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Chapter 3

AN ETIOLOGY OF HUMAN BEHAVIOR

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ABSTRACT

The definitions of human behavior guiding traditional psychology, psychiatry, or sociology lack the defining capacity of sciences, the provision of causal explanations of phenomena. Humanities are, by definition, anthropocentric disciplines. The mental, emotional, and social mannerisms or actions of human individuals or populations that represent behavior are manifestations of complex strategies responding to stimuli in perceived realities. In this they apply neurologically constituted means such as consciousness, theory of mind, and self-awareness, while also following culturally imposed conventions of various types. None of these and other factors contributing to human behavior can be dissociated from their historical trajectories, leading all the way into the deep hominin past. Nor can they be explained effectively without an understanding of these trajectories. Such understanding has largely escaped scientific attention thus far, and this chapter cannot provide more than a rudimentary introduction illustrating the profound shortcomings of traditional disciplines in defining the complexities of human behavior.

Keywords: hominin, behavior, pre-History, culture, cognition, primate, encephalization, exogram

INTRODUCTION

In seeking to explore the etiology of human behavior it is inescapable that such origins can only be prudently explored by reflecting on the hominin behavior of the Pliocene and Pleistocene periods, because it was then that patterns of behavior must have been established before they developed into those of today. Investigating modern human behavior by

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considering only its extant expressions is as unscientific as is the determination of diseases from their symptoms alone; any condition of humans needs to be understood in terms of its causes, not its effects. Therefore it is unavoidable that in defining a scientific understanding of behavior, the deep history of hominid and hominin evolution needs to be consulted. Unfortunately, this is where the major adversities are encountered in such a quest: the humanistic and anthropocentric disciplines of paleoanthropology and Pleistocene archaeology are dominated by sectarian cliques and the fads they have generated for over one and a half centuries. Few of the knowledge claims spawned by these disciplines since the mid-19th century are testable. The notoriously poor credibility of hypotheses widely regarded as true reflections of the human past has not prevented them from contaminating other major received truths. Indeed, the epistemological base especially of archaeology derives largely from etic taxonomic devices, or "institutional facts" *sensu* Searle (1995), such as invented peoples based on invented cultures based on invented tool types and their combinations (Bednarik 2013a). Paleoanthropology, on the other hand, revels in the invention of dozens of hominin species, without any credible evidence affirming their status as distinctive species. Yet as a discipline it remains incapable, right up to the present, of deciding a simple issue such as the taxonomic status of some primate bones from the cave Liang Bua in Flores (as shown by Henneberg and Schofield 2008; Eckhardt and Henneberg 2010).

One of the most conspicuous shortcomings of Pleistocene archaeology is that it has rarely addressed the most important question in that discipline: what is it that caused the development of hominins to change from an evolutionary (dysteleological) process to a teleological one? That this development began as an evolutionary progression, a process of Darwinian natural selection, is generally agreed. That it ended as the precise opposite, a teleological process, has not been explained by either archeology or paleoanthropology; in fact it has not even been considered. For instance, archaeologists often speak of the oxymoron 'cultural evolution,' when the ascent of human culture is evidently a teleological progression, whereas evolution is fundamentally dysteleological. Archaeology presents a progressivism based on a Eurocentric reality construct, implicitly viewing development as teleological, toward 'more developed' forms. But to regard evolution as having an ultimate purpose, such as the creation of superior species, is an ideologically inspired falsity deriving from the human exceptionalism of religion and has no place in science. This is only one of many expressions of incommensurability between science and archaeology. Thus the change from a dysteleological to a teleological development is the key element in understanding the human condition (Bednarik 2011a) and is fundamental to considering the etiology of human behavior, and yet it has rarely been examined in this light. Instead, a multitude of causes have been credited with prompting human evolution, including upright walk, tool use, language (Davidson and Noble 1990), 'art' (Dutton 2009), cooking (Wrangham 2009; Wrangham and Carmody 2010), sexual selection (Miller 2000) and technology (Taylor 2010). None of these diverse factors define humans, while the real difference between humans and other primates, the use of exograms (Bednarik 2014a), has remained completely ignored by an archaeology fused to 19th century thinking.

Moreover, the question of how and when the human species changed from a dysteleological route to a teleological is not the only crucial detail in understanding recent hominin history. Several others have been completely ignored by the gatekeeper disciplines of archaeology and paleoanthropology. For instance the tolerance by natural selection of the development of thousands of deleterious alleles in the human genome in its most recent period of evolution has never been examined by these humanistic disciplines, and remained unexplainable by the neurosciences because of the false models Pleistocene archaeology has promoted for decades (Bednarik 2011a, 2013a). Another example of their fundamental inadequacies is that both archaeology and paleoanthropology relished the model of a phenomenal rate of encephalization in hominins during the Pliocene and Pleistocene, ostensibly because it supported the progressivist notion of evolution toward greater sophistication, resulting in a species of apparently deity-like characteristics. Apart from the absurdity of this idea, both disciplines also chose to ignore the reality that for around forty millennia, since the time of the much-maligned 'Neanderthals,' the cranial volume of their descendants, the 'crown of evolution,' has plummeted at a rate 37 times (!) greater than that of previous, much lauded encephalization of 7 ml per 10 millennia (Henneberg 1988, 1990, 2004: Figure 1; Henneberg and Steyn 1993; Bednarik 2015a). This fatally questions the doctrine that the intellectual, cognitive, technological, and cultural development of humans was driven by the increasing brain size, one of the most enduring dogmas of archaeological religiosity. It stands to reason that the demands made on the human brain toward the end of the Pleistocene have, if anything, increased significantly, yet archaeologists and paleoanthropologists have ignored the rapid atrophy of the human brain during this very same period (Figure 1).

