

The Archaeological Framework of the Upper Paleolithic Revolution

Ofer Bar-Yosef

Introduction

Stone Age archaeology, traditionally known as the Paleolithic period, searches to uncover the past remains of humans and in particular the evidence of their actions. Achieving this aim is not an easy task. It is well known that during the last c. 2.5 million years, since hominins began making stone tools, natural agencies had major affects on the environment and thus on the chances for human survival. It is by developing the needed techniques for food procurement, searching for and creating shelters, and guarding the cohesion of the social group that humans have succeeded in surviving to date. However, the concrete evidence for their failures and successes is not always easy to recover.

Investigations of the opaque past are carried out primarily by archaeologists, often in cooperation with scholars from various fields of research such as geology, botany, zoology and other scientific domains. Hence, modern research into pre-history, as developed essentially during the last 50 years, is characterized by constant scholarly efforts to disclose the Paleolithic past.

The search begins with identifying sites through systematic surveys or accidental discoveries. Excavations of these prehistoric localities always address the issues of stratigraphy, chronology through variable dating techniques, analyses of the retrieved finds whether stone tools or animal bones, and the nature of the accumulations within the site. It is the analysis of the stone objects that serves to define the cultural entities and adaptive strategies of humans within their environment. Stone tools, bone and antler tools, rare finds of wooden tools, mobile art objects and parietal cave art are seen as expressions of human culture, and as outcomes of human, functional symbolic needs and their innovative minds. Examination of faunal and vegetal components retrieved systematically during the excavations discloses the details of human diet, the exploitation of organic materials, and particular

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taboos. Great efforts were invested in understanding how all these components accumulated to create a site. Techniques such as geomorphology, micromorphology and mineralogy are tools in this search for answers. Finally, our investigations culminate in a coarse-grained reconstruction of prehistoric life ways within an evolutionary context and thus enable the asking of further intriguing questions: (a) Was the observed cultural change the result of a technological, economic, ideological transition or revolution? (b) Did the observed socio-economic changes result from changes within the local population or were they due to diffusion of technologies by neighboring groups? (c) Can we identify where local populations are replaced by a new population of immigrants?

In order to answer these questions modern archaeological research stresses the necessity of establishing regional, well-dated cultural sequences, within their paleo-ecological contexts. Radiometric dating techniques facilitate establishing of the regional chronology and later allows for chronological correlations between regions across continents. The integration of our findings determines the reconstruction of global prehistoric cultures and stresses the observed continental-wide varieties.

Within the Paleolithic, the longest timespan in terms of human evolution, the accepted subdivision is three-fold: Lower, Middle and Upper Paleolithic (abbreviated as LP, MP and UP), known in sub-Saharan Africa as Early, Middle and Late Stone Age (abbreviated as ESA, MSA and LSA). These rough subdivisions were originally created during the 19th and early 20th centuries, and were based on changes in the shapes of stone tools. Although due to today's dating techniques we know that these subdivisions hardly indicate contemporaneity across the Old World, we continue to use them as general terms of reference. For each period archaeologists succeeded in clustering the information from assemblages of artifacts that contain the same or similarly shaped tools and gave them local names. For example the 'Acheulian' entity means assemblages with a few or many bifaces (handaxes), 'Clactonian' means a lithic (stone artifacts) industry of cores (nodules from which pieces were detached by a hammerstone) and flakes, with no bifaces. The 'Mousterian' means a cluster of Middle Paleolithic assemblages characterized by flakes and sometimes blades (i.e. more than twice as long as they are wide) shaped to 'sidescrapers' and 'points'. Often within each of these generalized categories we identify one or more local 'archaeological culture' such as the 'Mousterian of Acheulian Tradition', or the 'Eastern Micoquian' in the Middle Paleolithic, the 'Aurignacian', 'Gravettian', 'Ahmarian' in the Upper Paleolithic and many others across the world.

For the Upper Paleolithic, the period under discussion, the first to be discussed will be the cultural traits, for which the dates as cited below were obtained mostly by the techniques of radiocarbon (^{14}C) dating (for details see Wagner, 1998). They derive from laboratory analyses of samples such as wood charcoal, seeds and animal bones. The latter two are what we call 'short-lived' samples and therefore are preferable in order to avoid reliance on old wood used by prehistoric humans for their fires. In addition, since scientists discovered that the amount of ^{14}C in the atmosphere was not constant and fluctuated through time they have used the rings of old trees to find the fit between astronomical years and radiocarbon years. The calculation of the calendar years is known as the dendro-calibration curve. However, in spite of some amazing progress, there are still ambiguities concerning the calibration of

^{14}C dates to calendar years at the range of 50–40/38,000 years ago. Hence, all dates in this paper are cited as calibrated BP except when they are older than 40/38,000 years ago, when they will be marked as ‘uncalibrated BP’. It is worth noting a general agreement that at this early range the calibration of the radiocarbon dates will indicate a much shorter timespan. Thus readings between 47,000 and 42,000 uncalibrated BP may end up not 5000 years apart but more like 2000 to 1000 years (e.g. Hughen et al., 2004). Such a change has an important impact on our understanding of the time frame when the Upper Paleolithic revolution began, where geographically it started and the pace at which it spread to other regions.

