CREATIVITY IN HUMAN EVOLUTION AND PREHISTORY

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CHAPTER NINE

MIDDLE PALAEOLITHIC 'CREATIVITY'

Reflections on an oxymoron?

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When the editor of this volume first proposed the idea of writing a chapter on Neanderthal creativity, the initial reaction was that it would be a very short chapter indeed. The archaeological record of Neanderthals seems at first glance to provide little raw material for an essay on innovation. The Mousterian of Eurasia, the cultural period associated with the Neanderthals, is conspicuously bereft of evidence for artistic or aesthetic expression. Moreover, compared to later time periods, both artefacts and technology are remarkably uniform across space and stable over time during the Mousterian (Klein 1989: 296; Mellars 1989). Innovation is not usually the first word that comes to mind when one thinks of the Mousterian, but this makes the Mousterian all the more interesting from the perspective of the current volume. Attempting to account for the apparent absence of creativity in the material culture of the Neanderthals and other archaic hominids begs an examination of the general conditions that foster and encourage such creativity among later humans.

A number of recently published studies address possible changes in the structure of human/hominid cognition during the Pliocene and Pleistocene (Gibson and Ingold 1993; Mellars 1991; Mithen 1996a; Noble and Davidson 1996; Wynn 1989). Whereas the creative process is certainly a cognitive phenomenon, this chapter takes a somewhat different approach. Rather than addressing the mental foundations of innovation, we examine how unique creative acts can come to be visible in the archaeological record. Like many others, we assume that the very capacities of human beings for creative thought and action must have changed over the course of human evolution, and that this in turn must be reflected in the frequency with which novel objects and techniques appear in the archaeological record. However, it is one thing for a new and different idea to occur to an individual, but quite another for that idea to be actualised so as to produce the kind of durable and widespread material record that archaeologists can recognise. Of the two issues, the generation of a new idea and the repeated implementation or use of that idea, we focus on the latter. In light of the extremely 'coarse-grained' time resolution afforded by the Palaeolithic record, what is normally construed as evidence for creative behaviour – varied and rapidly changing material culture – may in fact reflect a more complex situation, consisting not only of the generation of novel designs or procedures but also of the widespread adoption and prolonged replication of these things. A diverse and dynamic archaeological record thus reflects both the creative tendencies of hominids and the ways in which creative behaviour was expressed, rewarded and disseminated within social groups.

Some aspects of the Palaeolithic record are more variable and show more rapid mutation than others, and, *a priori*, some aspects of material culture might be expected to be more dynamic than others. It is thus necessary to define where the best evidence for 'creativity' – and the most egregious lack of it – are situated within the Mousterian. Arguably, the most surprising lack of innovation, and the most pronounced contrast between the Middle Palaeolithic and later time ranges, is in the designs of stone artefacts, especially weapons. The record of modern humans leads us to expect a great deal of novelty and variety in this domain of technology, such that long periods of comparative stasis in the Middle Palaeolithic and earlier time ranges are truly noteworthy. Concentrating more narrowly on artefact design, it is possible to isolate the conditions which might foster long-term stability as well as the sorts of evolutionary factors which might lead to the apparent 'explosion' in creative expression during the later part of the Upper Pleistocene. At issue is the very role of technology in human adaptations: the extent to which material objects affect and are affected by other dimensions of human behaviour.

WHAT ARE WE TALKING ABOUT?

The Neanderthals are the most recent population of archaic *Homo* to have lived in Europe and southwest Asia. They are widely considered a subspecies of *H. sapiens* (*H.s. neanderthalensis*), although some researchers have revived the notion, prevalent up through the 1950s, that the Neanderthals represent a separate species (*H. neanderthalensis*). Archaeologically, the Neanderthals are most consistently associated with Mousterian or Middle Palaeolithic stone tool industries, a complex of archaeological assemblages found throughout western Eurasia. Although fossil remains classified as anatomically modern *H. sapiens sapiens* have also been found in association with Mousterian lithic assemblages at the sites of Skhul and Qafzeh in Israel (Vandermeersch 1981), the great majority of hominid remains from Mousterian sites are attributable to Neanderthals. There is no point in disputing the fossil associations, as they do show that skeletal 'modernity' is not equivalent to 'modern' behaviour. For the purpose of this discussion, we assume that the Eurasian Middle Palaeolithic is primarily but not exclusively the cultural record of the Neanderthals. Since this discussion concerns mainly archaeological patterns, the term 'Mousterian hominids' is more appropriate than 'Neanderthals', and the two designations are used more or less interchangeably below.

