

Chapter 1

THE ORIGINS OF MODERN HUMAN BEHAVIOR

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ABSTRACT

To explain human behavior through its present-day manifestations is like considering illness through its symptoms instead of its causes. A psychology that explores human behavior purely by analyzing its observed extant expressions, without recourse to how or why these may have developed, lacks a scientific context, which demands causal explanations. In this chapter, it is attempted to show that an etiology of human behavior would be achievable if a better-targeted database could be extracted from Pleistocene archaeology and paleoanthropology. Nevertheless, a rudimentary model of how and why hominin behavior patterns developed in the Pleistocene is presented here. In particular, "behavioral normality" is explored through the available empirical information and the rise of brain illnesses during the most recent history of our species. The establishment of self-awareness and consciousness is considered, as well as the role of "theory of mind" in the development of behavioral patterns. The advent of extra-cranial storage of symbolic and cultural meanings is also of relevance, as well as the development of constructs of reality in the cognitive evolution of hominins. In considering this etiological context of modern human behavior it is demonstrated that a judicious utilization of relevant data obtainable from the archaeological record can yield a realistic paradigm.

INTRODUCTION

In essence, psychology is the study of the human "mind" and behavior, generally through experiments, observations and questionnaires, but can also include animal studies,

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particularly ethology. The humanist concept of "mind" is broadly intended to refer to conscious experience and intelligent thought but lacks a clear-cut definition as a specific entity. Instead of assuming that mind exists, it may be more productive to ask, what are the neural and endocrine processes that make up the system that has traditionally been called the human mind, how do they work, and how can their interplay be described. Not surprisingly, psychology is widely seen as a "soft science," or as lacking the overarching or universal theory required of a proper science (Kuhn 1962). Its principal shortcoming, however, is perhaps that it is essentially observing and recording "symptoms," and from them creating taxonomies and remedies. But this does not constitute a valid etiology of conditions, even though they are expressed by "normal" or "aberrant" behavior. In considering the psychology of human behavior, as this volume professes to attempt, it is not adequate to describe such behavior in normative terms that are, for all practical purposes, its own results. In the first instance it is necessary to inquire into the primary causal explanations: what are the features in the human neural system that elicit observable effects?

This task, of course, falls to the neurosciences and endocrinology rather than traditional and essentially humanist psychology. However, there is a more important dimension to these issues: just as disease can only be understood from the perspective of its etiology rather than through its symptoms, any effective comprehension of human behavior involves the investigation of its origins. As Marks and Nesse (1994: 259) observed, "even if we knew every connection of every neuron, every action of every transmitter, our understanding would remain inadequate until we also knew the function for which those mechanisms were shaped." Inevitably, no such comprehension is possible without involving evolutionary psychology and indeed the field of hominin ethology—the study of the behavior of the human ancestors. This chapter will attempt to address that issue on the basis of the current, albeit quite limited and in certain ways flawed, knowledge.

The replacement of humanist psychology with scientific modes of investigation is a symptom of the inevitable general process of supplanting the "soft sciences" with the "hard" (Becher 2001; Bednarik 2011a), a slow but inevitable course. Just as astrology was replaced with astronomy, or phrenology with neuroscience, in many of its practices traditional psychology lacks the rigor of a scientific discipline. Phenomena that are of interest to it, such as emotion, thinking, or personality, cannot be quantified effectively and with a semblance of objectivity (Panksepp 1998: 9). The improbably high support research has reported for initial hypotheses in psychology and psychiatry (Sterling 1959; Klamer et al. 1989; Fanelli 2010) is several times that yielded in the hard sciences, indicating systematic bias. The logical and methodological rigor employed to test hypotheses varies systematically across disciplines and fields. Papers in psychology, psychiatry, and business studies report positive testing of hypotheses five times as often as space science, while the biological disciplines rank intermediate. Studies applying behavioral and social methodologies on people rank 3.4 times higher than physical and chemical studies on non-biological material, using the same index of confirmation bias (Press and Tanur 2001). The social sciences are thus qualitatively different from the hard sciences (Shipman 1988; Latour 2000; Simonton 2004; Bishop 2007; Bednarik 2011a), and psychology and psychiatry, in particular, "pretend to be sciences, offering allegedly empirical observations about the functions and malfunctions of the human mind" (Szasz 2006).

Another "social science" of importance in the context of considering the origins of human behavior is Pleistocene archaeology, the field professing to study traces of early

human behavior. The available information of archaeology is much more circumscribed than the limitations of available data would demand, for reasons that will shortly be considered. In addition to the dearth of knowledge itself, systematic misapplication of it to conform to preconceived notions of what the data should show is widespread (Bednarik 2012). Of all the "soft sciences," archaeology is arguably the softest. In contrast to the other humanities, archaeology, especially Pleistocene archaeology, offers no falsifiability. By its very nature, it cannot generate propositions that are testable—at least not without the help of hard sciences, usually physics or the earth sciences. It is then not a matter of a low rate of refutations, as in psychology or psychiatry, but hypotheses are not even presented as internally falsifiable propositions. Instead they are rated on the basis of "authority" (Lewis-Williams 1993). Some archaeologists themselves have defined the discipline as a political pursuit (Trigger 1984, 1989; Kohl and Fawcett 2000; Silberman 2000); it creates narratives about past cultures and societies for the presently dominant powers, the states. In this it is guided by Darwinist rationale: the apparent overall technological and somatic improvements foster the concept of inevitable "progress," be it cultural or somatic. This is a flawed notion even before it is examined closely. Both cultures and societies clearly evolve and devolve (Henrich 2004), and corresponding but also different effects can be observed in the human species as such (Bednarik 2011b), if degeneration were seen as devolution. The idea that evolution yields some "ideal" ultimate state permeates all of archaeology and colors all of its models, with the glorious descendents of the "African Eve" representing the final purpose of the evolutionary ascent: a creature in the image of a deity. In this nauseating self-glorification our species ignores that it is rapidly "devolving," as will be shown below.

The concept of a relentless progress derives from this self-delusion, guiding Pleistocene archaeologists in their expectations and thereby contaminating all hypothesis-building the field is capable of generating. In reality, cultural development is not a continuous upward process; there is no ultimate goal, and there are examples of cultural and technological "devolution." For instance after the Tasmanian Aborigines were separated from the Australian mainland tribes by the island's sundering toward the end of the Pleistocene, their cultural and technological abilities declined gradually (Jones 1977, 1978). Complex systems science predicts that the volume of information that can be stably maintained over time is limited by the propensity for introducing error in generational information transmission (Andersson 2011). This effect was first noted in the relationship between the length of genetic sequences and the rate of error in RNA replication (Eigen and Schuster 1977). As the mutation rate increases beyond a crucial point, the system of short-term memory carriers can no longer maintain a long-term memory. If cognition were the main constraint on technology—the mantra Pleistocene archaeologists are committed to—any early appearance of sophistication would be impossible, except by a "running ahead of time." But locally narrow specializations, such as in maritime technology, or technological forays during a small number of generations that failed to persist in the long run, may have had limited prospects of being retained over time. Technological conservatism was adaptive for hominins, complex systems science predicts. Most importantly, intelligence was driven by social factors, not by technology, which was not limited by some cognitive potential maximum sophistication. After all, cognitive evolution cannot be driven by selection for its technological effects, because cognitive capabilities simply must precede any technological expressions they might reasonably lead to (Alvard 2003). Andersson (2011) predicts that hominins must generally have been smarter than their technological traces—which are in any case significantly

misinterpreted—might lead us to believe. As he points out, this is the case today with modern humans, and it applies equally to other extant primates. In short, lowest common denominator technology, the kind archaeology might be able to recover, is no measure of cognitive potential, or of potential technological sophistication. The problem, according to complex systems theory, is in long-term transmission and maintenance of innovations and innovative practices. Neither Pleistocene archaeology nor paleoanthropology has applied any of these crucial points, and so they continue to deliver tainted explanations for their data.

The problem with these under-developed disciplines is identified by Kuhn (1962) who has shown that, in its earliest stages of development, a discipline can be completely fragmented theoretically and methodologically. Its course can be determined by different schools of thought that interpret the same phenomena in radically different ways. This is a condition that seems to characterize many fields in the social sciences and possibly some of the biological sciences as well (see also Cole 2001; Bednarik 2011a), but is particularly prominent in Pleistocene archaeology (Bednarik 2011b, 2011c, 2012). Data describing human or non-human behavior are inherently noisy in any discipline, and are open to alternative interpretations. Among the unconscious biases involved is that the human subjects of behavioral study can be subconsciously aware of researchers' expectations, and behave accordingly (Barber 1976; Shipman 1988; Latour 2000), and the tendency to hypothesize after the results is known (Kerr 1998).

THE STATE OF PLEISTOCENE ARCHAEOLOGY AND PALEOANTHROPOLOGY

There are a number of profound problems in science that, if solved, are guaranteed to revolutionize human comprehension of the world. Are non-carbon-based life forms possible? How does the brain create linguistic representations, or how does recursive language work? Is a unified theory of physics possible? What about string theory? How does self-awareness work, what is the self? Many of these most fundamental issues are connected with humans themselves, simply because these ultimately affect all other dimensions of human understanding. Some of them appear to have been solved, such as the question how human nature came about (Bednarik 2011b). Here it will be attempted to respond to the question, how did "modern human behavior" as we know it originate.

Since the origins of human behavior cannot possibly be considered without the relevant historical context, which is inevitably created by archaeology and paleoanthropology, it is requisite that this chapter begins by examining the quality of the information these disciplines are capable of providing. The inadequacies of mainstream Pleistocene archaeology (Bednarik 2012) range from the inability to create emic knowledge or testable propositions to a litany of epistemic, taxonomic, and ethical problems that have led to an historical trajectory of the discipline marked by an endless list of mistakes and blunders. One of the earliest was the categorical rejection, by all archaeologists, of customs official Jacques Boucher de Crèvecœur de Perthes' (1846) proposition that humans coexisted with Pleistocene fauna, thus delaying the acceptance of the Paleolithic for several decades. In fact the matter had to be resolved by two geologists, Prestwich (1859) and Falconer. Next, all archaeologists rejected the proposition of fossil humans, when teacher Johann Carl Fuhlrott (1859) presented the remains

from the Neanderthal. Again it took several decades to decide in favor of the non-archaeologist. Then Marcelino Santiago Tomás Sanz de Sautuola's (1880) proposal of Pleistocene cave art was so brusquely rejected by all archaeologists that it drove this amateur into a premature death. It took decades before the notion of Paleolithic art was grudgingly accepted by archaeology, after several other non-archaeologists had presented indisputable evidence (Cartailhac 1902). In the meantime, physician Eugene Dubois proposed that he had found the remains of a species intermediate between apes and humans in Java, only to be greeted by a chorus of derision and rejection from physical anthropologists and archaeologists. It took again several decades before his *Homo erectus* found acceptance. By then the titled and publicly funded academics had already embraced the finds from Piltdown as the "missing link," and it took them almost four decades to realize that they had been duped by a simple hoax. And it took again a non-archaeologist, Kenneth Oakley (Weiner et al. 1953) to reveal this. When anatomist Raymond Dart presented the first australopithecine remains in 1925, they were not rejected; they were simply ignored, in the safe knowledge that humans had evolved, very fittingly, in God's own country, England. The full viciousness of the discipline of archaeology is well illustrated by the Glouzel affair, which began in 1924 with the discovery of the extensive site complex by teenager Émile Fradin. It led to the attempted salting of the site by celebrated archaeologist Dorothy Garrod in November 1927, and to Fradin being beaten by police and indicted for fraud in 1928, action prompted by the president of the French Prehistoric Society, Felix Regnault. Fradin was only exonerated in March 1932, and since then the authenticity of the Glouzel finds has been proven by avocational archaeologists.

These are only some of the more prominent examples, but they show the general pattern: all important ideas in archaeology, especially Pleistocene archaeology, have been presented by people other than professional archaeologists, and they were typically rejected by the entire academic discipline. In most cases these serious errors of judgment were eventually corrected through the work of non-archaeologists. Anyone suggesting that archaeology might have learnt from this historical trajectory is mistaken. On the contrary, the frequency of erroneous announcements by professional archaeologists and paleoanthropologists has increased in recent decades, as has their viciousness whenever they found themselves contradicted by scientists. When in 1995 all commenting archaeologists claimed that a series of petroglyph sites in the lower Côa valley of northern Portugal and at nearby Siega Verde in Spain are of the Upper Paleolithic (Zilhão 1995), several scientists subjected themselves to a fully blind test and found that the Côa rock art is relatively recent, most being only a few centuries old (Watchman 1995, 1996; Bednarik 1995a). For this they were severely attacked, threatened, abused, and defamed, and their science was declared fraudulent by the archaeologists. While the evidence in favor of the scientists has since increased, no credible evidence for the archaeologically claimed age has come forth. A recent quantification of the fluvial erosion of dated inscriptions and petroglyphs at nearby Siega Verde has shown conclusively that both are generally less than 200 years old (Bednarik 2009). Another recent example (there are many others) of an archaeological and paleoanthropological blunder concerns the attribution of some primate bones found in the cave Liang Bua in Flores, Indonesia (Morwood et al. 2004). Since they have been reported, the bones have been attributed to a gibbon-like creature, an australopithecine, a relative of *Homo georgicus* or *Homo habilis*, a dwarf *Homo erectus*, or a modern microcephalic human. In other words, the collective opinion is that these primate remains are of a creature somewhere between an ape

and a modern human. To know that, one does not need paleoanthropologists, it is obvious to anyone; and this shows the significant problems with their guesswork discipline. The unseemly spectacle of unscholarly behavior accompanying these debates does little to inspire confidence in them. But the perhaps greatest example of a recent blunder by Pleistocene archaeologists refers to the most debated archaeological issue of recent decades, and one that is of central importance in the present chapter: the origins of "modern" humans (bearing in mind that "we have never been modern"; Latour 1993).

