BIOLOGICAL FOUNDATIONS: THE EVOLUTION OF HUMANS

- Being a Primate
  - Prosimians and Monkeys
  - Apes
    - Lesser Apes: Gibbons
    - Great Apes: Orangutans, Gorillas, and Chimpanzees
- The Hominid Family
  - Walking the Walk
  - Roots: Ardipithecus and the Early Australopithecines
  - Branches
    - Paranthropus: The Robust Ones
    - Later Australopithecines
    - The Genus Homo: The Brainy Ones
      - Habilis Types
      - Erectus Types
      - Recent Humans
        - Multiregional Origins, or Out of Africa?
        - Homo Heidelbergensis: Archaic People
        - The Neanderthals
        - Us: Homo Sapiens
- The Diversity of Modern Humans: Culture and Biology
  - Biological Diversity
    - Problems with the Idea of Race
    - The Great Diaspora and the Origin of Human Populations
      - African Roots
      - South Asia and the Pacific
      - Europe, Northern Asia, and the Americas

Author's note to online readers: This chapter needs a bit of updating, with discussions of the dwarf Homo erectus recently found in Southeast Asia, and possibly the mysterious giant chimpanzees some say exist in Congo. Also, I will be adding a general discussion of hunter-gatherer lifestyles, probably in this chapter.

BEING A PRIMATE

In order to trace human evolution, we need to return to our narrative of the history of the Earth. As we have seen, mammals began to expand just before the end of the Mesozoic Era, and then exploded into the vacant niches left by the extinctions of reptiles as the Cenozoic Era began 65 million years ago. Our particular order, the primates, originated right around this transition. The ancestral primates were insect-eating, tree-living creatures, rather like the first mammals millions of years before. Most primates have remained in the trees, though many of them have switched from insects to leaves or fruit. Most insect-eating primates are nocturnal, but fruit and leaf eaters are active in the daytime.

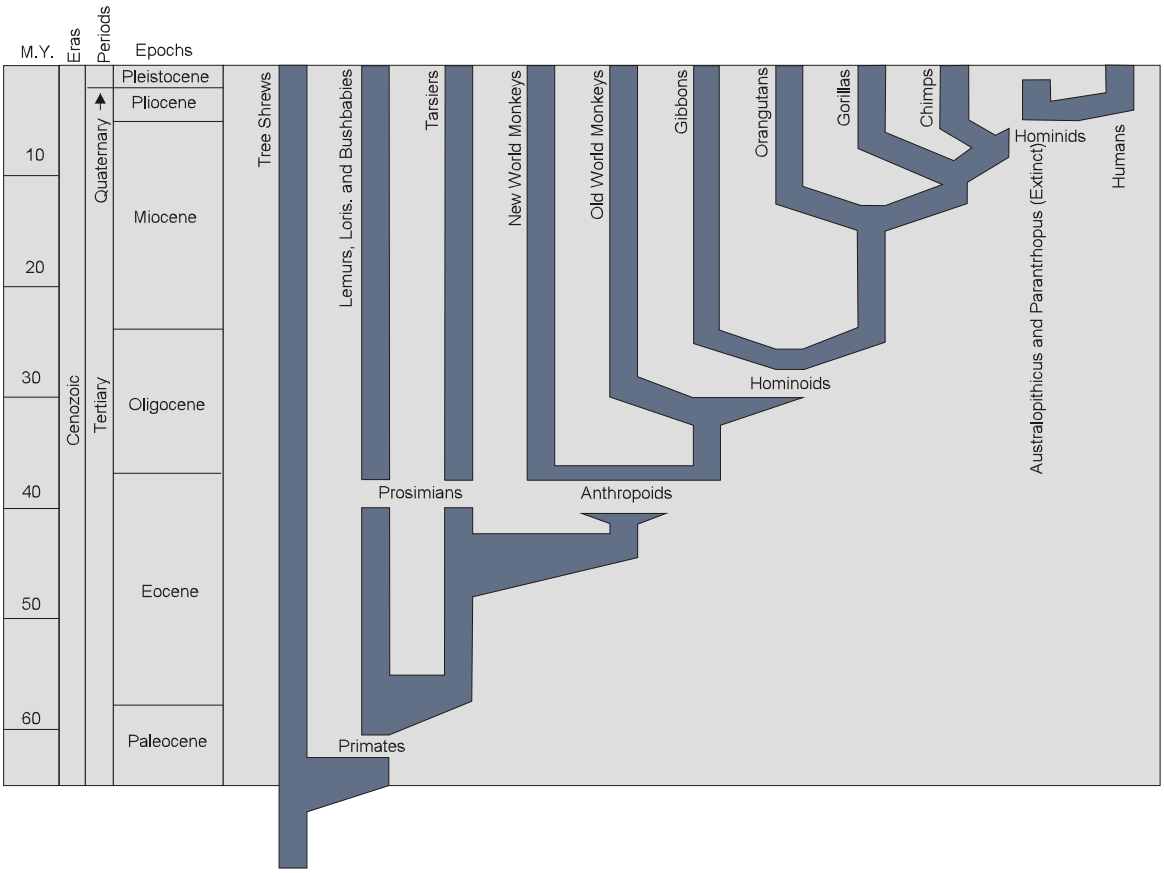
The typical primate lifestyle explains many typical primate features, and by extension, many of our own features. One of the most important is that primates rely on vision much more than smell. Most of them have short snouts, and relatively poor senses of smell, probably because scents don't leave clear trails in the trees. Primates compensate, however, with excellent, highly evolved eyesight. Unlike most other mammals, they have excellent color vision, which is very useful for detecting the ripeness of fruit. They also have excellent stereoscopic vision. Their brains, and ours, detect depth by comparing the slightly different images received by each forward-facing eye, an capacity which allowed early primates to catch insects efficiently with their grasping hands. Just as importantly, it allowed them to judge distances to nearby limbs before leaping for them, thus avoiding nasty falls.