Mousterian assemblages are remarkably widespread, occurring from north Africa to the plains of southern Russia, and from the Atlantic coast of France to as far east as the Black Sea. Recent developments in chronometric dating have shown that the Middle Palaeolithic lasted for a very long time as well. The earliest assemblages conventionally classed as Mousterian date to in excess of 250,000 BP (e.g. Mercier *et al.* 1995), whereas the most recent are perhaps 33,000 years old (Delibrias and Fontugne 1990; Hublin *et al.* 1995). The range of artefact forms and debris that make up the Mousterian is relatively limited compared with later time periods. The surviving toolkit includes a variety of flake and blade tools, as well as bifaces, all of chipped stone. Bone was occasionally employed as a raw material, but only in an extremely casual, expedient manner (Vincent 1988). After chipped stone, animal bones, prey of both hominids and other predators, provide the next most abundant source of information about the behaviour of Neanderthals, although for historical reasons there have been few detailed studies of faunal remains until recently. The predominant prey species were medium to large herbivores (cervids, equids, bovids) (Mellars 1996: 193–244; Stiner 1993a). Smaller animals such as reptiles and shellfish were sometimes exploited as well (e.g. Stiner 1993b). So-called art objects and decorated utilitarian items attributable to Neanderthals or other Mousterian hominids are extremely rare, and usually controversial (Chase and Dibble 1987; Davidson and Noble 1989; Mellars 1996: 369–381).[1]

When referring to the Neanderthals as a taxonomic group, one is by definition discussing an entire hominid subspecies or perhaps even species. Similarly, the term Mousterian refers to archaeological remains representing an interval of around 200,000 years. While a mere instant of geological time, this is a substantial span of cultural time. The very fact that it is possible to encapsulate technology and subsistence of the Middle Palaeolithic and the Neanderthals in a few paragraphs is important. By contrast, it is difficult to imagine how one could summarise the material culture of *H. sapiens sapiens* over even the past 10,000 years in a comparable amount of text.

WHAT CONSTITUTES EVIDENCE FOR CREATIVITY, OR FOR ITS ABSENCE?

In discussing the Mousterian, it is important to decouple creativity in its broadest sense from the specifically expressive or 'artistic'. Although various authors have argued for the existence of objects with symbolic content dating as far back as the Middle Pleistocene (Bednarik 1995; Goren-Inbar 1986), these specimens are very rare. The fact that alleged Mousterian symbolic objects tend to be unique casts further doubt on their actual symbolic content (Chase and Dibble 1987; Davidson and Noble 1989), for they provide no evidence for a shared system of meaning. It is significant that Neanderthals as a subspecies so infrequently created symbolic objects of durable materials, but it also leaves little to work with. In addition, the frequency and elaboration of what archaeologists would identify as art varies widely among past and current groups of modern humans. Even within the late Upper Palaeolithic of Europe, thought by most to represent the first flowering of expressive art, the frequency and elaboration of art objects varies widely over time and across space. The rich parietal and mobile art traditions of southwest Europe dominate the public imagination, but they are in fact quite exceptional (Conkey 1983; Straus 1995). Because the proliferation of symbolic objects of durable materials seems often to occur under some social conditions but infrequently under others, it is difficult to know what exactly to expect of our more remote hominid predecessors.

It is also vital to consider the kinds of 'innovation' that might stand a reasonable chance of being detected in the Pleistocene archaeological record. Most of us tend to envision the creative act as unique – a novel idea that begins with a single individual. However, given the coarse chronological 'grain' of most Palaeolithic records, in which the finest possible subdivision may represent tens or even hundreds of years, individual acts and even individual lifetimes are for all intents and purposes invisible. A singular act of innovation will appear to the archaeological observer as part of a 'normal' range of variation for a particular time period or place. A truly radical innovation, expressed as an entirely novel type of artefact or technique, may not be recognised as such, or, if it anticipates later procedures or artefact forms, might be passed off as an intrusion of more recent material into the older level.

Given the nature of the record, the phenomena most likely to be considered evidence for innovation, or for the absence of it, are rates of turnover and degrees of variety in artefact forms, and not single objects or classes of things. While most would agree that rapid changes in what artefacts look like and how they are made indicate high rates of innovation, this is innovation on a very different scale. Palaeolithic archaeologists are most likely to recognise creativity only if its results are widely adopted and retained over long periods. Someone or something must first generate novelty, but in order for these developments to be recognised by observers thousands of years later, the novelty must have been widely disseminated and replicated. Ironically, it is only through the imitativeness, the lack of creativity of many, that we are likely to recognise the creativity of a few. The products of unique or uncommon acts will tend to be 'lost in the mix', archaeologically invisible. As a consequence, enquiring about the presence or absence of 'creativity' in the Palaeolithic, obliges us to consider the conditions that encourage individuals to innovate, as well as factors that impel others to adopt newly developed ways of doing things.

It is equally important to recognise that the static nature of the Middle Palaeolithic is obvious only by comparison with later time periods. Compared with the first million or so years of the Lower Palaeolithic, the Mousterian seems like a veritable Renaissance, an interval of constant fomentation. Technological constancy has been the rule in human evolution. The expectations that technological change should be rapid and ecologically responsive are based exclusively on experience with the record of modern humans over the past 40,000 years or so. It is actually the Upper Palaeolithic, or the record of later anatomically modern humans in general, that is anomalous. In light of these points, the issue is not what inhibited change in the earlier time ranges, but what it is about modern humans that makes their material culture so fluid.

