**Editorial**

**The Acheulean in Europe: origins, evolution and dispersal**

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The collected works in this Special Issue represent outputs stemming from an international conference that was organized at the National Museum of Natural History in Paris, France, in November 2014, on the subject of sites with bifacial (Acheulean) technology in Europe. This event was supported by the National Museum of Natural History, the Centre National de la Recherche Scientifique, the Wenner-Gren Foundation, the Ile de France and Centre Regions, the Ministry of Culture and Ministry Foreign Office (Embassies) and Archea association (Centre Region). The conference was also under the patronage of UNESCO.

Over the last decades, new data from both Northern and Southern Europe fix the earliest appearance of assemblages with bifacial tools in Europe between 900 and 500 ka, providing new evidence about the onset of handaxe-making behaviour in this region. While handaxes appeared in Africa as early as 1.8 Ma, this tradition appeared later (700-600 ka) on the European continent and was apparently then only present in Western and Southern Europe (Beyene et al., 2013; de la Torre, 2011; Lepre et al., 2011). The origins of this tradition in Europe are difficult to establish, for example it is possible that the technique was spread rapidly through Western Europe by one or more new hominin species, or that there were discrete dispersals of this new technology from Asia through corridors of diffusion. Finally, the possibility that handaxe-making evolved locally in some areas cannot be ruled out at this stage. What is clear, however, is that the simple hypothesis of arrival of this new tradition first in the South before rapid diffusion to the North from 500 ka must be revisited and that new hypotheses on the timing, mode of diffusion and development over time of these assemblages must be formulated (Schreve et al., 2015). Of equal importance is the role of climate, environment and biogeography in the spread of the Acheulean, in particular the occurrence of periods of favourable climatic conditions, biogeographical barriers, competition from large carnivores and changing prey availability.

Assemblages with bifacial tools demonstrate a high diversity of technological and morphological features as early as 700 ka and are contemporary with non-handaxe assemblages. They also show specific features that contrast assemblages from Northern and Southern Europe (for instance, the use or otherwise of large flakes for bifacial manufacture, the presence or otherwise of cleavers on flakes). This diversity continues through time, even if assemblages dated to 500-350 ka are sometimes considered to be more standardized in terms of their bifacial tools.

The overarching goal of this meeting was to compare sites that have yielded handaxes dated between 900 and 350 ka, above and below the 45th parallel. Key themes to be explored concerned the geographical and environmental context of the sites, the need for underpinning by a detailed and robust chronological framework, and consideration of the hominin makers themselves, *Homo heidelbergensis* *versus* *Homo antecessor*, although the identity of the species (possibly more than one) remains controversial. Key questions included: 1) How did this tradition develop over time in both the South and the North of Europe?, 2) Does the earliest evidence reflect only sporadic Acheulean occupation, before the technology spread over Europe?, 3) Do the assemblages suggest one single locus of innovation (Africa?) or multiple centres including Europe?, 4) Can common technological or use (subsistence) strategies be defined despite the apparent diversity in the record?, and 5) Can distinct technological and typological phases for the Acheulean be identified through time that might reflect multiple influences or influxes of people or local transformations? The communications presented focused not only on individual site cases but also on regional syntheses, thereby allowing overview of the state-of-the-art regarding palaeoenvironmental context, chronology and hominin behaviours.

