CHAPTER 3
HISTORY AND CURRENT STATUS OF SIMILAR RESEARCH

This research utilizes concepts and approaches applied to the study of prehistoric lithic economy, adapting them to examine the relationship between raw material context and strategies of lithic economy. With the general aim of explaining variability in lithic assemblages, considerable efforts have been made over the years to examine the effects of raw material factors on lithic economy. The problem has been approached from a number of different angles, discussed below.

A number of factors have been put forth to explain assemblage variability: style and ethnicity (Bordes and de Sonneville–Bordes 1970; Gould 1980; Sackett 1973, 1977, 1986a, 1986b; Wiessner 1983, 1984), function (Binford and Binford 1966; Binford 1973, 1989), intensity of reduction and progressive modification (the Frison effect) (Dibble 1988), raw material availability and quality (Dibble and Rolland 1992), temporal variability (Mellars 1969), and technological variability (Jelinek 1988), among others.

The first section presents a brief summary of lithic research, with the focus on the development of research directed at addressing the nature and role of raw material in studies of lithic assemblages. The second section focuses on the debate centered on the nature and process of change during and following the Middle to Upper Paleolithic transition.

HISTORY OF LITHIC RESEARCH

Lithic studies up to the 1960s were aimed primarily at classification of tools (e.g., the work of Breuil, Bordes, de Sonneville Bordes, and others), examining the morphology of tools to identify distinct types. These studies were essentially descriptive, and technological aspects of tool production were merely used as characteristics to construct typologies for the different industries of the Paleolithic.

In the 1960s and 1970s, lithic research expanded to address three separate areas: typology (e.g., Bordes, Brézillion, etc.), technology and techniques of reduction (e.g., Crabtree 1972, Tixier 1978; Tixier *et al.* 1980) and use–wear analysis (e.g., Semenov 1964, Hayden 1979, Keeley 1974, 1980; Shea 1992). These areas focus on different aspects of lithic assemblages – form, process, and use. The nature of the raw materials exploited was seen as secondary and was addressed only cursorily (e.g., treating all flint as essentially similar, equally susceptible to reduction techniques) or in general terms (e.g., that coarse–grained materials are more difficult to fracture than fine–grained materials). Raw material characteristics were not seen as relevant to the questions addressed until the 1970s, when sourcing studies made them the specific focus.

The Bordes–Binford debate concerning the meaning of variability in Mousterian assemblages centered on whether such variability was due to ethnicity or to function. The effects of raw material on assemblage variability were not explicitly addressed, although, as will be seen, later research demonstrated that various raw material factors contributed to assemblage variability and that the debate was more complex than a simple dichotomy between style and function. When raw material was considered, albeit in very general terms, research tended to focus on differences in quality and nodule size with respect to core reduction, such as the relative ability to produce Levallois products, prismatic blades and other blank forms.

Raw material itself was not explicitly considered, however, as a major factor contributing to assemblage variability, and studies of sites and regions tended to simply mention general observations in passing. Féblot–Augustins (1997) has recently made an exhaustive survey of raw material research in Africa and Europe for the entire Paleolithic, bringing together diverse references to raw material in assemblage–based research. It can be seen that raw material data was not systematically collected or quantified or even systematically examined qualitatively until the 1970s.

In the 1970s and 1980s, debitage analysis gained credence as a valuable tool in understanding lithic technology and assemblage variability. It was finally recognized that an assemblage contained more than formal tools, and that the by–products of reduction, combined with refitting of cores, could lead to a more detailed understanding of technological processes (see Csiezla *et al.* (eds.) 1990). Marks and Volkman (1983) amply demonstrate that morphologically identical blanks (in their study, Levallois points produced at Boker Tachtit) may be produced via entirely different reduction processes. In the early levels at the site, core reduction strategies were aimed at specifically producing Levallois points. Later, however, non–Levallois core reduction to produce blades also produced opportunistic Levallois points.

Another core analysis considered raw material factors (quality and abundance), at the Aurignacian site of Zwierzyniec I in Poland. Sachse–Kozlowska (1983) examined the stages of core working to interpret reduction processes and differential utilization of local material. The main raw material (Upper Oxfordian flint) was of relatively poor quality due to the presence of numerous inner flaws but was abundant locally. In this case, abundance compensated for the poorer quality, as new blocks could be used to make up for the relatively low number of useable blanks produced from each core. Cores, blanks and tools were analyzed and measured. Sachse–Kozlowska concluded that 1) six core types were divided into two size groups, meant to produce two kinds of blade blanks (wide and narrow), 2) wide, massive blades were selected for retouch, 3) smaller blanks were not selected for retouch but could potentially have been used unretouched, 4) core reduction involved shaping of the core when the natural form did not conform to planned shape, which was necessary due to the poor quality of raw material which often caused cracking of larger cores.