Many primates live in groups, probably because this helps them watch for, and fight off, predators. Primate groups tend to resemble miniature soap operas, full of complex rivalries, coalitions, and dominance hierarchies. Such complicated social lives, more than any other factor, are associated with large brain size in mammals (relative to body size). Apparently, large brains are necessary to navigate the intrigues of a complex society. Primates have the most complex social behaviors of any mammal group, and relatively, the largest brain size.

PROSIMIANS AND MONKEYS

As Figure .1 shows, primates have traditionally been divided into two main groups:

Figure .1 Primate Evolution, Emphasizing Hominoids



prosimians, including lemurs, lorises, bushbabies, and tarsiers, and *anthropoids*, including monkeys, apes, and humans. This classification has recently been challenged, in part because tarsiers may be more closely related to monkeys than other "prosimians". The intricacies of primate phylogeny are not our main concern, though, so we will stick with the traditional classification. Prosimians are less like people's idea of a primate than other groups, and tend to look vaguely like a cross between a monkey and a raccoon or a squirrel. Most familiar are the lemurs, a diverse group found only on the island of Madagascar, and one of nature's premier examples of independent evolution on islands. Most other prosimians are nocturnal, with big eyes (enormous eyes, in the case of the tarsiers) and sometimes, large, bat-like ears. They are charming, but seldom seen, creatures.

Monkeys and apes are much closer to the stereotypical primate–a hairy creature with a striking resemblance to a human. Monkeys have evolved along independent paths in each

hemisphere. *New world monkeys*, such as tamarins, capuchins (organ grinders' monkeys), and howler monkeys, have wide-set nostrils, while *Old World monkeys*, such as baboons, macaques, and proboscis monkeys, have narrow-set nostrils (more like our own). The larger New World monkeys tend to have prehensile tails, while larger Old World monkeys tend to have calloused sitting pads, which may swell luridly in sexually receptive females.

APES

Among our fellow primates, our closest relatives are the apes. All the apes, as well as humans, are descended from a common ancestor which diverged from the old world monkeys about 30 million years ago. This lineage is known by the technical term **hominoid**. The word "ape" is an informal term denoting a lineage of tailless primates with longer arms than legs. Though we are descended from ape-like creatures, we are quite modified by biology and culture, so it is probably best to reserve *ape* as a useful term for non-human hominoids. We are hominoids, but we aren't apes, at least for the most part. The apes fall into two categories: the *lesser apes* and the *great apes*.

