

Lecture No. 1. The paleoanthropological and archaeological context

It is for all practical purposes impossible to consider the topics of cognition and symbolism in human evolution without extensive reference to Pleistocene archaeology and to the evolution of humans. The Pleistocene, also known as the “Ice Ages”, is the geological period during which the crucial stages of human evolution occurred, beginning about 1.7 million years ago and ending 10,500 years ago. Hominins — pre-human primates that are either precursors of the genus *Homo*, or may have been so — first evolved during the preceding Pliocene period, which lasted from 5.2 to 1.7 million years ago. Earlier contenders such as *Sahelanthropus tchadensis* are even 7 million years old, but the Pliocene is the period during which the australopithecines flourished in Africa. They occurred in several forms, at least one of which is thought by some to be a human ancestor. By about 3.5 million years ago, *Kenyanthropus platyops*, currently the earliest species thought to be directly ancestral to the human line, appeared in east Africa.

Up until recent years, paleoanthropologists distinguished between the subfamilies of Hominoids, which were humans and their ancestors, and Anthropoids. The latter comprised chimpanzees, gorillas and orangutan, according to the Linnean taxonomy. However, molecular DNA studies have shown that humans, chimpanzees and gorillas are genetically closer to each other than each of them is to orangutans. Therefore we now distinguish the subfamilies Pongidae (orangutans) and Hominiinae (humans, their ancestors, chimpanzees and gorillas). The latter were then divided into Hominini (humans and their ancestors), Panini (chimpanzees and bonobos) and Gorillini (gorillas). Therefore a *hominin* is a creature agreed to be either human or a probable human ancestor, such as the various species of *Homo*, *Australopithecus*, *Paranthropus* or *Ardipithecus*. In the past, these were subsumed under the name “hominids”, which now refers to what used to be known as “hominoids”, i.e. those early species that seemed to be broadly related to the human line.

African beginnings

In recent decades, a strong case has been made for hominins to have initially evolved exclusively in Africa. The issue, however, needs to be regarded as unresolved, because the amount of research conducted in Asia since the mid-20th century has been inadequate by comparison to the focus on Africa, especially eastern Africa. Prior to the 1950s, Asia shared with Africa the status of potential theatre of initial human evolution. While Asian pre-Pliocene primates such as *Ramapithecus* are no longer considered contenders as hominin ancestors, we need to be aware that there remain large gaps in our knowledge of human evolution. Most importantly, the available record is greatly biased, taphonomically as well as in terms of relative research efforts. Hominin and other fossils are only found in those regions where geological or other preservation conditions favored their survival, and they are only found where we look for them. Recent discoveries in Asia, such as the finds of *Homo floresiensis* on the Indonesian island of Flores, have shown that we have a great deal still to learn about hominin evolution, especially in Asia.

The African record would seem to favour an initial emergence of the hominin line in that continent, but even in Africa the course of human evolution is far from clear. For instance, the earliest species named there that seems to be ancestral to humans is *Sahelanthropus tchadensis*, a species from Chad with a braincase resembling that of a chimpanzee, but with more human-like teeth and a strongly developed brow ridge, a creature thought to have walked upright. If this is a human ancestor, it questions the role of the later australopithecines. *Orrorin tugenensis* from Kenya, at about 6 million years, is a million years more recent, and also challenges the status of the australopithecines as contenders of human ancestry. *Orrorin* was clearly bipedal and had a mixed diet that included meat, but acceptance of its hominin status also contradicts the so-called molecular clock prediction that humans and chimpanzees split about 5 million years ago. The position of the current two *Ardipithecus* species, *Ardipithecus ramidus* and *Ardipithecus kadabba*, also remains controversial. They lived about 4.4 million years ago, like the preceding species in forests rather than savannas, and since they also walked upright this seems to contradict the hypothesis that bipedalism is a response to reduction of woodlands. Moreover, there is disagreement over whether *Ardipithecus* is on the human or chimpanzee side after the split, which does not encourage much confidence in these various pronouncements.

