello and Peretto 2010).

This association of a Mode 1 technological repertoire and the earliest incursions into new territories appears to hold true almost everywhere (White 2000; Doronichev and Golovanova 2010). In the Levant, the Early Pleistocene site at 'Ubeidiya, Israel contains several levels with handaxes dating to ~1.4–1.2 ma BP although the basal levels have yielded only Mode 1 assemblages (Bar-Yosef 1998). Mode 1 is also found in Dursunlu, Turkey (Kuhn 2002) and Bizat Ruhama, Israel (Ronen et al. 1998) both dated to ~1–0.8 ma BP.

The emergence of the Acheulean (Mode 2) in Europe (see Chapter 3) probably relates to a separate, later phase of colonisation. In the Levant, where the Acheulean appears ~1.4–1.2 ma BP at 'Ubeidiya, evidence for continued handaxe production is limited until ~780 ka BP, as seen at Gesher Benot Ya'aqov (Goren-Inbar 1992, 2000; Bar-Yosef 1998). The earliest Acheulean in Europe also appears to belong to this period, the oldest securely dated examples occurring in the ~700–600 ka BP Level 'P' at Caune de l'Arago, France, its 'sudden' appearance suggesting that it was not an *in situ* development but an introduction from elsewhere (Barsky and de Lumley 2010). Following MIS15 (~600

ka BP), Acheulean industries are found throughout Europe (e.g. papers in Roebroeks and Van Kolfschoten 1995; Piperno et al. 1998; Tuffreau and Lamotte 2010; Despriée et al. 2010), with the notable exception of Central Europe, where a Mode 1 technology persisted until the advent of the Middle Palaeolithic (McBurney 1950; White 2000; Moncel 2010; Doronichev and Golovanova 2010; Haidle and Pawlik 2010). Only in Spain have claims for an older Acheulean been made – with a date of ~900 ka BP proposed for handaxes from Estrecho del Quípar and ~760 ka BP for Solana del Zamborino (Scott and Gibert 2009) – although some doubt has been expressed over the provenance of these handaxes and their relationship to the dated levels (Robin Dennell pers. comm.).

The palaeoclimatic and palaeoecological background to Early Pleistocene dispersals

Hominin dispersals out of Africa have often been correlated with the development of more arid conditions in Africa beginning ~2.5 ma BP (which required terrestrial hominins to widen their range to match the spread of animal resources of the African savannah and/or their analogous Eurasian grasslands) or with the dispersal of other animals (Vrba 1995; Turner 1992; Rolland 1992; Martínez-Navarro and Palmqvist 1995; deMenocal 2004; Dennell and Roebroeks 2005; Martínez-Navarro et al. 2007; Muttoni et al. 2010). The dates of these major climatic shifts in Africa, however, (~2.8, 1.7 and 1 ma BP; deMenocel 2004) do not fit neatly with the currently understood pattern of Early Pleistocene hominin dispersals, as Carbonell et al. (2010) point out, and the notion of multi-species dispersal events from Africa has also been questioned (O'Regan et al. 2009). By contrast, recent work by Trauth et al. (2009) detected a previously overlooked dust-flux in the marine sediments off West Africa indicating a period of aridity beginning ~1.5 ma BP and ending ~1 ma BP, which fits far better with documented dispersal events, in Europe at least. Lake sediments from ten Ethiopian, Kenyan, and Tanzanian rift basin localities furthermore suggest that three humid periods of ~200,000 years duration existed ~2.7–2.5 ma, ~1.9–1.7 ma and ~1.1–0.9 ma BP, which overlap and are largely superimposed on the longer-term process of aridification (Trauth et al. 2005). Trauth et al. (2009) suggest that the mismatch between evidence from dust fluxes and lake levels is best explained by regional responses to global climate change combined with local variations in insolation.

A key problem with most environmental hypotheses for hominin dispersals is that they generally rely on wiggle-matching environmental processes operating at scales of tens or hundreds of millennia with patterns of human dispersal and contraction operating at generational scales, and make uncritical assumptions of causal links between the two. Against the scale of geological time dispersals into Europe were effectively instantaneous. Based on an average rate of advance of one kilometre per year, hominins could move from the tip of the Levant into Georgia, and from there reach southern Spain – or indeed southern Britain – in only 6,000 years (Lewin and Foley 2004). Thus, given the errors involved in accurately dating deposits of the relevant age, the incompatibility of

different dating methods, and the often regional or local responses to global climate change (e.g. Trauth et al. 2005), such wiggle-matching must be considered at best terribly inaccurate and at worst grossly misleading. In fact, one might suggest that rather than emphasising environmental push factors within Africa that *forced* hominins to disperse out of the continent, one would be better served examining the ecological pull factors in Europe that *encouraged* or permitted hominins to disperse in. This might also bring us closer to the complex interplay of demographic, social, adaptive, behavioural, technological and cognitive factors involved and also eliminates the almost universal assumption that all 'outs' were from Africa.

The tempo and scale of global climatic fluctuations during the two main phases of hominin colonisation were also markedly different. The Early Pleistocene was a period of muted climatic cycles of low amplitude and high frequency, operating on an average duration of ~41 ka (controlled by orbital precession). The Middle Pleistocene, by contrast, saw low frequency but high amplitude climatic cycles of ~100 ka average duration (controlled by orbital eccentricity), triggering the familiar pattern of prolonged glacials and interglacials in Europe. The earliest severe glacial across Northern Europe occurred during MIS16 (~650–620 ka BP), although a series of discrete cold events can be seen in the marine record as early as MIS36 (~1.2 ma BP; Head and Gibbard 2005). Neither of these two significant dates coincides with an archaeologically visible major human dispersal. Moreover, as Dennell et al. (2011) emphasise, these ~100 ka cycles often conceal millennial scale variability similar to that seen during MIS3 (see Chapter 6), which may be of far greater consequence to patterns of human dispersal than the longer cycles, although matching these elusive wiggles is even more fraught with difficulty.

The archaeological significance of these global climatic cycles lies in their impact on regional climates and ecosystems. A number of recent studies of mammalian faunas have suggested that the first human dispersals into Europe were conditioned by the availability of familiar open grassland landscapes, which extended from North Africa, the Levant and Central Asia (Van der Made and Mateos 2010; Palombo 2010; see also Dennell and Roebroeks 2005). Palombo (2010) detected a faunal turnover ~1.4 ma BP, signalling the spread of more open environments and the presence of more scattered habitats across Europe, followed by a modest extinction of forest ungulates of all sizes ~1 ma BP. This opening up and fragmentation of the landscape was accompanied by a decline in highly gregarious small–medium herbivore species and a rise in herbivores living in small herds. As Palombo implies, this removed the element of 'safety in numbers' from these groups, providing humans with greater opportunities to hunt by pursuit, ambush or pack.

In an extensive study of large mammalian communities accompanying the earliest human dispersals, Kahlke et al. (2011) found evidence for a high diversity of habitats and a high diversity of resources, facilitating human expansion by offering the widest resource base possible for a colonising species. Similarly, the mild climates, low seasonality and lack of strong environmental fluctuations indicated by their data suggested that humans moved into stable, low-risk environments requiring little in the way of major new

behavioural adaptations (Figure 2.2). These conclusions are largely in agreement with studies of palaeoherpetological remains (reptiles and amphibians), which have shown that the first occupation of Iberia, ~1.4–1.2 ma BP, was associated with a sharp rise in temperature and increasing precipitation (Agustí et al. 2009, 2010). No human activity has yet been reported during the cold, arid phase that followed the earliest incursions (probably MIS22) but there is abundant evidence for human occupation during the renewed warm conditions of the late Early and early Middle Pleistocene. These authors therefore suggest that human dispersals were strongly influenced by climate (mediated by physiology and culture) with hominins preferring relatively warm, wet phases and shunning cold, dry phases.
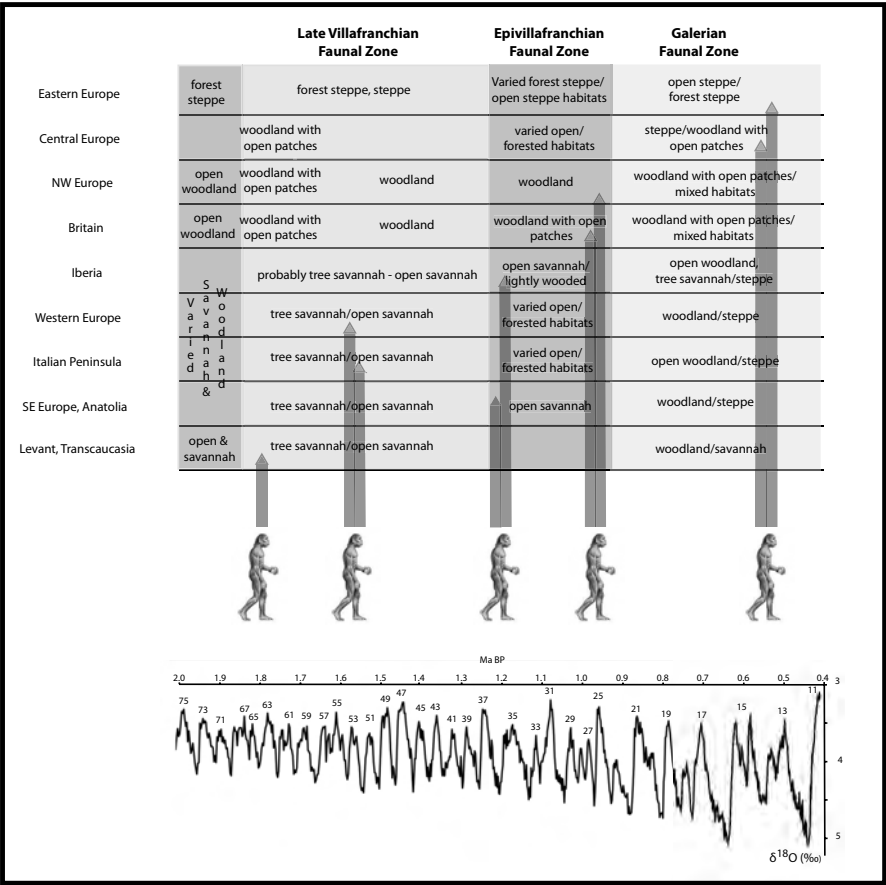
FIGURE 2.2
Schematic representation of the prevailing habitat character of western Eurasia during the Early Pleistocene and early Middle Pleistocene (~2.0–0.4 ma BP) inferred from the large mammal fossil records, in relation to global temperatures and the earliest records of human occurrence. A forward slash indicates the temporal alternation of habitats. (Redrawn and modified after Kalkhe et al. 2001; Elsevier, used with permission.)

