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An Evolutionary Framework for the Acquisition of Symbolic Cognition by *Homo sapiens*

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Human beings are unique in their possession of language and symbolic consciousness. Yet there is no doubt that modern *Homo sapiens* is descendedfrom a nonlinguistic, nonsymbolic ancestor. How might this extraordinary transition have occurred? Slow fine-tuning over the eons is not the answer: the apparent steadiness in hominid brain enlargement over the past two myr is probably an artifact of inadequate systematics, while behavioral innovation was highly episodic in human evolution, and nonsynchronic with anatomical innovation. Evidence for expression of symbolic behaviors appears only very late – substantially after *Homo sapiens* had arrived as an anatomical entity. Apparently the major biological reorganization at the origin of *Homo sapiens* involved some neural innovation that "exapted" the already highly evolved human brain for symbolic thought. This potential then had to be "discovered" culturally, plausibly through the invention of language. Emergence rather than natural selection is thus implicated in the origin of human symbolic consciousness, a chance coincidence of acquisitionshaving given rise to an entirely new and unanticipated level of complexity. This observation may undermine claims for "adaptedness" in modern human behaviors.

Keywords: Human Evolution, language, cognition, symbolism, symbolic consciousness

We human beings have an odd way of perceiving the world around us. Other organisms seem to react more or less directly to the stimuli they receive from the environment, albeit with wildly varying degrees of subtlety and complexity. In witness of our place within the living world we react directly too, as when we place our hand on a hot plate, or duck to avoid a hurled object. But at a higher level we are constantly recreating the world in our heads. Once that object has whizzed by, we start wondering why. We do this by decomposing the continuum of our surroundings into a mass of individual mental symbols, which we then combine and recombine to produce the intellectual constructs to which we react. And given the same facts, it's quite likely that each of us will produce a slightly – or even vastly – different construct. Of course, nowadays it's almost impossible to pick up a behavioral periodical without learning that one of the great apes or some other denizen of Nature has just been observed to exhibit yet another behavior that we had once believed unique to ourselves; and indeed cognitive psychologists have recently reported in this very Journal (Bluff et al., 2007) that New Caledonian crows share with humans and chimpanzees the ability to form and use stick tools – though the authors are wisely reluctant to conclude that parallel cognitive processes are involved in all three cases. Wisely, among other things, because it is important to distinguish between "symbolic" behaviors and those that are merely "intelligent." Our symbolic mode of reasoning is not simply like that of our undoubtedly intelligent (i.e. responsively complex) precursors and relatives, only more so; it is not the result of adding just a little more intelligence, as if filling up a glass. It is instead *qualitatively* different, operating on a different algorithm. Clearly, the intelligence of human beings can be dissected without too much difficulty into the same categories as those used by cognitive scientists to study other primates: memory, attention, inference, representation, and so forth. But the key point is that, even where some kind of continuum can be discerned among primates including ourselves, we *Homo sapiens* don't simply have more of the same; what is critical is how we integrate these elements.

Given that our roots lie deep in Nature we should hardly

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be surprised that we share a lot of our makeup with other creatures, and particularly with our closest relatives. One of the great behavioral revelations of recent years has been that we share with apes certain aspects of what we recognize as "culture," in the sense that some great ape populations also show local behavioral traditions that are passed through the generations by learning – in one case at least, apparently over millennia (Mercader et al., 2007). In a wider sense, however, the vastly varying cultures of modern humans are qualitatively different from anything we see amongst the great apes, principally because much of what makes human cultures unique lies in the abstract belief systems on which they are based, rather than on simple direct imitation. And on another cognitive level, what is truly *different* about human beings is that, based on our symbolic abilities, we have a generalized and apparently inexhaustible capacity for generating new behaviors when presented with new stimuli.

Certainly it is our symbolic cognition, rather than any of our many physical peculiarities, that gives us our very strong sense of apartness from the rest of Nature. Despite our very many cognitive as well as physical similarities to our closest living relatives, we do indeed appear to be most strikingly separated from the latter by a profound if narrow cognitive gulf. Yet at the same time there is equally no doubt that our species *Homo sapiens* is descended from an ancestor that lacked our unique cognitive mode. In other words, at some point a human precursor somehow managed the transition from one cognitive state to the other. How might this gulf have been spanned? Was this bridging achieved, as many authors in fields from neurobiology to archaeology (e.g. Deacon, 1997; Pinker, 1997; McBrearty and Brooks, 2000) appear to believe, via an insensible gradation of improvements over the eons through slow, steady honing by natural selection? If we did emerge in this way, we might be justified in concluding with the evolutionary psychologists that we *Homo sapiens* have been fine-tuned by Nature for those behaviors that are universal to members of our species. Alternatively, though, did we acquire our cognitive uniqueness in a shorter-term event, as the sheer qualitative nature of the difference between us and even our closest relatives might indicate? And if the latter, just when might this event have occurred? Given their profoundly different implications, these two basic alternatives clearly warrant investigation.

The most direct potential approaches to such investigation lie in the examination of the fossil and archaeological archives of the human past. Sadly, though, cognition in itself leaves no imprint in the tangible record. As a result, in trying to understand the evolution of our unusual cognitive mode we have to seek proxy systems. One obvious proxy for increasing cognitive and behavioral complexity that we

