Course Materials Title: Origin &Evolution of Man

Class: Zoology (Hons) Semester VI

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Our ancestry: Hominins through time:

At least 7 My of evolution separate the single living species of hominin, *Homo sapiens*, from the other living species of apes. Critical clues to the story of how our physical differences evolved come from the fossil record. There are few fossils of other ape lineages, but fortunately there are many hominin fossils. Some hominin species are known from only a few fragments, such as a jaw. Few are represented by enough specimens to determine whether one or several species were alive at the same time, or what the evolutionary relationships were among fossils from different times. But while there is uncertainty about some of those details, there is broad agreement about the major features of hominin evolution.

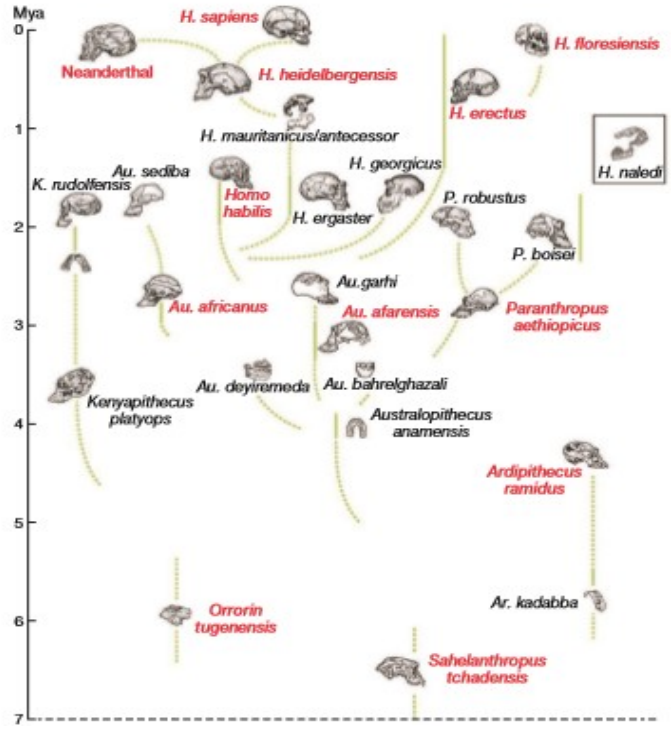

Figure: The dates and relationships of fossil hominins. Uncertain relations are indicated by dotted lines. Species named in red are discussed in the text. (Courtesy of Ian Tattersall, artwork by Patricia Wynne.)

More than 50 years later, the first hominin fossils were found in South Africa. The entire history of paleoanthropology since then has shown that Darwin's prediction was right: the origin and most of the later evolution of hominins, including Homo sapiens, played out in Africa.

Fossils show that after diverging from the chimpanzee lineage, hominins proliferated into several species. Most of them were not our direct ancestors, but instead were on closely related lineages that later became extinct. They give important clues to human evolution, however, because those extinct species are more closely related to us than to any living species. The species of hominins that are generally agreed on are shown in FIGURE. Most anthropologists are confident that *Sahelanthropus*, *Orrorin*, and *Ardipithecus* are members of the **hominin clade**. If so, the 6- to 7-My-old *Sahelanthropus* marks the minimal age of the split between hominins and the chimpanzee lineage.

A key link between hominins and their common ancestor with other apes may be *Ardipithecus ramidus* (FIGURE), from 4.4-My-old deposits in Ethiopia. It had many apelike features, such as a brain the size of a chimpanzee's and adaptations for climbing such as an opposable big toe. But it also had hominin features, such as small canine teeth (which are enlarged in male apes for fighting) and a pelvis adapted for walking upright.