Reconstructions of vegetation reveal a similar picture. In a study of pollen and large mammals from 12 Early Pleistocene sites, Leroy et al. (2011) found that the vegetation of the Early Pleistocene was characterised by closed forests for most of the time, even in the southern peninsulas (Figure 2.3). Although only half the sites studied provided a reliable pollen record, the combined floral and faunal record revealed that during the periods of human dispersal open 'Mediterranean-type' environments prevailed, with diverse ecosystems ranging from forested steppe to completely open grasslands. Climatic modelling further suggested that the areas occupied by humans had a minimum temperature range of 0–6° C, and summer precipitation of 30–60 mm a month: in short, during these early dispersals humans appear to have been moving into open woodland
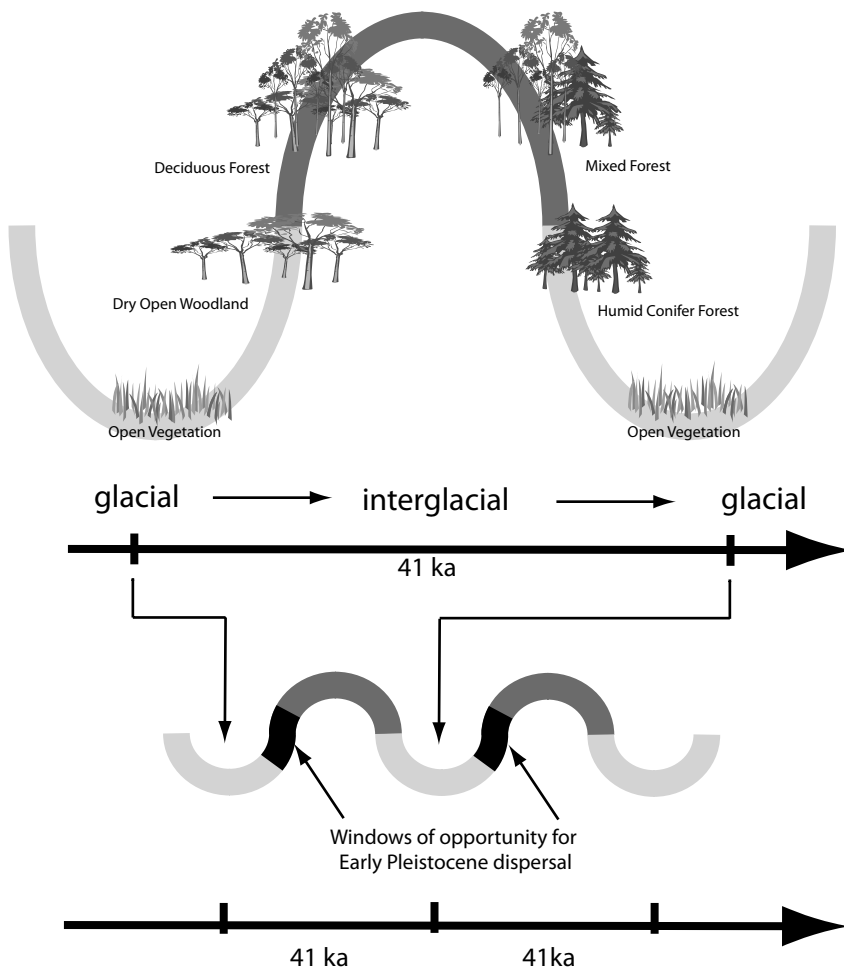
FIGURE 2.3
Schematic representation of vegetation cycles in Early Pleistocene Europe, showing periods of optimum opportunity for hominin dispersal during periods of warm, open environmental conditions. (Redrawn and modified after Leroy et al. 2011; Elsevier, used with permission.)

environments during periods when the climate was relatively warm and dry, but not arid (Leroy et al. 2011). The only exception to this pattern was found at Pont-de-Lavaud, where human occupation took place in deciduous forests during warm, wet conditions (Leroy et al. 2011; Messager et al. 2011).

Muttoni et al. (2010), somewhat at odds with the conclusions of most recent studies, suggested that all of the oldest European sites can be fitted into a temporal window between ~0.99 and 0.78 ma BP, the period which witnessed the establishment of ~100 ka climatic cycles and the inception of Northern Hemisphere glacial oscillations. According to these authors this led to aridity in the Sahara from ~950 ka BP and the development of steppic grasslands across the Eastern European Plain, with a number of large herbivore species (including both the steppe mammoth *Mammuthus trogontherii* and straight-tusked elephant *Palaeoloxodon antiquus*) seeking refuge in southern Europe. Humans probably followed these herds.

Whether this interpretation of the dating evidence stands up or not, from ~0.8 ma BP the 100 ka climatic periodicity became dominant, leading to much longer glacial–interglacial episodes, with net decreases in both moisture and temperature, and longer lasting switches between steppic and forested conditions (Van der Made and Mateos 2010; Palombo 2010). In fact, optimum forested conditions made up only a very small percentage of Pleistocene time (~8%; Gamble in Roebroeks et al. 1992), most of the period hosting a rich mosaic of grassland and open woodland, presaging the final expansion of the Mammoth Steppe across Northern Europe during the Upper Pleistocene. These environments were enriched by herbivore species with diverse feeding strategies and also saw a decrease in carnivore diversity (Turner 1992; Palombo 2010). It is under these conditions that the more 'permanent' occupations discussed in the next chapter took place.

Founder populations

The only human fossil remains associated with the earliest occupation of Europe currently come from Trinchera Dolina Level 6 and Sima de Elefante Level TE9 at Atapuerca, Spain. These have been classified as *Homo antecessor,* the probable ancestor of the European Middle Pleistocene hominin lineage that includes *Homo heidelbergensis* and *Homo neanderthalensis* (Bermúdez de Castro et al. 1997, 2010; Carbonell et al. 2008; see Figure 2.4). Bermúdez de Castro et al. (2010) argue that *Homo antecessor* colonised Early Pleistocene Europe from the east, and may have evolved from the Dmanisi humans, *Homo georgicus*, as yet the earliest known hominin taxon from Eurasia. A full consideration of the small-brained and highly dimorphic Dmanisi fossils lies outside our scope, but it is worth noting that their taxonomic status is unclear and they may represent more than one palaeodeme (Rightmire et al. 2006; Martinón-Torres et al. 2008). Rightmire et al. (2006) suggested that despite some habiline characteristics they were best placed within *Homo erectus,* suggesting the sub-species designation *Homo erectus georgicus*. De Lumley et al. (2006), on the other hand, considered them to be closest to *Homo rudolfensis*.

FIGURE 2.4
Maxilla and frontal bone of *Homo antecessor.* (Courtesy of Javier Troeba: Madrid Scientific Films.)

Based on the most recent fossil discoveries, however, it has been suggested that *Homo erectus* was not in fact an African species but evolved in Western Eurasia from the early human populations represented at Dmanisi, from there spreading east across Asia and south into East Africa (Lordkipanidze et al. 2006; Martinón-Torres et al. 2008; cf. T.D. White 1995; Dennell and Roebroeks 2005; Dennell et al. 2011). In a study of human teeth across the Old World, Martinón-Torres et al. (2007) similarly concluded that Asia had played a more important role in populating Europe than Africa. The dental record showed evidence of continuity in European populations from the Early Pleistocene until the Neanderthals, suggesting that Eurasia and Africa had independent evolutionary trajectories for much of the Pleistocene. Human prehistory was thus not a series of high-impact dispersals from Africa but a complex interplay of populations on both continents.

This 'Out of Asia' model represents a significant paradigm shift away from an Afro-centric view of human evolution. Robin Dennell – one of its principal architects – and colleagues have recently formulated this model into a series of formal testable hypotheses (Dennell et al. 2010, 439):

1   Humans (including early *Homo*) left Africa ~1.8 ma BP

2   *Homo erectus* originated in Southwest Asia, which was a central area for the dispersal of hominins in Eurasia

3   Hominin dispersals (and extinctions) in Eurasia during the Early Pleistocene were primarily driven by climate change that was both long-term (glacial–interglacial cycles) and short-term (millennial-scale oscillations)

4   Dispersals into southern Europe were possible by the early part of the Early Pleistocene (~1.75 ma BP)

5   At least one hominin dispersal event into Europe led to a speciation event by ~1.2 ma BP leading to *Homo antecessor*

6   Sub-Saharan Africa was isolated from Eurasia after ~0.8 ma BP because of the desert barrier between the Sahara and Arabia

7   *Homo heidelbergensis* is primarily a West Eurasian taxon that is absent from Africa and East Asia

8   The Acheulean in Europe (and possibly India) was introduced from Southwest Asia, not sub-Saharan Africa

9   After *H. heidelbergensis* dispersed into Europe, it replaced or may have interbred with some remnant populations of its own ancestor *Homo antecessor.*

This has a major bearing on how we interpret the evidence presented both here and in the following chapter.