This Special Issue is mainly devoted to exploring palaeoanthropological behavioural and archaeological data in the Acheulean of Europe and western Asia. A sister volume, published in the *Journal of Quaternary Sciences* (volume 30, 7, 2015) is devoted to the chronological and palaeoenvironmental evidence from these earliest Acheulean sites (Schreve et al., 2015). The shift to a 100 ka climatic cycle during the Mid Pleistocene Revolution led to the replacement of established widespread forests by mosaics of trees and more open environments, as well as the extension of grasslands into the higher latitudes, thereby opening or closing corridors for the dispersal of mammalian taxa (Almogi-Labin, 2011; Rodríguez et al., 2011; Abbate and Sagri, 2012; Martínez et al., 2014; Lozano et al., 2015; Markova and Vislobokova, 2015). However, the relationships between faunal turnovers across Eurasia and the onset of bifacial technology are not always easy to establish, due to a lack of clear mammalian dispersal events from Africa into Eurasia between 780 and 500 ka. Nevertheless, the demise of many large carnivores around 1Ma and further turnover in the carnivore guild around 500ka are likely to have played an important role in allowing the hominin niche to expand (Turner, 1992; Abbazzi et al., 2000; Stiner, 2002; Cuenca-Bescos et al., 2010; Bar-Yosef and Belmaker, 2011; Chapais, 2011; Manzi et al., 2011).

Cyclical climate changes, such as the major glaciations of MIS 16 and MIS 12, would have led to successive depopulation or extinction (especially on the North-West), and subsequent recolonization events aided by new techniques and new social organizations or the diffusion of traditions from group to group on a Mode 1-type (cores-and-flakes industries) substratum (Manzi, 2004). A second, later transition (Mid-Brunhes Event -MBE) occurred between MIS 13 and 11 and would have allowed for a more widespread diffusion of elaborate bifacial manufacture techniques aided for some authors by the sporadic control of fire (Gowlett, 2006; Roebroeks and Villa, 2011). A certain stability of the climatic context (even if the amplitude of glacial/interglacial cycles was wide) would have favoured moreover diffusion of some technological novelties and 9 and demographic expansion over Western Europe bewteen MIS 11 and 9 (Geyh and Müller, 2005; Rohling et al., 2010; Kleinen et al., 2014).

The scene was set concerning the state of palaeoanthropological knowledge in Europe with presentations by Stringer on human evolution in the Middle Pleistocene (Compton and Stringer, 2015; Stringer, 2014; Stringer, 2012), M-A. de Lumley on the Caune de l’Arago remains from France (de Lumley, 2015) and Manzi on the case-study of Ceprano, Italy (Manzi et al., 2011; Manzi, 2016). The morphological diversity seen in the sparse hominin remains preserved across Europe raises considerable questions as to the variability of *Homo heidelbergensis* and the potential presence of multiple hominin species that might account for the diversity of technological behaviours seen over time. The Ceprano skull, recently re-dated to a younger age than previously thought (now around 350 ka) epitomises this level of variability in anatomical features (Manzi et al., 2010). The early part of the late Middle Pleistocene also sees the ‘neanderthalisation’ in many key specimens (Swanscombe, Bilzingsleben), discussed in a keynote lecture by Hublin, “The Origin of Neandertals: Revisiting the Accretion Model”.

**Acheulean or not Acheulean?**

The term Acheulean has been frequently discussed since its first mention by V. de Pradennes and G. de Mortillet in the 19th century, with the debate accelerating over the last decade. Some authors consider that the term is a useful one to retain in order to describe assemblages with evidence of bifacial technology, irrespective of the morpho-technological details. Others believe the term should apply more to the range of behaviours on display, while still other workers argue for its deletion (Aureli et al., 2015; Boëda, 2005; Nicoud, 2013; Rocca et al., 2016). What is certainly true is that a “one size fits all” Acheulean model may now no longer be realistic, given the gaps in the dataset, especially for the earliest evidence, and difficulties establishing the nature of activities or types of site present, based on the composition of the archaeological assemblages.

R. Gallotti reviewed for the conference the available data from both Africa and Europe, showing the discontinuity in the available patterns on the bifacial and core technologies. Any attempt towards large-scale syntheses is currently not scientifically relevant. The Acheulean needs to be redefined based on systematic and detailed studies of complete collections at the «micro-regional» scale, including an evaluation of the role played by geological, biological and ecological factors on lithic production (Gallotti, 2015; Gallotti and Peretto, 2015). This type of integrated approach has recently led to revision of the date of the Italian site of Isernia by 39Ar/40Ar to 583-561 ka, thereby requiring revision of the archaeological sequence (Peretto et al., 2015a).

