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ARTICLES

The Impossible Coincidence. A Single-Species Model for the Origins of Modern Human Behavior in Europe

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Few topics in palaeoanthropology have generated more recent debate than the nature and causes of the remarkable transformation in human behavioral patterns that marked the transition from the Middle to the Upper Paleolithic in Europe.[1–11] Those of us who have argued for an effective technological and cultural "revolution" at this point in the Paleolithic sequence have emphasized three main dimensions[1,2,9,11–14]: the wide range of different aspects of behavior that appear to have been affected (Fig. 1); the relative speed and abruptness with which most of these changes can be documented in the archeological records from the different regions of Europe; and the potentially profound social and cognitive implications of many of the innovations involved. Most striking of all in this context is the abrupt appearance and proliferation of various forms of perforated animal teeth, shells, beads, and other personal ornaments, and the even more dramatic eruption of remarkably varied and sophisticated forms of art, ranging from representations of male and female sex organs, through the highly stylized animal and combined animal-human figures from southern Germany, to the striking wall paintings of the Chauvet Cave.[8,15–18] One might add to this the similar proliferation of more enigmatic but potentially equally significant abstract "notation" systems on bone and ivory artifacts.[19] To describe the Upper Paleolithic revolution in Europe as reflecting preeminently an explosion in explicitly symbolic behavior and expression is in no sense an exaggeration, as most prehistorians would now agree. We are probably on safe ground in assuming that symbolic behavior and expression of this level of complexity would be inconceivable in the absence of highly structured language systems and brains closely similar, if not identical to, our own.[5,17,20–28]

If we accept all of these social, symbolic, and cognitive implications of distinctively Upper Paleolithic behavioral patterns, then the issue of exactly how these patterns of behavior and the implied mental capacities they required emerged among European populations becomes one of the most critical issues in current evolutionary and cognitive research. Broadly, we are confronted by two fairly stark and sharply polarized alternatives: that these patterns of behavior and the implied levels of associated cognition emerged by a purely internal process of behavioral and cognitive evolution among the local European populations, extending directly through the European Neanderthal line; or, alternatively, that at least the majority of the new behavioral patterns, as well as the cognitive hardware necessary to support these innovations, was due to a major influx of new populations into Europe deriving ultimately from either an African or Asian source.[29,30] It is hardly necessary to stress the importance of this issue in evolutionary terms. If the Neanderthals *did* independently develop the whole range of behavior that traditionally has been regarded as the hallmark of fully "modern" humans, this would arguably be the most important thing we have learned about the Neanderthals since their original discovery more than 150 years ago. What follows is an attempt to review these two alternatives, as briefly as possible, in the light of the most recent archeological and biological research.

In a recent paper[31] I have attempted to explore the first of these scenarios from an explicitly Darwinian, evolutionary perspective, which puts the primary emphasis on the complex pattern of climatic and associated environmental changes that occurred in Europe around the middle of the last glaciation (the period of oxygen-isotope stage 3, from ca. 60,000–25,000 BP[32]) and the potential selective and adaptive effects of these environmental oscillations on the demographic, social, and other cultural patterns of the local Neanderthal

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populations (Fig. 2). Reduced to its bare essentials, this model assumes that the occurrence of major, rapid, and repeated environmental fluctuations could have precipitated repeated episodes of increased demographic and social competition between adjacent Neanderthal groups for both space and resources, which in turn would have imposed strong selective pressures on almost all aspects of their cultural and behavioral adaptations, leading to a range of associated patterns of technological, economic, and social change.[33] Arguably, an increased investment in various forms of symbolic expression and communication could be seen as one potentially direct evolutionary adaptation to cope with the increasing demographic and social pressures that emerged directly from the contemporaneous patterns of climatic and environmental change.[7,9,34,35] This model, of course, carries with it the automatic implication that all of the necessary intellectual and neurological capacities for these behaviors were either already present in the indigenous Neanderthal populations of Europe or that these capacities emerged, presumably as a result of one or more genetic mutations,[23,36] as a further direct evolutionary consequence of the various environmental, demographic, or other selective pressures to which the European Neanderthals were subjected.

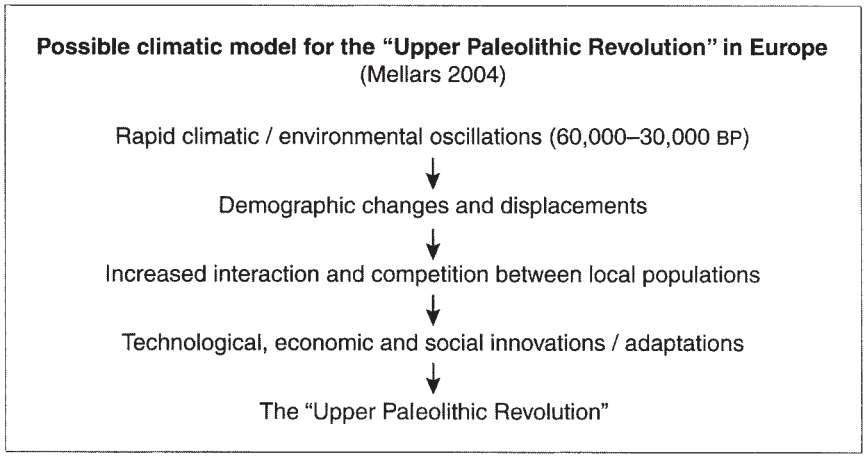

Figure 2. Possible climatic model for the "Upper Paleolithic revolution" in Europe,[31] based on potential technological and cultural adaptations to the rapid climatic oscillations of oxygen-isotope Stage 3.

Early Upper Paleolithic Innovations

1. Improved (punch-struck) blade and bladelet technology
3. New end-scraper and burin forms
4. Increased "imposed form" in tool manufacture (appearance of new "type-fossil" forms)
5. Complex, highly shaped bone, antler and ivory tools
6. Appearance of personal ornaments (perforated teeth, marine shells, shaped stone, and ivory beads)
7. Appearance of complex and varied art forms (engravings, sculptures, cave paintings)
8. Appearance of symbolic "notation" systems
9. New musical instruments (bird-bone flutes)
10. Long distance distribution and exchange networks (for marine shells, high quality stone, etc.)
11. Improved missile technology
12. Rapid changes in technological patterns
13. Increased population densities
14. More highly structured occupation sites
15. Increased "specialization" in some animal exploitation patterns

Figure 1. Early Upper Paleolithic behavioral innovations in Europe. For details, see Bar-Yosef,[1,2] Gamble,[12] Klein,[66] Mellars,[9,13,27,68,69] Kozlowski,[137] White,[15,16] Le Bon,[107] Conard and Bolus.[8]

Clearly, that kind of local evolutionary model represents an important theoretical perspective for the possible origins of Upper Paleolithic culture in Europe, and has been debated at various times and from a variety of different perspectives.[3,4,37–40] It was, of course, an essential and integral component of the multiregional or regional-continuity model of modern human origins that largely dominated this field throughout the 1960s and 1970s,[41] at much the same time as the strongly "processualist" notions of the New Archaeology and the strong reactions against large-scale diffusion and migration as an explanatory principle in accounting for prehistoric change. Recently, a similar viewpoint