LESSER APES: GIBBONS

Lesser apes are also known as gibbons (although one large gibbon is called a siamang). Though most people think all primates swing through the trees by hanging from their arms, gibbons are the only ones that do so as their main form of locomotion (monkeys run along the tops of limbs). Gibbons are unusual among primates in that they are monogamous, and like most monogamous mammals, the males are about the same size as the females. Pairs of gibbons stake out well-defined territories, which they announce with elaborate songs. They are altogether wonderful creatures.

GREAT APES: ORANGUTANS, GORILLAS, AND CHIMPANZEES

The other group of apes is the great apes–chimpanzees, orangutans, and gorillas. Orangutans, our most distant relatives in this group, live in Sumatra and Borneo. There are two

species of Orangutans, one on each island, and the first is endangered and the second critically endangered. Orangutans are remarkable for several reasons: They are the largest arboreal mammals, and the only exclusively arboreal great ape. They also seem to have simple cultures. One group, for example, is in the habit of sounding off with a loud raspberry before taking naps. Perhaps this is not a terribly useful behavior, but it is a clear example of cultural transmission.

Orangutans are isolated from the other great apes biologically as well as geographically. Genetic studies show that gorillas and chimpanzees are more closely related to us than to orangutans. This comes as a surprise to many, but perhaps it shouldn't. After all, gorillas, chimps, and humans are all products of Africa. Gorillas come in two species–Eastern and Western. They are the largest of the primates, with females weighing up to 200 pounds, and males topping out at 400 pounds. Gorillas are polygamous, which accounts for this size difference. Males compete for females, who surround the strongest males in large harems. This competition, combined with the female preference for the big boys, has selected for larger, stronger males. Gorillas are astonishingly powerful creatures, many times stronger than a human, but they are fairly gentle. Unlike the other great apes, they are strict vegetarians who feed mainly on leaves, which they digest in their large bellies.

There is common perception that chimpanzees are the most human-like animals. That perception is absolutely correct. A chimpanzee's genome is 98 % identical to a human's. Chimps and humans diverged from a common ancestor less than 10 million years ago, as Figure shows. Since they are so closely related to us, we will take a closer look at them. Around 1.5 million years ago, chimps diverged into two types, separated by the great Congo river. The more familiar is the Common Chimpanzee. Many people think of the small, big-eared, pale faced creatures from the movies when they think of chimpanzees, but movie chimps are almost always juveniles. Adult chimps may have dark faces, can weigh over 150 pounds, are easily twice as strong as a man, and are rather independent-minded, which is why they tend to retire from the entertainment business. The other species of chimp, the Pygmy Chimpanzee or Bonobo, is smaller–weighing from 70 to 90 pounds as an adult. (Find out about big chimps)

Like gorillas, both species of chimpanzees move around most of the time on all fours, walking on their knuckles. Chimps are capable of walking upright when they want to look around, but they do so with a rolling, shuffling gait. Their long, powerful arms make them very

comfortable in the trees, which is where they sleep, in temporary nests of folded branches. Chimps mostly eat fruit and leaves, but they will hunt and eat small animals such as monkeys or forest antelope. They hunt these creatures in cooperative, amazingly efficient groups, mostly composed of males. Chimps are among the only animals to prepare and use simple tools. They strip the leaves off of sticks to fish termites out of their nests, pound nuts with rocks, soak up water with bundles of leaves, and brandish sticks at rivals.

Both common chimps and bonobos live in diffuse bands of a few dozen individuals. Common chimps are the more aggressive species. Males are dominant over females, but both sexes have complex dominance hierarchies. Individuals often raise their status by forming coalitions with others. Such coalitions, along with the fortunes of those involved, can shift suddenly, and often violently. Males jealously guard the boundaries of their band's range, patrolling its borders and often killing members of other bands. Bonobos also patrol their ranges and establish dominance hierarchies, but they are significantly less violent than common chimps, and their societies less male-dominated (draw your own conclusions). Bonobos could have invented the slogan "Make love, not war." They seem to have replaced violence to some extent with sex, for which they have an astounding appetite. Sexual gestures, such as groping and feigned copulation, are common between individuals of all ages and both sexes, and seem to be used for social bonding.

