# Where are the Immigrants? Questions about the Demographic Underpinnings of Late Pleistocene Cultural Changes in Western Europe

## Wo sind die Einwanderer? Fragen zu den demografischen Grundlagen spätpleistozäner kultureller Veränderungen in Westeuropa

**Michael Jochim**

Department of Anthropology
University of California Santa Barbara
Santa Barbara, CA 93106, USA
mjochim@ucsb.edu

## ABSTRACT

Prevailing interpretations of late glacial "azilianization" processes in western Europe emphasize the role of adaptive responses to environmental changes by Late Epigravettian and Late Magdalenian populations. These interpretations stress the considerable cultural continuity across this transition. Recent DNA studies, however, have raised the possibility of a significant population turnover at this time, ultimately deriving from influences from the Near East, perhaps reflecting a demographic expansion. Such an expansion—or migration—should be reflected by some abrupt changes in the archaeological record, which at present are not obvious or emphasized. In an attempt to identify the proposed immigrants, the record in terms of lithic technology, projectile use, the domestication of dogs, and artistic and mortuary behavior is examined.

**Keywords:** Europe, Late Paleolithic, paleodemography, migration, innovations

## ZUSAMMENFASSUNG

Vorherrschende Interpretationen spätglazialer „Azilianisierungs"-Prozesse in Westeuropa betonen die Rolle anpassungsmäßiger Reaktionen von Populationen des Spätepigravettien und Spätmagdalénien auf Umweltveränderungen. Solche Interpretationen heben die beträchtliche kulturelle Kontinuität während dieses Übergangs hervor. Jüngste DNA-Studien haben jedoch die Möglichkeit eines erheblichen Bevölkerungswechsels zu dieser Zeit ins Spiel gebracht, der letztendlich auf Einflüsse aus dem Nahen Osten zurückzuführen ist und möglicherweise eine demografische Expansion widerspiegelt. Solch eine Expansion – oder Migration – sollte sich in einigen abrupten Änderungen im archäologischen Befund widerspiegeln, die derzeit jedoch


Cite this article: Jochim, M. 2022. Where are the Immigrants? Questions about the Demographic Underpinnings of Late Pleistocene Cultural Changes in Western Europe. MGfU 31: 71–86.

nicht offensichtlich sind oder hervorgehoben werden. In einem Versuch, die potentiellen Einwanderer zu identifizieren, werden die Befunde in Bezug auf die Steintechnologie, den Einsatz von Projektilen, die Domestizierung von Hunden sowie das künstlerische Schaffen und das Bestattungsverhalten untersucht.
**Schlagwörter:** Europa, Spätpaläolithikum, Paläodemografie, Migration, Innovationen

## Introduction

The late glacial cultural transition in western Europe from the late Upper Paleolithic Magdalenian to the Late Paleolithic Azilian and *Federmesser* industries is a significant period of culture change. Aspects of diet, lithic typology and technology, mobility, settlement patterns and art all undergo significant transformations during this period. Because these changes generally coincide with dramatic alterations in the climate, vegetation and fauna, interpretations of this transition have given explanatory priority to the environment. That is, these changes are seen to represent adaptations to the environmental alterations, which encouraged or forced responses by Magdalenian hunter-gatherer populations. As just one example, Grimm (2013, 175) states that "the Federmesser-Gruppen probably evolved from the Late Magdalenian due to the varying resource availability and necessities to cope [with] this changing environment." I have argued for this perspective as well, for example stating that "these changes transformed the environments (…) and demanded profound adjustments by human populations" (Jochim 2020, 81).

As a result, these interpretations have emphasized the evolutionary nature of the cultural changes, arguing that the Late Paleolithic industries develop directly from the preceding industries. For example, as Mevel (2013, 177) has stated, "Although we perceive several and clear technical and typological variations between the Upper Magdalenian and the Early Azilian (…) it should not hide real affinities (…). Therefore, the Early Azilian can be considered as a Final Magdalenian as much as an initial phase of the Azilian." Similarly, Grimm (2013, 175) has argued "Since no other information system (…) than the ones based on a Magdalenian substratum were observed, the transition from the Late Magdalenian to the Federmesser-Gruppen represented a change within a single social system and adoption as a reason for sudden changes can be excluded." Straus (1985) has also argued for a cultural continuum between the Magdalenian and Azilian in southwestern Europe.

Recent ancient DNA studies, however, have complicated these arguments. Pala et al. (2012) reported on mitochondrial evidence from Mediterranean Europe, the Caucasus and the Near East suggesting a major population expansion from the Near East into Europe after 19,000 years ago and particularly between 16,000 and 12,000 years ago. Based on an analysis of Pleistocene mitochondrial genomes, Posth et al. (2016, 828) presented "surprising evidence of a major population turnover in Europe around 14,500 years ago during the Late Glacial." Similarly, Fu et al. (2016, 200) used genome-wide data to argue that "During the major warming period after 14,000 years ago, a genetic component related to present-day Near Easterners became widespread in Europe." The earliest sample in their study that represents the new component is Vil-

labruna in Italy, with later sites in France and Germany. More recently, Bertolini et al. (2020) reported on a total genome study of a skeleton from the Italian site of Riparo Tagliente. This individual was found to be closely related to the Villabruna sample and later Western Hunter-Gatherers, but is dated to 16,980-16,510 cal BP, "therefore backdating by at least 3ka the occurrence of genetic components previously reported for the later Villabruna cluster." Moreover, the study by Posth et al. (2016) includes material from the Italian site of Paglicci, dated to around 18,000 cal BP, which is closely related to the genome of the new, expanding group (Scorrano et al. 2022). These earlier dates suggest that this population expanded into areas north and west considerably later than their appearance in the Mediterranean. Genome-wide studies by Villalba-Mouco et al. (2019) indicate that a skeleton from the Iberian site of El Mirón, dating to ca. 19,000 cal BP, carries dual ancestry that includes Villabruna-related individuals, suggesting "an early connection between two potential refugia" (Villalba-Mouco et al. 2019, 1169) and therefore backdating even farther the presence and spread of individuals identified in northern Italy. As Scorrano et al. (2022, 1) summarize, "we argue that this lineage took refuge in Italy during the LGM, followed by a subsequent spread to central-western Europe."

Given current samples, this DNA evidence suggests that immigration and population replacement or admixture may have occurred around the time of the cultural transition in western Europe and may have begun as early as 19,000 years ago in the south. This poses a challenge to our understanding of the late Pleistocene cultural changes, a challenge that cannot be ignored. Complete and abrupt replacement is unlikely, and there exists some evidence for admixture, at least in southwest Europe (Villalba-Mouco et al. 2019). The processes underlying this demographic replacement are not known, but some speculations can be made.

