

data shows that we all arose from a common apelike ancestor. DNA is like a molecular clock in that the number of amino acid differences in proteins between different lineages changes roughly linearly with time (proportionally). Scientists have found that chimps seem to be most like humans (98 percent DNA match). By comparing the genomes of chimps with the human genome and then comparing that 2 percent difference against the rate at which specific genetic substitutions are known to occur, scientists have calculated that the lineages of chimps and humans diverged about 5 to 7 million years ago.

Fossils have been found for a large number of hominin (human evolutionary group of) species. They are described on the Smithsonian National Museum of Natural History website (<http://humanorigins.si.edu>), which certainly does not render the information gospel truth, but does give weight to the notion that these are the serious and real findings and estimations of scientific discovery. The list of fossils in the human family tree is staggering. Wade through this information from the Smithsonian website to gain an appreciation for the developing story line:

The earliest humans and closest link to other primates lived in Africa. *Sahelanthropus tchadensis* lived 7 to 6 million years ago. *Orrorin tugenensis* also lived about 6 million years ago. *Ardipithecus kadabba* lived about 5.8 to 5.2 million years ago. *Ardipithecus ramidus* lived about 4.4 million years ago.

On another branch arose the *Australopithecus* group. *Australopithecus anamensis* lived about 4.2 to 3.9 million years ago. *Australopithecus afarensis* lived about 3.85 to 2.95 million years ago. *Australopithecus garhi* lived about 2.5 million years ago. *Australopithecus africanus* lived about 3.3 to 2.1 million years ago.

On another branch evolved the *Paranthropus* group. *Paranthropus aethiopicus* lived 2.7 to 2.3 million years ago. *Paranthropus robustus* lived about 1.8 to 1.2 million years ago. *Paranthropus boisei* lived about 2.3 to 1.2 million years ago.

And then the *Homo* genus emerged, the group whose members were the first to expand beyond Africa. *Homo rudolfensis* lived about 1.9 to 1.8 million years ago. *Homo habilis* lived about 2.4 to 1.4 million

years ago. *Homo erectus* lived about 1.89 million to 143,000 years ago; fossils were discovered in Java and China. *Homo heidelbergensis* lived about 700,000 to 200,000 years ago; fossils were discovered in Germany. *Homo floresiensis* lived about 95,000 to 17,000 years ago; fossils were found in Indonesia. And our friend *Homo neanderthalensis* lived about 200,000 to 40,000 years ago; fossils found in Germany, Belgium, and Gibraltar. Neanderthals made a diverse set of sophisticated tools, controlled fire, built houses, wore clothes, hunted large animals, ate plants, and made ornamental objects. There is evidence that they buried their dead and decorated graves, and that is why there is a good fossil record for this species.

Last, of course, came *Homo sapiens*, or "wise man," the hominin species that is modern man. *Homo sapiens* first appears in the fossil record in Africa during a period of climate change about 200,000 years ago. Both *Homo neanderthalensis* and *Homo sapiens* moved out of Africa. *Homo neanderthalensis* settled in Europe and Central Asia, and *Homo sapiens* eventually spread to the whole world. *Homo neanderthalensis* and *Homo sapiens* coexisted until the former went extinct about 39,000 to 41,000 years ago.<sup>39</sup> *Homo sapiens* is the only surviving hominin species.

In 1987, the journal *Nature* published the results from a worldwide survey of human mitochondrial DNA conducted by researchers in the Department of Biochemistry at the University of California, Berkeley. The researchers used genetic molecular clocks and showed that "all mitochondrial DNAs stem from one woman" who lived about 200,000 years ago in Africa.<sup>40</sup> The "one woman" quickly became known as Mitochondrial Eve, but these results do not suggest that there was only one woman alive at the time. Rather they suggest that she was one of many women of her time in a "genetic bottleneck," or a time when there was a small population. There are theories the size of the population was around 10,000 individuals.<sup>41</sup>

These population estimates come from computer simulations and probability models that extend assumptions about how many reproducing females might have lived and how many might have generated