Analysis of tools alone may yield information about variability in blank selection or raw material selection for particular kinds of tools, but analysis of the entire lithic assemblage, whether analyzed by raw material group or not, yields information about the degree and kinds of reduction techniques employed as well. Classification of artifacts in an assemblage according to products and by–products of the reduction process permits inferences about the stages of the *chaîne opératoire* that are present or absent. Debitage analysis thus leads to 1) a technological description of reduction techniques, 2) identification of variability in reduction between raw materials present.

Beginning with the 1980s, research specifically addressing the role of raw materials in lithic economy began to proliferate, with studies such as Demars (1982) and Geneste (1985) focusing on changes in raw material procurement and utilization through time within a single region, and the elaboration of the concept of *chaîne opératoire* applied to lithic economy. The concept of the *chaîne opératoire* forms the basis of analyses of the technological structure of assemblages studied. It is defined as the series of activities involved in interaction with raw material from initial procurement to discard and include procurement and transport, reduction, use and re–use, and discard. Geneste (1985, 1988, 1990) utilizes this concept to examine lithic economy, slightly modifying the terminology of the sequence: acquisition, reduction, retouch, use, recycling, abandonment.

Svoboda (1983) defines a “lithic exploitation area” as a geographical region several km around a localized raw material source, or in places of concentration of non–localized raw material. This concept is then used to examine settlement patterns, raw material economy, technology, and typology in four different regions in Moravia.

Tavoso (1984) analyzed lithic exploitation for the Mousterian “Languedocian” sites in southwest France. He states that, at these sites, materials are of very variable quality, which creates significant technological differences in their exploitation. He proposes three hypotheses: 1) each type of material played a specific role within an assemblage, where flint and quartzite were complementary and reserved for the tool types for which they were most efficient, 2) the same human group made different toolkits when they utilized different materials: the difference between denticulate Mousterian and sidescraper–rich assemblages was due to the use of different materials, and 3) the typological composition of flint reflects their distant origin, and is due to curation of the most elaborate or most often used tools, but such materials were not exploited (i.e., reduced) at the site.

Such studies directly examined the relationship between raw material and technology, with the emphasis on how different materials were procured and reduced rather than on reduction techniques in general. This type of research focused attention even more on the role of raw materials within lithic economy. It both broadened the question by examining lithic economy as a whole and by placing raw material firmly within the ranks of potential factors to explain lithic assemblage variability.

With the emphasis on lithic economy, other researchers attempted to isolate specific raw material factors that could conceivably impact lithic economy (quality, abundance, distance to sources, etc.), affecting how material was procured and transported, reduced and utilized Dibble and Rolland examined intensity of reduction and use as a factor contributing to assemblage variability, arguing that intensity is correlated with raw material availability (Dibble 1988, Dibble and Rolland 1992, Rolland 1990, Rolland and Dibble 1990). Regional studies focused on distribution and transport patterns of raw material, and variability in raw material exploitation and tool production (e.g., Caspar 1982, 1984, Morala 1980, Valoch 1984, Straus 1980).

Lithic assemblages were studied within environmental contexts to explain lithic economy. The emphasis was shifted to explaining human behavior – organization of lithic economy in space and time – and not simply on describing tool form or technological reduction processes. The scale of explanation had changed and technological and typological studies, valuable in themselves, were now placed in a broader, more interesting, explanatory framework.

Geological sourcing studies were seen as an increasingly necessary basis for regional studies of lithic economy (e.g., Séronie–Vivien and Séronie–Vivien 1987) to trace the distribution of different raw materials across space (Caspar 1982, Demars 1982, Turq 1990, Takacs–Biró and Tolnai–Dobosi 1990). For the first time, the notion that different sources were exploited, and possibly exploited in different manners, was put forward. Lithic studies changed from looking at assemblages as a whole to looking at them as composed of a variety of different materials. Intra–assemblage variability was clarified.