There may have been two possible factors for supplying an inducement or "push" to move north into west and central Europe, factors that also encouraged the northward penetration into the Alps during the Late Glacial period (Jochim 2020). As the Alpine glaciers melted, the ensuing "intense water discharge", erosion, colluviation and loess deposition (Angelucci and Bassetti 2009) surely impacted the north Italian Po plain, disrupting vegetation, while the water run-off itself raised the water table and created new wetlands and estuaries, transforming the environment (Birch et al. 2016). In both cases, a move northward would have preserved accustomed strategies of hunting in open steppe habitats. Secondly, the gradual disappearance of the Great Adriatic Plain may have provided an additional "push" (Naudinot et al. 2014; Birch et al. 2016). During the Last Glacial Maximum, the northern portion of the Adriatic Basin was exposed as a plain by the lower sea level. As glaciers began to melt, this plain was gradually inundated and the northern shore of the Adriatic shifted northward. Assuming that this plain had been sufficiently rich to support human groups (Miracle 2007), its flooding would have forced populations to the west, north and east, increasing relative population numbers in those areas, and thus providing an encouragement to expand into adjacent areas.

The route of an expansion from the Mediterranean northward may likely have been along the shore westward and then up the Rhone Valley to its headwaters. From there both the Rhine and the headwaters of the Danube can be easily reached, allowing pathways of movement into France

and Germany. This route was used already during Magdalenian occupations in southwestern Germany as exchange networks for Mediterranean shells that reached sites along the Danube (Weniger 1982, 199; Terberger and Burger 2017) demonstrate. Two challenges faced immigrants as they expanded: the environmental differences they encountered in the new areas and the presence of Magdalenian populations. These factors would have stimulated and required adjustments, in terms both of adaptive responses by the immigrants to the environment and of social negotiations among the different groups. These negotiations could have taken various forms, including hostilities, exchange and intermarriage. In addition, they may have resulted in mutual adoption of aspects of material culture. An ethnographic example of this process is provided by the early contact of ethnically distinct Inuit and Cree on the eastern shore of Hudson's Bay in the 1700s: "The Inuit apparently borrowed such items as snowshoes and crooked knives from the Indians, and the Indians adopted parkas, semilunar knives, and dog traction from the Inuit" (Barger 1979, 62). This occurred despite a history of chronic hostilities between the two groups. Similarly, during the early 1700s in north-central North America the forest-adapted Cree learned the technique of constructing and using the buffalo pound from their grassland-adapted Assiniboine neighbors (Ray 1998, 46). The European archaeological record, therefore, could show some similarities in adaptive behavior between the two groups, compounded by interaction and sharing with the Magdalenian population. In part, the record might easily appear to develop out of the Magdalenian.

Even so, such a demographic process should have played a role in this transition and the archaeological record might be expected to display some rather abrupt changes or discontinuities, at least given our chronological control, against the backdrop of the perceived more gradual cultural changes. Critically, such discontinuities might appear to be unrelated directly to environmental changes. In light of the apparent spatio-chronological patterns of the tested DNA samples, any such changes should appear earliest in the south (Italy) and later in the north/northwest. The question therefore is *where are the immigrants in the archaeological record*?

Terberger and Burger (2017, 87) state that "It has (…) not been possible to find archaeological evidence for the suggested population turnover around 12 000 cal BC which according to palaeogeneticists might have come with the arrival of new migrants from the Near East." Other scholars, however, have noted that there are indeed some hints of relative discontinuities in the current archaeological record. For example, Leesch (2013, 177) notes that "the shift from Magdalenian to Azilian [in Switzerland] seems to be abrupt. However, various Magdalenian assemblages from other sites in Switzerland (…) may represent 'transitional' assemblages." In discussing this issue for the Rhineland, Grimm (2013, 176) states, "In contrast to the other taxonomic characteristics, the disappearance of evident settlement structures from the archaeological record occurred suddenly between the sub-periods GI-1e and GI-1c3 (...). Perhaps, the change in the settlement structures and the appearance of specific mortuary practices reveal an important disruption in the otherwise continuous process of adaptation." In the following, some possible examples of such discontinuities are discussed in a general way, focusing on the late Pleistocene archaeological record, with the aim at provoking more detailed studies in the future.

There is a huge literature on the transition from the late Upper Paleolithic to the Late Paleolithic and the discussion that follows can touch on only a small portion of this literature, but can raise observations that relate to the possible role of immigration in this process.

## Lithic typology and technology

In Italy a number of typological and technological changes mark the transition from Gravettian to Epigravettian, beginning ca. 22,554-21,440 cal BP and continue throughout the Epigravettian until the beginning of the Holocene (Tomasso 2014, 2017). Initial changes include the loss of Noailles burins and the increasing scarcity of gravettes and long, rectangular, regular, narrow blades. Pointes à face plane appear and, later, microgravettes. By the period of 17,100-16,300 cal BP the use of soft stone hammer percussion appears in the lithic assemblage of Riparo Tagliente in Italy (Fontana et al. 2012). Around 16,000 cal BP a number of technological changes occur (Tomasso 2014) including:

- Progressive replacement of organic by soft stone hammer
- Decline of blade production and increasing production of bladelets and flakes
- Decreasing standardization of blades and bladelets
- Decreasing careful core preparation
- Development of short scrapers
- Relaxation of requirements for high quality raw material.

This constellation of changes approximately 16,000 years ago led Tomasso to recognize the period as the beginning of a significant new step – the transition between Early and Late Epigravettian, in contrast to earlier schemes of more smooth and gradual changes during this time (Tomasso 2014, 480). It is notable that the environment in the area of Tagliente was periglacial, consisting of bushes, herbs and scattered conifers, not heavily forested, rendering difficult an argument that the changes reflect adaptive adjustments to a forested environment (Berto et al. 2018). Broglio (1997) similarly argues for the rather abrupt set of changes closer to 14,477 cal BP, a period when the environment around Villabruna consisted of alpine prairies with scarce conifers (Vercellotti et al. 2008), changes that "unexclusively come from the Epigravettian entity. In fact, the spread of particular types of short end-scrapers, backed knives, and geometric implements obtained through the microburin method as well as trapezoids, is a complex phenomenon that goes beyond the Epigravettian area and points to the establishment of connections among different cultural entities" (Ferrari and Peresani 2003, 90).

These studies suggest that during the period of the early influx into Italy of populations with genetic ties to the Near East, evidenced by the Tagliente burial just after 17,000 cal BP and followed by the Villabruna burial around 14,500 cal BP, genetic changes occurred to culminate in the appearance of the U5 mitochondrial DNA haplogroup that then spread to the north and west. Furthermore, during this period a number of changes in lithic technology and typology developed that may have accompanied this demographic spread.

