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Beads and Cognitive Evolution

Robert G. Bednarik

Robert G. Bednarik specializes in the origins of human constructs of reality, cognitive archaeology, rock art dating, and microscopic studies, and he has conducted extensive fieldwork in all continents except Antarctica. He is the Editor and Permanent Convener of the International Federation of Rock Art Organizations (IFRAO), and the founder, Editor, and Secretary of the Australian Rock Art Research Association (AURA). He edits three scientific journals and three series of monographs. His over 1,000 articles and books include over 450 works in refereed scientific journals, and have appeared in 32 languages. robertbednarik@hotmail.com

Abstract
The study of human evolution has largely focused on skeletal developments and on the stone tools of successive technological traditions. The cultural and cognitive evolution of hominins has been comparatively neglected. Here it is proposed that beads and pendants provide some of the most reliable evidence for our non-physical (cognitive) evolution. The available corpus of such finds from the Middle and Late Pleistocene periods is presented and reviewed. It is shown to demonstrate not only the use of complex symbolisms several hundred millennia ago, but also the application of concepts of perfection and self-awareness. This finding agrees with other indicators of hominin cognition, but it clashes with the dominant notion that "modern" human faculties appeared with a hypothetical replacement of Europeans by Africans just 40,000 years ago. This notion is reviewed and shown to be based on fake datings and misidentifications of numerous human fossils, on questionable genetic contentions, and on inadequate consideration of the available empirical evidence.

Keywords: Bead, human evolution, cognition, replacement model, symbolism, human modernity

Introduction

There is a tendency in palaeoanthropology to overemphasize empirical data at the expense of theory building. What are perceived to be facts are considered a better source of knowledge than "theories." Despite a powerful, overarching conceptual framework (i.e., evolutionary biology), much research on the origins of "anatomically modern humans" is "undertheorized," and fails to appreciate or understand that "facts" are theory laden, and theories are typically underdetermined. These essentially epistemological issues underlie much of the controversy surrounding our cognitive as well as physical origins. Yet there is no consensus in contemporary archaeology of how, where and, especially, when key developments such as symboling began. This has led to the emergence of two mutually exclusive schools of thought, which are best described as a short-range and a long-range model. Few if any researchers occupy the middle ground between them. According to the currently dominant short-range model, the earliest evidence we possess of human symbolism is in the forms of art and indications of language ability. No art-like productions are recognized by the model's advocates of an age exceeding 32,000 or 35,000 years, and the earliest available language evidence is contended to be the first successful colonization of Australia, thought to have occurred perhaps 60,000 years (60 ka) ago. This school of thought is probably most coherently articulated in the work of Davidson and Noble (1989, 1990, 1992; Noble and Davidson 1996; Davidson 1997). It categorically denies the possibility of human symboling abilities beyond, say, 80 ka ago.

The long-range model, while favored by most linguists who have considered this topic (Bickerton 1990, 1996; Aitchison 1996; Dunbar 1996), enjoys little support from archaeologists. It postulates a very significantly longer use of symbolism by hominins, at the very minimum in the order of several hundred millennia, but more probably one million years or more. Thus there is a significant difference between these two incompatible paradigms. The short-range model attributes symbolism, and all it entails, solely to what has often been described as "anatomically modern humans," or *Homo sapiens sapiens*, or simply "Moderns" (Gamble 1994). It declares categorically that earlier hominins possessed neither language, art-like products, social systems, self-awareness, nor even proper culture. These certainties are not based on what is often called the "archaeological record", but on the very strong postulates of the "African Eve" model (also called "Garden of Eden," "replacement," or "punctuated equilibrium" model), and several variants called "Afro-European *sapiens* hypothesis," "wave theory," and "assimilation theory;" the latter are really just variations of the multiregional theory (see Relethford 2001; Relethford and Jorde 1999). Accordingly, "Moderns" evolved in genetic isolation in sub-Saharan Africa, some time between 200 and 100 ka ago. They then began a migration across Africa and out of Africa, reaching the Levant by 100 ka ago, and colonizing Asia and Australia by 60 ka bp (before the present time), and Europe some 25 ka later. In the process, they either out-competed or exterminated all resident human populations, wherever they went, and always without interbreeding with them. By about 28 ka bp, all other human populations had become extinct, by one means or another, and the genetically pure, victorious "Moderns" had taken over the world.

Here I will consider one of the most important empirical sources concerning the cognitive evolution of hominins—beads and pendants. A cardinal error of the supporters of replacement and indeed of the remaining "out of Africa" hypotheses, is that it is assumed that beads, like other forms of palaeoart, are entirely limited to "anatomically modern humans."

The importance of beads is that, first, their use demonstrates self-consciousness with all its implications, itself an important factor in cognitive evolution. But they also demand the existence and communication of complex symbolic meanings, without which beads are of no use. Whatever their practical purpose may have been (decorative, communicative, emblemic, economic, protective, commemorative, ideological, etc.), their function was always deeply symbolic; they demonstrate essentially modern cognition, irrespective of considerations of physical evolution or technology. Therefore, in gaining an initial access to a benchmark in our cognitive evolution—and thus in deciding which of the two basic models must be false—few classes of evidence can be as crucial as beads. This should prompt us to look for the earliest evidence of bead use.

Beads of the Middle Pleistocene

Fortunately, the secure identification of beads and pendants is largely uncontroversial. One of the principal arguments leveled against evidence suggestive of very early symbolism is that there are perfectly valid alternative explanations. This is indeed often the case. Natural surface markings of portable objects of various types have been misinterpreted as meaningful engravings in literally thousands of cases worldwide. I have examined and rejected hundreds of instances (600 in China alone). By far the most common examples are objects of bone, limestone, ivory, and ostrich eggshell, which I have shown to bear mycorrhizal grooves that may resemble engravings (Bednarik 1992a). Bone fragments often bear markings made by animal canines, by gastric acids (e.g. of hyenas), or by other taphonomic agents of various types (trampling, sediment movement, solifluction, cryoturbation, etc.). Another very common example is that of perforated bone fragments and shells, which some archaeologists have interpreted as anthropic products—intentionally made by humans. Bones can be perforated by animal teeth and corrosive agents; gastropod shells are commonly bored through by parasitic organisms. Similarly, natural surface markings on rock have often been archaeologically misinterpreted, and again I have corrected more such instances than anyone, in which either natural markings were identified as rock art, or rock art as natural markings (Bednarik 1994a).

Some commentators on the issue of whether perforations of Pleistocene objects were natural or artificial apparently make a fundamental error of logic (d'Errico and Villa 1997). They seem to believe that, in order to be considered to have been used as a bead, a perforated object must have been *made* by humans. Any consideration of the kinds of objects used as ethnographic beads will readily show this to be false. The correct logic is that one may be able to demonstrate the use of a bead in some cases from microscopic evidence (Bednarik 1997a, 2005), but one can never demonstrate that any perforated small object found in an occupation layer was *not* used as a bead. In view of the widespread use of beads today, and the frequency with which they are lost, and considering further that beads were in use for some hundreds of millennia (as we shall see below), almost certainly in large quantities, it is very much more likely than not that most perforated objects found in an occupation layer were used as beads. The fact that we cannot prove that a naturally perforated, bead-like object was used as a bead should not prompt us simply to exclude it from consideration.

The outstanding characteristic of manufactured beads and pendants is that their archaeological identification is usually unambiguous, which one cannot always say about other classes of symbolism evidence. Small objects, drilled through with stone tools, could be either beads or pendants, or they could be small utilitarian objects such as buckles or pulling handles, or the quangings (pulling handles used in sealing) of the Inuit (Boas 1888: Figs 15, 17, 121d; Nelson 1899: Pl. 17; Kroeber 1900: Fig. 8). Such utilitarian objects are generally of distinctive shape, use-wear, and material; they need to be very robust. Small objects that were drilled through either in the center or close to one end (e.g. teeth perforated near the root), that are too small or too fragile to be utilitarian objects, and that lack the typical wear patterns of such articles, can be safely assumed to be beads or pendants. The evidence that they were drilled with a stone tool is often indicated by a distinctive bi-conical and "'machined" section and sometimes by rotation striae. The wear of pendants can often be observed on archaeological specimens, including those made of stone (Bednarik 1997a), and is also quite typical.

An example of such complete lack of ambiguity is that of disc beads made from ostrich eggshell. These are extremely common in the ethnography of southern African people (Woodhouse 1997), and in the archaeological record they are found from there to China and Siberia (Bednarik 1993a). The ostrich (*Struthio camelus* ssp.), now extinct in Asia, was widespread in much of Africa and Asia to the end of the Pleistocene, even into the Holocene (at least in Arabia; Bednarik and Khan 2005). Its eggshell was used widely, as containers and as decorative material. In southern Africa, such use extends from the present back to the Middle Stone Age (MSA). Decorated fragments have been reported from the Howieson's Poort phase in Apollo 11 Cave, Namibia (Wendt 1974), from the MSA of Dieplkloof Cave in the southwestern Cape area (Beaumont 1992), and as beads from Bushman Shelter in Transvaal (Woodhouse 1997), both in South Africa, and from White Paintings Rockshelter in the Tsodilo Hills, Botswana (Morris 2000); and two ostrich-eggshell beads and several fragments, MSA but undated, presumed between 45 and 280 ka, are from Loiyangalani River Valley (Serengeti National Park, Tanzania). Some of these may be up to 80 ka old, and many more recent traditions have used such disc beads. Then there is a broken circular ostrich-eggshell pendant, 3 cm in diameter and with a central perforation, from Bed 9 containing "Late Pietersburg" plus segments at the Cave of Hearths (Mason 1988), with an estimated age of 76 ka on the basis of dates for comparable Stratum 1 RGBS lithics at Border Cave (Grün and Beaumont 2001).

