Proceedings of the British Academy, **88**, 179–201

The Emergence of Biologically Modern Populations in Europe: A Social and Cognitive 'Revolution'?

PAUL MELLARS

Corpus Christi College, Cambridge; Department of Archaeology, University of Cambridge, Downing Street, Cambridge, CB2 3DZ
Fellow of the British Academy

Keywords: Archaeology; Palaeolithic; human evolution; demography; modern humans; Neanderthal.

Summary. The appearance of anatomically modern populations in Europe around 40–45,000 years ago appears to reflect a major population dispersal, which replaced the preceding Neanderthal populations. Closely associated with this population dispersal there is archaeological evidence for a range of dramatic cultural innovations, including the appearance of more complex forms of stone and bone technology, personal ornaments, larger and more highly structured living sites, and remarkably sophisticated representational art and other forms of visual symbolism. There is also evidence for a major increase in human population densities, marked by an increase in the numbers of occupied sites in many regions. It is argued here that several other social transformations, including the appearance of larger residential group sizes, increased separation and specialization of personal roles within these groups, more sharply bounded territorial and demographic groupings, and more complex forms of descent and kinship structures, may be attributable at least in part to this increase in human population densities. A further critical factor in these social and cultural transformations was almost certainly the appearance of more complex and highly structured language patterns, associated with the dispersal of the anatomically modern populations. While the origins of these changes must be sought outside Europe, it was probably this

range of behavioural innovations which allowed the biologically modern populations to compete with, and eventually replace, the pre-existing Neanderthal populations of Europe.

INTRODUCTION

FEW TOPICS HAVE GENERATED MORE DEBATE RECENTLY than the origins of anatomically and biologically 'modern' human populations—that is populations which are anatomically closely similar to ourselves, and which are conventionally assigned to the same sub-species of *Homo sapiens sapiens*. From the spate of research carried out recently there seems to be an increasing consensus that the earliest anatomically and genetically modern populations probably originated in one specific region of the world (most probably Africa) and subsequently dispersed to all other regions. Support for this so-called 'Garden of Eden' or 'Out of Africa' hypothesis has come from extensive studies of both mitochondrial and nuclear DNA patterns in present-day populations, as well as from new discoveries and new dating of a range of human skeletal remains from Africa, Asia and Europe (e.g. Mellars & Stringer 1989; Trinkaus 1989; Aitken *et al.* 1992; Stringer & Gamble 1993; Nitecki & Nitecki 1994). Although still disputed by several workers (e.g. Wolpoff *et al.* 1994; Thorne & Wolpoff 1992), most of the latest research seems to be converging increasingly towards this hypothesis, and away from the alternative scenario of 'multiregional' or 'regional continuity' evolution (Harpending *et al.* 1993; Sherry *et al.* 1994; Cann *et al.* 1994; Stringer & Gamble 1994; Rogers & Jorde 1995).

The implications as far as the more northern latitudes of Asia and Europe are concerned are that anatomically modern populations would seem to have dispersed into the Middle Eastern region by at least 90–100,000 BP (as evidenced by the skeletal remains from Skhul and Qafzeh in Israel) and then, after an interval of perhaps 50,000 years, subsequently dispersed into the much colder and more ecologically demanding environments of eastern, central and western Europe—which at this period were in the grip of an essentially periglacial climate, approximately midway during the last glacial episode. The dispersal of the anatomically modern populations throughout Europe apparently led to the eventual decline and extinction of the preceding Neanderthal populations of the region, which are generally assumed to be the more or less direct descendants of the preceding *Homo erectus* or *Homo Heidelbergensis* populations, which had been present in the continent since at least the earlier stages of the Middle Pleistocene, around 500,000 BP (Stringer & Gamble 1993). According to this scenario, therefore, the anatomically modern populations were replacing

populations from whom they had been separated in evolutionary terms over a prolonged period. Whether or not there was any interbreeding between the two populations is currently a matter of lively debate, but the bulk of the available genetic and anatomical evidence would seem to argue against any very significant transfer of Neanderthal genes into subsequent European populations (Stoneking & Cann 1989; Stoneking *et al.* 1992; Stringer & Gamble 1993, 1994).

The critical interest of this episode of population replacement from a cultural or (as I would prefer to say) 'behavioural' point of view is that it allows us to make direct comparisons between the patterns of behaviour of two sharply contrasting biological populations, within precisely the same range of environmental settings. In other words, we can compare the archaeological records of these two successive populations within the different regions of Europe and see how far the replacement of the 'archaic' by the modern populations seems to be reflected in the associated behaviour of the two populations. Exactly how we explain any documented contrasts in behaviour of this kind is of course a separate and far more complicated issue, which may conceivably involve delving not only into the nature of the behavioural patterns themselves, but also into the underlying cognitive and intellectual capacities of the two populations. What I wish to argue in this paper is that many of the documented contrasts between the behaviour of the Neanderthal and modern populations could be related to a number of rather basic and simple changes in the social and demographic organization of the two populations. The separate and much more contentious issue of the deeper cognitive implications of these changes will be touched on more briefly in the final section of the paper.

BEHAVIOURAL CHANGES OVER THE MIDDLE-UPPER PALAEOLITHIC TRANSITION

Establishing exact correlations between the archaeological and anatomical records over the period of the Neanderthal-Modern human transition is still rather difficult, owing to the relatively small proportion of archaeological sites which have produced well preserved skeletal remains over the critical transition period. What can be said with some confidence, however, is that the most striking and dramatic changes in the archaeological records can be shown to coincide fairly closely in a chronological sense with the earliest appearance of typically 'modern' anatomical remains in the different regions of Europe, and that there are strong indications that the *earliest* manifestations of these new behavioural patterns are associated specifically with the dispersal of the anatomically modern populations. Since the

evidence for these correlations has been discussed fully elsewhere (Mellars 1992; Kozlowski 1992; Stringer & Gamble 1993, 1994; Howell 1994; Gambier 1993), I will not pursue these arguments in the present context.

The evidence for a major shift in human behavioural patterns at this point in the archaeological succession forms the basis for what archaeologists have traditionally referred to as the 'Middle-to-Upper Palaeolithic transition' or—increasingly over the past few years—the 'Upper Palaeolithic revolution' (Mellars 1989a, 1994). If we focus purely on the most archaeologically visible aspects of this transition, it is possible to document changes in at least seven or eight major behavioural domains, all clearly documented within the archaeological records of Europe within the general time range of *c.* 35–40,000 BP (Kozlowski 1990; Mellars 1989a, 1989b, 1991, 1996; Stringer & Gamble 1993):

1 A basic shift in the technology of stone-tool production, away from the predominantly 'flake-based' technologies of the Lower and Middle Palaeolithic, to the production of more elongated and technologically efficient 'blade' forms. A possible factor underlying this transition is generally thought to have been the introduction of so-called 'indirect' or 'punch' techniques of blade production.

2 A rapid proliferation in the forms of stone tools—almost certainly reflecting a major increase in the complexity of several other, associated aspects of technology (wood working, skin working, hunting missile technology etc.), and apparently indicating a greatly increased component of visual 'style' and deliberately 'imposed form' in the patterns of tool production (Mellars 1989b, 1991; Chase 1991).