The notion that the "Upper Paleolithic" was introduced into Europe from Africa has been around for a long time, for instance Dorothy Garrod of Glozel fame had believed in this invasion. In 1973 Professor Reiner Protsch "von Zieten" proposed that modern humans arose in sub-Saharan Africa, presenting a series of false datings (Terberger and Street 2003; Schulz 2004) of presumed "modern" fossil specimens over the following years (Protsch 1973, 1975; Protsch and Glowatzki 1974; Protsch and Semmel 1978; Henke and Protsch 1978). This was developed into the "Afro-European *sapiens*" model (Bräuer 1984), and a few years later the "African Eve" complete replacement scenario appeared (Cann et al. 1987; Stringer and Andrews 1988); followed by the Pennisi (1999) model, the "wave theory" (Eswaran 2002), the Templeton (2002) model, and the "assimilation theory" (Smith et al. 2005), among others. Of these, the mitochondrial Eve model is the most extreme, contending that the purported African invaders were a new species, unable to interbreed with the rest of humanity. They are said to have replaced all other humans, be it by exterminating or out-competing them. However, there were significant problems with the African Eve theory right from the start. The computer modeling of Cann et al. (1987) was botched and its haplotype trees were fantasies that could not be provided with time depth even if they were real. Based on 136 extant mitochondrial DNA samples, it arbitrarily selected one of 10^{267} alternative and equally credible haplotype trees (which are very much more than the number of elementary particles of the entire universe, about 10^{70}). Maddison (1991) then demonstrated that a re-analysis of the Cann et al. model could produce 10,000 haplotype trees that were actually more parsimonious than the single one chosen by these authors. Yet no method could even guarantee that the most parsimonious tree result should even be expected to be the correct tree (Hartl and Clark 1997: 372). Cann et al. had also mis-estimated the diversity per nucleotide (single locus on a string of DNA), incorrectly using the method developed by Ewens (1983) and thereby falsely claiming greater genetic diversity of Africans, compared to Asians and Europeans (they are in fact very similar: 0.0046 for both Africans and Asians, and 0.0044 for Europeans). Even the premise of genetic diversity is false, for instance it is greater in African farming people than in African hunters-foragers (Watson et al. 1996), yet the latter are not assumed to be ancestral to the former (see e.g. Ward et al. 1991). Cann et al.'s assumption of exclusive maternal transference of mitochondria was also false, and the constancy of mutation rates of mtDNA was similarly a myth (Rodriguez-Trelles et al. 2001, 2002). As Gibbons (1998) noted, by using the modified putative genetic clock, Eve would not have lived 200,000 years ago, as Cann et al. had claimed, but only 6000 years ago. The various genetic hypotheses about the origins of "Moderns" that have appeared over the past few decades placed the hypothetical split between these and other humans at times ranging from 17,000 to 889,000 years BP. They are all contingent upon purported models of human demography, but these and the timing or number of colonization events are practically fictional: there are no sound data available for most of these variables. This applies to the contentions concerning mitochondrial DNA ("African Eve") as much as to those citing Y-chromosomes ("African

Adam"; Hammer 1995). The divergence times projected from the diversity found in nuclear DNA, mtDNA, and DNA on the non-recombining part of the Y-chromosome differ so much that a time regression of any type is extremely problematic. Contamination of mtDNA with paternal DNA has been demonstrated in extant species (Gyllensten et al. 1991; Awadalla et al. 1999; Morris and Lightowlers 2000; Williams 2002), in one recorded case amounting to 90% (Schwartz and Vissing 2002). Interestingly, when this same "genetic clock" is applied to the dog and implies its split from the wolf occurred 135,000 years ago, archaeologists reject it because there is no paleontological evidence for dogs prior to about 15,000 years ago (Napierala and Uerpmann 2010; but see Germonpré et al. 2009). The issues of base substitution (Lindhal and Nyberg 1972) and fragmentation of DNA (Golenberg et al. 1996) have long been known, and the point is demonstrated, for instance, by the erroneous results obtained from the DNA of insects embedded in amber (Gutierrez and Marin 1998). Other problems with interpreting or conducting analyses of paleogenetic materials are alterations or distortions through the adsorption of DNA by a mineral matrix, its chemical rearrangement, microbial or lysosomal enzymes degradation, and lesions by free radicals and oxidation (Geigl 2002; Carlier et al. 2007).

Since 1987 the genetic distances in nuclear DNA (the distances created by allele frequencies) proposed by different researchers or research teams have produced conflicting results (e.g. Vigilant et al. 1991; Barinaga 1992; Ayala 1996; Brookfield 1997), and some geneticists concede that the models rest on untested assumptions; others even oppose them (e.g. Barinaga 1992; Hedges et al. 1992; Maddison et al. 1992; Templeton 1992, 1993, 1996, 2002, 2005; Brookfield 1997). The key claim of the replacement theory (the "Eve" model), that the "Neanderthals" were genetically so different from the "Moderns" that the two were separate species, has been under severe strain since Gutierrez et al. (2002) demonstrated that the pair-wise genetic distance distributions of the two human groups overlap more than claimed, if the high substitution rate variation observed in the mitochondrial D-loop region (see Walberg and Clayton 1981; Torroni et al. 1994; Zischler et al. 1995) and lack of an estimation of the parameters of the nucleotide substitution model are taken into account. The more reliable genetic studies of living humans have shown that both Europeans and Africans have retained significant alleles from multiple populations of Robusts (Hardy et al. 2005; Garrigan et al. 2005; cf. Templeton 2005). After the Neanderthal genome yielded results that seemed to include an excess of Gracile single nucleotide polymorphisms (Green et al. 2006), more recent analyses confirmed that "Neanderthal" genes persist in recent Europeans, Asians, and even Papuans (Green et al. 2010). "Neanderthals" (use of this term here is only to comply with established jargon and implies no approval; the term "Robusts" is preferable) are said to have interbred with the ancestors of Europeans and Asians, but not with those of Africans (Gibbons 2010; cf. Krings et al. 1997). The African alleles occur at a frequency averaging only 13% in non-Africans, whereas those of other regions match the Neanderthaloids in ten of twelve cases. "Neanderthal genetic difference to humans must therefore be interpreted within the context of human diversity" (Green et al. 2006: 334). This suggests that gracile Europeans and Asians evolved largely from local robust populations, and the replacement model has thus been decisively refuted. While this may surprise those who subscribed to Protsch's "African hoax," it had long been obvious from previously available evidence. For instance Alan Mann's finding that tooth enamel cellular traits showed a close link between Neanderthaloids and present Europeans, which both differ from those of Africans (Weiss and Mann 1978), had been ignored by the Eve protagonists, as has much other empirical evidence (e.g., Roginsky et

al. 1954; Yakimov 1980). In response to the initial refutations of the Eve model, Cann (2002) made no attempt to argue against the alternative proposals of long-term, multiregional evolution.

But faulty genetics are only one aspect of the significant shortcomings of the replacement model; it also lacks any archaeological, paleoanthropological, technological, or cultural evidence (Bednarik 1991, 1992, 1995b, 1997a, 1997b, 2008a, 2011b, 2011c). Nothing suggests that Upper Paleolithic culture or technology originated in sub-Saharan Africa, or that such traditions moved north through Africa into Eurasia. The early traditions of Mode 4 ("Upper Paleolithic") technocomplexes evolved in all cases *in situ*, and the Graciles of Australia, Asia, and Europe emerged locally from Robusts, as they did in Africa. By the end of the Middle Pleistocene, 135,000 years ago, all habitable regions of the Old World continents can be safely assumed to have been occupied by hominins. At that time, even extremely inhospitable parts, such as the Arctic (Schulz 2002; Schulz et al. 2002; see also Pavlov et al. 2001), were inhabited by highly adapted Robusts. Therefore the notion that African immigrants from the tropics could have displaced these with their identical technologies is demographically absurd. Wherever robust and gracile populations coexisted, from the Iberian Peninsula to Australia, they shared technologies, cultures, even ornaments. Moreover, the established resident populations in many climatic regions would have genetically swamped any intrusive population bringing with it a much smaller number of adaptive alleles. Introgressive hybridization (Anderson 1949), allele drift based on generational mating site distance (Harpending et al. 1998), and genetic drift (Bednarik 2011d) through episodic genetic isolation during climatically unfavorable events (e.g. the Campagnian Ignimbrite event, or the Heinrich Event 4; Barberi et al. 1978; Fedele et al. 2002, 2003; Fedele and Giaccio 2007) account for the mosaic of hominin forms found.

Mode 4 technocomplexes (Foley and Lahr 1997) first appear across Eurasia between 45,000 and 40,000 years ago, perhaps even earlier (Felgenhauer et al. 1959), at which time they existed neither in Africa nor in Australia. In fact right across northern Africa, Mode 3 traditions continued for more than twenty millennia, which renders it rather difficult to explain how Eve's progeny managed to cross this zone without leaving a trace. None of the many tool traditions of the early Mode 4 which archaeologists have "identified" across Europe have any precursors to the south, including the Aurignacian, Châtelperronian, Uluzzian, Proto-Aurignacian, Olshewian, Bachokirian, Bohunician, Streletsian, Gorodtsovian, Brynzenian, Spitzinian, Telmanian, Szeletian, Eastern Szeletian, Kostenkian, Jankovichian, Altmühlian, Lincombian or Jerzmanovician (Bednarik 2011b). Some of these "cultures" have provided skeletal human remains of Robusts, including "Neanderthals" (Gábori-Csánk 1993; Bader 1978; Smith et al. 1999; Smith et al. 2005; Ahern et al. 2004), but there are no unambiguous associations between "anatomically modern human" remains (Graciles) and "early Upper Paleolithic" assemblages (Bednarik 2008b). This is another massive blow to the replacement proponents, who relied on the unassailability of their belief that some of these traditions, especially the Aurignacian, were by Graciles—having fallen victim to Protsch's hoax. Moreover, these "cultures," as they are called, are merely etic constructs, "observer-relative or institutional facts" (Searle 1995); as "archaeofacts" they have no real, emic existence. They are entirely made up of invented (etic) tool types and based on the fundamental misunderstanding of Pleistocene archaeology that tools are diagnostic for identifying cultures. Indeed, the *cultural* variables of Pleistocene archaeology have never received much attention, or been employed in creating a cultural nomenclature. At

this point it becomes apparent that the received but probably false taxonomy of Pleistocene cultures has been matched with equally unrealistic ethnic entities, and the entire system begins to crumble. Cultures are undeniably defined by cultural variables, not by tools or technologies, and for that reason alone the cultures of the Pleistocene have clearly not been identified correctly. Archaeologists misuse the term "culture" in several senses, calling any sediment layer that contains charcoal a "cultural layer"; most charcoal in the ground was not even deposited by humans. Not only have archaeologists invented cultures on the basis of non-cultural diagnostics, even if that were not so, cultures would still not define peoples. The simplistic notion that one can trace ethnic differences through tool assemblages, a cornerstone of received Pleistocene archaeology, is therefore a major epistemic impediment in the discipline. Pleistocene archaeology as it is conducted is incapable of providing a cultural history, as it relegates the cultural information available (such as rock art) to marginal rather than central status, forcing it into the false technological framework it has created. Instead of beginning with a chronological skeleton of paleoart traditions and then placing tool assemblages into it, invented tool types forming invented cultures of invented ethnic and even genetic groups form the temporal backbone of the academic narrative. The result is a collection of origins myths for groups, nations, and for "modern humans" generally.