Recent work in East Africa has indicated that the presence of bifaces is not the only criterion to characterize new archaeological behaviours in Africa since 1.8 Ma and then again after 1 Ma (de la Torre, 2011). Aspects such as raw material management, core technology and use of territory change both gradually or abruptly. Describing bifacial technology is consequently not the only way to discuss lithic assemblages and interpret stone tool traditions, whatever continent one is on. Moreover, bifacial technology is not recorded at some sites, although certain technological strategies and novelties (namely in core technology) were apparently common with sites yielding bifaces. For instance, during Marine Oxygen Isotope Stage (MIS) 9, specialized sites for the butchery of large herbivores in Latium, Italy (perhaps surprisingly) do not all record bifacial technology. The industries of La Polledrara de Cecanibbio were made on small nodules, producing small flakes apparently useful for managing carcasses of elephants (Anzidei et al., 2012; Santucci et al., 2015). In contrast, at Castel di Guido, bifaces made on elephant bone appear to have at least partially replaced stone implements and were shaped and re-sharpened in the same way as stone bifacial tools made on large pebbles ( Radmilli and Boschian, 1996; Boschian and Saccà, 2014). Tradition, specific activities and raw material availability therefore seem to have intersected in a way that we often struggle to disentangle, based on the composition of the assemblages and the strategies performed (Key and Lycett, 2015; Moncel et al., 2015).

An understanding of the influence of raw material shape (for example the use of rounded nodules) allows a flexibility in the core technology, a criterion which may then be used to compare series (Guardiola et al., 2015). Similarly, Viallet (2015)’s discussion of macro-traces on bifaces from Terra Amata presents an alternative way of connecting modes of *façonnage* and modes of use in these frequently multifunctional tools (Viallet, 2016). Equally, a new program of automated refitting was presented by Davis et al., based on the Boxgrove and Atapuerca sites, thereby establishing future prospects for the more effective management of large lithic assemblages (Davis et al., 2014b).

Furthermore, experimental studies of bifaces and core technologies indicate that individual parameters and modes of social learning may affect the diversity seen in lithic assemblages. S.J. Lycett et al. demonstrated the factors affecting handaxe variation through the application of experimental approaches to cultural transmission parameters (imitation *v.* emulation) (Kempe et al., 2012; Lycett et al., 2015; Schillinger et al., 2015). For these authors, identifying individual factors of potential influence is therefore essential for the understanding of the Acheulean phenomenon at the macroscale.

Boëda’s techno-functional methodology raised the question of sophism regarding special pleading for the Acheulean classification of sites (Boëda, 1991; Boëda E., 2014). Building on this approach, M. Chazan discussed the concept of adaptive radiation in the Levant for the late Lower Palaeolithic and the emergence of the Early Middle Palaeolithic in MIS 7 (Chazan, 2016). Equally, R. Rocca explored hypotheses regarding the lack of bifacial technology in Central Europe and compared these assemblages with those containing small tools and rare bifaces in Central Europe and Italy (Rocca et al., 2015). From the same perspective, E. Nicoud assessed the local origins of bifacial technology in Europe and suggested the presence of several groups of bifacial traditions existing after MIS 12, possibly as the result of external influences (Nicoud E., 2013, 2014)

A scarcity of sites with bifacial tools between 900 and 500 ka is followed by a major dispersal of hominins with bifacial technology after MIS 12 in Western Europe. The specific time period of interest here is centred on the Middle Pleistocene Transition (MPT) after the Brunhes-Matuyama palaeomagnetic reversal at 780 ka. This intensification of climatic cooling led to an extension of grassland habitats into higher latitudes, thereby opening and/or closing corridors for migration in these regions (Ashton and Lewis, 2012; Head and Gibbard, 2015).The reasons for the Acheulean expansion must therefore be examined through a comparison the core technologies and modes of shaping of bifacial tools against the palaeoenvironmental data for each site, as well as the earliest technological data available in Europe, in order to explore the possibilities of breaks in traditions or parallel local originations.