EMPTY LANDSCAPES: BRITAIN ON THE EVE OF OCCUPATION

Environmental and climatic sequences of the Early and early Middle Pleistocene

The pioneering and largely ephemeral phases of human colonisation of Britain occurred in the Early Pleistocene and early Middle Pleistocene, during an extended, climatically variable period, referred to as the 'Cromerian Complex' (~MIS13–21) and late Beestonian (MIS22–25). This long period, extending from ~0.98 ma to 0.47 ma BP, includes at least eight interglacial and six glacial stages, as well as numerous interstadial and stadial sub-stages within these (Bassinot et al. 1994; see Figure 2.5). Traditionally, archaeological sites belonging to the Cromerian Complex have been treated together, mostly for

geological convenience (e.g. Hosfield 2011). As this is a book about the human settlement of Britain, not its geological succession, we deliberately break with this practice and draw our dividing line ~0.6 ma BP. This marks the period during which human settlement became more intensive and probably more continuous on a European scale, and also probably saw the emergence or arrival of the Acheulean (Roebroeks 2006; contra Scott and Gibert 2009). We therefore discuss Lower Palaeolithic archaeological sites belonging to MIS15 and thereafter in Chapters 3 and 4, although for ease of reference the entire Cromerian Complex is summarised diagrammatically here.[3]

Other than the key river terraces outlined below, the Early Pleistocene and early Middle Pleistocene in Britain is principally represented by the richly fossiliferous Cromer Forest-bed Formation (CF-bF) of Norfolk and Suffolk, a complex and spatially varied sequence of sediments that are exposed discontinuously for 80 miles along the North Sea coast. These sediments primarily comprise organic detrital muds and sands laid down in the channels and floodplains of rivers draining central and eastern England. West (1980) interpreted the CF-bF as representing a single interglacial stage, subdivided into four pollen zones (Cr I–Cr IV). It is now known, however, on the basis of mammalian and molluscan biostratigraphy, that as many as five discrete temperate episodes are represented (Preece and Parfitt 2000, 2008; Preece et al. 2009; Stuart and Lister 2001). These are unlikely all to be sub-stages of the same interglacial, but are equally unlikely to equate one-to-one with major, odd numbered interglacials in the isotope record, so some sub-stage divisions are almost certainly represented (Preece and Parfitt 2008). In the Netherlands, a series of four distinct interglacials (Interglacials I–IV) separated by periods of cold climate has similarly been recognised on the basis of palynology, lithology and heavy mineral analysis from borehole data (Zagwijn 1985, 1996). Correlation of the British and Dutch sequences remains extremely problematic. The earliest Dutch
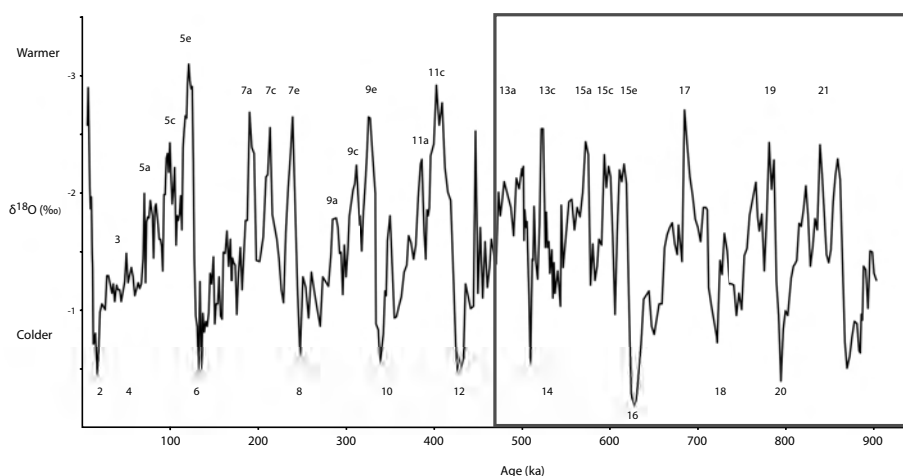
FIGURE 2.5
The Marine Isotope Curve from MIS1 back to MIS21. The Early Pleistocene and early Middle Pleistocene highlighted. (Data from Bassinot et al. 1994.)

Interglacial – Interglacial I – is magnetically reversed and has a highly diagnostic pollen zone characterised by *Carpinus* (hornbeam) and *Eucommia* (Chinese rubber tree) that is unknown from any subsequent interglacial event. Apart from those at Happisburgh 3, all interglacial sediments within the CF-bF are normally polarised and must therefore post-date the Dutch Interglacial I.

Recent stratigraphical and palaeontological investigations in East Anglia have shed some light on the complex nature of this period and identified a succession of temperate-climate episodes with diagnostic floral and faunal assemblages, within which periods of early human occupation may be identified (Turner 1996; Preece and Parfitt 2000, 2008; Stuart and Lister 2001; Parfitt et al. 2005, 2010). One of the key divisions between these early Middle Pleistocene assemblages is based on the evolution of the water vole from the extinct form *Mimomys savini* (in which the molars are rooted in older individuals) to the extant *Arvicola terrestris cantiana* (in which the molars are always unrooted). This transition is thought to have occurred during MIS15 (Preece and Parfitt 2008), an estimate supported by last appearance dates of *Mimomys savini* in a number of key European localities (e.g., 602 ± 52 ka at Gran Dolina, Atapuerca, Spain (Berger et al. 2008), Ar/Ar dates correlated with MIS15 from Isernia, Italy (Coltorti et al. 2005) and the presence of *Mimomys* in deposits above MIS16 Don Till in Russia (Preece and Parfitt 2008)). Other important markers among the microtine voles include *Mimomys pusillus*, which apparently became extinct ~0.7 ma BP, and the evolutionary transition from *Microtus gregaloides* to *M. gregalis* (see Figure 2.6).
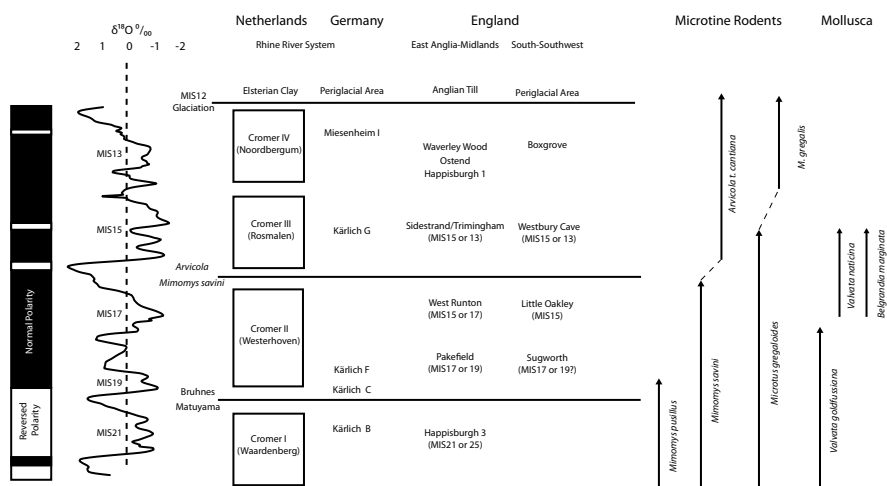
FIGURE 2.6
Tentative correlation of the English Cromerian temperate stages with the Rhine River System, deep sea Marine Isotope Stages and magnetostratigraphy. Direct correlation with the Dutch and British interglacials is not implied. (Revised and Modified after Preece and Parfitt 2000, incorporating data and ideas from Preece and Parfitt 2008; Ashton et al. 2008b; Preece et al. 2009; Parfitt et al. 2010.)

In Britain, the 'vole-clock' provides a ready method for dividing a series of early 'Cromerian' sites with *M. savini* (including the CF-bF sites at Pakefield, Happisburgh and West Runton and the Kesgrave sites of Little Oakley, Essex and Sugworth, Oxfordshire) and later 'Cromerian' sites with *A. terrestris cantiana* (e.g. Sidestrand and Ostend in Norfolk; Westbury-sub-Mendip, Somerset; Waverley Wood, Warwickshire; and Boxgrove, West Sussex). Entirely coincidentally, this evolutionary juncture in microtine voles also marks the division between the 'pioneer' and 'settler' phases of human occupation. Recent investigations of molluscan faunas have similarly identified three biostratigraphically significant assemblage groups (Meijer and Preece 1996; Preece and Parfitt 2000):

1   *Valvata goldfussiana – Tanousia runtoniana – Bithynia troschelli – Viviparus viviparous gibbus* – associated with *Mimomys savini* and found at West Runton, Pakefield and Sugworth

2   *Valvata naticina – Bithynia troschelli – Tanousia* cf. *stenotoma – Belgrandia marginata* – associated with *Mimomys savini* and found at Little Oakley

3   *Valvata naticina – Bithynia tentaculata – Belgrandia marginata* – associated with *Arvicola terrestris cantiana* and found at Sidestrand and Trimingham

A tentative correlation of key sites with the oxygen isotope record is presented in Figure 2.6.