The subsequent northern population expansion is documented by the DNA of skeletal remains from Oberkassel in the Rhineland dating to 14,223 + 58 cal BP (Janssens et al. 2018), and Bichon, 13,770-13,560 cal BP, and Rochedane, 13,090-12,830 cal BP in the Swiss Jura (Fu et al. 2016). The Oberkassel remains coincide with the beginning of the Late Paleolithic *Federmesser* industry in the area approximately 14,370 cal BP (Grimm 2013), and the two Jura sites belong to the Late Paleolithic Azilian culture, beginning in this region around 14,400 cal BP (Cupillard et al. 2015). The most detailed examination of the transition from the Upper Paleolithic to the Late Paleolithic industries of north and west Europe is that by Valentin (2008) for the Paris Basin. In this study the Azilian is divided into two stages. In the first stage, beginning around 14,800 cal BP at the site of Le Closeau, the primary production concentrates on large, standardized blades, as in the preceding Magdalenian, but using soft stone hammers (largely used only on blades) rather than organic hammers that were used earlier. In addition, short scrapers appear and antler points were gradually replaced by quickly made stone points (Bignon-Lau 2019). The second stage, by around 14,000 cal BP, shows a number of other changes, many of which are similar to earlier changes in Italy. These include:

- Fewer blades and greater use of less standardized short blades and flakes
- Absence of antler points
- Smaller stone points
- All lithic stages using soft stone hammer
- Much simpler core preparation
- Reduction of use of high-quality raw material.

In short, this study identifies two major periods of change in tool production in the Paris Basin relatively close in time to the dating of the Oberkassel skeleton, of which the earlier period is considered to be more profound (Valentin 2008, 23). It is notable that, in interpreting these changes, Bignon-Lau challenges the traditional scenario of progressive, evolutionary azilianization from the Magdalenian and suggests several alternative interpretations. Among these is "the possibility of a migration of Early Azilian societies from outside the Paris Basin into this territory" (Bignon-Lau 2019, 55).

For the Jura region of eastern France and Switzerland, Cupillard et al. (2015) note that the Azilian begins between 14,400 and 14,000 cal BP, as exemplified by the sites of Monruz and Champréveyres. It is noteworthy, however, that some later sites in this region have been reattributed to the Late Epigravettian rather than the Azilian (Cupillard et al. 2015, 54). In discussing sites in the Jura and northern Alps, including Rochedane level A4 (12,910-12,618 cal BP), Mevel et al. (2014) have discussed this reattribution, stating that "several sites very clearly share the same lithic component characterised by a single microlithic concept – points with backing on their right edge – and common technical tradition evident in the production of bladelets from very narrow cores using a soft-stone hammer. Taken together, this information suggests these industries are comparable with the Epigravettian, particularly its most recent phase (…). During

the Late Azilian we also note an important circulation of raw materials and ornaments from the Mediterranean to the Northern Alps, perhaps reflecting the path by which technical ideas, hitherto confined to southern Europe, diffused into the region" (Cupillard et al. 2015, 46). It is worth considering whether this "diffusion" might have been facilitated by ongoing population movement from the south.

In the Danube Valley of southern Germany, sampled skeletal material reflecting the new genetic group all date to the early Holocene Mesolithic, so the timing of their appearance in this area is either late or simply not detected in the current genetic samples. The Late Paleolithic industry of the region replaces the Late Magdalenian around 14,000 cal BP and has much in common with the Azilian. In a comparative study of Late Magdalenian and Late Paleolithic assemblages of this area, Fisher (2000) documents a decrease in laminar debitage as a steady decline in the average proportion of blades among all blades and flakes from 50% in the Magdalenian to 32% in the Late Paleolithic. Control over the preparation of cores appears to show a similar pattern. For example, there is a significant decrease in the percentage of faceted platforms from the Magdalenian to the Late Paleolithic which is characterized by diverse core types with little preshaping and relatively more flakes than more carefully made blades.

## Bow and arrow technology

Another aspect of technology that seems to appear in Europe around the time of the transition to the Late Paleolithic is the bow and arrow. This issue has been highly discussed. Aside from the debated find of a wooden bow fragment at the site of Mannheim-Vogelstang, Germany and dated to 18,000-17,500 cal BP (Rosendahl et al. 2006), the oldest concrete evidence of such technology in western Europe comes from the north German Ahrensburgian site of Stellmoor, dating to the Younger Dryas, in other words, very late in the Late Paleolithic. Many archaeologists, however, suggest that this technology first appeared in Europe considerably earlier. Although Marreiros et al. (2016) have suggested the presence of bow and arrow technology as early as the Early Gravettian in Portugal, many scholars, including Valentin (2008; Paris Basin), Leesch (2013; Swiss plateau), Otte (2013; Belgium) and Bintz and Griggo (2011; northern French Alps) have suggested its appearance by the Bølling, around 14,700 cal BP, based largely on the size of projectile tips. In the Jura, Cupillard (1998, 147) concurs and suggests that both bow and arrow and spears or darts were initially used by the same groups, but that bow and arrow largely replaced other projectiles by around 14,000 cal BP.

This issue of the timing of the appearance of the bow and arrow is difficult because bows and arrow shafts are rarely preserved, so that analyses must concentrate on the durable stone points. Problems with this approach have been much discussed in both the European and North American literature. Frequently, the assumption has been made that the size of points, known to have decreased in length from the Magdalenian to the Mesolithic, will distinguish spears and darts from arrows. For example, in an innovative study, Riede (2009) adopted a quantitative approach from Shott (1997) to examine north European points in an attempt to distinguish the different projectile types. Because the quantitative thresholds have not been widely agreed upon, however,

the best conclusion, at present, may be that of Hutchings (2016), who argues that current approaches to link point morphology to systems of projectile delivery are simply inadequate.

It is tempting to expect to see a rather abrupt and dramatic decrease in projectile point size with the appearance of the bow and arrow. The general picture, however, as seen in the south German site of Zigeunerfels, is a rather steady decrease in length during this time of transition, with the only possible more abrupt decline occurring in the transition from the Younger Dryas to the microlithic backed points of the Holocene (Taute 1972). Lyman et al. (2008), however, argue against this assumption of an abrupt transition. They point out that this technological transition should be characterized by initial use of the normal spear or dart points on arrows, accompanied by slight modifications and experimentation in order to achieve optimal arrow performance. If this were the case, then attributes such as average length might show little abrupt change. In addition, they suggest that any attributes might show greater variability early in the transition as experimentation proceeds, followed by decreasing variability as techniques are stabilized.

In seeking to explain the timing of the appearance of bow and arrow technology, the environmental changes during the Late Pleistocene have been seen as a driving force, related to supposed advantages of the bow in forested environments. Leesch (2013), however, has emphasized its appearance during the Bølling in Switzerland in a largely unforested landscape. Similarly, Valentin (2008) has argued that even during the Late Azilian of the Paris Basin between 14,000 and 13,000 cal BP the landscape was still a mosaic of sparse forests interspersed with grasslands. A simple adaptive explanation for the timing of the appearance of this technology cannot easily be reduced to a change in vegetation.

Discovery of arrow points embedded in bones has been suggested as an aid in determining the use of the bow and arrow (Bachechi et al. 1997). Unfortunately, very few such finds have been made in the Paleolithic record. One such discovery was made in a burial in the Sicilian cave of San Teodoro, in which a flint fragment – possibly the tip of a microlithic triangle – was found lodged in the pelvis (Bachechi et al. 1997). This burial lies under a level dated to before 15,224-14,708 cal BP (Garilli et al. 2020). A child burial at the Grotta dei Fanciulli (Grotte des Enfants) at the Italian-French border has a retouched bladelet lodged in a vertebra, dated to ca. 13,000 cal BP (Formicola and Holt 2015). Finally, a bear skeleton found in the site of Bichon in the Swiss Jura had a flint fragment embedded in a vertebra and dated to 13,770-13,560 cal BP (Morel 1998). Although none of these finds attest positively to the use of the bow and arrow, this is a possible interpretation.