Chimps of both species are far from monogamous. Females mate with several males in succession; often with every mature male in the band. This keeps the paternity of offspring mysterious. This is useful to females (and their babies) because male chimps, like many other mammals, sometimes kill young that are not their own. The evolutionary reason for this seems to be that this causes females to go back into estrous sooner, allowing that infanticidal male to mate with her himself. Male chimps fight over females a little, which explains why they are larger and stronger than females, but not to the extent that animals like elephant seals, elk, or even gorillas are. Much of the competition among male chimps takes the form of sperm production, which is why chimps have prodigious testicles.

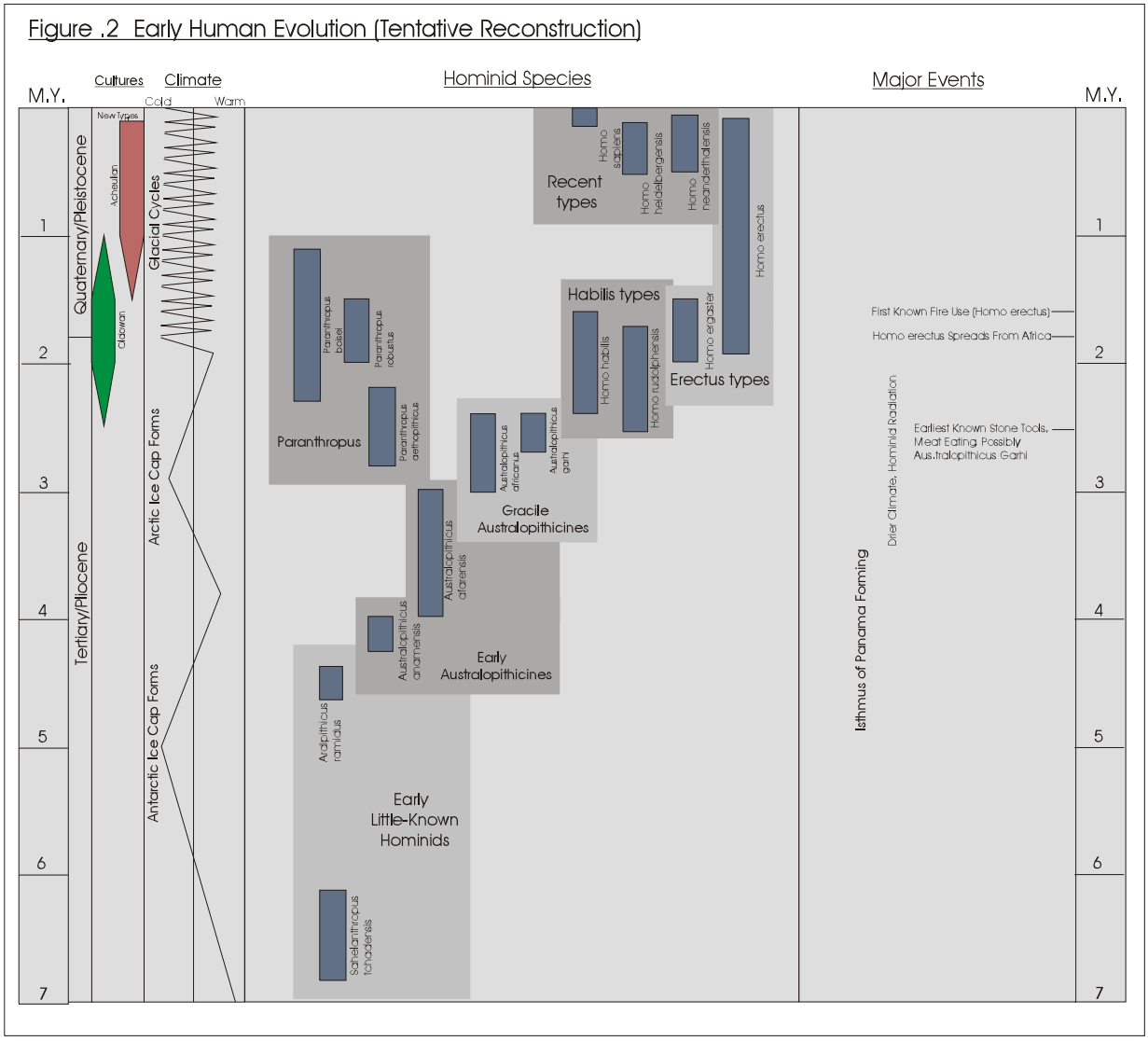
In and of themselves, chimps and bonobos are fascinating animals. But what fascinates most people about them is their undeniable resemblance to humans. Their physical appearance, sophisticated minds, complex, Machiavellian social life, use of tools, cooperative hunting, and