The long temporal duration and associated climatic complexity of the period under consideration renders a full discussion of the environmental sequence impractical, even if the relevant information actually existed in sufficient detail. Furthermore, the fact that hominins are currently understood to have been present on only two brief occasions prior to ~0.6 ma BP renders it unnecessary for present purposes. Suffice it to say that, based on our current understanding of the Early Pleistocene and early Middle Pleistocene in general, and the periods of hominin occupation in particular, there appear to be no simple climatic or environmental factors that allowed or prevented human dispersal into Britain.

Palaeogeography of Earlier Pleistocene Britain

The palaeogeography of Britain for the periods before and during the earliest human incursions has been summarised by Funnell (e.g. 1995, 1996; Figure 2.7). Sedimentological and biological evidence suggests that during the late Pliocene (>2.6 ma BP) Britain took the form of an island surrounded by warm seas, with free circulation of water around or across southern Britain (Funnell 1995, 1996); the depth of the Coralline Crag, which formed during this period, suggests relative sea levels ~70m above those of today. The first terrestrial connection with mainland Europe occurred during the earliest Pleistocene (~2.5 ma BP) and is associated with a global fall in sea-level corresponding to climate change beginning ~MIS100. These climatic changes also triggered modifications in the behaviour of major European rivers, which began to extend their headwaters and increase bedload transport, leading to progressive deltaic progradation in the southern
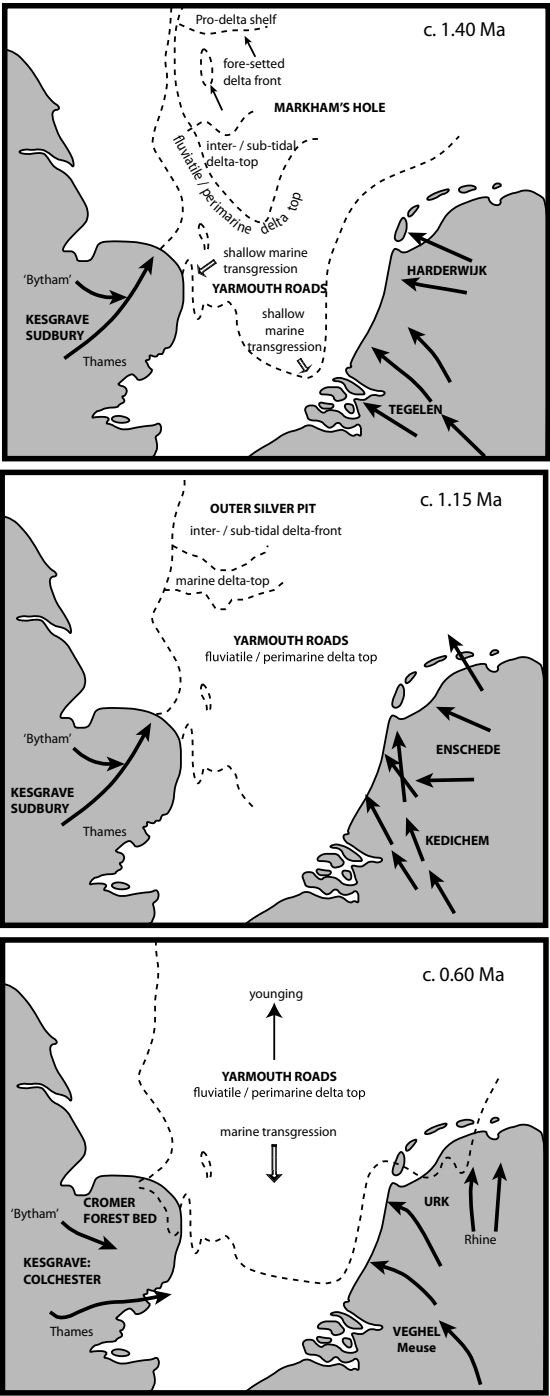
FIGURE 2.7
Palaeogeography of Southern Britain at ~1.4 ma BP, ~1.15 ma BP and ~0.6 ma BP. (Redrawn after Funnell 1996, Elsevier, used with permission.)

North Sea basin. This combination of lower sea-level and progressive sedimentation temporarily converted Britain into a peninsula of the European mainland ~2.3 ma BP; the ensuing 600 ka saw a number of marine transgressions and regressions.

By ~1.7 ma BP, however, progressive deltaic progradation saw the continued growth of the 'Great European (Ur-Frisia) Delta Top' which reinforced the terrestrial link, excluding all marine influence from the southern North Sea basin between ~1.7 and 0.5 ma BP. During this period, Britain was permanently a northwestern peninsula of Europe, even during periods of high sea level. Consequently, flora, fauna and early humans were able to disperse across the top of the Great European Delta Top and the Weald-Artois chalk ridge that closed the Dover Strait to the south (Figure 2.7). By the end of the Cromerian Complex (whatever that may mean), degradation and subsidence of the delta top allowed interglacial seas to encroach southwards across it, although circulation was still bounded in the south by the Weald-Artois chalk ridge, the breaching of which is discussed in Chapter 3.

During the Early Pleistocene and early Middle Pleistocene, therefore, southeast England lay at the western edge of a broad isthmus, while East Anglia was located at the margin of a large coastal embayment around the North Sea basin. The shallow marine deposits that formed in this basin are widespread in the eastern part of East Anglia, and often underlie the key archaeological and palaeontological deposits of the CF-bF. From oldest to youngest these comprise the Red Crag, Norwich Crag and Wroxham Crag. Recent summaries of the distribution, sedimentology and stratigraphy of these deposits can be found in Hamblin et al. (1997) and Rose et al. (2001, 2002). The terrestrial landscapes of eastern England during this period (i.e. the Wash Basin and the Fens) were characterised by greater elevations than the present day, with a higher-relief chalk escarpment (lying to the west of the modern East Anglian escarpment) linking the Chilterns and the Yorkshire Wolds (Lewis 1998; Clayton 2000; Hosfield 2011). The Wash and the present-day flat relief of this region is a product of later (MIS12) lowland glacial erosion.

The fluvial landscape of Britain during the Early and early Middle Pleistocene was dominated by four principal river systems (Bridgland 2010; Hosfield 2011; Rose 2009; Figure 2.8):

1   The extinct Bytham River, which flowed eastwards from the West Midlands, through East Anglia and into the North Sea, until its destruction during the Anglian Glaciation/MIS12 (Rose 1987, 2009). Six distinct terrace formations have been identified, from oldest to youngest: Seven Hills, Ingham, Knettishall, Timworth (MIS16), Warren Hill[*4] (MIS14) and Castle Bytham* (MIS12) (Lee et al. 2004). Using the 'simplified version' of Bridgland's terrace formation model advocated by Rose, Lee and colleagues, which assumes one terrace formation for every 100 ka climatic cycle, we presume the three oldest terraces would date from MIS22, 20 and 18 respectively. A very different interpretation was proposed by Westaway (2009, in press), who recognises only three terraces – the Timworth terrace (MIS12–13), Knettishall terrace (MIS14–15) and Seven Hills terrace (MIS16–15) – although Rose (2009) has refuted this sug-
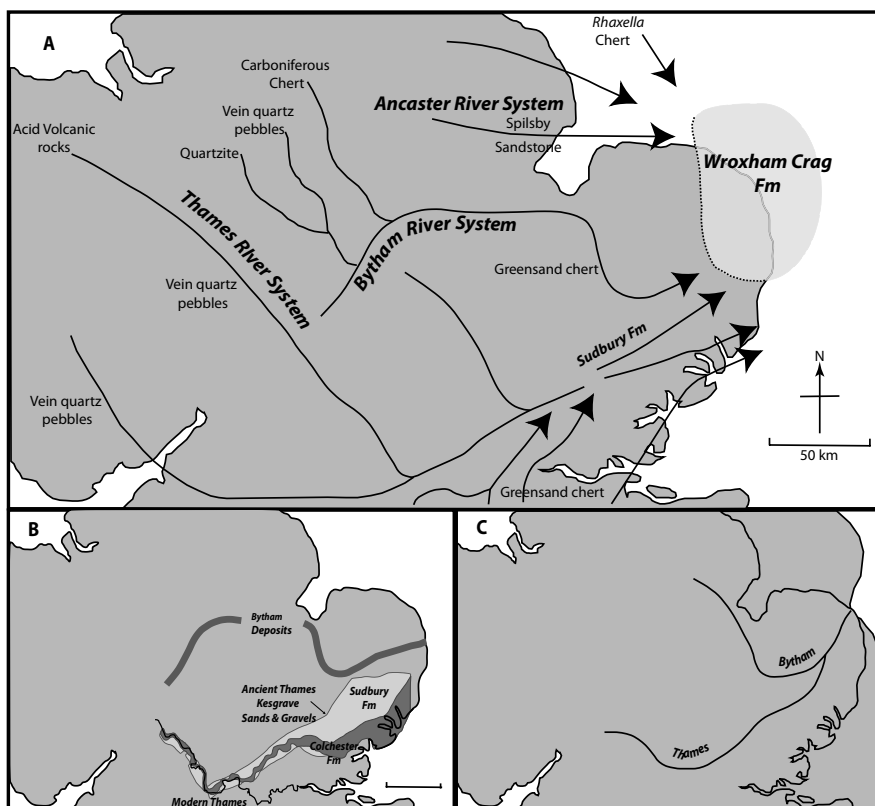
FIGURE 2.8

Composite sketch maps showing the principal river systems of Britain during the Early Pleistocene and early Middle Pleistocene, excluding the Solent system. (a) The Thames, Bytham and Ancaster Rivers, with principal sources of diagnostic rock lithologies. (Redrawn after Rose 2009, used with permission Elsevier.) (b) Extent of Thames and Bytham sediments of the Early Pleistocene and early Middle Pleistocene. (Redrawn and simplified from Whiteman and Rose 1992, used with permission Elsevier.) Note that, to date, no convincing archaeology older than MIS13 has been found in the Kesgraves, or inland within the Bytham system. (c) Proposed (alternate) palaeogeography during the occupation of Happisburgh. Note that the Bytham and Thames are confluent in this reconstruction. (Redrawn after Parfitt et al. 2010, and courtesy Simon Parfitt.)

gestion, arguing that Westaway conflated Bytham terraces with glaciofluvial and post-glacial deposits of the Waverney and for ignoring the implications of palaeosols within the various deposits.