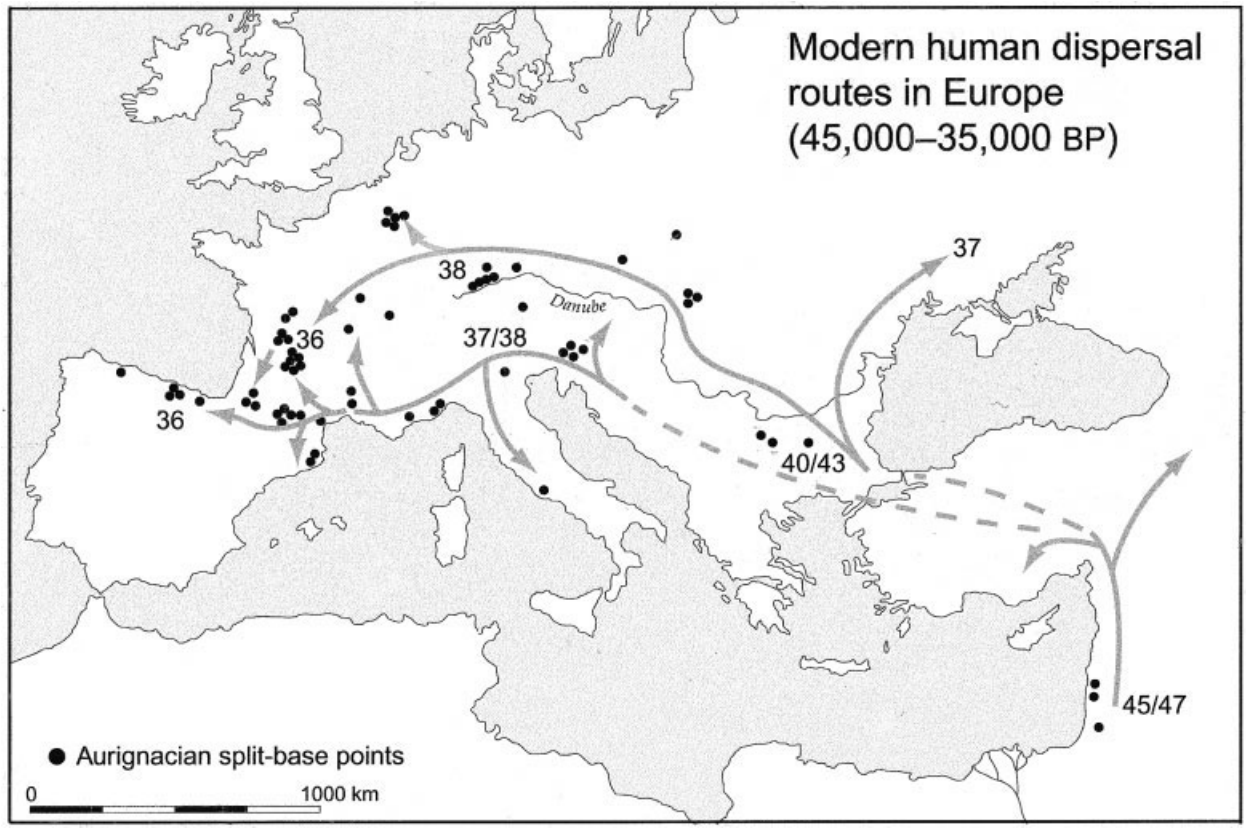

Figure 3. Apparent dispersal routes of the earliest anatomically and behaviorally modern populations across Europe, as reflected in the archeological data. The northern (Danubian) route is represented by the "classic" Aurignacian technologies, while the southern (Mediterranean) route is represented by the "Proto-Aurignacian" bladelet technologies with their inferred origins in the preceding early Upper Paleolithic technologies in the Near East and southeastern Europe.[56,60,71,107] Dates indicate the earliest radiocarbon dates for these technologies in different areas, expressed in thousands of radiocarbon years BP. (Note that these are likely to underestimate the true (calendrical) ages of the sites by between 2,000 and 4,000 years.[104–106])

has been argued strongly by Franceso d'Errico.[4]

Making the maximum possible allowance for these arguments, however, I continue to see a range of major obstacles to attempting to view these kinds of entirely local, indigenous evolutionary processes as providing more than, at best, a partial and inadequate explanation for the broad sweep of radical behavioral innovations that define the conventional Middle-Upper Paleolithic transition in Europe (Fig. 1). The problems, as I see them, stem from two separate sources: first, the spate of recent information on the anatomical and genetic origins and geographical dispersal of biologically "modern" populations; and second, a range of equally important developments in our understanding of the archeological evidence itself. The premise of what follows is that any fully balanced assessment of the problem of the emergence of "modern" behavioral patterns in Europe or elsewhere must be based on a closely integrated analysis of both these lines of evidence. While I fully agree with d'Errico that the biological and archeological evidence must, at certain levels, be treated separately and, in a sense, allowed to "tell their own stories," for any fully integrated perspective on modern human origins the separate dimensions of the archeological and biological evidence must inevitably be brought together. Stated bluntly, we simply cannot afford the luxury of allowing ourselves to look only at one side of the scientific coin if palaeoanthropology is to move forward as a fully integrated scientific discipline. From this perspective, the essential considerations, as I see them, can be summarized as follows.

THE CORRELATION OF BEHAVIORAL AND BIOLOGICAL CHANGE

The first and most conspicuous obstacle to the "independent-evolution" model for the origins of modern behavioral patterns in Europe stems from the extraordinary coincidence between the timing of the major behavioral innovations that define the classic Middle-to-Upper Paleolithic transition in Europe and western Asia and the generally agreed timing of the dispersal of anatomically and genetically modern human populations across the continent (Fig. 3). The evidence for this dispersal has been documented at length in the recent literature,[29,30,42] and rests on at least four separate and essentially independent lines of evidence:

1. The evidence of the mitochondrial DNA patterns of modern European populations, when analyzed in terms of "founder lineage" patterns, points to an initial dispersal of fully genetically modern populations (that is, with distinctively African-derived patterns of mtDNA) extending across Europe somewhere within the time range of ca. 40,000 to 50,000 BP,[43–45] best reflected in the distribution of the U5 haplogroup. It is now clear that all these patterns of mtDNA are radically different from those of the preceding Neanderthal populations in Europe, which have been shown from analyses of seven separate fossil samples to have mtDNA patterns that are totally lacking from both present-day European populations[45–47] and a sample of at least five early anatomically modern humans from Europe.[48,49]

2. A closely similar age estimate for the modern human dispersal across Europe was produced by Rogers and Jorde[50] and others from studies of mtDNA "mismatch" distributions. This again appears to show a major population expansion of genetically modern populations in Europe centred broadly around 40,000 BP.[51,52]

3. Analyses of Y-chromosome DNA patterns are less well calibrated in chronological terms than are those based on mitochondrial data and must be handled with caution. Nevertheless, studies of microsatellite and other data once again point to an initial expansion of modern DNA patterns across Europe (as represented by the M89/M213 lineages) at around 40,000 to 45,000 BP, with a subsequent expansion of the M173 lineage at around 30,000 BP.[53,54]

4. Evidence from fossil skeletal remains over the relevant time range is scarce and patchily distributed, but at least five or six discoveries point unmistakably to the presence of fully anatomically modern populations in both Europe and the adjacent parts of southwest Asia between ca. 30,000 and 45,000 BP.[55,56] Most significant in this context are the recently discovered remains of three separate individuals from the Peştera cu Oase cave in Romania, which have been directly dated by radiocarbon AMS techniques in two separate laboratories to 34,290 ± 900 BP and >35,200 BP.[57] Equally significant is the complete skeleton of a young individual from the early Upper Paleolithic "Ahmarian" levels at Ksar Akil in Lebanon, dated by radiocarbon and associated archeological material to well before 35,000 BP, and most probably around 40,000 to 42,000 BP.[58–60] There is also a fragmentary maxilla, said to be distinctively modern in morphology, from the early Upper Paleolithic levels at Kent's Cavern in England, which has been directly dated by AMS to 30,900 ± 900 BP.[55,61] Slightly less securely dated are the two modern crania from Mladeč in the Czech Republic, attributed, on the basis of ^{14}C dating of the associated calcite formations, to around 34,000 to 35,000 BP[62] and the two mandibles from Les Rois in southwestern France, apparently closely associated with the early Aurignacian levels on the site, again dating to around 32,000 to 34,000 BP.[63] From Kostienki site 14 (Markina Gora) in southern Russia, there is a burial of a fully anatomically modern skeleton dated to at least 30,000 to 32,000 BP.[64,65]

How do we account for the extraordinary coincidence between the timing of this population dispersal and the contemporaneous technological and cultural revolution that marks the Middle-Upper Paleolithic transition in Europe . . .

