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Guest Editorial

The environment and chronology of the earliest occupation of north-west Europe: Current knowledge, problems and new research directions

1. Context and origins

North-west Europe provides an important case study for understanding hominin adaptation to cooler, more seasonal environments at mid-latitudes in Eurasia, and, in broader terms, the widespread distribution of our own species as well as its predecessors within the genus *Homo*. In the last two decades much has changed in research on the early occupation of north-west Europe, including developments in dating methods, the discoveries of a series of surprisingly early sites through new fieldwork and a range of new research questions. In order to address these questions, a robust chronology and understanding of past environments is required. However, the chrono-stratigraphy of the late Early and early Middle Pleistocene, though much more refined than it was two decades ago, still presents a number of problems. The contributions to this volume are primarily the result of an international conference held in the Faculty of Archaeology, University of Leiden in 2009 with the aim of addressing this issue. Most importantly, the conference gave a state-of-the-art view of hominin environments and the chronological framework, and highlighted remaining problems. In addition, it provided a forum for interdisciplinary discussions leading to the new perspectives which are evident in a number of papers in this issue.

In this editorial we will outline some of the new directions in research on the earliest occupation of NW Europe, including some presented in this special issue, and how they relate to the broader research field. The aim is to demonstrate the importance of improvements in chronology and environmental data reported in this issue, as well as the need to resolve remaining issues. In addition, we review a number of important topics which receive less attention in this issue, with its heavy emphasis on dating and environmental reconstruction.

2. Chrono-stratigraphical issues and palaeoenvironmental reconstruction

A robust chronology is necessary to resolve questions about the timing and nature of the earliest occupation. However, establishing a robust chronology for the late Early and early Middle Pleistocene has proved challenging. This is particularly the case since the main geochronological dating methods often cannot be applied (Falguères et al., 2010).

Nevertheless, at least five temperate stages have been identified in the British early Middle Pleistocene, prior to the Anglian glaciation, based on distinctive faunal assemblages (Preece and Parfitt, 2012). This promises a relatively fine-grained chronological resolution for hominin occupation (at least in Palaeolithic terms): it indicates that hominins were present in the UK during more than one temperate period before the Anglian glaciation (MIS 12), and also before Boxgrove, for more than a decade seen as the earliest site in the UK. In addition, archaeology from Happisburgh Site 3 is attributed to the late Early Pleistocene (Parfitt et al., 2010). The possibility that the palaeomagnetic signal from Happisburgh Site 3 might represent an early Middle Pleistocene palaeomagnetic excursion, raised by Westaway (2011) is addressed by Preece and Parfitt (2012). This discussion highlights the importance of interpreting palaeomagnetic evidence in the context of other data. Amino acid racemization studies provide further support for differentiating temperate stages throughout the British Pleistocene, with potential for future refinement (Penkman et al., 2010, 2011). A key issue with regard to the UK regional chronology is the conflict between new interpretation of the glacial succession in North Norfolk (Rose et al., 1999; Lee et al., 2004a,b; Hamblin et al., 2005), and a range of other data sources (Gibbard et al., 2008; Pawley et al., 2008; Preece et al., 2009; Penkman et al., 2011). The main arguments and data relevant to this debate are outlined by Preece and Parfitt (2012). Another issue relevant to establishing a reliable chronology is the correct definition of the status of lithostratigraphical units, as for example discussed with regard to sediments encasing the important site of Happisburgh 3 (Gibbard, 2012).

New dates have been obtained for a number of key sites in this period. Detailed reinvestigation at West Runton, the Cromerian type-site, provided a range of data including palaeomagnetism, micro-tephra, AAR, small mammal biochronology and pollen which constrain the age of the site to a temperate phase post-dating MIS 19 and no younger than MIS 15 (Stuart and Lister, 2010). With the vole *Mimomys* present at West Runton, this also provides a maximum age for sites with *Arvicola*, such as Mauer and Boxgrove, both often assigned to MIS 13. Electron spin resonance (ESR/U-series) and infrared radiofluorescence (IR-RF) methods now support attribution of the Mauer fossil site to MIS 15 (Wagner et al., 2010, 2011), this is important because it refines dating of one of the oldest hominin fossils from northern Europe.