2   The ancestral form of the River Thames, which rose in the Cotswolds and followed its present valley until Reading, from which it flowed north-eastwards through the Vale of St Albans, into eastern Essex and out into the North Sea (Rose and Allen 1977; Whiteman and Rose 1992; Bridgland 1994; Rose et al. 1999). Large spreads of sand and gravel of the Kesgrave Formation of the ancestral Thames ranging from MIS65 to MIS12 have been mapped across

East Anglia (Rose et al. 1999; Rose 2009; Bridgland and Westaway 2008; Bridgland 2010 – see Figure 2.8). The Early Pleistocene and early Middle Pleistocene terraces comprise (from oldest to youngest): Beaconsfield Terrace (~MIS22), Gerrards Cross Terrace (~MIS18), Walringfield Terrace, Ardleigh Terrace* (~MIS17–15), Wivenhoe Terrace* (~MIS14–13) and the Lower St Osyth Terrace* (MIS12).

3   The extinct Solent River which drained most of the Hampshire basin, flowing eastwards past the Isle of Wight before turning southwards into the area of the English Channel (Allen and Gibbard 1993; Westaway et al. 2006). At least six terraces of Early Pleistocene and early Middle Pleistocene age have been mapped in the Solent system: Whitefield Hill Terrace (MIS22), Holmsley Ridge Terrace (MIS18), Wootton Terrace (MIS16), Sway Terrace* (MIS15b), Tiptoe Terrace* (MIS14) and Setley Plain Terrace* (MIS13).

4   The Ancaster-Trent, which possibly flowed northwards from the southern Pennines, across the carboniferous uplands, before veering eastwards through a series of gaps in the Jurassic escarpment at Lincoln and Ancaster and on into the North Sea. This reconstruction remains speculative; no deposits exist within the Trent of this age, high-level terraces of the Ancaster River have not been identified and its possible course is largely based on rockhead relief (Clayton 2000; Rose et al. 2001; Rose 2009; Howard et al. 2007; Bridgland et al. in press).

Despite recent evidence for hominin occupation in Britain during MIS17 and MIS21–25, not a single convincing artefact has been recovered from contemporanous sediments of any of these major river systems, outside the two find spots detailed below. One might infer from this that hominin presence was exceptionally sparse, possibly confined only to the east of England.

PIONEERS AT THE EDGE OF THE WORLD: THE EARLIEST OCCUPATION OF BRITAIN

At the end of the last century, there was a widespread consensus amongst British and European workers that the earliest occupation of Britain occurred during MIS13 (e.g. Roberts et al. 1995; Roebroeks and Van Kolfschoten 1995; Wymer 1999). This was consistent with emerging hypotheses concerning the occupation of the north discussed above, the oldest age most 'serious' scholars were even willing to entertain being MIS15 (~565 ka BP) at Westbury-sub-Mendip (Andrews et al. 1999) and Waverley Wood (Shotton et al. 1993; Bowen et al. 1989; Bowen 1999). Despite many early claims to the contrary (e.g. Moir 1917, 1921a and b; 1939), it was also universally agreed that there was no evidence of human activity within the CF-bF (Preece and Parfitt 2000; Stuart 1996; Wymer 1999). Discoveries at Pakefield, Suffolk during the Quaternary Research Association field trip in 2000, and subsequent excavations under the auspices of the Ancient Human Occupation of Britain Project (AHOB), changed all this[5].
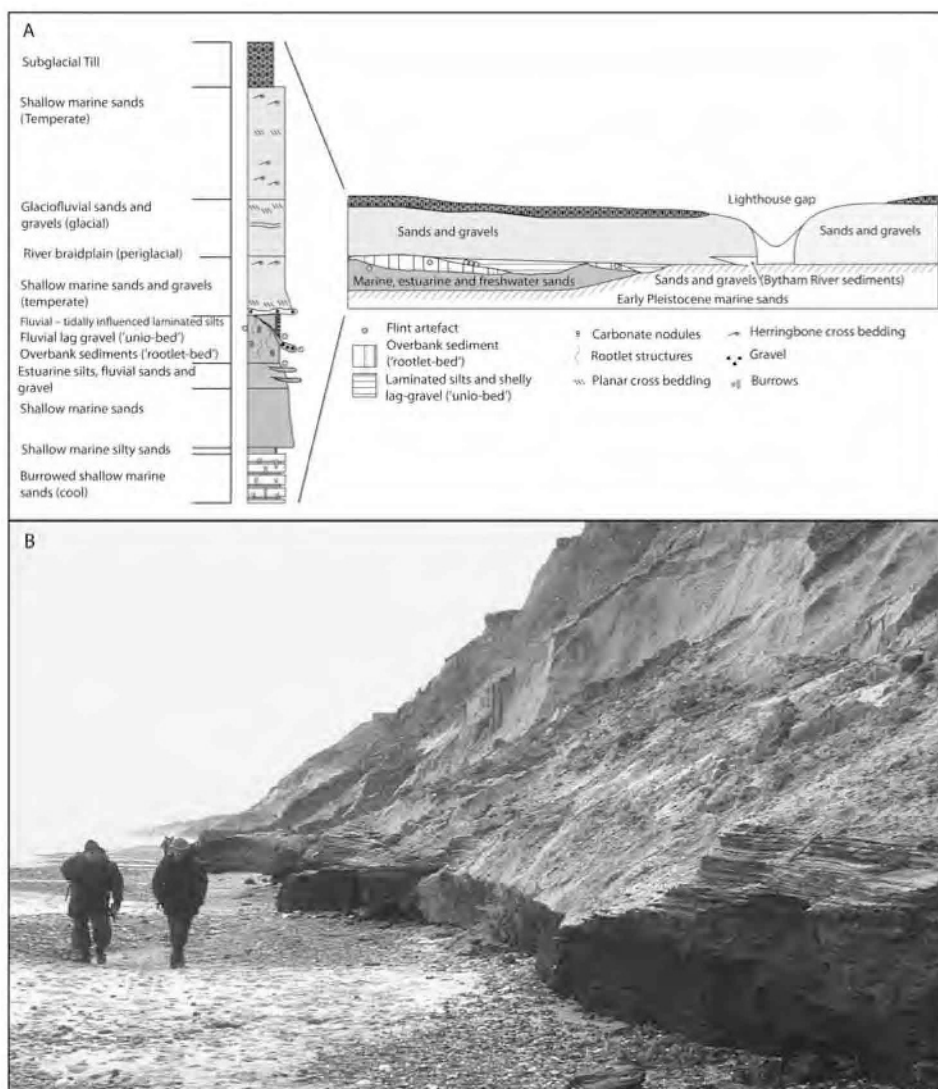
FIGURE 2.9
(a) Schematic section through the Cromer Forest Bed Formation at Pakefield, showing main environmental contexts and location of the flint artefacts (Redrawn after Parfitt et al. 2005, courtesy Simon Parfitt.) (b) Photograph of Pakefield Sections exposed during the Quaternary Research Associations' Easter 2000 Field Excursion. (Courtesy Simon Parfitt.)

Pakefield, Suffolk

Pakefield is situated on the Suffolk coast of East Anglia, at latitude 52° N. Some 34 flint artefacts were recovered from the interglacial fill of a channel (part of the CF-bF), incised into Early Pleistocene marine sediments, and overlain by a series of marine sands, glaciofluvial sediments and Lowestoft (MIS12) Till (Parfitt et al. 2005; Parfitt 2008) (Figure 2.9). The mineral composition of the fluvial sediments suggests deposition by the Bytham River, which at this time drained the English Midlands (ibid; Rose et al. 2001; Lee et al. 2006).