But there are several other impediments preventing the field from attaining scientific credibility. They are only mentioned in passing here (but see Bednarik 2012). Just as archaeology destroys the sediments it excavates, its deconstruction, objectification, and academic appropriation of the beliefs of other societies are injurious to them (Piotrowski and Ross 2011). Indigenous metaphysics cannot even be effectively translated into forms decipherable within a Western construct of reality (Berger and Luckmann 1966; Pinker 2002) without significant corruption. "Who has the right to frame and interpret the past of others?" (Lyons 2002: 127; cf. Barkan and Bush 2002: 2; Brown 2003: 184; McNiven and Russell 2005). Archaeological narratives are framed within the ever-changing kaleidoscope of Western society's prejudices and preconceptions, shaped by their social constructs rather than contributing to their shaping. Archaeologists, the "molesters of the past" (Campbell 2006), manage the remains and monuments of the defeated, marginalized, and superseded cultures for the victorious states whose servants they are, and who validate them. The political uses made of archaeology's "findings have facilitated ethnic clashes and cleansing, bigotry and nationalism far more often than they have promoted social justice" (Kohl and Fawcett 1995). Acquisition of knowledge about the ontologies of indigenous societies is integral to dispossession, to diminishment of indigenous values and sovereignty, and to gaining power through "interpretation."

Any recourse by referring to the ideal of academic freedom and the prerogatives of science is unjustified: the discipline refuses academic freedom to others by restricting access to its resources and opposing avocational researchers at every opportunity, and it maintains a non-scientific epistemology by eschewing principles of falsifiability. Its premises are rated by the perceived authority of the proposer, not according to testability, the most fundamental requirement in the sciences. Excavation inevitably results in the destruction of all spatial contexts and other relevant information, therefore the pronouncements of the excavator (e.g. the plan and section drawings) have to be accepted on authority; they are not testable data. Moreover, excavation can only yield non-random samples, another limitation in conflict with the requirements of scientific method. The remains secured from an excavation cannot be expected to be *representative* of anything other than themselves; their composition is merely

accidental, besides having been significantly affected by taphonomy (Bednarik 1994). Similarly, most finds are made accidentally, and there is not much control over the historical sequence of key discoveries. Since the order in which they are made is largely random, the dogma is similarly haphazard at any point in history. Therefore endeavors to preserve this intrinsically false dogma, which characterize so much effort in archaeology, are fundamentally anti-scientific. In this way the practices of the discipline conspire to keep it from attaining credibility, rather as if it had been designed to yield mostly questionable narratives. It is also an academic pursuit that defines its sphere of interest not by some concrete terms of reference, but self-referentially: archaeological subjects are defined so by what senior archaeologists take an interest in (Lewis-Williams 1993).

THE AVAILABLE DATABASE

All of this suggests that there are inherent problems with the way Pleistocene archaeology and paleoanthropology create their narratives of the human past. The gatekeepers of human evolution and paleo-ecology have not provided a consistent and comprehensive explanation of why humans are the way they are, or how they became what they are today. This leaves any endeavor to discuss the origins of human behavior with the choice of either abandoning that quest due to the incommensurability issues of the orthodox model, or approaching the data more circumspectly, excising from it what has been formulated in compliance with the orthodox dogma and reviewing critically the rest. Archaeology, of course, does not recover behavior. It may find traces caused by human behavior, it may employ uniformitarian analogy to explain such traces, but in the absence of refutability of any resulting hypotheses these are posited outside of science. One may cull from the wealth of available archaeological data that part that seems reliable, and attempt to generate better-supported hypotheses than those which traditional archaeology has offered. They are indeed likely to be more credible, but the fundamental problem of the lack of falsifiability remains.

There is, however, another way to pursue these issues, and it is the one adopted here. To circumvent the lack of archaeology's falsifiability one could recruit relevant hard sciences to provide testable propositions that could test otherwise untestable hypotheses. In certain areas this has long been done in archaeology, especially in the dating of occupation horizons and specific objects. The sciences recruited here were the earth sciences, palynology, nuclear physics and a few others. None of the hard sciences gradually taking over from the humanities (especially from psychology and psychiatry), which should be of particular relevance in considering behavior, have been sustainably brought into correlation with the question of early (Pliocene and Pleistocene) human behavior. In particular neuroscience and cognitive science need to be introduced to attempt a first etiology of hominin behavior. This should render possible the formulation of assertions that may be testable within the hard sciences, rather than by simple appeal to archaeological plausibility. The process would still be precarious, but should result in greatly improved resolution of the issues and possible solutions. It needs to start from the general rule of science that propositions must be presented in such a way that they can be disproved by some conceivable spatio-temporally located event exemplifying a possibility which the proposition would exclude. The credibility or veracity of any outcomes could be greatly enhanced if the experiment

departed from a considerably improved reliability of the underlying empirical archaeological database. Therefore this is attempted here before delving into the subject of the origins of human behavior.

In revising the empirical database of Late Pleistocene (130,000 to 10,000 years ago) archaeology it is essential to excise any aspects (statistics, interpretations, "institutional facts," etc.) that derive from the now discredited replacement hypothesis. As Christopher Hitchens once stated, "that which can be asserted without evidence can be dismissed without evidence." Applying instead the scientific methods of taphonomic logic (Bednarik 1994) and complex systems theory (Andersson 2011) unambiguously demands some form of gradualism in determining the human ascent. This development would be expected to have been punctuated by phases of "evolution" and occasional "devolution," with the former obviously dominating. The notion of devolution shows that the term "cultural evolution" is a misnomer, because whereas biological evolution is not teleological, having no ultimate purpose (therefore all biological development is evolutionary), cultures obviously can develop backwards (to a more primitive state) when ideas drop out of the "meme pool."

A skeletal framework can be established by initially inferring some key developments in the broadest possible sense. For instance, language ability: the most dramatic somatic development in human evolution is encephalization, the phenomenal increase in cranial volume, which is unparalleled in biology. Its evolutionary cost is massive, for instance in its obstetric demands (O'Connell et al. 1999). Just as the required increase in the size of the birth canal competes with the physical fitness of females, the enforced premature birth competes with the mobility of the band. Human infants are born in fetal form, unable to cling to a mother, and the prolonged period of their dependence on the mother and the group severely limits breeding frequency, and therefore reduces a woman's potential number of viable births. To suggest that such a severe impediment to reproductive fitness (Joffe 1997) as this abnormally enlarged organ was tolerated by evolutionary selection without some very significant compensatory development is biologically naïve. That major benefit might have been the advanced communication required to underwrite societal complexity (Falk 2009; Bickerton 1990, 1996, 2010). Therefore the null hypothesis should be that language ability and the development of speech can be correlated with the rapid increase in brain size, which commenced over two million years ago. Relevant are several empirical factors: the hyoid bone of juvenile australopithecine remains from Dikika, Ethiopia (Alemseged et al. 2006), and from a putative *Homo erectus* from Castel di Guido, Italy (Capasso et al. 2008), although their mere presence does not prove speech. Laryngeal movement is more important, as is the presence of Broca's and Wernicke's areas, which have both been claimed to be detectable on cranial endocasts of *Homo habilis* (Falk 1983). Ultimately, however, the presence of speech in early hominins has not been demonstrated somatically at this stage.

This provides an initial appreciation of where the goalposts might need to be located in that respect. The timing of a few other key developments helps sketching out a realistic framework, including the advent of colonizing sea crossings, roughly a million years ago (Bednarik 1997a, 2003a); and most especially the gradual introduction of the extra-cranial storage of symbolic information, commencing perhaps around the same time (see below). Both these indicators have provided solid empirical information through specific phenomena on the archaeological record. The concept of storage of symbolism outside the brain, i.e., in a

variety of objects and their properties, was first proposed by Gregory (1970: 148), who realized that this would be a relatively stable and permanent expression. This idea of an external, "surrogate cortex" was developed further by Goody (1977), Carruthers (1990, 1998), and eventually Donald (1991, 2001; Donald et al. 1993). It was Donald (1991: 308–333; 2001: 305–315) who coined the name "exogram," derived from the concept of the engram (Bednarik 1987), which is a hypothesized but not demonstrated persistent protoplasmic alteration of neural tissue thought to occur upon stimulation, and accounting for memory. This idea was mooted by Semon (1904, 1921: 24); used by authors such as Lashley (1950); and much later reinvented by Dawkins (1976) who called the memory trace a "meme." In fact Semon had already used the term "mnemic trace" in 1904, but it seems Dawkins was unaware of all of this. Similarly, Donald's three stages of cultural evolution were foreshadowed by Fairservice (1975). Donald, consequently, defines an "exogram" as an *external* memory record of an idea, a made, symbolic invention that may have undergone a process of repeated examination, testing, and improvement. However, this idea was also previously stated; Bednarik (1987) had related the notion of engrams to permanent externalizations of ideas (finger fluting patterns in caves), but without naming them. Donald (1991: Table 8.1) observes that engrams would be impermanent, of constrained format, fixed physical medium, limited capacity and size, and not easily refinable. In these and other characteristics they would differ fundamentally from exograms, which are often permanent, are unconstrained and reformatable, can be of any medium, have virtually unlimited capacity and size, and can be subjected to unlimited iterative refinement.

Donald's lack of familiarity with the empirical information on early symboling (Bednarik 1992, 2003; Hodgson 2003), combined with his inadequate understanding of anthropology (Brace 1993, 1996, 1999) and neglect of cognitive ethology (Cynx and Clark 1993) detract greatly from his work. For instance he accepts Lieberman's (Lieberman and Crelin 1971; Lieberman et al. 1972, 1992) notions of Neanderthal vocal capabilities, which were refuted (Falk 1975, 1987; Arensburg et al. 1989, 1990; cf. Laitman et al. 1992; Bickerton 1993, 1996, 2010; Dunbar 1996; Aitchison 1996; Falk 2009) and today are absurdities. Nevertheless, Donald's work has prompted the development of an academic cottage industry in the cognitive sciences, extended cognition studies (Clark and Chalmers 1998; Adams and Aizawa 2001, 2008; Malafouris 2004; Rupert 2004; Aizawa and Adams 2005; Block 2005; Prinz 2006). However, the formulation of Donald's concept of exograms provides a valuable benchmark for the determination of hominin capacities, because some forms of them attributable to specific times can survive for very long periods of time. These, collectively, represent one of the most instructive forms of empirical evidence for the cognitive evolution of humans, for the origins of human modernity (Bednarik 2011b, 2011c), and for the proliferation of symboling ability during the Middle Pleistocene (c. 780,000 to 130,000 years ago). Taphonomy (determining the selective survival of material evidence) sees to it that most exograms would never survive from the Pleistocene (Bednarik 1994), and most of those that could would not be recognizable as having functioned as exograms. However, there are several classes of such materials that can, under fortunate circumstances, remain not only recoverable, but are recognizable as exograms. Middle Pleistocene examples have been classified into beads, petroglyphs, portable engravings, proto-sculptures, pigments and manuports (Bednarik 1992, 2003a). Most of these classes of evidence offer no utilitarian explanations and they begin appearing with Mode 1 and Mode 2 technocomplexes (hand-axe-free and handaxe Lower Paleolithic tool traditions), i.e., about the same time in human

evolution as the first evidence of pelagic crossings, up to one million years ago. There are even indications that some utilitarian artifacts began to be invested with non-utilitarian properties during the "Acheulian" traditions of that time. Notably the development of the hand-axes to excessive perfection and symmetry has been suggested to be well beyond the necessary (Gamble 1997; Wynn 2002), and implies the introduction of a sense of perfection (Bednarik 2011c). Similarly, in some cases it has been suggested that the presence of prominent fossil casts on a few such Acheulian hand-axes is intentional; i.e., that the tool was deliberately worked around this natural inclusion (Oakley 1981). Vast numbers of late Acheulian hand-axes imply such outstanding workmanship and knapping skill that they appear to have been status symbols rather than mere tools. This would suggest that their incredible perfection was an exogrammic message.

While these interpretations are plausible, they are not testable, which also applies to the proposition that pigment use is necessarily proof of exogram use. Ochre and hematite pigments were certainly used extensively by people of Acheulian technology (Bednarik 1992, 2003a), but such substances can also serve utilitarian purposes. Similarly, a variety of arguments can be invented to deny that manuports (unusual natural and unmodified objects that were transported by humans, such as crystals, fossils, and strikingly shaped stones), portable engravings, and proto-sculptures acted as exograms. However, this position cannot be sustained for some classes of evidence, notably beads and petroglyphs of the Lower Paleolithic. They are far too sophisticated to be dismissed as coincidences, flukes, or evidence of a "running ahead of time" (Vishnyatsky 1994) in human evolution. While it is possible to deny the intentionality of simple engravings on bone, ivory and stone to preserve the replacement model of recent human evolution, the secure identification of beads and pendants is largely uncontroversial. Small objects, drilled through with stone tools, could be either beads or pendants; or they could be small utilitarian objects such as buckles or quangings (pulling handles used in sealing) as the Inuit use (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; or that lack the typical wear patterns of such articles; can be safely assumed to be beads or pendants (Bednarik 1997c). An example of such complete lack of ambiguity are the 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; Bednarik and You 1991; Grün and Beaumont 2001; Kumar et al. 1988; Mason 1988; Morris 2000; Wendt 1974; Woodhouse 1997). Of a significantly greater antiquity are the over forty similar ostrich eggshell beads from El Greifa site E, in Wadi el Adjal, Libya (Bednarik 1997c). 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 (Ziegert 2007). However, the Libyan beads, about 200,000 years old, may well be exceeded in age by many other finds, such as the pendants from the Repolusthöhle, in the Austrian Alps (Mottl 1951), or the several hundred centrally perforated fossils from Acheulian deposits in France and England (Bednarik 2005). First reported by Boucher de Perthes (1846), Prestwich (1859: 52) and Smith (1894), they remained widely ignored for the entire 20th century and were correctly identified as *Porosphaera globularis* only in 2005, and

their extensive modification and wear as beads were only then recognized. The crinoid fossils from a site in Israel are another example of Acheulian beads (Goren-Inbar et al. 1991).