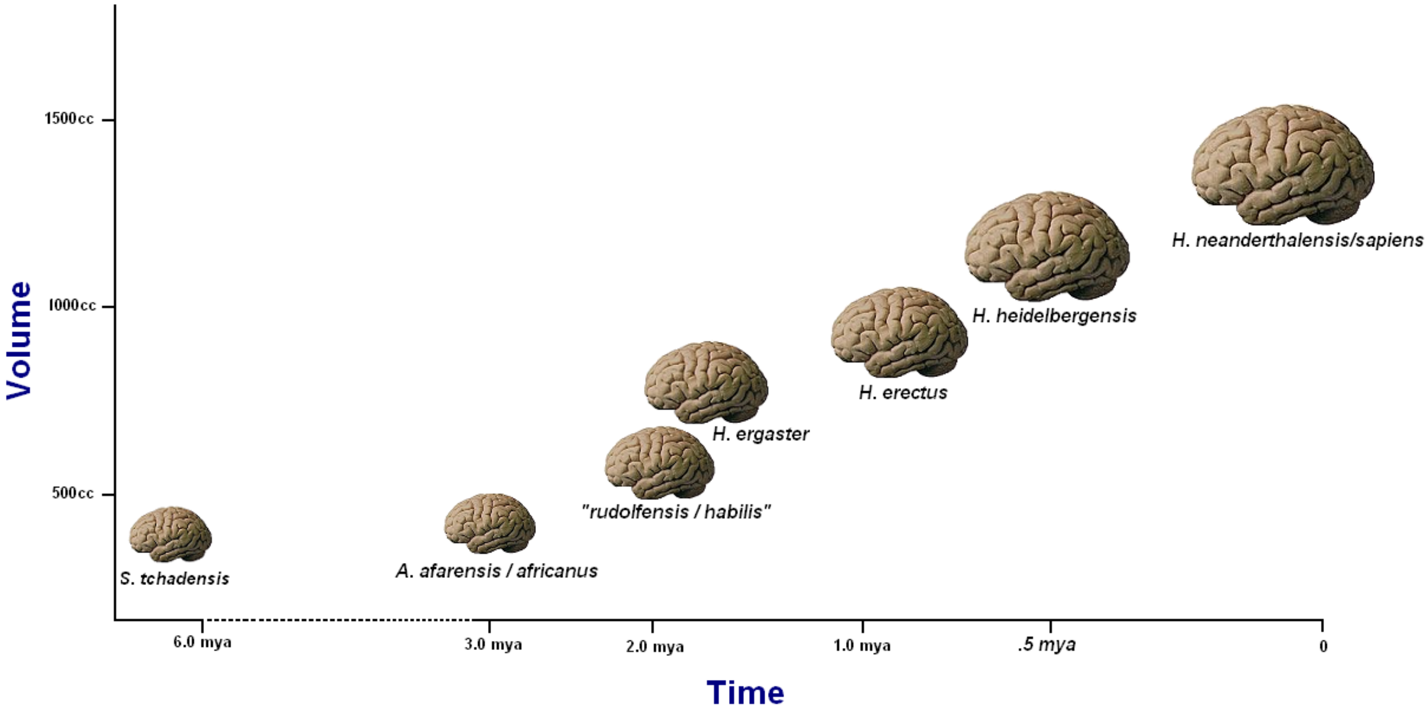

Figure 1. *A crude plot of average hominid brain sizes against time. Although, following an intial flatlining, this plot appears to indicate a consistent enlargement of the hominid brain over the last two million years, it is important to bear in mind that these brain volumes are averaged across an unknown number of different lineages within the genus Homo, and that it is likely that what the plot reflects is the preferential success over this period of larger-brained hominid species, rather than steady increase within a single lineage. Illustration by Gisselle Garcia.*

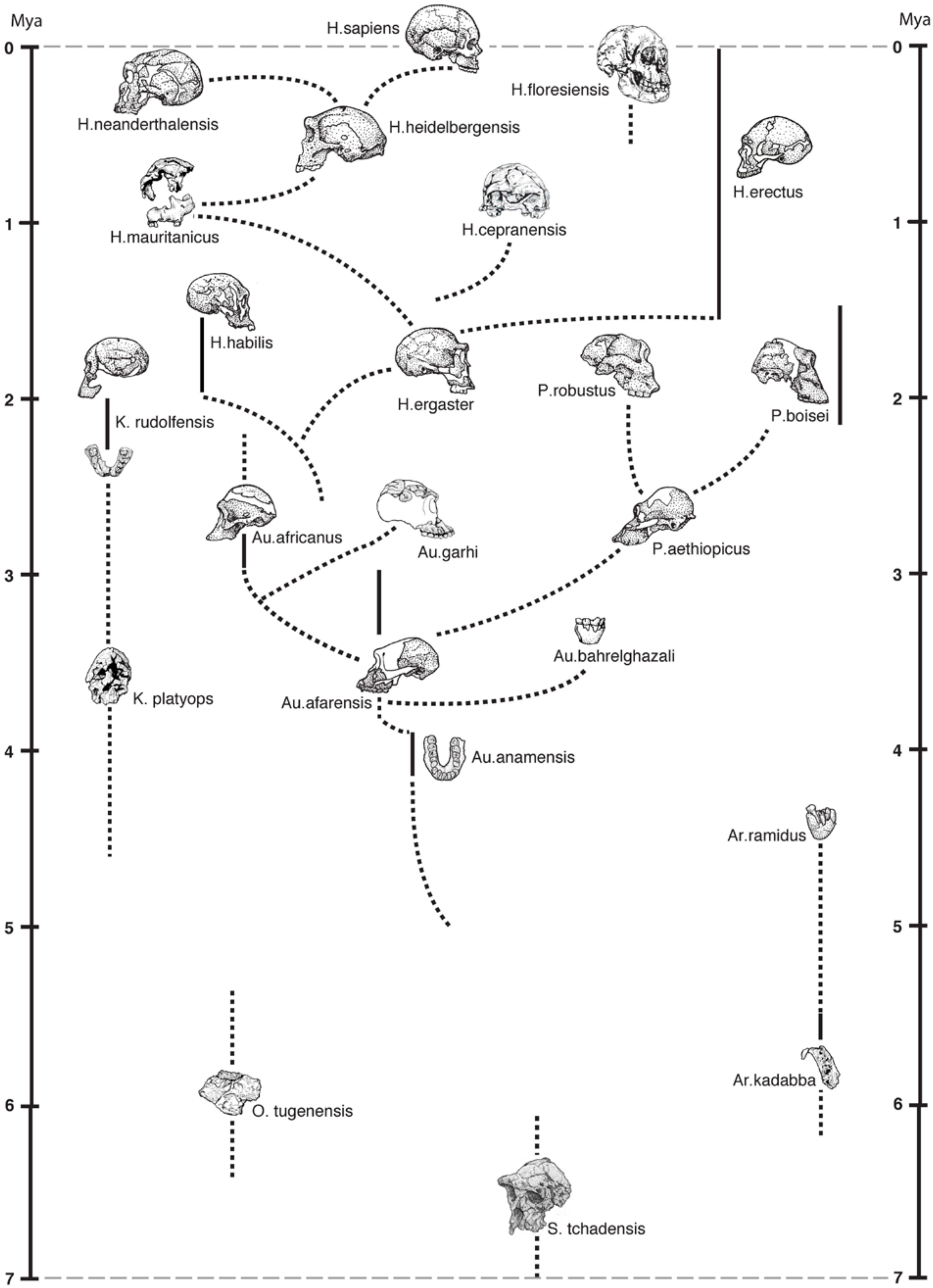

Figure 2. *One possible scheme of phylogenetic relationships within the family Hominidae, with time on the vertical axis. Solid lines show stratigraphic ranges. Many of the details of relationship are entirely conjectural, and this diagram shows most importantly that typically several different hominid species have coexisted at any one point in time. It is very much the exception that Homo sapiens is the lone hominid in the world today. ©Ian Tattersall.*

might look for in the fossil record, the material testament to our biological past, is the brain sizes of earlier hominid species, particularly in proportion to their body sizes (e.g. Jerison, 1991; Holloway et al., 2004). And indeed, a superficial look at a typical diagram such as that appearing in Figure 1 makes the situation appear pretty straightforward: an essential flatlining of hominid brain size over the first five of the seven million years of the existence of the Family Hominidae (the zoological grouping that includes *Homo sapiens* and all of its extinct relatives that are not equally or more closely related to apes), followed by a steady trend of increasing brain size over the past two million years or slightly less. Two million years ago, hominid brains remained essentially within the range relative to body size that is bracketed by the great apes today; a million years ago they had doubled in size; and today our brains are twice as large again. This trend certainly seems to suggest a two-million-year sustained pattern of inexorable increase in brain size – and by extension in "intelligence" – under the beneficent hand of natural selection; and this would certainly have to have been the case if hominid history had indeed taken the form of a single slowly modifying lineage: a simple if dogged slog from primitiveness to perfection.

There is, however, a fundamental problem with this picture, namely that for many years now the strong signal emerging from the hominid fossil record has increasingly been one of diversity. This rapidly enlarging record makes it evident (see Figure 2) that, from the beginning, many species and lineages of hominids have typically been out there (Tattersall, 2004; Schwartz and Tattersall, 2005). At almost all points on the timescale, several hominid species have typically existed at the same time – and even on the same landscape (Tattersall, 2000). Indeed, as "normal" as the splendid isolation that underpins the linear view may appear to us in our present unusual circumstances, it appears to be very much the exception, rather than the rule, for *Homo sapiens* to be the lone hominid on Earth. In the woeful current state of hominid systematics (we are still recovering, with glacial slowness, from the unilinear model of hominid evolution that was bequeathed to us by the "Evolutionary Synthesis" that dominated evolutionary theory in the mid-twentieth century) we do not have a clear idea of how many hominid species predated the arrival on Earth of *Homo sapiens*, let alone what their stratigraphic or brain-size ranges were. All we can suggest with any confidence is that there were a lot of them around – and that independent trends toward brain size increase can be detected in at least three separate lineages within the genus *Homo* (the lineages that include the species *H. erectus, H. neanderthalensis, and H. sapiens*). Knowing exactly what underpinned these independent but equally metabolically costly trends will be critical in developing a full picture of just what it was that ultimately made modern human consciousness possible; but for the present the most we can say based on the kind of data presented in Figure 1 is that over the past couple of million years larger-brained (hence, presumably, smarter) hominid species seem across the board to have preferentially survived in the competitive arena, to give rise to descendent species. This by itself is surely telling us something important about our family Hominidae, or at least about our genus *Homo*, and about the way its members have interacted with the world around them. But right now it is hard to say exactly what that something is, although it remains a good bet that it lies somewhere within the domain of cognition, and quite likely of social behavior as well.