Paralleling this sort of field survey and collection of lithic reference collections was the application of interdisciplinary analyses of flint for sourcing identification. Studies of mineral and chemical composition were aimed at making precise identification of flints from different sources. These analyses include trace–element analysis (e.g., Stockmans *et al.* 1981), neutron–activation analysis (Aspinall and Feather 1972), and atomic absorption and spectrophotometric emission analysis (Sieveking *et al.* 1972). If unique identifiers (such as particular minerals or configurations of several minerals) could be found, flint found in archaeological contexts could be analyzed and exact proveniences identified. In practice, such methods proved to be expensive for general application and results tended to show rather that variability within sources as well as between sources was much greater than expected, making precise identification of sources much more difficult, if not impossible. Samples taken from a single nodule proved to be very different in chemical and mineral composition. Such analyses, however, proved to be useful for identifying sources of very specific, highly localized variants, or for unique or unusual variants within an archaeological assemblage.

The late 1980s and 1990s brought further developments to the study of raw materials within the realm of lithic studies. More detailed analyses of raw materials have been undertaken (e.g., Andrefsky 1994, 1998; Floss 1991; Otte 1991a, Roth and Dibble 1998, Van Der Sloot 1997, 1998; Loodts 1998) at site and regional scales of analysis, in the recognition that raw material factors play an important role in shaping assemblage variability. Others examined the relationship between raw materials and mobility strategies (e.g., Féblot–Augustins 1993).

Hahn and Owen (1985) analyzed technological differences in the Aurignacian and Gravettian assemblages at Geissenklösterle Cave in southwest Germany. They note that the raw material context did not change – the same raw material types are used during both periods – but there are clear technological differences between the two technocomplexes. These include preferences of raw materials exploited (p. 70) as well as in the degree of core preparation and production techniques (p. 72–3). Given that raw material context remained constant, they interpret the observed differences as reflecting development in technology. During the Aurignacian, simplified core preparation took place, while Gravettian reduction is more complex, technologically more similar to the Magdalenian.

Turq (1990) examined the exploitation of raw materials in a series of Mousterian sites in the Dordogne and Lot valleys in southwest France. Flint sources were numerous in Cretaceous bedrock regions of the Périgord but rare in the Lot valley, where quartz cobbles were common. He analyzed the lithic assemblages from technological and typological viewpoints, as well as lithological, using macroscopic characteristics to identify materials. For Turq, distances to sources reflect differential use of territory, where short and medium distances (<5 km and 5–15/20 km) indicate the territory exploited by the groups during site occupation. Site location was selected in order to exploit the immediate area intensively and more distant zones sporadically. Turq also argued that non–local material (transported tools and prepared cores) could be seen as a “toolkit”, indicating the zone of origin of the group or the region previously occupied. As will be seen in my research, data from Belgium support a similar interpretation for Rank 2 materials.

For Turq, conditions of procurement affected how different materials were exploited. When flint was available, quartz was used for hammerstones; when it was rare, as in the Lot valley, quartz was exploited as a raw material to produce tools and existing (transported) flint was economized. For other materials, quality, rather than distance, was a factor: good quality material was used for Levallois methods and a non–Levallois technique with facetted platforms while poorly silicified material was used for ordinary, non–facetted flakes. He concludes that raw material exploitation is based on quality of material and conditions of procurement (a term analogous to my definition of raw material context) and that utilization of different reduction techniques was based both on technological choice and lithological constraints. "Cultural" (e.g., the specific kinds of tools produced and their quality requirements) and functional needs drive humans to adapt to the mineral resources available, with the ultimate goal to eliminate superfluous energy costs in transporting material.

In site reports, there is a clear shift from a few brief lines about the kinds of raw materials used to presentation of results of detailed raw material analyses. Conferences devoted to raw material research addressed the subject from multiple approaches (e.g., Séronie–Vivien and Lenoir 1990, Montet–White and Holen 1991).

