Editorial

Introduction to special issue Humans in transition: the occupation of Western Europe, 600–400 ka

1. Introduction

The Acheulean is the longest-lasting techno-complex in prehistory and its emergence from the Oldowan is one of the major transitions in human evolution (Clark 1994; Moncel et al., 2018; de la Torre, 2016). It is widely agreed that the innovation of Acheulean technology represents a critical stage in early human development (Issac, 1986; Wynn, 1989; Stout, 2015). Its success can be measured by its persistence over more than 1.5 Myr during the Early and Middle Pleistocene, over the vast geographical area of Africa and Eurasia, and the involvement in this techno-complex of at least three hominin species—*Homo erectus, Homo heidelbergensis*, and *Homo neanderthalensis*. The Acheulean was based on the use of longer, more complex operational chains, involving centripetal and recurrent knapping, which was adapted to different raw materials to create long, functional edges on a versatile tool. The 'Acheulean revolution' was the product of two main developments: 1) the production of large flakes that could be used as blanks for creating large tools, and 2) the existence of a ‘mental template’, prior to the shaping process, an innovation derived from previous technology and essential for producing a standardized tool—the handaxe. It has been considered as the highest reflection of human cognition during the earlier Pleistocene (Wynn, 2002; Stout, 2011) and had the advantage of being multifunctional and transportable with tools that could be resharpened and readapted for further use.

The emergence of the Acheulean in Africa from ca. 1.7 Mya (e.g., Lepre et al., 2011; Beyene et al., 2013) has been suggested as a behavioral response to changing ecological conditions and associated with the evolution of *H. erectus* (de la Torre, 2016). In addition, the technical requirements of handaxe manufacture with improved cognitive abilities may have been dependent on the increase in brain size of *H. erectus*. However,

the first appearance of this species with a simple core and flake technology in eastern Asia from over 2 Myr raises questions about the significance of a simple association of *H. erectus* with handaxe technology and the 'Out of Africa' hypothesis (Zhu et al., 2018; Luo et al., 2020; Husson et al., 2022). Occupation with similar core and flake technologies appears to be later in Europe with sites such as Dmanisi in Georgia at 1.7 Myr (Ferring et al., 2011), and from 1.4 Myr further west at Pirro Nord (Arzarello et al., 2015), Orce (Toro-Moyano et al., 2011; Sánchez-Bandera et al., 2020), and Atapuerca (Carbonell et al., 2008; de Lombera-Hermida et al., 2015).

The earliest handaxe assemblages beyond Africa are currently at Ubeidiya in Israel at ca. 1.4 Myr (Bar-Yosef and Goren-Inbar, 1993; Herzlinger et al., 2021), at Attirampakkam in southern India with average cosmogenic dates of 1.5 Myr (Pappu et al., 2011), and in China from 0.9 Myr (Forestier et al., 2022). Once again there appears to be a delay in the use of this technology in Europe. Evidence of the first Acheulean industries in Europe has been refined over the last decade through the discovery of new sites, new fieldwork at 'classical' sites, and better resolution of dating. La Boella (north-east Spain), dated to 0.9–1 Myr, is the oldest known Acheulean site in Europe (Vallverdú et al., 2014; Mosquera et al., 2016; Ollé et al., 2023). This may have been a one-off innovation, but it nevertheless became more widespread from 700–600 kyr with an increase in the number of known sites, and especially from 500 kyr, when Europe seems to have been widely occupied (Moncel et al., 2015). The period from 1.2 to 0.9 Myr corresponds with less stable climatic changes, warmer periods varying in both duration and intensity, increasing varieties of habitat, and relatively humid conditions, especially in the Mediterranean and south-west Europe (Kahlke et al., 2011; Hosfield and Cole, 2018). These climatic changes favored human dispersal across this area, while dispersals towards the north were probably restricted to favorable interglacials of low seasonality and high habitat diversity. The period after 900 kyr was controlled by episodes of 100 kyr periodicity, with longer and stable climatic intervals, progressive temperature decline and increasing aridity, greater seasonality, and increasingly

specialized mammal communities, especially after 500 kyr (Moncel et al., 2016; Hosfield and Cole, 2018). These environmental changes affected the survival opportunities for humans in Europe (Rodríguez et al., 2016), particularly the more oceanic climates of western Europe. These Atlantic regions seem to have provided a persistent corridor from Iberia to France and Britain, where the earliest sites in northern Europe survive from ca. 0.9 Myr with core and flake industries (Parfitt et al., 2005, 2010), and those with handaxes from ca. 0.7 Myr (Moncel et al., 2015; Antoine et al., 2019; Davis et al., 2021). It is the work across this region that has led to the current volume.