3 An even more striking proliferation of new forms of technologically complex, highly varied and visually standardized forms of bone, antler and ivory tools. This contrasts with the virtual lack of deliberately shaped bone tools in earlier Neanderthal contexts, and again seems to reflect an entirely new emphasis on visual form and standardization in artefact production.

4 A correlated shift in the whole tempo of technological change. While the preceding Middle Palaeolithic/Neanderthal phase was characterized by a remarkable lack of technological innovation (in most spheres) over a time span of around 200,000 years, the succeeding Upper Palaeolithic is marked by a series of rapid and conspicuous changes in both stone and bone tool production occurring at intervals of 3000–5000 years or less (Isaac 1972; Mellars 1989b).

5 The sudden appearance of a wide variety of beads, pendants and other items of 'personal ornament'—ranging from simple perforated animal teeth through to carefully shaped stone and ivory beads, together with a range of decorative sea shells, in many cases apparently transported over distances of 300 km or more (White 1989, 1993; Taborin 1993; Gamble 1986).

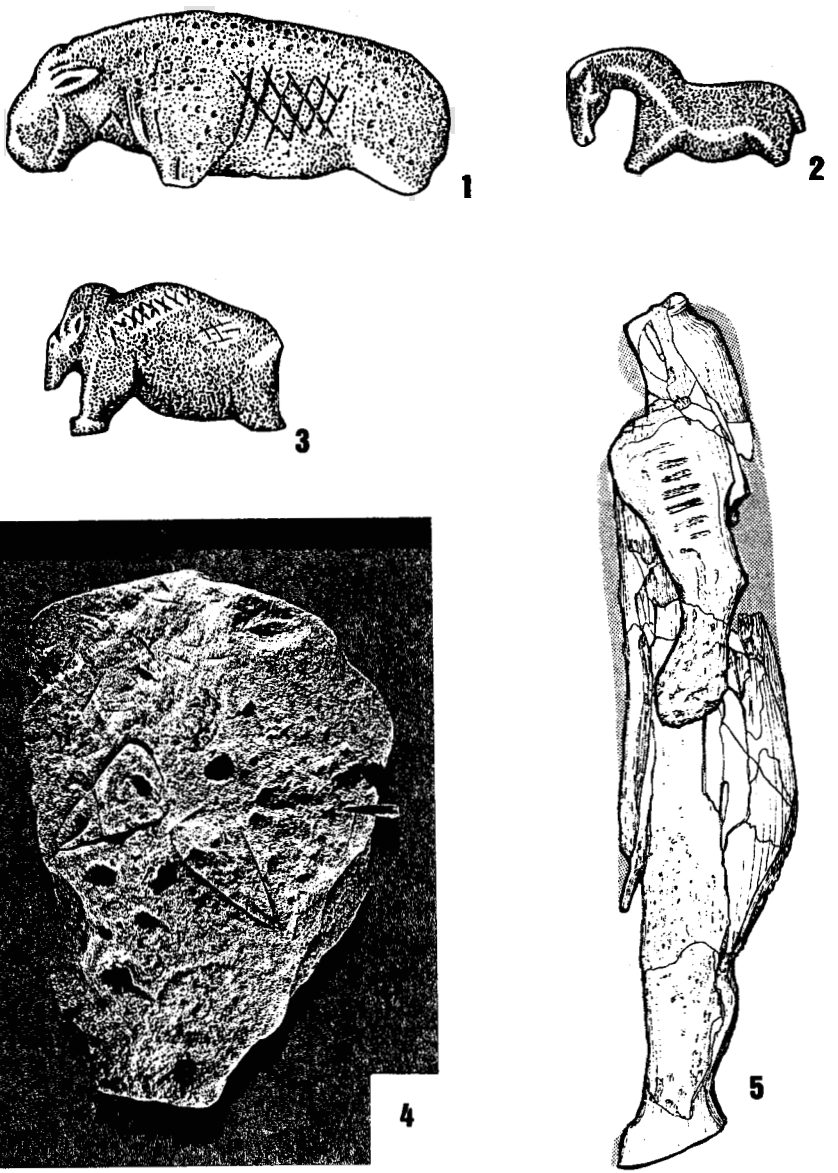

Figure 1. Early Upper Palaeolithic art objects from Aurignacian sites in Europe: 1–3, animal figurines carved from mammoth ivory, Vogelherd, south Germany; 4, female 'vulvar' symbols incised on limestone block, La Ferrassie, southwest France; 5, male human figure with animal's head, of mammoth ivory, Hohlenstein-Stadel, south Germany. Various scales. After Mellars 1989a; Hahn 1977.

6 The appearance of the first incontrovertible musical instruments—in the form of multiple-holed bone flutes (Scothern 1993).

7 Most striking of all, perhaps, the sudden appearance of both extensively incised or 'decorated' bone artefacts and (in certain contexts) remarkably sophisticated and complex forms of representational art. As shown in Figure 1, these range from explicitly vulvar or phallic representations to carefully modelled statuettes of animal, human, or even combined human/animal forms (Hahn 1972, 1993).

8 Lastly, at least strong hints of a number of closely associated changes in both the economic and residential patterns of the human groups. These are inevitably more difficult to document directly from the archaeological records, but nevertheless point strongly to: (a) the appearance of more sharply focused and economically 'specialized' patterns of animal exploitation, targeted on particular, apparently preferred species of game; (b) more efficient and highly organized patterns of procurement and distribution of high quality raw materials between local groups; and (c) the appearance of more highly 'structured' living sites, marked in several cases by deliberately constructed huts or similar structures, suggesting (as in the case of stone and bone tools) a much more explicit component of design and imposed form in the conception and planning of the structures (Mellars 1973, 1989a, 1996; Gamble 1986).

Arguably the most impressive feature of the above list is the wide range of different aspects of behaviour which seem to have been affected—ranging from shifts in basic lithic and bone technology, through subsistence changes, to a veritable explosion of explicitly symbolic expression, reflected in both the obvious fields of art and personal ornamentation, and the new component of increased standardization, 'imposed form' and apparent 'style' reflected in the production of stone and bone artefacts. It is the latter features which have led many authors to talk of a 'symbolic revolution' at this point in the archaeological sequence (Pfeiffer 1982; Chase & Dibble 1987; Mellars 1991; White 1993). To anticipate the discussion in the later part of this paper, it seems almost inconceivable to many workers that this kind of explosion of explicitly symbolic behaviour could have been achieved without at least some associated shifts in the overall complexity, structure or efficiency of language and related social communication patterns over the period of the Middle to Upper Palaeolithic transition (e.g. Clark 1981; Binford 1989; Mellars 1989a, 1991; Whallon 1989; Davidson & Noble 1989, 1993; Bickerton 1990; Lieberman 1991; Donald 1991). Even without this inference, however, it will be clear that we have some justification for speaking of a major 'revolution' in human behavioural patterns at this point in the archaeological sequence, at least as significant in my view as that which heralded the later and more widely publicised 'Neolithic' or 'Urban'

revolutions, and apparently reflecting a similar scale of transformations in virtually all of the archaeologically observable aspects of behaviour.

SOCIAL TRANSFORMATIONS

The critical question in the context of the present symposium is what this complex of behavioural changes may tell us about any associated changes in the patterns of social or demographic organization of human communities over the period of the archaic to modern human transition. In other words, does the so-called 'Upper Palaeolithic revolution' also correspond to a social revolution?