The Upper Paleolithic period

The term ‘Upper Paleolithic’ period was coined in western Europe, the original homeland of the discipline of prehistoric archaeology. It designated the observed change from the previous, Middle Paleolithic, tool manufacture techniques to those of blade-dominated artifact assemblages, with the proliferation of particular tool types such as end-scrapers and burins, as well as bone and antler objects, along with mobile art items and cave paintings. The latter were known especially from the Franco-Cantabrian region, and soon became the hallmarks of the culture of *Homo sapiens sapiens*. Indeed, the discoveries of human fossils equated the Upper Paleolithic with the appearance of *Homo sapiens sapiens* (modern humans), referred to as Cro-Magnons.

Intriguing questions were raised concerning the survival and demise of the Neanderthals, the bearers of the Middle Paleolithic cultures, and the identity of the makers of the new prehistoric cultures of the Upper Paleolithic period, which received local names such as ‘Châtelperronian’, ‘Aurignacian’ and ‘Gravettian’. The scientific discourse led to the proposal of two competing hypotheses: (1) the transition to the Upper Paleolithic was a major evolutionary event of global dimensions, brought about in Europe and western Asia by migrating groups of Modern humans from somewhere ‘east of Europe’; (2) the cultural transition was gradual stemming from a biological change when Neanderthals developed to become Modern humans.

In the last three decades, with the advent of molecular and nuclear genetics and the discovery that Modern humans emerged in sub-Saharan Africa, the issues became more complicated.

1. Was the cultural transition evident everywhere in the Old World?
2. Was the impetus for the change biological, cultural or both?
3. Are the Upper Paleolithic archaeological manifestations markers of human modern behavior expressed in the use of symbols?
4. Is there a prehistoric period other than the Upper Paleolithic when the archaeological record indicates emergence of modern behavior?

There is currently no way to satisfy the entire community of investigators by fully responding to these queries, because interpretations of the same evidence vary. In the following pages I provide a survey of the particular archaeological traits of the Upper Paleolithic, without lingering on controversial issues such as the ‘capacity

for modern behavior' (e.g. Gibson, 1996; Wadley, 2001). At the same time I try to provide the archaeological evidence for areas beyond the well-known regions of Europe and western Asia. I also present the terminological jumble that sometimes obscures interpretation of the retrieved information, and briefly comments on the geographical distribution of Upper Paleolithic entities.

The archaeological traits of the Upper Paleolithic revolution

The nature of the 'Upper Paleolithic Revolution' is at the center of current debates across the Old World (e.g. Bar-Yosef, 2002; Clark, 1997; Clark and Lindly, 1989; Derevianko and Rybin, 2005; Henshilwood and Marean, 2003; Hublin, 2000; Klein, 1999; McBrearty and Brooks, 2000; Mellars, 2005; Wadley, 2001; Zilhão, 2001; Zilhao and d'Errico, 1999). The variable mosaic of archaeological data sets is open to different interpretations. It is generally agreed that the way to identify a revolution is to compare the overall cultural, behavioral and economic systems before and after a given point in time. This means that we need to compare the Middle Paleolithic (and MSA in Africa) to the Upper Paleolithic (and LSA). These two archaeological periods are of different duration. Whereas the Middle Paleolithic (and MSA) lasted from ~250,000 to 40,000 or 30,000 years ago the duration of the Upper Paleolithic was ~40,000/~30,000 to 10,000 years ago. Therefore, only the last 30,000 years of the Middle Paleolithic should be taken into account.

Several scholars view the accumulation of material culture markers for modern behavior as appearing gradually in the course of the Middle Paleolithic (and the MSA). This is clearly documented in sub-Saharan Africa and parts of Europe in particular. Therefore they conclude that there was no revolution (e.g. Clark, 1997; McBrearty and Brooks, 2000; Straus, 1996). Others view the new technological innovations and the incipient shifts in social structure as appearing first within the late Middle Stone Age in Africa (e.g. Deacon and Deacon, 1999; Henshilwood and Marean, 2003; Mellars, 2005). Most scholars agree that, at least in Europe, western and northern Asia and north Africa, the observed cultural and technological traits reflect rapid cultural changes as well as an increase in population densities during the early Upper Paleolithic when compared to the slow pace of the Middle Paleolithic. Among the major human achievements during the Upper Paleolithic were the long-distance exchanges of raw materials and precious items that imply some means of communication and information transfer; the innovative technology that allowed the crossing of the geographic 'northern boundary' and a successful existence under periglacial conditions; the colonization of the Americas whether by land or sea; and the first decisive steps in coastal navigation and seafaring in the Pacific Ocean. The overall techno-economical processes portray the feedback relationship between innovative minds and fast-increasing populations (due to higher rates of survival of newborns). The full list of Upper Paleolithic new cultural and material components, although not necessarily present in each and every global region, is briefly summarized below:

(1) Upper Paleolithic artifact assemblages are generally characterized by the systematic production of prismatic blades, with only rare cases where flake production

continued to be the dominant mode (e.g. Kozłowski, 2000; Kuhn and Bietti, 2000; Rigaud, 1997). An exception is East Asia and Australia, where the common Late Pleistocene industries are flake-dominated, such as the Hoabinian. It should be stressed that the first appearance of blade production occurred around 250–150,000 years ago in Africa and Asia, and during the Last Interglacial in Europe (e.g. Bar-Yosef and Kuhn, 1999; Conard, 1990; Révillion and Tuffreau, 1994). The mode of Upper Paleolithic blade production evolved from 30,000 years ago in most regions of the Old World to the manufacturing of bladelets and their shaping into small, micro-lithic stone tools of various forms (e.g. Elston and Kuhn, 2002; Otte, 1994, 1999).