Revisiting the material record with considerations of this kind in mind thus seems worthwhile. In this review I shall attempt to approach the questions of pattern in human evolution generally, and of the early evidence for symbolic behaviors in particular, by looking briefly at the human fossil record, and more particularly at the archaeological record that documents the development of (primarily technological) hominid behaviors since the invention of stone tool making some 2.5 million years ago. Bluff and colleagues (2007: 1) rightly warn that "tool-related behaviour is not necessarily associated with unusually sophisticated cognition;" but in the context of the emergence of our uniquely human behavioral characteristics it is often the only proxy we have for the putatively increasing levels of cognitive sophistication that existed among our forebears.

Early Hominids

The hominid record goes back to the latest Miocene and the early Pliocene, roughly the period between about seven and four million years ago. In this formative phase several claimants exist to the title of the earliest hominid (Gibbons, 2006), their most important common feature being their adoption of upright bipedal posture and locomotion while on the ground. In many cases this adaptation is claimed on fairly slender evidence (Schwartz and Tattersall, 2005). However, few would argue nowadays that upright bipedalism was not the innovation on which all later developments in hominid evolution were founded, and it is significant in itself that even at this very early stage the hominid family tree was already "bushy" (Figure 2), with several different species and even genera experimenting with the evidently many different ways in which it is possible to be a hominid. Following the four million-year mark small-bodied early bipeds flourished and diversified widely in their natal continent of Africa, all of them retaining relatively "archaic" body proportions with relatively short legs, narrow shoulders, conical thoraxes, flaring pelves, long extremities, and so forth. All of these forms were still adept climbers and they appear to have been dependent to some extent on the shelter of trees.

But their adaptation does not appear in any way to have been a "transitional" one between forest and open ground, for their basic body plan remained stable for many millions of years. During this period hominids were essentially creatures of the forest edges and surrounding woodlands, in a continent where climatic drying and increasing seasonality was breaking up formerly monolithic forests (Maslin and Christensen, 2007). Given their unusual combination of traits, it is not uncommon nowadays for paleoanthropologists to describe these early hominids as "bipedal apes," since despite the many departures from the ancestral condition that they showed below the neck and to some extent also in their dentitions, these creatures still sported skulls in which, as in apes today, a tiny braincase lay behind a projecting face with large teeth. The contrast could hardly be more dramatic with modern human skull structure, in which a tiny face lies tucked underneath a large, balloon-like braincase (Figure 3).

At around 2.5 million years ago (Schick and Toth, 1993) the first stone tools mark the inauguration of the archaeological record. The earliest hominids that have been claimed to belong to our own genus *Homo* date to about this time, too, though the morphological evidence for this assignment is tenuous (Schwartz and Tattersall, 2005) and no firm association has yet been established between very early stone tools and any potential manufacturer. The closest thing to such an association is between cut-marked animal bones and the 2.5 million year-old *Australopithecus garhi* (Asfaw et al., 1999), which was one of the "bipedal apes." On the balance of current evidence it thus seems highly likely that the early "Mode 1" stone tools Figure 4), which consisted largely of irregular but invariably sharp-edged flakes produced by bashing one rock of suitable quality with another, were made by a hominid with archaic body proportions and a brain little if any larger than one might expect for an ape of his or her body size. If this is true we have here, right at the beginning, an example of a pattern that is later repeated again and again throughout hominid history: technological innovations are *not* associated with the emergence of new kinds of hominid. While this might at first appear a little counterintuitive, it actually makes eminent sense: for such innovations are necessarily made by individuals, who cannot differ too much from their own parents or offspring.

Prior to the invention of stone tools we have little reason

Figure 3. *Skulls in side view showing the dramatic difference in proportions between the facial and neurocranial skeletons of a chimpanzee (left) and a modern human (right). In the center is a cranium of* Australopithecus afarensis*, typifying the generally apelike skull proportions of the early bipeds. Illustration by Gisselle Garcia*

Figure 4. *Replica by Peter Jones of a Mode 1 stone tool, consisting of a small cobble (the "core") with several flakes knocked off it by blows from a hammerstone. Various kinds of cores have been identified, but at least as important in the tool kit were the small, sharp flakes. Photograph by Willard Whitson.*

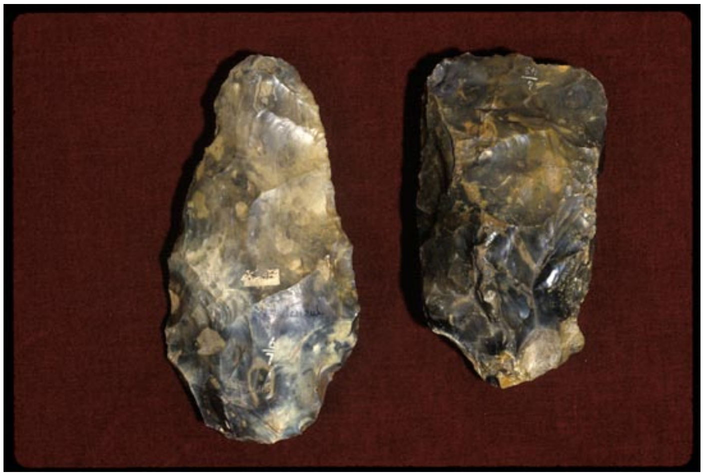

Figure 5. *A pointed Mode 2 handaxe (left) and a cleaver from deposits at St. Acheul, France. Both of these implements are typical of the "Acheulean" stoneworking tradition that derives its name from this site. Photograph by Willard Whitson.*

to suppose that the early bipeds were significantly different in cognition from today's admittedly remarkable apes. But with this technological innovation there can be little doubt that hominids were moving into new cognitive territory. For even though, after intensive coaching, some captive great apes have shown substantial improvement in their stone tool-making skills (e.g., Schick et al., 1999), Samuel Johnson would still, I think, have had to conclude that when all is said and done the act is (like a dog walking on its hind legs) remarkable for being done at all rather than for how well it is done. What is more, beyond the fact that the first hominid stone tool makers had spontaneously invented not merely a new but an entirely unprecedented behavior that involved a considerable degree of hand-eye coordination as well as an impressive level of conceptual complexity, these hominids clearly showed a degree of foresight and planning in anticipation of future needs (Schick and Toth, 1993) that is uncharacteristic of any great ape today. Thus, while the exact ramifications of this new behavior remain entirely unknown in terms of the wider behavioral repertoires of the ancient toolmakers and of the quality of their subjective experience of the world, we are amply justified in believing that the invention of stone tool making was witness to a significant cognitive advance among early hominids relative to their hominoid ancestor.