In short, we now have at least four essentially independent lines of evidence for a major dispersal of fully genetically and anatomically modern populations across Europe and western Asia somewhere within the range of 45,000 to 35,000 BP, that demonstrably and fairly rapidly replaced the preexisting Neanderthal populations.[29,42,49] The precision of the chronological estimates based on the DNA data remain open to some debate,[42] but the occurrence of unambiguous examples of fully anatomically modern, if fairly robust skeletal remains within this time span is now beyond dispute. This time range coincides precisely with that of the conventional Middle-Upper Paleolithic transition in Europe and with the broad spectrum of technological, symbolic, social, and other changes associated with this transition.[1,2,11,12] This clearly raises two critical questions:

- How could any major population dispersal of this kind fail to bring with it certain new technological or cultural elements, derived ultimately from regions beyond Europe, presumably from either Asian or African sources?
- How do we account for the extraordinary coincidence between the timing of this population dispersal and the contemporaneous technological and cultural revolution that marks the Middle-Upper Paleolithic transition in Europe, following a period of around 200,000 years of relative behavioral and technological stability throughout the preceding Middle Paleolithic period?[2,27,66] As I asked in an earlier paper, "Can we really believe that after a period of around 200,000 years of typically Middle Paleolithic technology and behaviour, the local Neanderthal populations in western Europe independently, coincidentally, and almost miraculously 'invented' these distinctive features of Upper Paleolithic culture at almost exactly the same time as anatomically and behaviourally modern populations are known to have been expanding across Europe?"[67] (p 44).

As indicated in the title of the present paper, this is what I am tempted to describe as the impossible coincidence in the parallel records of human biological and cultural development in Europe.

THE SCALE AND SPEED OF THE UPPER PALEOLITHIC REVOLUTION

The second significant feature to emphasize in this context is the dramatic scale of the so-called Upper Paleolithic revolution in Europe and the relative speed with which it oc-

curred. As noted earlier, the Middle-Upper Paleolithic transition is marked by changes in effectively all of the archeologically visible dimensions of behavior: radical innovations in both the forms and techniques of blade and bladelet production in stone tools; the sudden florescence of complex, varied, and highly shaped bone, antler, and ivory tools; the emergence of elaborate notation systems on bone and ivory artifacts; the appearance of extensive and organized exchange systems for the distribution of both raw materials and decorative prestige items; the effective explosion of perforated animal-tooth pendants, perforated marine shells, laboriously shaped stone and ivory bead forms, and other forms of personal ornaments; and the emergence of highly sophisticated and varied forms of both abstract and "naturalistic" art.[1,2,11,13–16] In addition, there were many more inferential but apparently closely associated changes in the economic, social, and demographic patterns of the human groups[2,9,12,68,69] (Fig. 1). Not only are all these features conspicuously absent from well-documented Middle Paleolithic contexts in Europe, as d'Errico[4] has recently stressed, but they show a close correlation, for the most part, with the distribution of various forms of distinctively Aurignacian and "Proto-Aurignacian" technologies across the continent, generally between ca. 40,000 and 35,000 BP.[8,11,56,70,71]

There is a sharp contrast between the relative speed and abruptness with which all of these novel technological and cultural features appear in the archeological records of Europe and the apparently more gradual, piecemeal fashion with which similar innovations appear in the archeological records of Africa. In short, any attempt to explain the Upper Paleolithic revolution in terms of purely local evolutionary processes in Europe would need not only to account for the impressive range and scale of the cultural changes in question, but to explain why these changes appear so much more rapidly in the archeological sequence of Europe than in that of Africa.

THE AFRICAN EVIDENCE

Our knowledge of the archeological evidence from Africa over the Upper Pleistocene time range has expanded dramatically during the past two decades.[5–7,66,72–74] On the basis of this new evidence it is now possible to show beyond any reasonable doubt that many of the most distinctive archeological hallmarks of the classic Middle-Upper Paleolithic transition in Europe can be documented at least 30,000 to 40,000 years earlier in certain parts of Africa than anywhere within Europe itself. In this context, the evidence reported recently from the so-called Howiesons Poort levels at Klasies River Mouth in South Africa, dated on the basis of several lines of evidence to around 70,000 BP,[72–75] and the evidence from the slightly earlier Still Bay levels at the nearby Blombos Cave (ca. 75,000 to 80,000 BP)[76–79] are especially significant. Leaving aside the occurrence of standardized blade technology, which is now known to occur sporadically in Middle Paleolithic/Middle Stone Age contexts back to at least 200,000 to 250,000 BP in both Africa and Europe,[2,6,27,80] this evidence can be summarized as follows:

. . . it is now possible to show beyond any reasonable doubt that many of the most distinctive archeological hallmarks of the classic Middle-Upper Paleolithic transition in Europe can be documented at least 30,000 to 40,000 years earlier in certain parts of Africa than anywhere within Europe itself.

1. The occurrence of relatively abundant and highly typical specimens of both end scrapers and burins, to all appearances identical to those encountered in European Upper Paleolithic sites[75] (Fig. 4). Even if rare specimens of burins have occasionally been claimed from the European Mousterian, fully typical specimens of end scrapers are at best a very rare and debatable occurrence.[81,82] The appearance of new end-scraper forms most probably reflects the emergence of new forms of skin-working technology, while the appearance of burins may or may not be directly related to the appearance of shaped bone tools at Blombos and other African sites.

2. The appearance of a range of carefully shaped small geometric forms, evidently employed as insets in multi-component hafted tools (Fig. 4). The highly varied geometrical shapes encountered in the Howiesons Poort industries at Klasies River Mouth and elsewhere (triangles, trapezes, crescents, and obliquely blunted points) not only reflect a high degree of deliberately "imposed form" in stone tool production, with possible social and symbolic connotations, as discussed by Wurz,[83] Deacon,[73] and others, but almost certainly reflect the appearance of new forms of multi-component tools employed as either hunting missiles or, possibly, as hafted insets for plant-processing tools.[74,75] The design complexity of these tools is unquestionably far greater than that of the occasional specimens of hafted Mousterian points recorded from the Eurasian Middle Paleolithic.[4] It should be added that the a large part of the lithic industry at Klasies River Mouth is manufactured on high-quality raw materials deliberately imported into the site from a distance of at least 20 km,[74] a feature that is again hard to parallel in European contexts before the earliest Upper Paleolithic. All in all, there is no doubt that at least the greater part of the industry from Klasies River Mouth would be unhesitatingly classified as technologically "Upper Paleolithic" if found in a European or southwest Asian context.

3. The appearance of extensively shaped bone tools, exhibiting once again not only a clear degree of imposed form but a complex sequence of manufacturing stages to shape and polish the tools. The best-described specimens are those from the Still Bay