However, correlating the temperate phases identified in the UK with similar phases on the continent remains difficult, setting limits on our understanding of hominin occupation of the region. This is especially problematic given the discontinuous nature of the estuarine and fluvial deposits in both the UK and the Netherlands, and the fact that

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only pollen data from boreholes is available for the latter region for most temperate phases (Meijer and Cleveringa, 2009; Preece and Parfitt, 2012). Preece and Parfitt (2012) identify a number of problems and questions to be resolved in the NW European chrono-stratigraphy of this period, and highlight the pressing need for a formal working group on the formal subdivision of the early Middle Pleistocene in NW Europe.

In central and eastern Europe and south Russia, relatively long stratigraphic sequences are available for the period of interest, providing an opportunity to build a robust chronology and make correlations that support chrono-stratigraphic schemes elsewhere in Europe. Glacial events form a widespread and important chronological marker in this region, and the timing and extent of glaciation is increasingly well understood. Based on the review by Gozhik et al. (2012), Scandinavian glaciers extended into Poland and the Ukraine three times during the late Early and early Middle Pleistocene, probably during MIS 22 or 20, 16 and 12. This large region also provides valuable biochronological data. In this issue Agadzhanyan (2012) reports fossils of the vole genus *Arvicola* from Mastyuzhenka in the Don basin, Russia, which based on lithostratigraphy are older than the Okian glaciation, attributed to MIS 12. Contrary to earlier arguments (Maul and Markova, 2007), this places the replacement of *Mimomys* by *Arvicola* in eastern and western Europe within a similar time-frame, supporting the use of this biochronological marker for large-scale correlation. This is particularly important for comparing the occupation history of north-west Europe with areas to the east characterized by greater seasonal variation in climate and particularly cooler winters.

Detailed palaeoenvironmental reconstruction of hominin habitats is possible based on multi-proxy evidence from a number of primary or close to primary context Lower Palaeolithic sites. Ashton and Lewis provide a valuable review of the evidence for hominin habitats from the UK in this issue, while Field (2012) reports preliminary results of palaeoenvironmental reconstruction from Happisburgh Site 1. In very broad terms, this shows that before c. 400,000 ka hominins were active in varied climatic and vegetation conditions; winter temperatures varied from milder to decidedly cooler than today, and vegetation varied from a mosaic of grassland, scrub and mixed woodland to deciduous forest. Nevertheless, until about 400–500 ka, the middle part of the Middle Pleistocene, there exists no indisputable evidence for occupation of mid-latitude Europe outside temperate periods (Cohen et al., in this issue). Parfitt et al. (2010) have made a case for adaptation to colder boreal settings at Happisburgh Site 3, at the end of an interglacial. Alternatively, the hominins at stake may simply have still been dwelling in the coastal areas of what is now East Anglia at the end of an interglacial, having expanded their range from southern areas earlier in the warm temperate period at stake.

3. New directions in research

3.1. Physical and behavioural adaptations of the earliest occupants

Most archaeologists would agree that the early colonization of Europe, a region where temperatures at times dropped below freezing point, was tied to the use of fire. However, a recent review suggests that early hominins may have moved into middle latitudes without the habitual use of fire (Roebroeks and Villa, 2011). The lack of fire proxies from a series of well-preserved sites with long archaeological sequences reflecting various glacial–interglacial cycles and dating to before 400,000–300,000 years ago makes this pattern particularly interesting. The hypothesis raises questions about how early hominins survived, particularly given the early evidence from Happisburgh Site 3, UK that they were present in areas with possibly cooler winter temperatures than present at a very early date. A range of possible solutions, likely adaptations and the relevant archaeological evidence are explored in detail by Ashton and Lewis (2012).

Given the scarcity of archaeological evidence for technological solutions such as fire and clothing, relevant comparative data is valuable. Modern human adaptations to cold stress include metabolic elevation, probably based on both genetic factors and short-term responses to cold stress (Snodgrass and Leonard, 2009). It seems likely that early colonists employed similar physiological adaptations, especially in the absence of present-day solutions such as tailored clothing. However, this would have required a substantial carbohydrate intake. Simple clothing, bedding and structures provide considerable thermal benefits, based on experimental studies and human physiology (Aiello and Wheeler, 2003; Chu, 2009): these approaches could make it possible to weigh the benefits against the costs to assess the likelihood that such strategies were employed. Alternatively, these early occupants could have made long seasonal journeys: the scale of journey necessary to reach areas with warmer climes in western Europe is large but not beyond the distances traveled by recent hunter-gatherers.