The gracile australopithecines commence about 4.2 million years ago. With a brain little more than a third the size of a modern human, they were certainly bipedal, as especially the Laetoli tracks amply demonstrate, but they remained rather chimpanzee-like creatures. It is unlikely that they possessed complex verbal communication. The Makapansgat cobble (Bednarik 1998), found among their remains in the filling of a dolomite cave in South Africa, may perhaps not have been deposited by them, but by a contemporary human such as *Kenyanthropus platyops*. The australopithecines are represented by several species, *Australopithecus anamensis* (4.2–3.9 mya), *A. afarensis* (3.6–2.9 mya), *A. africanus* (3–2 mya), *A. bahrelghazali* and *A. garhi* (c. 2.5 mya). The latter species has been found together with stone tools and butchered animal remains and has been suggested to link australopithecines to the hominin line. In view of the common use of tools by modern chimpanzees there can be no doubt that tool use was increasing during the long reign of the australopithecines. A particularly interesting aspect of the gracile australopithecines is that they apparently evolved into the robust forms, now subsumed under the genus *Paranthropus*. They were more muscular and their skeletal remains

are somewhat larger and more robust, and they developed alongside human species, beginning about two million years ago, in the very last part of the Pliocene. There is again much disagreement concerning the status of the genus, some researchers see it as too primitive to compete with the contemporary *Homo* species, but it has also been shown to have used Oldowan type stone tools, and one species, *Paranthropus robustus*, is credited with using both advanced tools and fire at Swartkrans, South Africa. Interestingly, this has been explained away as being evidence of imitation of human behaviour, an unlikely explanation that we will encounter again towards the end of the human ascent. The two other *Paranthropus* species currently distinguished are *P. boisei* (2.3–1.4 mya) and *P. aethiopicus*. (2.7–2.3 mya).

Kenyanthropus platyops lived about 3.5 to 3.3 million years ago and has been proposed by some to be human, perhaps ancestral to *Homo habilis*. Others include *K. platyops* with the australopithecines, suggesting that the species is not distinctive enough to warrant having its own genus. On the other hand, some prefer to group *Homo rudolfensis* with this genus, calling it *Kenyanthropus rudolfensis*.

The fully human species that existed alongside australopithecines and then later coincided with *Paranthropus* were *Homo habilis*, *H. rudolfensis* and *H. ergaster*. *H. rudolfensis* dates from about 2.5 to 1.9 million years ago, and the roughly contemporary *H. habilis* lived 2.3 to 1.6 million years ago. Numerous stone tools of the Oldowan tradition have been found with the latter's remains, and were probably also used by the former. Some researchers consider them a single species, but it is more widely thought that they are too different. There is much unresolved speculation about which of the two, if any, was the ancestor of the subsequent hominins, but *H. rudolfensis* seems more developed. The *H. habilis* brain of 650 cc was considerably larger than the average *Australopithecus* brain, and the brain shape was more human-like. In one of its endocasts, the bulge of Broca's area, related to the motor control of speech, is visible, suggesting that the species may have been capable of verbal communication. The brain size of *H. rudolfensis*, with an average cranial capacity of 750 cc (the modern average is 1350 cc, ranging from 900 to 1880 cc, that of australopithecines ranges from 400 to 545 cc), considerably exceeds that of *H. habilis*. *H. rudolfensis* brains show a pattern that may be related to handedness and tool-use or manufacture. The degree of cranial asymmetry also appears to increase in later hominins. The endocast of the type specimen of *H. rudolfensis*, KNM-ER 1470, shows a somewhat more complex and modern-human-like third inferior frontal convolution compared with those of pongids. This is one of the few sources of information we have of the evolutionary reorganization of the brain, because the area it concerns includes Broca's area. Unfortunately, later hominid endocasts, from *H. habilis* and *H. erectus* through archaic *H. sapiens* to the present, seldom show the sulcal and gyral patterns faithfully. With regard to brain reorganization, left-right cerebral hemispheric asymmetries exist in extant pongids and the australopithecines, but neither the pattern nor direction is as strongly developed as in modern or fossil *Homo*.