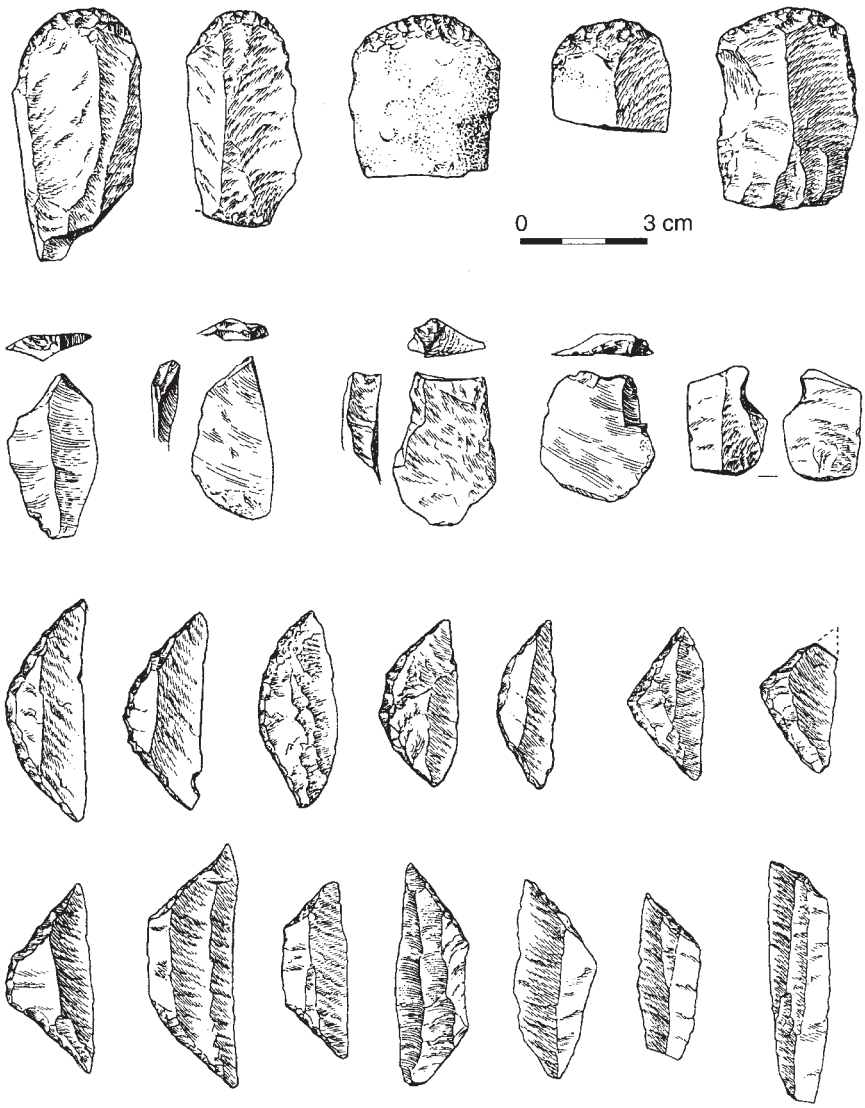

Figure 4. Stone tools from the Middle Stone Age Howiesons Poort levels at Klasies River Mouth, South Africa (ca. 70,000 BP), showing typical end scrapers, burins, and shaped "geometric" forms manufactured from blade segments, probably representing hafted inserts of composite hunting armatures (modified from Singer and Wymer[75]).

levels at Blombos cave, where they apparently served a range of functions, from sharply pointed awls and leather-piercing tools to carefully finished and polished projectile points.[77] Similar shaped bone tools have been recorded more sporadically from other African Middle Stone Age sites.[4,6] If the dating of the highly shaped barbed bone points recovered from three separate sites at Katanda in former Zaire can be securely attributed to around 90,000 BP,[84,85] the levels of complexity of bone working achieved in these early African sites will parallel anything at present known from the European Upper Paleolithic sequence. As d'Errico[4] has recently stressed, extensively shaped bone tools of any form are as yet effectively unknown from well-documented Middle Paleolithic sites in Europe.

4. The occurrence of large quantities of red ochre (including over 8,000 pieces from the Still Bay levels at Blombos) including many pieces with smoothed facets or deliberately scraped surfaces, which almost certainly imply their use as coloring pigments.[76,77] The presence of geometrical designs incised on at least two large pieces of ochre from Blombos seems to confirm their role in certain explicitly symbolic or ceremonial activities.[78] Similar use of ochre is, in fact, abundant in many African Middle Stone Age sites, apparently extending back, at the Twin Rivers site in Zambia and the Kapthurin sites in Kenya, to at least 250,000 BP.[6,86,87] Whatever significance one may attach to the sporadic occurrence of black manganese dioxide and occasional fragments of ochre at European Mousterian sites,[4] it is clear that the scale of this red ochre use at African sites vastly exceeds that recorded anywhere in Europe prior to the Upper Paleolithic.

5. Most significant of all, the occurrence of a range of explicitly "artistic" or "decorative" items, for which an interpretation in terms of complex symbolic communication systems now seems beyond question. The most significant finds are the two large pieces of red ochre incised with complex and repeated criss-cross designs recently reported from the Still Bay levels at Blombos.[77] These are now generally recognized as the earliest fully convincing examples of deliberate and repeated design motifs recorded anywhere in the world, certainly exceeding anything at present known from Mousterian or earlier contexts in Europe. Recently, the significance of these finds has been graphically underscored by the recovery from the same archeological levels of no less than 41 specimens of carefully perforated seashells (*Nassarius kraussianus*), which were apparently introduced into the site from estuarine contexts at least 20 km away from the site and, on the basis of microscopic analyses, were intended for suspension from cords or thongs[79] (Fig. 6). Even earlier occurrences of perforated marine shells have been reported from the 90,000-year-old Middle Paleolithic levels of the Qafzeh cave in Israel, where they were associated with a veritable cemetery of essentially anatomically modern human remains, including at least one in the form of a clearly ceremonial burial accompanied by red ochre and a large pair of deer antlers.[88,89] The latter finds, together with those from the nearby site of Skhul, presumably reflect a brief expansion of anatomically

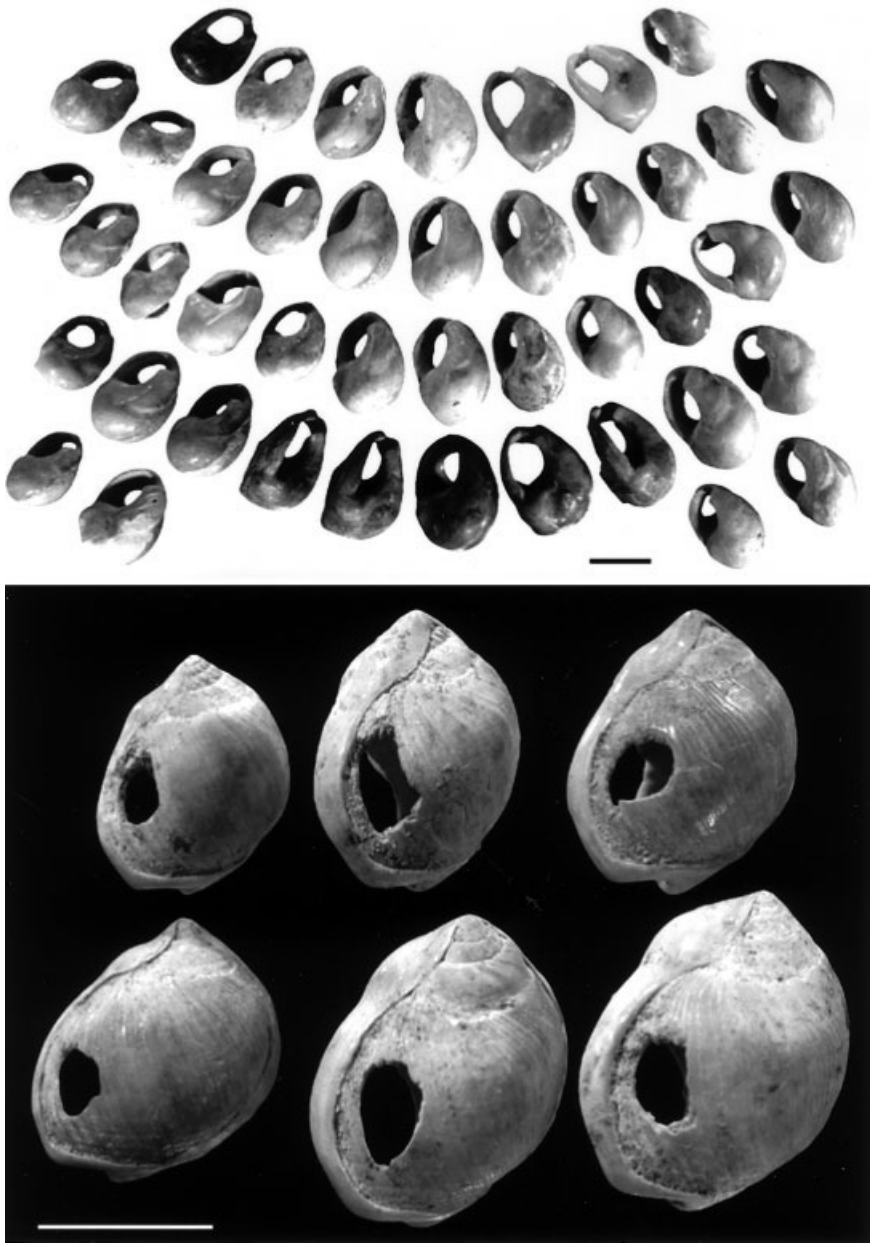

Figure 5. Perforated shells of *Nassarius kraussianus* from the Still Bay levels at Blombos Cave, South Africa, dated to ca. 75,000 to 80,000 BP (reproduced with permission from Henshilwood et al., Middle Stone Age shell beads from South Africa. Science 304:404. 2004 AAAS).

modern populations from Africa to the adjacent parts of southwest Asia at an early stage in the last glaciation.[29,30,60] At present, these finds rank as the earliest unambiguous examples of "personal ornaments" recorded in the archeological record, and again are without parallel from European sites prior to ca. 40,000 BP. In short, the appearance of complex social or symbolic communication systems by at least 80,000 to 90,000 BP in southern Africa and the Levantine region must now be accepted as a well-documented feature of the archeological record.