The artefacts (Figure 2.10) include two cores, a crudely retouched flake and débit-age; a small sample but nevertheless conforming to the general Mode 1 technology seen across Europe at this time (Parfitt et al. 2005; Parfitt 2008). They are all in a fresh preservational state and all on good quality black flint with water-worn cortex, suggesting that the raw material was gathered from local river gravels. The artefacts were recovered from four different contexts within the Pakefield sequence. The oldest evidence of hominin activity was recovered from the upper levels of an estuarine silt bed, which also yielded marine and brackish-water ostracods, foraminifera and marine mammals such as dolphin and walrus. The remainder were found in sediments
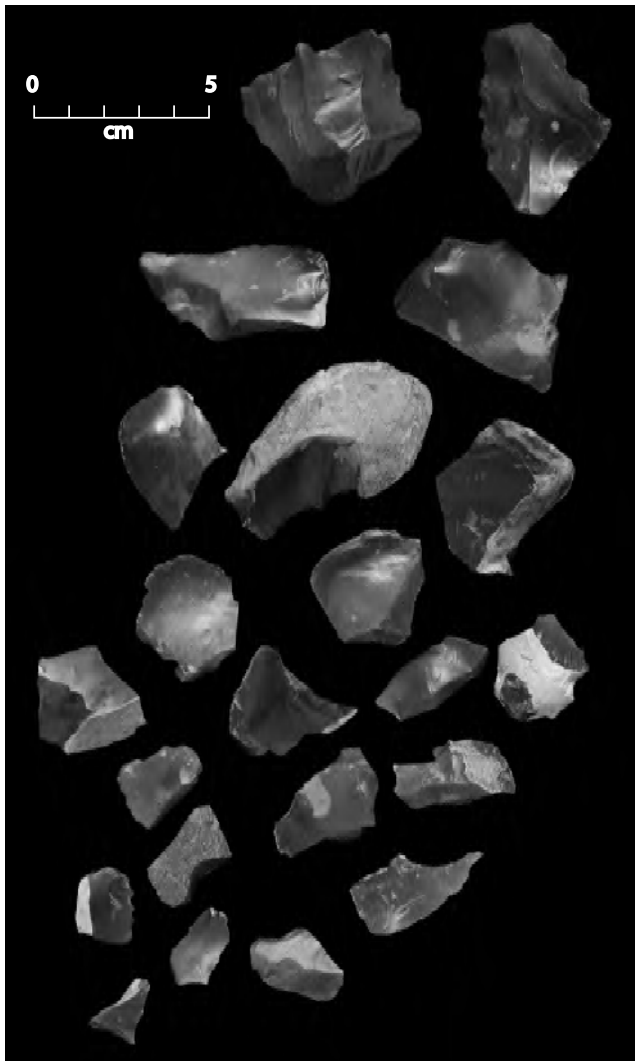
FIGURE 2.10
Artefacts from Pakefield. (Photographs by Harry Taylor and © Natural History Museum.)

attributed to the CF-bF (from top to bottom): the 'Rootlet bed' (overbank sediments with well-developed soil features including numerous fossil root-casts and pedogenic carbonate nodules (n = 2), the 'Unio-bed' (a lag gravel cutting into the overbank sediments (n = 30) and laminated silts at the edge of the channel (n = 1). The presence of micro-débitage indicates that knapping occurred on-site, while the occurrence of artefacts in several contexts has been argued to show that hominins were present for more than one phase of occupation (Parfitt et al. 2005; Parfitt 2008) although vertical and horizontal displacement cannot be ruled out.

The CF-bF sediments at Pakefield are normally magnetised, meaning that they post-date the Bruhnes-Matayama magnetic boundary and cannot therefore be older than 0.78 ma BP (ibid.). The sequence is capped by Lowestoft Till of Anglian (MIS12) age, meaning they cannot be younger than ~0.5 ma BP. The sediments between the CF-bF and the till were originally interpreted as Anglian glaciofluvial deposits (West 1980) which, parsimoniously, would make the Pakefield sediments late Cromerian, probably MIS13 or 15. Lee and colleagues, however, have proposed a longer chronology, in which the CF-bF was separated from the MIS12 Till by two high sea-level stands and two cold episodes. Counting back on the oxygen isotope record, this would suggest that the interglacial deposits at Pakefield date to MIS17 (~0.68 ma BP) at the youngest, and could possibly be as early as MIS19 (~0.75 ma BP) (Parfitt et al. 2005)[6].

An age within an early Middle Pleistocene interglacial is supported by evidence from mammalian biostratigraphy and amino acid geochronology. Although Pakefield was previously correlated with the deposits at West Runton on the basis of pollen and molluscs (West 1980; Preece 2001) the recent work of Parfitt and colleagues has suggested that this is not the case. West Runton lacks the southern thermophilous plants (e.g. water chestnut (*Trapa natans*), floating water fern (*Salvinia natans*) and Portuguese crowberry (*Corema album*)) and exotic beetles (*Cybister lateralimarginalis*, *Oxytelus opacus* and *Valgus hemipterus*) found at Pakefield. The mammalian fauna also shows a number of key differences that cannot be explained by different facies composition or collection history. In the large mammal assemblage several species from Pakefield – including *Hippopotamus* sp., *Megaloceros dawkinsii* (giant deer) and *Palaeoloxodon antiquus* (straight-tusked elephant) – have never been found at West Runton. Pakefield also has two species of the water vole genus *Mimomys*: *M. savini* and *M.* aff. *pusillus* (Figure 2.11). The latter is unknown from West Runton. In Eurasia, the last appearance of *M. pusillus* is in the Ilynian Complex of Russia, which underlies the MIS16 Don Till (Parfitt et al. 2005 and references therein). This suggests an age of at least MIS17 for the Pakefield *Unio* Bed. However, the oxygen isotope record reveals numerous short-lived sub-Milankovitch warm episodes to which any or all these sites might convincingly be related (cf. Westaway 2009a and b, and in press).

Palynological evidence suggests that the channel at Pakefield was infilled during a warm interglacial dominated by broad-leaf woodland (Parfitt et al. 2005). The combined palaeoenvironmental evidence suggests that locally the environment centred on a meandering river surrounded by marshy ground with reedy vegetation and alder-carr, with nearby areas of
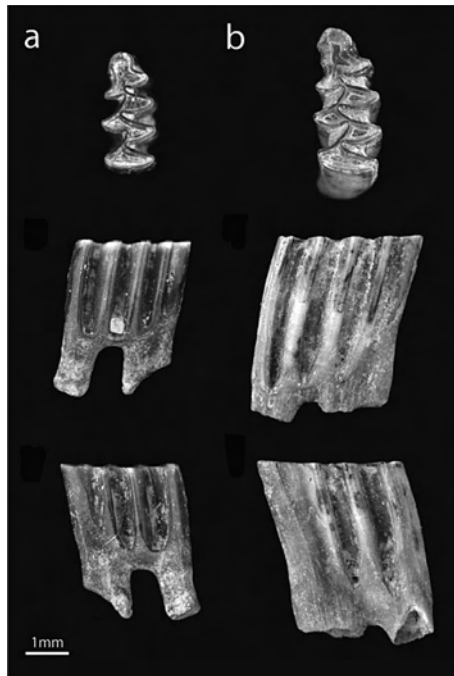
FIGURE 2.11
Mimomys teeth from Pakefield. (Photograph Phil Crabb and © Natural History Museum.)

oak woodland and open grassland (ibid.). These rich and varied habitats were exploited by a number of large herbivores including open-grassland species such as steppe mammoth (*Mammuthus trogontherii),* rhinoceros (*Stephanorhinus hundsheimensis)*, bison (*Bison cf. schoetensacki*) and giant deer (*Megaloceros dawkinsii and Megaloceros savini*); forest species such as straight-tusked elephant (*Palaeoloxodon antiquus*), wild boar (*Sus scrofa*) and fallow deer (*Dama dama*); the river-dwellers hippopotamus (*Hippopotamus* sp.) and beaver (*Castor fiber);* as well as their predators/scavengers including scimitar-toothed cat (*Homotherium sp.*), lion (*Panthera leo*), spotted hyaena (*Crocuta crocuta*) and wolf (*Canis lupus*) (Figure 2.12)*.* The floodplain would therefore have presented diverse plant and animal resources for early humans, in addition to raw material from the flint-rich river gravels, which was otherwise scarce in the immediate vicinity.

The warmth-loving and frost sensitive plants and insects alongside hippopotamus indicate warm summers and mild winters. MCR on beetles (see Text Box 2.2) has suggested mean July temperatures of 18–23° C and mean January/February temperatures between –6 and +4° C. Stable isotope analysis on pedogenic carbonate nodules from the 'Rootlet Bed' revealed intense moisture evaporation during their formation, suggesting highly seasonal precipitation regime (Candy et al. 2006; Parfitt et al. 2005). Together with the palaeotemperature reconstructions, this is argued to show that warm, seasonally dry 'Mediterranean' climates prevailed in Britain during the Pakefield interglacial.
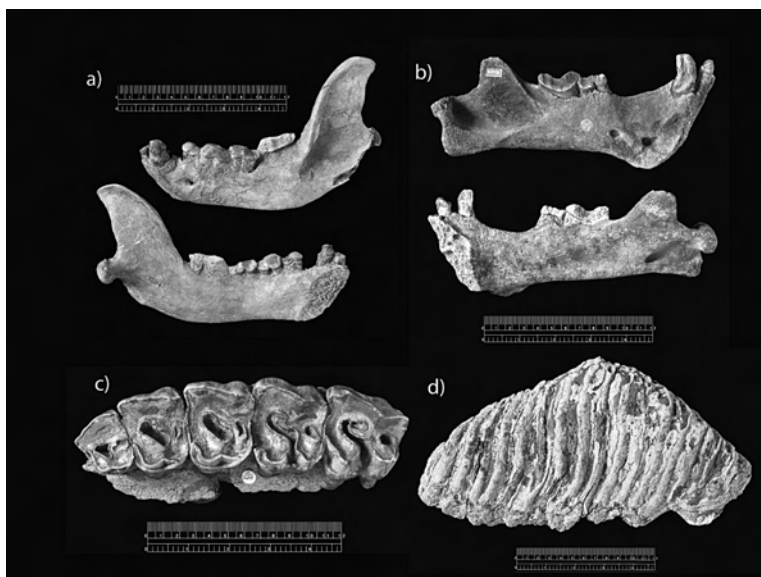
FIGURE 2.12

Carnivores and Herbivores from Pakefield. (a) Spotted hyaena (*Crocuta crocuta*); (b) scimitar-toothed cat (*Homotherium* sp.) (c) Rhinoceros (*Stephanorhinus hundsheimensis*); (d) Steppe mammoth (*Mammuthus trongontherii*). (Photographs Harry Taylor and © Natural History Museum.)