On the other hand, while the invention of stone tools offered hominids a host of lifestyle opportunities that had not existed before, as far as can be told this innovation did not usher in an era of restless exploration of these new possibilities. Instead, it was a million years before another significant innovation appeared in the technological record, at about 1.5 million years ago. This was the invention of the "Acheulean" Mode 2 handaxe, a largish and bilaterally symmetrical stone tool that was carefully shaped to a predetermined form by multiple blows to both sides (Figure 5). Typically teardrop-shaped, or ovoid with one oblique edge, tools of this kind were clearly made – sometimes in "workshops," in huge quantities – to a "mental template" that the toolmaker had in mind before the stone knapping started. The earliest stone tool makers had simply sought to obtain a particular attribute: a cutting edge; but with the appearance of the handaxe we see evidence for a totally different mindset. After a million years of technological stasis it seems reasonable to take this radically different approach to stone tool making as an indication of another significant cognitive advance that among other things involved an enhanced capacity to create mental representations, though once more the limitations of the record prevent us from discerning what its wider behavioral ramifications might have been.

Significantly, though, the appearance of this new technology significantly postdated the arrival on Earth of a new kind of hominid, often known nowadays as *Homo ergaster*. Best exemplified by the remarkably-preserved "Turkana Boy" skeleton from deposits some 1.6 million years old in northern Kenya (Walker and Leakey, 1993), and also represented (see Wood, 1991) by a variety of less complete materials in the 1.9 to 1.4 million-year range, *Homo ergaster* was an entirely unprecedented hominid form. It was tall and long-limbed; and despite a variety of dissimilarities in detail, it possessed the essential proportions of the modern human body skeleton. Here at last was a striding hominid suited to life out in the expanding African savannas, far from the shelter of the trees. Above the neck *Homo ergaster* also showed a radical departure from the bony anatomy of the bipedal apes that preceded it, although its face was still strongly built and its brain volume was little more than half of ours today. Yet for all its many physical innovations, this new species continued for several thousand years to make stone tools that were to all intents and purposes identical to those its predecessors had been making for the best part of a million years, and any refinements in lifestyle associated with the new body form remain for the moment entirely conjectural. Once again, we see a disconnect in time between the emergence of a new kind of technology and that of a new kind of hominid.

Yet lifestyle ramifications there undoubtedly were, because hard on the heels of the acquisition of fundamentally modern body proportions we find hominids exiting the continent of their birth for the first time. The 1.8 million year-old site of Dmanisi, in the Republic of Georgia, has yielded the exquisitely-preserved remains of several hominids (which have – perhaps somewhat dubiously – been assigned to *Homo ergaster* or a similar form: Gabunia et al., 2000), and claims have been made that some specimens of *Homo erectus* in Java are evidence for the presence of hominids in eastern Asia as early as 1.8-1.6 million years ago (Swisher et al., 1994). An early exodus of the genus *Homo* from Africa is also bolstered by the findings of stone tools at sites such as the 1.6 million-year old Riwat, in Pakistan (Rendell and Dennell, 1987). It is pretty clear that some behavioral acquisition related to its new body structure had enabled *Homo* to leave Africa for the first time; but it remains unclear exactly what that acquisition was. It was not a new and better technology, for the stone tools found at Dmanisi and Riwat are no more sophisticated than those made by the very early stone tool makers; and it did not depend on the possession of a significantly larger brain, because the skull vaults of the hominids from Dmanisi are notably small: marginally larger than those of the bipedal apes, but smaller than those of the first *Homo ergaster* known from East Africa.

As far as can be told, aside from the invention of the Acheulean in Africa (its spread beyond that continent occurred considerably later) the history of the genus *Homo* in the period between about two and one million years ago seems largely to have been one of local diversification across the Old World, but without radical physical or as far as we can tell cognitive innovation. It is not until about 600 thousand years ago that we find, again first in Africa, a new kind of hominid with a significantly larger brain (within the rather wide modern size range, although well below the modern mean). This is *Homo heidelbergensis* which, as its name suggests, rapidly became a cosmopolitan species with representatives now known from Africa, Europe (starting about 500 thousand years ago) and China. Its earliest African occurrence (at Bodo in Ethiopia) is in association with Mode 1 stone tools, indicating a much later transition between Modes 1 and 2 here than at other localities in Africa, and underscoring the disconnect between hominid types and stone toolmaking styles.

In Europe, too, the stone tools associated with *Homo heidelbergensis* tended at least initially to be rather crude, as at the classic 450 kyr site of Arago, in southern France (de Lumley, 1986). On the other hand, we do find some important technological innovations within the time range of this species. In Israel, a 90 thousand year-old site has produced the earliest evidence we have of the sustained domestication of fire in hearths (Goren-Inbar et al., 2004), although this crucial innovation does not appear to have been adopted as a regular feature of hominid life until about 400 thousand years ago – which happens also to be the approximate age of the earliest known structures, huts erected on an ancient beach at Terra Amata on France's Mediterranean coast (de Lumley and Boone, 1976; Figure 6). The domestication of fire would appear on the face of it to have been a momentous innovation in human prehistory. It underpinned later lifestyles, and provided not only warmth (presumably important in higher latitudes) and the far-reaching digestive benefits of cooked food, but a social focus and a unique form of protection from predators, particularly at night. It might seem a little odd, then, that so much time elapsed between the initial signs of controlled fire use and the general adoption of this behavior among hominids. Perhaps what we are seeing here is merely a vagary of the record; but equally possible is that this is yet another example of a general hesitancy among early hominids to adopt new technologies, seen earlier on in such things as the failure of Acheulean technology to spread rapidly beyond Africa. It is quite likely, indeed, that mul-

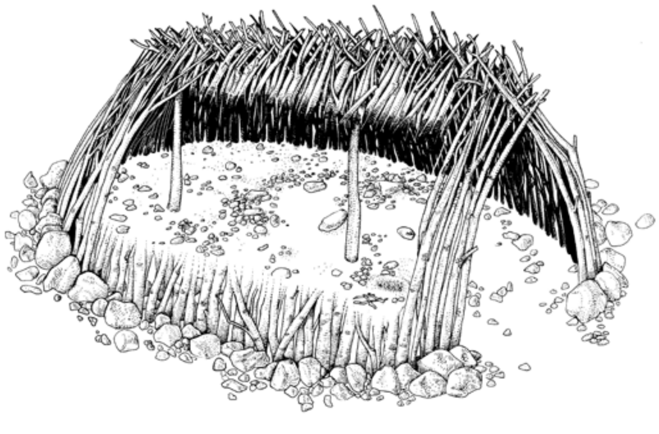

Figure 6. *Artist's reconstruction of one of the ~400 kyr-old shelters excavated at Terra Amata, in southern France. Made from saplings embedded in the ground and brought together at the top, this hut may or may not have been waterproofed with hides. In this view the side is cut away to show a hearth, containing blackened bones and stones, that lay just inside the gap in the reinforcing ring of stones believed to represent the entrance. Drawing by Diana Salles after a concept by Henry de Lumley.*

tiple inventions and extinctions were required before many of the behaviors that intuitively appear to us today as profoundly hominid became established. Clearly, there is not a one-to-one relationship between the potential to exhibit specific behaviors and their expression. What is more, the existence of controlled fire is not absolute proof of the ability to *make* fire, since wildfires could presumably have served at least sporadically as a source. Whether making fire requires a significantly more complex cognitive state than using fire is another open question: modern humans are both fire-makers and fire-users, while our closest living relatives are neither, depriving us of any observable model. Whatever the case, fire use by itself is prima facie evidence of a complex behavioral pattern involving not only planning and foresight (both present among the earliest stone tool makers) but an elaborate behavioral sequence and flexibility in response to conditions. Clearly, the manipulation of fire by early hominids required a significant amount of "intelligence;" but it is far less evident that this intelligence needed to be symbolic, as ours is. Indeed, the record of *Homo heidelbergensis* is remarkable for its entire lack of any unambiguously symbolic objects. Intuitive, nondeclarative reasoning processes can apparently underpin impressively complex behaviors.