In Tunisia and Algeria, Capsian occupation deposits have yielded ostrich-eggshell beads frequently, and these date from the very early Holocene. In India, 41 Late Pleistocene sites have produced ostrich-eggshell fragments, and radiocarbon dates derived from such fragments range from 39 to 25 ka (Kumar et al. 1988). At two sites, Patne and Bhimbetka, a few disc beads have been found (Bednarik 1993a, 1993b). The two specimens from Bhimbetka come from the neck region of a human burial, which suggests that they may have formed part of a necklace (Figure 1a–c). Similar beads occur in the Gobi desert, where they are found among the occupation remains of an Epipalaeolithic or even Mesolithic tool tradition usually named after the site of Shabarak-usu (Bednarik and You 1991). Further finds of ostrich-eggshell disc beads, of roughly similar age (final Pleistocene to early Holocene), have also been reported from Inner Mongolia (Hutouliang) and southern Siberia (Krasnyi Yar, Trans-Baykal).

Of a significantly greater antiquity are the more than forty similar ostrich-eggshell beads from El Greifa site E, in Wadi el Adjal, Libya (Bednarik 1997a). They come from a substantial sequence of Acheulian occupation deposits representing many millennia of continuous occupation of a littoral site, on the shore of the huge Fezzan Lake of the Pleistocene. This site has exceptionally good preservation conditions, with insect remains and seeds found together with bone. The typical Late Acheulian stone tool forms, including "handaxes," confirm the dating of the occupation strata by Th/U analysis to about 200 ka. These are the earliest known secure disc beads in the world, and there can be no reasonable doubt that they are indeed man-made beads, and not some chance product of nature (Figure 1d–f). Only three specimens were initially found, but recent work yielded many more and has demonstrated the greatest accumulation of stone dwellings found from the Lower Palaeolithic (Ziegert 2007).

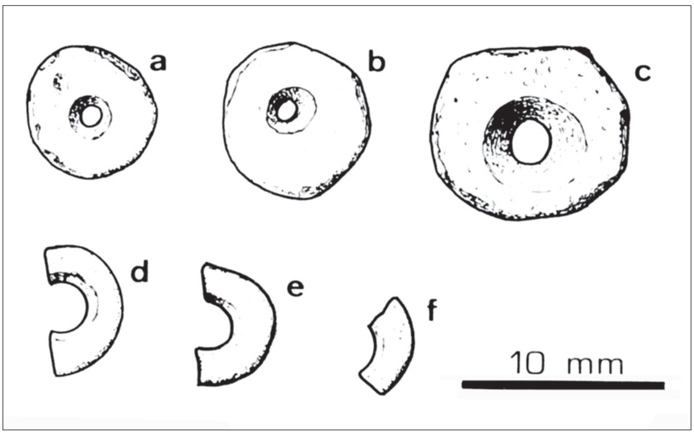

Fig 1 Pleistocene ostrich eggshell beads from India (a–c) and Libya (d–f). The three lower specimens are of the Acheulian.

Fig 2 Pendant from the Repolusthöhle in Austria, late Lower or early Middle Paleolithic. Wolf incisor, perforated near its root.

However, the Libyan beads may well be exceeded in age by many other finds, such as the two pendants from one of the occupation layers in the Repolusthöhle, in the Austrian Alps. A wolf incisor is perforated near its root, and a flaked bone point near its corner (Figure 2). These specimens occurred together with a large but non-diagnostic stone tool assemblage (Mottl 1951), variously described as Levalloisian, Tayacian, and Clactonian, three rather vaguely defined Lower Palaeolithic industries. There is no radiometric dating available, but the accompanying faunal remains imply an age of about 300 ka, especially through the phylogeny of ursine species. The assemblage is separated from an overlying "Aurignacian" (probably an Olschewian) by substantial stadial clastic deposits.

The first reports of Palaeolithic stone tools, by Boucher de Perthes (1846), already made mention of the occurrence of centrally perforated fossils together with Lower Palaeolithic "handaxes" at the type-site of St. Acheul in France. This was confirmed by Prestwich (1859: 52):

> Dr. Rigollot also mentions the occurrence in the gravel of round pieces of hard chalk, pierced through with a hole, which he considers were used as beads. The author found several, and recognized in them a small fossil sponge, the *Coscinopora globularis*, D'Orb., from the chalk, but does not feel quite satisfied about their artificial dressing. Some specimens do certainly appear as though the hole had been enlarged and completed.

But these finds were soon forgotten, as implied by Smith (1894) who presented similar specimens from England but made no mention of the French ones. All these finds remained largely ignored until 2003 (but see Keeley 1980: 164; Roe 1981: 281, Pl. 38; Marshack 1991), when I examined a total of 325 specimens labeled *Coscinopora globularis*, all collected in Acheulian deposits in France and England before the early twentieth century. The most secure component of this resource is that of the 59 specimens from the Acheulian of the Biddenham quarry at Bedford. All these beads had in fact been misidentified, being of the species *Porosphaera globularis* Phillips 1829, a Cretaceous sponge (Bednarik 2005). I demonstrated analytically that the specimens had been collected by humans, that many of them had been modified, and that many others bore extensive wear from having been threaded on a string and worn for many years (as determined by wear facets externally around the tunnel orifices rather than within the tunnels). The tunnels through these perforated silica fossils are largely natural phenomena, but they have often also been modified by human agency (Figure 3). The wear facets are always of a notably lighter color, and significantly they never bear any taphonomic markings as inevitably present on the rest of the surfaces of these fossil casts. It is evident that all worn specimens were worn only in two areas: next to, and surrounding the two tunnel openings. Only one type of abrasive wear can account for such consistently typical wear patterning: the siliceous stones must have been arranged with their tunnels permanently aligned to have become worn that way. Such consistent wear patterns cannot be explained as natural phenomena: the beads can only have been subjected to this wear through hominin intervention. Moreover, P. globularis range in size from under 1 mm to about 50 mm; only about a quarter of them are reasonably globular in shape; only 14 percent show any tunneling at all; and only a tiny fraction of these are tunneled right through, or to within a couple of millimeters (Nestler 1961). Yet all specimens recovered from Acheulian contexts are near-globular, fully perforated, and typically ranging from 10 to 18 mm diameter. It is then obvious that on the basis of size, shape, and perforation, the probability that they are anything other than a deliberately collected sample is almost zero. If we add to this the clear evidence of anthropic modification (Bednarik 2005: Fig. 7) and the common occurrence of wear facets, it becomes obvious that these fossils are not only beads, but also that they were

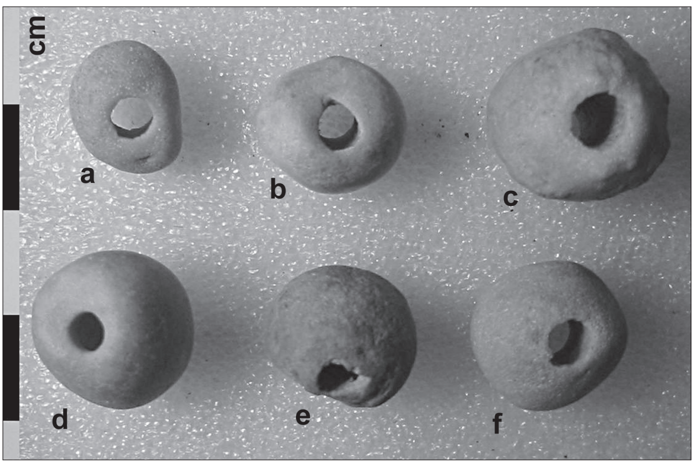

Fig 3 Six Acheulian beads made from Porosphaera globularis fossils. Note the very heavy wear that resulted in a distinct wedge shape on (b), the thin centric wear facets on (a) and (c), and the light-colored, distinctly asymmetric major wear facet on (d). Specimen (e) is fractured, and (f) shows very little use wear.

worn on strings for very long periods of time—certainly for many years in some cases, when more than a third of the original bead volume had been worn off in this way.