If the bow and arrow was indeed present in the early Bølling in Switzerland, the French Alps, the Paris Basin and Belgium, arrow points presumably consisted of relatively small Azilian points, the "quickly made flint points" of Valentin (2008, 8). In Italy, on the other hand, the find at San Teodoro, with its bone-embedded possible tip of a microlithic triangle, suggests that geometric microliths may have been used for arrow points even somewhat before the early Bølling in that area (Bachechi et al. 1997). In light of the Near Eastern genetic ties of the European immigrant population, it is worth exploring the dating of geometrics between that area and Italy.

According to Macdonald et al. (2016), the Geometric Kebaran level of the site of Wadi Mataha in Jordan contains geometric microliths in the form of trapeze-rectangles between 17,579 and 16,457 cal BP. Of note is that the fracture patterns indicate that most of these geometrics were used as projectile points. Farther afield, recent studies of skeletons at the site of Jebel Sahaba in Egypt, dating to 18,600-13,400 cal BP, identified wounds and embedded stone chips and retouched fragments interpreted as resulting in part from light arrows (Crevecoeur et al. 2021). In southwestern Anatolia, levels of the site of Okuzini Cave dating to the 17$^{th}$ to 15$^{th}$ millennium cal BP show the transformation of proto-geometric forms of inserts into typical geometrics, including segments, trapezes and triangles, that were probably used as arrow points (Kozlowski and Kaczanowska 2004, 12). In southern Italy, the site of Paglicci Cave contains a few microlithic trapeze-rectangles dating to the mid-15,000s cal BP (Ferrari and Peresani 2003). Somewhat later, geometrics appear (14,477-13,422 cal BP in level 10 of Tagliente). Thus, there is a possible trail of bow and arrow use extending through time from the Near East through Anatolia into Italy, with a later spread north and west into Europe.

## Dog domestication

Another innovation that may have coincided with, or at least accompanied and enhanced the demographic expansion is the domestication of the dog. This topic has attracted much discussion and debate, for good reason. As Camarós et al. (2016, 806) state, "during the early stages of domestication, distinguishing wolves (*Canis lupus*) from domestic dogs (*Canis familiaris*) is not easy from either archaeozoological or genetic studies." Many archaeological finds of canid skeletal material have been suggested to represent either domesticated animals or transitional stages in the domestication process (Perri et al. 2021). In general, research has demonstrated that early domesticated dogs in western Europe are very small and differ from those in eastern Europe and Siberia. Discussing the western European evidence, which is of relevance here, "the earliest generally accepted remains of a domestic dog, based on a convergence of morphological, genetic, isotopic, and contextual evidence comes from the site of Bonn-Oberkassel in Germany" (Perri et al. 2021), dated to 14,223 cal BP, although the authors note that claims for roughly contemporaneous dogs have been made for sites in France, Germany, Italy and Switzerland. Some proposed domesticated dogs are as early as approximately 16,000 cal BP, including the Swiss site of Monruz and the German site of Kniegrotte (Boschin et al. 2020), but their domesticated status is not certain. Recent studies in Italy do raise the possibility that domesticated dogs appear earlier in this area (Boschin et al. 2020). Based on examination of canid materials from the sites of Grotta Paglicci and Grotta Romanelli, the authors conclude that "our data (body size, genetics and dental internal structure) indicate that dog-like individuals were present in Apulia at least 14,000 years ago and likely as early as 20,000 years ago (…) while similar evidence began to appear only some millennia after in central Europe" (Boschin et al. 2020, 8).

If dogs accompanied the demographic expansion in western Europe from south to north, they may have provided a number of advantages to the human population. Evidence from the French sites of Montespan and Pont d'Ambon of cutmarked dog bones indicates at least some

consumption, although Pionnier-Capitan et al. (2011, 2138) suggest that this may have been irregular. On the other hand, the evidence from a healed dog femur from Montespan and of a dog burial from Oberkassel suggests a very different aspect of the relationship between humans and dogs, one of companionship and sharing (Orschiedt 2013). In addition, ethnographic accounts certainly testify to the potential benefits of dogs in both hunting and guarding against predators.

## Burials

Mortuary treatment may be one of the better indicators of cultural affinity (and ultimately of immigration), as such practices can be quite independent of environmental factors. Again, the archaeological data are rather sparse, but a number of observations can be made. For example, the burials in the Italian sites of Riparo Tagliente (16,980-16,510 cal BP) and Villabruna (14,180-13,780 cal BP) show considerable similarity, in accord with their ultimate genetic relationship. At Tagliente a young male adult was placed supine in a pit with legs covered by stones. The bones were stained with ochre and possibly accompanying the body were a stone with geometric designs of ochre, a bovid horn, a perforated shell and an engraved stone with figures of a lion and an aurochs horn (Gazzoni et al. 2013). The burial at Villabruna consisted of a young male adult placed supine in a pit accompanied by a stone knife, core, blade and hammer, a bone point, and a lump of beeswax. The body was covered with several stones, some of which contained drawings in ochre, and red ochre lines were painted on the wall above the burial (Vercellotti et al. 2008). A similar burial in Italy at the site of Grotta Vado All'Arancio consisted of an adult male placed on a layer of ochre in a pit and covered by stone blocks and possibly dating to around 15,400 cal BP (Orschiedt 2018). Accompanying the body were a few animal bones, two flint scrapers and a flake, and ten perforated shells. The burial of a female (Oriente C) at the site of Grotta d'Oriente on a Sicilian island is dated to 14,200-13,800 cal BP (Catalano et al. 2020). The body was in a supine position within a pit in which fires had been lit, and stone blocks were placed in and around the pit. Accompanying the grave was a perforated shell and some lumps of red ochre. "Oriente C shows a strong genetic relationship with Western European Late Upper Palaeolithic and Mesolithic hunter-gatherers, suggesting that the 'Western hunter-gatherers' was a homogeneous population widely distributed in the Central Mediterranean" (Catalano et al. 2020). Such burials have led Orschiedt (2013) to characterize a Late Epigravettian burial tradition in Italy as "simple inhumation with the body lying stretched out on its back and with little or no grave goods, except basic equipment like flint tools and personal ornamentation like perforated shells."

Later burials in Germany show some similarities with these. At the site of Bonn-Oberkassel (14,223 cal BP) an adult woman and man were buried close together in an area heavily stained with red ochre, with the woman's bones particularly colored. Accompanying the burial were a dog skeleton, a bone pin, a bear's penis bone and a bone engraved with the image of an elk (Orschiedt 2013, 122). The roughly contemporaneous site of Neuwied-Irlich contained fragmentary bones of an adult, two children and a neonate. The bones were stained with red ochre and ac-

companied by a backed blade, a burin spall, a bone point, and a decorated cervid tooth pendant (Orschiedt 2013, 123).