ability to walk upright; all these things allow us glimpses into the way the earliest humans may have looked and behaved. But we shouldn't carry the comparison too far. Chimps and humans are very different in many ways. They have evolved in different directions for ten million years. Because chimps live in moist forests where bones rot away quickly, we know hardly anything about their recent evolutionary history. Luckily, we know far more about our own.

THE HOMINID FAMILY

You and I belong to the species with the scientific name *Homo sapiens*, which means "wise man" (perhaps *Homo egotisticus* would be more apt). Aside from its translation, this designation also has a taxonomic meaning–*sapiens* is the name of our species, while *Homo* is the name of the next larger grouping–our genus. Other species in this genus have the "Homo" label as well, followed by a species label, as in *Homo habilis* or *Homo erectus*. Of course, these other species are now extinct. These days we are a lonesome species, the only one left in our genus, which in turn is the only remaining genus in the family Hominidae. But it wasn't always so. In the past, there have been at least three hominid genera, as Figure showed- Australopithecus, Paranthropus, and Homo. When we zoom in for our next timeline, Figure .2, it is apparent that each of these groups had multiple members. For most of the past few million years, there have been several species of hominid, usually with a handful walking the earth at any one time. In the next few pages, we will look at how these species may have evolved, how they may have been connected, and how we came to be, literally, the last ones standing.

Notice that Figure .2 does not show direct connections between species, because in most cases, we can't be sure that which species gave rise to which others. Ideas about hominid evolution are still very much in a state of flux. One reason is the scarcity of fossils. While hominids have a better fossil record than some groups, such as chimps and gorillas (which left practically no fossils) our record is quite sparse. Most of the species in the figure are known only from a handful of bones, often skulls or fragments of skulls. More fossils are being uncovered all the time, however. In fact, the more fossils we find, the more complicated the story of human evolution appears to be. Today we know that ancient hominids were much more diverse than we once thought, and probably more diverse than we know today.



Ideas about hominid evolution are continually being revised, and will be further revised in the future. Creationists have great fun with this constant revision, claiming that it shows the whole enterprise to be a highly contrived house of cards, built by conspiratorial scientists pushing a secular agenda. These claims are at best confused, and at worst, dishonest. To mock scientists for revising their theories is like mocking an athlete for lifting weights–mock all you like, but both are busy getting stronger. Revision in the face of new facts is the very engine that drives science, keeping it honest, and in the long run, making it accurate. With each revision, the house of cards grows more sturdy. Today's theories of human evolution do not exactly match the reality of human evolution. But they are getting closer all the time.

WALKING THE WALK

It is often assumed that what first put humans on a different trajectory from other animals was a great expansion in brain size. After all, primates tend to be brainy creatures, and humans are by far the brainiest of primates. Our cerebral cortex is so huge that our heads are positively bulbous compared to other animals. The first researchers into human evolution expected to find fossils of big brained creatures with ape-like bodies. In 1925, however, Raymond Dart found a fossil in southern Africa that was just the reverse–it had an apelike head and braincase on an upright body. This suggested that *bipedalism*–walking upright on straight legs and flat, elongated feet–came before bigger brains. Ironically, Dart's discovery was discounted for years because of the Piltdown find from a few years earlier in England, which turned out to be a fraud. At Piltdown unknown person had planted a human cranium with an orangutan jaw, giving the impression of a large-brained creature with ape-like features. By the time Piltdown was exposed in the 1950's, other fossils had accumulated, and the lesson was clear–the human foot preceded the human brain.