The point I wish to argue here is that while there is almost certainly much more to the Upper Palaeolithic revolution than a basic shift in social patterns (see below), it is arguable that at least many of the documented archaeological changes over this transition can be seen most economically as a reflection of some associated social and demographic processes. The main point I will argue is that many of these behavioural changes would fall naturally into place if the process of population dispersal which carried anatomically modern populations across Europe was associated with a major increase in population numbers—and therefore local population densities—in many parts of the continent. Some of the more general components of this model have already been discussed elsewhere, in the context of later developments in social complexity during the course of the Upper Palaeolithic (Mellars 1985). Here I want to expand on these ideas in the particular context of the Neanderthal to modern human transition, and by incorporating some of the recent speculations on the nature of associated cognitive and intellectual changes over this transition.

Population increase

The arguments for a major increase in human population densities associated with the dispersal of modern populations across Europe rest on two kinds of evidence. First, a number of recent studies of the mitochondrial DNA structure of present-day European populations (by the technique known as 'mismatch distributions') seem to point to a sharp increase in population numbers dated approximately to around 40,000 years ago (Harpending *et al.* 1993; Sherry *et al.* 1994). This of course would tally very well with all the current radiocarbon and other dating evidence for the dispersal of anatomically modern populations across Europe, and the associated revolution in behavioural patterns, discussed above. The other line of evidence comes directly from the

archaeological records, and lies in the sharp increase in numbers of occupied sites which can be documented in many regions of Europe, coinciding closely with the transition from the Middle to the Upper Palaeolithic. Clear patterns of this kind have been documented for example in the occupation of cave and rock shelter sites in the classic southwest French region (Mellars 1973, 1982), as well as in the adjacent areas of northern Spain and several parts of central and eastern Europe (Straus 1983, 1990: 286; Soffer 1989; Gamble 1986). Exactly what caused or supported this population increase is still a matter of debate, but there can be little doubt that it must have involved some significant increase in the efficiency or productivity of food harvesting strategies. All that needs to be recognized here is that from two quite separate lines of evidence there are now strong indications that human population numbers—and therefore local population densities—did increase sharply in many regions of Europe, at a time corresponding closely with the documented 'revolution' in behavioural patterns reflected in many other aspects of the archaeological evidence.

If population numbers and density did increase sharply with the replacement of Neanderthal by modern populations in Europe, it is reasonable to ask what other shifts in the social structure or organization of local populations we might expect to be associated with this demographic change. It is equally necessary to ask how far such changes can be recognized in the associated archaeological records. The answer, I would suggest, lies in a combination of four major social transformations. To reduce a rather complicated set of arguments to fairly simple terms, the relevant considerations can be summarized fairly briefly as follows:

Size of local residential groupings

The existence of some fairly close relationship between the local density of human populations in particular areas and the sizes of co-residential or co-operating social groups (what in hunter-gatherer societies are often taken to equate broadly with local 'bands') can be argued in at least four different ways:

1 Purely in terms of the basic logistics of economic exploitation and related land-use patterns, it could be argued that any major increase in local population densities would virtually demand the formation of increased co-residential or co-operating social groups, if only to avoid the kinds of recurrent conflicts which would inevitably arise from the uncoordinated activities of a large number of small, independent social units foraging within a relatively small, densely populated area. Arguably, without some degree of co-residence and direct co-operation or communication between group members, this situation would lead to endless confrontations or

conflicts over the exploitation of particular territories or resources, which would seriously undermine the viability of the population as a whole.

2 Second, it could be argued that whatever improvements in the efficiency or productivity of food procurement strategies made possible a significant increase in human population densities over the period of the Middle-Upper Palaeolithic transition would almost inevitably have made possible a corresponding increase in the sizes of local residential groups. The basic reasoning here is that any significant increase in the efficiency, productivity, or (perhaps most significantly) predictability and security of food procurement procedures would automatically increase the amount of food which could be secured on a reliable, day-to-day basis from a particular foraging area, and thereby increase the number of people who could be supported within this area. Exactly what form these improvements in subsistence strategies would have taken is more controversial, but they probably included improved forms of weapon technology, more highly organized and (probably) co-operative hunting methods, better transportation, improved information sharing on the distribution and movements of resources, and perhaps a broadening of the total range of subsistence resources exploited. Improved techniques of food storage could well have been a further critical factor allowing the formation of larger and more stable residential groups in many Upper Palaeolithic contexts (Mellars 1973; Soffer 1985; Peterkin 1993; Testart 1982).

3 Thirdly, it seems likely that at least some of the documented changes in the overall complexity of different kinds of technology and related subsistence strategies which seem to be indicated over the period of the Middle-Upper Palaeolithic transition would have either required, or at least strongly encouraged, the formation of larger groups of co-operating individuals. Obvious examples would be the introduction of more large scale communal hunting strategies; the emergence of wider ranging and more organized systems of procurement and distribution of raw materials; and perhaps the construction of relatively large and complex living structures. Although less easily demonstrable archaeologically, one can probably add the emergence of larger and more complex group ceremonial activities as a further factor favouring at least the temporary formation of relatively large social gatherings in many Upper Palaeolithic contexts.

4 Finally, an increase in the complexity of both social relationships and roles within local groups (as discussed below) and patterns of linguistic or other communication between members of the groups might well have facilitated the integration and co-ordination of larger social groups in the early Upper Palaeolithic. Several studies have emphasized that the capacity of large groups to function effectively—and to persist for long periods without internal conflict—can be critically dependent on the structure of

individual roles, ranking, and authority within the group as a whole (Lee & DeVore 1968; Steward 1972; Johnson 1982; Price & Brown 1985; Cohen 1985; Mellars 1985). In the same context, language could have been an equally critical factor, both in helping to integrate and co-ordinate the activities of large numbers of individuals within the local groups, to formalize rules of social behaviour, and to resolve potential conflicts within the groups.

How far one can support this kind of increase in the size of local residential groups from the archaeological evidence has been debated frequently in the literature. Most authorities seem to agree that local group sizes in most Neanderthal populations were relatively small, and that there is strong evidence for an increase in group sizes in the relatively large dimensions attained by many Upper Palaeolithic settlements (Mellars 1973, 1989a; Binford 1982, 1989; Soffer 1989, 1994; Stringer & Gamble 1993). While the evidence for this is clearest in sites dating from the middle and later stages of the Upper Palaeolithic (as for example in many of the open-air Gravettian sites of central and eastern Europe), there are at least strong indications of these significantly increased site sizes in some of the earliest Upper Palaeolithic settlements—as for example in the Aurignacian levels at Laussel, Abri Caminade and the Abri Pataud in southwest France, and at a number of open-air sites in central and eastern Europe (Mellars 1973; Hahn 1977; Kozlowski 1982). Similarly, there can be little doubt that the internal structure and organization of settlements became more elaborate during the earliest stages of the Upper Palaeolithic (as for example at Arcy-sur-Cure, Cueva Morín, Abri Pataud, Bacho Kiro etc.), which could be seen as a further indication of generally more complex patterns of social organization in early Upper Palaeolithic groups (Freeman & Echegaray 1970; Kozlowski 1982; Mellars 1989a, 1996; Binford 1989; Farizy 1990).