My research continues the focus on lithic economy, here in the context of the MP–UP transition and the Early Upper Paleolithic, a period of abrupt change in northwest Europe. EUP industries, radically different from local MP industries, require study from a raw material perspective for two main reasons. First, the use of different reduction techniques changes the raw material requirements to produce new kinds of blanks and tools, perhaps requiring a higher quality standard than for ordinary flake–based industries. Second, if EUP industries represent the “colonization” of northwest Europe by early modern humans replacing indigenous

Neandertal populations (perhaps gradual replacement over a few thousand years, with co–existence at the beginning of the EUP), then there would be a period of transition during which newcomers would become familiar with the landscape – the location of raw material resources, the nature and timing of availability of subsistence resources, the location of caves and water sources. Early Upper Paleolithic sites appear to be clustered in small regions (e.g., the Meuse Valley in Belgium: Ulrix–Closset 1975; Otte 1979; Ach valley [Geissenklösterle, etc.] and Lonetal [Höhlensteinstadel, etc.]: Hahn 1983a, 1983b; the Middle Rhineland: Bosinski 1988; Bosinski *et al.* 1995, Thuringia [Ranis, etc.]: Hülle 1935, 1936, 1938, in Germany). These micro–regions were typically river valleys, with access to caves for shelter and water and with raw material sources less than 40 km distant for the most part. This could indicate a relatively greater degree of semi–sedentism than previously thought, where seasonal mobility occurs within a more restricted geographic territory in which a variety of resources were available.

In this respect, the study of lithic economy of the Early Upper Paleolithic in Belgium has implications for the nature of the MP–UP transition to the Early Upper Paleolithic. A study such as the one attempted here demonstrates the variability in Early Upper Paleolithic adaptations to unknown environmental contexts.

THE MIDDLE TO UPPER PALEOLITHIC TRANSITION

The Middle to Upper Paleolithic transition, roughly 60–30,000 years ago, has been the subject of much research and often heated debate, particularly during the past twenty years. First, there are marked differences between Middle and Upper Paleolithic periods, in several domains (see below) and Neandertal anatomy disappears by the end of the transition. Researchers have attacked the related questions of what happened during the transition and why change occurred at this particular period from multiple domains: biology, technology, subsistence and cognition. The debate has focused on two opposing hypotheses which concern the evolutionary and behavioral relationships between Neandertals and early modern humans, the origins of modern humans and the origins of the Early Upper Paleolithic (see Allsworth–Jones 1993; Carbonell and Vaquero 1996; Clark 1989; Clark and Lindly 1989; Delporte 1968; Klein 1990, 1992; Kozlowski 1988, 1989; Marks 1983; Mellars 1973, 1989a, 1989b, 1990, 1991; Mellars and Stringer 1989; Akazawa *et al.* 1992, Akazawa *et al.* 1998; Nitecki and Nitecki 1994; Otte 1988, 1990a, 1990b, 1996; Straus 1983, 1990c; Straus and Heller 1988; Straus and Otte 1996; Straus *et al.* 1992; Stringer 1989; Svoboda 1986; Svoboda and Simán 1989; Tuffreau 1990; Valoch 1984; White 1982; Wolpoff 1989, among many others).

One hypothesis – *continuity* – argues for regional development of Early Upper Paleolithic behavior and evolution of early modern humans from local Middle Paleolithic populations. As will be seen in the following discussion, this is in part based on a lack of change or continuity in certain areas of behavior at the time of the transition, but which occurred later. Wolpoff's (1989) multi–regional hypothesis for the evolution of modern humans argues for parallel evolution, albeit with extensive inter–group gene flow, in various regions (Europe, the Near East, China), with modern humans evolving from regional populations and developing Early Upper Paleolithic behavior.

The opposing hypothesis, and one increasingly supported by multiple lines of evidence, is that of *replacement*. According to this view, early modern humans evolved independently of European Neandertal populations, probably in Africa or the Near East, and gradually migrated across Europe and Asia, replacing indigenous populations who eventually became extinct. This hypothesis has provoked further research into the nature of the presumed contact between Neandertals and early modern humans – whether or not there was interbreeding between the populations, exchange of ideas, peaceful co–habitation, acculturation (see Harrold 1989; d'Errico *et al.* 1998).

The discussion that follows examines the evidence from the four domains listed above – biology, technology, subsistence, and cognition – and discusses the implications of these results for the continuity and replacement hypotheses.

