Quaternary International 551 (2020) 1–6

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

A focus on the Middle to Upper Palaeolithic transition in the Mediterranean area

1. Introduction

Modern humans (MHs) are the only extant members of the genus *Homo* (i.e., *Homo sapiens*). Fossil evidence supports an African origin of *H. sapiens* sometime between 350,000 and 280,000 years ago (kya) (Hublin et al., 2017; Scerri et al., 2018). Nevertheless, the exact timing and geographic routes of migration out of Africa into Eurasia are still a matter of contention (e.g., Beyin, 2011; Petraglia et al., 2012; Groucutt et al., 2015; López et al., 2015; Langgut et al., 2018; Bons et al., 2019; Mihailović, 2020). Findings from Misliya in Israel document the earliest dispersal of *H. sapiens* into the Levant through the "Nile corridor" (the so called "Northern route") by approximately 194–177 kya, during the Marine Isotope Stage (MIS) 6 (Hershkovitz et al., 2018), supporting genetic (Posth et al., 2017) and potentially fossil (Harvati et al., 2019) evidence both of which suggest that migration out of Africa probably predates 200 kya. The site of Jebel Faya (United Arab Emirates) suggests that MHs also crossed the Bab al Mandab Straits (from East Africa to Arabia) about 125 kya, through the so called "Southern route" (Armitage et al., 2011). The archaeological sites of Qafzeh and Skhul in Israel confirm that MHs were still present in the Levant at the same time (between 130 and 100 kya; Mercier et al., 1995), and human remains from Fuyan Cave in Daoxian (southern China), dated between 120 and 80 kya, point at an eastward dispersal of these MH groups (Liu et al., 2015). While fossil evidence suggests that MHs have been resilient in southeast Asia until today, as advocated by the 73–63 kya old human teeth from Lida Ajer, Sumatra (Westaway et al., 2017), and by a human cranium and mandible dated 63–46 kya from TamPa Ling, Laos (Demeter et al., 2015), at present there are no MH remains in the rest of Eurasia dating between 90 and 60 kya.

The partial skull from Manot Cave in Western Galilee, Israel, attests that after 55 kya (Hershkovitz et al., 2015) MHs colonized Eurasia through a new dispersal either from Africa or from southern Eurasian *refugia*. A modern human femur from Ust'-Ishim, western Siberia (Fu et al., 2014), was dated ca. 45 kya. Human remains from Uçağizli Cave, Turkey (Güleç et al., 2007) and Ksar Akil, Lebanon (Douka et al., 2013), generally attributed to MHs, date between 45 and 40 kya, and a MH femur from Tianyuan Cave outside Beijing, China, was dated 40 kya (Fu et al., 2013).

In Europe, the spread of MHs took place during the Middle-to-Upper Palaeolithic Transition, when dramatic changes in human behaviour are mirrored by a well documented change in the archaeological record, marked by the appearance of a number of local technocomplexes (e.g., the Châtelperronian in central and southwestern France and northern Spain, the Uluzzian in Italy and Greece, the Neronian in south-eastern France, the Szeletian in Czech Republic and Slovakia, the Bohunician in Central Europe, the Jerzmanivician-Lincombian-Ranisian in the north of Europe) that replaced the pre-existing Mousterian material cultures (Hublin, 2015). Some scholars (e.g., Mellars, 2005) suggested that the appearance of marked expressions of modern human behaviour in Europe fall in the timeframe of the appearance and dispersal of MHs. Modern human behaviour is characterized by the exploitation of a wider range of (marine and terrestrial) faunal and vegetal resources, as well as typical stone tool production, including mechanically delivered projectile technology (Sano et al., 2019), wider catchment basins for lithic raw material procurement, the appearance of cave art, mobile art, and music (all of which are currently not attested, or rarely observed, for Neandertals; Churchill, 2014), as well as a systematic use of ornaments (e.g., shell beads), pigments (such as ochre) and bone tools. The variability of lithic raw material (specifically) and subsistence strategies (in general) may account for different mobility patterns between MHs and Neandertals (Wißing et al., 2019). Nevertheless, other scholars postulate that at least part of such cultural innovations were either independently achieved by Neandertals, and that MHs entered Europe after Neandertals had disappeared (d'Errico et al., 1998; Zilhão, 2007), or were produced by late Neandertals as a result of some level of cultural transmission from MHs to Neandertals (Hublin et al., 2012). Neandertals may indeed be characterized by a more complex sociocultural behaviour than previously believed. For example, recent studies suggest that Neandertals had a more varied diet than previously considered (e.g., Hardy and Moncel, 2011; Fiorenza et al., 2015; Weyrich et al., 2017), including a wide range of plant foods (e.g., Henry et al., 2014; Power et al., 2018) and possibly cooked food (Henry et al., 2011). There is evidence pointing to the use of personal ornaments (e.g., Peresani et al., 2011; Romandini et al., 2014), cave paintings (Hoffmann et al., 2018; but see debate in Slimak et al., 2018; White et al., 2019; Hoffmann et al., 2019), and complex technology (Niekus et al., 2019).