To summarize, we now have seemingly unambiguous evidence that at least the majority of the most distinctive and widely discussed archeological features of the so-called Upper Paleolithic revolution in Europe can be firmly documented in the archeological records of Africa by at least 70,000 to 80,000 BP, long before their occurrence in Europe (Fig. 6). Exactly how we interpret these features in cultural and cognitive terms will no doubt remain the topic of lively debate. There will no doubt be similar debate as to how far we can trace direct continuity of these features between the African sites dated to around 60,000 to 70,000 BP and the earliest manifestations of fully Upper Paleolithic culture in Europe and western Asia at around 40,000 to 45,000 BP. Perhaps the main point to be kept in mind here is that Africa is an extremely large and ecologically varied continent, and that, as Richard Klein[5,66] and others have recently stressed, well-documented archeological sites spanning the critical period between ca. 60,000 and 45,000 BP are still virtually lacking in most parts of Africa. Certainly sites showing a similar combination of blades, end scrapers, small "segment" forms and carefully shaped ostrich eggshell beads are well documented from at least 40,000 BP at sites such as Enkapune ya Muto in East Africa,[90] and may extend back to 50,000 to 60,000 BP at Mumba and elsewhere.[6,74] And of course the precise geographical source area (or areas) from which the small founder populations of anatomically and genetically modern humans colonized Europe and western Asia from ca. 45,000 to 50,000 years onward remains to be established.[60,91] But in any event, the occurrence of a wide range of distinctively "modern" (or indeed "Upper Paleolithic") behavioral features at a much earlier date in the continent that is known to have given rise to the evolution of anatomically and genetically modern populations can hardly be dismissed.[29,42,92] As I have commented elsewhere,[93] to ignore these striking and well-documented similarities between the Middle Stone Age archeological records of Africa and the early Upper Paleolithic records of Western Eurasia would be to take a strangely short-sighted view of the archeological evidence as a whole.

CHRONOLOGICAL PATTERNS

Finally in this context we should note what appears to be a more gen-

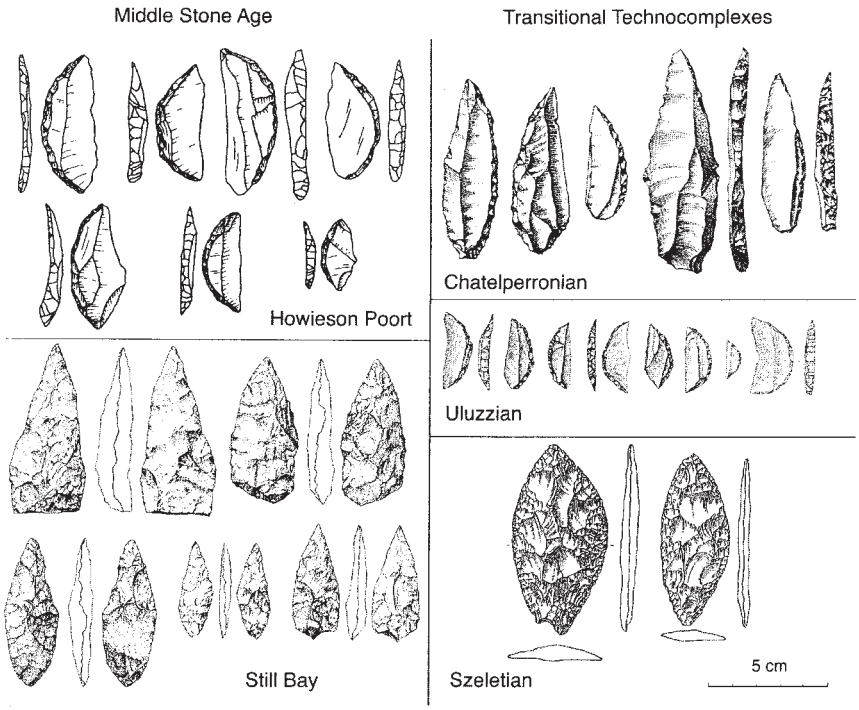

Figure 6. Comparison of artifacts from early Upper Paleolithic "transitional" levels in Europe and later Middle Stone Age levels in South Africa. Note that the South African forms are approximately twice as old as the typologically and technologically similar European forms (modified from d'Errico[4]).

eral chronological cline in the dispersal of early Upper Paleolithic culture across Europe and western Asia[11,56,60,70] (Fig. 3). From southwest Asia there is evidence of a relatively sudden and sharply defined transition from typically Middle to typically Upper Paleolithic technology; (marked by a proliferation of blades, end scrapers, burins, and new "type fossil" forms, together with a range of perforated shell ornaments) radiocarbon dated at the two sites of Boker Tachtit in southern Israel and Ksar Akil in Lebanon to around 45,000 to 47,000 BP.[1,35,60] The date of a similar transition in southeastern Europe, as at Bacho Kiro and Temnata in Bulgaria, seems to center on ca. 40,000 to 43,000 BP, while in western Europe there is no evidence of any substantial, analogous shift in technology until ca. 38,000 to 40,000 BP, in the form of the earliest Aurignacian and "Proto-Aurignacian" technologies.[1,2,8,11,56,60,71,94] If there is indeed a significant chronological cline in the appearance of distinctively Upper Paleolithic technology from east to west across Europe, and with a much earlier emergence of similar features in Africa, this would accord much better with the hypothesis of a gradual dispersal or diffusion of these technological elements (regardless of whether carried by new populations) than with a totally independent evolution of the same features within the individual regions of Europe.

Clearly, there is a further potential paradox inherent in the independent origin model here. If the argument is that characteristically Upper Paleolithic technology and culture developed entirely independently in several different regions of Europe, as reflected by the Chatelperronian in France, the Szeletian in Central Europe, and the Uluzzian in Italy, then this would require an extraordinary degree of convergent and simultaneous evolution in the patterns of technological development within these different regions. If, on the other hand, the assumption is that large-scale intercommunication and transmission of technology between these different areas accounts for these convergent patterns of development, this would imply large-scale technological diffusion among the later Neanderthal communities extending effectively across the whole of Europe and, presumably, the adjacent Middle East.[3,4,40] But in the latter case, of course, it is difficult to see how one could exclude the possibility that these technological diffusion processes originated in the gradual dispersal of anatomically and behaviorally modern populations from outside these regions—that is, ultimately from adjacent Asian or North African sources. As I will discuss further, this is what I would refer to as the inevitable "bow-wave" effect of technological and cultural diffusion extending some way in advance of the actual dispersal of anatomically modern populations into the different regions of Europe.