This is a fair indication of the profound disconnect between the ideas of these disciplines and the empirical data. Not only has the 'high priesthood' (Thompson 2014) of these branches of learning ignored such crucial evidence; it has misinterpreted the profound change in human evolution as a replacement of one species by another (e.g., Protsch 1975; Bräuer 1981, 1984a, 1984b, 1984c, 1989; Stringer 1984a, 1984b, 1985, 1989; Wainscoat et al. 1986; Cann et al. 1987; Wainscoat 1987; Stringer and Andrews 1988; Mellars and Stringer 1989; Churchill and Smith 2000a, 2000b) and similar origins myths. In short, it has failed to provide any semblance of a consistent explanation for all recent developments of importance in hominin evolution, and effectively explained them away with a thoroughly flawed scenario of wandering tribes and their global genocide (Bednarik 2008a, 2011a *et passim*).

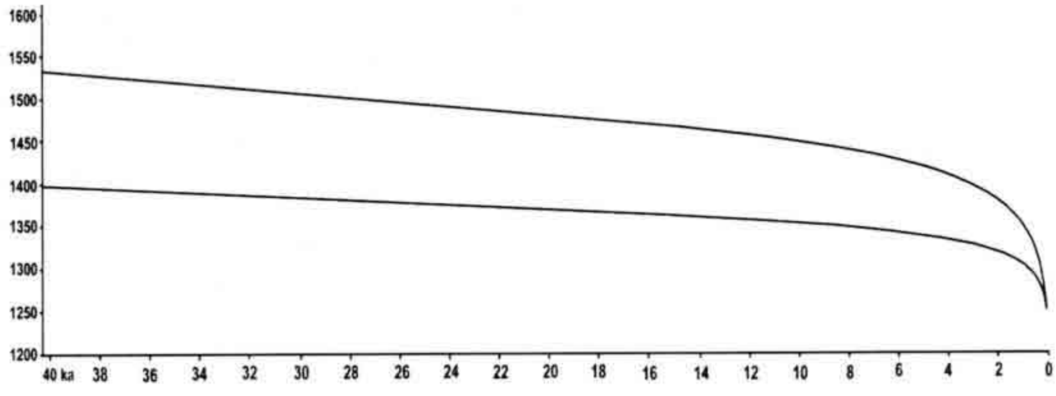

Figure 1. The atrophy of the human brain during the last 40,000 years: volume in cc versus age in 1000 years; the upper curve represents males, the lower is of females.

The upshot from all of this is that the fields of Pleistocene archaeology and paleoanthropology are in no condition to provide credible background evidence for the changes in human history that have given rise to hominin behavior. They have provided a great deal of empirical evidence, but their interpretations of these data and their narratives of the course of human evolution are epistemologically deficient. A discipline that pretends that tools are cultural markers while at the same time ignoring true cultural indicators, such as paleoart, is bound to yield endemic misinterpretations. And that is precisely what archaeology has done since the times of Boucher de Perthes in the early 19th century: it has the distinction of being the discipline that has always favored mistaken interpretations. So it rejected first the existence of humans and later of paleoart in the Pleistocene, the finds of human fossils such as Neanderthals, *Homo erectus* and the australopithecines, while embracing fakes like those from Piltdown and more recently the 'African Eve' hoax. Therefore, in a review of how human behavior came about, it is judicious to ignore archaeological beliefs and turn to the sciences.