(2) The exploitation of animal bones, antlers and ivory as raw materials for the production of mundane or ritual tools as well as for art objects became a common practice in the Upper Paleolithic (e.g. Djindjian et al., 1999; Mellars, 1989), although these raw materials were available to Middle Paleolithic humans. The presence of bone tools, although not in every East Asian site, facilitates nowadays the recognition of their attribution to the Upper Paleolithic. The exception is the rich assemblages of the Howiesons Poort entity in South Africa, and in particular in Bloombos cave (Deacon and Deacon, 1999; Henshilwood et al., 2001), generally dated to 80–60,000 years ago. For the time being this cultural phenomenon is unique, isolated, stratigraphically and chronologically intercalated between two MSA industries lacking bone tools. One may hypothesize that the makers of this culture did not survive to a later age and thus their innovative venture had no relationship to the appearance of similar bone and antler tools, beads and pendants in Eurasia.

(3) Systematic usage of body decorations, including beads and pendants made from marine shells, teeth, ivory and ostrich eggshells, is recorded from both Europe, western and central Asia and Africa (e.g. Ambrose, 1998a, b; Derevianko and Rybin, 2005; Kuhn et al., 2001; Taborin, 1993; White, 1997). These elements are seen as communicating the social identity of individuals and their group. No similar objects, except for those found within the context of the Howiesons Poort entity in South Africa, are known from Middle Paleolithic contexts, while most early Upper Paleolithic assemblages contain them.

(4) Long-distance exchange networks providing lithic raw materials and marine shells during the Upper Paleolithic are recorded from distances of up to several hundred kilometers (Gamble, 1999; Smith, 1999; Taborin, 1993). They consistently differ from the shorter ranges of raw material procurement during the Middle Paleolithic in Eurasia although some African cases indicate distances of up to 60 km during the MSA (e.g. Conard, 2001; Féblot-Augustins, 1993; Hovers, 2001; Marks and Chabai, 1998; Merrick and Brown, 1984). Perhaps one of the exceptions is again Howiesons Poort in South Africa (Deacon and Deacon, 1999).

(5) Middle Paleolithic spears hafted with Levallois or other Mousterian points were recorded in more than a few instances (e.g. Boëda et al., 1999; Plisson and Beyries, 1998; Shea, 1998). However, the Upper Paleolithic witnessed the invention of improved hunting tools such as spear throwers, and later bows and arrows and boomerangs (Mulvaney and Kamminga, 1999). These devices facilitated targeting animals from longer distances and could have brought higher rates of hunting success.

(6) Human and animal figurines, decorated and carved bone, antler, ivory and stone objects (Abramova, 2000; Delporte, 1993; Soffer et al., 2000) are reported from

many Upper Paleolithic contexts. Representational, abstract and realistic images, either painted or engraved, began to appear in caves, rockshelters and on exposed rocky surfaces by 36,000 and probably later in Australia (Bahn, 1997; Bednarik, 1994; Clottes, 1997; Lewis-Williams, 2002; Marshack, 1972, 1997; Zilhão, 1995). We must wonder why the Franco-Cantabrian region differs from the rest of the Upper Paleolithic world. It is not the lack of limestone caves or suitable rock surfaces that prevented other human groups or their shamans from leaving behind similar paintings and engravings. A possible explanation is that this region excelled in artistic manifestations due to the pressures faced by local hunter-gatherers interacting with newcomers from other regions. The Franco-Cantabrian region being a refugium at the edge of the inhabited world, namely western Europe, just as Australia was under similar conditions, was an arena of social interactions. In contrast, mobile imagery objects are found in other regions of the world such as eastern Europe, Siberia and the Levant (e.g. Derevianko and Rybin, 2005; Marshack, 1997).

(7) Storage facilities often characterize sites in regions in the northern latitudes, where seasonal depletion of resources led Modern humans to this invention/innovation (Grigor'ev, 1993; Soffer, 1989).

(8) Development of grinding tools is noticeable during the Upper Paleolithic in the subtropical belt including the region with the Mediterranean-type vegetation, where plant food was always a major component of the human diet. Unfortunately, knowledge concerning the exploitation of plant food during the Paleolithic is generally very poor. We have better information concerning the meat diets of Middle Paleolithic, MSA, Upper Paleolithic and LSA humans. There are regional differences in the Old World in the hunters' selection of game animals, as well as the trapping and hunting techniques, butchering, transport of whole or partial carcasses, and the skeletal parts which were left on site and sometimes fell prey to scavengers (e.g. Delpech, 1983; Roebroeks et al., 2001; Stiner, 1994). In certain regions population increases resulted in pressures that affected local resources (Stiner et al., 1999) while in others a change in the environmental conditions, or particular topographic alignments, favored one species over others as evidenced in the collected data (e.g. Adler et al., 2005; Grayson and Delpech, 2002).

(9) Structured hearths with or without the use of rocks for warmth, banking and parching activities are often recorded in Upper Paleolithic sites, although variable types of hearths are known from the Middle Paleolithic and MSA contexts (Bar-Yosef et al., 1992; Deacon and Deacon, 1999; Meignen et al., 2001; Pastó et al., 2000; Rigaud et al., 1995).

(10) Distinct functional spatial organization within habitations and hunting stations, such as kitchen areas, butchering space, sleeping grounds, discard zones and the like, are relatively common in Upper Paleolithic sites. These features reflect the social structure or a particular combination of members of the band, e.g. a male task force (Binford, 1983; Deacon, 1995). This kind of information is available from several Middle Paleolithic and MSA sites but mostly from Upper Paleolithic sites, whether these are caves, rock shelters or open-air habitations.