Among the earliest well-fossilized hominins is *Australopithecus afarensis*, dated at about 3.5 Mya. Its many ancestral features show that it had much in common with the ancestor of humans and chimpanzees, including a lower face that projected far beyond the eyes, large canine teeth, long arms relative to the legs, and a small brain, with a volume of about 400 cc (FIGURE 21.8). However, the limb structure shows that afarensis not only could climb trees, but also could walk. In fact, fossilized footprints have been found in rock formed from volcanic ash near an afarensis site in Tanzania dating to about 3.5 Mya. Bipedalism seems to have been the first distinctively human trait to have evolved.

Following A. afarensis, hominin species proliferated, and several coexisted. About 3.3 Mya, one of them mastered the technology of making stone tools that could butcher animals, opening up an important new food source. The tool maker may have been one of three hominin species (the "robust" australopithecines, Paranthropus) that became extinct without having contributed to the ancestry of modern humans. A slender species called *Australopithecus africanus*, which is thought to have descended from *A. afarensis,* had a greater cranial capacity (see Figure 21.8).

The earliest fossil from our own genus, Homo, dates to about 3 Mya. One early species in the genus was *H. habilis*. It resembled modern humans more than earlier hominins, with a flatter face, shorter tooth row, humanlike hand, and greater cranial capacity. Although its limbs suggest an ability to climb, its legs and feet show that its walk was nearly human. *H. habilis* made stone tools (habilis means "handy man"), and animal bones with cut marks have been found with its fossils.

FIGURE 21.8 Skulls of a chimpanzee (*Pan troglodytes*) and three hominins. Note the chimapanzee's large canines, low forehead, prominent face, and brow ridge. The skull of *Australopithecus afarensis* shows several similarities with that of the chimpanzee. *A. africanus* had smaller canines and a higher forehead. *Homo erectus* had a more vertical face and rounded forehead. (From [41].)

Later hominin fossils, from about 1.9 to about 0.2 Mya, are often referred to a species called *Homo erectus*. Most authorities think that habilis and then erectus were the ancestors of our own species. In many respects, *erectus* had the anatomy and behavior of modern humans. Its skull was rounded, its face projected less than in earlier species, and its teeth were smaller. Importantly, its cranial capacity was larger, about 1000 cc (see Figure 21.8 and 21.11).

Figure 21.11: Skulls of a human from 28 Kya and a Neanderthal from 60 Kya. Neanderthals had an even bigger brain than living humans, but other features of their skull, such as the brow ridge, were more like those of other apes.

Homo erectus made evolutionary history as the first hominin to leave Africa. Almost 2 Mya, it spread into the Middle East. Later, it pushed eastward all the way to China and Java and westward into Europe. It used stone tools that were more sophisticated than those of *H. habilis.* A million years ago, it made fire in southern Africa, and by 500 Kya fire was widely used across its range. *H. erectus* may have been the ancestor of an extraordinary species called *Homo floresiensis* which lived on a small Indonesian island about 700 Kya. It stood only a meter tall and had a tiny brain, but it used stone tools.

Starting about 600 Kya, a second wave of hominins spread out of Africa and across Europe and Asia. By about 500 Kya, that species (*H. heidelbergensis*) gave rise to the Neanderthals, named after the Neander Valley3 of western Germany, where their fossils were first discovered. Neanderthals had dense bones, a thick skull, and a projecting brow (FIGURE 21.11). Their brains were larger than ours (up to 1500 cc), and they had an elaborate culture that included stone tools, art, and burial of the dead.

In 2010, a research group led by Svante Pääbo published a remarkable paper. They sequenced a Neanderthal genome using DNA extracted from fossils. They confirmed that humans and Neanderthals are very closely related but genetically distinct. Pääbo's group then sequenced DNA from a 50,000-year-old finger bone found in a cave in Siberia. Astonishingly, its genome is sufficiently distinct that it must have belonged to another group of hominins that diverged from Neanderthals perhaps 400 Ky earlier. Named for the cave where the fossil was found, this group is called Denisovan. The phylogeny of the hominins, on which humans are a leaf, more closely resembles a densely tangled bush than an erect sequoia.