The creature whose remains Dart found belonged to the species *Australopithecus africanus*, which lived between 3 and 4 million years ago. In later years, several more Australopithicus fossils have been found; of the *africanus* species as well as other species in the genus. The australopithecines, which vaguely resemble upright chimpanzees, were for many years the earliest known hominids. Bipedalism dates back at least four million years, and genetic evidence suggests that humans and chimps split about 6 million years ago, so bipedalism probably originated sometime in between. Exactly when, and how, is not known for sure.

If you take a look at Figure .2, you will see that most fossil hominids date from more recently than 5 million years ago, with the exception of the recently discovered *Sahelanthropus tchadensis*, which lived between 6 and 7 million years ago. In recent years, a plausible scenario has emerged that places the origin of bipedalism at about five million years ago, evolving in response to changes in climate around that time. Some scientists have claimed that Sahelanthropus was bipedal. If so, this would push the origins of bipedalism further back in time. But since Sahelanthropus remains controversial, we will start with later hominids.

Around 5 million years ago, the long-term cooling trend of the Tertiary period intensified,

as ice caps grew large in Antarctica for the first time. In Africa, this resulted in an opening of forested areas into a drier, grassy savanna dotted with the occasional tree, similar to savannas today. Prior to this, our ancestors probably spent most of their time in the trees, a lifestyle to which our grasping hands and flexible shoulders still attest. But as the forests thinned and resources became more scarce, our ancestors would have had to spend more time on the ground, covering larger distances to find food. Walking upright may have been an adaptation to this situation. While it is not great for sheer speed (we are rather slow creatures), it is very efficient, and thus good for covering great distances. The upright posture also minimizes the amount of body surface receiving direct sunlight, allowing us to spend more time under the hot sun.

ROOTS: ARDIPITHICUS AND THE EARLY AUSTRALOPITHECINES

The earliest known hominid from around this time is a creature which lived in what is now Ethiopia, called *Ardipithecus ramidus*. *Ardipithecus* is similar to later australopithecines, and may even be their ancestor, resembling a chimp more than australopithecines do. The fossils are too few to conclude very much, however. It isn't known whether it walked upright or not, though the way the skull connected to the spine suggests a more upright posture than a chimp has. The next species we know about was the first true australopithecine, *Australopithecus anamensis*. These creatures had long arms, but they probably walked upright a good deal of the time, albeit with a rather clumsy gait. Like later australopithecines, they were probably quite comfortable in the trees, which would have served as a refuge from predators such as lions. Many a modern hiker has fallen back on this strategy when confronted with an angry moose or grizzly bear.

With the emergence of *Australopithecus afarensis*[1], the australopithicines really hit their stride (so to speak). This species lasted for at least a million years, from 4 to 3 million years ago, and they left a much better fossil record than their predecessors, which allows us a fairly good idea of what they looked like. The most famous one, very posthumously named Lucy, left an unusually complete skeleton along the Awash river in Ethiopia. Lucy was a young adult female

[1]Don't confuse *afarensis* with *africanus*, the species first found by Raymond Dart, which lived later. The name *afarensis* refers to the Afar region of Ethiopia, where the first specimen was found.

about 19 years old, and just under four feet tall. There seems to have been a greater size difference between males and female Australopithicines than in modern humans, which suggests that males fought over females more than modern males do. Some male *afarensis* specimens are around five feet tall, with thick bones that would have supported powerful muscles, far more powerful than those of most Homo sapiens. Like earlier hominids, they had powerful, protruding jaws, but their teeth were a bit smaller. They probably ate a diet similar to today's chimps, mostly fruit, tubers, insects, and the occasional small mammal. These creatures were probably clever, but no more so than today's chimps, whose brains are a similar size. They may have used rocks and sticks as tools opportunistically, as chimps do, though no evidence of this has been found. Their upright stance had freed their hands, however, and their descendants would eventually put them to use.