Sexual dimorphism, the strong differences of the sexes apparent in the early hominins, reduced gradually with the australopithecines, and by the time of *Homo ergaster* (848 to 908 cc) had largely disappeared. This species existed between 1.9 and 1.2 million years ago and it heralds significant changes, such as the production of typologically distinctive stone tools, most importantly bifaces (handaxes). It is also the first that can be shown to indisputably having left Africa, although the matter of possible previous human colonizers remains open.

The Asian lacunae

In particular, several human remains from Dmanisi, Georgia, which is referred to as *Homo dmanisi*, 1.7 million years old and with a brain ranging from 600 to 780 cc, seem to be closer to *H. habilis* than to *H. ergaster*. More importantly, the stone tools at Dmanisi are of the Oldowan cobble tool type, not of the Acheulian associated with *H. ergaster*. Moreover, the very much more recent *H. floresiensis* remains also show affinity with the Dmanisi remains.

For reasons that will become apparent later in this course, we will consider the Asian evidence more closely than the African. The earliest supposedly hominin finds reported from Asia are the late Pliocene mandibular fragment with two teeth and a single maxillary incisor from the Longgupo Cave site in China (Huang and Fang 1991; Huang et al. 1995; Wood and Turner 1995). Paleomagnetic dating suggests an age of 1.96 to 1.78 million years ago, electron spin resonance dating has provided a conservative minimum age of a million years, and this is supported by the plentiful accompanying faunal remains (116 species). Together with the very early dates for Javan *Homo erectus*, this find questions the sole African development of *Homo* (Culotta 1995). Lacking good diagnostic features, the Longgupo specimens were thought to resemble either *Homo habilis* (Ciochon 1995) or *Homo ergaster* (Wood and Turner 1995), but alternative possibilities offer themselves. Two stone tools were found in the hominid/hominin-bearing sediment stratum of the cave. While the upper lateral incisor is generally accepted as being human, the mandibular fragment is not, being attributed to an ape by some commentators (Schwartz and Tattersall 1996). Dennis A. Etlar and Milford H. Wolpoff (pers. comm. Nov. 1996) have both expressed the opinion that the latter might be of *Lufengpithecus*, but this explanation does not account for the upper incisor or the presence of two Oldowan-type stone implements. The incisor resembles both recent Asian specimens and *H. erectus*, but this would be as difficult to reconcile with the reported age as would be the occurrence of stone tools with an ape. However, it would be only "slightly" older than the claimed earliest date of that species in Java (Swisher et al. 1994) and the hominin at Dmanisi (Gabunia and Vekua 1995; Dean and Delson 1995). In 2000, stone tools found in Renzidong (Renzi Cave) in Anhui Province, eastern China, were assigned a date of 2.25 million years, fuelling debate about the origins of *Homo erectus*, a species widely but not universally accepted to be ancestral to modern humans.