The papers in this Virtual Special Issue emerged directly from a one-day conference held at the British Museum in October 2019. This was the final event of the Western European Acheulean Project, funded by the European Commission by a Marie Skłodowska Curie IF-EF-ST Project (Grant Agreement ID: 748316), led by Paula García-Medrano and supervised by Nick Ashton. The main aim of the project was to characterize the occupational pattern of the Western side of Europe from 700 to 300 kyr during the Middle Pleistocene (MP) through the study of handaxes and cleavers from 10 Acheulean sites across the UK, France, and Spain.

One of the most significant problems for comparing handaxe assemblages from different countries has been the various traditions of lithic analysis (e.g. Bordes, 1961; Roe, 1968; Wymer, 1968; Wenban-Smith, 1989; Boëda, 1990; Carbonell et al., 1992). The analyses have been focused on varying aspects of typology, technology, or operative chains, with different ways of categorizing or organizing information, all of which have made it very difficult to compare results. Thus, the first outcome of the project was the development of a unified protocol for technological analysis, overcoming the particular characteristics of each site and with a focus at a regional/continental scale (García-Medrano et al., 2020a, b). This new technological approach has been complemented by the use of three dimensional models to enable in-depth geometric morphometric analyses of the final shapes of tools. The unified method, combining

technology with morphometry and statistical analysis, has allowed us to define the technological similarities and differences of handaxes through Western Europe.

Having refined our understanding of the typological and technological variation in the Acheulean across Western Europe, we adopted a multidisciplinary approach to understand the evidence in the context of the complex, volatile changes in climate and environment which undoubtedly affected population dynamics through this period. This was the subject of the one-day conference 'Humans in Transition'. The multidisciplinary approach for the conference was covered by 13 talks from some of the leading specialists on these topics (Fig. 1), with an audience of more than 100 people from different disciplines and career stages from postgraduate students to professors. The multidisciplinary approach led to excellent brain-storming discussions and the idea that it would be an ideal topic for a VSI in JHE.

2. New research on Humans in Transition in Western Europe

The resulting VSI, “Humans in Transition”, explores the dynamics of the Middle Pleistocene occupation in Western Europe to address questions surrounding when, where, and how Europe was occupied, and by whom. The VSI comprises 11 papers divided into four themes. The first theme explores the distribution of hominins through modeling and mapping the environmental conditions for occupation with the perspectives of paleogeography and the ecological constraints of temperature, rainfall, and humidity. The second theme concerns the hominin species that inhabited Europe through this period; whether there was one or more species or subspecies is investigated through a comparison of the Boxgrove and Sima de los Huesos human remains. The third theme focuses on Acheulean technology and the cultural connections through Western Europe, while the fourth theme evaluates the technological innovations from the Acheulean to Middle Paleolithic industries, with two studies: the key sequence of Orgnac and the regional perspective of changes in flake tool usage at British sites.

The climatic conditions under which hominins lived in Western Europe during the Middle Pleistocene are explored and contextualized using two different approaches. The first two papers use micro-vertebrate data as the basis of analysis. López-García et al. (2021) apply a bioclimatic model to study rodent remains through the Mediterranean region, integrating the climatic parameters of mean annual temperature, mean temperature of the coldest month, and mean temperature of the warmest month. It is the first time that an analysis has included all the data from deposits with human and rodent fossils from the MP. Hominins were well adapted to diverse environmental conditions and, as a part of the ecosystem, were distributed in the region in a mosaic of microenvironments during glacial phases. The authors conclude that whereas in Iberia mild climate conditions prevailed, in southern France and northeastern Italy weather conditions were more severe. Blain et al. (2021) use statistical and geographical techniques to analyze the amphibian and reptile-based paleoclimate and habitat reconstructions to investigate if temperature, precipitation, and/or forest cover may have impacted the hominin occupation of the territory during the Early and Middle Pleistocene. Their results indicate the existence of climatic constraints associated with rainfall and humidity. The Early Pleistocene and the first half of the Middle Pleistocene were dominated by the occupation of relatively humid, wooded areas, whereas during the second part of the Middle Pleistocene, a broadening of the earlier ecological niche is clearly observed toward the occupation of more open arid areas.