WHERE IS THE ABSENCE OF INNOVATION MOST OBVIOUS?

Although the Mousterian/Middle Palaeolithic is often characterised as static and homogeneous, it does change, if incrementally, and it does vary geographically, if subtly (cf. Bar Yosef *et al.* 1992; Jelinek 1982; Mellars 1996: 315–355). Indeed, it is patently unrealistic to portray this or any other manifestation of human or hominid behaviour as totally fixed. Evolution cannot occur at all in the absence of variation, and Neanderthals could not have persisted for tens of thousands of years in some of the most extreme and unstable environments the world has ever seen without being quite flexible in their behaviour.

On closer analysis, it seems that the relative stasis and homogeneity that have impressed prehistorians actually reside in a few specific dimensions of the Middle Palaeolithic record. In some areas, such as in techniques for working stone, the Mousterian actually shows considerable diversity. A surprising variety of methods was employed for producing tool blanks, ranging from biface technology to prismatic blade production, and including a broad range of techniques labelled 'Levallois' (e.g. Boëda 1991, 1993a, 1993b; Boëda *et al.* 1990; Conard 1990; Marks and Monigal 1995; Mellars 1996: 56–94; Van Peer 1992). It could be argued that Mousterian lithic technology shows more variety than is manifest in Upper Palaeolithic stone tool production. Although distinct regional and chronological variants are present as well (e.g. Mellars 1996: 56–94), a significant component of the variation in methods of tool manufacture appears to represent responses to factors such as raw material forms and qualities, tool functions and even the logistics of keeping mobile individuals supplied with serviceable implements (e.g. Dibble 1985; Henry 1995; Jelinek 1988; Kuhn 1992, 1995; Rolland and Dibble 1990; Wengler 1990). A comparable degree of tactical flexibility appears to have characterised the procurement and transport of lithic raw materials (Geneste 1989a, 1989b; Roebroeks *et al.* 1988).

There is also good reason to believe that Middle Palaeolithic hominids exhibited a great deal of flexibility in their foraging and subsistence behaviour. The simple fact that the Mousterian is found over a vast area and across a broad range of palaeoenvironments demonstrates that the hominids of the time were capable of adjusting to the exigencies of making a living under radically different conditions. It is impossible, for example, that Neanderthal populations living in the southern Levant during hyperarid intervals pursued the same lifeways and exploited the same resources as did populations living in periglacial north-central Europe. When and where archaeologists have sought variability in Mousterian foraging economies over time or across space, they have quite often found it (e.g. Chase 1986; Farizy and David 1992; Mellars 1996: 193–244; Stiner 1993a, 1994). Whether Mousterian economic variability differs from what is observed in later periods (e.g. Klein 1989: 318–327; Stiner 1993a) is significant, but it is also a separate consideration.

A specific illustration of variation in Middle Palaeolithic technology and subsistence practices can be drawn from our research on several stratified Mousterian cave sites in west-central Italy (Kuhn 1995; Stiner 1994; Stiner and Kuhn 1992). In this area, distinct changes in foraging patterns and lithic technology occur around 55,000 BP, well within the temporal limits of the later Mousterian in Europe. Mousterian faunas dating to after this interval provide the first clear evidence for heavy dependence on hunting in the study area. Virtually entire carcasses of red deer, fallow deer and ibex were returned to the caves and eaten, often down to the marrow in the phalanges (Stiner 1994). In the most recent of these Mousterian faunas (from Grotta Breuil, see Bietti *et al.* 1990–91), foragers showed a marked tendency to target prime individuals of common ungulate species, a propensity rare among non-human predators but common in human populations during the Upper Pleistocene. This tendency persists in many cultures of the Holocene as well (Stiner 1990). The increasing emphasis on hunting in the Mousterian of west-central Italy is accompanied by a number of technological shifts, including declining numbers of exotic artefacts, markedly less intensive resharpening of tools, and changes in core reduction technologies, showing that cores of local raw materials, rather than more portable tools, were the primary object of conservation. Patterns of mobility provide the link between technological and faunal evidence. Briefly, before 55,000 BP, Mousterian subsistence in our study area was based to a large extent on dispersed small-package resources, including tortoises, shellfish and some scavenged game. This resulted in wide-ranging foraging patterns and a high degree of residential mobility, marked in the lithic assemblages by evidence for considerable reliance on extensively maintained transported tools. The provisioning of shelter sites with hunted game after 55,000 years ago is associated with somewhat longer stays in the caves, reducing dependence on transported toolkits, and allowing the Mousterians to collect small stores of scattered local raw materials that could be used and discarded as convenient (Kuhn 1992, 1995).