About Behavior

Numerous sciences are relevant to an investigation into the etiology of behavior, ranging from ethology and primatology to cognitive science and neuroscience. They all need to be engaged in this quest, in which the present chapter cannot be more than a preliminary attempt to prepare the ground for such an ambitious endeavor. Nevertheless, if ideas about behavior are to be endowed with a semblance of scientific probity, it may be advisable to abandon the proposition that archaeology can recover intention or behavior. Such a pursuit also needs to start from a behavioral science free of traditional psychology, with such fields as behavioral biology and behavioral genetics. Behavior is itself a somewhat flexible concept, for instance it can refer to the way a device or system operates, or it can define any observable response produced by an organism, including a plant. It can even be applied to a state of probation about someone's conduct. More pertinently, it means the way a living creature behaves or acts, and in the case of humans it defines conduct relative to social norms. Actually, "behavioral scientists do not agree on what constitutes behavior" (Levitis et al. 2009). These authors favor the definition "behavior is the internally coordinated responses (actions or inactions) of whole living organisms (individuals or groups) to internal and/or external stimuli." The ambiguity and latitude of the term are both well illustrated by the many adjectives that are routinely applied to 'behavior,' including abnormal, abusive, acceptable, adaptive, aggressive, appropriate, assertive, bad, collective, compulsive, corporate, correct, criminal, defensive, deviant, disgusting, ethical, good, immoral, inappropriate, incorrect, interpersonal, irresponsible, learned, moral, nonverbal, normal, odd, offensive, parental, poor, professional, questionable, responsible, right, rude, self-destructive, sexual, social, stupid, unacceptable, undesirable, unethical, unprofessional, verbal, violent, or wrong, to name examples helping to define the vast range of human behavior. Generically, behavior is the range of actions and mannerisms by individuals, organisms, systems, or artificial entities in conjunction with themselves or their environment. It is the response of the system or organism to various stimuli or inputs, whether internal or external, conscious or subconscious, overt or covert, and voluntary or involuntary.

Human behavior, more specifically, refers to the range of physical action/reaction and observable emotion associated with individuals, as well as human society as a whole. The range of behaviors exhibited by humans is influenced especially by culture, genetics, attitudes, emotions (affect), values, and ethics, but also by authority, rapport, hypnosis, persuasion, and coercion. An important factor is conditioning, of which two forms can be distinguished: *classical* conditioning was famously discovered by Ivan P. Pavlov in 1927 (Fiske et al. 2006); while *operant* conditioning derives from the idea that if behavior is reciprocated with a certain consequence (positive or negative reinforcement), the behavior is more likely to be repeated (Skinner 1974).

From a detailed scientific perspective 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, and vasopressin; and the growth hormone-releasing, thyrotropine-releasing, gonadotropin-releasing, and corticotropin-releasing hormones. Then there is the pituitary gland just below it, whose anterior section controls the hormones for growth, thyroid-stimulation, and adrenocorticotropic, 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. 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 2011a: 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 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.

It appears that human behavior is believed to be prompted by very numerous kinds of immediate stimuli, which act on the nervous and endocrine systems. This occurs usually in accordance with pre-existing patterns determined by genetic factors und cultural attitudes, individual values and emotional states. An apparent correlation between the complexity in the behavior of an organism and that of its nervous system confirms this. Organisms with more complex nervous systems inevitably have a greater capacity of adjusting behavior by learning new responses, and they tend to do so much quicker than simpler organisms.

All of this broadly describes the present-day behavioral mechanisms in humans; it provides no guide in defining those that would have been prevalent hundreds or even thousands of millennia ago—when today's patterns would have first begun emerging. Of the main variables determining behavior today, emotional states could be regarded as 'noise' in the present context because of their stochastic nature. Individual 'values' do not arise autonomously; they are in effect a subset of cultural attitudes, arising from interplay between cultural mores and the internalized manifestations of other, usually subliminal cultural imperatives. They, and the genetic makeup of the individual, together with the cognitive tools available to it, are the primary determinants in behavior today, and here we shall make the uniformitarian assumption that this was also largely the case in the distant hominin past.

CULTURAL AND GENETIC IMPERATIVES

To appreciate that cultural constraints, priorities, and obligations differ significantly between societies it is not necessary to understand cultures of the distant past. The ethnographic evidence from extant groups confirms this overwhelmingly. Indeed, these differences cannot be over-emphasized; they tend to be greater than popularly appreciated. Conspecific groups such as contemporary indigenous peoples or 'sub-culture' bands (e.g., fundamentalists, 'Goths,' 'vampires') literally exist in realities that differ greatly from those of more mainstream societies, and can sustain behavioral norms that other groups would view as aberrant. Of the greatest interest in the present context are the cultural constructs of populations that have not been exposed to the supposedly homogenous Eurocentric worldview usually defined as 'Western.' The reality constructs of these 'native' or 'indigenous' societies are perhaps not adequately understood by those who sought to record them (Bednarik 2011b), but even limited understanding suffices to appreciate the huge disparities between the cosmovisions (*Weltanschauungen*) different groups subscribe to.

There is a distinctive human tendency to believe that one's own construct of the world is correct, or at least resembles 'truth' most closely. The 'Western' version derives its confidence especially from the belief that it has science on its side. In this it fails to appreciate that it is the outcome not of a scientific view, but of historical developments that have more often than not prevented science from influencing its worldview. Even the most cursory review of different worldviews demonstrates great differences between them, and it may be useful to distinguish between two main types. On the one hand are those that derive from religious convictions, such as Western views and many others. These contrast with belief systems based on forms of science. For instance while the Christian conquistadors debated whether the South American 'Indians' had souls, Amazonian Amerindians applied principles of science when they experimented on conquistadors by drowning them, to see whether they would rot and thus be human (Viveiros de Castro 1992). For these Amazonians, all living things are bound together by human culture, whereas they are divided by their different materialities. This contradicts traditional binarism of nature versus culture, which is derived from religious dogma and is thus more primitive than the model of non-Europeans. Or, as Lévi-Strauss observed wryly, perhaps the Spaniards were better in the 'social sciences,' while the Amerindians were conducting their research according to natural sciences protocol long before Europeans had developed a science.