Homo erectus first appears 1.8 million years ago with a brain capacity of about 850 cc, but its late representatives, in the order of 500,000 years old or perhaps even more recent, ranged from 1100 cc to 1250 cc, i.e. well within the range of modern humans. The increase occurs without any apparent change in body size, *H. erectus* is roughly of modern height. The species' fossils occur widely in Africa and Asia, but European claims of its occurrence are rejected by many scholars. In China, its remains were initially found at the Zhoukoudian 1 Site, later at Gongwangling, Chenjiawo, Donghecun, Qizianshan, Tangshan, Longtandong, Xiaohuashan, Xichuan, Danawu, Quyuan River Mouth, Yunxia, Longgudong-Yunxian, Longgudong-Jianshi and Bailongdong. The original type fossil comes from Java, where numerous specimens have been found and where the species has been claimed to have held on until the Late Pleistocene (Swisher et al. 1996). First found at Trinil on the Solo River (Dubois 1894), Early Pleistocene hominids were also recovered from the upper part of the Pucangan beds and the probably later lower part of the Kabuh beds at Sangiran, Java. Klaatsch (1908) was the first to propose an evolutionary sequence connecting the Javanese hominids with Australids. After the discovery of much more recent hominid remains at Ngandong, Weidenreich (1943, 1945) developed this idea, which was eventually incorporated in what is today known as the multiregional hypothesis of the origins of modern humans (Coon 1962; Larnach and Macintosh 1974; Thorne 1980; Thorne and Wilson 1977; Thorne and Wolpoff 1981; Wolpoff 1980, 1991). The Mojokerto child is the earliest known hominid fossil in Java, being from the Pucangan deposits and 1.81 million years old (Swisher et al. 1994), while the Sangiran individuals are about 1.66 million years old.

Despite a considerable number of hominin fossils from the Middle Pleistocene, the subsequent evolutionary history of humans in Asia defining the grading of *H. erectus* into archaic *Homo sapiens* remains unclear. Chinese fossils of early archaic *H. sapiens* of erectoid features are those from Xujiayao, Dingcun, Yunxia, Yenshan and the Dali cranium which is already of the early Late Pleistocene, but still of very robust features. The maxilla from Wanlongdong at Changyang is of similar age, and is similarly archaic. The picture becomes even more confusing when we consider the only two Indian finds, of the last part of the Middle Pleistocene and found with a rich assemblage of Acheulian tools. The Hathnora calotte from the Narmada valley was initially described as a late *H. erectus* (de Lumley and Sonakia 1985), and while its thick torus, postorbital construction and bone thickness suggest this, the vault is far too well rounded and of exceptional size. At approximately 1300 cc it is not only above the range of *H. erectus*, it is even high for a *H. sapiens*, since it is thought to be of a female in her thirties. Only the right half of the cranium, with zygomatic arch, right torus and right part of occipital are intact (Bednarik 1995: 611). The second Indian specimen, from the same site and stratum, but from another individual and perhaps even another species, is an adult clavicle that suggests a body size of little over a metre (Bednarik et al. 2005). Combined with the recently discovered new hominin dwarf species from Flores, *Homo floresiensis*, this serves to underline the extremely fragmentary nature of our evidence of hominin evolution in Asia. This is particularly unfortunate because the current cultural evidence suggests that some of the major developments in non-physical human evolution occurred in southern Asia. Certainly the large numbers of hominin specimens in Africa and eastern Asia since the late Pliocene demands that southern Asia must have been occupied for at least two million years. The recent discovery of stratified Oldwan cobble tool industries, particularly in the basal layer of Daraki-Chattan, central India, adds a tantalizing note to this scenario (Bednarik et al. 2005). The most parsimonious interpretation of the data as it stands appears to be that pre-*H. erectus* hominins were established in both southern and eastern Asia.

Further east, again in Java, there is a second group of very robust hominins, from the much younger High Solo Gravels. At the main site, Ngandong, 14 partial or complete crania and other remains have been found since 1931, variously described as *H. erectus soloensis* or as archaic *H. sapiens*. Swisher et al. (1996) have provided a series of indirect electron spin resonance and uranium-series dates for these deposits (from animal teeth), suggesting very recent dates (ranging from 53,000 to 27,000 years), but these are controversial. Unpublished dates by Christophe Falguères, of about 300,000 years, obtained directly from human remains are much more realistic. Whatever the case, these finds are more properly assigned to *H. sapiens*. The early Javanese group, from Sangiran, averages a brain volume of 875 cc for females (n=5), 1032 cc for males (n=2), while the Ngandong group averages 1093 cc for females (n=2) and 1177 cc for males (n=4). The latter figures are barely below the sizes among early Australid crania, which average 1119 cc for females (n=22) and 1239 cc for males (n=51), which are indisputably archaic *H. sapiens* (Larnach and Macintosh 1974; Wolpoff 1997). Australia is currently assumed to have been first colonized about 60,000 years ago.