These strongly linked shifts in foraging and technology in this case reinforce the observation that all aspects of the Mousterian were not necessarily fixed or rigid. We also emphasise that most of the behavioural shifts documented in west-central Italy appear to have been responses to changing resource availability in and around some uniquely situated sites. They are evidence not of some profound evolutionary change in the capacities of the hominids, but of a simple adjustment to changing circumstances. The cave sites from which most of the archaeological data are drawn currently lie within 1 km of the Mediterranean sea, as they also did at the end of the last Interglacial. Declines in sea levels over the course of the later Pleistocene gradually exposed several kilometres of coastal plain, radically altering the nature of foraging opportunities available to Mousterian hominids using those shelters. Opportunities to hunt large grazing and browsing ungulates almost certainly improved as the sea receded and the environment around the caves became increasingly terrestrial in nature.

Returning to the central argument, the dimension of Middle Palaeolithic behaviour in which change is least noticeable is the designs of stone artefacts. What often strikes prehistorians familiar with later time periods is that the basic shapes of Mousterian tools seem to be virtually the same everywhere: very few edge types and tool forms comprise the bulk of all Middle Palaeolithic artefact assemblages. This homogeneity may be partially explained by the likelihood that most of Mousterian tools were used for processing food or working other materials (e.g. Anderson-Gerfaud 1990; Beyries 1987; Shea 1989), 'high tolerance' functions in which we might not expect a great deal of change or variety in artefact design. Progressive use and resharpening, the reduction effect (Dibble 1987) could further restrict the amount of variation in tool form that we observe. Yet, despite these qualifications, there remains a conspicuous absence of variety and novelty in Middle Palaeolithic artefact forms relative to later time periods.

The lack of variation in Mousterian tool design is perhaps most obvious in artefacts that might have been related to procuring and processing food, hunting weapons in particular. Given the vast geographic and ecological range over which Mousterian industries are found, it is inevitable that the degree to which people relied on large game animals varied extensively. Moreover, Mousterian hominids exploited many different species, ranging from small, semi-solitary ungulates such as gazelle and roe deer to large, gregarious animals like red deer, horses and wild cattle.

Relatively 'low-tolerance', time stressed activities such as the hunting of large animals place rather strict constraints on the design of implements (Bleed 1986; Torrence 1983), stimulating tool makers to develop a variety of more or less specialised forms. Yet potential Mousterian stone weapon tips, known as Levallois and Mousterian points, are made on very much the same plan wherever they occur. The main difference between the two forms is that Levallois points generally lack retouch, while Mousterian points are shaped by marginal flaking. Otherwise, both forms are large, essentially triangular stone flakes, sometimes with thinned butts. If hafted, both types of artefact are most likely to have been mounted on heavy thrusting or throwing spears (Churchill 1993; Shea 1993). Although the stone points do vary somewhat in size and elongation, differences in shape are generally attributable to raw materials or techniques of blank production.

The frequencies of likely projectile components vary across regions in unexpected ways as well. Potential weapon tips are not most abundant where one might expect on ecological grounds. For example, Mousterian and Levallois points tend to be more common relative to other 'tool forms' in assemblages from the southern end of the Mousterian range – the Levant and the Zagros mountains – rather than in more northerly areas where large animals must have played a more important role in the diet during cold seasons. It is not simply the case that Middle Palaeolithic foraging and technology were unrelated. In the Mousterian of west-central Italy, technology and foraging seem to have been linked mainly through land-use patterns, via their effects on lithic raw material economy. However, in our database, the shift from a notable reliance on scavenged game and small package resources like shellfish and tortoises to an emphasis on ambush hunting occurred around 55,000 years ago. Not long after this interval, and still well within the Mousterian, hunters were concentrating on prime-aged animals, the largest, fattest, but arguably the most difficult to obtain members of an ungulate population. Yet within the limits of available evidence, this important transition in human ecology was not accompanied by any substantial change in the lithic artefacts that might have been related to game procurement. Both the forms and the frequencies of potential stone weapon tips remained essentially constant across this entire interval in the study area.

In marked contrast to the Mousterian, the Upper Palaeolithic of Eurasia is characterised by a rich and rapidly changing array of weapons and other implements directly or indirectly related to food procurement. With the earliest Upper Palaeolithic, a remarkable variety of components for spears, darts, lances and harpoons make their appearance in Eurasia. This is not the place to develop a synthetic overview of potential Upper Palaeolithic weapons (see instead Knecht 1991, 1993; Larsen Peterkin 1993; Straus 1990, 1993). However, it is safe to say that within the comparatively brief span of the Upper Palaeolithic, both the diversity of implements for game procurement, and the variety of raw materials from which they were made, greatly exceed what even the most enthusiastic observer would identify for Middle Palaeolithic hunting technology (e.g. Shea 1989, 1993). Moreover, patterns of variation in the abundance and complexity of Upper Palaeolithic artefacts seem to be much more closely related to geographic and climatic factors than during earlier time periods, fitting well with general expectations about the importance of large game and other resources in human diets. For example, elaborate bone and antler projectiles, a defining characteristic of many later Upper Palaeolithic industries in northern Europe, are quite scarce in semi-arid southwest Asia during the later Upper Pleistocene. Conversely, ground and pecked stone tools apparently employed to process vegetable foods are much more common in the drier, warmer Near East during this same interval (e.g. Bar-Yosef and Belfer-Cohen 1988; Gilead 1991; Wright 1994).[2]