Another example and one that this author is much more familiar with, having worked intensively with 'men of high degree' of the Australian Aborigines since the 1960s, illustrates this perspective. The belief systems of the original Australians were always, to the best of our knowledge, science based: derived from observations of nature and from cause and effect reasoning. So for instance their ethnoscientists have understood for millennia that the Sun goes clear around a spherical Earth, or that the tides are caused by the Moon (Warner 1937; Wells 1964; Hulley 1996). What causes both lunar and solar eclipses is correctly defined in myths about the Sun-woman and Moon-man (Warner 1937; Bates 1944; Johnson 1998). Like ethnoscientists in many parts of the world, Aboriginal astronomers indicated phenomena such as the equinox in their stone arrangements (Norris et al. 2013), and they created star maps (Galiina Ellwood et al. 2013). Indeed, indigenes of central Australia had known and named every one of the c. 400 stars up to the fourth magnitude (Mountford 1976).

The discovery of evolution is regarded as one of the greatest achievements in science, credited principally to Charles Darwin. It has in fact many precedents, contributed by Greek and Arab philosophers, and was not a new idea at all in the 19th century. Most notably, Abu Uthman'Amr ibn Bahr, commonly known as al-Jahiz (776–869 CE), expressed the idea of evolution in his work *Kitab al-hayawan* ('The book of animals') a millennium before Darwin. Al-Jahiz considered humans as an evolutionary stage of animals and discussed the struggle for existence and animal adaptation, thus anticipating Darwin's natural selection (Sarton 1927: 597; Siddiqi 1988: 276). Many subsequent Arab authors adopted his views, including Al-Farabi, Al-Mas'udi, Imam Raghib Isfahani, Ibn Miskawaih, Al-Biruni, Ibn Sina, Ibn Tufayl, Al-Khazini, and Ibn Rushd, all of whom lived from the 9th to the 12th centuries CE. Darwin himself, who read Arabic, was aware of this work. The idea that one type of organism could descend from another was even earlier mooted by pre-Socratic Greek philosophers, such as Anaximander and Empedocles (Kirk et al. 1983). However, all this pales besides the understanding of Aborigines (or Amerindians, or other indigenes), since time immemorial, that all humans descend from other animals, just as all animals are anatomically related. Their ethnoscientific apprehension derived from the observation of the many skeletal similarities and the shared inner organs and sensory organs. The cause and effect reasoning of the Aborigines is exemplified by their belief that all rocks were once, in the distant past, soft. Having observed many natural phenomena, ranging from plant and animal fossil casts, to lava flows and to wind-lain sedimentary rocks, they considered it inescapable that rocks must have once been soft. Geology accepts today that ultimately all rocks derive from non-solid phases, but if one would have claimed this in Europe just a few centuries ago one might have faced the fury of the Inquisition (Figure 2).

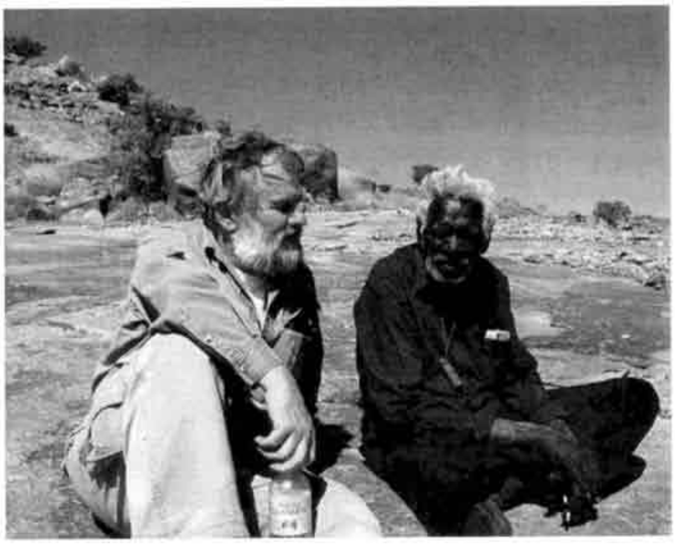

Figure 2. The author with Aboriginal 'man of high degree' Monty Hale, who confirmed that humans descend from other animals and that rocks were once soft.