**The Levantine record**

The earliest evidence of African bifaces occurs in the Levant at 1.8 Ma. The celebrated assemblages from ‘Ubeidiya (1.4-1.2 Ma) suggest, for some authors, a link between East Africa and the Levant through corridors of dispersal (Bar-Yosef and Goren-Inbar, 1993; Sharon et al., 2010; Chevrier B., 2011; Lepre et al., 2011; Beyene et al., 2013). M. Devès and colleagues introduced the idea of complex topography and heterogeneous landscapes, integrated with evidence for soils and animal movements, in order to explain the locations of sites, using Levantine and African examples (Devès et al., 2014; Devès et al., 2014)

The hypothesis of diffusion of bifacial traditions at the end of the Middle Pleistocene is supported by the recent discovery of the site of Rodafnidia-Lisvori on Lesvos (Galanidou et al., 2013),. Early arrivals in Europe could have come from either the Levant or possibly via the Straits of Gibraltar, a hypothesis recently revisited by Sharon (2011) and Santonja et al. (2015). At the gate-way of Europe, the occurrence of the Large Flake Acheulean, as seen in the Levant and Spain, could represent one phase of the “Out of Africa” scenario, the earliest stage of the European Acheulean ( Sharon, 2010; Sharon and Barsky, 2015). In contrast, other authors, such as B. Chevrier in his consideration of the lithic series of Kokiselei 4 and Ubeidiya, consider in contrast that the Levantine Acheulean was an independent phenomenon arrived at by techno-functional convergence (Chevrier, 2011). Additional behaviours from this period, such as evidence of hafting present on the proximal parts of flakes at Gesher Benot Ya‛aqov (c. 800ka), were described by Alperson-Afil and Goren-Inbar (Alperson-Afil and Goren-Inbar, 2016).

Levantine assemblages display variation over time and the meaning of sequences such as Nadaouiyeh was discussed by R. Jagher (Jagher, 2016). Bifaces, made both on flint or on poor quality raw materials, are the main component throughout the sequence, with less elaborate bifaces becoming more frequent towards the top. These data indicate the range of technological and stylistic changes within the Acheulean. Variability in traditions and/or temporal hiatuses with the emergence of new traditions can therefore be imagined.

Finally, the evidence from the Georgian sites of Koudaro and Tsona in the South Caucasus provides a reminder that although radiations could potentially occur from the Levant, the Caucasus Mountains acted as a biogeographical barrier, leading to both unique and shared features with the Levantine record as regards the bifacial tools (Mgeladze and Moncel, 2015). Bifacial technology apparently never crossed the Caucasus Mountains and did not reach the North Caucasus (Blackwell et al., 2005; Doronichev and Golovanova, 2010; Doronichev, 2015).

**Acheuleans in Southern Europe**

Recent discoveries over the last decade in southern Europe have raised further questions as to the onset of bifacial technology. The site of La Boella in Spain has yielded two crude bifacial tools dated at around 900-800 ka. Sporadic partial bifacial tools are found in some sites in Europe but they seem to be local attempts to shape bifacially, since there is no similarity with the phases seen in Africa (de Lombera-Hermida et al., 2015; Moncel et al., 2015). La Boella may therefore be the only currently-known example for the Early Pleistocene through which the question of a possible local origin or of early, sporadic arrivals of new hominins or traditions in Europe can be addressed (Vallverdú et al., 2014; Mosquera et al., 2015a, 2015b).