Perforated fossils have also been found in the Acheulian of Israel, from which Goren-Inbar et al. (1991) report the occurrence of fossil crinoids, although no wear traces are reported. This raises the question of how widespread the use of beads or pendants could have been in the Lower Palaeolithic, and how far back it could have extended in time. We cannot answer this by archaeological observation and reasoning alone, but a credible scenario can be provided by taphonomic logic (Bednarik 1994b). If the earliest-found representatives of a class of material evidence are among the most deterioration-resistant types of that class, then the probability of significantly older, less resistant types is very high indeed. Ethnographic beads are often made of perishable materials, such as seeds of fish vertebrae, and materials like ostrich eggshell can only survive in high-pH soils. A significant observation we can make from the available finds of Middle Pleistocene beads is that they are extremely rare, and that they are widely separated, both chronologically and spatially. But beads cannot, by definition, occur in isolation. To possess and convey meaning, they need to occur in large number *in any society* that uses them, because symbolic meaning can only be conferred by repeated and "structured" use. Therefore we need to assume that we are dealing with a severely truncated record here, a phenomenon whose taphonomic threshold is much more recent, certainly within the Holocene. When we bear in mind that one single site in Russia, of an Early Upper Palaeolithic tradition with distinctive Middle Palaeolithic roots (the Streletskian, resembling the Szeletian), has yielded more beads from just three graves than the remaining Pleistocene of the entire world, the extent of taphonomic distortion becomes evident. The three burials at Sungir, perhaps in the order of 28 ka old, yielded 13,113 tiny ivory beads and more than 250 perforated fox teeth (Bader 1978). This should be seen as a preservational fluke, and as an indication that the few earlier beads we have from the previous several hundred millennia represent all that we have managed to recover from the astronomical numbers of beads made in the Lower and Middle Palaeolithic. Taphonomic logic demands this (Bednarik 1994b: Fig. 2).

Beads of the Late Pleistocene

Misunderstandings and misinterpretations have bedeviled not only the beads or pendants of the Middle Pleistocene, but also those of the subsequent period. For instance there has recently been a great overemphasis on the forty-one perforated snail shells (*Nassarius kraussianus*) from Blombos Cave, South Africa, of the MSA and about 75 ka old. In this it is not only ignored that much older finds are available, as listed above, but also that there are much better made bead specimens that need to be attributed to Robusts rather than Graciles ("Moderns"). Here I will attempt to present a more balanced, if brief, overview.

The two perforated *Conus bairstowi* seashells, one with the BC3 burial, from stratum IRGBS, of the MSA (Howieson's Poort) in Border Cave (Beaumont et al. 1992), are about the same age as the Blombos find (dated by AAR and ESR; Miller et al. 1999; Grün and Beaumont 2001).

The perforated shell from Oued Djebanna, Algeria, is probably older, being of the "early Late Pleistocene" (McBrearty and Brooks 2000). A similar antiquity is suggested for the four deliberately drilled quartzite flakes from Debenath, Nigeria; as well as for a bone pendant from Grotte Zouhra, Morocco (ibid.).

Europe, too, offers many perforated small items likely to have been pendants or beads, and attributable to Robusts (Neanderthaloid, i.e. either of *Homo sapiens neanderthalens* or of what I call "Post-Neanderthals:" see below). To begin with those of the Micoquian, we have the artificially perforated wolf vertebra, Bocksteinschmiede, Germany, thought to be about 110 ka old (Narr 1951). Marshack (1991) has provided satisfactory evidence that the perforation is anthropic. From the same site comes an artificially perforated wolf metapodium (Marshack 1991). Following Davidson's (1990) claim that the hole is the product of gnawing, Marshack has again provided convincing evidence that the perforation is human made. Then there are the 111 perforated phalangi of *Saiga tatarica* from the Micoquian of Prolom 2, Crimean Peninsula (Stepanchuk 1993). Although here proof has not been provided that the perforations are intentional, it would seem unusual for there to be such a large number of identical bones with

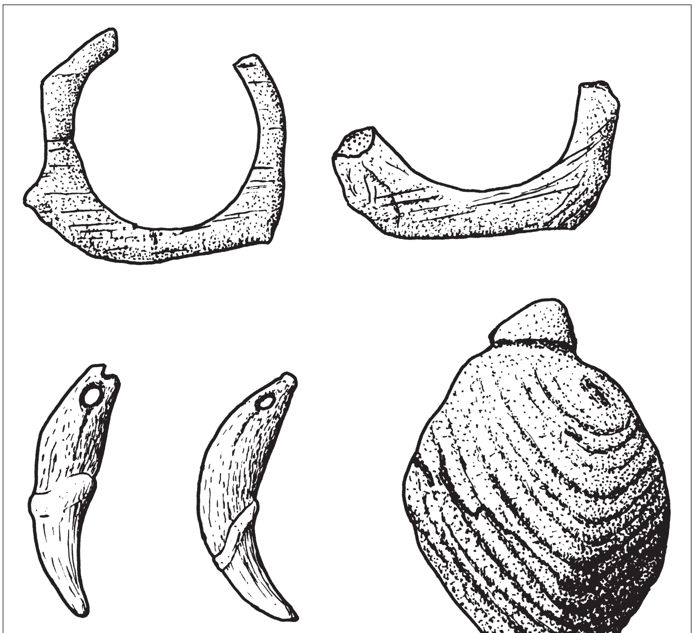

Fig 4 Two ivory ring fragments, two perforated animal canines and a fossil shell with an artificial groove for attachment. Châtelperronian, Grotte du Renne, Arcy-sur-Cure, France. These objects were used, and almost certainly made, by Neanderthals.

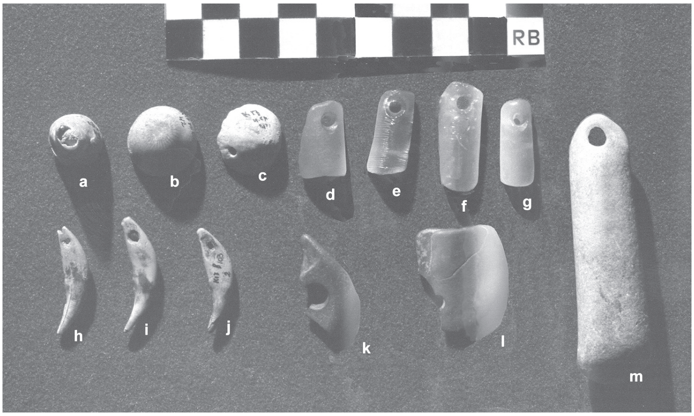

Fig 5 Beads and pendants from Kostenki 17, Russia, probably made by Neanderthaloid people.

identical taphonomic marks, particularly as the occupation site has also yielded portable engravings. The two perforated canines from the Bachokirian of Bulgaria are considerably more recent (Marshack 1991), and there is also a spindle-shaped bone pendant, all from level 11 of Bacho Kiro.

The numerous Châtelperronian palaeoart objects of the Grotte du Renne at Arcy-sur-Cure, France, are well known, and since 1979 it has also been appreciated that they are presumably the work of "Neanderthals" (Figure 4). However, it has escaped the attention of many that the thirteen artificially perforated objects from the lower occupation layer at Kostenki 17, Russia (Praslov and Rogachev 1982), below a volcanic deposit of the Campanian ignimbrite eruption (Fedele and Giaccio 2007), also derives from a transitional or Early Upper Palaeolithic (EUP) tradition, which has elsewhere yielded both robust and gracile specimens. Stratum 2 of Kostenki 17, a Spitzinian occupation, yielded three polar fox canine pendants, three perforated gastropod shells, four fossil objects of translucent amber color (belemnite), and three stone objects, including one large, elongated, and well-made pendant (Figure 5). All holes are distinctly conical or bi-conical in section, and the rotation marks are clearly visible, often to the naked eye, or at least under the microscope. In the hole of the large pendant (object m), even the wear of the suspending string remains clearly discernible.

A partly perforated fox canine comes also from the Mousterian of La Quina, France (Martin 1907–10; Marshack 1991), together with a perforated reindeer phalanx (Marshack 1976). Bordes (1969) has reported a further bone pendant of the Mousterian from Pech de l'Azé, also in France, and Baldeon (1993) notes the occurrence of drilled phalanges and a perforated cranial fragment from the Mousterian of Lezetxiki, Spain. Conversely, early perforated shells have been reported from other sites, even from Australia (at Mandu Mandu Creek rockshelter), where jthe Middle Palaeolithic or mode 3 technology continued to the mid-Holocene (Morse 1993).

If we add to this list of probable beads or pendants made either by Robusts or by people of essentially mode 3 technologies the many ostrich-eggshell specimens listed above, we realize that we already have a large corpus of such material. But a very much greater body of the Late Pleistocene still needs to be considered. We have noted that the 13,370 or so beads found in just three Streletskian interments at Sungir, near Moscow, relate to a stone-tool technology that is far from mode 4 (pure 'Upper Palaeolithic'). The Streletskian remains dominated by bifacial artifacts are inspired by the still contemporary Eastern Micoquian or Mousterian in parts of Russia. Indeed, the regions of the Don river, the Crimea, and northern Caucasus experience the coexistence of seven accepted tool traditions between 36 ka and 28 ka BP: the Mousterian, Micoquian, Spitzinian, Streletskian, Gorodtsovian, Eastern Szeletian, and Aurignacian (Krems-Dufour variant). The introduction of a first fully developed 'Upper Palaeolithic' tradition (the Kostenkian) appears only about 24 ka at the Kostenki-Borshevo site complex. Clearly there is a continuation and very gradual change from mode 3 technologies that takes at least ten millennia, marked by numerous occurrences of beads and other material interpreted as body ornaments (White 1993). In Siuren 1 (units G, H), "Aurignacians" and "Micoquians" occupied the site alternatively (Demidenko 2000). At Buran-Kaya 3, level B, a Micoquian assemblage overlies the "Upper Palaeolithic" Szeletian industry of level C (Marks 1998).