Increased separation and specialization of individual roles within local groups

The emergence of more specialized and sharply defined social and economic roles of individuals within local residential groups could be seen as a largely direct consequence of several of the factors discussed above, for at least three reasons:

1 It is self evident that any increase in the size of local residential groups would automatically create more scope for the increased separation and specialization of individual roles within these groups. It would obviously be difficult, for example, to have much specialization of roles in societies including, say, only 4–5 adults of either sex within a local group; the potential for role-specialization must inevitably be to a large extent contingent on the overall size of the group.

2 By the same token it is clear that any increase in the general complexity of various economic, technological or social activities of the kind which is generally envisaged for the period of the Middle-Upper Palaeolithic transition (for example in the spheres of bone or wood working; the production of artwork or ornaments; more complex hunting strategies, or elaborate ceremonial activities) would automatically create both more *scope* for the work of specialists, and arguably more *need* for individuals to acquire and practise the necessary skills to perform these different roles. As argued further below, similar separation and clear identification of personal roles within local groups may have been necessary to maintain the social integration and cohesion of relatively large numbers of people—at least over extended periods—within these local groups. If, as many of us suspect, there was a significant increase in the relative duration or permanence of occupation in particular settlements over the course of the Middle-Upper Palaeolithic transition, this would have put a further loading on the need for more clearly defined social structures and mechanisms to avoid or resolve conflicts between group members.

3 Finally, one should emphasize the potentially crucial role of advanced, highly structured language in any clear identification and definition of individual social and economic roles within societies. The ability to clearly *categorize* these roles in conceptual and verbal terms, and the ability to *express* potentially complex social relationships between individual roles, could be critical to the emergence of increasingly complex social relationships within human groups (Gellner 1989; Bickerton 1990; Donald 1991; Knight 1991).

Evidence of increased identification and demarcation of personal roles in Upper Palaeolithic societies can be argued from two main aspects of the archaeological data: first, from the dramatic proliferation of various kinds of personal ornaments (perforated animal teeth, stone and ivory beads, transported sea shells etc.) in the earliest stages of the Upper Palaeolithic—which are often seen as a direct reflection of at least the increased potential, if not the increased need, for clearer expression and visual symbolization of the personal roles of individuals within local groups (White 1989, 1993; Soffer 1989; Mellars 1989a, 1991; Wiessner 1983); and second, from the similar emergence of explicitly 'ceremonial' burial practices, which could be taken as a further reflection of the ascription of special roles or status to individuals within the groups (Binford 1968; Harrold 1980). While many of these burials date from the later stages of the Upper Palaeolithic, the discoveries at Sungir in Russia, Dolní Věstonice in Czechoslovakia, Paviland in Wales and (perhaps more tenuously) Cueva Morín in northern Spain, extend back at least to the earlier stages, if not the very beginning, of the Upper Palaeolithic sequence (Gamble 1986; Mellars 1994). Significantly,

both well documented personal ornaments and convincing ceremonial burial practices are at present lacking from pre-Upper Palaeolithic Neanderthal contexts in Europe (Chase & Dibble 1987; Mellars 1989a).

More 'bounded' territorial and demographic units

Arguments for the emergence of more sharply prescribed or 'bounded' demographic and territorial units associated with an increase in population densities over the period of the Middle-Upper Palaeolithic transition have been advanced on several occasions (Isaac 1972; Wobst 1974, 1976; Gamble 1986; Mellars 1989a) . The arguments run essentially as follows:

1 Wobst (1974, 1976) and others have argued that the formation of 'closed' demographic networks (i.e. breeding units with distinct boundaries) are only possible where regional population densities are reasonably high. He argues that if groups living in very low population densities were to practise this kind of bounded mating network, it would be necessary for groups occupying the edges of these units to travel over very large distances to maintain contacts with a sufficiently large number of other groups to maintain demographically viable breeding units. Any significant increase in population density would therefore make the formation of more bounded demographic units more viable, if not necessarily more beneficial to the survival prospects of the group.

2 In a related vein, it has often been pointed out that low population densities would largely preclude any clear definition or attempted defence of specific territories among hunter-gatherer groups (e.g. Dyson-Hudson & Smith 1978). As Wobst (1974, 1976) and others have argued, clear definition and defence of social or economic territories is not only generally unnecessary under conditions of low population density, but effectively impossible to operate or 'police' with so few people on the ground.

3 Under these conditions, several factors might well have served to encourage a much stronger separation of demographic units, and sharper definition of territorial boundaries, as a result of increased population densities in the Upper Palaeolithic period. Dyson-Hudson & Smith (1978), for example, argued that in all human societies clear territoriality is most likely to emerge under conditions of direct competition for economic resources, among relatively high density populations. In these situations, the clear definition of territorial boundaries is often beneficial not merely to safeguard essential economic resources for the local groups, but as a legalistic device to avoid recurrent and disruptive conflicts between neighbouring groups for the exploitation of these resources—much in the way that in our own societies 'good fences make good neighbours'.

4 Finally—and perhaps most significantly—one should stress once again the potentially crucial importance of language patterns in the definition and separation of demographic and ethnic units. Almost all of the classic 'tribes' recognized among modern hunter-gatherers (as for example in Australia, the Kalahari or the Arctic) are defined essentially as linguistic units, based on major (and often mutually unintelligible) dialectical differences between adjacent tribes (Lee & DeVore 1968; Damas 1969; Bicchieri 1972; Peterson 1976; Wiessner 1983). If there is any truth in the suspicion that fully developed language emerged only with the appearance of anatomically modern populations in Europe (as discussed above) then at least the *scope* if not the need for the separation and isolation of discrete 'tribal' or 'ethnic' units would presumably have increased commensurately over the period of the Neanderthal to modern human transition.

A direct archaeological reflection of this increased degree of demographic separation over the period of the Neanderthal/Upper Palaeolithic transition has often been seen in the emergence of increasingly localized and sharply defined 'style zones' apparent in many Upper Palaeolithic contexts. Hahn (1972, 1993), for example, has argued for this kind of patterning in the distribution of various artistic and decorative motifs in the early Upper Palaeolithic Aurignacian industries, while similar patterns have been claimed in the distribution of stylistically distinctive technological variants in the later Perigordian and Solutrian periods (David 1973; Smith 1966) and in the distribution of Magdalenian art styles (Jochim 1983; Bosinski 1990 etc.). While there is certainly evidence for some degree of regional patterning in the basic technology of Neanderthal groups (Kozlowski 1992; Mellars 1996), there is general agreement that this kind of patterning is not only very much greater in the Upper than in the Middle Palaeolithic, but almost certainly based on a much more obvious *symbolic* component in effectively all spheres of material culture (Chase & Dibble 1987; Mellars 1991; Knight 1991). The argument is sometimes extended to suggest that much of the impetus for the emergence of a clearly 'stylistic' component in Upper Palaeolithic tool forms may have derived from the need to reflect these increasingly complex demographic and 'ethnic' distinctions in visually symbolic terms (Isaac 1972; Wobst 1977; Close 1978; Gamble 1986; Sackett 1982, 1988).