The Oscillayers dataset (Gamisch et al., 2019) is the basis of the analyses of the next two studies. Rodríguez et al. (2021) review the distribution of archeological assemblages in Western Europe from MIS 14 to MIS 11 and obtain estimates of the climatic conditions. Their results show that hominins tolerated cold exposure not only during the glacial stages but also during the interglacials, with winter temperatures estimated below 0 °C at many localities. They propose that Middle Pleistocene European populations were able to endure the low temperatures of those glacial stages by

combining anatomical and physiological adaptations with behavioral responses, such as the use of shelter and simple fur clothes. By contrast, Hosfield (2022) explores the major transformation in the hominin occupation of Europe from MIS 13 to MIS 11, pointing out that climate may only be a partial factor behind the smaller-scale occupations. The increase in hominin activity during MIS 13 contrasts with the relatively severe conditions of late MIS 13, and probably reflects significant physiological and/or behavioral adaptations. The author also shows that the expanded occupation of north-western Europe during MIS 11 is probably related to the extended mild conditions of MIS 11c. Site-specific conditions in south-western Europe suggest milder winters, warmer summers, and reduced seasonal variability compared to north-western Europe. Finally, comparisons between north-western and north-central European sites indicate relatively small differences in seasonal temperatures, suggesting that climate only partially contributed to the reduced number of sites in north-central Europe during MIS 13–11.

The complexity of Middle Pleistocene settlement patterns and population diversity is reflected in the study by Lockey and colleagues (2022). They carried out an in-depth study of some of the classic human remains in Western Europe by comparing the tibia and incisors from Boxgrove (UK) with those from Sima de los Huesos (Atapuerca, Spain). The authors conclude from the analysis of the incisors that there is no justification for assigning the Boxgrove and Sima de los Huesos to distinct paleodemes. By contrast, based on the tibial data, the Boxgrove and Sima de los Huesos samples show greater differences, suggesting these two samples are unlikely to represent the same population. Thus, if the Boxgrove incisors and (one) tibia represent a single population, their combination of traits suggests distinct paleodemes as the result of complex population dynamics with varying levels of isolation and genetic flow between groups.

Variation in lithic technology during the MP of Western Europe reflects the human record, with diverse populations adapted to a wide range of environmental conditions. The abundant lithic record can be used to help track population distribution and

movement. The third theme draws together three different studies that focus on some of the key sites in Western Europe (e.g., la Noira and Menez Dregan) as well as on regional approaches to Acheulean variability from MIS17 to MIS11. Moncel and colleagues (2021) present an in-depth technological analysis of the la Noira site (France) comparing its two archaeological levels, strata a, dated to ca. 700 ka, with strata c, dated to ca. 450 ka. Given the significant time gap between the two levels, the site poses the question of whether there is evidence at this site of continuity or discontinuity in lithic technology. The climatic evidence would suggest that during this period there would have been, if not a depopulation of Europe, significant shifts in population distribution and perhaps a decrease in occupational intensity, particularly during the intense cold of MIS 12. The archaeological evidence from la Noira indicates that populations returned to the area at the end of MIS 12 or the beginning of MIS 11, having maintained some technological traditions, but also show several technological innovations and wider landscape use.

From MIS 12–11, the occupation of Europe shows both an increase in the archaeological evidence and a strong adaptation to localized territories, with longer periods of continuous occupation and a greater variety of technological adaptations. Menez-Dregan I is one of the few sites with a long sequence of Middle Pleistocene occupation from MIS 12 to MIS 5. Ravon et al. (2022) offer a detailed diachronical assessment of the complete sequence of the site, showing the persistent use of the same lithic raw materials and technologies, including fire use, through the sequence. The results suggest the development of a material culture that reflects the local resources and environment and sustained hominin occupation of the area, despite varying climate. To complement this scenario, Ashton and Davis (2021) present a regional analysis of the British record between MIS 15 and MIS 11, where hominin occupation was more sporadic and driven by cyclical climate change. They use the British data to examine the implications for Europe and propose the 'Cultural Mosaic Model.' Their findings suggest that the Acheulean reflects a range of expressions, which is unlikely to be caused purely by raw material constraints or functional variation, but rather reflects regional populations

with different material cultures. They suggest that these regional signatures were maintained through stable climate, but that environmental disruption through climate change caused increased population movement, but with the benefits of increased knowledge transfer and gene exchange.