Amazingly all these numerous beads managed to survive for hundreds of millennia, only to be ignored or rejected by archaeologists, according to whose beliefs such complex symbolic objects could not possibly have existed in those early times. Firstly, 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 cannot possibly exist. Whatever their practical purpose may have been (decorative, communicative, emblematic, economic, protective, commemorative, ideological, etc.), their function was always symbolic: they demonstrate essentially modern cognition, irrespective of considerations of physical evolution or technology. Contrary to Malafouris (2008) who sees "the self as emerging through the ornament [bead]," self-awareness, including autoegetic awareness, must precede bead use, because without self-awareness (and several other precursory conditions) beads lack any justification for existence. Hominins did not first make beads and then find a way to make them relevant. The example Malafouris cites, the forty-one late Middle Stone Age shells from Blombos Cave in South Africa, are certainly not the "landmark" in cognitive evolution he sees in them. Not only are they preceded by earlier beads and pendants several times as old (Bednarik 1997b, 1997c, 2001, 2005, 2008c), self-awareness predates them in the primate ancestry by dozens of million of years. The view that the first appearance of "the human ability to be reflectively conscious of one's own perspective on the world" must be deducible from archaeological finds is itself archaeocentric. Beads are exograms conveying complex meanings, and they imply other faculties still. For instance beads and pendants involve the use of cordage, which in turn almost demands the facility of knotting—both of which also are practically required for the construction of seagoing rafts (Bednarik 1997a, 1999, 2003b). And as replicative archaeology would have shown archaeologists, the making of beads, especially from ostrich eggshell, involves some rather complex technological steps (Bednarik 1997c). But they were certainly not the first exograms used by hominins.

Another form of evidence illustrating the cognitive status of Lower Paleolithic humans that has been largely ignored by Pleistocene archaeology is the occurrence of petroglyphs safely dated to that period by excavation. So far limited to about 550 cupules (hemispherical cup-marks hammered into hard rock panels, also known from practically all subsequent periods up to the 20th century) and three linear petroglyphs at two sites in central India, these constitute the earliest known rock art in the world (Bednarik 2008d). They were found in two quartzite caves, Auditorium Cave at World-Heritage listed Bhimbetka (Bednarik 1993b), and Daraki-Chattan (Kumar 1996; Bednarik et al. 2005). There are, however, first indications that some of the earliest cupules in southern Africa could be of the Fauresmith tool tradition, which is also Lower Paleolithic (Beaumont and Bednarik 2010), but here better evidence of age is still required. Replicative archaeology has established that to produce one of these cupules on the rock in question requires in excess of 30,000 strokes with the types of hammer stones demonstrated to have been used (Kumar 2010). Moreover, cupules are generally limited to the smallest possible size, relative to their depth, which implies rather obsessive behavior in the service of a production that provided no tangible benefits for the maker, and no apparent selective advantages. Indeed, it is the features driven by obsessive behavior that are the very basis of human civilizations. The compulsion for perfection underlying such products as beads and cupules is the very same drive that underpins all of modern culture and

all its institutions—not least of all academia and science. Without this obsessive behavior the human ascent would not have been possible. Apes, apparently, feel no impulse to improve their simple sleeping nests or implements, and there is no such obsession evident in the stone tools of the human ancestors from the australopithecines to *Homo erectus*, i.e., until the template of the hand-axe began to be developed beyond the purely functional. Since that time, and coinciding with the development toward robust *Homo sapiens*, the phenomenon of “progress”—reified by the search for improvement—has been the principal determinant of human cultural evolution (Bednarik 2011b, 2011c). It began perhaps at an imperceptibly slow pace, gradually acquiring momentum, until in recent millennia it became an overpowering force driving humanity’s relentless technological ascent. Today’s human society would be unthinkable without it. On the archaeological record this development can be first identified in time through such objects as beads and pendants, cupules, and the evolving ability to harness the forces of nature: e.g., wind, waves, currents, and buoyancy, as manifested in the earliest demonstrated maritime colonization events (Bednarik 1997a, in press); or the first evidence of the controlled use of fire (Beaumont 2011).

ARCHAEOLOGICAL INTERPRETATIONS OF HUMAN BEHAVIOR

The hypothesis of the introduction and rise of exograms has attracted almost no interest from archaeologists, and the available empirical information relating to it has been either ignored or explained away. Exograms have generally been interpreted in terms that are comprehensible within the simplistic worldview of archaeology, usually as “primitive art.” There is no scientific reason to refer to anything of the Pleistocene as “art,” which is why the material in question is preferably called “paleoart”: it is no more “art” than a peanut is either a pea or a nut. The word simply defines art-like manifestations of the deep past, without implying what they are or what their roles were.

Archaeologists have also espoused numerous premature and untestable hypotheses about paleoart, such as the notion that it was introduced by shamans. Despite isolated claims for Holocene evidence (e.g. Porr and Alt 2006), it remains profoundly unknown at what point in human history the practices defined as shamanism were introduced. But there are alternative, logical methods of investigating the role of shamanism in rock art. In the entire ethnographic world literature there is not a single report of a shaman having produced rock art. There are, however, numerous cases of rock art production having been observed and recorded, or where the authors of the “art” may be known to us (e.g. Haskovec and Sullivan 1986; Bednarik 1998: 26; Novellino 1999). In all such cases no shamans were involved, and the utilitarian or ceremonial purpose of the rock art, where it is known, lacks any connection with shamanism. Indeed, one of the most obvious prerequisites for considering what the characteristics of shamanic art might be is a definition of its ethnographically demonstrated idiosyncrasies. In the absence of such an explicit index any definitive way of identifying authentically shamanic art traditions is lacking. Moreover, most of the world’s rock art occurs in regions from which no shamanic practices are known ethnographically. Although none of this demonstrates that no rock art was ever produced by shamans, the proposition that significant quantities of rock art are the work of shamans (Lewis Williams and Dowson 1988) is unwarranted by the

empirical data, and it is of course untestable. Thus the scientific null hypothesis, that most rock art is not shamanic, has empirical support; the archaeologically favored shamanic hypothesis has none.

The altered states in (North American) shamanism were perhaps first recognized by Oesterreich (1935: 295). Peters and Price-Williams (1980: 397) examined them across 42 cultures. Loeb (1924), Radin (1937), and Devereux (1961) defined shamans variously as epileptic, hysteric or neurotic, whereas Silverman (1967) introduced the notion that shamanism is an acute form of schizophrenia. His hypothesis attracted immediate criticism (Handelman 1968; Weakland 1968; Boyer 1969) and was followed by later work rejecting it. Lex (1984) suggested that the popularity of the notion that schizophrenia provides an explanation for shamanic experiences and behavior appears to emanate from distorted and romantic interpretations of the significance of hallucinatory symptoms. Noll (1983), in examining altered states of consciousness, demonstrated that the anthropological "schizophrenia metaphor" of shamanism and its altered states is untenable. Significant phenomenological differences exist between the shamanic and schizophrenic states of consciousness. Despite these authoritative rebuttals the notion that there is a connection between shamanism and schizophrenia continued to be pursued in recent years (e.g. Polimeni and Reiss 2002; El-Mallakha 2006) and has given rise to various archaeological theses. For instance Whitley (2009) attributes both early rock art and shamanism to bipolar disorder.

Of particular concern are the endemic modes of polemic presented by the shamanists. Rather than citing ethnographic information they reinterpret the original texts "creatively" (Hromnik 1991; Solomon 1999, 2000; Le Quellec 2006; Helvenston 2012) and replace key terminology with their own preferred words. For instance, Lewis-Williams replaces the terms "sorcerer," "witchdoctor," "medicine man," or "healer" (and even "teacher") with his preferred word "shaman," even though there are very significant differences between these concepts. But he believes that is what the ethnographers (e.g., Bleek 1933, 1935, 1936; How 1962; Katz 1976, 1982; Katz and Bieseke 1986; Lee 1967; Marshall 1969; Orpen 1874; Prins 1990) meant when they wrote of sorcerers and medicine men, and that they were too ignorant to understand metaphors. He also mistranslates the word "medicine man" used by an old Xhosa or Mpondomise woman in relation to the rock art painters (Lewis-Williams 1986; cf. Jolly 1986). He further conflates hallucinogen-induced trance with trance involving no drugs, confusing analogical effects with identical causes (Lewis-Williams 2002). Similarly, he continues to ignore the advice of those genuinely engaged in the study of authentic shamanism (Eliade 1964; De Heusch 1965; Rouget 1980; Hamayon 1982, 1990, 1995; Hultkrantz 1993; Francfort et al. 2001), although he lacks first-hand knowledge of shamanism.

However, shamanism is not the only frivolous explanation of rock art, the perhaps most numerous representative of exograms surviving from the Pleistocene. Other speculations concern proposals that rock art and other evidence of "modern behavior" were introduced through various brain illnesses. As noted, such hypotheses began appearing in the first half of the 20th century, explaining shamanism as the result of epilepsy, hysteria, neuroses, and schizophrenia (see e.g. Kroeber 1940; Demerath 1942; Devereux 1956; Silverman 1967; Scheff 1970; Le Barre 1970, 1972). This fashion of presenting essentially unsupported theories of this kind has continued to the present time, with the most recent proposals including the attribution of paleoart and all archaeological indicators of "modernity" to autism and Asperger's syndrome. Indeed, the human brain disease autism (Hermelin and O'Connor

1970; Frith 1989; Hughes et al. 1997; Baron-Cohen 2002, 2006; Allman et al. 2005; Grinker 2007; Brasic 2009a, 2009b, 2010; Balter 2007; Burack et al. 2009; Bednarik and Helvenston 2012; Helvenston and Bednarik 2011) has been proposed to have been instrumental in introducing Pleistocene paleoart so often that it is hardly an original idea (Kellman 1998, 1999; Humphrey 1998; Haworth 2006; Spikins 2009; Bogdashina 2003, 2010: 159–160; cf. Marr 1982; Treffert 2010), and yet some of its most ardent promoters seem to think they discovered it. This illustrates how inadequately these proposals were researched. There are, of course, many other explanations of hominin behavior in the archaeological literature, but before they are considered it needs to be appreciated that the discipline *is not capable of detecting behavior*. It merely records objects and their physical contexts; it can within limits also estimate the ages of remains; but its etic explanations and interpretations lack any emic credibility. Some of its inherent limitations could be overcome by introducing more rigorous practices, especially “taphonomic logic” (Bednarik 1994) and the “metamorphology” developed from it (Bednarik 1995c). However, these proposals have attracted virtually no enthusiasm in archaeology, which itself implies fundamental structural problems in the field. Preservation of the dogma has precedence, simply because a paradigmatic shift is thought to be too traumatic for the discipline. That may well be true but the question is: is it better to facilitate the promotion of precipitate models, such as those of a mythical African Eve or the involvement of brain diseases in the recent (Final Pleistocene) development of human cognition, enculturation and technology?

As the author has exhaustively investigated the African Eve hoax elsewhere (Bednarik 1991, 1992, 1997b, 2003a, 2008a, 2008b, 2011b, 2011c, 2001d) he focuses here on the second issue, that of the contribution of neuropathologies to the human ascent.

The Rise of Brain Illnesses

Although Humphrey's (1998) paper presents no convincing case for a nexus between Pleistocene cave art and *autism*, he does raise some very pertinent and interesting points. One concerns the deeply ingrained belief that the “Upper Paleolithic” artists shared our modern “mind.” Pleistocene archaeologists often use such terms as “modern behavior” or “modern mind” but it is becoming increasingly apparent that there is no agreement as to what they mean. Some authors refer to human modernity as a set of abilities one can reasonably expect to find a million years ago, even earlier (Bednarik 2011b, 2011c). Others favor a much more narrow definition, attributing a “pre-modern mind” even to the cave artists of the early Upper Paleolithic (see Humphries 1998 and debate therein) and suggesting the “modern mind” to postdate 20,000 years BP. Bearing in “mind” that it is not clear what the mind is (what is its appearance, weight, or composition?) and that this is probably intended as a shorthand generic term for mental processes occurring in the human brain, the concept of “modernity of mind” is fraught with various difficulties. It is therefore doubtful that a scientific (testable) case can be made for a connection between the exceptional skills sometimes (but very rarely) found in autistics (Waterhouse 1988; Mottron and Belleville 1993, 1995; Mottron et al. 1999; Happé and Vital 2009) and the abilities of the graffitiists of the Franco-Cantabrian caves.