None of the seven traditions of southern Russia can be clearly and consistently identified as being the work of unambiguously anatomically modern humans, and much the same can be said about central and western Europe. A second major body of beads occurs about the same time in the west. These are mostly ivory beads, like the bulk of those at Sungir, and White (1993) has described in detail the process of mass-producing them. There are more than 1,000 Aurignacian ivory beads from several French sites (Brassempouy, Saint-Jean-de-Verges, Isturitz, La Souquette, Castanet, and Blanchard), made from rods, and similar beads from Spy (Belgium), while a different type occurs at Geißenklösterle in Germany. Traditionally the Aurignacian has been regarded as an industry of anatomically modern humans, just as the roughly contemporary Châtelperronian was mistakenly attributed to "Moderns." With the recent redating of numerous European human fossils, it has now become evident that we have six cases of direct association between Neanderthaloid remains and EUP occupations, but not a single one of fully modern human remains with any EUP tradition, including the Aurignacian (Bednarik 2006, 2007, 2008a). Therefore it appears that all EUP "cultures" of Europe relate to Robusts, including "Neanderthals" or "Post-Neanderthals."

Until quite recently many commentators claimed that the occasional use of "symbolic" material like pendants by "Neanderthals" indicated that such objects were "scavenged" from the living sites of "Moderns," which I considered to be illogical: what possible use could symbolic artifacts have to people who had no comprehension of symbolism? The opposite, now, appears to be more realistic or logical: the majority of beads and pendants of the Late Pleistocene were made by Robusts, and the practice declined with the gracilization of Europeans toward the end of the Pleistocene.

Making Beads

In exploring the symbolic significance of beads, archaeologists are likely to mention their occurrence in burials, or relate them to "decoration." What does it mean that a particular condition is perceived as "decorative?" Does a nonhuman animal perceive beads, or cicatrices, body painting, or tattoos on a human body as "decorative?" Probably not. So this is very likely an anthropocentric perception, and is perhaps not likely to be shared by either other animals or a hypothetical visitor from outer space.

Beads, whether sewn on apparel or worn on strings, have symbolic meanings that are far removed from simplistic Western empiricism. They, or pendants, may for instance be protective, warding off evil spirits or spells, or they can be good luck charms. They can signify status, and convey complex social, economic, emblemic, ethnic, or ideological meanings, or any subtle combinations of them. Their meanings can be public or private, but they may be difficult to convey to an alien researcher, and they could never be analyzed archaeologically. How would an interstellar visitor interpret the carved ivory figurines of an incomplete chess set? If his anthropology were as simplistic as ours he might well explain its knights as evidence of an equine cult. It is at this level that most interpreting of Pleistocene symbolism has occurred, which I find quite unsatisfactory.

At least some symbolic systems must have been available to hominins by 850 ka ago at the latest. The evidence for this includes the collection of crystals, fossils, and red pigment (Bednarik 2003a), besides language use implied by maritime navigation (Bednarik 1999). A variety of birds, most notably the Australian bowerbirds, collect colorful or shiny objects; some even erect display structures and paint them with plant juices. The question arises, was the hominin behavior qualitatively different from that to be observed in such birds? We can assume, through the evidence that these hominins navigated the sea, that they had some form of "reflective" language. By 300 or 200 ka ago, at the latest (but probably much earlier), their symbolic abilities had evolved to the point at which they produced rock art, portable art, and beads. Of these forms of symbolic products, beads seem to tell us the most.

First, there are the purely technological aspects. To make a bead one has to, in most cases, be able to drill through an object, to thread a string through the hole, and to fasten the ends of the string, presumably by knots. To persist with such a complex process of manufacture, one must have a mental construct of the end product, and a desire to acquire what is clearly a nonutilitarian artifact. To be more precise, the bead is such an artifact, but the string is not, being utilitarian. The latter is merely a means of permitting the bead to fulfill its nonutilitarian role. So we have here not only a combination of diverse artifacts, but also a hierarchy of diverse concepts of relating to them. The primary imperative, presumably, is to display the bead to its best advantage; the secondary intent is to find a means of doing so. Now, a piece of ostrich eggshell can be worn on a string without first drilling a hole through it, so why bother with this additional and very delicate work? This kind of exploration raises a whole swathe of questions, and it is through it that the beads begin to become alive with meaning and significance.

This logic-based interpretation needs to be underpinned by an intimate knowledge of the technology involved, and for this purpose I have conducted extensive replicative experimentation with ostrich eggshell (Bednarik 1992a, 1993a, 1993b, 1995a, 1997a). The results pertaining to disc beads manufactured with Lower Palaeolithic stone tools have been described in some detail—they are only briefly summarized here. I found that the most effective way of producing precise replicas of Acheulian and later Pleistocene ostrich-eggshell beads, using such technology, is first to break the shell into polygonal fragments of 1–2 cm^2 area. These are then drilled individually, from one side only. Once the chert drill breaks through, the hole is reamed out from the other side. The specimen is then firmly gripped between two fingers, and the excess area trimmed off, either by pressing the protruding part on its convex side against a stone surface, or by using one's teeth as a vice. Once the excess material is snapped off, the bead blank is abraded on a coarse siliceous rock such as quartzite or silcrete. The beads from the Libyan Acheulian are of about 6 mm diameter, and I found that the average time of producing replicas of them is about 17 minutes, or about 25 minutes if the time of preparing and resharpening stone points is included (Bednarik 1997a: 33–6).

An animal tooth, such as the wolf's incisor from the Repolusthöhle, is much more difficult to perforate. At the time of the EUP technologies, between 45 and 30 ka ago, even stone materials were perforated by the Robusts, to be used as pendants. Early examples are the several items from Kostenki 17, made from stone, fossil coral, and belemnites (Bednarik 1995a: Fig. 4), and the broken specimen from Shiyu wenhua in central China (Figure 6). However, the sparse record available to us provides no indication of an 'evolution' in the standard of workmanship. On the contrary, some of the older examples are much better produced than the more recent. The Libyan Acheulian beads are more carefully made than the Upper Palaeolithic specimens from India (Figure 1a–c). The perforation on the Repolusthöhle tooth is significantly finer than the clumsily made holes in the two Bacho Kiro teeth, which are 'merely' 42 ka old (Marshack 1991). There can be no doubt that even the earliest beads and pendants currently available to us have involved a great deal of skill and understanding of

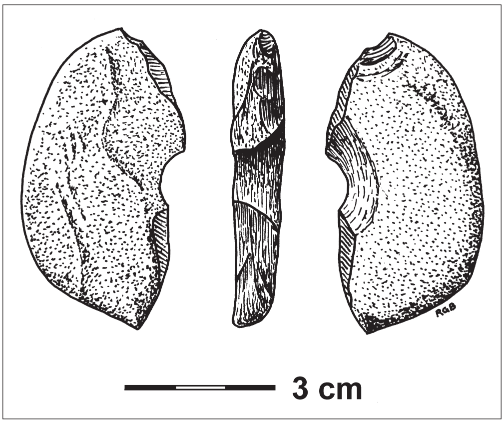

Fig 6 Broken stone pebble pendant, drilled through the center, from Shiyu wenhua, China. From the Middle/Upper Paleolithic transition.

material properties in their production. The hominins who made them were outstanding craftsmen.

Of much greater significance, however, are the findings concerning the symbolic qualities of the beads. In making many replicas of the Acheulian ostrich-eggshell beads I discovered that the smallest size to which such a bead can realistically be ground down is about 6 mm diameter. There are two reasons for this. First, as the size approaches this order of magnitude, the disc becomes increasingly difficult to hold between fingers, and as the finger tips are beginning to rub against the grindstone as the bead becomes smaller, their skin is also abraded and the process becomes quite painful when making many beads, and my fingertips began bleeding (the *heishi* technique was unknown in the Acheulian; cf. Francis 1982a, 1982b, 1989). Second, since the diameter of the central hole can be no smaller than 1.4 to 2.0 mm, it follows that the bead's fragility increases exponentially as the outside diameter of 6 mm is approached. This diameter represents the smallest size at which the bead remains structurally strong enough to withstand some rough handling. I have established this quantitatively, through controlled-destruction experiments.

The next observation is even more meaningful. The Acheulian beads are very well made, with a near-perfect circular outer margin and an equally perfect rim thickness all around. In my replication work I found that these precise forms can be achieved only intentionally, by constant checking of the shape during the final abrading phase. It is practically impossible to obtain such a perfect round shape and centrality of the perforation by accident. This means that the makers had not just a well-developed sense of symmetry, but a clearly defined concept of the perfect geometric form they aspired to.