In Italy, the sequence of Notarchirico (Venosa, Basilicate) is provides additional evidence for the onset of bifacial technology. The date of the site has recently been revised through 39Ar/40Ar dating of the volcaniclastic deposits, yielding an age of 670 ka (Pereira et al., 2015). Hominins were present at this site during a period of cold-climate conditions, MIS 16, indicates that the palaeoclimatic gradient played a major role in influencing hominin dispersal during periods of climatic deterioration; these would have been particularly significant in northern Europe, suggesting that the Mediterranean region fulfilled an important refugial function. Some levels at Notarchirico have yielded bifaces and a large quantity of bifacial pointed chopping-tools characterizes the the entire series (Santagata, 2016). The bifacial management seen suggests, however, that the site could have witnessed punctuated arrivals of hominins or new traditions in Southern Europe before 500 ka (Moncel et al., 2015; Moncel et al., 2015; Santagata, 2012). At Lézignan-la-Cèbe, Hérault (France), level US4 also contains some pieces attributed to the Large Flake Assemblages (LFA), attributed by the authors to an early phase of Acheulean complex in Europe (Bourguignon et al., 2016).

The Caune de l’Arago example (Tautavel, France), presented by A.-M. Moigne et al. and H. and M.A. de Lumley, provided an opportunity to discuss chronostratigraphical continuity and diversity of behaviour in a sequence covering 600 ka to 400 ka with the earliest evidence of bifaces from levels P-Q dated to around 550 ka (Moigne et al., 2006, 2014; Barsky and Lumley, 2010; de Lumley and de Lumley, 2014; Falguères et al., 2015). The mode of shaping of the bifacial tools (bifaces and cleavers made on flakes) on various lithologies, some from semi-local outcrops, seems to confirm the hypothesis of an external origin for this type of behaviour, as seen at la Noira in central France, dated to 700 ka (Moncel et al., 2013; Moncel et al., 2015).

Large mammal dispersal and faunal dynamics in southern Europe during the Middle Pleistocene presented by M. R. Palombo indicate that at the time of the Mid-Pleistocene Revolution, the dynamics of the large mammal fauna were mainly regulated by major climate changes leading to discrete dispersal events (some of which may have involved small groups of hominins) (Palombo, 2016). Predator-prey relationships may have been important factors governing hominin presence/absence at any site, although the presence of large predators does not, in itself, seem to have had any particular role on human dispersal and settlement. The impact of palaeoclimatic change on hominin dispersal would be indirectly felt, through changes in the structure of ungulate communities and carnivore guilds (Palombo, 2010), although competition with carnivores for prey and shelter would also play a role (Turner, 1992). Further information from palaeoenvironmental proxies, especially rodents and herpetofauna at the Caune de l’Arago and at Aridos 1 (Spain) have provided additional, detailed data on the climatic background to hominin occupation from MIS 14 to MIS 11 (Blain et al., 2015; Lebreton et al., 2015).

The conference also permitted new studies of key sites and new fieldwork to be presented, for example recent investigations by J. Baena et al., which have revealed the complexity of land-use patterns in the Madrid area, by hominin groups using bifacial technology during the second half of the Middle Pleistocene, where evidence of quarrying, extraction and management of flint nodules can be seen (del Cueto et al., 2016). The karstic sequence of the Santa-Anna cave (Cáceres, Spain) was examined by A. Canals et al. (Canals et al., 2014) and the renowned sequences at Atapuerca (Spain) provided an opportunity to discuss on the necessity to note the recurrence or not of occupations for understanding the bifacial technology spread over time (innovation v. invention) and chronological gaps in hominin occupation during the Middle Pleistocene. Investigation on pertinency of European and Middle Pleistocene data was tested through the long karstic sequences of Atapuerca by Olle et al. including Grand Dolina, Sima de los Huesos and Galeria II lithic series (Arnold et al., 2014; García-Medrano et al., 2014, 2015; Moreno et al., 2015)(Ollé et al., 2016). Long-term and short-term occupations were discussed in regard to the composition of assemblages (for instance at Galeria II with evidence of scavenging in a cave-trap and introduction of rejuvenated lithic material).

