

## Human Evolution

Colin Groves<sup>1</sup>

The molecular clock seems to indicate that humans separated from chimpanzees some 7 million years ago, with a possible range of about 6 to 8 million. The earliest fossil plausibly assigned to the human lineage is *Sahelanthropus tchadensis* from the Koro Toro district of Chad, although some authors have misgivings about it, and it remains possible that it in fact denotes a time before the separation of human and chimpanzee lineages, or it may even be a member of the gorilla lineage. It is represented by a magnificent, but distorted, cranium (it is the distortion that is the main source of the misgivings), plus a few other fragments.

From Lukeino in the Kenya Rift Valley comes a more widely accepted fossil taxon<sup>2</sup>, *Orrorin tugenensis*, one of the few proto-human fossils known almost entirely by post cranial bones, and identified as being part of the human clade<sup>3</sup> mainly by incipient bipedal features of the femur. A few jaw fragments and teeth also represent this species. It is interesting that from the same deposits come a few teeth that are the first plausible fossil representatives of the gorilla lineage: it has always seemed odd that we know plenty of human ancestors and collaterals, but no gorillas (and there are still no chimpanzees until we get to a mere quarter of a million years ago). *Orrorin* is nearly 6 million years old; a long-known but still unnamed jaw from the Rift Valley site of Lothagam is 5.5 million; *Ardipithecus kadabba* is somewhat over 5 million; *Ardipithecus ramidus* is 4.4 million; and shortly after that we begin to get remains of the big-toothed fossils called australopithecines.

But these 'pre-australopithecines' are now becoming better known, and actually they seem to form a nice graded series, through which we can see the beginnings of bipedal specializations developing into a fully fledged upright locomotion, and we can see the canine teeth becoming smaller, though they are still larger in the males than in the females. They all had relatively shorter, thicker jaw bodies than 'apes', but the enamel coating on their cheekteeth was thin like a chimpanzee's. The coming of the australopithecines (first known by fossils from southern Ethiopia, a little over 4 million years ago) seems to represent a somewhat new direction, with very large molar and premolar teeth coated with thick enamel, still smaller canines, and fully-fledged upright stance; it is unclear whether they were derived from *Ardipithecus ramidus* or both were derived from an earlier common ancestor.

Australopithecines were very diverse. There was no 'onward and upward': they separated into many different species, some of them restricted geographically and replaced by relatives in other geographic areas, others apparently specializing in different modes of exploitation of the environment. They are often divided into several different genera: *Australopithecus*, *Paranthropus*, *Praeanthropus*, *Kenyanthropus*, and certainly there were a number of different species, perhaps as many as 10 or even more over the 3 million years in which 'australopithecines' shambled around Africa. All of them had relatively small canine teeth (the size of the canines can be seen reduced over time), small brains (more or less chimpanzee-sized, the cranial capacity about 380-520 cc), and protruding muzzles (prognathism). The most specialized of them, the ones often placed in a distinct genus

---

<sup>1</sup> Colin Groves holds a PhD in primatology from the University of London, and has worked on the taxonomy and evolution of primates and other mammals, and on human evolution. He is at present involved in a series of projects concerned with revising our knowledge of the classification, biogeography and phylogeny of wild cats, red pandas and weasels, of rhinos and antelopes, and of primates.

<sup>2</sup> Fossil taxon: a taxon (species, genus or whatever) known only as fossils.

<sup>3</sup> Clade: an evolutionary branch, consisting of an ancestor and all its descendants.

*Paranthropus*, had tiny front teeth and huge cheekteeth, and fed on heavy vegetation; stable isotope analysis shows that they moved between woodland and river valley habitats, and there is now an interesting argument that they may have eaten termites, inserting sticks into the mounds like chimpanzees do.

Though there is absolutely no doubt that the australopithecines stood and walked upright, they may still have been capable of climbing in trees and even of walking quadrupedally using the knuckles of their hands like chimpanzees. The problem is how we want to interpret the primitive characters they still possess in their skeletons, such as their curved phalanges (finger and toe bones) and the knuckle-walking features in their wrists: are they mere relicts of an evolutionary past when they clambered through the branches and knuckle-walked along the ground, or did they persist in these behaviours sometimes? Certainly, the knees were ‘valgus’, meaning that they were placed under the centre of gravity of the body, because the thighs sloped in from hip to knee; the pelvis was low and broad; and the great toe was apparently not very divergent, if at all. Even if we see them as entirely bipedal, interpreting their other locomotive features as mere relicts, we should not think of them as walking entirely like us: aspects of the pelvis indicate that their body did not rotate as they walked to the same degree as ours, and their legs were short, and they did not therefore have the easy, loping, striding gait that we have.