More complex descent and kinship systems

Finally, and perhaps most importantly, there are strong reasons to suspect that the structure and complexity of social linkages and relationships both within and between individual social groups would have increased sharply over the period of the Middle-Upper Palaeolithic transition. This could be

argued from several aspects of the evidence: evidence for the increased size and scale of local residential groups (as discussed above); the apparently clear evidence for the emergence of more wide ranging exchange or 'alliance' networks between widely dispersed communities, in some cases extending over distances of several hundred kilometres (Gamble 1982, 1986); and the virtual inevitability that groups living in high population densities would need to maintain some form of closely structured social relationships between members of the individual local groups, if only to mitigate the potentially disruptive effects of direct competition or conflict for particular economic resources or territories between groups living in close juxtaposition. Once again, the most critical factor in these relationships however is likely to have been the nature and complexity of language patterns. As Donald has recently stressed (1991: 213–5) it is only with the aid of relatively complex linguistic and semantic systems that one can either clearly conceptualize or formally express the kinds of complex social relationships that might be involved in, say, formalized systems of cross-cousin marriage, the formation of male clan groups, or other forms of complex inter-group kinship systems or moieties (see also Gellner 1989). Significantly, it has recently been pointed out that it is these particular between-group patterns of kinship and descent linkages which form the most diagnostic feature of all modern human societies, and which are conspicuously lacking in all of the documented non-human primate groups (Rodseth *et al.* 1991). If language and linguistic complexity *did* change fairly radically over the period of the Middle-Upper Palaeolithic transition, it would be surprising if this were not reflected in the general structure and complexity of social roles and relationships over this period. As I have attempted to argue above, this would be at least consistent with many different dimensions of the archaeological records of the Middle-Upper Palaeolithic transition in Europe.

DISCUSSION

The preceding sections have presented a model of social changes associated with the transition from archaic to modern populations in Europe which reduces in many respects to a question of 'social scale'. The argument, in essence, is that more or less concomitant with the dispersal of anatomically modern populations throughout Europe, there was a major increase in the total numbers of human population, leading to a significant increase in overall population densities in at least many areas of the continent. Partly dependent on this increase in population densities, but also stimulated by other factors such as associated changes in technology, hunting patterns, and probably language and associated symbolic communication, it is

suggested that there would have been a corresponding increase in the size of local co-residential and co-operating groups, with its own attendant set of social consequences. Other social adaptations, such as the increased complexity, separation and specialization of roles of individuals within the societies, similar increasing complexity in the structure of local and regional descent and kinship systems and (more hypothetically, but very probably) an increasing trend towards more sharply bounded and territorially defined demographic units (roughly equivalent to the conventional notions of hunter-gatherer 'tribes') can be seen as in many ways directly dependent on these basic changes in the size and scale of social units.

There is no suggestion of course that these changes in the overall size and complexity of social units would necessarily be apparent in *all* the local populations of anatomically modern humans across Europe. Since the most critical factor in these social transformations is assumed to be the *density* of local populations, it is inevitable that these population densities would have varied within fairly wide limits in the different ecological regions of Europe (probably dependent mainly on the character, productivity and long-term dependability of local food resources), which would have led to equally wide variations in the extent of social pressures and constraints arising from these population numbers. Most of the social responses I have described above are therefore likely to be most apparent in the areas with naturally high concentrations of critical food resources (such as concentrations of large herd animals) where the degree of both population crowding and the associated element of *competition* between closely packed human groups for the use of specific territories and economic resources are likely to have been most acute (Mellars 1985; Cohen 1985). As I and several others have pointed out, this is why the most impressive manifestations of social and cultural 'complexity' in the archaeological records of the European Upper Palaeolithic (such as concentrations of cave and portable art, large, rich sites, elaborate dwelling structures, ceremonial burials etc.) seem to be concentrated strongly in certain specific regions, such as the classic Perigord region of southwest France, the adjacent Cantabrian region of northern Spain, and parts of the ecologically productive loessic plains of central and eastern Europe (Jochim 1983; Mellars 1985; Soffer 1985; Straus 1990). In other, ecologically poorer areas, population densities throughout the Upper Palaeolithic sequence may well have remained at relatively low levels, with correspondingly much weaker pressures—and indeed opportunities—for the development of more complex patterns of social organization (Gamble 1982, 1986).

This emphasis on the basic dimensions and scale of social units as a major stimulant of social change is of course by no means new in either the archaeological or ethnographic literature. Much of the discussion of the

varying levels of organizational complexity in modern hunting and gathering societies (e.g. Service 1962; Lee & DeVore 1968; Steward 1972; Sahlins 1972; Woodburn 1982; Price & Brown 1985; Cohen 1985; Keeley 1988) has placed a similar emphasis on factors such as the size and scale of local co-residential and co-operating groups, and the extent of competition and interaction maintained between adjacent social groups. Broadly similar processes (though of course on a much larger scale) are generally seen as underlying the major social transformations associated with the so-called 'Neolithic Revolution'—i.e. an increase in local population numbers (ultimately dependent on increased efficiency of food production), leading to larger and more permanent residential groups, which in turn generated further social complexity in both the internal structure and external social relationships of these enlarged social groups (Bar-Yosef 1994). In both cases it is assumed to be shifts in the basic scale of both local population densities and residential group sizes which served as the primary stimulants for further, concomitant patterns of social change.

In many ways the most crucial question in the present context is how far the patterns of social change visualized over the transition from archaic to modern populations were dependent not only on these shifts in the basic scale of social and demographic units, but also on changes in the underlying cognitive structures of the two populations. There is hardly space here to provide a detailed review of the current thorny debates over the nature of cognitive changes over the period of the archaic/modern human transition, but as noted earlier, there is widespread agreement that this involved an effective 'explosion' in most forms of symbolic expression and behaviour, and almost certainly at least some significant changes in the overall structure and complexity of language (Pfeiffer 1982; Gibson 1985; Chase & Dibble 1987; Binford 1989; Mellars 1989a, 1991; Lieberman 1991; Donald 1991; Knight 1991). While it seems highly unlikely that Neanderthals and other archaic populations possessed no forms of language, it has been argued by many authors these are likely to have been far less complex, less structured, and probably less functionally 'efficient' than those which accompanied the spread of biologically and behaviourally modern populations across Europe (e.g. Bickerton 1990; Lieberman 1991).

Exactly how the structure and complexity of language and associated forms of symbolic communication would have impinged on different aspects of social organization can no doubt be argued in several ways. In the preceding sections I have argued that this could have played a crucial role in several kinds of social structures: in the degree to which individual personal roles and identities within societies could be clearly formalized and defined; in the similar conceptualization and formalization of structured descent and kinship relationships—both within and between local groups; in the

capacity to integrate increasingly large numbers of individuals into effective interacting and co-operating units; and (above all perhaps) in the potential effects of language and linguistic differentiation on the kinds of social boundaries which would have emerged between neighbouring demographic and territorial groups (Gellner 1989; Whallon 1989; Donald 1991). Whether or not there were any significant contrasts between the innate 'intelligence' of Neanderthal as opposed to anatomically modern populations is of course an entirely separate question, which is notoriously difficult to approach from the standpoint of the archaeological evidence (Gowlett 1984; Gibson 1985; Wynn 1989; Binford 1989; Gibson & Ingold 1993; Mellars & Gibson 1996). Without making any assumptions about changes in intelligence, however, it is clear that any major shift in the character and complexity of language—or indeed other forms of symbolic expression and communication, such as the use of personal ornaments to signify social identity, or the role of 'stylistic' contrasts in tool manufacture as a means of reflecting membership of particular tribal groupings—could have had a potentially profound effect on many different aspects of the social and demographic organization of archaic and early modern human groups.