Finally, the coexistence of Early Middle Palaeolithic and Acheulean techno-complexes in the Middle Pleistocene of the Iberian Peninsula allowed discussion of behavioural strategies during the transition from Acheulean to the Middle Palaeolithic (Santonja et al., 2015). The lithic strategies and aspects of hunting intensification, as viewed through the faunal spectrum at Gran Dolina (for instance in level TD 10), attest to an early transition in this region, perhaps as early as MIS 10 (Rodríguez-Hidalgo et al., 2015). This early date is also observed at Guado San Nicola (Italy) with an assemblage associating crude bifaces and some Levallois cores (Peretto et al., 2015b). Revision of younger sites such as the Observatory (Monaco) and Prince (Balzi Rossi, Liguria, Italy) Caves by E. Rossoni-Notter et al. reviewed the variability of strategies and modes of shaping and flaking on various raw materials over time in a regional Mediterranean context after MIS 12 (Rossoni-Notter et al., 2016a, 2016b). Likewise, a synthesis on the industries of the Tagus Basin in the Iberian Peninsula provided a chronological and technological framework for the contained bifacial industries, mainly dated to MIS 11 to 9 (Panera et al., 2016). The transition to the Early Middle Palaeolithic is seen in MIS 9-8 at Orgnac 3 by C. Matthias (Moncel et al., 2011, 2012; Fontana et al., 2013; Mathias, 2016) and A. Malinsky-Buller presented a synthesis on the Lower-Middle Palaeolithic transitions(s) and implications from bifacial technologies in the Levant, Southern and Northern France (Malinsky-Buller, 2014, 2015).

**What about Acheuleans in Northern Europe?**

As stated above, North-West Europe is considered to be the birth place of the term Acheulean. With this in mind, the use of handaxe style as a chronological indicator in Western Europe was revisited by Bridgland and White (2015), using advances in the dating of Pleistocene sediments in Britain to assess, for the first time, changing patterns in technology and morphology related to variations in practices and cultural preferences through time. Relationships with the landscape for north-west European Acheuleans were examined by M. Pope and B. Scott who examined the location of the finds, recommending geomorphological reassessment of the region and an integrated sedimentological, climatic and topographic model of landscape evolution through time, to account for distributional patterns (Pope et al., 2016). A. Brown and L. Basell presented a Nutritional Niche Approach for interpreting patterns of archaeological distribution, revealing concentrations of sites in the middle-lower reaches of river valleys, close to locations of estimated interglacial tidal limits (Brown and Basell, 2014). The lower floodplain areas were proposed to be optimal areas for nutritional opportunities for hominins (Brown et al., 2013; Brown and Basell, 2014). New fieldwork in the Somme Valley (Amiens Rue du Manège and the celebrated site of Carrière Carpentier) has indicated that hominin occupation was not earlier than MIS 14 (Antoine et al., 2015). Although the chronological evidence therefore indicates that the earliest evidence for bifacial technology comes from outside northern Europe, much can be gleaned, under a revised dating and palaeoenvironmental framework, of hominin occupation in response to broad and smaller-scale climatic changes through the early Middle and early part of the late Middle Pleistocene (Candy et al., 2015; Voinchet et al., 2015; Limondin-Lozouet et al., 2015). Within the context of the Franco-British ANR project on which this conference was founded, Moncel et al. (2015) presented a comparison of the technological features of the Acheulean lithic series in north-west Europe (700-400 ka) against data from southern Europe.

Two further significant sites were discussed, which together form part of the “Boxgrove Palaeolandscape”, Boxgrove itself and the Valdoe. M. Roberts presented the data from Boxgrove, West Sussex (UK) and addressed their contribution to questions of resource procurement, processing, and patterns of discard in the early Middle Pleistocene archaeological record (Roberts M., 2014). This site is noted for its large quantity of flint bifaces (frequently displaying a “coup de tranchet” to the tip) and for evidence not only of the kill sites of various large mammals but also for butchery, processing and possibly consumption (Roberts and Parfitt, 1999). The new site of Valdoe, discussed by M. Pope, complements the evidence from Boxgrove in relation to the transport and discard of bifaces in across the wider landscape (Pope M., 2014). R. Davis and colleagues extended the view across southern England, presenting a synthesis on the sites of the Solent Valley and using this information to infer patterns of population increase and decline (Davis et al., 2014a).