Here, then, lies one of the most ambiguous and fascinating aspects of the Middle Palaeolithic. On the one hand, it is obvious that the behaviour of Mousterian hominids was by no means rigid and unchanging. Neanderthals survived, even prospered, in a wide range of environments. They were more than capable of adjusting the ways in which they made stone tools to the diverse raw materials they encountered and even to the short-term tactical demands of keeping themselves supplied with usable tools in uncertain environments. Yet the designs of implements, a hallmark of innovative behaviour among modern humans and a particularly dynamic dimension of the later Upper Palaeolithic archaeological record, are curiously static for long periods of time within the Mousterian. Many of the functional and strategic factors that are expected to influence artefact design among later populations seem to have had little or no effect on how Neanderthals did things. We do not wish to argue that the absence of elaborate weapons technology compromised the predatory abilities of Neanderthals and their contemporaries. They were certainly capable of taking large game animals, and they probably used weapons to do so. What is strange is that there seems to be so little preserved evidence for technological responses to either documented or inferred shifts in how and how frequently large game was procured.

WHAT MIGHT LEAD TO ACCELERATED RATES OF CHANGE?

Although the persistence of Middle Palaeolithic artefact forms is striking, it is not without precedent: relative technological stasis has been the rule in human evolution for 2 million years or more. It is therefore unnecessary to invoke a special mechanism, such as exceedingly rigid and persistent cultural conventions, to explain why Neanderthals' stone tools changed so slowly. Rather than asking what kept the Neanderthals from changing, what we really should consider is what might have made the technologies of modern humans so dynamic by comparison with those of earlier hominids.

This is obviously an ambitious question, and we will not propose a comprehensive answer here. However, if one is going to ask why things change, specifically technology related to getting food, it is crucial to consider the conditions that would most stimulate rapid and constant change in the design of those tools. As discussed above, accounting for the kind of rapid turnover in artefact forms that an archaeologist might perceive as evidence for an acceleration in rates of technological innovation, in turn requires that we focus on both innovation and on the adoption and spread of novel forms, procedures and ideas.

To the extent that technology is a response to local conditions, instability and continuous change imply that there was almost always an advantage, roughly speaking, to getting better at something – in the case under discussion, the acquisition and preparation of food. Among modern humans, much of this pressure relates to patterns of sharing and the sizes of consumer groups. In foraging societies, food-sharing networks are (or were) usually quite flexible, almost open-ended, at least within the limits of local group sizes. No matter how much people collect or kill, there is someone to eat it, either immediately or in the future (with storage). Moreover, broad patterns of sharing appear to cement social ties and reinforce relationships in what may be called 'social storage'. A surprisingly broad cross-section of anthropologists, with theoretical backgrounds ranging from Marxism to sociobiology (see discussion in Hawkes 1992; Ingold 1991; Kelly 1995: 178–181), have noted how judicious redistribution of excess resources can provide a distinct advantage to some individuals, whether this advantage is measured in terms of increased survivorship of offspring, social prestige, reproductive opportunities, or some other currency. Under such conditions there may be, over the long term, a real benefit to becoming more efficient or faster at harvesting resources, even when they are not scarce in the environment relative to consumer demand

Long periods of relative stasis in the evolution of humans (and other organisms) show us that selective pressures on anatomy and behaviour were far from constant. Perhaps the monotony of early hominid food procurement technology – despite known or probable variation in diet – means that the potential payoffs for obtaining surpluses of food were not so open-ended among archaic humans as they are among modern peoples. The stability in archaic hominid food procurement technologies might reflect, albeit indirectly, something about the composition of social groups and the economic relationships between individuals within them. We do not mean to suggest that Neanderthals did not share food, or at least some kinds of food. It is well documented that large game were killed and carcasses sometimes transported to caves where they were extensively processed and consumed, implying either that game was regularly shared or else that individual Neanderthals were terrific gluttons. However, if sharing the fruits of foraging was nearly always limited to small groups – a female and her children, a mated pair and offspring, a group of close allies – then there would have been less general benefit to increasing the effectiveness of techniques for harvesting food resources in bulk so long as those resources remained at least moderately abundant in the environment.

It is instructive to look beyond a strictly human/hominid context with regard to the question of sharing as a stimulus for innovation in food procurement technology. In contrast to both humans and some social carnivores, non-human primates and most other omnivorous animals do not as a rule share food voluntarily. A good deal of what has been described as sharing among primates appears to be better described as 'tolerated theft', a situation in which the potential cost of defending a resource does not merit the effort (see Blurton-Jones 1987; King 1994: 65–67).[3] However, for pregnant or lactating females, a certain degree of sharing with offspring is obligatory, and demand for nourishment is as close to open-ended as it gets for an organism that doesn't habitually share. Interestingly, it seems that many 'advances' in primate foraging, particularly involving the use of tools or in techniques for processing food among chimpanzees, originate with or are most extensively exploited by females (e.g. Boesch and Boesch 1981, 1984; McGrew 1992: 88–106).