Also from the 400-kyr time period come the miraculously-preserved long wooden throwing spears of Schoeningen, in Germany (Thieme, 1999). Made in a material that only preserves under exceptional circumstances, these spears were carefully shaped to concentrate the weight toward the front, as in modern javelins, and were apparently intended for throwing rather than for thrusting. Athough their penetrating power has been questioned, they suggest that *Homo heidelbergensis* may have developed more sophisticated ambush-hunting techniques than are suggested by the stone tool record in isolation. Once again, we see a strong hint that the stone tools that for obvious reasons comprise the vast bulk of the Paleolithic archaeological record are only telling us a very small part of the overall story of early hominid lifestyles. Still, it is also within the tenure on Earth of *Homo heidelbergensis*, albeit quite late in that span, that we see the next major innovation in stone tool making. This is the "prepared-core" (Mode 3) tool, whereby a lump of suitable rock was carefully shaped on all sides until a single final blow could detach what was a more or less finished tool, with a continuous cutting edge right around its periphery (Figure 7).

Figure 7. *Replica by Dodi Ben-Ami of a Mode 3 flake tool, with the core from which it was detached. The careful preparation of the core ensures that the final flake tool will have a long, continuous cutting edge. Photograph by Willard Whitson.*

Clearly, the record left by the fairly large-brained *Homo heidelbergensis* and/or its contemporaries suggests a cognitive sophistication for which we do not see evidence earlier in time. However, it is doubtful that any aspect of Paleolithic stoneworking technology can be taken even as prima facie evidence for symbolic reasoning, and as noted there is nothing associated with *Homo heidelbergensis* that can convincingly be interpreted as a symbolic object. The same is true even of the Neanderthals, *Homo neanderthalensis*, an extinct hominid species endemic to Europe and western Asia that came on the scene some 200 thousand years ago and had a brain fully as large as our own. Neanderthals made stone tools in the Mode 3 style that were exquisitely crafted and often very beautiful, but they made them rather monotonously throughout the large area and long time-span that they inhabited. They clearly had enormous adroitness and high imitative skills; but they evidently lacked the creative spark of the *Homo sapiens* who entered their domain and entirely evicted them from it in the approximately ten millennia following their incursion about 40 thousand years ago; and they apparently related to the world around them in a very different fashion. Even the practice of burying the dead, unquestionably invented by the Neanderthals at some time following about 100 thousand years ago, did not necessarily (and probably did not) have the same significance to the Neanderthals as it has to us; and although we can legitimately recognize a profound aspect of what we recognize today as "humanity" in the evidence that they looked after disadvantaged members of the social group (Trinkaus and Shipman, 1993), only with extreme difficulty can we accept either of these behaviors as substantive evidence of symbolic cognitive processes. Members of *Homo neanderthalensis* clearly reacted to stimuli from the surrounding social and external environments in very sophisticated ways; but they most probably did not remake those worlds in their heads.

The Arrival of Homo sapiens

Both the fossil and the molecular records strongly indicate that, as an anatomical/biological entity, *Homo sapiens* had its origin in Africa at some time between about 200 and 150 thousand years ago. Among other evidence, crania from the sites of Herto (White et al., 2003), and Omo Kibish (McDougall et al., 2005) in Ethiopia, and Singa in Sudan (Grün and Stringer, 1991) indicate the presence of *Homo sapiens* or something very much like it in subsaharan Africa within this time period; and and unarguable *Homo sapiens* is certainly present at the site of Jebel Qafzeh in Israel by about 93 thousand years ago (Valladas et al., 1988). The archaeological assemblage associated with the Herto finds combines elements of both Modes 2 and 3, a few Mode 3 implements have been associated with an Omo specimen, and the well-documented stone tool assemblage at Jebel Qafzeh is closely similar to both earlier and later Mode 3 assemblages associated with Neanderthals at nearby sites. In other words, *Homo sapiens* seems to have come into the world bearing a technology that was basically indistinguishable from those of its contemporaries and immediate predecessors – repeating the pattern of disconnection of anatomical from behavioral innovation that had apparently applied throughout the hominid record.

It is only in the period following about 100 thousand years ago that we begin to find any convincing evidence of symbolic behavior patterns among populations that we can recognize as, or reasonably suppose to have been, *Homo sapiens*. The earliest stirrings of symbolic behaviors have been discerned in the use of space at the South African shelter site of Klasies River Mouth, dated to around 100 thousand years ago. At this site the living space seems for the first time to have been divided up into different functional areas, a behavior that can be argued to be symbolic (Deacon and Deacon, 1999). But for tangible artifacts that can be construed as symbolic we have to wait for some time yet. The site of Blombos Cave, a little to the west along the southern African coast from Klasies, has yielded small ochre plaques bearing distinct geometrical designs (Henshilwood et al., 2003). Not everyone is happy to see these objects as symbolic; but the notion that they are has been quite widely accepted, and is reinforced by the finding in the same 75 thousand year-old levels at Blombos of small shells apparently pierced to be worn as a necklace (Henshilwood et al., 2004). Body ornamentation is one of the most fundamental reflections of the human symbolic sensitivity, with extensive cultural ramifications, and the interpretation of the Blombos shells as beads has been supported recently by a similar finding at the 82 thousand year-old Grotte des Pigeons site in Morocco, at the opposite extremity of the African continent (Bouzouggar et al., 2007).

There are various somewhat later examples of putative early symbolism at other African sites, including engraved ostrich eggshell beads (Ambrose and Lorenz, 1990). However, soon after Blombos times southern Africa was essentially depopulated by drought lasting for several tens of thousands of years, in which case these early South African manifestations of the human symbolic spirit may simply have been an early behavioral experiment that ultimately did not give rise to later cultural developments. Whatever the case, the most stupendous early outpourings of the human creative spirit currently known are found rather later in time, in Europe. Following about 40 thousand years ago, the native Neanderthals found their tranquillity, such as it may have been, disrupted by a new kind of hominid moving in from the east and south. These newcomers, known locally and informally as Cro-Magnons, were *Homo sapiens* who were modern not only in their anatomical characteristics but in their behaviors too. From the very beginning, the Cro-Magnons showed evidence of the entire amazing behavioral panoply that characterizes symbolic *Homo sapiens* worldwide today. Exactly where and how this new and unprecedented suite of behaviors had been acquired by the ancestors of the Cro-Magnons is unknown, although it is a reasonable bet that its ultimate source was Africa. But the material testimony to the new spirit that the Cro-Magnons left us in Europe is so far unsurpassed. Well over 30,000 years ago these humans were painting stunning images on the walls of caves, creating exquisite carvings, playing music on remarkably sophisticated flutes, and keeping records and making notations on plaques of bone (White, 1986). Tool kits were unprecedentedly varied and were made using a greater variety of materials than ever before, all worked with a subtle appreciation of their particular mechanical qualities. Before long, the Cro-Magnons were finely sewing garments using tiny eyed bone needles, and were even baking ceramic figurines in simple but remarkably effective kilns.