Therefore it is not obvious or even realistic that the Western paradigm is necessarily better in defining reality, and we know from theoretical physics that our understanding of the world remains miniscule even today. European thought was until very recently largely predicated on what neuroscientists call 'magical thinking' ('associative thinking' is a more apt term), whereas the alternative cause and effect thinking still has to be acquired ontologically. Its widely practiced application in so-called primitive societies would seem to suggest that their cognition was more advanced than that of Europeans. It raises the possibility that earlier cognitive abilities, beyond the late Holocene, were not necessarily 'inferior,' and that it may be hasty to attach simplistic labels to the hominins of earlier phases. Yet until most recently, practically all archaeologists perceived robust *Homo sapiens* types, such as the much maligned Neanderthals, to have been somewhere between primitive and exceptionally primitive. Many denied them the faculty of verbal communication (Liebermann 2007); some even placed them closer to the apes than to humans (Davidson and Noble 1990). Without evidence Neanderthals were almost universally believed to be a different species and a 'dead side branch' that could not possibly be an ancestor of the crown of evolution—as archaeology perceived it (Figure 3).

The discipline of inventing human pasts could not have been more wrong. Not only are the Neanderthals (whose correct scientific name remains *Homo sapiens neanderthalensis*) or other robust sapienoids our forebears; their art-like productions were unarguably much more sophisticated than those of their eventual descendants of the final Pleistocene and much of the Holocene (Bednarik 2007, 2008a, 2011a, 2012a; Sadier et al. 2012). By far the most artistically advanced paleoart of the Ice Age is that of Chauvet Cave in France, which apparently is the work of Neanderthaloid people—and to a large extent probably the work of juveniles.

Figure 3. Reconstruction of Neanderthal by an artist who should not be named.

Not that this comes as a surprise for those who had considered the empirical evidence outside of archaeological doctrine. It has long been known that Neanderthals had significantly larger brains than their descendants, including anatomically modern humans. The rapid atrophy of the human brain over the last forty millennia had remained almost unnoticed by archaeology, while the gracilization of skeletal architecture and other decline caused by neoteny and the rise of neurodegenerative and mental illnesses in the same period (Bednarik 2011a) were simply ignored. It remained therefore unknown that the development from Neanderthal to Moderns was not an ascent, but rather a decline in evolutionary fitness. This is not the kind of finding both the public and humanists appreciate, and establishment archaeology has long been in the business of inventing grandiose human pasts for its masters, the nation states (Bednarik 2013) and currying favor with its benefactor, the public (because it produces nothing of economic worth it needs full public support).

Nor is it new information that Neanderthaloid people survived successfully for several hundred thousand years of climatic upheaval in Eurasia, whereas Moderns have only appeared very recently (between 40,000 and 30,000 years ago), and, judging by their brief history they are well on the way to forfeiting their viability as a species (Bednarik 2013a). This is not just because their niche construction strategies are actually destroying their living space (and that of many other species); it is primarily because the culturally driven changes to their genome are largely disadvantageous (Bednarik 2011a *et passim*). Therefore *Homo sapiens sapiens* is perhaps the least viable of all primate species/sub-species, judging from his track record so far.

Cultural imperatives differ greatly among cultures, and if they influence behavior, they need to be understood if their effects are to be fathomed. The cultures of the Pleistocene remain unknown because archaeology has misidentified them, confusing technology with culture. Therefore their impact on the behavior of early hominins cannot even be conjectured with any semblance of credibility. The genetic origin of behavior would be a much safer basis of conjecture, but the amount of data currently available from the hominin genomes remains minute, for two reasons: this analytical approach has only been developed most recently; and procuring preserved genetic material from hominin remains is difficult. Such vestiges tend to be poorly preserved or mineralized when they are of Pleistocene age. Whereas many megafaunal specimens have been recovered from permafrost sediments, they have sadly not included any Pleistocene hominin finds so far. No analyses have been made to date of the sequences available from the perspective of speculating about behavior.

ABOUT HUMAN COGNITION

In contrast to the cultural and genetic basis of the behavior of hominins, which at this stage cannot be reliably accessed, their cognitive origins are—rather surprisingly—of somewhat better accessibility, provided that adequate care is taken in interpreting them. A rough framework for formulating a preliminary etiology of hominin behavior is available, based on scientific (rather than archaeological or paleoanthropological) evidence and reasoning. Distinctive precursors of modernity in human behavior must have been present several million years ago, and since then have become gradually more established. By the beginning of the Middle Pleistocene (about 780,000 years ago), modern human cognitive processes seem to have been largely established (Bednarik 2012a). This is, however, widely rejected by the academic gatekeepers of human history. Pleistocene archaeology has strenuously precluded any signs of cognitive sophistication prior to the Upper Paleolithic, in order to sustain its replacement hypothesis (i.e., 'African Eve'; Stringer 1989 *et passim*). Paleoanthropology, in its obsessive zeal in creating dozens of imagined human species, has equated 'primitive' physiology with primitive cognition in its similarly sapiens-centric outlook. However, the sciences can provide much more reliable frameworks of understanding than these two overextended and ideologically inclined disciplines, which believe in a teleological human evolution (all evolution is strictly dysteleological, as noted above). These beliefs require them to deny the ancients any cognitive complexities or 'advanced' abilities, but they are generally incompatible with the hard evidence. For instance, the belief that verbal communication was not available to any hominins beyond Moderns is not even compatible with archaeological and paleoanthropological information (Falk 1983, 1987, 2009; Dunbar 1996; Aitchison 1996; Bickerton 1996, 2010). Maritime colonization, which began around one million years ago (Bednarik 1997, 2003, 2014b), is simply impossible without complex communication (Figure 4). The occupation of cold-climate regions, up to two million years ago, required shelter, clothing, and controlled fire use (Beaumont 2011), yet the minimalist ideology of archaeology has long rejected the availability of these advantages for nearly all of human history. Beads and pendants prove not only that their makers or users had certain technological skills (Bednarik 1997); they also demonstrate that those who wore them possessed fully developed self-awareness.