The final point which must be recognized is that by choosing to focus this study specifically on the evidence from Europe, I have presented what is in effect a 'before and after' scenario for the patterns of social and cognitive change over the period of the archaic-to-modern human transition. As I indicated at the beginning of the paper, all the current evidence points to the conclusion that in Europe the appearance of biologically and behaviourally modern populations was due to a major dispersal of new populations from some region further to the east or south, which eventually replaced the local Neanderthal populations. By comparing the behaviour of these biologically modern populations with that of the preceding Neanderthals, therefore, we are comparing the behaviour of populations who are likely to have been pursuing largely separate lines of both biological and behavioural development over a period of at least 300,000, if not closer to a million years (Stringer & Gamble 1993). The question of exactly how, where and why these new patterns of behaviour and cognition initially evolved is therefore neatly side-stepped by focusing on the evidence from European sites.

As I have discussed at more length elsewhere (Mellars 1989a) the answer to the preceding question almost certainly lies partly in the evidence from western Asia, and partly on the much earlier records from southern Africa (see also Klein 1989, 1994; Deacon 1989; Foley 1989; Clark 1992; Bar-Yosef 1994). At a purely theoretical level it is possible to visualize a wide spectrum of different scenarios whereby complex, multi-dimensional patterns of technological, social and cognitive change could have emerged more or less

in parallel with the evolution of biologically modern populations. In theory, changes in many different aspects of behaviour—ranging from technology, through subsistence practices, to demography or even basic cognitive structures such as language—could have served as the initial catalyst for long-term processes of behavioural and social change. One only has to contemplate the wide range of alternative models which has been advanced to account for the so-called 'Neolithic Revolution' (e.g. Cohen 1977; Bender 1978; Gebauer & Price 1992) to appreciate the difficulties of formulating neat, coherent, and archaeologically testable cause-and-effect relationships for these complex, multifactorial processes of cultural change. In archaeological terms the difficulties arise partly from the very patchy and incomplete nature of the available archaeological records in many of the most potentially crucial areas (such as southern Africa, or central Asia) and partly from the difficulties of reconstructing the precise *sequence* in which the different aspects of behavioural change occurred in particular areas. In the present paper I have tried to show how many different dimensions of social and demographic organization appear to be closely interrelated, and to suggest how these might have been related in turn to simultaneous changes in economic, technological and cognitive patterns. But the task of presenting a neat, coherent and easily testable model of exactly how these complex changes originated in the course of the long evolutionary transition from archaic to modern human populations remains, I suspect, a challenge for the next millennium.

REFERENCES

Aitken, M.J., Stringer, C.B. & Mellars, P.A. (eds.) 1992: *The Origin of Modern Humans and the Impact of Chronometric Dating*. London: Royal Society (Philosophical Transactions of the Royal Society, series B, 337, no. 1280).

Bar-Yosef, O. 1994: The contributions of southwest Asia to the study of the origin of modern humans. In *Origins of Anatomically Modern Humans* (ed. M. H. Nitecki & D. V. Nitecki), pp. 24–66. New York: Plenum Press.

Bender, B. 1978: Gatherer-hunter to farmer: a social perspective. *World Archaeology* 10, 204–222.

Bicchieri, M.G. (ed.) 1972: *Hunters and Gatherers Today*. New York: Holt, Rinehart & Winston.

Bickerton, D. 1990: *Language & Species*. Chicago: University of Chicago Press.

Binford, L.R. 1982: Comment on R. White 'Rethinking the Middle/Upper Palaeolithic transition'. *Current Anthropology* 23, 177–181.

Binford, L.R. 1989: Isolating the transition to cultural adaptations: an organizational approach. In *The Emergence of Modern Humans: biocultural adaptations in the later Pleistocene* (ed. E. Trinkaus), pp. 18–41. Cambridge: Cambridge University Press.

Binford, S.R. 1968: A structural comparison of disposal of the dead in the Mousterian and Upper Paleolithic. *Southwestern Journal of Anthropology* 24, 139–154.

Bosinski, G. 1990: *Homo Sapiens*. Paris: Editions Errance.

Cann, R.L., Rickards, O. & Lum, J.K. 1994: Mitochondrial DNA and human evolution: our one lucky mother. In *Origins of Anatomically Modern Humans* (ed. M.H. Nitecki & D.V. Nitecki), pp. 135–148. New York: Plenum Press.

Chase, P.G. 1991: Symbols and Paleolithic artifacts: style, standardization, and the imposition of arbitrary form. *Journal of Anthropological Archeology* 10, 193–214.

Chase, P.G. & Dibble, H.L. 1987: Middle Paleolithic symbolism: a review of current evidence and interpretations. *Journal of Anthropological Archeology* 6, 263–296.

Clark, J.D. 1981: 'New men, strange faces, other minds'. An archaeologist's perspective on recent discoveries relating to the origins and spread of modern man. *Proceedings of the British Academy* 67, 163–192.

Clark, J.D. 1992: African and Asian perspectives on the origins of modern humans. In *The Origin of Modern Humans and the Impact of Chronometric Dating* (ed. M. Aitken, C.B. Stringer & P.A. Mellars), pp. 201–216. London: Royal Society (*Philosophical Transactions of the Royal Society*, series B, 337, no. 1280).

Close, A.E. 1978: The identification of style in lithic artefacts. *World Archaeology* 10, 223–237.

Cohen, M.N. 1977: *The Food Crisis in Prehistory: overpopulation and the origins of agriculture.* New Haven & London: Yale University Press.

Cohen, M.N. 1985: Prehistoric hunter-gatherers: the meaning of social complexity. In *Prehistoric Hunter-Gatherers: the emergence of cultural complexity* (ed. T.D. Price & J.A. Brown), pp. 99–122. Orlando: Academic press.

Damas, D. 1969: *Contributions to Anthropology: ecological essays.* Ottawa: National Museums of Canada, Bulletin 230.

David, N.C. 1973: On Upper Palaeolithic society, ecology and technological change: the Noaillian case. In *The Explanation of Culture Change* (ed. A.C. Renfrew), pp. 277–303. London: Duckworth.

Davidson, I. & Noble, W. 1989: The archaeology of perception: traces of depiction and language. *Current Anthropology* 30, 125–155.

Davidson, I. & Noble, W. 1993: Tools and language in human evolution. In *Tools, Language and Cognition in Human Evolution* (ed. K.R. Gibson & T. Ingold), pp. 363–387. Cambridge: Cambridge University Press.

Deacon, H.J. 1989: Late Pleistocene palaeoecology and archaeology in the southern Cape, South Africa. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 547–564. Princeton: Princeton University Press.

Donald, M. 1991: *Origins of the Modern Mind: three stages in the evolution of culture and cognition.* Cambridge, Massachusetts: Harvard University Press.

Dyson-Hudson, R. & Smith, E.A. 1978: Human territoriality: an ecological reassessment. *American Anthropologist* 80, 21–41.

Farizy, C. 1990: The transition from Middle to Upper Palaeolithic at Arcy-sur-Cure (Yonne, France): technological, economic and social aspects. In *The Emergence of Modern Humans: an archaeological perspective* (ed. P. Mellars), pp. 303–326. Edinburgh: Edinburgh University Press.