This pattern of mortuary treatment appears to be considerably different from that of the Late Magdalenian in western Europe and may represent a rather abrupt change in behavior. As summarized by Orschiedt (2013, 117), "in France, for example, of the remains of some 232 individuals known for the Magdalenian, only 5.6% (N = 9) comprise decently complete skeletons and were probably derived from burials, whereas 94.5% (N = 223) are highly fragmentary, and 40% (N = 95) of these bear cut and scrape marks indicative of defleshing, while 54% (N = 125) show no signs of any kind of treatment." Furthermore, he calls attention to the Magdalenian selection in particular of cranial and dental remains for special treatment, and that "human remains were curated and used, and probably played a significant role for the Magdalenian people" (Orschiedt 2013, 126). The German Magdalenian site of Brillenhöhle has been described as a secondary burial association of skeletal elements of adults and children with similar evidence of dismemberment and defleshing (Orschiedt 2013). Sala and Conard (2016) suggest that this site can be interpreted as evidence of cannibalism.

## Art

A significant transformation of artistic behavior occurs during the Late Paleolithic in Europe, manifested in the practical abandonment of figurative art and the proliferation of schematic art, including paintings in red ochre and engravings on pebbles and bones (Bintz and Griggo 2011, 16). Pebbles with abstract signs in red ochre, such as those from Mas d'Azil in France are the most well-known. In this context, it should be noted that Magdalenian sites in Germany, such as Kleine Scheuer and Hohle Fels, both dating to before the Bølling, contain rock slabs with paintings of red dots (Conard and Floss 1999), and the early Italian burials at Grotta Tagliente and Grotta Villabruna both contained stones with designs in red ochre, chronologically preceding the Azilian of northern area. Consequently, such abstract art has deep roots. Moreover, some figurative art, in the form of engravings, does persist, including finds at Tagliente, Oberkassel, and Le Rocher de l'Impératrice in France (Naudinot et al. 2017). The general impression, however, is that Azilian and Late Epigravettian art appears much impoverished compared to the earlier cultures, lacking the figurines, female imagery, and much more that is common in the Magdalenian.

This change seems to be rapid. Although he argues for cultural continuity between the Magdalenian and Azilian, Straus (1985, 117) does state that "one can but only speculate that the apparently abrupt change in artistic activity coeval with the Azilian, might be a reflection of new forms of social organization." Other interpretations of this transformation, however, might include a demographic influx from the south.

## Conclusions

During the Last Glacial Maximum, the northern Mediterranean and its hinterlands were a refugium for populations from the northern areas that were largely depopulated due the harsh

conditions (Jochim 1987). Interaction and population movements along the shores apparently ultimately linked groups from the Near East to those at least as far as Italy even before the development of the genetic signatures identified by the studies of Fu et al. (2016) and Posth et al. (2016). These processes surely involved interbreeding, cultural sharing and innovation. The archaeological record in Italy suggests that this region served as a cultural melting pot that encouraged the development of a number of practices that later were brought into northern regions. The outcome of this expansion may have differed from region to region according to local factors such as population density and local subsistence and settlement organization. A number of these practices, including changes in art and mortuary behavior, appear to have been unrelated to the environmental changes taking place. Others, such as changing lithic technology and typology, as well as the use of the bow and arrow and the domestication of dogs, may also have been not directly related, but certainly would have proven beneficial as groups expanded, perhaps even facilitating their ultimate success. The widespread distribution of the genetically new population in western and central Europe by the end of the Pleistocene indeed testifies to the success of the incoming groups.

The apparent continuities with previous practices may in part represent interaction and interbreeding with Magdalenian populations, building on their baseline along with the influx of new ideas and new people, as they all adapted to the environmental transformations of the Late Pleistocene. In the Paris Basin, at least, there appears to be a clear overlap in dated sites of the Magdalenian and Azilian, implying the possibility of interaction between the two upon contact (Bignon-Lau 2019). Additional genetic studies as well as an increasing focus on discontinuities in the archaeological record should allow a more detailed and nuanced understanding of this period of cultural transition.

## References

**Angelucci,** D. E. and Bassetti, M. 2009: Humans and their landscape from the Alpine Last Glacial Maximum to the Middle Holocene in Trentino: geoarcheological considerations. Preistoria Alpina 4, 59–78.

**Bachechi,** L., Fabbri, P.-F., and Mallegni, F. 1997: An Arrow-Caused Lesion in a Late Upper Palaeolithic Human Pelvis. Current Anthropology 38,135–140.

**Barger,** W. K. 1979: Inuit-Cree Relations in the Eastern Hudson Bay Region. Arctic Anthropology 16, 59–75.

**Berto,** C., Luzi, E., Montanari Canini, G., Guerreschi, A., and Fontana, F. 2018: Climate and landscape in Italy during Late Epigravettian. The Late Glacial small mammal sequence of Riparo Tagliente (Stallavena di Grezzana, Verona, Italy). Quaternary Science Reviews 184, 132–142.

**Bertolini,** E., Pagani, L., Oxilia, G., Posth, C., Fontana, F., Badino, F., Saupe, T., Montinaro, F., Margaritora, D., Romandini, M., Lugli, F., Papini, A., Boggioni, M., Perrini, N., Oxilia, A., Aiese Cigliano, R., Barcelona, R., Visentin, D., Fasser, N., Arrighi, S., Figus, C., Marciani, G., and Silvestrini, S. 2020: Early Alpine Occupation backdates westward human migration in Late Glacial Europe. Current Biology 31, 2484–2493.

**Bignon-Lau,** O. 2019: About the Early Azilian Way of Life in the Paris Basin: Economical and Spatial Insights from Zooarchaeological Data. In: S. B. Grimm, M.-J. Weber, L. Mevel, and I. Sobkowiak-Tabaka (eds.), From the Atlantic to Beyond the Bug River. Finding and Defining the Federmesser-Gruppen/Azilian. RGZM-Tagungen 40. Heidelberg: Propylaeum (open access) and Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 35–60.

**Bintz,** P. and Griggo, C. 2011: Climats et premiers peuplements des Alpes du Nord françaises: des derniers chasseurs aux premiers paysans (15 000 à 5 000 ans av. JC.). Revue de primatologie 3 (online): http://primatologie.revues.org/789.

**Birch,** S. E. P., Miracle, P. T., Stevens, R. E., and O'Connell, T. C. 2016: Late Pleistocene/Early Holocene Migratory Behavior of Ungulates Using Isotopic Analysis of Tooth Enamel and Its Effects on Forager Mobility. PLoS ONE 11(6): e0155714.

**Boschin,** F., Bernardini, F., Pilli, E., Vai, S., Zanolli, C., Tagliacozzo, A., Fico, R., Fedi, M., Corny, J., Dreossi, D., Lari, M., Modi, A., Vergata, C., Tuniz, C., Moroni1, A., Boscato, P., Caramelli, D., and Ronchitelli, A. 2020: The first evidence for Late Pleistocene dogs in Italy. Scientific Reports 10: 13313.