Figure 4. Maritime colonization began with bamboo rafts about a million years ago.

To the scientist this does not come as a great surprise: the sentience of one's own knowledge, attitudes, opinions, and existence is available to various species. Some of the great apes, the elephants and bottlenose dolphins are among the species that have passed the mirror test, which is one of the measures of self-awareness (De Veer and Van Den Bos 1999; Gallup 1970; Gallup et al. 2002; Heyes 1998; Keenan et al. 2003; Mitchell 1993, 1997, 2002; but see Swartz 1997; Morin 2003 for critical reviews). Significantly, these are much the same species shown to possess von Economo neurons (Seeley et al. 2006; Butti et al. 2009; Hakeem et al. 2009). Von Economo neurons seem to occur in relatively large species with large brains and extensive social networks (Bednarik 2012a). Not only has visual recognition of the "self" been demonstrated in many animals, metacognition (Smith et al. 2014) and theory of mind (ToM; Bednarik 2015b) have also been revealed in many species, ranging from primates to rodents and birds—along with long-range planning and empathy (Bednarik 2011a). Birds such as parrots, ravens and magpies; fish such as coelacanths and tuna; invertebrates like the octopus and the squid; and a variety of insects, including bees, are among the animals capable of adopting complex learnt behavior.

It is difficult to see how constructs of individuality could have evolved without social networks. Even today, ideas of the self are largely derived from the individual's social context. Indeed, it is incomprehensible how social complexity could have developed beyond that of ants, bees, or termites without some level of self-awareness. It follows that the introduction of beads and pendants is of importance in the determination of the faculty of well-developed self-awareness in hominins (Bednarik 2005). Naturally we cannot expect to find the earliest instances of such body adornments, because they were most probably of perishable materials and even the odds against finding those that were not are most unfavorable. Nevertheless, the earliest beads we do have are of the Acheulian technocomplex (Bednarik 1997b, 2005), i.e., several hundred thousand years old; yet in order to preserve their 'African Eve' model some archaeologists have strenuously tried to explain them away (d'Errico and Villa 1997; Rigaud et al. 2009). While science would expect that all hominins, like apes, possessed self-awareness (Sedikedes et al. 2006: 66), these humanists would deny them such level of cognition to save their African Eve doctrine, which was initially based on academic fraud (Schulz 2004). Yet an incipient self-adornment behavior may have been observed by McGrew and Marchant (1998; McGrew 2004: 77, Figure 5.1; Nishida et al. 2009) in a group of chimpanzees. Having killed and eaten a red colobus monkey one afternoon in 1996, the apes were observed again the next morning, when one of the juvenile females was noted "grooming" a strip of colobus skin. The following morning another female wore the skin strip draped around her neck. When she discarded it later that third day the investigators found that the skin had formed a necklace by having been tied in a single overhand knot. Colobus monkeys are highly valued food to chimpanzees, so it seems the female sought to enhance her appearance and/or status by adorning herself with the skin. Unless this was an accidental occurrence, that observation would presumably make the colobus skin a symbol. The ability of non-human primates to tie simple knots has been demonstrated before (Warner and Bednarik 1996), and numerous other embryonic forms of behavior thought to be limited to humans have been observed widely in other species. Toolmaking, for instance, is now known from dozens of species, and forms of language-like communication from even greater numbers. Deliberate deception, domestication of other species, and the ability of interpreting others' intention have all been demonstrated in various species by ethology. And when it comes to walking on two legs, this is available to thousands of species, especially birds. The bipedal locomotion of humans has been simplistically attributed to environmental change, while alternative explanations were ignored; for instance it could be ascribed to the neoteny of the human foot, a possibility never considered (Bednarik 2011a).

The concept of 'self-awareness' remains poorly defined in philosophy, psychology, and artificial intelligence, and at this stage science can only provide very fragmentary information

(Dalton 1997): the neuronal processes generating conscious experience remain profoundly unknown. Self-awareness is taken to refer to an 'explicit understanding of an individual that it exists,' and seems to require consciousness as a prerequisite. It may also include the understanding that other individuals are similarly self-aware, which resembles the function of theory of mind (ToM). Most importantly, self-awareness is absent in small infant humans. Much of what we tend to regard as self-awareness in extant humans probably just relates to ideological, ontological, and cognitive a prioris, and to simple biological equipment, such as proprioceptors. The differences among species, in levels of self-awareness, may therefore not be as pronounced as we might be inclined to think. Similarly, the ability of various apes to master a range of symbols has been well established and, again, human superiority in symbolling ability may not be as pronounced as ideological systems accentuating the exceptional status of humans tend to emphasize.