This leads to several observations. Even if it is preferred to have a perforated bead, this does not necessarily call for a *central* perforation. The rational explanation for the maker's going to such lengths to abrade the bead equidistantly is his or her sense of perfection. This proposition is confirmed by the size of the beads. It seems self-defeating to make beads so small. If the purpose of a bead is to be seen, a large bead would fulfill that role much better. Yet the labor investment of making a very small bead is significantly greater than that required for a large bead. Perhaps the most telling aspect of the production process is that the Acheulian beads are, as noted already, of the smallest possible size in which these objects can realistically be made. There is a palpable impression that the primary objective was to push the available technology to its very limits. It is from this perspective that we need to examine these symbolic objects, and the nature of their semiotic function.

Lower Palaeolithic hominins have few models of the form-concept that would underpin the mental template of a disc bead. To our thinking, used to the idea of the wheel, this is a great deal more familiar than it would have been to early humans. Of course they may have collected circular fossils such as those reported above, and used them as beads. Perhaps this is how the very concept came into being, and the human-made disc beads were merely substitutes, in place of the fossils that were in short supply. Whatever the process was, these hominins did possess a clear concept, applied no doubt many thousands of times, of a perfect geometric form that had no practical value at all. It may sound provocative to say this, but they had in fact developed the wheel without discovering its practical application. As one reams out the perforation it is easiest to hold the reamer still and rotate the disc around it, like a wheel. Similarly, the finished bead can be turned around the string, or one can run it along a surface like a wheel by holding the string tautly.

Naturally the hominins had no use for wheels (or means of making large-scale versions), but they may well have been fascinated by their properties. They certainly went to a great deal of effort to produce not just disc beads, but perfectly proportioned, "aesthetic" masterworks. Even as nonutilitarian objects, the beads did not need to be so well made. There is some special significance in this perfection, this self-conscious display of ability. The perfection itself expresses it, *it is itself a symbol*. Not only does the product no doubt have one or more cultural meanings of a kind that will remain inaccessible to us, one meaning is not: the bead expresses perfection, technological confidence, and competence. Its perfection has become a symbol of achievement, and it is displayed to the beholder at least partly for this very reason. As an experienced maker of such beads I can see no other reason for wanting to create perfectly proportioned specimens of a demonstrably smallest possible size. Occam's Razor demands that there must have been a justification for this considerable labor investment in artifacts that are of no practical use or survival value. All of this tends to attribute essentially modern human-behavior patterns to hominins of the late Lower Palaeolithic.

To produce this purely symbolic object, methods were required that may have become available for nonutilitarian purpose, and to display it effectively, nonutilitarian technology had to be engaged. Cordage of some form was almost certainly used for a variety of other purposes (e.g. to construct rafts, which had been necessary for the colonization of Wallacea almost a million years ago; Bednarik 1999), and a string was threaded through the bead's perforation, and in some way fastened. So a whole interplay of different materials and production tools came together, different methods of technology, forms of procuration and maintenance, and all with one ultimate purpose in mind: to lead to the display of a perfect, and perfectly useless, tiny object, probably together with many similar objects. If the beads were used in this way, which seems highly probable, then their number would invoke yet another message and become another symbol. It would underline the message of perfection, and add one of surplus energy. This is a far cry from the bleak picture of a subsistence-level existence archaeologists have always painted for early hominins.

Reviewing the African Eve Model

The idea that symbolism was the exclusive preserve of "Moderns," that in fact the faculties derived from symboling abilities were the principal factor in the evolutionary success of "Moderns," is in my view a major fallacy in Pleistocene archaeology. According to this school of thought, all earlier hominins lacked these abilities, and consequently effective communication and social structures that were so useful in the effective colonization of the world through the progeny of Africa's Eve.

It is therefore essential to consider the African Eve model before one can realistically reexamine the advent of human symboling abilities. It is, however, not the only relevant issue. The second topic to be considered here is the question of the type of evidence one needs to review to arrive at a realistic perspective. Here, the two opposing schools agree on some points, while disagreeing on others. For instance, it seems to be widely agreed that the ability to cross the ocean by means of a vessel is adequate evidence to demonstrate the existence of an effective communication system—particularly when the ocean crossing is followed by the successful establishment of a new population. On the other hand, there is much disagreement about the function or purpose of many archaeological finds that have been suggested to indicate the use of art or symbolism.

The most obvious deductions to be made from the Eve model are that our victorious ancestors first conquered the world during the Final Pleistocene, that they were genetically so different from all their contemporaries that they were a separate species, unable to interbreed with any other humans. Therefore all extant human populations originate from a small, isolated population from some small part of Africa. Indeed, ultimately they are all related to one single female, dubbed Eve. They were the only humans who ever succeeded in crossing that Rubicon between the subhuman and the human, between instinct and intelligence, between absence and presence of culture.

This scenario does not resemble a realistic model of phylogenetic evolution or demographic population dynamics. Illustrating what happens to a noncompetitive population, it extols the virtues of competition, it explains and justifies colonization as a historical phenomenon and genocide as an inevitable process. It is thus not just a simplistic and naive but harmless mythology: it can be used to underpin and legitimize quite insidious ideologies, by appealing to "common sense" and prejudice. Moreover, this model has dominated archaeological thought for two decades, and has determined dogma and dictated research directions and priorities.

Yet the Eve or replacement model's genetic justification is far from impeccable. Different research teams have produced different genetic distances in nuclear DNA—i.e., the distances created by allele frequencies that differ between populations (e.g. Vigilant et al. 1991; Barinaga 1992; Ayala 1996; Brookfield 1997). Some geneticists concede that the model rests on untested assumptions; others even oppose it (cf. Barinaga 1992; Templeton 1996; Brookfield 1997). The various genetic hypotheses about the origins of "Moderns" that have appeared like mushrooms over the past two decades place the hypothetical split between "Moderns" and other humans at times ranging from 17 to 889 ka bp. They all depend upon preferred models of human demography, for which no sound data at all are available. This applies to the claims concerning mitochondrial DNA ("African Eve") as much as to those citing Y-chromosomes ("African Adam"). The divergence times projected from the diversity found in nuclear DNA, mtDNA, and DNA on the nonrecombining part of the Y-chromosome differ so much that a time regression of any type is now extremely problematic. Contamination of mtDNA with paternal DNA has been demonstrated (Gyllensten et al. 1991), and Kidd et al. (1996) have shown that, outside Africa, the elements of which the haplotypes are composed largely remain linked in a limited set of them. The genetic picture in Africa as well as outside of Africa has been found to be far more complicated than the replacement proponents ever envisaged. Assumptions about a neutral mutation rate are often unwarranted, and a constant effective population size is extremely unlikely; and yet these variables determine the outcomes of all the calculations. For instance, if the same divergence rate as one such model assumes (2%–4% base substitutions per million years) is applied to the human-chimpanzee genetic distance, it yields a divergence point of 2.1 to 2.7 million years, which we consider to be unambiguously wrong. Nei (1987) suggests a much slower rate, 0.71% per million years, according to which the human-chimpanzee separation would have occurred 6.6 million years ago, which is close to the estimate from nuclear DNA hybridization data, of 6.3 million years. This would produce a divergence of Moderns at 850 ka bp, over four times as long ago as the favored models, but Nei has since abandoned his prediction. Interestingly, when the same "genetic clock" is applied to dogs, and suggests that the split between wolves and dogs occurred 135 ka ago, archaeologists reject it on the basis that there is no palaeontological evidence for dogs prior to about 14 ka bp. In other words, the weak theory that provides the only basis for the replacement scenario is rejected when applied to other species.

Instead of unambiguously showing that these "Moderns" originate conclusively in one region, Africa, all the available genetic data suggest that gene flow occurred in the Old World hominins throughout recent human evolution (Templeton 1996). *Homo sapiens sapiens* has evolved as a single unit across much or most of the region then occupied by hominins, from southern Africa to eastern Asia. Some of the most recent studies have resulted in radically different views than those of the replacement protagonists, e.g. that modern humans evolved from two discrete populations, one resulting in modern African, the other in non-Africans (Pennisi 1999). This is confirmed by a comprehensive study of teeth, which are considered a reliable indicator of genetic distance (Martinón-Torres et al. 2007). In the absence of any reliability of the proposed rates of nucleotide changes and the many variables still to be accounted for effectively, the claims by the replacement advocates are premature, and nucleotide recombination renders their views fundamentally redundant (Strauss 1999). Moreover, the recent finding that DNA deteriorates rapidly after excavation, and that most genetic material is lost through treatment and storage, suggests that over-reliance of museum specimens (such as the Neanderthal remains) is misplaced (Pruvost et al. 2007). Gutiérrez et al. (2002) have shown how much the Neanderthals overlap genetically with anatomically modern populations, and genetic studies of living populations, which are much more reliable, have demonstrated that both Europeans and Africans retained significant alleles from multiple robust populations (Hardy et al. 2005; Garrigan et al. 2005; cf. Templeton 2005).