A key issue is the interaction between brain size, adaptive flexibility and seasonal environments (particularly winter food shortages). This is particularly interesting, as energy-demanding brains increased in size during this period to reach a scale more comparable to that of recent humans than early *Homo* (Rightmire, 2004; Robson and Wood, 2008). Seasonal food scarcity might be expected to set an energetic constraint on the success of large-brained hominin populations; at the same time, a large brain and associated capacity for learning and innovation could reduce the impact of seasonal resource scarcity, for example by allowing learning of a useful foraging strategy (van Woerden et al., 2012). Hunting has been highlighted as a crucial strategy for surviving in an environment with seasonal resource scarcity, which is demanding in terms of social skills and knowledge (Roebroeks, 2001). Hominins certainly had access to animal carcasses at an early stage of consumption (Roberts and Parfitt, 1999; Saladié et al., 2011). Other resources which would have been available year round include aquatic foods and edible roots and tubers (Cohen et al., in this issue; Hardy, 2010). While evidence for these other resources is subject to severe preservation bias, new methods are being developed which could help to assess their dietary role (Hardy et al., 2009; Henry et al., 2011). In addition, a number of authors in this special issue draw attention to the situation of specific archaeological sites at the edge of one or more ecotones, along rivers and near the coast, where a wide range of resources would have been available (Ashton and Lewis, 2012; Cohen et al., in this issue). Fully understanding hominin survival strategies requires research on a wide range of aspects of behaviour, aided by new approaches, as well as detailed environmental reconstruction.

3.2. Technology

Unusually, given the strong archaeological contribution to this special issue, lithic technology has received relatively little attention in this issue. A key question concerns whether the earliest hominins in this region employed new stone tool technology to solve new environmental problems. Based on relatively late dates for the Acheulean in Europe, it has been argued that Europe was colonized first by a population bearing a Mode 1 technology, who were replaced by a second population introducing a Mode 2 (Acheulean) technology (Carbonell et al., 1999, 2010). However, the extent to which a change in technology can be identified in this period can be questioned based on new chronological evidence. New dates for the early Acheulean have been obtained for Venosa Notarchirico, Italy, where the Acheulean underlies a tephra with a date of 640 ± 40 ka (Lefèvre et al., 2010); in the Loire valley, France, ESR

dating places a number of Acheulean sites at c. 700 kya (Voinchet et al., 2010). While evidence suggesting an Early Pleistocene age for the Acheulean in Spain conflicts with other age indicators (Scott and Gibert, 2009; Jiménez-Arenas et al., 2011), the dates from Italy and France push the age of the Acheulean in Europe beyond c. 600 kya, closer to dates for the earliest hominin presence in the region. An early arrival of the Acheulean in Europe is not unlikely, given its Early Pleistocene presence in the Levant (Goren-Inbar et al., 2000). While a number of key early sites lack handaxes, they have undiagnostic small industries (Parfitt et al., 2005, 2010), although other assemblages are larger (Ollé et al., 2011). The most parsimonious view is that early occupants of Europe used Acheulean technology, and were flexible in their strategies for tool manufacture and discard. However, further study is necessary to assess other aspects of the organization of lithic technology as part of the survival strategies of the early occupants of Europe.