The technological innovations of the Middle Paleolithic, particularly the use of Levallois technology, are the key to understanding the end of the Acheulean. Recent research has established that the oldest Neanderthal fossils and the first signs of their technologies and behavior appear from MIS 11 or possibly earlier. But did the new technological complexity of the Middle Paleolithic represent an abrupt change or was it a gradual process? Bahain et al. (2021) provide a new chronological framework for the Orgnac 3 sequence, using TL and ESR/U-series data. Their research confirms the attribution of the Orgnac 3 archaeological sequence to MIS 10–8. Although the earliest Levallois core technology is sporadically recorded earlier than at Orgnac 3, the transition of an interglacial/glacial period (MIS 9/8) marks the first persistent and prevalent use of Levallois technology. The authors conclude that Levallois debitage at Orgnac 3 appeared progressively rather than suddenly. The Lower to Middle Paleolithic transition was examined from a different angle by Rawlinson et al. (2022) through the analysis of the flake tool component from 25 British sites attributed to MIS 9. The authors demonstrate more continuity than change in relation to earlier periods. Contrary to the perception that there is an increase in flake tool use prior to the Middle Paleolithic, the British evidence shows little increase in the flake tool component or in the elaboration of scrapers. They also conclude that the presence of more elaborate flake tools in MIS 9 does not appear to be linked to the prepared core technology.

The last paper of the volume presents a regional interpretation of Acheulean technology. García-Medrano and colleagues (2023) present a technological and morphometrical analysis of handaxes and cleavers from 10 Middle Pleistocene sites in Western Europe. The authors highlight the existence of two main technological groups in the sampled record: 1) northwestern and central France and Britain, from MIS 17/16

to MIS 11, and 2) the Atlantic edge, from MIS 12/11 to MIS 8. The authors show that shaping of large tools was developed as a continuum of accumulative actions, with longer and more complex shaping strategies over time. In addition, shaping technology shows traditions of manufacture over both time and across geographical areas, which indicate cultural diffusion. Moreover, the geometric morphometric analysis helped to identify not only general trends but also local adaptations in handaxe forms. García-Medrano et al. (2023) concluded there were no apparent sudden innovations, but rather the application and development of specific techniques to refine size and shape.

3. Conclusions

"Humans in Transitions" explores the dynamics of the Middle Pleistocene occupation in Western Europe from a multidisciplinary perspective, linking discussion about environmental conditions, ecological constraints, hominin species, variability of Acheulean technology and the transition towards the Middle Paleolithic.

A period of complex changes in climate and environment should affect population dynamics. According to the compiled studies, rainfall and humidity meant a clear constraint, displacing the occupation from humid and wooded areas during the early Middle Pleistocene to more open arid areas during the second part of this period. Nevertheless, temperature had a partial effect on Middle Pleistocene human occupations. Those populations were adapted to lower temperatures through a combination of physiological adaptations and innovations. The population complexity, the apparent co-existence of different human lineages/species, and the taxonomically mosaic anatomies found in some of the fossils is attested when comparing Boxgrove and Atapuerca-Sima de los Huesos fossils. Their morphological differences show two different paleodemes in Western Europe.

The diverse populations adapted to different environmental conditions are reflected in technological variations. Technological analysis points to a clear connection between France and Britain, from MIS17/16 to MIS11. This technology remained stable

as an accumulative process of knowledge, with increments in the degree of complexity and the production of increasingly standardized tools. But from MIS12, increased population, its diversity and adaptation to different scenarios is in part reflected in the use of new raw materials through simpler technological approaches in southwest Europe, compared to northwest Europe, and with a strong regionalization of technology, which resulted in different material cultures.