One of the most challenging hominin finds is the recently discovered *Homo floresiensis*, thought by most to be an endemic species of one Indonesian island, Flores (Morwood et al. 2004). This is a dwarf form, only about one metre tall, with a cranial volume of only 380 cc. It lived there in the second half of the Late Pleistocene, and stone tools found with it appear to be of Upper Paleolithic technology. I had established before its discovery that *H. erectus* had reached Flores before the Middle Pleistocene, and subsequently also colonized Timor. This incredible feat of seafaring was almost certainly accomplished by bamboo raft, as I demonstrated in numerous replication experiments (Bednarik 1997, 1999; Bednarik and Kuckenburger 1999). Dwarfing of large mammalian species is a very common process among isolated island populations, and this renders it possible that *H. floresiensis* developed locally over a period exceeding 700,000 years. However, the issue remains very controversial, and there are potential alternative scenarios. It has been suggested that the Flores dwarfs resemble *Homo dmanisi* more than another known hominin, while others insist that they are simply a microcephalic population, or even that they are apes. If the stone tools found with them are theirs, these latter possibilities appear very unlikely. But in view of one other known Asian dwarf of the Pleistocene, one of

the two Narmada specimens, it seems more likely that there are far too many lacunae in our knowledge and understanding of human evolution in Asia to explain the issue at this stage. We cannot even be sure that Asia was initially settled in the late Pliocene from Africa, perhaps it played a greater role than currently believed. This possibility is highlighted not only by the inadequate state of our knowledge, there are controversial claims for earlier Asian stone tool assemblages. An objective review shows unambiguously that there are too many pieces of the puzzle missing at present. If we could re-focus our attention on Asia for the next century, the picture might become much clearer.

The European theatre

Geographically, the hominins of Dmanisi in the Caucasus occur on the doorstep of Europe. Being 1.7 million years old, and probably predating *H. erectus* morphologically, they also pose questions. No human remains have been found in Europe for the next million or so years. What was the role of the Dmanisi hominins in Asia? The presence of *H. erectus* in Europe is, as already mentioned, disputed by some, and the earliest available remains in that continent come not from its east, but from Iberia. *Homo antecessor* from Gran Dolina in the Sierra de Atapuerca, Spain, is dated to about 800,000 years and has a brain size of just over 1000 cc. It shares some features, especially triple-rooted molars, with the much earlier *H. ergaster*, its double arched brow-ridges with *H. erectus* and the much later Neanderthals. The appearance of humans in southwestern Europe with a corresponding lack of early occupation evidence in eastern Europe, the similarity of the tools and technological trajectories both north and south of the western Mediterranean (including the use of beads, as we will see in the fourth lecture), and the evidence of navigation of an inland lake then existing in the Sahara render it likely that Europe was settled via Gibraltar. The Strait has existed for much longer than hominins have, but the incredible feats of seafarers in the Indonesian archipelago beginning at least a million years ago render a crossing at Gibraltar very likely. I have experimented there also with primitive rafts made entirely with Lower Paleolithic stone tools and although I did not attempt the crossing, I know that it would be feasible to do so on bundles of locally occurring cane (Bednarik 2001).

By 600,000 years ago, a new human species is distinguished in Europe, *Homo heidelbergensis*. Its remains have been found in Mauer near Heidelberg, Arago, Boxgrove and Petralona. Being about the size of modern Europeans, or even slightly taller, this species had a brain capacity ranging from 1100 to 1400 cc, which is close to modern humans and well within their range. *H. heidelbergensis* specialized in large game hunting, especially forest elephants, rhinos, horses and deer. It is assumed to be the ancestor of *Homo sapiens*, including *H. sapiens neanderthalensis*, a local variation limited in distribution to Europe and far-western Asia, and *Homo sapiens sapiens*, which includes all extant humans. *H. heidelbergensis* may have buried their dead, although this is not generally recognized, and built shelters. Their stone implements are mostly of the developed Acheulian types, but there appear to be also biface-free assemblages. This species used beads and made simple portable engravings on bone and stone.