Text Box 2.2

BEETLE FAUNAS AND ENVIRONMENTAL RECONSTRUCTIONS

Insect remains, particularly those of coleoptera (beetles), provide a valuable tool for reconstructing Quaternary environments, and are often found in anoxic (oxygen depleted) waterlain sediments that both preserve and concentrate a range of organic detritus (Elias 1994). Beetles occupy a very wide range of terrestrial and freshwater habitats, and many species are stenotopic (precisely adapted to particular habitats and temperature ranges), meaning they can provide a high-resolution picture of a wide range of localised palaeoenvironments and palaeoclimates (Coope 2006). As many taxa have very specific feeding habits, they are also useful in augmenting our understanding of local (rather than regional) vegetation, herbivore and avian communities, and the type of carcasses that littered the landscape, even if these are not themselves recovered from palaeofaunas (Elias 1994). Critically, the similarities between suites of associated beetles found in fossil and modern contexts, as well as a range of independent proxies, suggest that beetles have not greatly altered their ecological preferences during the course of the Pleistocene (ibid.), and are thus a reliable proxy.

Text Box 2.2

As with pollen, however, there is an ever present danger that at a local level allochthonous 'background faunas' may have strayed into deposits or been carried there by animals; a particular problem when dealing with small numbers of individuals, and perhaps most significant when dealing with later human settlements or closed environments (Kenward et al. 1985). For Palaeolithic studies, however, seeking to understand both the local and regional environmetal structure, the issue of scale becomes important. Precisely because beetles are highly sensitive to factors such as vegetation, temperature, soil type, chemical variation and hydrology, they emphasise the micro-habitats of the preservational basins being sampled rather than providing a picture of a wider landscape. Some are totally dependant on their particular hosts and do not stray far from them at all (Coope 2006). Thus, the very specificity that makes them such sensitive environmental and ecological indicators, may also limit their scope when trying to reconstruct Palaeolithic landscapes (depending of course on the scale of preservation and the sample strategy).

At regional scales, coleopteran data are very useful for reconstruction palaeoclimates. As climate changes, beetles respond not by evolving in terms of Darwinian natural selection, but by altering their geographic ranges, which they can do much more rapidly than many other terrestrial biota (Coope 2002). In some cases, this may lead to the beetle faunas being out of phase with other proxies (ibid.). Several methods of inferring past climates from beetle assemblages have been devised. One depends on mapping the modern geographical distribution of individual species and taking the conditions in the region of maximum overlap as the most likely palaeoenvironment for the fossil assemblage (e.g. Coope 1959). Coope (2002) highlights several problems with the method: it assumes complete knowledge of modern distributions; it fails to consider the possibility that modern distributions may not fully cover the potential range of a species; and the patchy distribution of many species makes simple overlapping in geographical space difficult. The method most often applied today is the 'mutual climatic range' (MCR) (Atkinson et al. 1987; Coope 2000, 2002), which plots species distribution not in geographical space but climatic space. This creates a series of 'climatic envelopes', the inferred palaeoclimate being derived from the coordinates of the area of maximum overlap of these envelopes. To keep temperature estimates independent from other complicating factors, such as the distribution of host plants, only carnivorous species are used. The results are usually presented as T_{max} (mean temperature of the warmest month) and T_{min} (mean temperature of the coldest month). A range of values is usually provided, the figures indicating that the actual T_{max} and T_{min} lay somewhere between these limits and not that it ranged between them (Murton et al. 2001). Individual daily figures would obviously fluctuate enormously around the mean. Sensitivity tests on the MCR procedure, using modern coleopteran faunas living near to meteorological stations, show that there is often a disparity in the MCR estimates and the actual mean monthly temperatures measured at those stations – winter temperature estimates are usually too warm.

Happisburgh Site 3, Norfolk

Happisburgh Site 3 was discovered in 2005, during an excavation programme designed to examine the Pleistocene sequence between Happisburgh and Ostend, Norfolk (N. Ashton pers. comm. November 2010). One objective of the project was to recover artefacts and fauna from interglacial sediments beneath the Happisburgh Till, in order to establish a probable age for material recovered from the beach (including a handaxe found *within* the interglacial sediments), which had become embroiled in a wider debate concerning the glacial sequence in Norfolk (e.g. Rose et al. 2001; Lee et al. 2004, 2006; Preece and Parfitt 2000; Preece et al. 2009; see Text Box 2.3). The results of this project suggested that the Happisburgh Till was deposited during MIS12, and that the immediately underlying implementiferous and fossiliferous deposits at Happisburgh I belonged to MIS13 (Ashton et al. 2008b; Preece et al. 2009). Those from Happisburgh 3 (Figure 2.13), however, are possibly much older (Parfitt et al. 2010).

FIGURE 2.13
Overhead view of the Happisburgh 3 site, and detail of excavations in progress. (Courtesy Nick Ashton.)

THE AGE OF THE HAPPISBURGH TILL: GLACIAL STRATIGRAPHY VERSUS BIOSTRATIGRAPHY

For the past 30 years, the glacial tills of East Anglia have been widely understood as deposits laid down by an oscillating British and Scandinavian ice sheet during a single glacial event – the Anglian (MIS12) glaciation (e.g. Perrin et al. 1979; Rose 1987; Table 1). Over the past decade, however, a research team from Royal Holloway and the British Geological Survey has made a strong and vocal challenge to this, provoking an equally robust response from supporters of the traditional model. The age(s) of the glacial deposits of East Anglia has major ramifications for the dating of the Early Pleistocene and early Middle Pleistocene occupation of Britain. Of key concern here is the age of the Lowestoft and Happisburgh Formations.

Table 1 The glacial stratigraphy model compared to the biostratigraphical model for the ages of the East Anglian tills (data combined after Preece and Parfitt 2008; Preece et al. 2009)

Glacial stratigraphy model				Biostratigraphical age model
Proposed MIS age	Formation	Member	Key fossil sites (MIS)	MIS: water voles
			Sidestrand Cliff Formation (Trimingham Lake Bed)	11 or 9
6	Briton's Lane Fm	Britons Lane Sand and Gravel Mb		12
10	Sheringham Cliffs Fm	Weybourne Town Till Mb		12
		Runton Till Mb		12
		Bacton Green Till Mb (3rd Cromer Till)		12
12	Lowestoft Fm	Walcott Till Mb (=2nd Cromer Till)		12
				12
		Lowestoft Till Mb		
16	Happisburgh Fm	Corton Till member Mb		12
		Happisburgh Till Mb		12

Text Box 2.3

| ≥17 | Cromer Forest Bed Fm | Sidestrand Hall Mb (≥17) Happisburgh 1 (≥17) West Runton (17/19) Pakefield (17/19) | 13 or 15: *Arvicola* 13 or 15: *Arvicola* 15 or 17: *Mimomys* 17: *Mimomys* |

The glacial stratigraphy model (e.g., Hamblin et al. 2000, 2005; Lee et al. 2004, 2006; Rose 2009; Lee 2009)

Advocates of the glacial stratigraphy model argue that the sedimentary character, lithology and ice-flow direction of the East Anglia tills demonstrate that they represent a series of glacial episodes dating to MIS6, MIS10, MIS12 and MIS16, rather than belonging to a single MIS12 glaciation (Lee et al. 2004; Hamblin et al. 2005; Rose 2009). Only the deposits of the Lowestoft Formation are considered to be MIS12, with the glacial deposits of the Happisburgh Formation suggested to belong to MIS16. This conclusion is founded on a simplified version of Bridgland's terrace formation model (Bridgland 1994; Bridgland and Allen 1996), whereby terraces are assumed to form at regular 100 ka cycles. In this reconstruction, the three lowest terrace aggradations of the Bytham River are assigned to MIS16 (3rd or Timworth Terrace), MIS14 (2nd or Warren Hill Terrace) and MIS12 (1st or Castle Bytham Terrace); the latter age being supported by evidence for continuous sedimentation from fluvial to ice-dammed lake conditions during MIS12. Concomitantly, the presence of till-balls, erratics and heavy minerals characteristic of the Happisburgh Till in deposits of the 'MIS16' Timworth Terrace at Leet Hill (Lee et al. 2004; Hamblin et al. 2005) demands that the Happisburgh Till is older than the terrace formation, a date earlier within the MIS16 glaciation being favoured (Rose et al. 1999; Lee et al. 2004; Rose, 2009). Unconformable contacts and differential weathering between the Lowestoft and Happisburgh Formations (Hamblin et al. 2005), combined with evidence that a shallow (non-glacial) marine phase separates the Happisburgh Formation (Corton Till) from the Lowestoft Till at Chapel Hill (Read et al. 2007), also demand their attribution to different climatic cycles.

The conclusions of this model contradict several long-held biostratigraphical frameworks, particularly the dating of the *Mimomys–Arvicola* transition. Lee et al. (2004) therefore suggested that the first and last appearances of these biostratigraphical markers is uncertain, and may not relate to full MIS stages but substages, and the assumption that evolution and replacement was synchronous across Eurasia is unproven – the two species could have co-occurred in some regions.