The final and perhaps most puzzling aspect of the local-origins model lies in the ultimate fate of the Neanderthals. Proponents of the local-origins model would, of course, dispute the notion that there was any inherent cognitive or intellectual superiority of the biologically modern populations over those of the Neanderthals. They would also argue that most if not all of the technological and symbolic innovations that traditionally have been credited to the dispersal of modern populations had already been developed independently among the final Neanderthal communities, according to the multiple-species model for the origins of behavioral modernity.[3,4,40] But this, of course, immediately and inevitably begs the question of exactly why and how the Neanderthals declined so rapidly to extinction in the face of the modern human dispersal across Europe. This question becomes even more acute if we bear in mind the fact that the Neanderthals were the product of at least 200,000 years of biological and behavioral adaptation to the demanding glacial and periglacial environments of Europe, whereas the intrusive modern populations had evolved in biological, anatomical, and presumably behavioral terms to the massively different tropical and subtropical environments of sub-Saharan Africa.[5,29,30,95] Stated crudely, if the European Neanderthals were so cognitively advanced and had developed most if not all of the elements of char-

acteristically "modern" culture and cognition, why did they succomb so rapidly to a biologically and environmentally less well adapted species within a space of, at most, a few thousand years?[96]

DISCUSSION

My overall conclusion is that whatever weight we may attach to the capacity of the climatic and environmental oscillations of OIS-3 to foster adaptive changes in the behavioral patterns of later Neanderthal communities, this still remains at best a highly inadequate explanation to account for the broad range of radical technological, social, and cognitive changes that define the classic Middle-Upper Paleolithic transition in Europe and western Asia. I certainly am not suggesting that the technological and cultural adaptations of Neanderthal populations were static throughout this period. Inevitably, there would have been significant adaptations in both the technology and economic patterns and, no doubt, the related social organization of the human groups in response to the many episodes of climatic change throughout the 200,000-year span of the Middle Paleolithic sequence, as I have discussed in detail elsewhere.[27,31] The critical objections to a strictly *in situ* model for the emergence of fully Upper Paleolithic culture in Europe remain simply those of the radical scale and complexity of the behavioral changes involved, the clear evidence for the emergence of most if not all of these features at a much earlier date in Africa than in Europe (in close association with the biological emergence of our own species), and what I have described as the extraordinary "coincidence" that all of these behavioral innovations appear in the archeological records of Europe and western Asia at almost precisely the same time as the well-documented expansion of anatomically and genetically modern populations across these regions, with a clear chronological cline in the appearance of these elements from east to west across the continent (Fig. 3). As I discussed earlier, is it really plausible that the dispersal of an entirely new population across Europe, by groups who are generally now seen as a separate biological species from the Neanderthals,[29,97] would not bring with it some new behavioral elements derived ultimately from either African or Asian sources? And if the Neanderthals independently developed all of these features, why did they so rapidly become extinct in the face of a biologically and environmentally less adapted species?

Interaction Scenarios

One element that is, of course, implicit and inescapable in any model of modern human dispersal across Europe is the occurrence of various forms of contact, and therefore potential interaction, between the expanding *sapiens* and indigenous Neanderthal populations across effectively the whole of the continent. These contacts must have been repeated and must have occurred in all the areas occupied by Neanderthals at the time of the modern human dispersal. One critical and unavoidable issue in any consideration of modern human dispersal must therefore be the precise nature of these interactions between Neanderthals and modern humans and their potential reflections in the archeological records of the different regions of Europe.

. . . if the European Neanderthals were so cognitively advanced and had developed most if not all of the elements of characteristically "modern" culture and cognition, why did they succomb so rapidly to a biologically and environmentally less well adapted species within a space of, at most, a few thousand years?

There is hardly space here to rehearse all of the long-running debates over potential contact and related "acculturation" scenarios between Neanderthals and modern humans that have occupied much of the archeological literature on modern human origins over the past decade.[3,4,10,98–102] Ultimately, many of these debates will rest heavily on the accuracy and precision of the associated dating evidence, which, in the case of radiocarbon dates in the region of 30,000 to 40,000 BP are notoriously problematic, due mainly to the massive problems of contamination effects in this time range,[103] and to the current uncertainties over the precise patterns of atmospheric ^{14}C fluctuations and their effects on associated calibration curves.[104–106] It is now apparent that many of these uncertainties will not be resolved decisively in the immediate future.

The one point that is now clear is that in the case of the best-documented and most widely discussed of these acculturation scenarios, the French Chatelperronian, the totality of the available dating evidence from radiocarbon, thermoluminescence, uranium-series, electron-spin-resonance, and other methods now leaves no significant room for doubt that at least the greater part of the Chatelperronian development in central and western France, including the much debated levels from Arcy-sur-Cure, must be seen as broadly contemporaneous with the presence of various forms of "Aurignacian" technologies and associated anatomically modern populations in the adjacent areas of both Central Europe and, almost certainly, along the Mediterranean coast and northern Spain.[8,10,56,67,107] The available radiocarbon dates for the Chatelperronian levels at Arcy-sur-Cure cluster around 33,000 to 35,000 BP, and are reinforced by the results of radiocarbon, thermoluminescence, and electron-spin-resonance dating from a range of other sites, including St. Césaire, Les Cottés, Le Moustier, Combe Saunière, Roc de Combe, and Grotte XVI, all of which put the time range of the Chatelperronian back to, at most, ca. 39,000 to 40,000 BP in uncalibrated radiocarbon terms.[10,67,108] By comparison, we now have multiple radiocarbon dates for clear occurrences of early Aurignacian technology from the sites of

Geissenklösterle (level III) and Keilbergkirche in Germany, and Willendorf (levels 2 and 3) in Austria, clearly within the time range of 36,000 to 39,000 BP. These points have now been documented clearly in recent papers by Conard and Bolus,[8] Conard, Dippon, and Goldberg,[109] Haesaerts and Teyssandier,[110] and Richter and coworkers.[111] And from France itself, we now have a series of ^{14}C dates for early Aurignacian levels ranging between 35,000 and 37,000 BP, with the possibility of even earlier dates for the currently undated bladelet Aurignacian level (layer K) at the base of the long Aurignacian sequence at Le Piage.[67,107] Even if we set aside the disputed interstratifications of Aurignacian and Chatelperronian levels in three separate French sites (Le Piage, Roc de Combe, and Chatelperron itself)[112] there can be no serious doubt that the greater part of the Chatelperronian sequence in France, including the occurrence of simple bone tools and associated grooved or perforated animal-tooth pendants at Arcy-sur-Cure, are contemporaneous with the presence of both Aurignacian technologies and apparently associated anatomically modern populations in the closely adjacent areas of Central Europe. Similarly, there can be no doubt that distinctively "proto-Aurignacian" bladelet industries were being manufactured at the Abri Fumane and other sites along the Mediterranean coast at broadly the same date, between ca. 36,000 and 39,000 BP.[10,67,113–115]

The critical question in this context is exactly what significance we should attach to the presence of these simple bone tools and animal-tooth pendants in the Chatelperronian levels at Arcy-sur-Cure and, in a few isolated cases, in other French Chatelperronian sites. As I have discussed elsewhere,[10] the Neanderthals were clearly expert craftsmen. The ability to shape simple bone tools or to incise grooves or perforations in the roots of animal teeth would have posed little challenge to groups who could shape wooden spears or produce elegantly controlled Levallois points or cordiform bifaces, given the opportunity to observe these technologies (or their products at first hand).[102] Clearly, the critical issue is whether the production and use of these items carried precisely the same social and cultural *meanings* among the final Neanderthal communities of western Europe as they did among the intrusive populations of biologically and behaviorally modern people. The alternative, of course, is that these artifacts served as various forms of personal or sexual display or prestige behavior within the social and demographic context of the late Neanderthal communities and in this way played a vital role in their demographic selection and competitive strategies.[10,17,116] As I have commented elsewhere,[10] if the earliest anatomically modern populations arrived in western Europe manufacturing complex bone and antler tools and wearing a variety of personal ornaments and other items of social display, as demonstrably they did, then some exchange or replication of these behaviors by the local Neanderthal groups would seem an inevitable and totally predictable reaction, as observed in effectively all recent contact situations between indigenous and intrusive, more technologically "advanced" groups. Put differently "in a contracting, competitive, late Neanderthal world, it may have been precisely the ability to copy the habits or appearance of the new, intrusive groups which conveyed increased social or personal prestige, or even improved mating success, within the local or regional groups. If this were the case, then this could have had a critical impact on the evolutionary survival strategies of the final Neanderthal groups"[67] (p 44). The exchange, of course, is unlikely to have been a one-sided process; it is equally predictable that several other aspects of behavior, such as specific hunting strategies or the use of new raw-material supplies would have been exchanged between the Neanderthals and the incoming modern groups. In this sense the word "acculturation" should perhaps be abandoned, if only because of its potential to be misrepresented in social or socio-political terms.[40] But to assume that some exchange of technology between the indigenous and intrusive populations necessarily implies identical social and cognitive meanings for the technological elements involved would not simply be logically unwarranted, but positively bad anthropology, as numerous ethnographic and anthropological studies of recent ethnic contact situations have revealed.[117] To argue in these terms seems to me not so much reactionary, hidebound, and politically incorrect conservatism, as Zilhão[40] has recently suggested, but the most balanced and economical way of accounting for the totality of the available archeological, biological, and chronological data.