Humphrey's challenge of archaeologists' “received view” (Dennett 1998)—to show why they assume that Upper Paleolithic paleoartists must have shared present-day perception and reality—is of particular interest. So is Dennett's observation that “It will be interesting to see

if the defenders of the received view have such facts in reserve to salvage their case, or whether they will have to fall back on simply citing various eminent opinions in favor of the received view." Certainly the responses of archaeologists following the presentation of Humphrey's hypothesis have failed to offer such "facts." Another fascinating aspect of Humphrey's contentions arises when he quotes Mithen as stating "that modern humans ... were capable of the type of symbolic thought and sophisticated visual representation that was beyond Neanderthals." Two issues arise from this statement. First, the art of the "Aurignacians" provides no proof whatsoever of symbolic thought, which seems to be believed by nearly all Pleistocene archaeologists. It only provides evidence of depiction, no more. That is not to say that the "Aurignacians" were not capable of symboling, but the proof for that is to be (and can be) found elsewhere. Second, we have no evidence of any kind that "Aurignacian" palaeoart was produced by "anatomically modern humans," because all Late Pleistocene human remains of Europe predating, say, 26,000 years are either of Robusts (usually called Neanderthals there) or of intermediate forms (Bednarik 1995b, 2007, 2008a, 2011b, 2011c). Therefore Mithen's claim is probably wrong on both counts and merely expresses the inherent defects of the replacement hypothesis.

Humphrey presents only a single example of an autistic child with advanced artistic abilities (Selfe 1977), although some others have long been known (e.g. Pring and Hermelin 1993; Kellman 1998, 1999; Happé and Frith 2010), and he seems unaware of other authors pursuing the same issue. Moreover, his hypothesis suffers from his lack of awareness that such abilities in children are certainly not limited to autistic savants, but are also well known as "precocious realism" in the art of non-autistic children (Selfe 1983; Drake and Winner 2009; O'Connor and Hermelin 1987, 1990; contra Snyder and Thomas 1997). Seen in that overall context, Humphrey's hypothesis loses its appeal. If his suggestion that the palaeoart of the early "Upper Paleolithic" implies an absence of language use, because of their naturalism, were applied to, say, the realistic rock art attributed to the San Bushmen, its absurdity becomes apparent. Similarly, he seems to be unaware that throughout the world, the images we tend to regard as naturalistic are preceded by traditions that lack iconographic elements. Finally, the extremely rare occurrence of autistics with exceptional depictive abilities does not explain why 99.99% of autistic spectrum disorder (ASD) patients lack them. After all, ASD has recently become a very common illness, affecting one in 110 children now (Weintraub 2011; locally even as high as one in 38). The epidemic increase in this diagnosis, from one in 5000 in 1975, cannot be entirely attributed to changing diagnostic criteria (cf. Buchen 2011). The explanation offered in Bednarik (2011b) is perhaps the most eligible.

Similarly, Spikins' (2009) "different minds theory" suffers from an inadequate consideration of the relevant empirical evidence a more careful review of paleoart would reveal. Spikins explains "modern behavior" as the rise in cognitive variation within populations through social mechanisms for integrating "different minds." She focuses particularly on one form of autism, *Asperger's syndrome*, because it does not inhibit the effective use of language or cognitive development, and the associated attention to detail enables patients to compensate for the deficit of empathy. Subjects with autistic conditions (as well as in schizophrenia; Brüne 2006) have cognitively based deficiencies in "theory of mind" (ToM, see below). Contradicting the scientific evidence, Spikins' hypothesis misuses the term "species" by maintaining that *Homo sapiens neanderthalensis* is a separate species, when in fact it is a subspecies (different species cannot produce fertile offspring with each other). She believes that the earliest evidence of symbolic communication appears in South

Africa 165,000 years ago. Leaving aside the issue that symbolic communication, like behavior or intention, cannot be demonstrated by archaeology, only conjectured, she ignores both the inferred use of symbolic communication by Lower Paleolithic hominins (suggested by language use, seafaring, use of beads, palaeoart of various types) and the experimentally demonstrated symbolic communication ability of extant animals other than humans.

This does not necessarily render Spikins' hypothesis false, because it could still be validly applied to a model of hominin evolution based on empirical data rather than archaeological myths (Bednarik 2008a, 2011b). Her main contention is that autism is a spectrum of differences displayed across the modern population, and that modern behavior arose when autistic modes of thinking were integrated into the practices of human societies. She emphasizes the analytical and mathematical thinking in Asperger's, a form of "mild autism" (Rodman 2003; Bednarik and Helvenston 2012), and attributes to it the changes she detects in technology: "Rigid analytical thinking (both by autistic individuals and through their influence) might improve technology and foraging efficiency." She cites projectile weapons, bladelets, bone artifacts, hafting, "elaborate fire use," exploitation of marine resources and large game, apparently unaware that all of these have been demonstrated from the Lower Paleolithic, together with palaeoart and "personal ornamentation." Nevertheless, she feels that these are all attributable to the "attention to detail, exceptional memory, a thirst for knowledge and narrow obsessive focus" of autistics, particularly when coupled with their desire for social isolation.

However, these proficiencies are obviously not limited to people with ASD, a condition that also happens to include diagnostic characteristics such as inflexibility in thinking, difficulty with planning and organization, and rigorous adherence to routine (Pickard et al. 2011), which impede originality and innovative thought. The creativity Spikins invokes is normally impoverished in ASD patients (Frith 1972; Craig and Baron-Cohen 1999; Turner 1999), unless fostered, and the savant skills ascribed to them need to be nurtured and are specific to the ordered cultural context of modern life (Baron-Cohen 2000; Folstein and Rosen-Sheidley 2001; Thioux et al. 2006). Moreover, the neuropsychiatric disorders of humans, absent in other extant primates (Rubinsztein et al. 1994; Walker and Cork 1999; Enard et al. 2002a; Olson and Varki 2003; Marvanová et al. 2003; Bednarik and Helvenston 2012; Sherwood et al. 2011), are a deleterious by-product of recent evolution (Bednarik 2011b, 2011c, 2011d, in press; Bednarik and Helvenston 2012; Helvenston and Bednarik 2011; Pickard et al. 2011). The phylogenetic timing of the introduction of ASD is the crucial issue here: *to influence society the illness had to exist, but to do so, society and selective processes had to first tolerate it*. The lack of social skills typical of ASD in societies heavily reliant upon social dynamics would tend to select against it, socially as well as genetically. Thus Spikins' hypothesis runs up against the classical Keller and Miller (2006) paradox, the resolution to which will be considered below because it applies to all neuropathologies. Spikins fails to take into consideration the complexities of their genetic bases and how or why they arose in the first place. Until now (Bednarik 2011b, 2011c), no solution had been provided for this, which renders her stab in the dark without reference frame and scientific justification.

Schizophrenia (Os and Kapur 2009) is a polygenetic disorder (Cardno and Gottesman 2000; Kennedy et al. 2003; Riley and Kendler 2006). However, because its underlying physiological abnormalities remain inadequately understood, a properly integrated etiologic and pathophysiologic model does not yet exist. Schizophrenia is a disease of decreased

cellular connectivity in the brain, precipitated by environmental stress during brain development, among those with genetic vulnerability (Ayalew et al. 2012). Although numerous schizophrenia susceptibility genes have been identified (NRG1, NRG3, DTNBP1, COMT, CHRNA-7, SLC6A4, IMPA2, HOPA12bp, DISC1, TCF4, MBP, MOBP, NCAM1, NRCAM, NDUFV2, RAB18, ADCYAP1, BDNF, CNR1, DRD2, GAD1, GRIA1, GRIA4, GRIN2B, HTR2A, RELN, SNAP-25, TNK1, HSPA1B, ALDH1A1, ANK3, CD9, CPLX2, FABP7, GABRB3, GNB1L, GRMS, GSN, HINT1, KALRN, KIF2A, NR4A2, PDE4B, PRKCA, RGS4, SLC1A2, SYN2; Yoshikawa et al. 2001; Spinks et al. 2004; Cho et al. 2005; Li et al. 2006; Xu et al. 2006; Ayalew et al. 2012), they are of small or non-detrimental individual effects. Susceptibility alleles only constitute increasing risk for schizophrenia through aggregating, be it by chance, assortative mating, or by other mechanisms (Cannon 2005). Carriers of small numbers of schizophrenia susceptibility genes are far more numerous (about 15% of any population) than cases of the actual disorder (0.3–1%), and the advantages selected for in first-degree relatives of schizophrenia patients have been suggested to include creativity (Horrobin 2001). According to Crow (1997), schizophrenia and language are linked to cerebral asymmetry, and the hemispherical dominance for language led to the collateral hemispheric lateralization and psychosis (Crow 1995a 1995b). However, this notion is countered by several indices, not only the obvious error of linking language origins with the falsity of speciation of *Graciles* (see above, and Falk 2009; Bickerton 2010). For instance, the planum temporale, presenting a left-right asymmetry favoring the left (Geschwind and Levitsky 1968), which has been related to language reception, is also present in great apes (Gannon et al. 1998, 2001). Moreover, the detection of the *FOXP2* gene on chromosome 7 of two *Robusts* from El Sidrón in Spain (Krause et al. 2007; cf. Enard et al. 2002b; Zhang et al. 2002; Sanjuan et al. 2006), but absence of such schizophrenia susceptibility alleles as *NRG3* in *Robusts* refutes the idea (in fact schizophrenia may have appeared much later than *Graciles*; Bednarik and Helvenston 2012).

Children later diagnosed with schizophrenia had persistent reading impairment and low IQ scores (Karlsson 1984; Crow et al. 1995), and all cultures perceive the illness as a serious maladaptive dysfunction (Pearlson and Folley 2008). Introverted anhedonia, a typical symptom of schizophrenia (Schuldburg 2000), decreases creative activity significantly, thus providing a clear separation between creative and clinical cohorts. However, as in autism, there is a spectrum within which schizophrenia is merely the extreme form. For instance, first-degree relatives of psychotic patients have been consistently shown to be notably creative (Heston 1966; Karlsson 1970). Elevated levels of some of the schizotypal traits are commonly observed in individuals that are active in the creative arts (Schuldburg 1988, 2000; Brod 1997; Nettle 2001). Schizotypal diathesis, which may lead to actual illness under specific environmental factors (Tsuang et al. 2001) but in most cases does not, is therefore more convincingly implicated in creativity, much in the same way as mild forms of autism can yield high-performing individuals. Schizophrenia is associated with drastically reduced probability of reproduction (Bassett et al. 1996; Avila et al. 2001), through significantly diminished fertility, mediated by reduced survival and social competence (Brüne 2006), reduced attractiveness for mating and lower marriage rates, as well as possibly via reduced fertility once married. The notion that artistic production has its origins in “costly displays” (Miller 2000, 2001; Varela et al. 2011) would therefore seem to exclude the involvement of schizophrenic artists. Of potential interest would be how schizotypy relates to mating

behavior, e.g., through an increase in extra-pair copulations, a higher turnover of relationships, or less time between relationships.

However, the involvement of schizotypy in shamanism deserves further examination. The discovery of the rubber hand illusion (RHI) in schizophrenic patients (Peled et al. 2003) has considerable implications for the notion of out-of-body experiences (Thakkar et al. 2011). It has been suggested that a weakened sense of the self may contribute to psychotic experiences. The RHI illustrates proprioceptive drift, which is observed to be significantly greater in schizophrenia patients than in a control sample, and can even lead to an out-of-body experience, linking “body disownership” and psychotic experiences. In summary, there is no credible empirical evidence linking schizophrenia with palaeoart production, just as there is none linking shamanism with it or with schizophrenia. Nevertheless, susceptibility to proprioceptive drift can be shown to be linked to schizotypy, and may well account for certain experiences of shamans.

Finally, Whitley (2009) proposed that rock art arose from “mad geniuses” via shamanism, attributing it to *bipolar disorder*, but without any credible justification or empirical evidence. This disease differs from schizophrenia in some ways: it is not neurodegenerative with advanced age, and there is decreased neuronal and glial density in association with glial hypertrophy (Rajkowska 2009). Both illnesses are highly heritable (Edvardsen et al. 2008), as shown by monozygotic twin studies (Kieseppä et al. 2004), and they are clearly polygenic as indicated by the wide spectrum of their manifestations. The bipolar range stretches from bipolar I through bipolar II and to mild forms of cyclothymia. It is reflected in the lack of resolution in decisively determining the genetic basis, although regions of interest identified in linkage studies include chromosome 18, 4p16, 12q23-q24, 16p13, 21q22 and Xq24-q26 (Craddock and Jones 1999; Craddock et al. 2005; Saito et al. 2001), and genes DRD4, SYNJ1 and MAOA have been implicated (Muglia et al. 2002; Stopkova et al. 2004; Andres et al. 2004; Cho et al. 2005; Preisig et al. 2005; Jansson et al. 2005). Just as autism and schizophrenia comprise spectra rather than discrete illnesses, much the same applies to bipolar disorders, and probably for the same reasons: numerous genetic predispositions (Schulze 2010) and a range of environmental factors determine any patient’s specific condition. However, bipolar illness is a very serious disorder and even today is not well controlled in many patients (Helvenston 2012). Like schizophrenia and other brain illnesses it would have severely affected the life prospects of sufferers in the Pleistocene, and the likelihood of passing on their genes, as they would have been completely disabled to even survive for periods of time.