Around 2.3 million years ago there is evidence of a new type of proto-human, with a shorter, more parabolic palate, a fully upright head posture, and longer legs. I say ‘a’ new type, but in fact it is the site of Hadar that yields the palate, Sterkfontein that has the basicranial specimen, and from Bouri come the limb bones: it is tempting to put them together into a single creature, and perhaps add the Chemeron temporal bone with its suggestion of increased brain size, but at present these disparate fragments do not permit us to do this! It is not until we get evidence of ‘habilines’ at 2 million years ago in East Africa, of which the best-known species is *Homo habilis*, that we have the first evidence of a creature with somewhat increased brain size (cranial capacity 510-680 cc), head balanced on the spine in the modern fashion, shorter jaws and smaller cheekteeth. Even then, the postcranial skeleton is poorly known, but the latest evidence does suggest relatively longer legs than any australopithecine.

The earliest proto-human species with a striding gait is *Homo ergaster*, so far known for sure only from the Lake Turkana sites of Koobi Fora (on the east side of the lake) and Nariokotome (on the west side) from 1.8-1.4 million years ago, but several skulls and a nearly complete skeleton, the ‘Turkana boy’, are known. The brain size was larger than any previous species (cranial capacity 800-900 cc), there were thin but protruding brow ridges, the face was much less prognathous, and for the first time there was a somewhat protruding nose. The pelvis was virtually modern in form, and in most respects the skeleton was modern, although the femur was not precisely like modern humans.

For a long time it was assumed that the descendants of *Homo ergaster* did not extend their range outside Africa until about a million years ago, or even less. The earliest species to live outside Africa was thought to be *Homo erectus*, known from several fossil sites in Java; this species had a low, angular thick-walled braincase, with very thick, protruding bar-like brow ridges. Indeed, traditionally all proto-humans except for the habilines were placed in *Homo erectus*, which was envisaged as the ancestral species to *Homo sapiens*, but over the past five to eight years all this has changed. It is realized now that the old ‘catch-all’ usage of *Homo erectus* is misleading: the Java species could certainly not be ancestral to modern humans, and unless we clearly distinguish the different populations (probably different species) at one time lumped into *erectus* there would never be any hope of disentangling evolutionary lineages.

But another, quite unexpected, turn of events has forced an even more radical rethink: the discovery of the extraordinarily rich site of Dmanisi, in the Republic of Georgia. Not only is this outside the tropics, at a strikingly early period (1.7 million!), but the fossils from the

site are actually more primitive even than *Homo ergaster* – intermediate, in fact, between that species and *Homo habilis*. So far, as of mid-2006, as many as five excellently-preserved skulls have been found, as well as several jaws (most of them fitting the skulls) and postcranial bones, not yet fully described. They had small brains, about 650-750 cc, thin protruding brow ridges, considerable prognathism, the beginnings of a protruding nose, and an unexpected degree of sexual dimorphism: when a new jaw was discovered in 2003, it was so much bigger than those previously known that there were doubts whether it was the same species, but it seems now clear (because the recently discovered skull that fits it is not very different from the other skulls) that it is simply a very large male and the other jaws were mostly small females.

How many times did populations of early humans leave Africa and spread to Asia and Europe? It is still unclear, but it seems at least three times. We should not think of these early proto-people as getting the wanderlust, or being forced to leave for some reason; they were animals like any other, and animals just expand their range as far as suitable habitat extends, to the point where geographic barriers get in the way. The difference in this case is that the proto-human ecological niche seems to have been broadening progressively, so that there was a wider range of habitats that were suitable for them.

What, then, in the days of *Homo ergaster* was the human ecological niche? Their remains are found in lightly wooded or savannah habitats, as the associated fauna tells us, but generally in the vicinity of streams or lakes. Here they probably ate vegetable matter such as fruit, seeds, stems and underground plant parts, and certainly ate meat; the meat, though, was most likely scavenged in the main, because the cut-marks of their stone tools frequently overlie those of the teeth of big cats and other carnivores.

They made these stone tools, of course, as they had done since the time of their presumed ancestor, *Homo habilis*; we can presume that australopithecines and even the ‘pre-australopithecines’ used stone to pound hard foods, and modified vegetation and wood to use as probes, digging sticks and even weapons, because chimpanzees do all that and our ancestors would presumably have been capable of no less, but modifying stone before it is used as a tool is more than chimpanzees do. The first definite stone tools occur in 2.3 million-year-old levels at Hadar, alongside the earliest known palate of a habiline. By 1.9 million years ago, at Olduvai Gorge, some proto-human, presumably *Homo habilis*, was collecting suitable stone from as much as 12 km away; chimpanzees certainly bring stones to crack nuts from several hundred metres away, but 12 km seems a fairly major intellectual achievement.