**Broglio,** A. 1997: Considérations sur l'Epigravettien italique. In: J. M. Fullola Pericot and N. Soler i Masferrer (eds.), El món mediterrani després del pleniglacial (18.000-12.000 BP). Col-loqui Banyoles 1995. Serie Monografica 17. Girona: Museu d'Arqueologia de Catalunya, 147–157.

**Camarós,** E., Münzel, S. C., Cueto, M., Rivals, F., and Conard, N. J. 2016: The evolution of Paleolithic hominin-carnivore interaction written in teeth: Stories from the Swabian Jura (Germany). Journal of Archaeological Science: Reports 6, 798–809.

**Catalano,** G., Lo Vetro, D., Fabbri, P. F., Mallick, S., Reich, D., Rohland, N., Sineo, L., Mathieson, I., and Martini, F. 2020: Late Upper Palaeolithic hunter-gatherers in the Central Mediterranean: New archaeological and genetic data from the Late Epigravettian burial Oriente C (Favignana, Sicily). Quaternary International 537, 24–32.

**Conard,** N. J. and Floss, H. 1999: Une Pierre Peinte du Hohle Fels (Baden-Württemberg, Allemagne) et la Question de l'Art Pariétal Paléolithique en Europe Centrale. Paléo 11, 167–176.

**Crevecoeur,** I., Dias-Meirinho, M.-H., Zazzo, A., Antoine, D., and Bon, F. 2021: New insights on interpersonal violence in the Late Pleistocene based on the Nile valley cemetery of Jebel Sahaba. Scientific Reports 11: 9991.

**Cupillard,** C. (ed.) 1998: Les derniers chasseurs-cueilleurs du massif jurassien et de ses marges (13000-5500 avant Jésus-Christ). Lons-le-Saunier: Centre Jurassien du Patrimoine.

**Cupillard,** C., Magny, M., Bocherens, H., Bridault, A., Bégeot, C., Bichet, V., Bossuet, G., Drucker, D. G., Gauthier, E., Jouannic, G., Millet, L., Richard, H., Rius, D., Ruffaldi, P., and Walter-Simonnet, A.-V. 2015: Changes in ecosystems, climate and societies in the Jura Mountains Between 40 and 8 ka cal BP. Quaternary International 378, 40–72.

**Ferrari,** S. and Peresani, M. 2003: Trapezoids and Double Truncations in the Epigravettian Assemblages of Northeastern Italy. Eurasian Prehistory 1(1), 83–106.

**Fisher,** L. E. 2000: Land Use and Technology from Magdalenian to Early Mesolithic in Southwestern Germany. PhD dissertation, University of Michigan, Ann Arbor.

**Fontana,** F., Cremona, M. G., Bertola, S., Falceri, L., Gajardo, A., Ndyae, M., Neri, A., Visentin, D., and Guerreschi, A. 2012: Lithic Technical Systems in the First Part of the Late Glacial at Riparo Tagliente (Stallavena Di Grezzana, Verona). Journal of Biological Research 85, 102–103.

**Formicola,** V. and Holt, B. 2015: Tall guys and fat ladies: Grimaldi's Upper Paleolithic burials and figurines in an historical perspective. Journal of Anthropological Sciences 93, 71–88.

**Fu,** Q., Posth, C., Hajdinjak, M., Petr, M., Mallick, S., Fernandes, D., Furtwängler, A., Haak, W., Meyer, M., Mittnik, A., Nickel, B., Peltzer, A., Rohland, N., Slon, V., Talamo, S., Lazaridis, I., Lipson, M. Mathieson, I., Schiffels, S., Skoglund, P., Derevianko, A. P., Drozdov, N., Slavinsky, V., Tsybankov, A., Grifoni Cremonesi, R., Mallegni, F., Gély, B., Vacca, E., González Morales, M. R., Straus, L. G., Neugebauer-Maresch, C., Teschler-Nicola, M., Constantin, S., Moldovan, O. T., Benazzi, S., Peresani, M., Coppola, D., Lari, M., Ricci, S., Ronchitelli, A., Valentin, F., Thevenet, C., Wehrberger, K., Grigorescu, D., Rougier, H., Crevecoeur, I., Flas, D., Semal, P., Mannino, M. A., Cupillard, C., Bocherens, H., Conard, N. J., Harvati, K., Moiseyev, V., Drucker, D. G., Svoboda, J., Richards, M. P., Caramelli, D., Pinhasi, R., Kelso, J., Patterson, N., Krause, J., Pääbo, S., and Reich, D. 2016: The genetic history of Ice Age Europe. Nature 534, 200–205.

**Garilli,** V., Vita, G., Mulone, A., Bonfiglio, L., and Sineo, L. 2020: From sepulchre to butchery-cooking: Facies analysis, taphonomy and stratigrapy of the Upper Palaeolithic post burial layer from the San Teodoro Cave (NE Sicily) reveal change in the use of the site. Journal of Archaeological Science: Reports 30: 102191. https://doi.org/10.1016/j.jasrep.2020.102191.

**Gazzoni,** V., Goude, G., Herrscher, E., Guerreschi, A., Antonioli, F., and Fontana, F. 2013: Late Upper Palaeolithic human diet: first stable isotope evidence from Riparo Tagliente (Verona, Italy). Bulletins et Mémoires de la Société d'Anthropologie de Paris 25, 103–117.

**Grimm,** S. B. 2013: Phase transition in behaviour? From Magdalenian to Federmesser-Gruppen in western central Europe. In: J. Holzkämper, I. Kretschmer, A. Maier, M. Baales, A. von Berg, J. A. A. Bos, M. Bradtmöller, K. Edinborough, S. Flohr, L. Giemsch, S. B. Grimm, J. Hilpert, A. J. Kalis, T. Kerig, M. C. Langley, D. Leesch, J. Meurers-Balke, L. Mevel, J. Orschiedt, M. Otte, A. Pastoors, P. Pettitt, E. Rensink, J. Richter, F. Riede, I. Schmidt, R. W. Schmitz, S. Shennan, M. Street, Y. Tafelmaier, M.-J. Weber, K. P. Wendt, G.-C. Weniger, and A. Zimmermann, The Upper-Late Pa-

laeolithic Transition in Western Central Europe. Typology, Technology, Environment and Demography. Report on the workshop held in Rösrath, 21st – 24th June 2012. Archäologische Informationen 36, 175–176.

**Hutchings,** W. K. 2016: When Is a Point a Projectile? Morphology, Impact Fractures, Scientific Rigor, and the Limits of Inference. In: R. Iovita and K. Sano (eds.), Multidisciplinary Approaches to the Study of Stone Age Weaponry. Vertebrate Paleobiology and Paleoanthropology Series. Dordrecht: Springer, 3–12.

**Janssens,** L., Giemsch, L., Schmitz, R., Street, M., Van Dongen, S., and Crombé, P. 2018: A new look at an old dog: Bonn-Oberkassel reconsidered. Journal of Archaeological Science 92, 126-138.