BRANCHES

PARANTHROPUS: THE ROBUST ONES

Around three million years ago, the world's climate began to cool further, and ice began to accumulate in the Arctic. In Africa, this caused climates to become drier than before. The savanna vegetation became more desert-like; tougher and thornier. Probably as a response to this change in conditions, australopithecines began to diversify. One group became very heavily built, and developed heavy jaws, presumably for chewing the coarse vegetation common at the time. These used to be classified as "robust" australopithecines, but many scientists have decided that they are different enough to be accorded their own genus name, *Paranthropus*. These types had brain sizes similar to *afarensis*, and seem to have responded to adversity by becoming stronger, especially in their jaws. They were quite successful, and at least three species, and probably more, roamed southern and eastern Africa for nearly two million years.

LATER AUSTRALOPITHECINES

The australopithecine species first discovered by Raymond Dart, *africanus*, took the

opposite course, becoming more slender, or "gracile". Another type, *Australopithicus garhi*, lived in the Ethiopian region. The name "garhi" which means "surprise" in the Afar dialect of Ethiopia, refers to the fact that its features don't quite fit into either the gracile or robust categories. *Garhi* was found together with several extremely primitive stone tools, basically pebbles with pieces knocked off to form a sharp edge. Also nearby were fossils of animals which had been butchered with similar tools. It is not certain that garhi made these tools and butchered those animals, but it is quite likely. If so, it would be the first known case of the deliberate construction of tools, as well as the first evidence of systematic, rather than opportunistic, meat eating. Perhaps meat eating and tool use evolved together, possibly in response to the harsher conditions of the time. Interestingly, *garhi's* brain was not significantly larger than *afarensis*, which indicates that tool construction and meat eating proceeded future brain growth (perhaps it helped foster it). Some of *garhi's* features, as well as its habits, lead many scientists to suggest that it was our direct ancestor, which gave rise to the first members of our own genus, *Homo habilis.*

THE GENUS HOMO: THE BRAINY ONES

HABILIS TYPES

Homo habilis lived in eastern Africa, along with a another type known as *Homo rudolphensis.* These seem to have been different, but closely related species. Perhaps their relationship was analogous to that of today's chimps and bonobos–very similar, but not the same. I will refer to both together as "*habilis* types". *Homo habilis* means "handy man", a reference to their tool use. Originally, tool use was one of the reasons for assigning it to the genus *Homo*, instead of *Australopithicus*. If garhi used tools, as it seems to have, then tool use (more precisely, manufacture and use) is not exclusive to humans. Still, the *habilis* types were clearly different from the australopithicines. Its teeth and jaws were smaller, its face flatter, and its cranium larger, to accommodate a larger brain. But the *habilis* types were a far cry from modern humans. While they were brainier than their predecessors, their brains were only about half the size of modern humans. They were short, around 4.5 feet tall on average, with the males significantly larger than

the females. Their arms were relatively much longer than ours, and they probably spent a good deal of their time in trees.

Homo habilis and *rudolphensis*, and perhaps *Australopithecus garhi*, represent a very different adaptation to harsh environments than other hominid lineages of the time. *Australopithicus africanus* seems to have responded by becoming smaller and lighter, perhaps so it would require less energy to live. The *Paranthropus* genus responded by becoming heavier and growing powerful jaws, for chewing up the coarse plants of the time. The first members of the *Homo* lineage, on the other hand, responded by growing smarter, learning to make tools, and using them to include more meat in their diet. By eating meat, they gained access to energy locked away in plants that they could not digest, by eating the animals that could.