Human “Devolution”

This raises the perhaps most fundamental problem with the shamanic, bipolar, schizophrenic, Asperger’s, autistic and similar archaeological “explanations” of rock art and human modernity: their advocates make no attempt to determine whether these conditions actually existed in the Pleistocene. This is not just a question of clarifying when neuropathologies began to have a significant impact on the human genome, but more importantly, why they were not selected against. The mental and cognitive developments in the human brain rendered humans vulnerable to neurodegenerative diseases as well as frontal lobe connectivity problems, to demyelination or dysmyelination, Mendelian disorders—in

fact to thousands of syndromes and disorders endemic to humans (Bednarik 2011b). Why their rise was not vigorously selected against by natural evolution is the classic *Keller and Miller* (2006) *paradox*, which was resolved only recently (Bednarik 2007, 2008a, 2008b). In a species fully subject to the canons of natural selection such numerous disadvantageous mutations would be suppressed vigorously. They include thousands of Mendelian (single gene) disorders, but also countless somatic changes, such as cleidocranial dysplasia or delayed closure of cranial sutures, malformed clavicles and dental abnormalities (genes RUNX2 and CBRA1 refer), type 2 diabetes (gene THADA), or the microcephalin D allele, introduced approximately 37,000 years ago through a single progenitor copy (but could be as recent as 14,000 years ago, at 95% confidence interval; Evans et al. 2005). Another contributor to microcephaly, the ASPM allele, appeared around 5800 years BP (Evans et al. 2005; Mekel-Bobrov et al. 2005).

It should be clarified that the contradictory nature of the notion of "devolution" indicates that the concept of "evolution" is misused in cultural studies. Devolution cannot occur in biology, because any change, any development is evolutionary, or attributable to genetic adaptation in populations. The confusion arises because archaeology uses the term analogically but in the sense of "development toward more complex forms," and perceives human history as a teleological process. This is just one example of the incommensurabilities between scientific and humanistic meanings of terminology, which shows that effective communication is almost impossible between the two (Bednarik 2011a). Here, the term "devolution" is placed in quotation marks and refers to both somatic and neural developments that are not the outcome of natural selection and lead to inferior characteristics, rather than adaptively better genetic or physiological fitness.

The suspension of human evolution determined by natural selection and genetic drift (Bednarik 2011d) has remained completely unrecognized until recently, in part because Pleistocene archaeology and paleoanthropology have pursued the replacement hypothesis with such fervor that they failed to notice that it was initially based on a hoax by a German archaeologist. However, it has no genetic, skeletal or cultural justification whatsoever (Bednarik 2008a). That hypothesis demands that natural selection and genetic drift governed recent evolution and speciation, when in fact the emergence of the Graciles involved no speciation; they and the Robusts are one species (Green et al. 2010). The distinctive changes during the final third of the Late Pleistocene are almost entirely the result of self-domestication caused by the determination of breeding patterns by rising cultural imperatives that have been identified (Bednarik 2008b). Domestication promotes unfavorable alleles (e.g. Horrobin 1998, 2001; Andolfatto 2001; Lu et al. 2006), and it can even account for otherwise unexplained features, such as the abolition of estrus in females. If it was under the auspices of this process that predispositions for brain illnesses were protected from natural selection, such pathologies must postdate these developments, and it would be expected that most appeared less than 40,000 years ago and are endemic to the subspecies *Homo sapiens sapiens* (Bednarik 2008a, 2011b; Helvenston and Bednarik 2011). Where relevant genetic indications are already available, they confirm this prediction. For instance the genes CADPS2 and AUTS2, involved in autism, appear with Graciles, and NRG3 (schizophrenia) is also absent in Robusts. Using the human haplotype map to test for selective sweeps in regions associated in genome scans with psychosis, such as 1q21, is promising (Voight et al. 2006). Such selective sweeps tend to yield relatively recent etiologies, of less than 20,000 years. Some conditions, such as schizophrenia, have been suggested to be much more recent (Bednarik and

Helvenston 2012), and so far no known relevant susceptibility alleles have been reported from Robust remains.

Therefore at this stage none of the more severe brain illnesses should be expected to be found in hominin populations prior to the partial suspension of natural selection, which on present indications may have begun, initially on a small scale, between 50,000 and 30,000 years ago. It is therefore unlikely that by the time the first known cave art was created (Bednarik 2007), any of the brain diseases to which it has been attributed could have even taken root. Moreover, the establishment in the human genome of thousands of deleterious alleles during the Final Pleistocene is certainly not the only detrimental change identifying the transition from robust to gracile human forms. Indeed, most of these changes have been maladaptive. They include significantly reduced brain volume (by ~13%) and cranial as well as other skeletal robusticity, and greatly reduced physical strength. Most importantly, hominin neoteny, which had already had a slight effect in previous physical evolution, accelerated rapidly between fifty and thirty millennia ago, to the point of prompting the notion of replacement, which nearly all archaeologists were duped by.

Neoteny, pedomorphism, fetalization, or juvenilization defines the retention into adulthood of juvenile or fetal physiology (Gould 1979; Ashley Montagu 1989; Thiessen 1997). Humans resemble chimpanzees anatomically most closely in the latter's fetal stage (Haldane 1932; De Beer 1940; Ashley Montagu 1960). The skull of an unborn ape is thin-walled, globular and lacks the prominent tori of the adult ape, thus resembling the cranium of a modern human. Upon birth its robust features develop rapidly. The slow closing of the cranial sutures in humans is another neoteny feature (genes *RUNX2* and *CBRA1* refer). The face of the ape embryo forms an almost vertical plane, as it does in the modern human all the way through adulthood, which is not the case in mature apes. Even the brains of fetal apes and adult humans are much more similar to each other, in terms of proportion and morphology, than they are to those of adult apes. Both the fetal chimpanzee and the adult human have hair on the top of the head and on the chin, but are otherwise largely naked. All male adult apes have a penis bone, but it is categorically absent in both fetal chimpanzees and all humans. The atrophy of the penis bone in humans appears to have been compensated for by the organ's significantly increased length and thickness, relative to apes (Badcock 1980: 47). Similarly, in female chimpanzees, the *labia majora* are an infantile feature; in humans they are retained for life. The hymen, too, is present only in the neonate ape, but in the absence of penetration is retained for life in human females. The organs of the lower abdomen, such as rectum, urethra, and vagina, are typically aligned with the spine in most adult mammals, including apes; only in fetal apes and humans do they point forward relative to the spine. The human ovary reaches full size at the age of five, which is the age of sexual maturity of the apes (De Beer 1940: 75). The legs of fetal apes are relatively short, while the arms are about as long in relation to the body as in humans. In the apes, the arms become much longer after birth. Human hands and feet resemble those of embryonic apes closely, but differ significantly from both hands and feet of mature apes. In fact the human foot, especially, retains the general structure found in unborn apes, which rather contradicts the hypothesis that it is an adaptation to upright walking. It could equally well be the case that upright walk is an adaptation to the neoteny foot of hominins, a possibility never considered by paleoanthropology. Even the shape of the cartilage of the ear in humans is a neoteny feature.

Neoteny is a phylogenetic development in which fetal characteristics remain into adulthood, and specific processes of anatomical maturation are retarded (de Beer 1940). "But neoteny does not only contribute to the production of large structural change; it is also the cause of the retention of plasticity" or "morphological evolvability" (de Beer 1930: 93). Adaptively useful novelties supposedly become available as maturation genes are freed by pedomorphosis. In hominin evolution encephalization and neoteny are quite probably related, perhaps through supervenience (Bednarik 2011b). It is self-evident that, relative to the neonate ape, the newborn human is not remotely as far developed. In the first year after birth, the human brain more than doubles in both volume and weight. It continues to grow, approaching adult size by the age of three, but goes on expanding slightly more up to adolescence and even beyond. This extraordinary development, unheard of in the rest of the animal kingdom, compares with that of other primates, with rhesus monkey and gibbon achieving 70% of adult brain size at birth, the remaining 30% in the subsequent six months. In the larger apes, the size of the brain approaches adult size after the first year of life.

In the human genus neotenous traits include an exceedingly large brain, thinness of skull bones, flattened and broadened face, lack of tori, relatively large eyes, smallish nose, small teeth and jaws, and limbs that are proportionally short relative to the torso, especially the arms (Gould 1977; Ashley Montagu 1989; de Panafieu 2007). The acquisition of some of these characteristics involved enormous evolutionary costs, and most are decidedly detrimental to a primate. As in the case of adverse changes to the neural and endocrine systems, these deleterious developments need to be explained, because many of them completely contradict the principles of evolution. These have been suspended and replaced by the rules of domestication: systematic sexual selection in favor of specific characteristics, which were determined by cultural factors rather than those determining evolutionary fitness. In other words, in the most recent history of hominins, natural selection became increasingly moderated, and eventually almost replaced, by cultural selection (Bednarik 2008a, 2011c).

This process can be observed in the rapid gracilization among skeletal remains, especially in the females, beginning about 40,000 years ago (Bednarik 2008b, 2011b, 2011d). It was the females who led the neotenization in recent humans, and neoteny, although occurring in both genders, has remained more strongly expressed in women than in men. Its typical features are smaller body size, more delicate skin and skeleton, smaller mastoid features, significantly reduced or absent tori, less hair but retention of fetal hair, higher pitch of voice, more forward tilt of head but more backward tilt of pelvis, smoother ligament attachments and narrower joints, but they include also increased longevity, lower amount of energy expended at rest, faster heartbeat and prolonged development period (Ashley Montagu 1960). Few of these features present any appreciable evolutionary benefits.

One of the very few significant differences between humans and other animals is that no animal, including all other primates, has any preferences in mate selection of youth, specific body ratios (e.g. hips vs waist), facial features and symmetry, skin tone or hair color. In modern humans these culturally determined factors are undeniably crucial in the preference of mating partners, therefore they must have been introduced at some time in the past. Apart perhaps from facial symmetry, which may imply high immunocompetence (Grammer and Thornhill 1994; Shackelford and Larsen 1997), there are no biological advantages in these strongly developed *cultural* biases. Facial "attractiveness," for instance, is a cultural construct found in all extant societies (Cunningham et al. 1995), and in female humans, neotenous facial features are strongly preferred by males (Jones 1995, 1996). These include, irrespective

of cultural context, neonate large eyes, shiny hair, small noses, reduced lower facial regions, thin jaws, and high foreheads (Perrett et al. 1994; Sforza et al. 2009), which are all distinctive neonate features. Obviously such pronounced preferences in female mate selection will inevitably effect significant somatic changes in populations that are totally unrelated to environmental variables. Such changes can be best observed in the hominins of central Europe, such as those from many Czech sites, of the period from about 35,000 to 25,000 years ago (Bednarik 2008b). Darwin's laws of evolutionary theory were supplanted by Mendelian laws of inheritance (Mendel 1866), and humans domesticated themselves, albeit unintentionally, through selective breeding favoring specific physical characteristics (Bednarik 2008a, 2008b, 2011b, 2011c, 2011d). However, this "devolution" in the most recent phylogenetic history of humans is not limited to physiology; neoteny was also favored psychologically (Charlton 2006). The neotenuous psychological traits of individuals of outstanding mental faculties derive precisely from the "retention of plasticity" or "morphological evolvability" de Beer (1930) had already referred to. The baby-faced students Zebrowitz et al. (1998) refer to tend to outperform their less-neotenized peers academically today.

Domestication is the collective genetic alteration of the physiology, behavior or life cycle of species through selective breeding. Humans are not the only initiators of domestication, many animal species, vertebrate and invertebrate, from mammals to ants, have domesticated others, for instance to modify foods undigestible by the domesticators, or for their labor, or simply to serve as staple food source (Bednarik 2011b). Selective breeding defies natural evolution in the sense that it can rapidly change the characteristics of a population without any natural selection in the Darwinian sense occurring. Selection for single traits inevitably results in changes in numerous others, and these changes tend to be deleterious. For instance domestication of animals typically results in decreased cranial volume relative to body size, a decrease that can be as much as 30–40 %. Neotenuous physical traits arising from the domestication of animals include changes in reproductive cycles (estrus), fewer or shortened vertebra, curly tails (Trut 1999), loss of hair, larger eyes, rounded forehead, and shortened muzzle (Bertone 2006). Many of these (and others) reflect the gracilization noted in humans, and that also applies to the changes in behavior, toward playfulness, behavioral plasticity, exploratory pattern and pathology (note the juvenile behavior of a dog vs that of a wolf).