**Jochim,** M. 1987: Late Pleistocene Refugia in Europe. In: O. Soffer (ed.), The Pleistocene Old World. Regional Perspectives. Interdisciplinary Contributions to Archaeology. New York and London: Plenum Press, 317–331.

**Jochim,** M. 2020: A Lacustrine Revolution: Adaptive Shifts in the Late Glacial of South Central Europe. Mitteilungen der Gesellschaft für Urgeschichte 29, 81–92.

**Kozlowski,** J. K. and Kaczanowska, M. 2004: Gravettian/Epigravettian Sequences in the Balkans and Anatolia. Mediterranean Archaeology and Archaeometry 4, 5–18.

**Leesch,** D. 2013: The Upper Palaeolithic-Late Palaeolithic transition in Switzerland. In: J. Holzkämper, I. Kretschmer, A. Maier, M. Baales, A. von Berg, J. A. A. Bos, M. Bradtmöller, K. Edinborough, S. Flohr, L. Giemsch, S. B. Grimm, J. Hilpert, A. J. Kalis, T. Kerig, M. C. Langley, D. Leesch, J. Meurers-Balke, L. Mevel, J. Orschiedt, M. Otte, A. Pastoors, P. Pettitt, E. Rensink, J. Richter, F. Riede, I. Schmidt, R. W. Schmitz, S. Shennan, M. Street, Y. Tafelmaier, M.-J. Weber, K. P. Wendt, G.-C. Weniger, and A. Zimmermann, The Upper-Late Palaeolithic Transition in Western Central Europe. Typology, Technology, Environment and Demography. Report on the workshop held in Rösrath, 21st – 24th June 2012. Archäologische Informationen 36, 176-177.

**Lyman,** R. L., VanPool, T. L., and O'Brien, M. J. 2008: Variation in North American dart points and arrow points when one or both are present. Journal of Archaeological Science 35, 2805–2812.

**Macdonald,** D. A., Chazan, M., and Janetski, J. C. 2016: The Geometric Kebaran occupation and lithic assemblage of Wadi Mataha, Southern Jordan. Quaternary International 396, 105–120.

**Marreiros,** J., Bicho, N., Gibaja, J., Cascalheira, J., and Pereira, T. 2016: Early Gravettian Projectile Technology in Southwestern Iberian Peninsula: The Double Backed and Bipointed Bladelets of Vale Boi (Portugal). In: R. Iovita and K. Sano (eds.), Multidisciplinary Approaches to the Study of Stone Age Weaponry. Vertebrate Paleobiology and Paleoanthropology Series. Dordrecht: Springer, 147–158.

**Mevel,** L. 2013: Adoption or adaptation? Late Magdalenian and Early Azilian societies in northern French Alps. In: J. Holzkämper, I. Kretschmer, A. Maier, M. Baales, A. von Berg, J. A. A. Bos, M. Bradtmöller, K. Edinborough, S. Flohr, L. Giemsch, S. B. Grimm, J. Hilpert, A. J. Kalis, T. Kerig, M. C. Langley, D. Leesch, J. Meurers-Balke, L. Mevel, J. Orschiedt, M. Otte, A. Pastoors, P. Pettitt, E. Rensink, J. Richter, F. Riede, I. Schmidt, R. W. Schmitz, S. Shennan, M. Street, Y. Tafelmaier, M.-J. Weber, K. P. Wendt, G.-C. Weniger, and A. Zimmermann, The Upper-Late Palaeolithic Transition in Western Central Europe. Typology, Technology, Environment and Demography. Report on the workshop held in Rösrath, 21st – 24th June 2012. Archäologische Informationen 36, 177–178.

**Mevel,** L., Fornage-Bontemps, S., and Béreiziat, G. 2014: Au carrefour des influences culturelles? Les industries lithiques de la fin du Tardiglaciaire entre Alpes du Nord et Jura, 13500-9500 cal BC. In: M. Langlais, N. Naudinot, and M. Peresani (eds.), Les Groupes Culturels de la Transition Pléistocène-Holocène entre Atlantique et Adriatique. Séances de la Société préhistorique française 3. Paris: Société préhistorique française, 45–81.

**Miracle,** P. 2007: The Late Glacial 'Great Adriatic Plain': 'Garden of Eden' or 'No-man's Land' during the Epipalaeolithic? A View from Istria (Croatia). In: R. Whallon (ed.), Late Paleolithic Environments and Cultural Relations around the Adriatic. BAR 1716. Oxford: BAR Publishing, 41–51.

**Morel,** P. 1998: La Grotte du Bichon (La Chaux-de-Fonds, canton de Neuchatel, Suisse): un site archéologique singulier, ou l'histoire d'une chasse à l'ours brun il y a 12000 ans dans le Jura suisse. In: C. Cupillard (ed.), Les derniers chasseurs-cueilleurs du massif jurassien et de ses marges (13000-5500 avant Jésus-Christ). Lons-le-Saunier: Centre Jurassien du Patrimoine, 88–93.

**Naudinot,** N., Tomasso, A., Tozzi, C., and Peresani, M. 2014: Changes in mobility patterns as a factor of $^{14}C$ date density variation in the Late Epigravettian of Northern Italy and Southeastern France. Journal of Archaeological Science 52, 578–590.

**Naudinot,** N., Bourdier, C., Laforge, M., Paris, C., Bellot-Gurlet, L., Beyries, S., Thery-Parisot, I., and Le Goffic, M. 2017: Divergence in the evolution of Paleolithic symbolic and technological systems: The shining bull and engraved tablets of Rocher de l'Impératrice. PLoS ONE 12(3): e0173037.

**Orschiedt,** J. 2013: Bodies, Bits and Pieces: Burials from the Magdalenian and the Late Palaeolithic. In: A. Pastoors and B. Auffermann (eds.), Pleistocene Foragers: Their Culture and Environment. Wissenschaftliche Schriften des Neanderthal Museums 6. Mettmann: Neanderthal Museum,117–132.

**Orschiedt,** J. 2018: The Late Upper Palaeolithic and earliest Mesolithic evidence of burials in Europe. Philosophical Transactions of the Royal Society of London Series B, Biological Sciences 373: 20170264. http://dx.doi.org/10.1098/rstb.2017.0264.

**Otte,** M. 2013: The transition from Oldest Dryas to Younger Dryas in Belgium. In: J. Holzkämper, I. Kretschmer, A. Maier, M. Baales, A. von Berg, J. A. A. Bos, M. Bradtmöller, K. Edinborough, S. Flohr, L. Giemsch, S. B. Grimm, J. Hilpert, A. J. Kalis, T. Kerig, M. C. Langley, D. Leesch, J. Meurers-Balke, L. Mevel, J. Orschiedt, M. Otte, A. Pastoors, P. Pettitt, E. Rensink, J. Richter, F. Riede, I. Schmidt, R. W. Schmitz, S. Shennan, M. Street, Y. Tafelmaier, M.-J. Weber, K. P. Wendt, G.-C. Weniger, and A. Zimmermann, The Upper-Late Palaeolithic Transition in Western Central Europe. Typology, Technology, Environment and Demography. Report on the workshop held in Rösrath, 21st – 24th June 2012. Archäologische Informationen 36, 172.