Consciousness (subjective experience) can be defined as a transparent representation of the world from a privileged egocentric perspective (Trehub 2009) and has been subjected to much philosophical attention. Whereas self-awareness focuses on the self, processing both private and 'public' information about selfhood (Carver 2002; Gallup 1998; Gallup and Platek 2002), consciousness focuses attention on processing incoming external stimuli of the organism's environment (Dennett 1991; Farthing 1992). The self-referentiality of consciousness is noted by Schrödinger (1964: 19) when he states "the reasoning *is part of* the overall phenomenon to be explained, not a tool for any genuine explanation" (emphasis added). Wittgenstein (1982: 42) sees consciousness and perceived reality as equivalent. The etiology of this self-referential awareness, so crucial to understanding human behavior, remains fundamentally unknown. The quest to explain the ability to experience reality consciously is one of the hardest tasks of science, precisely because of its self-referentiality, and Hofstadter (2007) compares it to finding a self-consistent set of axioms for deducing all of mathematics: as shown by Gödel (1932) this is impossible. For any recursive axiomatic system powerful enough to describe the arithmetic of natural numbers there are true propositions that cannot be proved.

The great efforts made to explain consciousness—the central fact of existence—have indeed yielded very little so far. Because consciousness vanishes when the brain is switched off (by whatever agency), it seems safe to assume that the brain is the organ hosting consciousness—and more specifically the cerebral cortex (Goldberg et al. 2006; Frässle et al. 2014) and possibly the claustrum (Crick and Koch 2005; Koubeissi et al. 2014). The lack of involvement of the cerebellum is striking, because it has more neurons than the cerebral cortex and is just as complicated (i.e., the cerebellum is made up by just over 80% of the brain's 86 billion nerve cells; Herculano-Houzel 2012). 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. The importance of consciousness in considering behavior is illustrated by it being assessed by *observing* behavior. However, this can sometimes be misleading; for instance it is doubtful whether the behavior of a sleepwalker is indicative of any consciousness. Human consciousness is also thought to involve gamma activity (Engel and Singer 2001; Imas et al. 2005) and a frontal P300, as during dreaming sleep (Cote et al. 2001; Takahara et al. 2002). The P300 wave is absent in some brain-damaged patients able to communicate (King et al. 2013), and a similar but weaker wave has been detected in small infants (Kouider et al. 2013).

Therefore the solution to what are widely (but not universally) regarded as the "hard problems of consciousness" (Chalmers 1995) remains elusive. One of the approaches developed in recent times has resulted in the *global workspace theory* (GWT; Baars 1997, 2002), imagining a workspace in the brain where sensory events may compete with each other for consciousness (Robinson 2009). GWT posits that incoming information becomes conscious only when three conditions are met: this information must be represented by networks of sensory neurons; it must last long enough to gain access to a second stage of processing, distributed across the brain's cortex, and especially involving the prefrontal cortex; and this combination of bottom-up information propagation and top-down amplification through attention must 'ignite' to create a state of reverberating, coherent activity among many different brain centers. The theory does, however, at best provide an account of cognitive function; it remains mute on the nature of consciousness (see also objections by Blackmore 2005).

Another recently developed approach is that of *integrated information theory* (IIT; Tononi 2008; Barrett and Seth 2011; Oizumi et al. 2014). It begins with five phenomenological axioms: intrinsic existence, composition, information, integration, and exclusion. IIT "provides a principled account of both the quantity and the quality of an individual experience (a quale [pl. qualia]), and a calculus to evaluate whether or not a particular physical system is conscious and of what" (Tononi and Koch 2015). The theory is even compatible with quantum mechanics. IIT also agrees with the "Chinese room argument" (Searle 1984, 1992, 1995, 1999) that a computer simulation of the conscious human brain will not have consciousness—just as the technology of brain "nanodisassembly" (assuming that it is feasible; Drexler 1986, 1992; Morevec 1988; Merkle 1994) will not yield anything other than a dead brain (Bednarik 2013b). According to IIT, the Turing test is not a valid criterion for consciousness. Another advantage of IIT is that it can account for why consciousness evolved, by attributing a better match of causal structure with environment to a brain with a high capacity for information integration (Tononi and Koch 2015). Integrated information enriches experience and would increase the abundance of neurons and their interconnections.

A thought experiment useful in this context is the following. Suppose some mutation has produced humans that are in all respects like other humans, except that they have somehow lost Searle's "causal properties." One would assume that natural selection would favor these "mutants" because of their simpler design, so the other humans would be replaced by them. If Searle is right, it would be likely that present-day humans are such mutants that mistakenly believe they are actually conscious (Crevier 1993; Harnad 2001). Irrespective of this being a valid assessment (there are alternative scenarios), it has been understood at least since Plato's time (cf. his simile of the cave) that the reality experienced by humans is an artifact. This is the central theme of Plotkin's *The imagined world made real* (2002), arguably the most advanced text so far on the nature of humanly experienced reality. Perceived reality is certainly not equivalent to objective reality—assuming that such a state actually exists (Bednarik 2011a).