Foley, R.A. 1989: The ecological conditions of speciation: a comparative approach to the origins of anatomically modern humans. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 298–320. Princeton: Princeton University Press.

Freeman, L.G. & Echegaray, G. 1970: Aurignacian structural features and burials at Cueva Morín (Santander, Spain). *Nature* 226, 722–726.

Gambier, D. 1993: Les hommes modernes du début du Paléolithique supérieur en France: bilan des données anthropologiques et perspectives. In *El Origen del Hombre Moderno en el Suroeste de Europa* (ed. V. Cabrera Valdès), pp. 409–430. Madrid: Universidad Nacional de Educacion a Distancia.

Gamble, C. 1982: Interaction and alliance in palaeolithic society. *Man* 17, 92–107.

Gamble, C. 1986: *The Palaeolithic Settlement of Europe.* Cambridge: Cambridge University Press.

Gebauer, A.B. & Price, T.D. 1992: *Transitions to Agriculture in Prehistory.* Madison, Wisconsin: Prehistory Press.

Gellner, E. 1989: Culture, constraint and community: semantic and coercive compensations for the genetic under-determination of *Homo sapiens sapiens.* In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 514–525. Princeton: Princeton University Press.

Gibson, K.R. 1985: Has the evolution of intelligence stagnated since Neanderthal Man? (Commentary on Parker). In *Evolution and Developmental Psychology* (ed. G. Butterworth, J. Rutkowska & M. Scaife), pp. 102–114. Brighton: Harvester Press.

Gibson, K.R. & Ingold, T. (eds.) 1993: *Tools, Language and Cognition in Human Evolution.* Cambridge: Cambridge University Press.

Gowlett, J.A.J. 1984: Mental abilities of early man: a look at some hard evidence. In *Hominid Evolution and Community Ecology* (ed. R.A. Foley), pp. 167–192. London: Academic Press.

Hahn, J. 1972: Aurignacian signs, pendants, and art objects in Central and Eastern Europe. *World Archaeology* 3, 252–266.

Hahn, J. 1977: *Aurignacien: Das Altere Jungpaläolithikum in Mittel- und Osteuropa.* Koln: Fundamenta series A9.

Hahn, J. 1993: Aurignacian art in Central Europe. In *Before Lacaux: the complex record of the early Upper Paleolithic* (ed. H. Knecht, A. Pike-Tay & R. White), pp. 229–242. Boca Raton: CRC Press.

Harrold, F. 1980: A comparative analysis of Eurasian Paleolithic burials. *World Archaeology* 12, 195–211.

Harpending, H., Sherry, S., Rogers, A. & Stoneking, M. 1993: The genetic structure of ancient human populations. *Current Anthropology* 34, 483–496.

Howell, F.C. 1994: A chronostratigraphic and taxonomic framework of the origins of modern humans. In *Origins of Anatomically Modern Humans* (ed. M. H. Nitecki & D. V. Nitecki), pp. 253–319 New York: Plenum Press.

Isaac, G.Ll. 1972: Early phases of human behaviour: models in Lower Palaeolithic archaeology. In *Models in Archaeology* (ed. D.L. Clarke), pp. 167–199. London: Methuen.

Jochim, M. 1983: Palaeolithic cave art in ecological perspective. In *Hunter-gatherer Economy in Prehistory: a European Perspective* (ed. G.N. Bailey), pp. 212–219. Cambridge: Cambridge University Press.

Johnson, G. 1982: Organizational structure and scalar stress. In *Theory and Explanation in Archaeology* (ed. C. Renfrew, M. Rowlands & B. Segraves), pp. 389–421. New York: Academic Press.

Keeley, L.G. 1988: Hunter-gatherer economic complexity and 'population pressure': a cross-cultural analysis. *Journal of Anthropological Archaeology* 7, 373–411.

Klein, R.G. 1989: Biological and behavioural perspectives on modern human origins in southern Africa. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 529–546. Princeton: Princeton University Press.

Klein, R.G. 1994: The problem of modern human origins. In *Origins of Anatomically Modern Humans* (ed. M. H. Nitecki & D. V. Nitecki), pp. 3–17. New York: Plenum Press.

Knight, C.D. 1991: *Blood Relations: Menstruation and the Origins of Culture.* New Haven: Yale University Press.

Kozlowski, J.K. 1982: *Excavation in the Bacho Kiro Cave (Bulgaria): Final Report.* Warsaw: Panstwowe Wydawnictwo Naukowe.

Kozlowski, J.K. 1990: A multi-aspectual approach to the origins of the Upper Palaeolithic in Europe. In *The Emergence of Modern Humans: an archaeological perspective* (ed. P. Mellars), pp. 419–437. Edinburgh: Edinburgh University Press.

Kozlowski, J.K. 1992: The Balkans in the Middle and Upper Palaeolithic: the gateway to Europe or a cul de sac? *Proceedings of the Prehistoric Society* 58, 1–20.

Lee, R.B. & DeVore, I. 1968: *Man the Hunter*. Chicago: Aldine.

Lieberman, P. 1991: *Uniquely Human: the evolution of speech, thought, and selfless behavior*. Cambridge, MA: Harvard University Press.

Mellars, P.A. 1973: The character of the Middle-Upper Palaeolithic transition in south-west France. In *The Explanation of Culture Change: Models in Prehistory* (ed. C. Renfrew), pp. 255–276. London: Duckworth.

Mellars, P.A. 1982: On the Middle/Upper Palaeolithic transition: a reply to White. *Current Anthropology* 23, 238–240.

Mellars, P.A. 1985: The ecological basis of social complexity in the Upper Paleolithic of southwestern France. In *Prehistoric Hunter-Gatherers: the emergence of cultural complexity* (ed. T.D. Price & J.A. Brown), pp. 271–297. Orlando: Academic Press.

Mellars, P.A. 1989a: Major issues in the emergence of modern humans. *Current Anthropology* 30, 349–385.

Mellars, P.A. 1989b: Technological changes across the Middle-Upper Paleolithic transition: technological, social, and cognitive perspectives. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 338–365. Princeton: Princeton University Press.

Mellars, P.A. 1991: Cognitive changes and the emergence of modern humans in Europe. *Cambridge Archaeological Journal* 1, 63–76.

Mellars, P.A. 1992: Archaeology and the population-dispersal hypothesis of modern human origins in Europe. In *The Origin of Modern Humans and the Impact of Chronometric Dating* (ed. M. Aitken, C.B. Stringer & P.A. Mellars), pp. 225–234. London: Royal Society (*Philosophical Transactions of the Royal Society*, series B, 337, no. 1280).

Mellars, P.A. 1994: The Upper Palaeolithic Revolution. In *The Oxford Illustrated Prehistory of Europe* (ed. B. Cunliffe), pp. 42–78. Oxford: Oxford University Press.

Mellars, P. 1996: *The Neanderthal Legacy: an Archaeological Perspective from Western Europe*. Princeton: Princeton University Press.

Mellars, P. & Gibson, K. (eds.) 1996: *Modelling the Early Human Mind*. Cambridge: McDonald Institute for Archaeological Research.

Mellars, P.A. & Stringer, C.B. (eds.) 1989: *The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans*. Princeton: Princeton University Press.