The multidisciplinary approach to the archaeological record supports the regional interpretation of data. Nevertheless, to understand the particularities of each site is the only way to get a fruitful discussion about population dynamics on a wider canvas. The archaeological register always offers an incomplete scenario. We should continue adding sites, compiling knowledge and filling spatial and chronological gaps to understand how Humans transited through Europe during the Middle Pleistocene.

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References

Antoine, P., Moncel, M.-H., Locht, J.-L., Bahain, J.-J., Voinchet, P., Herisson, D., Hurel, A., 2019. The earliest record of Acheulean Human occupation from Northern Europe and the rediscovery of the Moulin Quignon site. Sci. Rep. 9, 13091.

Arzarello, M., Peretto, C., Moncel, M.H., 2015. The Pirro Nord site (Apricena, Fg, Southern Italy) in the context of the first European peopling: Convergences and divergences. Quat. Int. 389, 255–263.

Ashton, N.M., Davis, R.J. 2021. Cultural mosaics, social structure and identity: The Acheulean threshold in Europe. J. Hum. Evol. 156, 103011.

Bahain, J.-J., Mercier, N., Valladas, H., Falguères, C., Masaoudi, H., Joron, J.-L., Froget, L., Moigne, A.-M., Combier, J., Moncel, M.-H., 2021. Reappraisal of the chronology of Orgnac 3 Lower-to-Middle Paleolithic site (Ardèche, France), a regional key sequence for the Middle Pleistocene of southern France. J. Hum. Evol. 162, 103092.

Bar-Yosef, O., Goren-Inbar, N., 1993. The Lithic Assemblages of ‘Ubeidiya, a Lower Paleolithic Site in the Jordan Valley. Institute of Archaeology, Hebrew University of Jerusalem, Jerusalem.

Beyene, Y., Katohc, S., WoldGabriel, G., Harte, W.K., Uto, K., Sudo, M., Kondo, M., Hyodo, M., Renne, P.R., Suwa, G., Asfaw, B., 2013 The characteristics and chronology of the earliest Acheulean at Konso, Ethiopia. Proc. Nat. Acad. Sci. USA 110, 1584–1591.

Blain, H-A., Fagoaga, A., Ruiz-Sánchez, F.J., García-Medrano, P., Ollé, Jiménez-Arenas, J.M., 2021. Coping with arid environments: A critical threshold for human expansion in Europe at the Marine Isotope Stage 12/11 transition? The case of the Iberian Peninsula. J. Hum. Evol. 153, 102950.

Boëda, É., Geneste, J.M., Meignen, L., 1990. Identification de chaînes opératoires lithiques du Paléolithique ancien et moyen. Paleo 2, 43–80.

Bordes, F., 1961. Typologie du Paléolithique Ancien et Moyen. Delmas, Bordeaux.

Carbonell, E., Mosquera, M., Ollé, A., Rodríguez, X.P., Sala, R., Vaquero, M., Vergés, J.M., 1992. New elements of the logical analytic system. Cahier Noir 6, 5–61.

Carbonell, E., Bermúdez de Castro, J.M., Parés, J.M., Pérez-González, A., Cuenca-Bescós, G., Ollé, A., Mosquera, M., Huguet, R., van der Made, J., Rosas, A., Sala, R., Vallverdú, J., García, N., Granger, D.E., Martinón-Torres, M., Rodríguez, X.P., Stock, G.M., Vergès, J.M., Allué, E., Burjachs, F., Cáceres, I., Canals, A., Benito, A., Díez, C., Lozano, M., Mateos, A., Navazo, M., Rodríguez, J., Rosell, J., Arsuaga, J.L., 2008. The first hominin of Europe. Nature 452, 465–467.

Clark, J. D., 1994. The Acheulian industrial complex in Africa and elsewhere. Integrative paths to the past. In: Corrucini, R.S., Ciochon, R.L. (Eds.). Paleoanthropology Advances in Honor of F. Clark Howell. Prentice-Hall, New Jersey, pp. 451–469.