. . . if the earliest anatomically modern populations arrived in western Europe manufacturing complex bone and antler tools and wearing a variety of personal ornaments and other items of social display, as demonstrably they did, then some exchange or replication of these behaviors by the local Neanderthal groups would seem an inevitable and totally predictable reaction . . .

Needless to say, one would not expect the transfer of technology between the *sapiens* and Neanderthal populations (or vice versa) to involve exact replication of the various technological elements in question. Each element would, no doubt, be assimilated and integrated into the recipient communities in terms of their own preexisting technological practices and ideological structures.[102,117] This is clearly apparent in both the lithic technology and the majority of bone artifacts of the late Chatelperronian groups, neither of which replicates

precisely those of the earliest Aurignacian populations. Nevertheless, Randall White[118] has shown that certain specific elements of the nonlithic artifacts from Arcy-sur-Cure do exhibit such specific similarities to those from nearby Aurignacian sites (such as the frequent use of fox canines as personal ornaments and the presence of distinctive bone tubes and ivory ring-like forms) that probability that these forms originated entirely independently in the two groups seems virtually inconceivable. While many of the bone artifacts at Arcy-sur-Cure can reliably be shown to have been produced on the site,[3] the possibility of an actual exchange of certain items such as personal ornaments between the Chatelperronian and Aurignacian groups can in no way be ruled out, as Hublin[98] and others have stressed. The possibility that these exchanges involved some limited degree of interbreeding between the two populations cannot be ruled out from either the DNA or skeletal evidence[29,47,49] and should also be taken into account.

In this context, one should recall Francesco d'Errico's[4] recent suggestion that "it may have been precisely the new situation involving contact between anatomically modern people and Neanderthals, and the consequent problems of cultural and biological identity, that stimulated an explosion in the production of symbolic objects on both sides." While this suggestion seems to me astute and potentially highly germane to the present discussion, it is, of course, a specifically interactive model, which implies and assumes a close contemporaneity and direct interaction between the two groups. It is frankly difficult to visualize in this situation how one would ever discriminate definitively between the independent-evolution model versus acculturation scenarios for the emergence of distinctively Upper Paleolithic features among the final Neanderthal populations.

"Bow-Wave" Diffusion Effects

All of these arguments about direct interaction or acculturation effects of course rest heavily on the detailed space-time patterning of the final Neanderthal and earliest anatomically modern populations, and on the accuracy and precision of the associated dating evidence. There is, however, a further major factor to be taken into account in this context, which might be most conveniently referred to as the ripple or "bow-wave" effect of cultural and technological diffusion, potentially extending well in advance of the actual dispersal of behaviorally and anatomically modern populations across Europe.[10,31] The premise, quite simply, is that among the later Neanderthal populations of Europe there must inevitably have been various forms of communication or interaction between geographically adjacent groups. Whether visualized in terms of systems of local mate exchange or the exchange of flint or other raw materials,[12,119,120] these linkages are likely to have provided potential channels of communication for particular elements of technology or technological innovations extending across large areas of Europe, and potentially between communities that were only distantly related in social and demographic terms. These "chains of connection" as John Mulvaney[121] has described them, have been widely documented among recent hunter-gatherer groups, and are known to have carried both technological ideas and particular elements of material culture, such as prized species of marine shells and especially valued raw materials, over distances of several hundred and, in some cases, thousands of kilometres.[122] Similar patterns can be seen in the diffusion of specific elements of European technology, such as metal knives, guns, and horse transportation, among the native populations of North America and Canada at the time of European contact.[117] One critical factor in the rate of dispersal of any technological innovations of this kind would presumably have been the relative functional efficiency of the innovations in question in comparison with the preceding Middle Paleolithic techniques. But it is not difficult to visualize how certain technological elements that had strong adaptive advantages, such as new forms of skin-working technology, reflected in the use of new end-scraper forms, or simple forms of bone and antler technology, could have dispersed in this kind of "bow-wave" diffusion process well in advance of the dispersal of anatomically modern populations into the more central and western parts of Europe. Once again, such patterns are not merely plausible, but arguably inevitable and predictable in the social and demographic context of the late Neanderthal groups. To describe this kind of diffusion process as "acculturation" may or may not be appropriate. But it could well have served as an important factor in the earliest appearance of certain distinctively Upper Paleolithic elements of technology over many areas of western Asia and Europe in the period between ca. 45,000 and 35,000 BP.

. . . among the later Neanderthal populations of Europe there must inevitably have been various forms of communication or interaction between geographically adjacent groups.

"Contextual" Factors in Early Modern Culture

All expressions of human culture are, of course, ultimately dependent not only on the underlying cognitive and technological repertoires of the societies involved, but also on their interaction with purely local conditions of various environmental factors, population densities, and so on.[9] Recently there has been considerable debate on the contribution of these so-called contextual factors in the varying geographical expressions of early "modern" culture, centering on the archeological records of both Africa and Europe.[5,7,8,73] In southern Africa, most of the debate has focused on how the archeological expressions of new cultural and cognitive patterns may have been influenced by chang-

ing population densities of local communities and the potential impact of these episodes of population increase or decrease on local social and economic patterns.[5,7,72,73] It goes without saying that these local contextual factors can be invoked only in contexts where both the innate cognitive capacities for particular patterns of behavior and the essential technological expertise for the behaviors in question are already present in the populations involved.

These factors, however, may be central to understanding the varying expressions of characteristically early Upper Paleolithic culture in different regions of Europe and Western Asia. It has often been suggested, for example, that the earliest stages of the Upper Paleolithic sequence in the Middle East and parts of Mediterranean Europe are poorly equipped in terms of bone and antler technology.[39] In reality, this is a considerable overstatement, since a wide range of bone and antler artifacts are well represented in the early Aurignacian levels at Hayonim, Kebara Cave, and elsewhere in Israel, dated to around 34,000 to 36,000 BP[60,123] and in the similar Aurignacian levels (before 32,000 BP) at Ksar Akil in Lebanon.[124] But in these areas, where a large part of the food supply was almost certainly derived from plant foods rather than animal resources, and where wood is likely to have been far more readily available for tool manufacture than in contemporary sites in most of northern and western Europe, a reduced emphasis on bone and antler for tool production is no doubt largely predictable in environmental terms. The same could be said of many parts of southern and Mediterranean Europe, where early Upper Paleolithic bone tools are similarly relatively sparse.

Conard and Bolus[8] have recently argued that similar environmental factors are likely to have been effective in the emergence of highly complex forms of bone, antler, and ivory technology in the early Aurignacian sites in southern Germany, and perhaps also in the florescence of both personal ornaments and the impressive mobiliary art objects from sites such as Vogelherd, Geissenklösterle, and Hohlenstein Stadel. In brief, their argument is that local climatic and ecological conditions in this region could have fostered relatively high densities of local populations, which may have been largely sedentary over at least part of the annual cycle. By analogy with the behavior of recent hunter-gatherer groups in similar arctic and periglacial environments, such as the Inuit, it could be argued that this could well have fostered more complex patterns of both technology and various kinds of ceremonial than those practiced by groups in more temperate or forested environments.[34,125,126] One could add to their arguments that a strong focus on specifically animal-centered art and technology would hardly be surprising among groups who are likely to have been almost entirely dependent on animal resources for their daily and annual food supplies. It is therefore unlikely to be a coincidence that the most technologically and artistically complex expressions of Aurignacian culture in Europe are found in the most northerly, periglacial parts of its geographical range. Jochim,[127] I,[128] and others have suggested similar environmentally related factors for the extraordinary concentration of both Upper Paleolithic cave and mobiliary art within the densely occupied regions of southwestern France, the Pyrenees, and Cantabrian Spain. In my view, none of this detracts from the striking uniformity of most aspects of early Upper Paleolithic culture over large areas of Europe and the adjacent Middle East, as reflected above all in the widespread distribution of the highly distinctive Aurignacian and Proto-Aurignacian technologies.[11,56,70,71,129] But we should certainly not fall into the trap of expecting to find an identical expression of these early forms of Upper Paleolithic culture over the whole of the highly environmentally diverse regions of Europe and southwest Asia. It goes without saying that even greater technological, economic, and social adaptations would be expected in the preceding dispersal of anatomically modern populations from Africa to the vastly differing environments of western and northern Eurasia.[93] When allowance is made for these factors, the broad similarities of many aspects of early modern technology and culture extending from the southern tip of Africa to the Atlantic coast of western Europe becomes, arguably, even more remarkable.