It is unlikely that a single model of group composition would serve for the entire Middle Palaeolithic: the actual sizes and compositions of Neanderthal groups probably varied somewhat, as would be expected for any social omnivore living under a comparably broad range of conditions. The point is that long-term stability of food procurement technologies during the Middle Palaeolithic (and earlier) may be in part attributable to the existence of sharing networks that were quite small in scale relative to what is known of modern foragers. Moreover, here the discussion concerns only the sizes and structures of economically cooperative, sharing social units. Other larger (and probably looser) social aggregates may well have existed, related to mating networks or defence against predators.

Although many of the developments in weapons technology during the Upper Palaeolithic do appear to have conferred tangible mechanical advantages, and presumably increased efficiency or effectiveness in procuring food, there is certainly more to it than that. It is unrealistic to think that all of the variation among and within human technologies reflects functional factors alone, and that every new form of implement that appears in the archaeological record is necessarily a better tool. It is abundantly clear today that the astounding variety in how people see fit to do and make things relates to much more than how those things actually function, and that the nature of a technology often has a great deal to do with the meaning assigned to technological acts in other domains of culture. Artefacts participate in the social and symbolic as well as the material realms of human existence. This very 'interconnectedness', the embedding of technology (or any other action) in the social, religious and economic domains, has consequences that might easily influence rates of technological change at an evolutionary time scale. Simply stated, the technologies of modern humans may be exceptionally volatile and diverse because they impact on so many aspects of cultural life, and because so many domains of culture impact on them. The multiplicity of influences on recent technologies may act almost like a mutagen acts on the genome, increasing variety on which selective processes may then operate.

In the diverse cultures of modern humans, an individual's proficiency as a maker of things and reputation as a holder of knowledge may have a profound impact on social position, the ability to attract mates, and access to other resources and information. There are sometimes great individual benefits to be gained by being – or appearing to be – a master of some aspect of technology. One way to demonstrate that mastery is to produce new and evidently better things. Moreover, because the constraints on artefacts' performance in the ideologic, social and functional domains are quite different, artefact design is simultaneously pushed in a variety of directions. Making an artefact work better as a medium for communicating social identity will not necessarily ensure that tools will be more effective in performing other practical tasks. On the other hand, this sort of process will encourage the production of novel forms, at least some of which may end up providing advantages to users in other domains. In some contexts, a premium on innovation or originality in design *per se* may exist, but this is not necessary to encourage elevated levels of technological creativity.

There are parallels between the evolution of somatic traits in animals and rates of change in artefact design. Anatomical features such as molar teeth, which are subject to stringent functional constraints, are well known to be highly conservative. On the other hand, features such as secondary sexual characteristics that are involved in competitive displays or physical conflicts designed to attract and gain access to mates are quite malleable on an evolutionary time scale. These features must still fill several roles: in addition to attracting a mate, a bird's feathers must also insulate and function in flight. However, the participation of a trait in more than one selective arena seems to confer a greater potential for rapid evolutionary change. In the case of features like pelage colour, feathers or antlers, a degree of novelty may in fact be favoured, as it causes an individual to stand out.

Of course, the value of a novel idea must be recognisable in order for others to emulate it. However, it is not always essential to build a significantly better mousetrap in order to have the world beat a path to your door. One can speculate that the mechanical characteristics of a particular innovation sometimes have relatively little impact on its initial spread and replication. Many developments in prehistoric technology seem to have provided such marginal functional advantages to the tool-user that it would be difficult for a single individual to evaluate them accurately over the short term. Initially, individuals may choose to adopt a novel way of doing things because it seems to work better, because of the reputation of the originator, or because it affords them some other benefit, such as identification with a particular subset of society. On the other hand, long-term retention and replication of a particular technological alternative, especially when it cross-cuts ecological and social boundaries, is more likely to reflect more fundamental, less contextually sensitive mechanical or functional factors.

Of course, not all aspects of modern technologies are equally dynamic. Some ways of doing or making things have been comparatively stable over long periods, while others change quite rapidly. Episodes of rapid diversification within our own society may occur when a technology begins to participate in a different domain of cultural life. The explosive growth in the athletic shoe industry in the United States is a case in point. For many years, the range of footgear available for sports and exercise was quite limited and relatively fixed; there were just a few brands, and each offered a few basic models. However, over the past 10–15 years, the range and variety in styles and 'functions' of athletic shoes has exploded, to the point that there are now large stores devoted exclusively to the sale of this one class of item. To be sure there have been changes in who wears athletic shoes and for what purpose, and there have certainly been advances in functionality. On the other hand, it is unlikely that the physical parameters of human exertion have changed enough in the last decade and a half to necessitate so many radical alterations in shoe design. Something else is afoot, namely that shoes have become social symbols as well as aids to athletic performance. Indeed, the athletic shoe as social symbol has spread well beyond the well-publicised cases of gang membership among inner city adolescents. Exercise, or at least exercise equipment, has become an important component of individual and social identity in many subsets of American society. In this instance, capitalist marketplace factors have amplified the scale of the response and the level of innovation in design, just as they have in other areas (the computer and car industries, for example). But the same basic phenomenon may characterise a wide range of human economic systems. The important point here is that the 'creative explosion' in athletic shoe design would never have occurred had the social valuation of sport not also changed.