The archaeological evidence is even more unambiguous (Duff et al 1992; Bednarik 1995b). If there had been a mass migration out of Africa, by a technologically, cognitively, and intellectually superior human species, one would expect to find their arrival marked by a new technology, new tools, new types of subsistence extraction methods, and so forth. There is not one iota of evidence, anywhere in the world, that would suggest the arrival of any innovation coinciding with the arrival of Eve's supposed progeny. On the contrary, there is ample evidence that, wherever the supposedly Moderns appeared and coexisted, often for long time spans, with archaic Homo sapiens (such as Neanderthaloids and other Robusts), they invariably adopted the lifestyle and technology of the resident archaic populations. This applies at least in the Levant and southwestern Europe, central Europe, eastern Europe, and eastern Asia, as well as in various regions of Africa and in Australia. Moreover, there is no indication that Upper Palaeolithic technology could have been imported through northern Africa. On the contrary, the MSA of sub-Saharan Africa, where Eve's "tribe" is supposed to have evolved in total genetic isolation, continues right up to 20 ka, and there is certainly no trace of a superior technology moving northward. Upper Palaeolithic traditions first appear between 50 and 40 ka ago in southern Siberia, at sites such as Makarovo 4/6 and Kara Bom, and seem to be a technological response to relatively cold environments. Their advent in Spain between 45 and 40 ka ago (El Castillo, Abric Romani) predates the "demise" of the Neanderthals significantly (Cabrera Valdés and Bischoff 1989; Bischoff et al. 1994). From Senftenberg in Austria we have even earlier carbon dates from an Aurignacoid occupation (Felgenhauer et al. 1959: 60). The Châtelperronian of France, an Upper Palaeolithic culture, was a tradition of "Neanderthals," and it included the production of complex symbolic artifacts, such as beads and pendants, as we have seen. The same applies to the superb beads and pendants of the Spitzinian. The Robusts used dwellings similar to those of Upper Palaeolithic peoples in Russia and the Ukraine (such as the mammoth-bone huts), and there is ample evidence, in eastern as well as central and southern Europe, for a continuous technological as well as phylogenetic evolution of humans from Middle to Upper Palaeolithic times (Bednarik 1995c). There are numerous finds of intermediate hominins, displaying both archaic sapienoid and anatomically modern characteristics, including those from Mladeč Cave, Krapina, Vindija Cave, Hahnöfersand, Lagar Velho, Crete, Starosel'e, Rozhok, Akhshtyr', Romankovo, Samara, Sungir', Podkumok, Khvalynsk, Skhodnya, Narmada, Jinniushan, and other sites. These range in age from the late Middle Pleistocene to the Holocene (Hahnöfersand, Drigge) and show either that there is no genetic separation of Robusts (or Archaics) and Graciles (or Moderns); or that Robusts (including Neanderthaloids) have contributed to the subsequent human populations (Roginsky et al. 1954; Yakimov 1980; Gutiérrez et al. 2002). The sapienization (gracilization) process in human evolution occurred not in one region, or in one closed population, but probably widely across the

Old World, even in relatively isolated regions such as Australia.

Precisely the same can be observed with the development of technology, wherever populations were not isolated by barriers such as high sea levels, deserts, mountains, or glaciers. For instance, in central Europe, technological traditions such as the Bohunician (intermediate between a Levallois Mousterian and an Aurignacian; Svoboda 1993), the Szeletian (an EUP industry with distinct features of the Micoquian; Allsworth-Jones 1986) and Olschewian (an archaic Aurignacian found mostly in cave bear lairs; Bayer 1929) show through their intermediate characteristics that the Upper Palaeolithic was not imported, but that it developed locally and gradually. More importantly, no anatomically fully modern human remains have ever been found with any of the more than dozen EUP traditions of Europe, including the Aurignacian, but these cultures have yielded at least six Neanderthaloid specimens (Bednarik 1995b, 2006, 2007). Therefore a key postulate of the replacement advocates in Europe, that the Aurignacian is of "Moderns," lacks any sound evidence. In eastern Europe, the corresponding Streletskian and Spitzinian exhibit similar technological patterns, with the former especially showing a long persistence of distinctive Mousterian traits (these intermediate industries, in general, being between 40 and 32 ka old, even younger in the east), while at the same time yielding vast numbers of beads as we have seen. A similar pattern still persists in eastern Asia, for instance in the two substantial intermediate occupation layers of Shiyu in China (Bednarik and You 1991). Thus the picture of a sudden change from Middle to Upper Palaeolithic occupations is limited to a few western European sites, whereas in most of Eurasia, there is a gradual technological evolution (Bednarik 1995c), and nothing to indicate the sudden appearance of a new strain of people, least of all one from Africa.

The discovery of what has been claimed to be a common ancestor of both Neanderthals and Moderns at Atapuerca in Spain (Arsuaga et al. 1993) only confirms the close relationship between the two hypothetical groups. I say "hypothetical" because we lack any real proof that Neanderthals differed from Moderns in any way other than some skeletal features, and they were certainly a form of *Homo sapiens*. The most probable explanation for their archaic features is that at certain times, determined by the periodic times of cold climate, European populations became isolated from the main body of Old World hominins. The type fossils of the Neanderthals, the late "classical Neanderthals," are far from being typical specimens. They probably represent regressive marginal and inland populations (since we have no evidence whatsoever of the coastal half of the world's Pleistocene human population, be it skeletal, cultural or technological), and to use their very fragmentary DNA data, as has been attempted, to explore the evolutionary history of the human mainstream population of Africa and Asia is futile (cf. Pruvost et al. 2007). The DNA of the original specimen from the Kleine Feldhofer Grotte of the Neander valley probably tells us nothing about the origins of extant humans.

To survive, the replacement model has to deny any knowledge of evidence suggestive of complex technologies and, most particularly, of symboling abilities prior to, in Europe, 40 ka ago. It has done this by several strategies, all of which are now becoming undone. First, most reports of advanced hominin abilities predating the advent of "Moderns" have been rejected out of hand, either as being unreliable or as being susceptible to alternative explanations. Those finds that could not be swept under the carpet were grudgingly accepted as flukes, as the work of unusually gifted individuals, even as evidence of "running ahead of time" in human development (Vishnyatsky 1994). Their claimed small number was often cited as being enough reason to ignore them (Chase and Dibble 1987; Davidson and Noble 1989). When in response it was pointed out that their number was actually very much greater than assumed (Bednarik 1992b), the response was that this still made no difference to interpretation.

Technologies before Eve

A balanced model of human cultural evolution can only be gained from an unbiased study of the technology and symbolic evidence of hominins. As soon as we consider the technological evidence of the Lower and Middle Palaeolithic periods, we encounter a significant bias of preservation—but not of preservation alone. Practically all publications about very early technology deal primarily with stone implements, which is a result of taphonomically imposed limitations. This limits our knowledge of technology very significantly, because in reality, stone tools were always a numerically minor component of early material cultures. Considerations of technology should include not only the use of nonlithic materials, but also the questions of procuring all materials used, their transport, curation, storage, processing, preparation, manufacture, and maintenance.

The very significant underrepresentation of artifacts from relatively perishable materials has prompted distorted technological characterizations of Lower Palaeolithic traditions. For instance, bone, ivory, fiber, leather, or wood are poorly represented, if at all—although there are in fact far more wooden finds from the Lower Palaeolithic than from the Upper Palaeolithic. The technology of Lower Palaeolithic woodworking has never been examined in a consistent and comprehensive fashion, even though we know that the period's stone tools were primarily used to work wood (Keeley 1977). The same applies to the Middle Palaeolithic (Beyries 1988). For instance, microwear studies by Anderson-Gerfaud (1980, 1990) of lithics from Pech de l'Azé, Corbiac, and other sites showed that only about 10 percent were used for working hides, while the majority served to fashion wooden objects. There can be no doubt that astronomical numbers of wooden tools and weapons were made before the Upper Palaeolithic, but almost none survived from the Middle Palaeolithic. From the Lower Palaeolithic, we have a minute sample, but even this has not been considered in a collective technological perspective. An example of sophisticated woodworking from the Lower Palaeolithic is the Acheulian plank of willow wood, shaped and bearing anthropic polish, at least 240 ka old, from Gesher Benot Ya'aqov, Israel (Belitzky et al. 1991; Bednarik 1991). The probably older yew spear point from Clacton-on-Sea, England, and the complete spear found among the ribs of an elephant skeleton at Lehringen, Germany (Jacob-Friesen 1956), have long been known. The hunting spears from Schöningen were carefully fashioned from spruce wood. They are aerodynamically designed, sophisticated hunting weapons, and they are about 400 ka old. Schöningen has also produced other wooden artifacts (Thieme 1995), among them two notched staffs that are thought to have been hafts for stone flakes—the earliest evidence of hafting in the world. There was also a flat wooden artifact found embedded among the remains of a butchered animal, which is thought to be from a lance. Another apparent wooden lance comes from the travertine deposit of Bad Cannstatt (Wagner 1990). A fragment of a Lower Palaeolithic wooden lance or spear was found at yet one more German site, Bilzingsleben, a site that yielded also other wooden fragments. Possible wooden lances (Howell 1966: 139) were found among the many elephant remains of Torralba, Spain. The Kalambo Falls site in Zambia, of the late Acheulian, yielded a number of wooden tools and weapons. Wooden remains are less common from the subsequent Middle Palaeolithic, but we have a thin, worked, and stone-tool-shaped plank of mulberry wood from Nishiyagi, Japan (Bahn 1987); a curved wooden implement with parallel markings on the end from Florisbad, South Africa (Volman 1984), and several shallow wooden dishes from the Mousterian in Abri Romani in Catalonia, Spain.