The Neanderthals also left behind a copious material record of their existences: a record that makes them by far the best-known of any extinct hominid species. Inhabiting the same place at the same time, the Neanderthals thus provide the ideal contrast with Cro-Magnons: a contrast in which we can perceive the dimensions of the latters' uniqueness – and of ours too, since the Cro-Magnons were undoubtedly *us* in the most profound of senses. Aside from a handful of very short-lived and geographically limited apparently Neanderthal cultures, dating from the early days of Cro-Magnon occupation of Europe, that incorporated certain elements of Cro-Magnon technology – and the significance of which is hotly debated – we see a very clear pattern of abrupt replacement of Neanderthals by Cro-Magnons, at site after site. There is little if any credible evidence for biological mingling of the two populations – which had last shared a common ancestor over half a million years ago (Krings et al., 1997) – and although we do not know its precise cause, there is a high probability that the extinction of the Neanderthals was directly related in some way to the arrival of *Homo* *sapiens* (see discussion in Tattersall, 1999). The Neanderthals had successfully occupied a very difficult set of terrains through a long period of constantly shifting and sometimes very severe climatic conditions, and there is no doubt that they were capable and resourceful hominids, admirable in many ways. Still, there can be little question that their disappearance was linked to the fact that they perceived and related to the environment around them very differently than the Cro-Magnons did – and that we do today.

It is in just this difference that we may most reasonably seek the fundaments of our own cognitive uniqueness in Nature. And without doubt the most striking behavioral contrast that we see between the archaeological records of the Neanderthals and the Cro-Magnons is to be found in comparing the essentially symbol-free material productions of the former with the quite evidently symbol-drenched lives of the latter.

There is little if anything in the Neanderthal record that can be convincingly seen as intended to represent anything in the external or abstract worlds. And while it seems fair to say that the large-brained Neanderthals may well have achieved the maximum that is possible using intuitive, nondeclarative means of reasoning, it is also reasonable to conclude that the reason why we are here today, and they are not, lies in our unique symbolic condition, our ability to imagine alternate worlds. Moreover it is this quality, above all, that underwrites the fact that while throughout hominid history, up to and including the Neanderthals and other contemporaneous hominid species, substantive change in lifestyles and technologies seems to have been been typically rare and highly sporadic (Figure 8), the Cro-Magnons launched upon a trajectory of constant cultural ferment and change, inaugurating the cycle of technological and behavioral innovation that still characterizes and indeed dominates our species today.

So What Happened?

Despite the fact that *Homo neanderthalensis* boasted a brain as large as that of its Cro-Magnon contemporaries it is not, perhaps, particularly surprising that these two morpho-

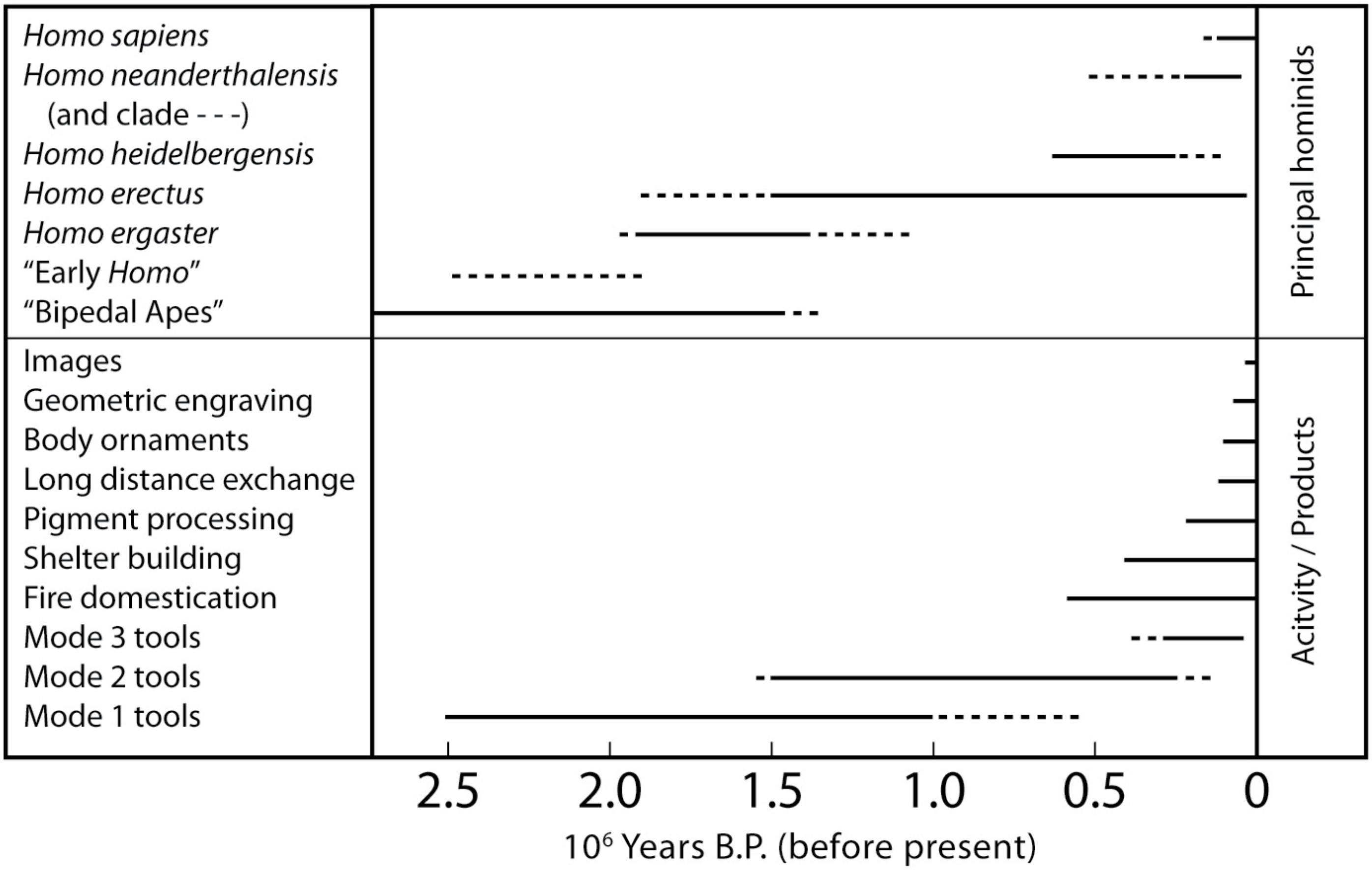

Figure 8. *Chart summarizing the chronologies of various major species of the genus Homo and some of the most significant technological/cultural innovations made over the 2.5 million years since the invention of stone tool making. Although the time spans indicated are approximate, there is a clear disconnect between the times of appearance (and disappearance) of new technologies and new species. Chart drawn by Jennifer Steffey.*

logically distinctive and fairly distant relatives apparently lay on opposite sides of the symbolic/nonsymbolic gulf. For while the superabundance of metabolically expensive brain tissue in both cases can only be explained by a countervailing advantage in terms of "intelligence," the *kind* of intelligence involved was not necessarily the same in both cases. Indeed, the disparate behavioral record of the two suggests that to assume that it was involves excessive anthropomorphizing. What may thus on the face of it seem more remarkable is that we do not see any convincing evidence of symbolic behavior – and certainly no indisputable symbolic artifacts – until long *after* anatomically recognizable *Homo sapiens* had arrived on the scene. In the Levant, anatomically distinctive early *Homo sapiens* behaved, as far as can be told, pretty much as the Neanderthals had done for tens of thousands of years both before and after the episode of occupation by early moderns; and earlier *Homo sapiens* or near-*Homo sapiens* in Africa are invariably associated with much more archaic stone tool industries than those characteristic of the Cro-Magnons in Europe. Modern human behaviors, then, began to be expressed only when modern anatomy had already been long established; and we thus have to make a conscious mental effort to distinguish between "behaviorally archaic" and "behaviorally modern" *Homo sapiens*. This is so even though there is no way to distinguish between these two forms of *Homo sapiens* in zoological taxonomy (except through subspecific distinction, which would raise its own substantial difficulties).