From a biological perspective, results from ancient DNA suggest that gene flow from Neandertals into non-African MHs occurred before the divergence of the different Eurasian populations (Green et al., 2010). This admixture, albeit of low magnitude (1.5–2.1%), occurred ca. 60 kya, mainly in Southwest Asia (Prüfer et al., 2014, 2017). A study of present-day genomes (e.g., Noonan et al., 2006) has shown that although Neandertals were widespread in Europe no evidence was found that they interbred with MH in Europe. This would support the arguments that the two groups 1) did not chronologically and/or geographically overlap and 2) did not culturally interact. An alternative view (Fu et al., 2015) is that admixture between MH populations and local Neandertals occurred in Europe as well, but that these pioneering MH were later replaced by other MH groups and thus did not contribute much genetically to later European populations (Fu et al., 2016).

https://doi.org/10.1016/j.quaint.2020.06.029

Available online 30 June 2020

It is evident, therefore, that the origin and significance of the cultural changes and biological interaction between MH and Neandertal are yet to be understood, and continue to be of considerable interest for palaeoanthropology and archaeology (e.g., Bailey et al., 2009; Bar-Yosef and Bordes, 2010; Benazzi, 2012; Higham et al., 2014; Sankararaman et al., 2014; Vernot and Akey, 2014; Fu et al., 2015; Hublin, 2015; Greenbaum et al., 2019). The current scientific debate focuses on a number of critical issues including: 1) whether MH and Neandertal co-existed in Europe; 2) whether the arrival of MH coincided with the transition from Middle to Upper Palaeolithic in terms of material culture; 3) whether MH colonized areas after Neandertal populations had left or if these human groups interacted (e.g., if there might be documented instances of exchange of cultural information or possible competition for the same eco-cultural niche); 4) whether the ecological success of MH is intrinsically related to a suite of behavioural and cognitive abilities unique to MH, favoring their migration and eco-geographic adaptation; and 5) whether the migration of MH in Europe was promoted by temporary climate ameliorations (interstadial periods) within the MIS 3.

Several factors contribute to the persisting uncertainty on the timing and mode of the earliest migration of MHs in Europe and the demise of Neandertals.

First, only a subset of the several European archaeological sites recording the Middle-to-Upper Palaeolithic Transition have been accurately investigated, or are well-documented and precisely dated (Dinnis et al., 2019; Higham et al., 2011, 2012). Cutting-edge excavation methods and dating techniques are pivotal for interpreting an archaeological deposit, namely evaluating its integrity and assessing the chronological uncertainty of each material cultural expression (e.g., final Mousterian, Transitional, Early Upper Palaeolithic cultures), in order to correctly locate the site in its own climatic and environmental context, and to draw comparisons across different contexts.

Second, there is a general lack of large-scale comparison of the information obtained from deposits dated to the Middle-to-Upper Palaeolithic Transition (e.g., lithic manufacturing methods and raw material procurement, faunal exploitation strategies). For example, aside from a few previous attempts based on typological parallels (Gioia, 1988, 1990; but see also Palma di Cesnola, 2001), there is a lack of rigorous studies aiming to formally compare specific technological features characterizing the Uluzzian with attributes defining the Châtelperronian, or the Uluzzian from northern Italy to that from southern Italy.

Third, human remains dated between 50 and 35 kya were only documented in a restricted number of European sites, and just consist of a small number of fragmented fossils. With just a few exceptions, most of this material is unsuitable for the current debate, either because its taxonomic attribution is unknown or because it is not associated with specific technocomplexes, or the association is debated (for recent claims, see Hublin, 2015; Gravina et al., 2018; Zilhão et al., 2015; Talamo et al., 2016; Moroni et al., 2018).

To summarize, the time period comprised between 45 and 40 kya is pivotal to disentangle the cultural and biological processes underlying the shift from Neandertals to MHs in Europe. Neandertals disappeared around 41–39 kya (Higham et al., 2014), and even though remains dated to 40–35 kya are sporadic, available fossils are attributed to MHs and are generally associated with either Early Aurignacian (La Quina-Aval and Brassempouy, France; e.g., Verna et al., 2012) or Classic Aurignacian material culture (Mladeč, Czech Republic; Wild et al., 2005). The fragmentary state of the available archaeological and palaeoanthropological evidence, however, leaves room for many potential explanatory models spanning from the direct/indirect competition between MHs and Neandertals, culminating in the defeat of Neandertals by MH newcomers between 45 and 40 kya, to less crude scenarios that attribute the demise of Neandertals to other factors (e.g., climatic change, demographic collapse, reduced food resources) and envisage parts of Europe as an almost empty environment when the earliest MHs arrived.