Therefore the first major factor in understanding early human behavior is that what are perceived as certain modern patterns very probably appeared together with the rapid somatic changes of the last part of the Late Pleistocene. They are then essentially attributable to human neotenization, which demonstrably accelerated markedly at that time. In many ways this process resembles devolution, and it occurred almost entirely outside the canons of Darwinian evolution. This does not, however, imply that modernity in human behavior should be expected to have appeared as one single package during that time, which archaeologists in Eurasia call the "early Upper Paleolithic," and which witnessed rapid gracilization of all human populations in four continents (Bednarik 2011c). To consider the origins of human behavior it does not suffice to focus on these last forty or so millennia. What transpires from the above is that *it was human behavior itself* that determined the most recent course in the development of the species, from robust *Homo sapiens* (such as *H. sapiens neanderthalensis*) to *H. sapiens sapiens*. This immediately raises the question: what were the preceding developments that set the stage for this final phase? If a viable and comprehensive etiological

history of human behavior is to be formulated, it will be necessary to consider the possible antecedent developments that could have led to the final ascent of culturally induced neoteny.

THEORY OF MIND, SELF-AWARENESS, AND CONSCIOUSNESS

Three factors demanding attention in any speculation about early hominin behavior are theory of mind (ToM), the issue of self-awareness, and consciousness. ToM defines the ability of any animal to attribute mental states to oneself and others, and to understand that conspecifics have beliefs, desires, and intentions; and that these may be different from one's own (Premack and Woodruff 1978; Baron-Cohen 1991; Frith and Happé 1994; Ozonoff and Miller 1995; Happé et al. 1996; Happé 1997; Baron-Cohen et al. 1997; Jarrold et al. 2000; Jacques and Zelazo 2005; Bednarik 2011b). Each organism can only prove the existence of his or her own "mind" through introspection, and has no direct access to others' "minds." The presumption that other cognizing organisms have beliefs, intents, desires, pretending, knowledge, etc. is the basis of a ToM. Although present in numerous species, at greatly differing levels, it has perhaps attracted most attention in the study of two groups, children and great apes, and the level they conceive of mental activity in others, attribute intention to, and predict the behavior of others (Call and Tomasello 1998). It is thought to be largely the observation of behavior that can prompt a ToM.

The discovery of mirror neurons in macaques in the 1990s (Di Pellegrino et al. 1992; Rizzolatti et al. 1996) has provided much impetus in the exploration of how a ToM is formed (Gallese and Goldman 1998; Iacoboni et al. 2005). Mirror neurons are activated both when specific actions are executed and when identical actions are observed, providing a neural mechanism for the common coding between perception and action (but see Hickok 2009). One of the competing models to explain ToM, simulation theory (Gordon 1986, 1996; Preston and de Waal 2002), is said to derive much support from the mirror neurons, although it predates their discovery by a decade. These neurons are seen as the mechanism by which individuals simulate others in order to better understand them. However, mirror neurons have so far not been shown to produce actual behavior (Provine 2009). Motor command neurons in the prefrontal complex send out signals that orchestrate body movements, but some of them, the mirror neurons, also fire when merely watching another individual—not necessarily a conspecific—perform a similar act. It appears that the visual input prompts a "virtual reality" simulation of the other individual's actions. However, ToM and "simulation," though related, may have different phylogenetic histories (Somerville and Decety 2006; Keysers and Gazzola 2007), and the roles of mirror neurons may be much more complex than anticipated; they may be involved in the formulation of constructs of reality (Bednarik 2011b). Ramachandran (2009a) has speculated about the roles of mirror neurons in cognitive evolution (Oberman and Ramachandran 2009), in empathy, imitation (cf. Ferrari et al. 2009), and language acquisition (cf. Rizzolatti and Arbib 1998). His examples of germane evidence include anosognosia in a small cohort of right hemisphere stroke patients, which prompts denial of paralysis in other patients; and the suppression of the MU brain wave in humans when their hand is moved.

Neurological conditions have shown that the self is not the monolithic entity it believes itself to be (see Dielenberg, this volume). These conditions include out-of-body-experiences, apotemnophilia (alienation of a body part, especially a limb, which derives from alienation

due to a congenital defect in the right parietal), transsexuality, Cotard's syndrome (patient is convinced to be dead), the Capgras delusion (because visual and emotional brain areas are disconnected, patient experiences familiar entities as substitutes or imposters), or akinetic mutism (patient is completely unresponsive, unable to talk or walk, despite being fully awake; caused by damage to the anterior cingulate) (Ramachandran 2009b). It has been shown above that susceptibility to proprioceptive drift, demonstrated by the rubber hand illusion (Peled et al. 2003), probably accounts for out-of-body-experiences (Thakkar et al. 2011). This is one of the examples Ramachandran cites, and this susceptibility varies considerably among individuals. It is probably connected with low levels of "body ownership" and schizotypy, and such conditions can induce the belief that the patient is outside of his/her body, e.g., floating above it and actually seeing the body. Other conditions confirm that the brain's right parietal lobe contains in the superior parietal lobule an internal image of the body. Pathology affecting this body image has psychologically demonstrable, dramatic effects. For instance it is thought to be the underlying cause of anorexia nervosa and somatoparaphrenia (or apotemnophilia; cf. anosognosia). The latter syndrome, found in about 5% of right hemisphere stroke patients, leads these to deny their own paralysis. Some of these patients even deny the similar paralysis in fellow patients, which as noted is probably attributable to the function of the mirror neurons. Ramachandran (2009a) suggests that, to make a judgment about somebody else's movements, one has to run a virtual reality simulation of the corresponding movements in one's own brain. Other phenomena probably involving mirror neurons are contagious acts such as yawning and laughing, or the odd fact that one cannot tickle oneself (Provine 2009). There is, however, nothing trivial about the gravity of these various insights, an importance that cannot possibly be overstated. They seem to bring into focus the most profound question an intelligent organism appears to be able to contemplate: how does the brain form a construct of external reality? They raise the possibility that Plotkin's (2002) concept of an imagined world made real was closer to factuality than even he anticipated. Ultimately it must be recognized that, so far, there has not been a viable universal theory of how the neuronal mechanisms and systems of the brain create reality from the sensory input of the phenomenal world, which after all underlies all human comprehension of the world. These above considerations suggest that, put simply, the parietal lobe might be creating a virtual-reality-like model of the external world, much in the same way as it forms a mental image of the body.

But these considerations lead too far from the present concerns (and their adequate treatment would involve a separate book; cf. Bednarik in prep.), which are limited to the "more manageable" topics of ToM and self-awareness. It must also be mentioned that there is evidence against attributing ToM to mirror neurons. Brain regions implicated in it are the anterior paracingulate cortex, the superior temporal sulci and the temporal poles bilaterally (Gallagher and Frith 2003), among others. But the mirror neurons are located in the inferior frontal cortex and superior parietal lobe. Also, macaques lack a developed ToM despite having mirror neurons. Both ontogenically and phylogenically, a ToM is acquired gradually, and precursory behaviors to a ToM are recognized. Understanding attention (Baron-Cohen 1991), understanding of others' intentions (Dennett 1987), and imitative experience with conspecifics (Horowitz 2003) are hallmarks of a ToM. The "false-belief task" (Wimmer and Perner 1983), which establishes the ability of an individual to attribute false beliefs to a conspecific, is seen as a key indicator of the level of development of ToM. In humans it occurs normally around the age of four, but while it is found in children with Down

syndrome, it is absent in most of those with autistic spectrum disorder (Baron-Cohen et al. 1985; Leslie 1991), and a link with mirror neurons is suggested (Williams et al. 2001; Oberman et al. 2005; Oberman and Ramachandran 2007). Another such test (Gopnik 1988; Gopnik and Astington 1988) can be passed by most 5-year-olds (see also Zaitchik 1990; Leslie and Thaiss 1992; Sabbagh and Moses 2006). These abilities would seem to mark the threshold of human ToM, but since precursory behaviors indicative of ToM are found widely among non-human species, such behavior would be expected in human phylogeny well before the australopithecines. Similarly, in a realistic model well-developed stages of ToM would need to be attributed to such species as *Homo habilis* or *Homo erectus*. The ontogenic parallels are relatively well understood. Intentional behavior can be detected by infants 5–9 months old (Woodward 1999), while at 15 months infants can classify actions according to their goals (Csibra et al. 2003). The same abilities are available to chimpanzees and orangutans (Call and Tomasello 1998), but apparently not to monkeys (Jellema et al. 2000). Between 18 and 24 months, the child establishes joint attention (Franco and Butterworth 1996), as well as engages in pretend-play, and it develops an ability to understand desires (Wellman and Wooley 1990; Rapacholi and Gopnik 1997; Wellman and Liu 2004). Again, apes use gaze monitoring to detect joint attention (Hare et al. 2000), but monkeys apparently do not. But it is with the appearance of “metarepresentation,” the ability to explicitly represent representations as representations (Leslie 1994; Baron-Cohen 1995; Perner and Garnham 2001), and with recursion that human ToM emerges, as these are lacking in the great apes (Suddendorf 1999; Call and Tomasello 1999). Similarly, the apes have so far provided very tenuous indications of episodic memory or future planning (Suddendorf and Busby 2003). Episodic memory, which is identified with autonoetic consciousness, can be impaired in humans, e.g., in amnesia, Asperger’s syndrome, or in older adults (Gardiner 2001). It can be attributed to differential activity in the medial prefrontal and medial parietal cortices, imaging studies of episodic retrieval have shown (Lou et al. 2004).

Homology would then suggest that precursory ToM behavior such as the detection of intention, goals, and joint attention would have appeared in human ancestors during the Miocene, while metarepresentation and recursion are likely to have emerged in the Pliocene. Planning of future action, self-representation, complex syntax and creative thought are rendered possible by these, as well as metamemory and counterfactual reasoning (Shimamura et al. 1990; Suddendorf 1999; De Villiers 2000; Shimamura 2000; Saxe and Kanwisher 2003; Samson et al. 2004). It is roughly at the age of 40 months that the child surpasses the ToM level of the other great apes. Thus the executive control over cognition unique to humans, together with metarepresentation and recursion, should have developed in the last 5 to 7 million years. Although the brain areas accounting for the latter two faculties remain unidentified, executive control resides in the frontal lobes. Since the frontal and temporal areas have experienced the greatest degree of enlargement in humans (Semendeferi et al. 2001; Bednarik and Helvenston 2012), uniquely human abilities would be expected to be most likely found there, although inter-connectivity rather than discrete loci may be the main driving force of cognitive evolution. But it is precisely the expansion of association cortices that has made the human brain disproportionately large (Preuss 2000).

Turning to self-awareness, the sentience of one’s own knowledge, attitudes, opinions, and existence, it is again obvious that various levels apply to different species. Some of the great apes, the elephants, and bottlenose dolphins are among the species that have passed the mirror test (Gallup 1970; Mitchell 1993, 1997, 2002; Heyes 1998; Gallup et al. 2002; Keenan et al.

2003; but see Swartz 1997; De Veer and Van Den Bos 1999; Morin 2003 for critical reviews), and interestingly they are much the same species shown to possess von Economo neurons (Seeley et al. 2006; Butti et al. 2009; Hakeem et al. 2009). This is perhaps not so much a relationship of direct supervenience; the connection may be via social complexity. Von Economo neurons seem to occur in relatively large species with large brains and extensive social networks (Bednarik 2011b) and have recently been identified in macaques (Evrard et al. 2012), and it may be that constructs of individuality evolved in tandem with these networks. Indeed, it is difficult to see how social complexity could have evolved beyond that of ants, bees, or termites without some level of self-awareness, just as the advent of self-awareness is hard to account for. Self-awareness is seen as a superior, more developed form of consciousness. The hallmark of consciousness may be a transparent representation of the world from a privileged egocentric perspective (Trehub 2009) but this does not reveal how it could have come about. Consciousness focuses attention on the organism's environment, merely processing incoming external stimuli (Dennett 1991; Farthing 1992), whereas self-awareness focuses on the self, processing both private and "public" information about selfhood. The capacity of being the object of one's own attention defines self-awareness, in which the individual is a reflective observer of its internal milieu and experiences its own mental events (Gallup 1998; Gallup and Platek 2002; Carver 2002). What is regarded as the "self" is inherently a social construct (Seyfarth and Cheney 2000), shaped by the individual's culture and immediate conspecifics (Leary and Buttermore 2003). But the self is not the same as consciousness (Natsoulas 1998), as shown by the observation that many attributes seen as inherent in the self are not available to conscious scrutiny. People invent the neurological computation of the boundaries of personhood from their own behavior and from the narratives they form, which also determine their future behavior. Thus it needs to be established how the chain of events from sensory input is established and how behavior is initiated, controlled, and produced (Carruthers 2002; Koch 2004; Nelson 2005; Clowes 2007). It appears that subcortical white matter, brainstem, and thalamus are implicated in consciousness (Fernández-Espejo et al. 2011), although it is assumed that unconsciousness mainly involves the cortical brain (Velly et al. 2007) and the thalamus is not believed to drive consciousness. Ultimately consciousness is self-referential awareness, the self's sense of its own existence, which may explain why its etiology remains unsolved. Hofstadter (2007) likens this quest to finding a self-consistent set of axioms for deducing all of mathematics, which Kurt Gödel has shown to be impossible, due to the self-referential nature of mathematical statements.