Davis, R.J., Ashton, N.M., Hatch, M.T., Hoare, P.G., Lewis, S.G., 2021. Palaeolithic archaeology of the Bytham River: Human occupation of Britain during the early Middle Pleistocene and its European context. J. Quat. Sci. 36, 526–546.

de la Torre, I., 2016. The origins of the Acheulean: Past and present perspectives on a major transition in human evolution. Philos. Trans. R. Soc. B. Biol. Sci. 371, 20150245.

de Lombera-Hermida, A., Bargalló, A., Terradillos-Bernal, M., Huguet, R., Vallverdú, J., García-Antón, M.-D., Mosquera, M., Ollé, A., Sala, R., Carbonell, E., Rodríguez-Álvarez, X.-P., 2015. The lithic industry of Sima del Elefante (Atapuerca, Burgos, Spain) in the context of Early and Middle Pleistocene technology in Europe. J. Hum. Evol. 82, 95–106.

Ferring, R., Oms, O., Agustí, J., Berna, F., Nioradze, M., Sheila, T., Tappern, M., Vekua, A., Zhvania, D., Lordkipanidze, D. 2011. Earliest human occupations at Dmanisi (Georgian Caucasus) dated to 1.85-1.78 Ma. Proc. Natl. Acad. Sci. USA 108, 10432–10436.

Forestier, H., Zhou, Y., Sophady, H., Li, Y. Codeluppi, D., Auetrakulvit, P., Zeitoun, V. 2022. The first lithic industry of mainland Southeast Asia: Evidence of the earliest hominin in a tropical context. L'Anthropologie 126, 102996.

García-Medrano, P., Ashton, N., Moncel, M.-H., Ollé, A., 2020a. The WEAP method: A new age in the analysis of the Acheulean handaxes. J. Paleolit. Archaeol. 3, 756–793.

García-Medrano, P., Maldonado-Garrido, E., Ashton, N., Ollé, A., 2020b. Objectifying processes: The use of geometric morphometrics and multivariate analyses on Acheulean tools. J. Lithic Stud. 7(1).

García-Medrano, P., Moncel, M.H., Maldonado-Garrido, E., Ollé, A., Ashton, N., 2023. The Western European Acheulean: Reading variability at a regional scale. J. Hum. Evol. 179, 103357.

Gamisch A., 2019. Oscillayers: A dataset for the study of climatic oscillations over Plio-Pleistocene time-scales at high spatial-temporal resolution. Glo. Ecol. Biogeogr. 28:1552–1560.

Herzlinger, G., Brenet, M., Varanda, A. Deschamps, M., Goren-Inbar, N., 2021. Revisiting the Acheulian large cutting tools of 'Ubeidiya, Israel. J. Paleolit. Arch. 4, 31.

Hosfield, R.T., 2022. Variations by degrees: Western European paleoenvironmental fluctuations across MIS 13–11. J. Hum. Evol. 169, 103213.

Hosfield, R.T., Cole, J., 2018. Earliest Europeans: Integrating perspectives from archaeology, palaeoanthropology and palaeoclimatology. Quat. Sci. Rev. 208, 140–142.

Husson, L., Salles, T., Lebatard, A.E., Zerathe, S., Braucher, R., Noerwidi, S., Aribowo, S., Mallard, C., Carcaillet, J., Natawidjaja, D.H., Bourlès, D., Aumaitre, G., Bourlès, D., Keddadouche, K., 2022. Javanese *Homo erectus* on the move in SE Asia circa 1.8 Ma. Sci. Rep. 12, 19012.

Isaac, G., 1986. Foundation stones: Early artefacts as indicators of activities and abilities. In: McBurney, C.B.M., Bailey, G.N., Callow, P. (Eds.), Stone-Age Prehistory: Studies in Memory of Charles McBurney. Cambridge University Press, New York, pp. 221–241.

Kahlke, R.-D., García, N., Kostopoulos, D.S., Lacombat, F., Lister, A.M., Mazza, P.P.A., Spassov, N., Titov, V.V., 2011. Western Palaearctic palaeoenvironmental conditions during the Early and early Middle Pleistocene inferred from large mammal communities, and implications for hominin dispersal in Europe. Quat. Sci. Rev. 30, 1368–1395.

Lepre, C.J., Roche, H., Kent, D.V., Harmand, S., Quinn, R.L., Brugal, J.-P., Texier, P.-J., Lenoble, A., Feibel, C.S., 2011. An earlier origin for the Acheulian. Nature 477, 82–85.