(11) Burials are already known from Middle Paleolithic contexts, and their presence has led to debate concerning their interpretation as implicit or explicit symbolic behavior (Belfer-Cohen and Hovers, 1992; Chase and Dibble, 1987). The evidence for

rare grave goods incorporated into Middle Paleolithic burials, e.g. the Skhul V burial (Garrod and Bate, 1937), where a wild boar jaw was placed under the arm of the dead. During the Early Upper Paleolithic, burials are absent and only a few isolated skulls were reported, mostly recovered from non-habitation localities. The impression conveyed by the bulk of excavated sites is that burial activities did not take place where the living camped. This approach changed sometime in the late Upper Paleolithic, mainly after 25,000 years ago, as indicated by decorated individuals such as those at Sungir (Bader and Lavrushin, 1998), or the joint burial of three individuals in Dolni Vestonice (Svoboda et al., 2000).

Ambiguities and clarifications in defining early Upper Paleolithic cultures

The definitions of 'archaeological cultures' have been based on classifications of durable finds. However, archaeologists sometimes diverge in their selection of what among the material components should be taken as characterizing a given culture in the past. An additional source of confusion derives from interpretations of field observations. I will exemplify the first issue by briefly summarizing the history of a few of the cultural definitions of early Upper Paleolithic entities, and discuss the second in a following section in respect of the relationships between human remains and stone tool assemblages.

The roots of current terminological ambiguities are embedded in one hundred years of research when schools of prehistory did not communicate with each other, sometimes for geopolitical or linguistic reasons. The first to propose names for Upper Paleolithic contexts was Abbé Breuil (1913), who pioneered the original synthesis of the Upper Paleolithic sequence in western Europe. He based his reconstruction on the available stratified stone tool assemblages from rock shelters in southwest France. The earliest entity, overlying the Middle Paleolithic (the Mousterian) was named Aurignacian, and subdivided into three phases (Lower, Middle and Upper). Each of the three phases was subsequently recognized as an independent culture. Succinctly described, these are the Châtelperronian (interchangeably called Castelperronian and characterized by backed curved knives or points and bone tools), the Aurignacian (with carinated and nosed scrapers, and rich in bone, antler and ivory items, beads and pendants and mobiliary art objects), and the Gravettian (with straight-backed points on blades, and with many bone, antler and ivory objects). Younger entities overlying the Gravettian were the Solutrean (typified by numerous delicate bifacial tool types, most probably projectile points), and the Magdalenian (rich in antler and bone work, among which the harpoon types are most famous). This culture witnessed the full appearance of microlithic stone tools towards the end of the Glacial period (e.g. Bordes, 1968; Dinjdzian et al., 1999; Gamble, 1999).

In the 1930s, D. Peyrony suggested that the early Upper Paleolithic entities in France expressed the presence of two partially contemporaneous populations, each practicing a different method for the production of blanks, as well as exhibiting marked differences among the most common tool types. He grouped them under the terms 'Perigordian' and 'Aurignacian' traditions. However, his scheme, although

supported by the influential studies of F. Bordes and D. de Sonneville-Bordes, did not hold, and recent decades have seen a return to the cultural sequence of Châtelperronian, Aurignacian and Gravettian as independent entities.

The original term 'Aurignacian' (coined by Breuil) marked the initial Upper Paleolithic at this time. Given the human fossils classified as *Homo sapiens sapiens* and attributed to an Aurignacian context, this culture remained equated, in the minds of archaeologists and paleoanthropologists, with the new population. Although stratigraphically the Châtelperronian was earlier than the Aurignacian, and was considered as heralding the Upper Paleolithic with its diagnostic stone tools, interpretations that they had possibly been made by Neanderthals were mentioned in the literature. Support for this hypothesis derived from published discoveries such as the secondary Neanderthal burial in St Cesaire and the presence of Neanderthal teeth in Grotte du Renne, both found in Châtelperronian layers (Leroi-Gourhan, 1961; Leroi-Gourhan, A. and Leroi-Gourhan, Ar., 1964; Lévêque and Vandermeersch, 1981). This issue is discussed below.

As part of the trend to view the Aurignacian as the earliest Upper Paleolithic entity, several scholars adopted the approach of classifying lithic assemblages as 'Aurignacian' on the basis of an insufficient number of attributes. The original definition of this culture was based on a particular suite of stone and bone and antler tools in western Europe. Although it is expected that not all types will be found at all the sites to which the bearers of this industry dispersed, the use of one morphotype, such as the carinated narrow cores for removing bladelets, hardly justifies calling assemblages 'Aurignacian'.

The carinated (keeled) cores are nodules that were shaped for detaching bladelets from a narrow rounded front. It is a technique known not only from the classical European Aurignacian assemblages, but also from cultures in other regions, such as the Kebaran (20–16 BP) in the Levant. We should therefore adopt a cultural definition for the Aurignacian based on a minimal composition of specific tool types, such as nosed scrapers, carinated scrapers on flat thick flakes, and cores from which small twisted bladelets were removed, often with inverse retouch, known as *lamelle Dufour*. Bone and antler objects such as split base points characterize the original Aurignacian culture as defined in Europe and should be present across the Aurignacian territory. The earliest date for the Aurignacian is not absolutely clear, but whether *c.* 36.5 BP or *c.* 38 BP it makes no difference, because the European Aurignacian *was not* the original culture of Modern humans, the colonizers of Europe. The rich lithic, bone, antler, ivory and mobiliary art indicates that the classical Aurignacian developed from local European Initial Upper Paleolithic industries such as the Bachokirian, 'proto-Aurignacian', 'Fumanian' and the Châtelperronian.