This 'interconnectedness' between technology and other domains of human existence may be a unique characteristic of modern human culture beginning about 40,000 years ago. It does not seem to be an inevitable by-product of simply possessing some sort of culture and a minor dependence on tools. How much does a chimpanzee's skill at foraging or tool-use really impact on its opportunities for mating or its place in the social hierarchy? Probably very little, except insofar as the ability to obtain nourishment permits an individual to maintain a large body and a high level of activity. For a chimp, the activity of tool-using simply does not participate very much in any domain of life beyond the procuring of a few specific types of food.

The leisurely pace of change and broad spatial scale of variation in the technologies of Pleistocene human ancestors may imply an organisation of culture and a role of technology within it very different from what is typical of modern humans. If the various domains of early hominid cultures – especially the technological and social – were largely independent of one another, then the forces stimulating innovation and producing variety in technological behaviour, variety upon which selection could act, would have been much more limited. If all that Neanderthals did with tools was make other tools and help feed a small group of close allies or relatives, and if their knowledge of how to create things was of consequence only in this very limited arena, then the influences on technological behaviour would have been few, and the scope of innovation and change comparatively narrow. Under such conditions, we might not expect many aspects of hominid technology to change much more rapidly than hominid anatomy, which one can indeed argue was the case throughout the Lower and Middle Palaeolithic.

In turn, the acceleration in rates of technological change with the onset of the Upper Palaeolithic may be the equivalent of an 'adaptive radiation' in biological evolution, marking a point at which technology took on new roles in human existence. This expansion in the roles of technology seems to have occurred 60,000 years or more after the appearance of skeletally modern humans. For the first time in prehistory, artefacts began to have social and symbolic significance, and it is noteworthy that other media of communication such as body ornamentation first appeared and proliferated then (e.g. White 1989). Perhaps for the first time, tools and other artefacts took on the role of material culture as we now understand it. Whereas we certainly do not wish to argue that all changes in the forms of weapons or other tools, from the early Upper Palaeolithic on, reflect exclusively symbolic or social factors, once artefacts assumed 'functions' in these domains, the value of novelty and the rate at which new designs were produced and incorporated could have increased radically.

Why might technology have begun to participate in the social and ideological realms of prehistoric human life only at the beginning of the Upper Palaeolithic?[4] Clearly, the organisation of culture around symbolic interaction is a key. Symbols are, among other things, the currency that translates achievement in one domain into status in another. It is a common symbolic currency that qualifies a maker of fine leather clothing to be an oracle, that renders a good blacksmith a powerful magician, or that makes a successful hunter an interesting sexual partner. These are abstract, symbolic associations, much like the associations between a few lines of ochre on the wall of a cave and an actual horse. There are many strong opinions and little consensus about the symbolic capacities of Neanderthals and earlier hominids (see reviews in Mellars 1996: 388–391; Mithen 1996b; Noble and Davidson 1996); in fact, even the authors of this chapter do not agree about the extent to which Neanderthal communication resembled modern human language. However, regardless of what Neanderthals were capable of, there is certainly evidence for an amplification of many channels for information transmission with the beginning of the Upper Palaeolithic, whether in the appearance of well-defined and redundant 'art objects' or in abundant use of personal ornamentation (Gamble 1983; White 1989). By the beginning of the Upper Palaeolithic, human beings were clearly communicating with one another through material objects, if not for the first time, then far more than they ever had in the past. It is possible that these changes simply reflect that an organisational threshold had been reached, that regional populations had reached a level at which new channels of information transmission became necessary to alleviate conflict and establish boundaries. These same facts could also mark the first appearance of symbolic language as we now know it. We only comment that language is obviously central to, but not necessarily a precondition for, changes in both the sizes of human groups and the organisation of human cultures. In fact, the problems of avoiding conflict within ever denser regional populations, as well as of organising and coordinating action within increasingly large cooperating social groups (discussed by Gamble 1983; Whallon 1989; Wobst 1976, among others), could provide just the sort of selective context that pushed an already large-brained organism like *archaic H. sapiens* across a new threshold in communication.