Biology

Near East skeletal remains of early modern humans and Neandertals show the co–existence of two different populations for at least 30,000 years. Early modern humans have been found at Skhul and Qafzeh and are dated by TL to around 100–90,000 years ago (Schwarcz *et al.* 1988; Valladas *et al.* 1988) while Neandertals have been found at Kebara, dated by TL to around 60,000 years ago (Bar–Yosef *et al.* 1992). Two points can be made based on this evidence. First, early modern humans could have evolved out of local Neandertal populations in the Near East, having had no contact with the European population, or have evolved in Africa and migrated first to the Near East. Second, Neandertals could have migrated eastward to the Near East after early modern humans had already colonized the region. Both populations shared Mousterian technology, although differences in hunting techniques are observable, particularly related to the seasonal hunting of gazelle (Lieberman and Shea 1994). Considering that both populations had similar lithic technology, the question of which population was responsible for Middle Paleolithic assemblages in the Near East becomes important. More detailed analyses of behavior, along the lines of Lieberman and Shea's ungulate dental cementum analyses study, are necessary to identify potential behavioral differences which would distinguish the two populations in the absence of human remains.

At any rate, the early presence of modern humans and the co–existence of the two populations suggest evolution of modern humans independently of the European Neandertal population.

In France, late Neandertals have been found at the sites of Saint–Césaire and la Grotte du Renne, dated to around 35,000 years (Lévêque and Vandermeerch 1980; Lévêque *et al.* 1993). The associated technocomplex – the Chatelperronian – is found in France and Spain and is noted for its Upper Paleolithic character. The makers of the Chatelperronian are seen as being Neandertals, and this suggests the survival of Neandertals in marginal areas or areas reached most recently by early modern humans, with co–existence for around 5,000 years until Neandertals became extinct. This situation parallels that of the Mesolithic–Neolithic transition in northwest Europe, France and Spain, where Neolithic farmers gradually but steadily occupied Europe. Full Neolithization is observed on the loess plains and along rivers of central Europe, but along the coastal margins and in northwest Europe, only part of the "Neolithic package" was adopted or Neolithization occurred very late, with co–existence of Mesolithic hunter–gatherers and Neolithic farmers (see Bar–Yosef 1994).

With regard to the MP–UP transition, this suggests that it took until around 35,000 years for early modern humans to reach France, therefore around 10,000 years if we go by the date of the earliest Aurignacian site – Bacho Kiro layer 11, Bulgaria, dated to >43,000 yrs BP (GrN–7545) (Kozlowski 1982).

The existence of the Chatelperronian technocomplex, limited to France and Spain, has provoked research on the possibility of acculturation of Neandertals in contact with early modern humans, because it contains elements similar in some respects to the Aurignacian: a blade–based lithic industry, the working of bone to make tools and ornaments. The exact nature of Neandertal–early modern human contact is still the subject of much research and debate (see d'Errico *et al.* 1998). Similar industries are not, however, found in the rest of Europe, indicating a localized “acculturation” phenomenon in France and Spain. What *is* seen, particularly in eastern and southeast Europe, during the Late or Final Mousterian and during the MP–UP transition, is a multiplicity of different industries characterized by different reduction techniques and new tool types, such as foliate points (e.g., Szeletian, Jerzmanowician, etc.) and foliate point industries in northwest Europe (observed at the Belgian sites of Couvin, Spy, Goyet, Trou Magrite, and British sites of Beedings and Kent’s Cavern), which could represent localized acculturation processes.

It is the co–existence of Neandertals and early modern humans in the Near East and the association of late Neandertals with the Chatelperronian technocomplex that makes these human remains relevant to the MP–UP transition. The most limited interpretation is that there were two separate human groups which co–existed for around 30,000 years, when something caused early modern humans to change their behavior, to migrate and to eventually replace Neandertals in Europe.

Another line of evidence focuses on the analysis of mitochondrial DNA in contemporary modern humans (Cann *et al.* 1987; Stoneking and Cann 1989; Stoneking 1997). This led to the “Out–of–Africa” hypothesis, which argued that modern humans evolved in Africa and migrated out of Africa (via the Near East into Europe and Asia) around 200,000 years ago. Despite statistical problems in the initial analysis (see e.g., Templeton 1996), recent studies have supported this view.

More recently, mtDNA extracted from Neandertal bones demonstrated that Neandertal genetic variability falls outside the normal limits of modern humans and thus that Neandertals did not contribute to the modern gene pool (Krings *et al.* 1997). This research is currently based on a single sample, but suggests that Europe was colonized by early modern humans who did not interbreed with indigenous Neandertals.

In sum, the biological evidence to date suggests a non–European, probably African, origin for modern humans who remained essentially similar in behavior to Neandertals in the Near East until around 60,000 years ago. Beginning at this time and continuing during the MP–UP transition, major behavioral changes began to occur, although not simultaneously, and early modern humans began to migrate into Europe and Asia, gradually replacing Neandertals as new patterns of behavior gave them a selective advantage over Neandertals.