Who made these cultures?

The issue of the kind of people who made the archeological remains, be they stone tools, cave art or dwellings, intrigues all scholars. Worth mentioning is that a wealth of Neanderthal remains, the cold-adapted people, were uncovered in Middle

Paleolithic contexts in Europe. Archeologists digging in Western Asia demonstrated a more complex picture. Due to earlier migration from Africa most of the early Middle Paleolithic entities in the Levant were the products of archaic Modern humans called the Skhul-Qafzeh people after two cave sites in Israel. However, during the later time of the Middle Paleolithic in the Near East, some 80/75,000 years ago, Neanderthals from eastern and southeast Europe or Turkey invaded this region. Thus the makers of the late Middle Paleolithic cultures in the Levant, the Zagros and the Caucasus were Neanderthals whose skeletal remains were found throughout these regions.

This is a partial picture because although Neanderthals reached central Asia they are not known in eastern and southern Asia. Middle Paleolithic populations in this immense area could have been the same as the Skhul-Qafzeh people or the descendents of earlier populations of *Homo erectus*.

The debate on 'who made the stone tools' of the initial Upper Paleolithic rages among researchers working in Eurasia, and in particular across Europe. The crux of the problem is the question 'Did Neanderthals evolve to become modern humans or were they simply replaced by incoming Moderns who migrated from Africa through the Near East into Europe and Central Asia?'

Let us begin again in western Europe. It was suggested that the Châtelperronian culture originates within a late Middle Paleolithic entity, the 'Mousterian of the Acheulian Tradition' (abbreviated as MTA). However, the makers of this entity, the Neanderthals, only infrequently employed the blade production mode (considered to be the hallmark of Upper Paleolithic technology). In addition, the geographical distribution of the Châtelperronian sites seems to overlap that of the MTA.

Resolving this issue requires us to re-examine observations reported during the process of excavating a site. The premise that there is a biological continuity from the Middle Paleolithic population concurrent with a cultural change that marked the new (Upper Paleolithic) era is still based on two field observations: first, the discovery of a secondary burial of Neanderthal remains in a Châtelperronian layer at St Césaire (Lévêque and Vandermeersch, 1981); and second, the fragmentary temporal and isolated Neanderthal teeth found in Grotte du Renne (Arcy-sur-Cure), mostly in the lowermost Châtelperronian layer.

Unfortunately, the published evidence from both Châtelperronian sites is open to different interpretations. Let us consider, for example, the possibility that the secondary burial in St Césaire may imply that the person died somewhere else and the corpse brought for burial on site by members of his Neanderthal group. It is feasible that the rock-shelter of St Césaire was their ancestral home. The ethnographic literature summarized elsewhere (e.g. Pardoe, 1988) clearly indicates that burial places demarcate the rights of a group to use and control their restricted resources and that this notion is passed down through generations. It is important to stress that, at the time of the burial, local Neanderthals were already retreating under the pressure of the expanding groups of Modern humans, and the secondary burial was probably meant to symbolically flag the site as belonging to their people. This proposal fits what is known about the behavior of hunter-gatherers who colonize the territories of other foragers and tend to occupy the same locations as the natives because these are among the best places for camping and foraging. If this

interpretation is accepted then the association of the Neanderthal remains with the Châtelperronian toolkit is only fortuitous.

Stronger doubts are raised concerning the presence of isolated Neanderthal teeth mostly in the lower Châtelperronian layer at Grotte du Renne where Modern humans probably made bone, antler and ivory objects. It was these newcomers who dug postholes and scraped shallow cavities for hearths in the upper part of the Mousterian layer. Their activities caused the admixing of old Middle Paleolithic (Mousterian) stone tools and isolated Neanderthal teeth with the new and rich Upper Paleolithic material elements.

In sum, the cultural turnover, whether we consider it revolutionary or not, between the Middle and the Upper Paleolithic across Europe and western Asia involved a change of populations. A clear archeological example that demonstrates the lack of continuity between the Neanderthal cultures and those of Modern humans is the case of the Bohunician culture in central Europe. This lithic industry, dated to 43–38,000 uncalibrated BP, lacks any technological and typological relationship with the earlier Middle Paleolithic assemblages in this region (e.g. Svoboda and Bar-Yosef, 2003; Svoboda and Skrdla, 1995; Tostevin, 2000). This technological disjunction is entirely due to the bearers of each culture having employed two different methods of making stone tools. The process of producing stone tools is acquired through learning and imitation. It is an acquired behavior, often transmitted with the aid of oral explanations, but we can surmise that the Bohunicians did not speak the same language as the local Mousterian people. Similar finds from Bulgaria and Israel, dated to 47/46–45,000 uncalibrated BP, probably marked the path of migrating groups of Modern humans who came to Europe from the Near East through the ‘Danube Corridor’ (Conard and Bolus, 2003; Kozłowski, 2004; Svoboda and Bar-Yosef, 2003). When different populations confront each other, the issue of human interactions needs to be discussed.

Cultural interactions

It is fascinating to observe interpretations of cultural phenomena, particularly in the context of asking ourselves ‘what happened to the Neanderthals encountering the migrating Modern humans?’. At that time all people were foragers, subsisting on hunting, trapping and gathering edible plants and slow-moving reptiles. When a population of hunter-gatherers moves into a new region that is already exploited, even by dispersed groups of ‘others’, it has three options: to ignore the presence of the ‘others’; to get involved with them on friendly terms that may result in interbreeding; or engage in physical conflict. The nature of the relationships can change and alternate through time. If we use these ethnographic observations to interpret the initial stages of the Upper Paleolithic we may recognize that the cultural mosaics across major regions of the Old World were effectively the results of interactions between locals and migrants, as well as the increasing stress on the cultural individuality of both large and small social groups during this period.