In this debate, the Mediterranean area plays a pivotal role for a number of reasons: 1) its ecological variability and geographic position at the intersection of the possible main MH migratory routes; 2) the presence of transitional and early Upper Palaeolithic complexes; and 3) the presence of human fossil remains associated with the different Palaeolithic cultures (e.g., Benazzi et al., 2011, 2015).

The purpose of this special issue titled "*Peopling dynamics in the Mediterranean area between 45 and 39 ky ago: state-of-the-art and new data*" is to extensively review and update our current knowledge on the critical problem of the arrival of MHs in southern Europe. Most contributions focus on the relationship between Late Mousterian and transitional-Early Upper Palaeolithic technological and material cultural assemblages, as well as on the emergence of the Initial Upper Palaeolithic assemblages in the Near East, and on the role of environmental change and its impact on adaptive strategies, technology, settlement pattern, subsistence practices, and timing of human dispersals over the continent.

More in detail, Badino et al. (2020, this volume) summarize the current state of knowledge about the millennial scale climate variability and terrestrial vegetation dynamics during Marine Isotope Stage 3 (MIS 3). High-resolution records covering Middle to Upper Palaeolithic transition are considered and compared in order to explore the effects of short-term climate variability (Dansgaard - Oeschger cycles, Heinrich events) on different ecosystems from continental Europe to the Mediterranean areas.

Weber et al. (2020, this volume) re-investigated the partial calvaria from Manot Cave (Israel) dated to >55 ka. The ecto- and endocranial shape analyses confirm that Manot 1 is unequivocally modern human. New data from the endocranium show that it is markedly different from the earliest known *Homo sapiens*, close to the Levantine Qafzeh/Skhul assemblage (120-90ka) as well as modern humans, but still shows some deviations from both groups, indicating that this population had not yet fully reached the brainshape of modern humans after 35ka.

Goring-Morris and Belfer-Cohen (2020, this volume) discuss the Middle-Upper Palaeolithic transition in the Levantine. The Levantine 'bridge' between Africa and Eurasia was populated during the Middle Palaeolithic by varied populations displaying distinct Neandertal and MH characteristics; instead, the emergence of the Upper Palaeolithic was impacted by uniquely distinct, local circumstances. Examination of observed Initial Upper Palaeolithic techno-typological chipped stone assemblage variability indicates they are parsimoniously interpreted as representing a single entity, albeit with differences reflecting chronological, geographical and environmental factors.

Mihailović (2020, this volume) discusses the push-and-pull factors that influenced the expansion of MHs into Europe and the demise of Neandertals in the Balkans. The study showed that the withdrawal of Neandertals may have followed two scenarios. Under the first scenario, with the advent of MHs, Neandertals withdrew to the west of the Balkans where their extinction occurred. According to the second scenario, Neandertals withdrew to suboptimal zones, which might have been followed by their subsequent acculturation and assimilation.

The review presented by Doyon (2020, this volume) of chronostratigraphic and morphometric evidence for Aurignacian osseous projectile points in Southern Europe questions the hypothesis according to which these tools would represent a reliable proxy for the initial dispersal of MHs in the continent. In his paper, Doyon argues the appearance of split- and massive-based points in the archaeological record signals the development of novel socio-economic strategies along two parallel cultural trajectories. This reassessment highlights complex population dynamics on the onset of the Upper Palaeolithic.

Saos et al. (2020, this volume) provide information about new excavations carried out at La Crouzade cave (Gruissan, Aude, France). Their results reveal three main Middle Palaeolithic layers characterised by a dominant Levallois production and an assemblage of Pleistocene large mammals, that have been dated between 49,776 and 44,805 cal BP by AMS 14C for the deepest level (layer C8) to 42,000 ± 3000 years BP by combined ESR-U series on horse teeth for the top (layer C6). An

Aurignacian layer is preserved only as patches in the actual excavation area, and a charcoal from this layer gave an age at 38,430–37,331 cal BP similar to the MH maxillary previously discovered in the beginning of the twentieth century, confirming it's stratigraphic attribution that remained doubtful.

Mazo and Alcolea (2020, this volume) present the first results from the Neandertal occupation in the late Pleistocene (MIS 3) cave site called Aguilón P5, increasing the number of classic Mousterian sites known in the Northeast Iberia. Archaeological evidence discussed in this paper supports the northern slope the Iberian System and the south of the Ebro basin were no longer occupied by Neandertals around 42–40 kya, according to the available chronometric information and the current state of the research.