**Pala,** M., Olivieri, A., Achilli, A., Accetturo, M., Metspalu, E., Reidla, M., Tamm, E., Karmin, M., Reisberg, T., Hooshiar Kashani, B., Perego, U.A., Carossa, V., Gandini, F., Pereira, J. B., Soares, P., Angerhofer, N., Rychkov, S., Al-Zahery, N., Carelli, V., Sanati, M. H., Houshmand, M., Hatina, J., Macaulay, V., Pereira, L., Woodward, S. R., Davies, W., Gamble, C., Baird, D., Semino, O., Villems, R., Torroni, A., and Richards, M. B. 2012: Mitochondrial DNA Signals of Late Glacial Recolonization of Europe from Near Eastern Refugia. The American Journal of Human Genetics 90, 915–924.

**Perri,** A. R., Feuerborn, T. R., Frantz, L. A. F., Larson, G., Malhi, R. S., Meltzer, D. J., and Witt, K. E. 2021: Dog domestication and the dual dispersal of people and dogs into the Americas. Proceedings of the National Academy of Sciences of the USA 118: e2010083118. https://doi.org/10.1073/pnas.2010083118.

**Pionnier-Capitan,** M., Bemilli, C., Bodu, P., Célérier, G., Ferrié, J.-G., Fosse, P., Garcià, M, and Vigne, J.-D. 2011: New evidence for Upper Palaeolithic small domestic dogs in South-Western Europe. Journal of Archaeological Science 38, 2123–2140.

**Posth,** C., Renaud, G., Mittnik, A., Drucker, D. G., Rougier, H., Cupillard, C., Valentin, F., Thevenet, C., Furtwängler, A., Wißing, C., Francken, M., Malina, M., Bolus, M., Lari, M., Gigli, E., Capecchi, G., Crevecoeur, I., Beauval, C., Flas, D., Germonpré, M., van der Plicht, J., Cottiaux, R., Gély, B., Ronchitelli, A., Wehrberger, K., Grigorescu, D., Svoboda, J., Semal, P., Caramelli, D., Bocherens, H., Harvati, K., Conard, N. J., Haak, W., Powell, A., and Krause, J. 2016: Pleistocene Mitochondrial Genomes Suggest a Single Major Dispersal of Non-Africans and a Late Glacial Population Turnover in Europe. Current Biology 26, 827–833.

**Ray,** A. J. 1998: Indians in the Fur Trade. Toronto: University of Toronto Press.

**Riede,** F. 2009: The Loss and Re-introduction of Bow-and-Arrow Technology: A Case Study from the Northern European Late Palaeolithic. Lithic Technology 34, 27–45.

**Rosendahl,** G., Beinhauer, K.W., Löscher, M., Kreipl, K., Walter, R., and Rosendahl, W. 2006: Le plus vieil arc du monde? Une pièce intéressante en provenance de Mannheim, Allemagne. L'Anthropologie 110, 371–382.

**Sala,** N. and Conard, N. 2016: Taphonomic analysis of the hominin remains from Swabian Jura and their implications for the mortuary practices during the Upper Paleolithic. Quaternary Science Reviews 150, 278–300.

**Scorrano,** G., Holtsmark Nielsen, S., Lo Vetro, D., Sawafuji, R., Mackie, M., Margaryan, A., Fotakis, A. K., Martínez-Labarga, C., Fabbri, P. F., Allentoft, M. E., Carra, M., Martini, F., Rickards, O., Olsen, J. V., Winther Pedersen, M., Cappellini, and Sikora, M. 2022: Genomic ancestry, diet and microbiomes of Upper Palaeolithic hunter-gatherers from San Teodoro Cave. Communications Biology 5:1262. https://doi.org/10.1038/s42003-022-04190-2.

**Shott,** M. J. 1997: Stones and Shafts Redux: The Metric Discrimination of Chipped-Stone Dart and Arrow Points. American Antiquity 62, 86–101.

**Straus,** L. G. 1985: Chronostratigraphy of the Pleistocene/Holocene Boundary: The Azilian Problem in the Franco-Cantabrian Region. Palaeohistoria 27, 89–122.

**Taute,** W. 1972: Die spätpaläolithisch-frühmesolithische Schichtenfolge im Zigeunerfels bei Sigmaringen (Vorbericht). Archäologische Informationen 1, 29–40.

**Terberger,** T. and Burger, J. 2017: Migration im Paläolithikum und Mesolithikum Mitteleuropas – Archäologie trifft Paläogenetik. In: H. Meller, F. Daim, J. Krause, and R. Risch (eds.), Migration und Integration von der Urgeschichte bis zum Mittelalter. Tagungen des Landesmuseums für Vorgeschichte Halle (Saale) 17. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt/Landesmuseum für Vorgeschichte, 87–104.

**Tomasso,** A. 2014: Territoires, Systèmes de Mobilité et Systèmes de Production. La fin du Paléolithique supérieur dans l'arc liguro-provençal. PhD thesis Université de Nice Sophia-Antipolis.

**Tomasso,** A. 2017: L'épigravettien: variabilité diachronique et géographique. In: M. Olive (ed.), Campo delle Piane. Un habitat de plein air épigravettien dans la Vallée du Gallero (Abruzzes, Italie centrale). Publications de l'École française de Rome. Rome: École française de Rome, 13–21.

**Valentin,** B. 2008: Productions lithiques magdaléniennes et aziliennes dans le Bassin parisien: disparition d'une économie programmée. The Arkeotek Journal 2(3), 1–54.

**Vercellotti,** G., Alciati, G., Richards, M. P., and Formicola, V. 2008: The Late Upper Paleolithic skeleton Villabruna 1 (Italy): a source of data on biology and behavior of a 14,000 year-old hunter. Journal of Anthropological Sciences 86, 143–163.

**Villalba-Mouco,** V., van de Loosdrecht, M. S., Posth, C., Mora, R., Martínez-Moreno, J., Rojo-Guerra, M., Salazar-García, D. C., Royo-Guillén, J. I., Kunst, M., Rougier, H., Crevecoeur, I., Arcusa-Magallón, H., Tejedor-Rodríguez, C., García-Martínez de Lagrán, I., Garrido-Pena, R., Alt, K. W., Jeong, C., Schiffels, S., Utrilla, P., Krause, J., and Haak, W. 2019: Survival of Late Pleistocene Hunter-Gatherer Ancestry in the Iberian Peninsula. Current Biology 29, 1169–1177.

**Weniger,** G.-C. 1982: Wildbeuter und ihre Umwelt. Ein Beitrag zum Magdalénien Südwestdeutschlands aus ökologischer und ethno-archäologischer Sicht. Archaeologica Venatoria 5. Tübingen: Verlag Archaeologica Venatoria.