An interesting question can be proposed with respect to the changes occurring in the Final Mousterian in eastern Europe between 60 and 45,000 years ago (see Svoboda 1986; Svoboda *et al.* 1996; Svoboda and Simán 1989; Allsworth–Jones 1986). If early modern humans were still using Mousterian technology, is it possible that they migrated out of the Near East into eastern Europe carrying this Mousterian technology and then were responsible for the variety of Final Mousterian industries there, leading to the origin of the Aurignacian? On a time scale, this would mean that early modern humans were in eastern Europe between 60 and 45,000 years ago, undergoing a period of experimentation with new techniques and tool types, finally developing the Aurignacian around 45,000 years ago, and then colonizing the rest of Europe from 45 to 35,000 years, transporting Aurignacian technology.

Technology

The differences between Middle and Upper Paleolithic technology, as noted by numerous researchers (e.g., Mellars 1989b), are striking: a change in techniques of manufacture and core preparation, from flake technology that produced ordinary and Levallois flakes to prismatic blade technology, a much greater diversity and standardization in formal tool types, the appearance of an elaborate bone/antler/ivory industry to produce tools, ornamentation (e.g., beads and pendants) and mobile art.

The first difference appears to reflect a change in how cores were perceived. Boëda (1990) argues that the change in core reduction techniques reflects a change from surface to volumetric conception of the core. Instead of shaping the core to extract a blank from the surface, as is done, for example, in Levallois technology, the core is prepared to produce a continuous series of similar blanks until the core is exhausted, without the need for intervening elaborate core preparation. Hayden (1993:118) argues that prismatic blade technology is "'incomparably easier' than the manufacture of a Levallois point." Prismatic blade technology is also seen as a more efficient core exploitation strategy: more blanks are produced per core and there is more useable edge on blades than on flakes. Finally, blade technology, by the serial sequence of production, permits the production of standardized blanks for easy hafting as interchangeable elements.

The second difference, greater diversity in tool types, appears, at first view, to contradict the standardization of blanks. However, while blade blanks are essentially similar in form (long, narrow, with roughly parallel lateral edges), it is the secondary treatment – retouch and tool shaping – that contributes to the diversity in tool forms. During the Middle Paleolithic, flakes could be retouched in a limited number of ways but during the Early Upper Paleolithic, new tool forms were developed that went beyond simple edge retouch.

This diversity has been interpreted as reflecting the development of special–purpose tools as opposed to general, multi–function tools (Straus 1990a, 1993; Peterkin 1993). More specifically, specialized tools appear to have been associated with different game hunted, most clearly around 20,000 years, at the Last Glacial Maximum and during the Late Upper Paleolithic. The development of burins and perçoirs (borers) has been seen as related to the appearance of a bone industry.

In contrast to such diversity and tool specialization, Mousterian assemblages are generally dominated by sidescrapers which were used for multiple purposes, as seen in the results of use–wear analysis (Beyries 1988, Anderson–Gerfund 1990).

The Early Upper Paleolithic is thus characterized by continued innovation and improvement. This is in marked contrast to the long period during which the Mousterian toolkit remained basically unchanged.

The most striking difference between Middle and Upper Paleolithic technology is the appearance of an elaborate industry exploiting bone, antler and ivory. For the first time, these materials form an important part of the raw materials exploited to produce tools. In addition, they were used to produce objects of art and ornamentation. While deliberately flaked bones have been found in Middle Paleolithic contexts, they are rare. The crucial difference, apart from the common use of these materials during the Early Upper Paleolithic, is that their physical properties are recognized and taken into account when worked. The earlier flaked bones appear to have resulted from attempts to flake bone as if it were stone.

Bone, antler and ivory were used to make tools and weapons, ever increasingly so during the Upper Paleolithic. Perhaps more importantly, from a cognitive or social point of view (see below), they were also used for art (carved figurines, engravings, etc.) and ornamentation (beads, pendants, etc.), unknown during the Middle Paleolithic.

Finally, this is probably the first time that stone tools were made for use in making other elaborate tools (apart from shaping wooden spears, digging sticks and the like).