3.3. Sinks and sources, tolerance and taphonomy

Given its geographically marginal position and sometimes severe climate, north-west Europe was not permanently occupied until the Holocene, and occupation is likely to have been particularly transient in the early period under discussion. The population of north-west Europe can be seen as a marginal or 'sink' population (Hublin and Roebroeks, 2009; Dennell et al., 2010). Identifying cases of regional extinction of hominin populations demands use of multiple sources of data, most of which are unavailable for the Lower Palaeolithic (Hublin and Roebroeks, 2009). Nevertheless, the 'source' areas probably played an important role in human evolution in Europe (Dennell et al., 2010). Iberia, Italy, the Balkans and the Caucasus are all plausible sources for hominin populations in the Early and early Middle Pleistocene because the impact of glacial climates in these regions was limited and each formed a refugium for other plant and animal species (Hewitt, 2000). Different 'source' areas may have dominated in different temperate phases; indeed, some of these areas may also have been abandoned in the more severe glacial maxima (Agustí et al., 2009; Dennell et al., 2010). In this issue, MacDonald et al. carry out a comparative exercise, based on a review of the rich palaeoenvironmental, archaeological and hominin fossil record from Iberia. They argue that the fossil record in particular suggests discontinuity in occupation in Iberia, supporting the view that *Homo antecessor* was climate-sensitive. Comparison with this possible 'source' area highlights differences in the conditions at hominin sites in the UK, suggesting that new adaptations were needed (Ashton and Lewis, 2012), or even that the two regions were occupied by different hominins (MacDonald et al., 2012). Ultimately, this issue is difficult to resolve in the absence of early fossils from mid-latitude Europe, while some of the inferred "source" areas are even devoid of any traces of a hominin presence. The striking absence of early archaeological evidence from the Aegean, a likely refugial area and corridor, is explained by dynamic landscape processes and sea-level rise (Tourloukis, 2011; Tourloukis and Karkanas, 2012). While the role of taphonomic circumstance in determining site distribution is generally acknowledged, Tourloukis' research is an unusual example of a systematic study addressing this.

3.4. New fieldwork

New fieldwork has played a key role in stimulating reassessment of the early occupation history of Europe in general, in particular the results of the last decades of fieldwork at Atapuerca, Spain (Bermúdez de Castro et al., 2008) and Dmanisi, Georgia (Ferring et al., 2011). These two sites alone managed to overturn prominent scenarios for the colonization history of Eurasia, which illustrates how weakly grounded many of our current models are. Fieldwork in NW Europe has also been crucial in the falsification of some explanatory models, such as the "modified" Short Chronology of Dennell and Roebroeks (1996). In particular, this is the case for investigation of deposits from the Cromer Forest-bed Formation, exposed by rapid marine erosion and now a key area of research for the Leverhulme-funded Ancient Human Occupation of Britain (AHOB) project. Current fieldwork projects in East Anglia include excavations of Happisburgh site 1 by a team from Leiden University in collaboration with AHOB. This is important because of the scarcity of early Middle Pleistocene sites, and particularly because of the high-quality multi-proxy palaeoenvironmental evidence which is being recovered. In this issue, Field reports the recovery of the first British record of *Actinidia faveolata* from Happisburgh 3, which possibly has important chronological implications and sheds light on vegetation evolution in this region. Ongoing investigation of the Cromer Forest-bed Formation deposits will enrich our understanding of the chronology, environmental context and behaviour of early hominins. Less than a decade of fieldwork has already dramatically shown that these deposits, which had been under intensive investigation since the days of Charles Lyell, without producing traces of any hominin presence until recently, can still surprise us.

4. Broader context

This research has many parallels with the broader field of study of the earliest occupation of Eurasia. New fossil and archaeological discoveries have raised questions about the species that were involved, which way they were going, and where the core population areas were (Dennell and Roebroeks, 2005; Wood, 2011). The diminutive hominin fossils from Flores even present a challenge for the view that the first hominins present outside Africa were substantially different from australopithecines (Wood, 2011). As discussed above, until about 400–500 ka, convincing evidence for occupation of mid-latitude Europe outside temperate periods is lacking (Cohen et al., in this issue). This pattern from the western part of Eurasia is mirrored by Dennell's recent (in press) review of the Nihewan Basin, located more than 40° north, and of the regional record from China north of the Qinling Mountains. There, until the later part of the Middle Pleistocene, human occupation was also restricted to warmer and humid periods with a dominance of summer monsoon. According to Dennell, hominins may even have visited these areas only in summer months. Sites testifying to occupation under cooler and drier conditions date, as in Europe, to later parts of the Middle Pleistocene (Dennell, in press). This is consistent with the view that the Early Pleistocene occupation of middle latitudes in Eurasia was extremely transitory. Dennell and Roebroeks (2005) have highlighted the role of research history, and the scarcity of long sequences and large sites as factors leading to scarce early evidence particularly from the 'crossroads' area of north-west Asia. Indeed, Bermúdez de Castro and Martinón-Torres (in press) suggest that this region formed the central area from which populations dispersed during the Early and early Middle Pleistocene. Research on the earliest occupation of north-west Europe is influenced by these themes and approaches, and contributes to our understanding of these broader trends, making the contents of this special issue very timely.

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