There is no evidence that these early stone tools, known as pebble tools, were anything but ad hoc; they would pick up one of their collected stones and strike flakes off it until they had one that they could use. The early out-of-Africa proto-people used pebble tools as well; tools shaped to a mental template, to produce a deliberately shaped product such as a hand-axe, began to appear about 1.4 million years ago, and spread through Africa, and eventually into Europe, but in Asia they got no further than the Indian subcontinent, and that not till much later.

By about 600,000 years ago, a big-brained species known as *Homo heidelbergensis* had spread throughout Africa, and when the climate permitted throughout much of Europe as well. For this was the time of the ice ages; since a million years ago or more, periodic spread of the polar ice sheets had made much of the high latitudes uninhabitable by humans, and they spread and receded again at approximately hundred thousand year intervals. When they receded, *Homo heidelbergensis* spread north into Europe; when they came down again, the populations were compressed back into Africa. But there came a time when evolving cultural adaptations permitted them to stay in Europe and ride out the bitter cold, and in this sort of environment they changed, developing bigger brains (as big as ours), big facial sinuses and huge noses, and a characteristically stocky build, people we call the Neanderthals, *Homo neanderthalensis*. Remains of the Neanderthals are known from all over Europe and the Middle East from about 300,000 years ago. Meanwhile in Africa, a new type was emerging

as well: people with round high braincases, short faces and long limbs – the first *Homo sapiens*.

For a long time, these two species were geographically separated. In the caves of northern Israel, dating between 60,000 and 120,000 years ago, remains of both are found, but not in the same layers. Associated fauna shows that, when the climate was cold, the Neanderthals lived there; when it was warm, the Neanderthals retreated north, and *Homo sapiens* spread into the region from Africa. But the time came when some accident of history – the invention of the blade technology of stone tool making, perhaps – gave our species an advantage, and *Homo sapiens* spread on, north into Europe and east into the main mass of Asia. From 40,000 years ago, modern humans spread westward through Europe, and the Neanderthals crumbled before them; we need not invoke warfare or anything like that: simply, for some reason, the moderns did the human thing just slightly better than the Neanderthals, and their populations increased and the Neanderthals' decreased. The last of the Neanderthals hung on until 30,000 years ago or less in Spain and Portugal, and the skeleton of a five year old child found in Portugal, dating to 25,500 years ago, has been identified (admittedly very controversially) as a hybrid.

And as modern humans spread east, the remnants of other species gave way before them as well. It is claimed that 'Solo Man', a direct descendant of *Homo erectus*, survived until 30,000 years ago in Java; by this time modern humans were already present in the region (the first *Homo sapiens* remains are 40,000 years ago, from Niah in Sarawak, but moderns must have been there still earlier, because Australia was occupied by 50,000 years ago). And there was someone else present in the region as well – someone whose presence was totally unsuspected until 2004. *Homo floresiensis*, the Hobbit from Flores, four islands to the east of Java, separated from anywhere else by deep water.

People have found it hard to come to terms with this Hobbit. A humanlike creature one metre tall, with a cranial capacity of 400 cc, and not only no chin but strong internal buttressing of the jaw; with short stout legs and long feet; known from a nearly complete skeleton and the isolated bones and teeth of a dozen individuals ranging from 90,000 to 12,000 years ago. There have been all sorts of extravagant and implausible claims that they were actually dwarfed, pathological, or otherwise defective modern humans: microcephalics, cretins or whatever. Ockham's Razor has been notable by its absence. Detailed analyses by different sets of authors seem to be settling on an interpretation that *Homo floresiensis* was a descendant of a late australopithecine or perhaps of *Homo habilis*, meaning that there was a dispersal of a proto-human species out of Africa even before Dmanisi. And why not? From now on, archaeologists working in subtropical and tropical Asia will be alert to the possibility that the earliest occupants of their sites may be these habilines that ended up in Flores.

They were there then; they are not there now. *Homo sapiens* stands alone. But *Homo sapiens* is descended from animals, which lived like animals, evolved like animals, speciated and diversified like animals. It is as well to remember this, and to draw the inevitable conclusion: *Homo sapiens* is still an animal.

### Further Reading

Cameron, David W. & Colin P. Groves. 2004. *Bones, Stones and Molecules*. Elsevier Academic Press.

Foley, Jim. Fossil hominids: The evidence for human evolution.  
<http://www.talkorigins.org/faqs/homs/>