All of these differences appeared with the earliest Aurignacian and became more and more elaborate during the Early Upper Paleolithic. They thus follow the MP–UP transition and indicate that something fundamental occurred during the transition to provoke such radical changes in social and technological behavior.

In sum, there is a radical change in technological behavior occurring at and subsequent to the MP–UP transition. This can be seen as abrupt, in marked contrast to the long period during which the Mousterian technocomplex remained unchanged, but it probably developed gradually in one particular area (perhaps eastern Europe) before becoming widespread across Europe and Asia as the Aurignacian technocomplex. Again, this is similar to the Neolithic: domestication of plants and animals occurred in the Near East, with major social changes and the development of an established sedentary farming culture before Neolithic populations began migrating across Europe. Bar–Yosef (1994) suggests that the MP–UP transition should be studied in a manner analogous to the way the origins of agriculture have been studied. The core area – the area of origin for Aurignacian technology – should be identified, followed by documentation of its spread and development during the Early Upper Paleolithic. Such a view would further support the replacement hypothesis.

Art and Ornamentation

I will discuss only briefly here the appearance of art and ornamentation during the Early Upper Paleolithic, as there is a voluminous literature devoted to all aspects of Paleolithic art. Here it suffices to observe that it is in the Early Upper Paleolithic that we first see cave paintings (e.g., Chauvet, dated to 30,000 years BP; Chauvet *et al.* 1995), mobile art (carved anthropomorphic and animal figurines, engraved bone plaquettes and atlatls) and body ornamentation (beads, pendants).

The existence of such art and ornamentation has been interpreted, in general, as serving symbolic, religious and social functions, and to transmit information (e.g., Mithen 1990). Whether or not we are able, today, to reconstruct past religious systems, the presence of art and symbols supports the interpretation that such systems did, in fact, exist.

Lindly and Clark (1990), arguing for the continuity hypothesis, compare the first early modern humans in the Near East and South Africa during the Middle Paleolithic with those of the Early Upper Paleolithic in order to identify whether or not symbolic behavior existed for the first modern humans, that is, whether symbolic behavior is linked to biological differences between modern humans and Neandertals. They find little evidence for symbolic behavior in the Middle Paleolithic and thus argue that the changes observed in the Early Upper Paleolithic are not related to a modern/archaic human dichotomy and that there is continuity across the MP–UP transition with respect to symbolic behavior. As will be seen below, Mithen suggests a cognitive explanation that accounts for this.

Subsistence

In contrast to technology, subsistence behavior does not appear to change greatly during the MP–UP transition but rather gradually over the course of the Early Upper Paleolithic, with the most marked changes occurring around 20,000 years BP, at the Last Glacial Maximum. Early modern humans continued to hunt animals individually or in small groups with no evidence of specialization until later in the Early Upper Paleolithic (see Enloe 1993, Pike–Tay 1991, 1993).

Chase (1989) surveys European data from the Middle and Upper Paleolithic to address whether the MP–UP transition was accompanied by a shift to specialized hunting, and whether there is evidence for planning and foresight during the Middle Paleolithic. He concludes that there is only sporadic evidence for specialized hunting during the Early Upper Paleolithic, with the major shift in hunting practices occurring around 20,000 years BP. It is at this period that there is a shift from hunting individual animals to mass hunting and the development of techniques aimed at hunting specific animal species, which become even more marked during the Late Upper Paleolithic (see for example, Straus 1992, Audouze 1987, Audouze and Enloe 1992).

For the MP–UP transition and the Early Upper Paleolithic, I would expect to see a process of change going through the following stages: invention of new technology – experimentation – adoption and maturation with associated changes in other areas of culture – establishment of culture – spread (migration and/or diffusion) with ongoing development and elaboration. During the MP–UP transition and the beginning of the Early Upper Paleolithic, one should expect to find the causes of observed change and only later would the effects of such initial innovation be observed. For each area discussed so far, one can see the initial appearance of new ideas and behavior, followed by their development and elaboration throughout the Early Upper Paleolithic.

The MP–UP transition can be seen as a germination period, with the Early Upper Paleolithic seeing the maturation and flowering of modern behavior. Radical or abrupt change did not occur in all domains simultaneously, and at different times in different regions of the world. The absence of immediate change in hunting behavior, while used as support for the continuity hypothesis, does not necessarily contradict the replacement hypothesis either.