Still, there is nothing much in this scenario to raise eyebrows, for the wider paleontological record shows that the pattern of disconnection between innovation in structure and in behavior typical for hominids is far from confined to that group. The ancestors of birds, for example, possessed feathers for many millions of years before co-opting them into indispensable adjuncts of flight (Norell, 2005). Indeed, it is self-evident that all innovations have to arise independently of any function(s) to which they might eventually be put. After all, the origin of biological novelty is essentially a random affair invoving genetic copying error, and as a result no novelty can ever arise *for* anything. Natural selection and those other processes that are active in shaping evolutionary histories cannot generate new features, however desirable their possession might be; they can capitalize only on what is spontaneously presented to them. For the most part, indeed, those forces act simply to eliminate deleterious novelties. Only much more rarely do they promote the new; and even then they are not – they cannot be – creative forces that drive the new into existence.

Homo sapiens appears to be highly derived in many of its skeletal characters, whereas it is quite probable that the skeleton of *Homo neanderthalensis* is more primitive in many respects for the genus *Homo*, or at least for its immediate clade (Tattersall and Schwartz, 2006). In such features the Neanderthals appear to be fairly typical members of the genus *Homo*, and comparison with them serves very effectively to illustrate the extraordinary peculiarities that *Homo sapiens* displays throughout the skull and skeleton (Figure 9). The precise ancestry of *Homo sapiens* among known potential close fossil relatives is unclear. But what is quite evident is that the distinctive osteolology of *Homo sapiens*, postcranial as well as cranial, resulted from a short-term genetic/developmental reorganization that, whatever its mag-

Figure 9. *Composite skeleton of a Neanderthal (left) compared with that of a modern human of similar stature. The differences are striking throughout the skeleton: in addition to the very distinctive skull structures, note particularly the dramatically different proportions of the thorax and pelvis, features which would have produced a very different appearance on the landscape. Given that it is likely that the Neanderthal more closely represents the conformation of the common ancestor, the comparison serves to emphasize the scope of the biological reorganization that accompanied the origin of* Homo sapiens *as an anatomical entity. Photograph by Ken Mowbray ©AMNH.*

nitude on the structural genetic level, had major developmental ramifications throughout the body skeleton. And it is far from implausible to conclude that this reorganization, already manifest in fossils of the 200-150 thousand-year range, may have extended beyond simple osteology to other, less tangible, aspects of the human makeup.

Klein and Edgar (2002) have suggested, in contrast, that the astonishing symbolic behaviors exhibited by *Homo sapiens* subsequent to some 50 thousand years ago resulted from some genetic acquisition made at that much later point in time. Such an acquisition might have been facilitated by the possible genetic bottlenecking event (a reduction of the human population to perhaps as few as a few thousand) that the molecular record suggests occurred at some time before this (see review by Harpending and Rogers, 2000); but, if so, it was an innovation that affected only those structures directly related to cognition, and that left no imprint on the bony elements that preserve in the fossil record. Moreover, this scenario would require the wholesale, Old-World-wide, replacement of nonsymbolic populations of skeletally identical *Homo sapiens* by symbolic ones in an extremely short time frame. And it would also cast doubt on the earliest African putative expressions of symbolism as features of the true creative human spirit as we understand it today.

None of these possibilities can be dismissed out of hand. Still, it is far more likely that the neurological underpinnings of the human symbolic capacity were born in the major genetic/developmental reorganization that resulted in the physical entity *Homo sapiens* as we know it today – but that the *expression* of this underlying capacity had to await release by some cultural (White, 1982) rather than biological acquisition (Tattersall, 2004). This, of course, begs the question of what this cultural acquisition might have been; and it is hardly original to suggest that the prime candidate for the cultural releasing agent of the human symbolic capacity is the invention of language, facilitated by an already existing neural substrate. It is difficult if not impossible for us today to imagine symbolic thought in the absence of language (at least as a property of the species as a whole), or vice versa: all normal modern humans have both. And the notion that the two features emerged interdependently, on the basis of an existing but previously unexpressed biological substrate, not only agrees well with what we know of evolutionary processes in general, but also eliminates the necessity of having to explain the origin of either in isolation.

In a provocative and influential contribution attacking the notion that early African anatomically modern *Homo sapiens* were "behaviorally primitive," McBrearty and Brooks (2000) discerned elements of what they saw as "modern" behavior patterns extending back as far as 250 thousand years and more. Most of the behaviors they documented are, however, technological; and, as already observed, it is dubious whether any aspect of Paleolithic stoneworking technology can be used as a proxy for symbolic cognitive processes. Yes, the dazzlingly creative Cro-Magnons typically made "blade" tools (Figure 10): implements based on flakes more than twice as long as wide. But this does not mean that we can take African blade industries from as long ago as a quarter-million years or more as prima facie evidence that their makers were symbolic. Even such behaviors as the transport of desirable materials over long distances (presumably by exchange among contiguous populations) which was a notable feature of Cro-Magnon behavior and is documented in Africa to around 140 thousand years ago, constitute rather hollow evidence for the full-fledged human sensibility. By 140 thousand years ago, of course, anatomically modern (and thus potentially behaviorally modern) humans were already on the scene; and, especially if we view behavioral modernity as a cultural rather than as a biological acquisition, it is only reasonable to suppose that the entire potential of the modern human creative capacity was not discovered at once. Indeed, we are still discovering new ways of employing that capacity today. But only with the production of overtly symbolic objects can we be confident that this sensibility had emerged. For, as we have seen, convincing examples of such objects only begin to show up much later, and the "time lag between the appearance of anatomical modernity and perceived behavioral modernity" to which McBrearty and Brooks (2000: 453) take exception does on current evidence appear to be a real phenomenon.

Interestingly, it was over the matter of the emergence of modern human cognition that Charles Darwin and Alfred Russel Wallace, the co-inventors of the notion of evolution by natural selection, experienced the only truly profound disagreement ever to fissure their professional relationship. For Darwin (1871), natural selection was unambiguously the explanation for the appearance of humanity in all of its complexity. "If [the intellectual and moral properties of man]," he wrote, "were formerly of high importance to primeval man and to his ape-like progenitors, they would have been perfected or advanced through natural selection." (Darwin 1871: vol. 2: 153). Wallace, on the other hand, was less convinced: "How could "natural selection," or survival of the fittest in the struggle for existence," he asked, "at all favour the development of mental powers so entirely removed from the material necessities of savage men, and which even now, with our comparatively high civilization, are, in their farthest developments, in advance of the age...?" (1870: 351-352). Sadly, his subsequent conclusion that "a superior intelligence has guided the development of man in a definite direction" (1870: 359) has clouded Wallace's reputation ever since. But his central perception that for the reasons already elaborated natural selection could not have propelled human