Nitecki, M.H. & Nitecki, D.V. 1994: *Origins of Anatomically Modern Humans*. New York: Plenum Press.

Peterkin, G.L. 1993: Lithic and organic hunting technology in the French Upper Palaeolithic. In *Hunting and Animal Exploitation in the Later Palaeolithic and Mesolithic of Eurasia* (ed. G.L. Peterkin, H.M. Bricker & P. Mellars), pp. 49–68. Archaeological Papers of the American Anthropological Association No. 4.

Peterson, N. 1976: *Tribes and Boundaries in Australia*. Canberra: Australian Institute of Aboriginal Studies.

Pfeiffer, J.E. 1982. *The Creative Explosion: an enquiry into the origins of art and religion*. New York: Harper & Row.

Price, T.D. & Brown, J.A. 1985: Aspects of hunter-gatherer complexity. In *Prehistoric Hunter-Gatherers: the emergence of cultural complexity* (ed.. T.D. Price & J.A. Brown), pp. 3–20. Orlando: Academic Press.

Rodseth, L., Wrangham, R.W., Harrigan, A.M. & Smuts, B.B. 1991: The human community as a primate society. *Current Anthropology* 32, 221–254.

Rogers, A.R. & Jorde, L.B. 1995: Genetic evidence on modern human origins. *Human Biology* 67, 1–36

Sackett, J.R. 1982: Approaches to style in lithic archaeology. *Journal of Anthropological Archaeology* 1, 59–112.

Sackett, J.R. 1988: The Mousterian and its aftermath: a view from the Upper Paleolithic. In *Upper Pleistocene Prehistory of Western Eurasia* (ed. H. Dibble & A. Montet-White), pp. 413–426. Philadelphia: University of Pennsylvania, University Museum Monographs No. 54.

Sahlins, M.D. 1972: *Stone Age Economics*. New York: Random House.

Scothern, P. 1993: *The Music-archaeology of the Palaeolithic within its Cultural Setting*. PhD Dissertation, University of Cambridge.

Service, E.R. 1962: *Primitive Social Organization*. New York: Random House.

Sherry, S.T., Rogers, A.R., Harpending, H., Soodyall, H., Jenkins, T. & Stoneking, M. 1994: Mismatch distributions of mtDNA reveal recent human population expansions. *Human Biology* 66, 761–775.

Smith, P.E.L. 1966: *Le Solutréen en France*. Bordeaux: Publications de l'Institut de Préhistoire de l'Université de Bordeaux, Mémoire 5.

Soffer, O. 1985: Patterns of intensification as seen from the Upper Paleolithic of the Central Russian Plain. In *Prehistoric Hunter-Gatherers: the emergence of cultural complexity* (ed. T.D. Price & J.A. Brown), pp. 235–270. Orlando: Academic Press.

Soffer, O. 1989: The Middle to Upper Palaeolithic transition on the Russian Plain. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 714–742. Princeton: Princeton University Press.

Soffer, O. 1994: Ancestral lifeways in Eurasia—the Middle and Upper Paleolithic records. In *Origins of Anatomically Modern Humans* (ed. M. H. Nitecki & D. V. Nitecki), pp. 101–109. New York: Plenum Press.

Steward, J.H. 1972: *Theory of Culture Change*. Urbana: University of Illinois Press.

Stoneking, M., & Cann, R.L. 1989: African origin of human mitochondrial DNA. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 17–30. Princeton: Princeton University Press.

Stoneking, M., Sherry, S.T., Redd, A.J. & Vigilant, L. 1992: New approaches to dating suggest a recent age for the human DNA ancestor. In *The Origin of Modern Humans and the Impact of Chronometric Dating* (ed. M. Aitken, C.B. Stringer & P.A. Mellars), pp. 167–176. London: Royal Society (Philosophical Transactions of the Royal Society, series B, 337, no. 1280).

Straus, L.G. 1983: From Mousterian to Magdalenian: cultural evolution viewed from Cantabrian Spain and the Pyrenees. In *The Mousterian Legacy* (ed. E. Trinkaus), pp. 73–111. Oxford: British Archaeological Reports International Series S164.

Straus, L.G. 1990: The early Upper Palaeolithic of southwest Europe: Cro-Magnon adaptations in the Iberian peripheries, 40,000–20,000 BP. In *The Emergence of Modern Humans: an Archaeological Perspective* (ed. P.A. Mellars), pp. 276–302. Edinburgh: Edinburgh Univeristy Press.

Stringer, C. & Gamble, C. 1993: *In Search of the Neanderthals: solving the puzzle of human origins*. London: Thames & Hudson.

Stringer, C. & Gamble, C. 1994: The Neanderthal World: flat earth or new horizon (with accompanying comments). *Cambridge Archaeological Journal* 4, 95–119.

Taborin, Y. 1993: Shells of the French Aurignacian and Perigordian. In *Before Lacaux: the complex record of the early Upper Paleolithic* (ed. H. Knecht, A. Pike-Tay & R. White), pp. 211–229. Boca Raton: CRC Press.

Testart, A. 1982: The significance of food storage among hunter-gatherers: residence patterns, population densities, and social inequalities. *Current Anthropology* 23, 523–537.

Thorne, A.G. & Wolpoff, M.H. 1992: The multiregional evolution of humans. *Scientific American* 266, 28–33.

Trinkaus, E. (ed.) 1989: *The Emergence of Modern Humans: biocultural adaptations in the later Pleistocene*. Cambridge: Cambridge University Press.

Whallon, R. 1989: Elements of cultural change in the later Palaeolithic. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 433–454. Princeton: Princeton University Press.

White, R. 1989: Production complexity and standardization in early Aurignacian bead and pendant manufacture: evolutionary implications. In *The Human Revolution: behavioural and biological perspectives on the origins of modern humans* (ed. P. Mellars & C. Stringer), pp. 366–390. Princeton: Princeton University Press.

White, R. 1993: Technological and social dimensions of "Aurignacian-age" body ornaments across Europe. In *Before Lacaux: the complex record of the early Upper Paleolithic* (ed. H. Knecht, A. Pike-Tay & R. White), pp. 277–300. Boca Raton: CRC Press.

Wiessner, P. 1983: Style and social information in Kalahari San projectile points. *American Antiquity* 48, 253–276.

Wobst, M. 1974: Boundary conditions for Paleolithic social systems: a simulation approach. *American Antiquity* 39, 147–178.

Wobst, M. 1976: Locational relationships in Paleolithic society. *Journal of Human Evolution* 5, 49–58.

Wobst, M. 1977: Stylistic behavior and information exchange. In *Papers for the Director: Research Essays in Honor of James B. Griffin* (ed. C.E. Cleland), pp. 317–342. Ann Arbor: Anthropological Papers, Museum of Anthropology, University of Michigan No. 61.

Wolpoff, M.H., Thorne, A.G., Smith, F.H., Frayer, D.W. & Pope, G.G. 1994: Multiregional evolution: a world-wide source for modern human populations. In *Origins of Anatomically Modern Humans* (ed. M. H. Nitecki & D. V. Nitecki), pp. 175–199. New York: Plenum Press.

Woodburn, J.A. 1982: Egalitarian societies. *Man* 17, 431–451.

Wynn, T. 1989: *The Evolution of Spatial Competence*. Urbana: University of Illinois Press.