There is, however, again considerable ongoing discussion about the course human evolution took. Some researchers believe that *H. ergaster* gave rise to *H. heidelbergensis* who went on to evolve into *H. sapiens*. They regard *H. erectus* as an off-shoot of the main stem that eventually became extinct. Others consider both *H. ergaster* and *H. heidelbergensis* to be in fact *H. erectus*. The difference is between the “splitters” and the “lumpers”, those who have a tendency to invent separate species where there are none, and those who take a more realistic view, namely that there can be considerable variation within a species. We can compare these differences of opinion to the way there were once claimed to be some 300 species of grizzly bears, when in a strict biological taxonomy the grizzly bear is itself merely a sub-species. In the case of hominins, the extreme form of “lumping” is the proposition that all humans, beginning with *H. erectus*, are in fact the same species. This is not a popular view among palaeoanthropologists, who derive their reputations from presenting and defending their claims, and whose individual prestige is enhanced by having identified a new species. It may be judicious to lean towards the “lumpers”, because the identification of a species is that its members can all interbreed to produce fertile offspring. When we consider that widely separated species, such as the wolf and the coyote, can do so very successfully, it becomes apparent that the “splitters” are probably wrong in the case of human evolution. They have made a career from emphasizing minor dissimilarities between fossils, whereas the “lumpers” tend to regard these as geographical variations as they are found within all non-human species. It might also be judicious to remember that, even in Europe and Africa, the fossil record still remains most inadequate.

Between 250,000 and 200,000 years, *H. heidelbergensis* grades into the Neanderthals in Europe, a local form with a brain size (1400 to 1750 cc) exceeding that of modern humans on average. *Homo sapiens neanderthalensis* is the best-known human fossil, because their habit of burying their dead in limestone caves, which offered the best preservation conditions, has greatly facilitated the survival of their skeletal remains. Those of hundreds of individuals have been recovered, from Iberia to Uzbekistan. Anatomically, Neanderthals were very similar to modern humans, except that they were far more robust and muscular, and perhaps of twice our strength. There were considerable differences among them, those of the later period in western Europe being typically more robust than others. Minor differences between them and modern humans concern the structures of the shoulder blade and the pubic bone. Their brain casts are so similar to ours that no evolutionary change is indicated by them, their hyoid bone (which is essential for speech) was similar, and their capacity of speech probably resembled ours. Neanderthals underwent considerable technological changes, starting off with a Lower Palaeolithic tool kit and developing the distinctive Mousterian typology that is seen as their hallmark. Four basic forms of the Mousterian are recognized, indicating a growing cultural differentiation. Beginning with 45,000 years ago, Neanderthal gradually developed Upper Palaeolithic traditions in most parts of