Internally directed aspects of cognition, such as ToM, episodic memory, self-evaluation, and self-awareness derive from the default mode network (DMN), which is considered to be a functionally homogeneous system (Sestieri et al. 2011). Relative to ToM, conscious self-awareness is even less understood and accounted for ontologically. Neuroscience and neuropsychology favor the view that it is located primarily in a neural network of the prefrontal, posterior temporal, and inferior parietal of the right hemisphere (Stuss et al. 2001; Decety and Sommerville 2003; Gusnard 2005; but see critiques in Morin 2002, 2004; Morin and Michaud 2007). In humans, a diminished state of self-awareness occurs for instance in dementia, sleep, or when focusing upon strong stimuli (Cavanna and Trimble 2006). Ultimately self-awareness must be the result of interplay of many variables, starting from the input of the proprioceptors to the engagement of several brain regions. It includes the operation of distal type bimodal neurons (moderating anticipation and execution; Maravita et

al. 2003). What can be said about it is that it can be safely attributed to all hominoids and hominins, and there is a reasonable expectation that it became progressively more established with time. In contrast to the dogmatic rejection of Lower Paleolithic beads by some archaeologists, from a biological perspective it is rather surprising that such artifacts, quintessential to defining self-awareness archaeologically, appear so late on the available record (during the Acheulian traditions). As in so many other issues, biological, empirical, and scientific perceptions clash irreconcilably with the fictitious narratives of Pleistocene archaeology (Bednarik 1992, et passim).

Thus the relevant scientific information would provide a rough framework for a first attempt to formulate a preliminary etiology of hominin behavior, in which archaeological dogma, however, has no place. Lower levels of ToM certainly have to be expected in the Miocene and Pliocene ancestors of humans (i.e., for much of the last 20 million years) and beyond, and could reasonably be presumed to have developed further during these periods (Foley 1997). The behavior of these primates must be assumed to have been attuned to the level of ToM and self-awareness that was available to them. In view of the dysteleological nature of evolution, the archaeological, teleologically guided assumption of a development of increased complexity cannot apply to a natural system. If it did, the system would cease to be natural (governed by Darwinian evolution alone). On the other hand, *culture can develop teleologically*, via incremental improvements involving a moderating intellect of gradually increasing autonomy. Therefore hominin intellect is neither archaeologically recoverable nor can it be inferred from stone tools, which is the underlying "lithocentric" mantra of most scholars in the field. The sciences, on the other hand, are perfectly capable of providing some of the crucial goalposts, and since these account perfectly for the most dramatic aspect of hominin evolution, encephalization, they need to gain priority in explaining the human ascent, including how modern behavior originated. Given that natural selection can only select expressed characteristics, not latent ones, the indices Pleistocene archaeology fields in its speculations about behavior, cognition, or even technology are inevitably flawed. The absurdity of archaeology's "explosion" or "great leap" around 40,000 years ago illustrates this, when it is contrasted with the empirical observation that the human brain approached its modern size many hundreds of millennia ago. Just as language can only be selected for after it has appeared, so can larger brain size, and to suggest, as archaeology implies, that for millions of years this brain increased relentlessly without being much used, is unacceptable to the biological sciences.

CONCLUSION

According to these deliberations, distinctive precursors of modernity in human behavior were present several million years ago, and since then have become gradually more established. At the upper end of the time scale, the rapid neotenization and incidental self-domestication of the human line over the last forty or so millennia (Bednarik 2008a, 2008b, 2011b) were such that they would have completed the journey to fully modern behavior. However, in the task of beginning to formulate a first outline of the etiology of human behavior these are merely prelude considerations. Much of modern behavior is driven by a set of powerful imperatives, especially the desires for security, peer approval, and "respect."

There are the desires to be taken seriously, the desire of belonging (to a place, group, or whatever), to believe in something (which is cognitively easier than not to do so). There are also desires to be useful, for control, for love, and for more of what is desired, which contrast with what is essential for survival. Defining these and other properties in neuroscientific terms is well beyond present means, and the biases likely to occur when a narrow-minded organism deigns to study itself must also be considered. Human priorities in studying the neotenuous ape define the shortcomings of such an approach, particularly when they are dominated by a Western righteousness that has yet to learn that all human groups exist, and have existed, in different constructs of reality. As Helvenston argues cogently in this volume, conflating literate minds with the oral minds that inhabited the human past, which "cognitive archaeology" does without realizing, is the result of one such epistemological impairment.

"Modern behavior," therefore, does not refer to the behavior of modern Westerners, or to that of any other extant human group. Instead it is defined by the state of the neural structures that are involved in moderating behavioral patterns, which ultimately are determined by inhibitory and excitatory stimuli in the brain. The many behaviors mapped onto these structures are more different than the countless languages that have been mapped onto similarly inherent systems of language centers. After all, human behavior is not only determined by the intrinsic structures giving rise to it; these are demonstrably influenced by ontogenic experiences of the individual and their effects on these neural configurations. Just as there can be no doubt about the ontogenic plasticity of behavior, it follows that the behavior of all individuals must be different, each reflecting individual experience—just as the precise realities in which human individuals exist must all differ from one another. As Malafouris (2008) states, "the functional structure and anatomy of the human brain is a dynamic construct remodeled in detail by behaviourally important experiences." Cultural activity modifies the chemistry and structure of the brain through affecting the flow of neurotransmitters and hormones (Smail 2007) and the quantity of gray matter (Maguire et al. 2000; Draganski et al. 2004). For instance the general introduction of writing in recent centuries has dramatically changed the brain of adult humans. Although they start out as infants with brains similar to non-literate peoples, these brains are gradually reorganized as demanded by the thinking implicit in literacy, which is totally different from the thought patterns found in oral societies (Helvenston, this volume). The use of all symbol systems (be they computer languages, conventions for diagrams, styles of painting) influence perception and thought (Goodman 1978). Therefore the complexity of the issue cannot be overestimated, but this does not change the underlying proposition that there must have been dominant patterns of hominin behavior at any point in history. These would have been determined by the interplay of specific behavioral imperatives: social norms and pressures, the range of behavioral options perceived to be available to the individual, given a specific set of beliefs. These beliefs would have been formed by many influences, such as society's framework and individual life experience, i.e., ontogenic factors specific to the individual.

In a scientific sense, behavior is the outcome not only of neuronal activity; other factors are also involved, especially the endocrine system. The hypothalamus alone controls the neurotransmitter dopamine and the hormones somatostatin, oxytocin, vasopressin; and the growth hormone-releasing, thyrotropine-releasing, gonadotropin-releasing, and corticotropin-releasing hormones. Then there is the pituitary gland just below it (Figure 1), whose anterior section controls the hormones for growth, thyroid-stimulation, and adrenocorticotrophic,

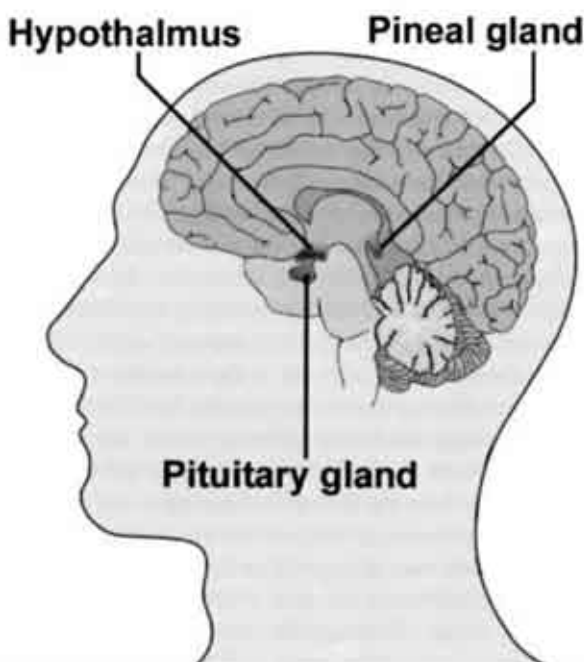


Figure 1. The locations of human brain glands.

follicle-stimulating, luteinizing, and luteotropic hormones; its intermediate section maintains melanocyte-stimulating hormone; and the posterior section provides oxytocin, vasopressin and anti-diuretic hormones. The pineal gland controls melatonin. Specific neurons can have considerable influence on behavior, for instance the von Economo neurons have already been mentioned. The tonically active neurons, functioning as a gating mechanism between the matrisome and the striosome regions, modulate the orbital frontal cortex and anterior cingulate by adjusting the degree to which the thalamus drives both areas (Bednarik 2011b: 177). But still other substances of the brain can influence behavior. For example the protein tau, a component of intracellular neurofibrillary tangles, has profound effects as neurons and synapses die and axons degenerate in Parkinson's disease. The current Human Microbiome Jumpstart Reference Strains Consortium (2010) has even offered the suggestion that gut microbiota may be involved in neural development and function, e.g., in mood disorders (Forsythe et al. 2010). Similarly, *Helicobacter pylori*, a bacterium implicated in ulcers and stomach cancer, may help trigger Parkinson's disease. In short, human behavior is the result of an exceedingly complex etiology that currently defies comprehensive explanation.

Nevertheless, this paper has attempted a scientific definition of the broad parameters of the likely behavior of hominins to probe the origins of modern behavior. It has done this not by offering speculative musings about specific behavior patterns, but by introducing relevant issues from the biosciences, thus facilitating the formulation of propositions that are testable within these. Archaeological appeal to plausibility has been explicitly excluded as being merely a stratagem to preserve a false dogma. That dogma demands that modern behavior appeared with the purported speciation to recent Graciles and is expressed in the Final

Pleistocene cave art of southwestern Europe (from 32,000 years BP onwards); therefore any preceding evidence of human modernity must be either false, incorrectly dated, or its presenters must be mistaken. All of the assumptions underpinning this notion are false: the first Upper Paleolithic cave art is not the work of Graciles (Bednarik 2007); the amount of Middle Paleolithic rock art surviving today is probably much greater than that of Upper Paleolithic rock art (Bednarik 2010); and empirical evidence of "behavioral modernity" precedes the Graciles by hundreds of millennia (Bednarik 2011c). Attempts to sustainably bring the neurosciences and cognitive sciences into correlation with archaeological narratives of Pleistocene human behavior have been made, but have been severely hampered by false archaeological models, especially the replacement hypothesis. Human modernity, be it somatically, culturally, or behaviorally, did not appear as a single package at a particular time, but emerged as a series of progressive developments culminating in the recent neotenization episode in the last part of the Late Pleistocene. Human behavior 30,000 years ago would have certainly differed dramatically from today's patterns, and yet it was fully modern in the sense that the biological structures producing patterns of behavior were largely similar to today's. However, these similarities had been developing for eons prior to the emergence of that glorious crown of evolution, *Homo sapiens sapiens* (Bednarik 2011b).

The core trait under selection in the evolution of cognition is not tool use, or even ToM; it is high order control capacity (Christensen in prep.). ToM, self-awareness, consciousness, technology, and culture were all available to non-human species, but were not developed to an integrated system of a self-reflective brain that observes itself and then makes conscious decisions based on excitatory/inhibitory neural functions. For instance, the sleeping nests or tools of the great apes were not improved upon; there was no volition to do so. Therefore volition becomes the prompter, and it needs to be explained how its ability to derive abstract goals from the prefrontal cortex arose (R. Dielenberg, pers. comm.). The answer, it is proposed here, lies in the rise of cultural behavior and its growing conscious comprehension of cause and effect (Bednarik 2011b). This development apparently took place in the Early Pleistocene. By the beginning of the Middle Pleistocene, 780,000 years ago, human behavior as a neurological process was well established, in the sense that the neural structures involved in moderating behavioral patterns were substantially in place. Fully modern human behavior, however, did not appear until recent centuries, because the ontogenic development of human brains has changed significantly over the course of recent centuries (for instance through the widespread introduction of literacy). Therefore the archaeological claims placing the advent of modern behavior 30 or 40 millennia ago are false, however such behavior is defined. It can be safely assumed, as a null hypothesis, that for much of the Pleistocene and for most of the Holocene, human behavior was modern in the sense that it used much the same structures as today, but it was certainly not modern in its expressions. Indeed, even among contemporary conspecifics, behavior can differ widely, for instance according to the conventions of symbol use (see Helvenston, this volume) and sophistication of cause and effect reasoning. The use of symbols or exograms changes with time, while fully coherent cause and effect reasoning is a recent introduction and not yet accessible to most of humanity, whose cognition remains widely dominated by what neuroscience terms "magical thinking."

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