Lockey, A.L., Rodríguez, L., Martín-Francés, L., Arsuaga, J.L., Bermúdez de Castro, J.M., Crété, L., Martinón-Torres, M., Parfitt, S., Pope, M., Stringer, C. 2022. Comparing the Boxgrove and Atapuerca (Sima de los Huesos) human fossils: Do they represent distinct paleodemes? J. Hum. Evol. 172, 103253.

López-García, J.M., Cuenca-Bescós, G., Galindo-Pellicena, M.A., Luzi, E., Berto, C., Lebreton, L., 2021. Rodents as indicators of the climatic conditions during the Middle Pleistocene in the southwestern Mediterranean region: Implications for the environment in which hominins lived. J. Hum. Evol. 150, 102911.

Luo, L., Granger, D.E., Tu, H., Lai, Z., Shen, G., Bae, C.J., 2020. The first radiometric age by isochron 26Al/10Be burial dating for the Early Pleistocene Yuanmou hominin site, southern China. Quat. Geochronol. 55, 101022.

Moncel, M.-H., Ashton, N., Lamotte, A., Tuffeau, A., Cliquet, D., Despriée, J., 2015. The Early Acheulian of north-western Europe. J. Anthropol. Archaeol. 40, 302–331.

Moncel, M.H., Arzarello, M., Peretto, C. 2016. The Hoslteinian period in Europe (MIS 11-9). Quat. Int. 409(Part B), 1–8.

Moncel, M.-H., Arzarello, M., Boëda, E., Bonilauric,S., Chevrierc, B., Gaillarda, C., Forestiera, H., Yinghuad, L., Sémaha, F., Zeitoune, V., 2018. Assemblages with bifacial tools in Eurasia (third part). Considerations on the bifacial phenomenon throughout Eurasia. C. R. Paleovol 17(1–2), 77–97.

Moncel, M.-H., García-Medrano, P., Despriée, J., Arnaud, J., Voinchet, P., Bahain, J.-J., 2021. Tracking behavioral persistence and innovations during the Middle Pleistocene in Western Europe. Shift in occupations between 700 and 450 ka at la Noira site (Centre, France). J. Hum. Evol. 156, 103009.

Mosquera, M., Ollé, A., Saladié, P., Cáceres, I., Huguet, R., Rosas, A., Villalaín, J., Carrancho, A., Bourlès, D., Braucher, R., Pineda, A., Vallverdú, J., 2016. The Early Acheulean technology of Barranc de la Boella (Catalonia, Spain). Quat. International, 393, 95–111.

Ollé, A., Lombao, D., Asryan, L., García-Medrano, P., Arroyo, A., Fernández-Marchena, J.L., Yeşilova, G.C., Cáceres, I., Huguet, R., López-Polín, L., Pineda, A., García-tabernero, A., Fidalgo, D., Rosas, A., saladié, P., Vallverdú, P., 2023. The earliest European Acheulean: new insights into the large shaped tools from the late Early Pleistocene site of Barranc de la Boella (Tarragona, Spain). Front. Earth Sci. 11

Pappu, S., Gunnell, Y., Akhilesh, K., Braucher, R., Taieb, M., Demory, F., Thouveny, N., 2011. Early Pleistocene presence of Acheulian hominins in South India. Science 331, 1596–1599.

Parfitt, S.A., Barendregt, R.W., Breda, M., Candy, I., Collins, M.J., Coope, G.R., Durbidge, P., Field, M.H., Lee, J.R., Lister, A.M., Mutch, R., Penkman, K.E.H., Preece, R.C., Rose, J., Stringer, C.B., Symmons, R., Whittaker, J.E., Wymer, J.J., Stuart, A.J., 2005. The earliest record of human activity in northern Europe. Nature 438, 1008–1012.

Parfitt, S.A., Ashton, N.M., Lewis, S.G., Abel, R.L. Coope, G.R., Field, M.H., Gale, R., Hoare, P.G., Larkin, N.R., Lewis, M.D., Karloukovski, V., Maher, B.A., Peglar, S.M., Preece, R.C., Whittaker, J.,E., Stringer, C.B., 2010. Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe. Nature 466, 229–233.

Ravon, A.-L., García-Medrano, P., Moncel, M.-H., Ashton, N.M. 2022. Acheulean variability in Western Europe: the case of Menez-Dregan I (Plouhinec, Finistère, France). J. Hum. Evol. 162, 103103.