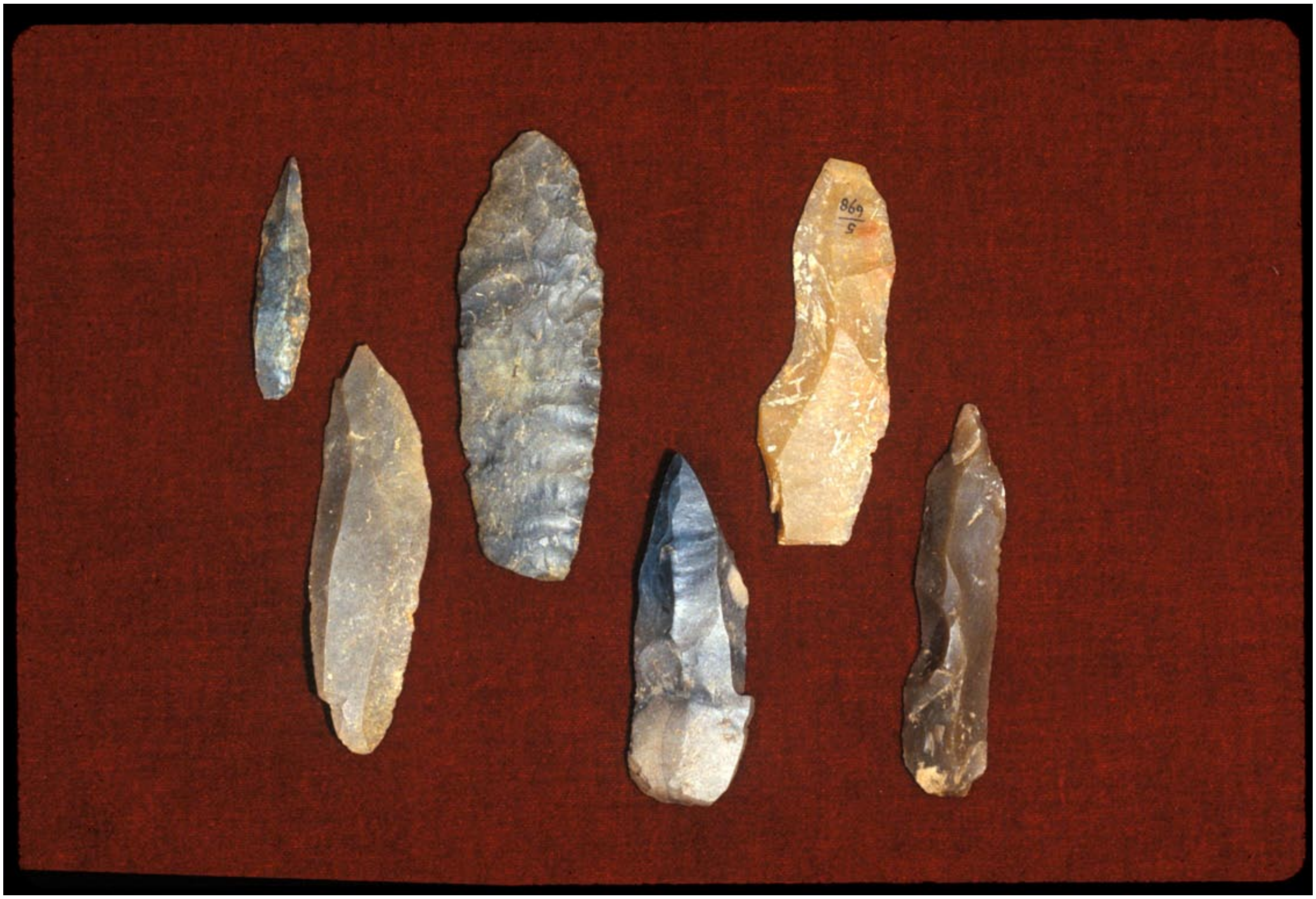

Figure 10. *Cro-Magnon blade tools in flint, from various sites and periods in western France. From blanks more than twice as long as wide, struck from a single cylindrical core, a whole variety of different tools could be fashioned. Photo by Ian Tattersall.*

consciousness into existence was clearly an accurate one; it was only his choice of mechanism – constrained by the knowledge and beliefs of his day – that was in error.

In hindsight it is possible to see that both men were right, each in his own way. Darwin was correct to conclude that human consciousness is the ultimate product of a long and accretionary process of brain evolution that ultimately reaches back to the most rudimentary origins of the craniates, almost 400 million years ago. No step along this long road could have been taken in the absence of any of the others that preceded it; but the key in the human case lies in the fact that, although a brain capable of producing modern human consciousness was the outcome of this extended evolutionary journey, it was not *predicted* by any aspect of it. In other words, as Wallace so clearly realized, human symbolic reasoning is not simply an extrapolation of this extended history, simply a little bit more of the same. It is, instead, something truly new and unpredicted by what went before – even by the increase in the mass of metabolically expensive brain tissue that seems to have independently characterized several lineages within the genus *Homo*, though it was clearly dependent on this development. And while Wallace was regrettably unable to profit from our modern perspective, today it is possible to see that the origin of modern human consciousness must have been an emergent event, whereby an entirely unanticipated level of complexity was achieved by a sheer chance coincidence of acquisitions. Evidently by the time *Homo sapiens* came on the scene the hominid brain (possibly in multiple lineages; this is certainly true in terms of brute size) had evolved to a point at which a single random change – or genetically related group of changes – was sufficient to generate a structure with an altogether new potential. What exactly this change was, is beyond my expertise to speculate, although numerous suggestions have been made: one intriguing suggestion is that a neural system linking the basal ganglia and other subcortical structures with the cortex, and initially adapted for motor control, was coopted to cognitive functions (Lieberman, 2006, 2007); another possibility is of a mutation affecting working memory or phonological storage capacity in the prefrontal cortex (Coolidge and Wynn, 2005). Whatever it was, like the keystone of an arch this innovation had the effect of supporting an entirely novel function. And this new function had to be discovered by its unwitting possessor, something that evidently occurred only some tens of thousands of years after the acquisition of the enabling biological substrate.

Remarkable as its product undoubtedly is, the scenario I have just sketched is something that is perfectly routine in evolutionary terms. We do not have to adduce any special rules to explain the unusual hominid result. But humdrum as the mechanics may be, the implications of this sequence of events are profound for our own view of ourselves. Since the middle of the twentieth century, the paleoanthopological mindset has been dominated by the Evolutionary Synthesis, a highly reductionist formulation in which virtually all evolutionary change in the genus *Homo* has been ascribed to the generation-by-generation modification of gene frequencies in a gradually transforming central lineage. Under this construct, natural selection has been steadily fine-tuning our lineage in all of its features, including those related to cognition. This is by itself improbable in light of the fact that all traits are inextricably linked via a complex interacting genetic system that ultimately expresses itself in whole individuals rather than in disembodied traits whose history we can independently track. And were we indeed fine-tuned in the way the Synthesis suggested, the “human condition” would presumably be something relatively straightforward to describe. Variations there would be, of course, but central tendencies in human behavior would be evident, and some at least of the numerous cases of apparent “maladaptation” in the human psyche could plausibly be ascribed to a recent “environment of evolutionary adaptation” that, as a result of lifestyle change, no longer exists.

Yet it is clear that on the cognitive and behavioral levels the modern human condition is impossible to specify. Individuals can readily be found to illustrate both extremes of any pair of moral or behavioral or intellectual antitheses it is possible to imagine. Fortunately, we are victims of the normal distribution in behavioral as well as in physical traits, which means that most individuals lie close to the average in these features, promoting social cohesion and making societies easier to organize. And social organization itself feeds back into basic regularities of behavior that can indeed be exegecized by philosophers and sociobiologists. But the realization that the human capacity is emergent, rather than fine-tuned, makes it simpler to understand why, cognitively, today’s *Homo sapiens* presents itself as such a bizarre and elusive entity. And it fits quite comfortably with the extensive recent accretions to the fossil record that make it plain that from the very start hominid phylogeny has been a story of extensive evolutionary experimentation, with multiple species originations and extinctions transforming what once appeared as an elegant slender family tree – essentially, an updated version of the *scala naturae* of the medieval scholastics – into an untidily branching bush (Figure 2). In this bush it is evident that in the past – indeed, until very recently – it has been routine for several different types of hominid to coexist not simply in the world but even in the very same place. That we *Homo sapiens* are the lone hominid in the world today tells us a great deal about quite how unusual we are; and it does not necessarily bespeak a comfortable reality.

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