CONCLUSION

Early hominid material culture, from the Oldowan through the Mousterian, is noticeably uniform and slow to change. In attempting to explain the slow pace of change in Middle Palaeolithic artefact designs, it is all too easy to assume that Neanderthal brains simply lacked the mental cog or sub-routine that provides the spark of creativity to modern humans. However, while Neanderthals probably did not think just like we do, they were equally large-brained, undeniably intelligent hominids who managed to flourish under an extraordinary range of conditions. Middle Palaeolithic behaviour was not, and indeed could not have been, completely static. Whether in foraging or in tool making, Mousterian hominids successfully coped with changing needs and conditions by altering what they did and how they did it. There was not necessarily anything stifling creativity or holding back change among Neanderthals and their forebears; it was simply that there was little spurring it on. The comparative dynamism of the Upper Palaeolithic, and of recent human material culture in general, stems at least in part from a major expansion in the role of technology in human culture. Sometime around 40,000 years ago (in Eurasia at least) it appears that material items came for the first time to participate regularly in the social and symbolic lives of humans (see also Mithen 1996a, 1996b). As an upshot of this 'radiation' of technology into new roles, the number of influences on the designs of implements increased exponentially, resulting in the kind of rapidly changing record that characterises the later Pleistocene in Eurasia and Africa. We emphasise that the specific social or ideological significance of particular material items is not at issue here. What is important is that material goods initially began to play a part in these domains of human existence in the Upper Palaeolithic.

A question to be addressed in future research is why there is evidence for the generation of novelty in some areas early on (techniques of stone working for example) and not in others, such as artefact design. Several possible resolutions to this problem present themselves. It is possible that innovation in methods of core reduction was actually favoured above creativity in artefact design, in that the factors influencing how stone is worked – raw material form and amiability, for example – required a more immediate response. On the other hand, the appearance of change in one domain and relative stasis in another may be simply a matter of what is available for comparison. As noted above, not all dimensions of the modern human archaeological record are equally dynamic and variable; for example, Late Holocene lithic technology is rather homogeneous across broad areas of the southwestern United States (Olszewski and Simmons 1982) at a time when ceramics diversified rapidly. It is possible that core reduction technologies in the Middle Palaeolithic seem so varied only because there was not so much variation during the later time periods. Perhaps because their utility as media for visual communication is limited, methods of flake and blade production never came to be of much wider social significance during the Upper Palaeolithic, so that they continued on the trajectory of very gradual change. It may also be the case that we simply know much more about variation in lithic technology during the Mousterian. Certainly, there has been more research on methods of blank production in the Middle and Lower Palaeolithic, and many of the more active researchers involved with the study of Palaeolithic *chaînes opératoires* are Mousterian specialists. Thus, while the surprisingly broad range of methods for flake production found in Mousterian assemblages does show that Middle Palaeolithic hominids did not always behave in a hidebound and stereotypical manner, in the end these phenomena may not actually be especially dynamic.

We have discussed Neanderthal 'creativity' at some length without referring explicitly to the cognitive abilities of those hominids. We have not addressed this topic because it lies outside our areas of greatest expertise, and because the cognitive aspects of the creative process are treated in depth by other contributors to this volume. In focusing mainly on the social contexts that might encourage technological innovation and the diffusion of novelty in material culture, we have attempted to draw attention to a more general set of factors that may be behind both long periods of stasis and intervals of explosive diversification in many aspects of human production and expression. It is very likely that fundamental shifts in human cognition accompanied the appearance of the Upper Palaeolithic. However, whether as prerequisite or consequence of changes in how hominids thought, conditions must have been right for cognitive developments to be expressed archaeologically. Moreover, while it is likely that the basic structure of human cognition has changed relatively little since the Upper Palaeolithic, the same principles behind the first 'radiations' in hominid technology during the Upper Palaeolithic continue to affect the world in which we live, albeit on a much more restricted scale.

NOTES

1 For extensive syntheses of the archaeology and physical anthropology of the Neanderthals, see Mellars (1996) and Stringer and Gamble (1993).

2 The focus of this chapter on implements that may have been used in procuring large animals reflects the composition of the archaeological record rather than some particular fascination with big-game hunting. Implements that might have been related to collecting and processing vegetable foods – milling, grinding, pounding tools – are extremely scarce and geographically unpatterned in the Middle Palaeolithic of western Eurasia.

3 Some primates do appear to share food regularly, but this accounts for a small portion of the total diet, and the sharing often takes place in a restricted social context (e.g. alliance formation among males) (e.g. Boesch and Boesch 1989; de Waal 1989; King 1994: 65–70; McGrew 1992: 106–113). Sharing is certainly not a ubiquitous organising principle in the foraging of any non-human primate, as it is among human beings (Hawkes 1992).

4 Whether the earliest symbolic objects and personal ornaments date to the very end of the Middle Palaeolithic or the beginning of the Upper Palaeolithic is not at issue here. A few cases of possibly symbolic objects, musical instruments or beads, found either in association with alleged Neanderthal fossils or dating to periods well before the appearance of anatomically modern humans in Europe, have been interpreted variously as evidence for the symbolising abilities of late Neanderthals or trade with early modern human groups. We are most concerned with the general timing of these developments and their broader evolutionary significance, less so with the species or subspecies involved.

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