I would argue that migration of early modern humans implies the continual encountering of new environments and unfamiliarity with the range and availability of subsistence resources. It is logical to assume that for each new region, there is a period of familiarization – mapping onto the landscape – followed by elaboration of hunting and gathering practices once the population had become established. If early modern humans reached France and Spain by around 35,000 years ago, familiarization and establishment would occur after this point, and at around 30,000 years, we see the appearance of the Gravettian technocomplex and changes in hunting strategies. In eastern Europe, where the Aurignacian was established earlier, establishment would also occur earlier.

Cognition

The observed changes during the MP–UP transition and the Early Upper Paleolithic, occurring over a period from 60–30,000 years ago, are found in different behavioral domains – technology, social structure, the development of art and ornamentation which probably served religious/ritual function and conveyed social information and eventually subsistence practices, all of which have been examined by archaeologists interested in the origins of the Early Upper Paleolithic (see, for example, White 1992, 1993; Klein 1990; Lindly and Clark 1990; Chase and Dibble 1987). Cognitive archaeologists view these changes as reflecting a fundamental change or evolution in the structure and organization of the human mind. I present here a discussion of Mithen's (1996) analysis of the evolution of the human mind.

Mithen (1996) argues that this change in the human mind is the evolution of "cognitive fluidity", the integration of intelligence modules or domains devoted to specific kinds of information (technical, linguistic, social and natural history). In his book, *The Prehistory of the*

Mind, utilizing concepts from developmental and evolutionary psychology, he proposes three phases for the evolution of the mind:

> "Phase 1. Minds dominated by a domain of general intelligence – a suite of general–purposed learning and decision–making rules.
> Phase 2. Minds in which general intelligence has been supplemented by multiple specialized intelligences, each devoted to a specific domain of behaviour, and each working in isolation from the others.
> Phase 3. Minds in which the multiple specialized intelligences appear to be working together, with a flow of knowledge and ideas between behavioural domains (Mithen 1996:69).

Mithen compares the mind to a cathedral, with a "nave" of general intelligence, separate "chapels" devoted to specific domains of intelligence and possibly a "superchapel" corresponding to Sperber's (1994) "module of metarepresentation". Without going into detail here for the earlier phases (occurring earlier in human evolution), it is Phase 3 that Mithen sees as occurring at the MP–UP transition. It is at this point that the chapels, formerly isolated, are connected, permitting direct access between different domains (p. 76). Cognitive fluidity thus permits analogical thinking, imagination, creativity and innovation. It permits humans to see their world differently and to envision new solutions and behaviors that give them a selective advantage over populations lacking cognitive fluidity, such as the Neandertals.

The Neandertal mind, in Mithen's model, is still in Phase 2, possessing all of the domains which are isolated or only partially connected (Mithen 1996:163, Fig. 15). Early modern humans, first appearing around 90,000 years ago, start the process toward cognitive fluidity, with a connection between language, social and natural history intelligence but where technical intelligence is still isolated (Mithen 1996:206, Fig. 26). It is at the MP–UP transition, starting around 60,000 years ago, that cognitive fluidity begins to be achieved and all domains are connected (Mithen 1996:173: Fig. 17). In chapter 9, Mithen discusses in detail the various innovations in the Early Upper Paleolithic and explains them as resulting from the combined utilization of multiple domains of intelligence, from the advantages gained by cognitive fluidity (Mithen 1996:204, Fig. 25).

His explanation for why cognitive fluidity evolved in modern humans is based on the following (p. 221–2): increase in brain size around 500,000 years ago, which was related to the evolution of a grammatically complex social language that also included some non–social information; individuals who were able to exploit this non–social information gained a reproductive advantage; as social language switched to a general–purpose language, individuals acquired an increasing awareness about their own knowledge of the non–social world; consciousness adopted the role of an integrating mechanism for knowledge that had previously been 'trapped' in separate specialized intelligences.

Mithen argues that the "final step to a full cognitive fluidity occurred at slightly different times in different populations between 60,000 and 30,000 years ago. This involved an integration of technical intelligence, and led to the changes in behaviour that we refer to as the Middle–Upper Paleolithic transition. In other words, it created a cultural explosion: the appearance of the modern mind" (Mithen 1996:222). It is due to this "explosion" that research on change in the Early Upper Paleolithic is crucial: we are at the beginning of the modern human mind and can observe, via the archaeological record, how early modern humans first adapted to the range of environments in Europe, how their culture, in a broad sense, changed in now inter–related domains.