German archaeologists have also found the earliest solid evidence of resin use for stone-tool hafting. The Mousterian of Königsaue and Kärlich has provided not only resin fragments, but also resin with imprints of both wooden haft and stone tool, as well as the complete hafted tool (Mania and Toepfer 1973). Middle Palaeolithic hafting resin was also found in the Bocksteinschmiede, Germany (Bosinski 1985), and at Umm el Tlel, Syria (bitumen on two tools; Boëda et al. 1996). Hayden (1993) describes the indirect evidence of hafting on Levallois and Mousterian points as "copious," and the tanged Aterian tools of northern Africa were apparently designed specifically for hafting.

A further misapprehension among some archaeologists, that bone points, and the skilled use of bone, ivory, and antler generally, do not appear before the Aurignacian, is also incorrect. Salzgitter-Lebenstedt, a German Micoquian site, alone provides ten bone points, mostly on mammoth ribs, besides the delicate and complex "winged point" and an antler implement (Tode 1953). The polished Bilzingsleben ivory point is not just Lower Palaeolithic, but even seems to bear an engraving (Bednarik 1995b). Ivory points occur also in the Acheulian, for instance possibly at Ambrona, where Howell and Freeman (1982) suggested that they may have been hafted. Even "handaxes" have been made from bone, e.g. the specimen from Rhede, Germany (Tromnau 1983). During the Mousterian, bone was used widely, including for the building of dwellings (at Starosel'e), a use some archaeologists think was restricted to the Upper Palaeolithic.

Despite the dramatically distorted record from the Lower Palaeolithic, there can be no doubt that these hominins as well as those of the subsequent Middle Palaeolithic had a technology that cannot be defined from stone tools alone, the only type commonly found. We also know that underground mining was conducted in the Middle Palaeolithic/MSA (Bednarik 1995d), but perhaps the most dramatic evidence we have of very early technology is that *Homo erectus,* the species before *H. sapiens* appeared, had seafaring capability (Bednarik 1997b, 1997c). We know that hominins reached the island of Flores, in the Lesser Sunda Islands of Indonesia. These islands were never connected to the Asian mainland, at any past sea level, and the only way the hominins could have reached and settled them is by means of seagoing vessels, presumably bamboo rafts. Although we have no skeletal remains of the descendants of these first seafarers, we do have large numbers of stone tools from a series of sites on Flores, and also a find on Timor, further east (Bednarik 1999; Bednarik and Kuckenburg 1999), excavated together with extinct fauna, and dated to 850 or 750 ka at Flores. This is well before the first archaic *Homo sapiens* forms appeared. Even the most determined opponents of the long-range model of symbolic development and language, Davidson and Noble, have always accepted that seafaring ability proves language use, but unfortunately they were unaware that such an ability was available to hominins over three quarters of a million years ago. The evidence for this is by no means new, since it has been available for almost half a century, but until recently only in German (Verhoeven 1958; Maringer and Verhoeven 1970; Sondaar et al. 1994).

While the navigational prowess of *Homo erectus*, the greatest colonizer in the two or three million years of human history (Bednarik 1997d, 1999), is by itself sufficient evidence to show that the capacity of reflective communication, presumably by verbal means (i.e. language), was available at least 850 ka ago, there are still a few other technological points to consider. The construction of rafts is contingent upon the use of cordage of some type, in the form of vines, sinews, fibers, or whatever similar material. This demands further complexities in the available technology. Cordage of any type can only be employed usefully by means of knotting. Strings, ropes, and thongs were no doubt used for much of the Palaeolithic, but we have no physical evidence of knots and almost none of cordage, except from the Upper Palaeolithic (Leroi-Gourhan 1982; Nadel et al. 1994). The use of hunting nets has been suggested for the Gravettian of Pavlov, Czech Republic, after the impressions of weaved plant fibers were observed on burnt clay surfaces of 26–25 ka age (Pringle 1997).

Warner and Bednarik (1996), in reviewing the issue, traced the assumed use of cordage back through its depiction in Upper Palaeolithic art and the much earlier occurrence of drilled objects such as beads and pendants, and via other indirect evidence. This indicates that some form of strings must already have been in use during Lower Palaeolithic times. Artificial perforation of small objects suitable as beads or pendants appears a few hundred millennia ago, according to current knowledge. The kind of technology used in their production seems to provide a realistic means of gauging the true technological capability of the earliest period in the history of humans, the Lower Palaeolithic.

The Origins of Symbolism

One form of symbolism, language, thus probably began its development some time between the appearance of *Homo erectus* (about 1.8 million years ago, at which time the species is found in eastern Africa, in the Caucasus and on Java, and its tools in several other places) and his first known crossing of the open sea (perhaps 0.9 million years ago, from Bali to Lombok and then to Flores). Verbal language is a form of communication that involves the use of conventionalized vocal sounds in meaningful patterns. Any form of complex communication requires the use of symbolisms, and in order to develop beyond simple action and response patterns (which apply, in various complexities, throughout the animal world), culturally determined meanings need to be attached to the "signs." In other words, such meanings are not genetically passed on, but are acquired during the life trajectory of each individual; they are learned. Culture is of course not limited to humans, it is available to many other animals, albeit in considerably less complex forms. In humans culture has reached extraordinary levels of complexity, which are only possible through the use of an unusually large brain.

The question is therefore not really when did culture begin, but rather it should be asked: when did culture (individually acquired systems of "understanding") begin to become such a dominating determinant of selection that it began to rival environmental factors in determining the course of evolution, especially cognitive evolution, for hominins? In other words, when did our ancestors begin to exercise sufficient control over environmental variables that a neural feedback system emerged which led to consciousness, and thus to what we regard as conscious modulation of response patterns? Such a development made the proliferation of cultural systems almost inevitable, and the increasing skill in the use of symbolisms became a necessity. The short-range model of cognitive evolution, epitomized in the African Eve hypothesis, perceives this development as having occurred during the Upper Pleistocene, concurrent with the assumed migration of Moderns out of Africa. All earlier hominins were incapable of symbolism, including language. In the most extreme form of this hypothesis, language is only possible as a result of figurative depiction, of which we have no frequent evidence older than 32 ka (Davidson and Noble 1989), and earlier hominins belong to the apes rather than the humans (Davidson and Noble 1990).

According to the long-range model, this was a slow and gradual process that was already in progress at the time of the first humans. The marked encephalization in the earliest humans, be it in the habilines or *H. ergaster*, which led to massive increase in cranial capacity among early hominins, is seen as being related to cognitive development. The oldest archaeological find known in the world that has been suggested to indicate a hominin ability to recognize iconic resemblance (the visual similarity of two otherwise unrelated objects) is the Makapansgat cobble from South Africa. It cannot occur naturally in the dolomite cave, so it must have been carried almost 3 million years ago into the site, which contained numerous remains of *Australopithecus africanus*. However, it may have been a relative of *Kenyanthropus platyops* rather than an australopithecine who deposited the object in the cave. The unmodified cobble (Figure 7) is of a conspicuously reddish jasperite and has the appearance of a head, with distinctive "staring eyes" and a "mouth"

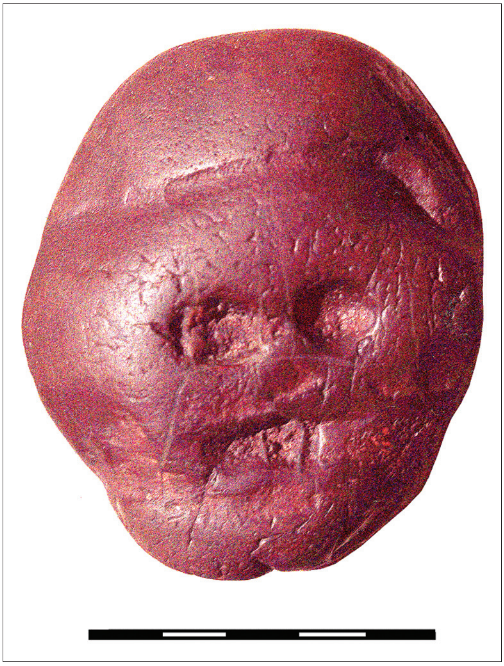

Fig 7 Jasperite cobble from Makapansgat, South Africa, deposited in an australopithecine-bearing cave sediment almost three million years ago; scale in cm.

(Bednarik 1998). "Staring eyes" motifs can lead to visually determined reactions even in insects and birds—responses to them appear to be deeply embedded in neural systems of mammals—and apes as well as humans have a clear preference for the color red (Oakley 1981). While the curation and transport of the stone does not necessarily demand full symboling ability, it does suggest the existence of incipient neural structures that would make it possible to recognize the relationship between signifier and the signified in a more systematic pattern—i.e., symbolism as we define it.