Between Northern and Southern Europe, the site of la Noira in central France (c. 700ka) has yielded evidence of occupation alongside a river, on a bed of limestone slabs, immediately preceding MIS 16 (Despriée et al., 2011; Moncel et al., 2013, 2015). Large slabs at la Noira were selected and managed according to their quality and size, broken or used for a short flaking and shaping (Despriee et al., 2016). N. Connet and colleagues reported on similar sites in this area with the contribution of the site of Londigny (Charente, France) (Connet et al., 2014) and D. Hérisson et al. presented a synthesis from the MIS 11-10 site of La Grande Vallée, Colombiers (Vienne, France) where several levels show bifaces made on slabs and evidence of workshops (Hérisson et al., 2016). The site of Menez-Dregan (Plouhinec, France) and its lithic industry from layer 7 with Acheulean components offered the opportunity to discuss the definition of Acheulean. This site was used to define the Colombanian, on account of the scarcity of bifacial tools on pebbles but revision of the lithic industry by A -L. Ravon et al. attests of the extensive use of flint for knapping and of the presence of some large cutting tools (cleavers on flakes and partial bifaces on quartzite pebbles)(Ravon et al., 2016).

**Summary**

The key aim of the conference was to focus on the questions regarding (1) the contrast between traditions developed through time in Southern and Northern Europe, (2) hypotheses regarding the earliest evidence for the Acheulean before its spread over Western Europe, (3) the possibility of a single locus of innovation (Africa?) or multiple centres including Europe, (4) different or common technological or subsistence strategies despite the apparent diversity in the archaeological record, and (5) technological and typological phases for these industries through time that might reflect multiple influences or influxes of people or local transformations.

The hypotheses and observations differ according to the proxies used. In Europe, well-dated sites are relatively scarce before MIS 12 and include sites with and without bifaces. Some series clearly belong to the first phases of occupation (cores and flakes, Mode 1), although non-bifacial industries are present until MIS 9 in Northern Europe. Other aspects of core technology indicate that behavioural changes in core technology occurred as early as 700 ka in Europe, whether associated or not with bifacial technology.

The African record suggests the onset of bifacial technology first at 1.8 Ma and then a second pulse at 1 Ma. Before 500ka, however, European data is more sporadic, perhaps reflecting the isolation of small, mobile hominins groups unable to maintain social networks or to occupy permanently some areas, explaining the technological diversity between biface and non-biface industries (Stewart and Stringer, 2012; Hölzchen et al., 2015). Hominins tended to occupy more marginal areas only under favourable climates and environments, especially in the northern part of the continent. Latitudinal climatic gradients would explain the prevalence of occupations in the south during periods of climatic deterioration or periglaciation in the northern and central zones. These climatic oscillations continually obliged hominins to retreat, expand or even disappear (leading to genetic “bottlenecks”, local or even total extinction). After 500 ka, from MIS 11 to 9, diversity of technological behaviours again characterizes the archaeological assemblages, equally with or without bifacial tools. The subsistence strategies indicate ever more complex (even targeted) hunting strategies and new land-use patterns. These observations are based on more numerous assemblages of artefacts that have allowed new statistical comparisons and trends to be identified. Changes in climate cycles (stability, amplitude and duration) are likely to have influenced these behavioural changes, favouring emergence of regional traditions, demographic expansion and genetic exchanges (growth and regular adaptation without demographic discontinuities) and new skills (see examples of more or less rapid processes of population dynamics and cultural changes) (Sánchez Yustos and Diez Martín, 2015). Furthermore, the advent of new dating methods and revisions, as well as detailed palaeoenvironmental studies have demonstrated that a detailed chronological and ecological framework is essential to compare sites, raw material acquisition and management and subsistence patterns, and thereby progress our understanding of behavioural adaptations and innovations. Together, these (along with any new sites that may emerge in the coming years) provide an excellent basis for interpreting the origins of bifaces and cleavers.

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