These kinds of interactions can, for example, explain the cultural variability in central and eastern Europe. Archaeologists had already observed that certain

cultures of the Upper Paleolithic age combine the toolmaking traditions of northern and eastern European Neanderthals with the innovations of Modern humans. A good example is the Szeletian, which emerged from Mousterian industries with foliates (Kozłowski, 2000; Ronen and Weinstein-Evron, 2000, and papers therein). However, this interpretation is not accepted by all. Although when one considers the aspect of learned behavior it does seem that tools classified as Szeletian foliates, due to their bifacial fabrication and pointed shape for example, convey the evidence for continuity from the previous Eastern Micoquian. At the same time, Szeletian hunter-gatherers adopted blade production, brought by Modern humans from the Near East and southeast Europe.

Similar interpretations may apply to the entities named Jermanowician, Bryndzenian and Streletskian, all of which postdate the first colonization of the region by the bearers of the Initial Upper Paleolithic whose first material expressions are called Bachokirian, Bohuniucian and the like (Kozłowski, 1982, 2000; Svoboda and Bar-Yosef, 2003). Future findings of Neanderthal relics and/or Modern humans in the aforementioned cultural contexts will facilitate the testing of this proposal.

The presence of Modern humans in Europe prior to the establishment of the Aurignacians should be stressed. They were the bearers of IUP industries such as the Bachokirian and Bohuniucian as well as the Uluzzian and Fumian, and the 'proto-Aurignacian'. All of these entities preceded the classical Aurignacian and therefore it is among these that we should look for the roots of the latter (e.g. Teyssandier, 2005).

In sum, western European scholars considered the Aurignacian to be the first culture of Modern humans despite varying interpretations of the radiometric dates (Davies, 2001; Mellars, 2005; Zilhão and D'Errico, 1999). Uncalibrated dates of 38–36,000 for the earliest Aurignacian residues in temperate Europe would support the proposal that these cultural manifestations of local *Homo sapiens sapiens* were a few thousand years later than the onset of the Upper Paleolithic in the Levant and the earliest migrations into Europe. We therefore need to examine the geographical distribution of Upper Paleolithic cultures and take note of those regions where archaeologists recorded different cultural manifestations.

The geography of the Upper Paleolithic cultures and their contemporaries

There is no doubt that the Initial Upper Paleolithic began some 47/45,000 radio-carbon years ago, at least in the Levant, but most probably also in northeast or eastern Africa. In the Levant, as discussed below, the initial cultural expressions are what is known as the 'Transitional Industry' or Emiran, when the first body decorations are found. It was followed by the full development of the Early Ahmarian, a blade-dominated industry with rare bone tools. The bearers of these cultures migrated into Europe at c. 43–38,000 uncalibrated BP along routes mapped out, among others, in Figure 1.

Within a somewhat similar timespan an eastward geographical trajectory can be seen across central Asia, beyond the Caspian Sea, and into northern Asia. The Early Upper Paleolithic blade assemblages from the Denisova cave, which also furnished a

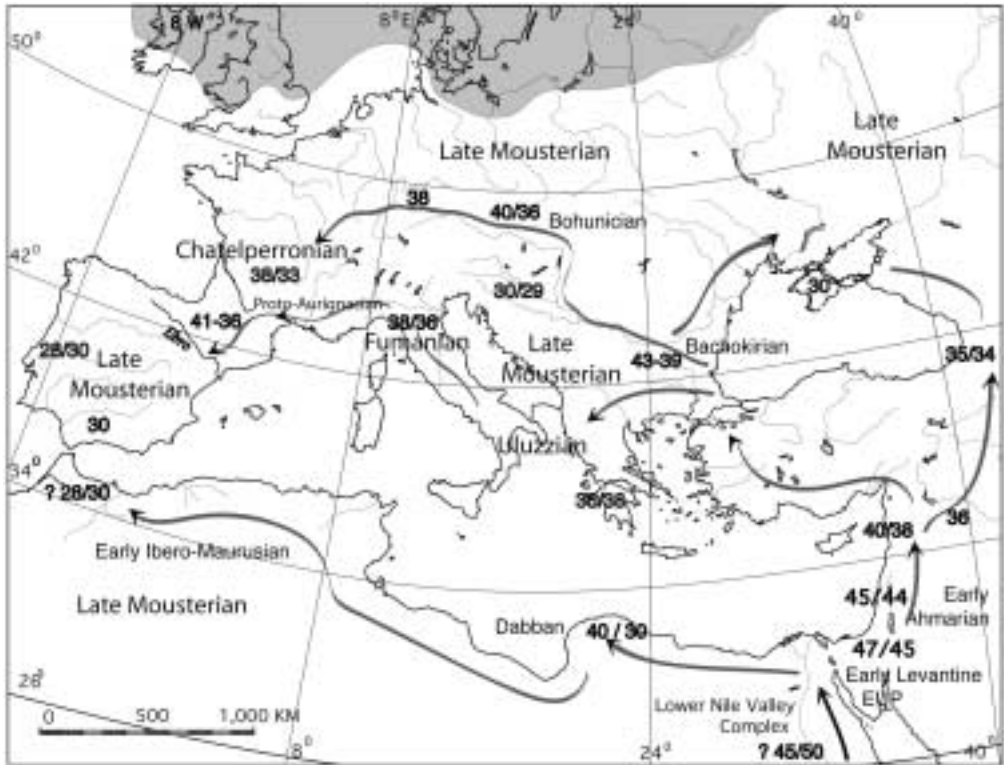


Fig. 1. Routes by which bearers of the Emiran and Early Ahmarian cultures migrated into Europe c. 43–38,000 uncalibrated BP