occupied Europe, from Spain to Russia, with many local traditions appearing. They include the Châtelperronian, around 35,000 years ago, and the early Aurignacian, but in all about a dozen or so distinctive traditions are distinguished by archaeologists. The Campanian Ignimbrite event (about 39,000 years ago) and subsequent sharp climatic decline created the genetic and cultural bottleneck conditions that, together with demographic adjustments, generated physical changes resulting in Post-Neanderthal populations as well as accelerating cultural change. The former are especially well documented in the more central regions of Europe, initially occurring as sexual dimorphism, in which there was gracilization of females first, followed much later by that of the males. This process has continued to the present period, the Holocene, and is still active in human evolution. The face, jaw and teeth of European humans 10,000 years ago are in general 10% more robust than those of today's Europeans, and those of 30,000 years ago are 20–30% more robust. The most recent, Holocene gracilization could be explained as a response to more advanced food-processing techniques, but this is less likely during the Late Pleistocene. It is an unexplained phenomenon, in the sense that natural selection cannot account for a reduction in robusticity and reversal of encephalization, without any apparent trade-off in evolutionary benefits elsewhere. Such benefits are not apparent, and yet this process is apparently universal wherever humans existed then. One very popular theory proposes that gracile humans from Africa invaded Europe, and replaced the resident Neanderthals either by genocide, by out-competing them, or by introducing new diseases the resident population had no resistance to. Another concedes that there was interbreeding between the two populations, squarely contradicting the key element of the first theory: that the two populations could not interbreed. There is, however, no indication of any movement of culture or technology from northern Africa, rather the cultures evolved in situ, and wherever the Robusts and Graciles existed contemporaneously in the same region, they always used similar tools and art objects. The only evidence cited in favour of the replacement by Africans is that there is claimed to be adequate genetic difference between the robust and gracile populations of Europe to justify the theory. That same argument is not used anywhere else, and the genetic evidence is disputed by some geneticists. However, this complex issue will be considered in more detail in the second lecture of this course.

Summary

There are several important points emerging for this very brief and cursory review of the course of hominin evolution. First, it is premature to form firm opinions about most aspects of it. What we knew about this subject 50 years ago sounds rather simplistic and naïve today, and what we believe to know today will appear just as simplistic in 50 years from now. Moreover, especially the evidence from Asia is clearly far too fragmentary to form any solid views.

Secondly, there remains much disagreement among scholars on many details of the human ascent, and it would be judicious to exercise skepticism of the many competing claims. Clearly much better resolution is required, and even where relatively good consensus seems evident, mere agreement of specialists is no proof of veracity. Consensus of archaeologists has been wrong on countless occasions for as long as the discipline has existed.

Thirdly, I have drawn attention to the steady increase in brain size documented as a function of time. It seems to form a perfect upward curve until very late in the Pleistocene, when the trend is suddenly reversed and the brain begins to “shrink”. While there may not be a perfect correlation between the size and the capability of an organ (it is not size, but how one uses it, I understand), it is impossible to refute that the most extraordinary aspect of human physical evolution is the encephalization, the rapid increase of the brain size. Without dwelling here on the primary effects of this (which this course will address in detail), I draw attention to another issue. Evolution “experiments” constantly, but it simply does not tolerate long-term adaptations that are consistently detrimental to the organism in question. The enlargement of the brain in humans, utterly unique in all of biological history, came at enormous evolutionary costs. Not only is the brain the most energy-hungry organ we possess, there is another high prize to pay for it. The human pelvis, already troubled by our development from quadrupedal to bipedal locomotion some millions of years ago, now has to cope with the need to be able to expel extraordinarily large heads through the birth canal. This leads to a dual compromise: how large can the brain be at birth without demanding a pelvic architecture that would impede female locomotion to the point of falling prey to predators more easily; and at what stage in the growth of the fetus should it be expelled without rendering it totally dependent for an unduly long period of time? The answer, obviously, has been given by evolution, and it is without doubt a very tight and complex compromise. To then argue, as many palaeoanthropologists and especially archaeologists have done, that for most of the human ascent, these oversized brains were not really used for much, ignores that evolutionary imperatives rule all organisms. No organ in any species will be allowed to be enlarged to a grotesque size unless there are very considerable evolutionary benefits gained. In other words, such a feature must serve a purpose. The still dominant model of archaeology, which I will deal with in the next lecture, states essentially that all significant cognitive, cultural and intellectual evolution occurred in the last half of the Late Pleistocene, i.e. in the last <1% of the duration of human evolution. This is incompatible with the record, which shows that there was a continuous enlargement of the brain throughout hominin evolution, accelerating in the last two million years of this process to the point of yielding a grotesquely oversized organ. No explanation of the past that takes this into adequate consideration can be considered biologically viable or plausible.

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