Within this context, new evidence places Italy as a keystone region in answering questions surrounding this transition due to its geographic position, ecological variability, and the key archaeological sites representing Middle-to-Upper Palaeolithic cultures. Moreover, several teeth retrieved from Italian archaeological sites, associated with both Uluzzian and Protoaurignacian cultures, were pivotal for stimulating novel debates about the biological shift that occurred in Western Europe around 45,000–35,000 years ago. Remarkably, Italy has largely been absent in the research. The recently obtained funding from the European Research Council (ERC CoG no. 724046 SUCCESS; website: http://www.erc-success.eu) tackles this issue.

Marciani et al. (2019, this volume) provide a synthesis of the main technical features of the techno-complexes in Italy from 50 to 39 kya, i.e. the Late Mousterian, the Uluzzian and the Protoaurignacian were examined from a diachronic and spatial perspective. Their overview allows to documented some crucial element characteristic of these techno-complexes: in the Late Mousterian tools were manufactured with great attention being paid to the production phases and with great investment in initialising and managing core convexities; in contrast, Uluzzian lithic production proceeded with less careful management of the first phases of debitage, mainly obtaining tool morphologies by retouching. in the Protoaurignacian the production is carefully organized and aimed at obtaining laminar blanks (mainly bladelets) usually marginally retouched. Collina et al. (2020, this volume) present the entire stratigraphic sequence of Roccia San Sebastiano which is a tectonic-karstic cave located at the foot of the southern slope of Mt. Massico, in the territory of Mondragone (Caserta) in Campania (southern Italy). Moreover, the authors provide a technological description of the lithic materials retrieved from Uluzzian levels. The Uluzzian lithic assemblage at Roccia San Sebastiano used mostly local pebbles of chert in order to produce small-sized objects. The utilised concept of debitage is simple and it is attested the use of both direct freehand percussion and bipolar technique on anvil in the same reduction sequence. Arrighi et al. (2020, this volume) provide an overview of the Italian evidence regarding bone tool manufacturing and the use of ornaments and pigments in the time span encompassing the replacement of Neandertals by MHs (between 50 and 39 kya). These categories of archaeological findings play a key role in defining behavioural modernity because they are often considered as indicators of complex thinking. Current data show that formal bone tools, ornaments and other non-utilitarian artefacts appear to be occasional in the Mousterian. In contrast, they are well spread and documented during the Uluzzian and the Protoaurignacian. Romandini et al. (2020, this volume) present both a state-of-the-art review of published data and new information on the late Middle-to-Upper Palaeolithic Transition human ecology and exploitation of mammals and birds in the Italian Peninsula between 50 and 35 kya. Intra- and inter-site comparison of zooarchaeological evidence is carried out both through standard NISP counts as well as through the use of probabilistic methods (aoristic analysis) that have never been employed on palaeolithic contexts before. This research generates empirical results that allow for a diachronic comparison of inter-regional trends in subsistence strategies, environmental change, and human exploitation of animal resources a key Mediterranean context for understanding the complex mechanisms of interaction and competition between Neandertals and MHs.

Fiore et al. (2020, this volume) present results of the archaeozoological and taphonomic study of bird remains from the whole sequence of Grotta di Castelcivita, including an interesting discussion on the multipurpose role avifaunal resources played during the Middle to Upper Palaeolithic transition at this site. The authors provide a clear and detailed overview of the evidence relating to cut-marks and other modifications occurring on bird bones from the late Mousterian, the Uluzzian and the Protoaurignacian assemblages, arguing that some of the anthropogenic traces identified on the wing bones of raptors and corvids, especially from the Uluzzian layers, are related to the exploitation of feathers.

Bouchard et al. (2020, this volume) yielded important new methodological, empirical and behavioral insights into the Protoaurignacian occupations of Riparo Bombrini, which in turn provided the first detailed analysis of Protoaurignacian large mammal exploitation at the Balzi Rossi and indeed in the Liguro-Provençal arc more broadly. The authors carried out taphonomic and archaeozoological analyses with integrated systematic ZooMS using a mass sampling strategy. On the behavioral front, the results suggest stability in hunting strategies over time in spite of the apparent shift in mobility strategies from level A2 to level A1 at Riparo Bombrini.

The authors of this editorial would like to thank the European Research Council, ERC CoG no. 724046 SUCCESS (awarded to S. Benazzi; website: http://www.erc-success.eu), which support was pivotal to conceive this special issue, ultimately providing an opportunity to discuss both the state-of-the-art narratives and new acquisitions on a larger biogeographic perspective, in order to better evaluate potential interaction between the two human groups through similarities and differences in behaviour, technology, and adaptive strategies.

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