rich collection of ivory beads and pendants, the Ust-Karakol site and other sites in the Altai region (Derevianko and Shunkov, 2003), support this contention. The earliest dates for the Upper Paleolithic seem to cluster around 38,000 uncalibrated BP. The published earlier dates at Kara Bom, an open-air site, need to be reconfirmed before acceptance at face value. The geographical trend for later dates continues from Siberia into Mongolia, northern China, Korea and Japan (e.g. Bae and Kim, 2003; Brantingham et al., 2001, 2004 and papers therein; Derevianko, 1998; Derevianko et al., 2000).

Without a doubt, the shift to the Upper Paleolithic in various refugia within western Eurasia took place at a later date. The replacement in the Caucasus occurred around 35–34,000 uncalibrated BP (Adler et al., 2005; Meshveliani et al., 2004). The earliest Upper Paleolithic in this region is characterized by small prismatic cores, the production of bladelets shaped into microliths of various forms, as well as bone and antler objects. The geographical spread of this entity differs markedly from that of the Mousterian industries. For thousands of years the Eastern Micoquian dominated the northern slopes of the Caucasus while the Mousterian, rich in side scrapers and

points, was the kind of industry produced on the southern slopes. The presence of the same Upper Paleolithic toolkits on both sides of these mountain ranges speaks for the rapid movement of Modern humans, and the eventual colonization of the plains further north.

The vast region of east and southeast Asia did not witness the same rapid shift in knapping techniques. In China the 'small flake industry' marks the Upper Paleolithic, together with the presence of bone tools, used as cultural markers as radiocarbon dates are rare. Blade industries are known from northern China and date to *c.* 25–20,000 years ago (Brantingham et al., 2004; Cohen, 2003), and the same seems to hold for Japan and Korea, where manufacture of bifaces (handaxes) continued until this time. A good example of the late survival of flake industries is the Hoabinian, in southeast Asia, which is generally a flake-dominated industry (e.g. Anderson, 1997).

Given the current knowledge, one can define an assemblage as being exclusively of Upper Paleolithic age when, in addition to simple stone tools, there are other elements such as bone or antler tools, beads, pendants and worked shells. The production of blades, and later of microliths, characterizes the very late Pleistocene in certain parts of east and southeast Asia just prior to the emergence of agriculture.

Africa presents another challenge to our Eurasian concept of the Upper Paleolithic. North African environments, whether along the Nile or in the Maghreb, seem to exhibit a sequence of technological changes similar to those described above. In the Nile valley a series of Upper Paleolithic sites rich in blades seems to form a continuity with a late bladey Mousterian in this area. The near-modern human skeleton discovered at Taramsa 1, in the mid-Nile Valley, was buried in a sandy deposit, and its context, a Middle Paleolithic industry, dated it to around –80,000 to –50,000 (Vermeersch et al., 1998). While the human remains are pre-Upper Paleolithic, the lithics of a later exploitation of the site, dated at 38–37,000 uncalibrated BP, demonstrate transitional morphologies of the artifacts that closely resemble those of the Levantine Initial Upper Paleolithic. The ensuing Upper Paleolithic entities in the Nile Valley demonstrate the same degree of variability as in Europe – higher than what has been observed in western Asia.

Further south, at a Kenyan site (Ambrose, 1998a, b), the evidence shows early manifestations of body decoration in the form of beads dated to around 40,000 uncalibrated BP. Hence, according to several authorities (e.g., Klein, 1999), the dawn of the Upper Paleolithic revolution is to be first observed in east Africa. This observation supports the genetic model of Modern humans coming 'out of Africa' some 60–50,000 years ago (Forster, 2004).

In other parts of Africa, in particular southern Africa, a region that is better known than eastern Africa, the material culture does not exhibit sudden changes, i.e. the 'Upper Paleolithic revolution' (McBrearty and Brooks, 2000). Records show the gradual appearance of a suite of indicators for modern behavior, and although there is a distinct increase in the number of these attributes around 50,000 years ago, it is not interpreted as a major change. Assemblages of Late Stone Age seem to be no older than 25–20,000 years ago. Hence the special phenomenon of the Howeisons Poort, as mentioned above, is not connected to later cultural developments.

Where did the Upper Paleolithic revolution begin?

Scholars may refer to the emergence of the Upper Paleolithic as a 'revolution' or 'transition'. The word 'revolution' has a complex definition and ancient roots in Latin. In planetary physics it indicates the orbital motion. In geology 'revolution' is the time of major crustal deformation, when folds and faults are formed. In technology it is a sudden or momentous change in a situation, for example the 'revolution in computer technology'. In the socio-political arena it can mean the overthrow of one government and its replacement with another. In this article, as mentioned above, I have used the term 'transition' as a gradual and inherently continuous cultural change, while 'revolution' corresponds to a relatively abrupt change and is better characterized by a 'burst' rather than 'continuity'. In the current state of radiocarbon dating and calibration it is quite feasible that the timespan between the demise of Late Mousterian and the onset of Initial Upper Paleolithic across northeast Africa and most of Eurasia was short, perhaps in the order of 1000–2000 years, and therefore marks a 'revolution'. It would be the same as the 'punctuated equilibria' theory suggested by biologists Eldredge and Gould (1972) to explain biological evolution. Hence, lessons from the Industrial and Neolithic Revolutions can be employed in order to discover the evidence concerning the 'when' and 'where' of Paleolithic revolutions, including that of the Upper Paleolithic. One makes the assumption that it happened in a 'core area', but when the latter cannot be positively identified due to paucity of archeological evidence, we may use the archeological records from the first major area colonized by Modern humans to learn about the new inventions and innovations. Thus, to confirm whether the 'core' area were in east Africa, or in the Nile Valley, as mentioned above, it is advisable to turn to the Levant, where there is an abundance of material evidence (Goring-Morris and Belfer-Cohen, 2003 and papers therein).