But when could we expect such an ability to have developed sufficiently to have a major impact on the behavior of hominins? By 1.5 million years ago, *Homo erectus* began to produce formalized tools suggestive of mental templates, "handaxes." By that time, that species had successfully occupied vast areas of the Old World, apparently within a geological instant, adapting no doubt to many environments and climates in the process. If there were a hominin predisposition to achieve this, it would have been attempted earlier, so the evidence suggests the availability to this tropical creature of conceptual tools not being available 2 million years ago. By about 850 ka ago, *H. erectus* had acquired seafaring ability and he also used manuports that seem to have no utilitarian significance. He collected two types of minerals and we find them deposited in his occupation sites. Clear quartz crystals occur first in South Africa, soon after in India, and then elsewhere (Bednarik 1994c). Sometimes these are so tiny that they could not possibly have been used as tool material, and they bear no traces of wear. It seems that they were collected for their exotic visual properties, and hominins of the period are also thought to have taken a special interest in fossil casts (Oakley 1981). At about the same time, perhaps 800 ka ago, we have the first evidence that hominins collected red mineral pigments (hematite or ochre), again in South Africa (Wonderwork Cave) and India (Hunsgi), followed much later by several sites in France, Spain, Czech Republic, and several more areas of Africa. We cannot know what the coloring material was used for, except that one of the Hunsgi specimens bears traces of having been used as a crayon on a rock surface (Bednarik

1990). However, it is not very important whether the hematite was used to color rock surfaces, artifacts, animal hides, or human bodies: in all cases such use would imply distinctive cultural behavior. Since the first use of such materials coincides with the first clear evidence of advanced language use, through seafaring, it seems reasonable to propose that by 850 ka ago, hominins had developed numerous distinctive forms of cultural behavior, various forms of symbolism, and technologies that would not be significantly improved until the advent of the Holocene, a mere 10.5 ka ago. At that stage, human society had come to depend so much on culture that we can assume fully modern behavior patterns to have emerged.

One more strand of relevant evidence is provided by the rapid gracilization of all human populations in four continents during the second half of the Late Pleistocene, especially after 50 ka ago. This involved significant reduction of evolutionary fitness (reduction in brain size, skeletal robusticity, and muscle bulk, i.e. physical strength) in a very short time, and a distinctive process of developing neotenous features (Bednarik 2006, 2007, 2008a). Anatomically modern humans are a foetalized form of ape; they share most of the physical features distinguishing them from mature chimpanzees with foetal chimpanzees (Bednarik 2008a). As these deleterious changes occurred uniformly among all populations, a universal explanation seems required, and I have proposed that natural evolutionary processes were suspended and replaced by selective breeding—i.e., domestication. Cultural imperatives were becoming so dominant that they began to control breeding patterns through culturally motivated mate selection. Humans "domesticated" themselves, albeit unintentionally, over the last 40 or 50 ka. The gracilization was clearly led by the females, in Europe especially around 30 ka ago, but by 20 ka ago the males began to catch up. The most parsimonious explanation is that a preference for neotenous females began in the last quarter of the Late Pleistocene, leading to the rapid replacement of robust features. The process has continued throughout the Holocene and can be assumed to remain the main factor in present hominin development. This development is almost entirely controlled by culture nowadays.

It therefore appears that the most likely time frame for the crucial developments in establishing the role of symbolism in human culture is that these developments commenced with the rapid expansion of *Homo erectus*, perhaps 1.8 million years ago, and resulted in structured societies with complex technology, modes of symbol use and effective language about a million years later. From there on, the cognitive and intellectual evolution of hominins merely followed an established trajectory demanding accelerating refinement. There are home bases with established activity zones, increasing use of fire, specialized hunting of very large animals (especially elephants and rhinos), refinement of weapons and artifacts, and increasing use of pigments.

The next major step seems to occur somewhat later, but still in the Acheulian, the perhaps most widespread technological tradition of the Lower Palaeolithic. "Palaeoart" is now being produced in several world regions, and in various forms. Engravings on portable objects of bone, ivory, and stone appear on the available record about 300 ka ago, with the sites Bilzingsleben (Mania and Mania 1988; Bednarik 1995b), Stránská skála (Valoch 1987) and Sainte Anne I (Crémades 1996) being some of the early representatives. The earliest 'protosculpture' is the Tan-Tan quartzite object from the Middle Acheulian of Morocco, with its engraved grooves and hematite coating (Bednarik 2003b). It is followed by the Late Acheulian scoria pebble from Berekhat Ram, Israel, also a natural form altered by human hand (Goren-Inbar 1986; Marshack 1997). Petroglyphs appear first in the Lower Palaeolithic of India, in the form of about 540 cupules and a few engraved lines (Bednarik 1993a; Bednarik et al. 2005). The cupules are particularly noteworthy, because they represent the earliest form of rock art in all continents except Antarctica (Bednarik 2008b). For instance, the oldest known rock art of Europe are the 18 cupules on the underside of a block placed over the grave of a Neanderthal child in La Ferrassie, France (Peyrony 1934), but these are far more recent than those of the chopping-tool period of India, predating the Acheulian at least in Daraki-Chattan Cave, but probably also in Auditorium Cave at Bhimbetka.

It is against this background of other presumed symbolic production that we need to see the first appearance of beads and pendants. If compared to these many other developments, they are no longer unexpected or "unexplainable." By the middle part of the Middle Pleistocene, hominins had mastered many uses of symbols—they had in effect acquired the art of storing information outside their own brains (Gregory (1970: 148; Donald 1991: 124–61). This development, more than anything else in the entire record of human evolution, marks the origins of modern behavior and culture, and thus of modern humans. Therefore, as well as for other reasons, the obsession with finding the origins of *anatomically* modern humans emerges as a rather vacuous issue; in a scientific sense it is as relevant as the origins of the anatomically modern fruit fly.

As the Lower Palaeolithic period gradually makes way for the Middle Palaeolithic in the last part of the Middle Pleistocene, the Levallois technique and the use of "handaxes" continues, but greater differentiation becomes evident in lithic traditions. Symbolic evidence, such as palaeoart (Bednarik 1994c; for a comprehensive summary see 2003a), occurs widely in the Micoquian and Mousterian of Europe, in the MSA of sub-Saharan Africa, and the Middle Palaeolithic (mode 3) industries of Asia and Australia (which in the latter continent continue to the middle of the Holocene, and in Tasmania to European occupation). Middle Palaeolithic seafarers achieved incredible ocean crossings in the region to the north and northeast of Australia (Bednarik 1997d), and underground mining (of ochre and chert) occurs in Europe, two regions of Africa, and in Australia (Bednarik 1995d). None of these developments is attributable to the supposed descendants of Africa's Eve—in fact, there is not a single technological, cognitive, or symbolic innovation that can be traced to their presumed appearance. If that tribe or race ever did exist as a genetically discrete entity, for which there is no evidence other than the claims of *some* geneticists, then that "race" contributed little to the human ascent. All fundamental innovations and achievements predate them, and the greatest or most important are squarely attributable to *Homo erectus*, the predecessor of the various forms of *Homo sapiens*.

Conclusion

It has now become obvious that the hominins who first engaged in symboling practice not only had a great deal of technology at their disposal, they applied and retrieved a variety of symbolic meanings, which could be attached to objects at will, through complex cultural conventions. The practice of wearing such objects as beads and pendants obviously requires a comprehension of the self, of the existence of the individual. Individuality is a central factor in all "decoration," necessarily, and that applies also to the pretense of perfection: there seems to be no reason to wish to project the concept of perfection in the absence of a concept of the self. Self-consciousness with all its implications is an important factor in cognitive evolution, and can be assumed to have been available to select for, probably well before the advent of beads.

In this paper I have argued that the African Eve model, which emphasizes the differences between the "Moderns," the "chosen people" of evolution, and all other hominins, has no archaeological justification whatsoever. From a biological perspective, particularly ethologically, humans are so closely related to other primates that incipient forms of even their most distinctive cognitive abilities can be observed in other species. Human technological ascent and encephalization over the past three million years demand a much earlier appearance of language, culture, and modern cognition than any version of the Eve model could possibly accommodate. The use of symbolic systems demonstrated by seafaring and palaeoart extends certainly several hundred millennia into the past, which deprives the Eve model of all plausibility. The same is demanded by applications of taphonomic logic, to any class of relevant evidence, and I regard this as particularly strong evidence that the African Eve advocates are severely mistaken. Taphonomic logic should have precedence over any other form of archaeological reasoning (Bednarik 1994b).

Finally, the use of such sophisticated objects as beads and pendants in the Lower Palaeolithic demonstrates, beyond reasonable doubt, that its hominins possessed well-established semiotic systems of various types. In examining the origins of symbolism we would be well advised to abandon the traditional focus on the art of the Upper Palaeolithic of southwestern Europe. It played no decisive role in the advent of human symboling capacities, and it is probably not even relevant to the topic of symbolic origins. What *is* relevant to this topic are the products of symbolism that have survived from the earliest phase of human culture, the Lower Palaeolithic. This evidence has so far hardly been considered, but has been neglected widely since its first tenuous mention over 160 years ago. It is especially through this neglect, and through the frequent neglect of evidence not published in the English language, that the precarious models of recent years have been able to flourish as they did.

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