The Human Revolution?

In conclusion, we might ask what relevance all of this has to the notion of an "Upper Paleolithic Revolution" associated with the appearance of modern humans in Europe or, indeed, a more general "human revolution" associated with the emergence of our species as a whole, both of which have generated lively debate in the recent literature.[1,2,5–7,73] Clearly, there has been confusion in some of the recent discussions of these issues. Those of us who have argued for the notion of an effective revolution in human behavioral patterns over the period of the conventional Middle to Upper Paleolithic transition in Europe and western Asia have always tried to make it clear that we were visualizing this phenomenon essentially as a before-and-after scenario, associated directly with the appearance of new populations in Europe and deriving ultimately from regions beyond Europe, in the ways discussed in the earlier part of this paper.[1,2,9,14,90,116] In other words, this pattern could be seen as a revolution in terms of its reflection in the archeological records of the classic Middle to Upper Paleolithic transition, but emphatically not as implying an autochtonous, *in situ* evolution of these behavioral patterns within Europe itself. My own publications from 1989 onward have always tried to make this implication clear. Whether this behavioral revolution originated in some closely adjacent core area, such as the Nile valley or Northeast Africa, or in more distant parts of Africa remains the central element in most of the recent debates.[1,2,5,6,9,90,93]

How far we choose to visualize what happened in Africa as reflecting a revolution seems to me largely a question of semantics and, no doubt, personal taste. McBrearty and Brooks[6] were quite right to stress the contrasts between the archeological records of Europe and those of Africa in this context in their influential paper entitled, engagingly, "The Revolu-

tion That Wasn't." Indeed, I had tried to make the same points myself in 1989, when I discussed in detail the archeological records from Klasies River Mouth and elsewhere showing a much earlier emergence of many distinctively "modern" (or even Upper Paleolithic) technological features in southern Africa than in Europe or the Near East.[130] Subsequent discoveries at the Blombos Cave and elsewhere have only served to underscore this point.

Whether or not the whole notion of "revolutions" in early human development (or, indeed, in more recent phases of prehistory) is of any value in this context could no doubt be debated at some length, as Ofer Bar-Yosef[1,2] has recently discussed very effectively. But it could certainly be argued that discoveries over the past few years have pointed to a much more rapid emergence of many of the most widely accepted hallmarks of supposedly modern behavioral patterns in Africa than was apparent even a decade ago. From the combined discoveries at Klasies River Mouth and the Blombos Cave, for example, we can now show that at least six or seven of the most striking features of "modern" technology had appeared in this region of southern Africa over, at most, ca. 10,000 years. As discussed earlier, these include typically Upper Paleolithic end scraper and burin forms, extensively shaped bone tools, large-scale transport of high-quality raw materials, carefully shaped insets for multi-component hafted tools, clearly imposed form (or "style") in tool manufacture, abundant seashell ornaments, and the earliest unambiguous examples of complex design or "abstract-art" motifs (Figs. 4–6). Interestingly, these include most of the features that Henshilwood and Marean[7] have recently discussed in their "trait list" of conventionally modern behavioral features. While they apparently attribute this list to an article I published in 1973,[68] it should be recalled that this was never intended as more than an empirical contrast between the archeological records of the Upper versus Middle Paleolithic in one small area of Europe, the classic Perigord region of southwestern France. It was never intended or presented as any kind of global characterization of "modern" behavioral patterns across Europe as a whole, let alone on a more intercontinental scale! To find most of the elements on this 30-year-old French "trait list" cropping up in the archeological records of southern Africa between 70,000 and 80,000 years ago is at least intriguing and, as I have argued in the preceding sections, potentially highly significant in evolutionary and cognitive terms. In this context, it may well be significant that we now have DNA evidence of a major demographic and geographical expansion of genetically modern populations in Africa at around 60,000 to 80,000 BP, best reflected in the expansion of the L2 and L3 mitochondrial lineages.[42,131]

How far other elements of these supposedly modern behavioral features can be identified significantly earlier than ca. 80,000 BP in Africa or elsewhere will no doubt remain a critical focus for future research. As noted earlier, there are slightly controversial claims for highly shaped barbed bone spear points from the Katanda sites in former Zaire provisionally dated to around 90,000 BP[84,85] and unambiguous indications of ceremonial burials associated with a range of perforated seashell ornaments and large quantities of red ochre at the site of Qafzeh in northern Israel, dated to ca. 90,000 to 100,000 BP and associated with essentially modern skeletal populations.[60,89] The fact that the lithic technology associated with the Qafzeh burials is in all respects typically Middle Paleolithic in character could be seen as a strong indication that at least certain basic features of unambiguously symbolic and ceremonial behavior had emerged among these early anatomically modern populations before any obvious technological transition to typically Upper Paleolithic technology. The same inference might be drawn from the presence of clearly ceremonial burials and human cremations in Australia dated to at least 40,000 BP and again associated with essentially Middle Paleolithic technology.[122,132,133] Presumably these reflect an early dispersal of anatomically and genetically modern populations from Africa—via Asia—to Australia sometime before the emergence of more advanced technologies in the presumed African homeland.[29,30] There are also some claims for potentially ritualistic or ceremonial treatment of the early anatomically modern remains recently reported from Herto in Ethiopia, extending back to ca. 150,000 to 160,000 BP.[92] All of these discoveries could be seen as reflecting the emergence of a strong symbolic component in human behavioral patterns substantially before any major change in the associated lithic and bone technologies.

Those of us who have argued for the notion of an effective revolution in human behavioral patterns . . . have always tried to make it clear that we were visualizing this phenomenon essentially as a before-and-after scenario . . .

The remaining features that are sometimes cited for the emergence of "modern" behavioral patterns in Africa prior to ca. 100,000 to 150,000 BP are arguably of more questionable significance. These include the presence of highly developed blade technology at sites such as Kapthurin in Kenya, dated to ca. 250,000 BP, the extensive use of red ochre at the Kapthurin sites and the Twin Rivers site in Zambia at a broadly similar date, and the occasional occurrence of backed segment forms at apparently early Middle Stone Age sites.[6,86,87,134] However, all of these features have potential parallels from unquestionably Mousterian or Middle Paleolithic sites in either Europe or Western Asia[4,27,80] and could most economically be seen as part of the basic cultural repertoire associated with pre-anatomically modern human populations in both Africa and Eurasia. Foley and Lahr[30,135] have argued that these be-

havioral elements could be associated with an earlier population dispersal from Africa to Eurasia associated with fully developed Middle Paleolithic (Mode 3) technologies, and perhaps with the hypothetical common ancestor of both the European Neanderthals and the African *sapiens* populations, which they have attributed to the *Homo helmei* lineage.

The full cognitive and evolutionary implications of all these recent discoveries in the archeological records of Africa and Eurasia have still to be worked out. As I have argued, the most striking feature overall is the very much earlier appearance of a range of unambiguous and relatively complex symbolic components of material culture in association with populations of anatomically modern humans in Africa and the immediately adjacent parts of southwest Asia than among the contemporaneous populations of European Neanderthals. How far these developments may be associated with the emergence of more complex language patterns, changes in the neurological structure of the brain, or specific genetic mutations, such as the recently discovered $FOXP_2$ gene,[36] have been debated at length in the recent literature, and I will not attempt to pursue these arguments here.[5,7,17,20–28,73] Collectively, however, these features could be argued to reflect a significant "revolution" in human behavioral and cognitive patterns, associated closely with the biological and evolutionary emergence of our own species. As the evidence stands at present I suggest that these features can be accommodated more economically in terms of a single-species model for the emergence of at least most of the basic elements of behavioral "modernity," however that concept is defined, than in terms of a massively coincidence-dependent model of "multiple-species" origins.

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