The earliest dates for sites such as Boker Tachtit (levels 1–3) and Ksar 'Akil (layers 25–21), though not well verified, are considered to fall in the range of 50–43,000 BP (Bar-Yosef, 2000; Marks, 1983). At other sites, such as Uçagizli (Kuhn et al., 2001), Kebara cave (Bar-Yosef et al., 1996), and Um el Tlel (Boëda and Muhesen, 1993; Bourguignon, 1996), it seems there is a clear change in the manufacturing process of the stone tools, and shells appear for the time as decoration. In local terms these assemblages are called 'Transitional Industries' or 'Emiran'. The development of blade production proliferates in the immediately following phase known as the Early Ahmarian, with the ongoing elaboration of prismatic cores and the eventual emergence of bladelet production (Goring-Morris and Belfer-Cohen, 2003). By 35–33,000 BP the Late Ahmarian is notable for the production of delicate blades and a particular type of retouched point, known as the el-Wad point, that resembles the European Krems and Font-Yves points. Bone tools are found in most Late Ahmarian sites although this is raw material not as extensively used as in Europe. Also at this time some Aurignacian sites are to be found in the central and northern Levant (Belfer-Cohen and Bar-Yosef, 1999) and, as mentioned above, they are thought to represent an eastward migration by the bearers of this culture from Europe or Turkey.

In sum, the Levantine Initial Upper Paleolithic predates other manifestations across Eurasia. It demonstrates, on the one hand, artifact assemblages using modi-

fied Middle Paleolithic techniques and, on the other, production of new shapes of blanks and tools characteristic of the Upper Paleolithic. Nothing in the evidence can answer the 'why' question concerning this technological revolution, but the available dates, and the similarities to a particular Late Mousterian culture in the Nile Valley, hint at the general geographical origin of this revolution.

Conclusions

The Upper Paleolithic revolution, sometimes called 'the creative explosion', is seen as the period when the forefathers of modern forager societies emerged. As with the Industrial and Neolithic revolutions, it represents a short timespan when numerous inventions appeared and cultural changes occurred. The inventions were in the domain of technology, i.e. the shaping of new stone tool forms, long-distance exchange of raw materials, and the use of bone, antler and ivory as well as rare minerals for the production of domestic and ritual objects. Spatial analysis of 'living floors' indicates the presence of a kitchen area, sleeping grounds, storage facilities (in certain regions) and a discard zone. Success in feeding newborns led to population increase and thus to expansion into previously uninhabited regions. Among these new habitats was the arctic region, and its long-distance coastal seafaring that facilitated the colonization of the Americas. We can also detect a certain increase in social hierarchy and the presence of shamans, considered to be the creators of the famous Upper Paleolithic cave art and other artistic manifestations (Clottes, 1997; Lewis-Williams, 2002). Interaction between human groups was expressed through establishing alliances as a buffer against seasonal, annual and decadal depletion of resources (e.g. Gamble, 1999). Finally, personal individuality emerges and is visibly expressed in body decoration (d'Errico et al., 2003; White, 1997).

Several hypotheses, often grouped under the term 'modern behavior', have been proffered as an explanation for the initiation of all these cultural changes. The most revolutionary idea is that this dramatic shift from Middle Paleolithic to Upper Paleolithic life-ways was caused by a neurological mutation (Klein, 1999, 2001). Hence, except for the emergence of the founder population in sub-Saharan Africa, Upper Paleolithic cultural traits were dispersed through the movements of that population as they replaced earlier populations across the entire Old World (Cavalli-Sforza and Feldman, 2003).

Several scholars consider that the population increase during the Late Mousterian led to intense competition between distinct social groups, encouraging an accelerated rate of innovation. Others view the environmental conditions as facilitating the cultural processes of replacement of Neanderthals by Modern humans across western Eurasia. The European climate of MOIS 3 (the Würm glaciation of the ice age of -55,000 to -30,000 years ago) was more warmly humid in its early phase than its later phase which tended to be drier and colder (van Andel, 2002; van Andel and Davies, 2003 and papers therein). However, to assume that increasingly cold conditions endangered the survival of the Neanderthals simply ignores two facts: first, their successful survival of several previous glacial cycles; and second, the sudden presence of 'foreign people' on the continent. It stands to reason that attributing the

new and successful technologies observed in the Eurasian Upper Paleolithic to intrinsic social processes and economic innovations by local Middle Paleolithic populations would need a better archeological demonstration than that available today. For the time being, the emergence of Modern humans in sub-Saharan Africa, and the socio-economic dynamism that caused them to expand through the Nile Valley into the Near East and migrate along the 'southern route' of Asia all the way to Australia, is the most plausible scenario, though it still leaves much to be corroborated or contradicted by future archeological research.

Ofer Bar-Yosef
Harvard University, Cambridge, MA