Text Box 2.3

The biostratigraphical model
(Preece 2001; Stuart and Lister 2001;
Preece and Parfitt 2008; Preece et al. 2009)

In contrast, the biostratigraphical model reinforces the traditional viewpoint that the East Anglian tills all belong to MIS12. The foundation of this model has undoubtedly been the evolution of the water vole from *Mimomys savini* (with rooted molars in older individuals) to *Arvicola terrestris cantiana* (with molars that are always unrooted), a transition thought to have occurred during MIS15 (Preece and Parfitt 2008), as on the continent. For Preece and Parfitt it is difficult to reconcile this pattern with the glacial stratigraphy model, which would require all sites with *Mimomys savini* to fall between the end of MIS19 and MIS17, before being replaced by *Arvicola* just before the Happisburgh Glaciation (*Arvicola* occurring in deposits directly beneath Happisburgh Till at Sidestrand, Happisburgh 1 and Ostend). There is also no evidence for the interdigitation of *Mimomys* and *Arvicola* that would support claims for progressive and diachronic evolution with significant ebb and flow of populations over time. Other important markers among the microtine voles include *Mimomys pusillus*, which apparently became extinct in MIS17.

This model is supported by multiple and independent lines of evidence, including molluscs, ostracods and beetles (Preece and Parfitt 2008; Preece et al. 2009). A recent OSL dating programme also supported an MIS12 age for all the sampled East Anglian tills (Pawley et al. 2008), while AAR estimates on molluscs from Sidestrand indicated an MIS11 or MIS9 age for temperate sediments capping the Happisburgh Till, but an MIS13 or 15 age for the interglacial sediments underlying it (Preece et al. 2009; Penkman et al. 2010). The inescapable conclusion is that the intervening till is of MIS12 age. Re-mapping and uplift modelling of the Bytham Terraces by Westaway (2009a), furthermore, resulted in the incorporation of the first three terraces of Lee *et al.* (2004) into a single aggradation belonging to MIS13 and MIS12. While Rose (2009) offered a critical rebuttal to Westaway, Preece and Parfitt (2008) also suggested that the lowest three Bytham Terraces belonged to MIS12, stressing the effects of crustal movement and glacial displacement on terrace formation, which cannot be expected to operate in a regular 100 ka cycle in all river systems. Indeed, this fact has long been recognised by David Bridgland, the architect of the prevailing model of climatically driven terrace formation, and is exemplified in the two MIS12 terraces of the Thames (Winter Hill and Black Park) (Bridgland 1994; Maddy et al. 2000; Bridgland and Westaway 2008) and the paired terraces of the Solent (Bridgland 2001; Westaway et al. 2006).

We follow the biostratigraphical model, with the caveat that if this ultimately proves to be wrong, our preferred dates for some sites may require adjustment.

Text Box 2.3

Artefacts at Happisburgh 3 were recovered from fluvial (lag) gravels and laminated estuarine sands and silts filling a series of stacked, overlapping channels (Figure 2.14). These were incised into sands and silts of the Norwich Crag Formation and overlain by Happisburgh Till (Parfitt et al. 2010; see Figure 2.15). The implementiferous deposits have been assigned to the newly defined Hill House Formation. Their sedimentology suggests deposition in the upper part of the estuary of a large river. Non-local and exotic clasts included vein quartz and quartzite from the Midlands, Carboniferous chert, Hertfordshire Puddingstone and Greensand chert from southeast England and acid volcanic rocks probably derived from Ordovician strata in North Wales. Together this suite is consistent with deposition by the ancestral Thames – flowing some 150 km north of its present estuary – with some contribution by the Bytham River (ibid.).

A total of 78 artefacts were recovered from six horizons in Layers C, D, E and F. Many were in a fresh preservational state (Figure 2.16). The assemblage is characterised by large flakes (>145 mm) with sharp cutting edges and cortical backs. The unusual size range and proportion of naturally backed knives was argued to show that the artefacts had been transported to the site from knapping areas elsewhere (ibid.).

The human environment of Happisburgh 3 has been reconstructed through a number of terrestrial and marine proxies, including pollen, plant macrofossils, beetles, molluscs,
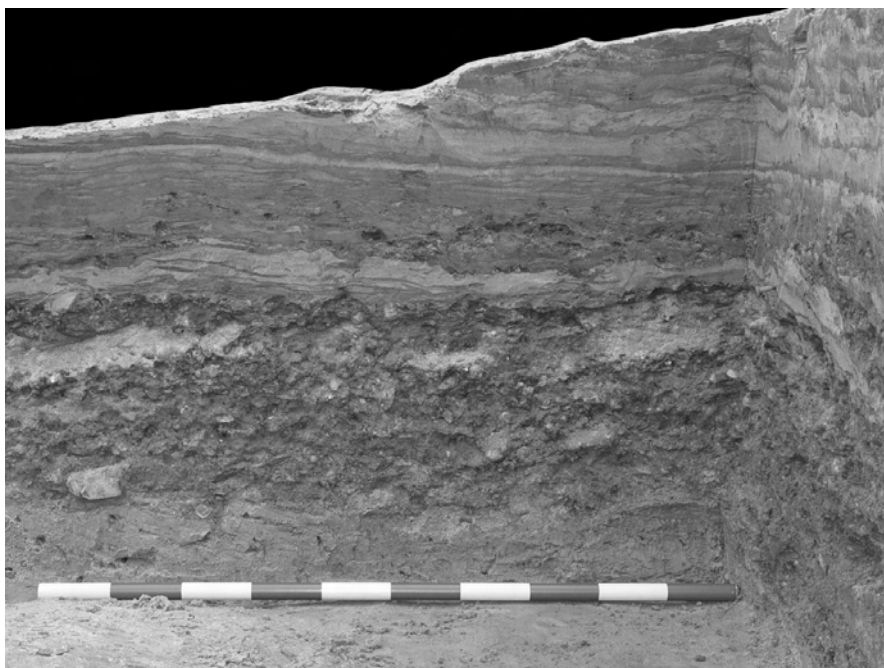
FIGURE 2.14
The implementiferous fluvial (lag) gravels and laminated estuarine sands and silts from Happisburgh 3. (Courtesy Nick Ashton.)
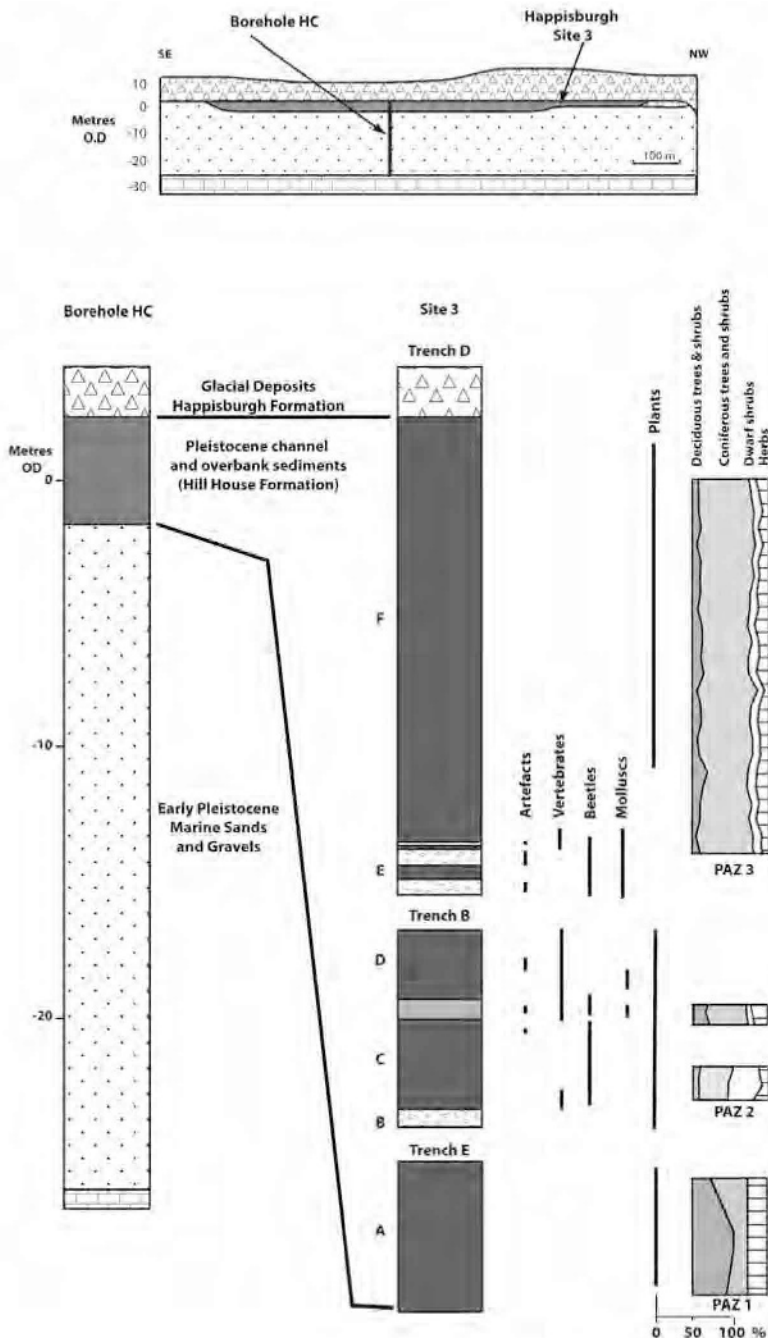
FIGURE 2.15
Stratigraphical context of the Happisburgh 3 artefacts and biological remains. Top: Coastal section showing location of R.G. West's Borehole HC. Below: Lithostratigraphy of Borehole HC, alongside composite lithostratigraphy for Site 3. (Redrawn and simplified after Parfitt et al. 2010, and courtesy Simon Parfitt and Nick Ashton.)