If this position is adopted as a given, it emerges that the mental world of ancestral hominins does not necessarily have to be 'inferior.' It was no doubt less sophisticated, less developed than modern worldviews; but if the construct of reality of present-day humans is essentially an imagined world made real by culture—which can be regarded as a valid working hypothesis—it is not a basis for understanding the world. Nor should one assume that behavior based on such a construct is necessarily more rational than the behavior, for instance, of the ancients. The last word on the issue belongs to the dictum that there is no reason to assume that an entirely false, cultural cosmology or epistemological model could not be formed and maintained indefinitely by an intelligent species (Bednarik 2011a: 7), provided that it is inherently as consistent as that of mathematics. Gödel's incompleteness theorems see to that.

Cognition and Behavior

How a construct of reality is established from sensory input—which remains profoundly unknown—and how behavior is initiated, controlled and produced (Carruthers 2002; Clowes 2007; Koch 2004; Nelson 2005) is crucial to the subject of this chapter. Intentional or volitionally driven behavior is regarded as one of the quintessential aspects of humanness. In the ontogeny of the individual human it can be detected in infants 5–9 months old (Woodward 2003). By the age of 15 months infants can classify actions according to their goals (Csibra et al. 2003). Both these functions are available to chimpanzees and orangutans (Call and Tomasello 1998), but apparently not to monkeys (Jellema et al. 2000). Next, the child establishes joint attention between the ages of 18 and 24 months (Franco and Butterworth 1996), and begins to engage in pretend-play and develop an ability to understand desires (Wellman and Wooley 1990; Rapacholi and Gopnik 1997; Wellman and Liu 2004). Apes use gaze monitoring to detect joint attention (Hare et al. 2000), but monkeys apparently do not. The more developed theory of mind (ToM) of modern humans only becomes evident 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. Both of these faculties seem to be lacking in the great apes (Suddendorf 1999; Call and Tomasello 1999) and probably emerged in human ancestors during the Pliocene (Bednarik 2012b). Planning of future action, self-representation, complex syntax, and creative thought are rendered possible by these abilities, 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 great apes. The apes have so far provided no evidence 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).

This reasoning offers a rough framework for the cognition of early hominins. Most certainly any cognitive abilities available to extant apes should be attributed also to the first ancestral hominids after they split from the pongid branch, even though their late Miocene fossil remains have not yet been recovered. The technology of the subsequent australopithecines, of the Pliocene and Early Pleistocene, suggests that their culture had become more developed, before the advent of the first members of *Homo*, perhaps 2.5 million years ago. The latter's technology was more advanced again, and based on the theorem that cognition developed at a rate roughly commensurate to the increase in cranial capacity, the increase in the complexity of human cognition must have been a gradual process occupying millions of years. That hypothesis derives from the great social, economic, and evolutionary costs entailed by encephalization (Bednarik 2011a, 2012b). The era of the subsequent *Homo ergaster/Homo erectus* (1.9 million years ago to the end of the Middle Pleistocene) is marked by further and continuous increase in brain volume through most of the Pleistocene, and it is during this phase that some of the most obvious consequences of human advances become evident. For instance these hominins became able to occupy cold regions of Eurasia, especially through their controlled use of fire, and probably by the use of built shelter and clothing. Fire use by *H. erectus* has been proposed at several sites (Olorgesailie, Chesowanja, Koobi Fora, and Gadeb in Africa) where alternative explanations are possible (James 1989). However, Gesher Benot Ya'akov in Israel has furnished more solid evidence dated to the early Middle Pleistocene (Goren-Inbar et al. 2004; Pettitt and White 2012: 194). Moreover, the large hearth far inside Wonderwork Cave in South Africa, dated to about 1.7 million years ago (Beaumont 2011), not only provides solid evidence of controlled fire use, it also contains many hundreds of smashed and calcined animal bones (Figure 5), demonstrating the cooking of meat by very early *H. erectus* (Bednarik 2014b: 31). Evidence of shelters built by hominins of the Acheulian technocomplex (Mode 2) has been provided by sites in France, India, Morocco, and Libya. But the perhaps most consequential achievements of *H. erectus* is his development of seafaring ability to the level required by repeated feats of maritime colonization, particularly in the Indonesian archipelago (Bednarik 1997a, 1997c, 1999, 2000, 2001, 2003, 2014b; Bednarik and Kuckenburg 1999), and the evidence of body decoration in the form of beads during the Acheulian (Bednarik 1997b, 2005, 2014b).

Figure 5. Smashed and deeply calcined bone in the 2 m long hearth deep in Wonderwerk Cave, South Africa, c. 1.7 million years old.