Rawlinson, A., Dale, L., Ashton, N.M., Bridgland, D.R., White, M.J. 2022. Flake tools in the European Lower Palaeolithic: A case study from MIS 9 Britain. J. Hum. Evol. 165, 103153.

Rodríguez, J., Mateos, A., Hertler, C., Palombo, M.R. 2016. Modelling human presence and environmental dynamics during the Mid-Pleistocene Revolution: New approaches and tools. Quat. Int. 393, 19–23.

Rodríguez, J., Willmes, C., Mateos, A., J., 2021. Shivering in the Pleistocene. Human adaptations to cold exposure in Western Europe from MIS 14 to MIS 11. J. Hum. Evol. 153, 102966.

Roe, D.A., 1968. British Lower and Middle Palaeolithic Handaxe Groups. Proc. Prehist. Soc. 34, 1–82.

Sánchez-Bandera, C., Oms, O., Blain, H.-A., Lozano-Fernández, I., Bisbal-Chinesta, J.F., Agustí, J., Saarinen, J., Fortelius, M., Titton, S., Serrano, A., Luzon, C., Solano-García, J., Barsky, D., Jiménez-Arenas, J.M., 2020. New stratigraphically constrained palaeoenvironmental reconstructions for the first human settlement in Western Europe: the Early Pleistocene herpetofaunal assemblages from Barranco León and Fuente Nueva 3 (Granada, SE Spain). Quat. Sci. Rev. 243, 106466.

Stout, D., 2011. Stone toolmaking and the evolution of human culture and cognition. Philos. Trans. R. Soc. B. Biol. Sci. 366, 1050–1059.

Stout, D., 2015. Cognitive demands of lower Paleolithic toolmaking. PLoS One, 10, e0121804.

Toro-Moyano, I., Martínez-Navarro, B., Agustí, J., Souday, C., Bermúdez de Castro, J. M., Martinón-Torres, M., Palmqvist, P., 2013. The oldest human fossil in Europe, from Orce (Spain). J. Hum. Evol. 65, 1–9.

Vallverdú, J., Saladié, P., Rosas, A., Huguet, R., Cáceres, I., Mosquera, M., Garcia-Tabernero, A., Estalrrich, A., Lozano-Fernández, I., Pineda-Alcalá, A., Villalaín, J.J., Bourlès, D., Braucher, R., Lebatard, A., Vilalta, J., Esteban-Nadal, M., Lluc Bennàsar, M., Bastir, M., López-Polín, L., Ollé, A., Vergé, J.M., Ros-Montoya, S., Martínez-Navarro,

B., García, A., Martinell, J., Expósito, I., Burjachs, F., Agustí, J., Carbonell, E., 2014. Age and date for early arrival of the Acheulian in Europe (Barranc de la Boella, la Canonja, Spain). Plos One 9, e103634.

Wenban-Smith, F.F., 1989. The use of canonical variates for determination of biface manufacturing technology at Boxgrove Lower Palaeolithic site and the behavioural implications of this technology. J. Archaeol. Sci. 16, 17–26.

Wymer, J.J., 1968. Lower Palaeolithic Archaeology in Britain as Represented by the Thames Valley. John Baker, London.

Wynn, T., 1989. The Evolution of Spatial Competence. University of Illinois Press, Illinois.

Wynn, T., 2002. Archaeology and cognitive evolution. Behav. Brain Sci. 25, 389–402.

Zhu, Z., Dennell, R., Huang, W., Wu, Y., Qiu, S., Yang, S., Rao, Z., Hou, Y., Xie, J., Han, J., Ouyang, T., 2018. Hominin occupation of the Chinese Loess Plateau since about 2.1 million years ago. Nature 559, 608–612

Figure caption

Figure 1. Participants in the 'Humans in Transition' one-day Conference at the British Museum. From right to left: Matt Pope, Chris Stringer, Juan Luis Arsuaga, Hugues-Alexandre Blain, María Martinón-Torres, Robert Hosfield, Jesús Rodríguez, Paula García-Medrano, Anne-Lyse Ravon, Andreu Ollé, John Gowlett, Marie-Hélène Moncel and Nick Ashton.

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