This is not to say that they were great hunters, or that their tools were very impressive. The tool making culture of the *habilis* types, now known as the Oldowan[2], lasted for over a million years, longer than *habilis* itself (Figure). Oldowan tools were extremely simple, consisting of two basic types, called *choppers* and *flakes*. Choppers were round stones with pieces knocked

---

[2]Archaeologists and Paleoanthropologists divide the history of human culture into Cultural Stages, which may contain one or more Cultural Periods. The Oldowan cultural period, for example, as well its successor in some places, the Acheulian, occured during the Lower Paleolithic cultural stage. The suffix "lithic" means *stone*, so Paleolithic means "Old stone age". The paleolithic lasted for a long time, so it is divided into the Lower, Middle, and Upper Paleolithic. After the Paleolithic came the Mesolithic, or "Middle Stone Age", and the Neolithic, or "New Stone Age". Most human populations passed through Paleolithic and Mesolithic stages, though some were still basically Mesolithic until just a few years ago. Those peoples who passed out of the Mesolithic went through further cultural stages. After the Neolithic, many peoples in Europe and Asia went through a "Copper Age", a "Bronze Age", and an "Iron Age". However, one shouldn't get the idea that this is a rigid sequence that every culture must go through, or would if they had "progressed" far enough. Various regions passed into various stages at different times. One usually can't say things like "when Europe was in the Bronze Age", because, while some parts of Europe were in the Bronze Age, others were in the Stone Age, or the Iron Age. Some regions skipped stages, as when parts of Africa went directly from the stone age to the iron age. And these stages simply don't apply to other parts of the world, such as the Americas. Cultural periods, at least after the Oldowan, are even less universal than cultural stages, because they describe particular cultures in particular regions. For example, the Magdalenian, East Gravettian, and D'uktai cultures existed for a while at the same time (around 12,000 to 17,000 years ago), in western Europe, the eastern European steppes, and northeast Siberia, respectively. So, cultural periods are individual cultures of a certain time and place, while cultural stages are a quick way of describing and categorizing such cultures.

away, to produce a sharp edge. The pieces knocked away were the flakes, and they seem to have been much more important than the larger choppers, because they were sharper and could cut through tough plants and animal carcasses. Many of the "choppers" are probably just leftover cores for flake production, though some were probably used for more heavy duty tasks, such as chopping at wood or bone. Unlike later stone tools, Oldowan tools were not symmetrical or standardized. They show evidence of skill, but not much evidence of a mental image of a final product, or an appreciation of one form over another. They were often carried great distances, however, which shows that the *habilis* types did have some foresight.

I said above that *habilis* types used stone tools to add more meat to their diet, but I did not say that they used them to hunt. It is not clear that habilis and its immediate relatives did much hunting, especially of large animals. Oldowan tools seem to be better suited to butchering than hunting. There is an archaeological site where several *habilines* butchered a hippopotamus along the side of a river. It is possible that they killed it, but much more likely that they simply found it, after it had been killed by larger predators or disease. While later hominids became highly skilled, well-organized big game hunters, there is no evidence that the habilis types were capable of such things. More likely, they obtained the meat of large animals only by scavenging it, perhaps driving off predators long enough to cut away a flank and make off with it. Of course, they were probably quite capable of taking small animals, by hitting them with rocks, simply pouncing on them, or even surrounding them in organized drives, as chimps do. Still, meat was probably just an important supplement to a diet consisting mainly of fruit, nuts, and other vegetarian fare.

ERECTUS TYPES

In 1890, a Dutch army surgeon named Eugene Dubois found one of the first known hominid fossils, on the Indonesian island of Java. He named his find *Pithecanthropus erectus*, meaning "upright ape-human". Since Dubois, many other fossils of this species have been found, and it is now known as Homo erectus. Dubois assumed that humans had evolved in southeast Asia, which is why he had gone to Java in the first place. Today, it is almost certain that humans first evolved in Africa, and erectus was simply the first to spread out of Africa, leaving fossils

throughout the southern half of Eurasia, from England to China and the Indonesian islands.

Actually, there seem to have been at least two *erectus* type hominid species. The other, called *Homo ergaster*, may have been the first to evolve, and seems to have stayed in Africa. As Figure shows, these species emerged just as the cooling trend of the Tertiary period slipped into the glacial cycles of the Pleistocene epoch of the Quaternary Period. Once again, the *erectus* types may have evolved in response to harsher and drier conditions in Africa, representing a further development along the "tall, brainy, meat-eating, tool-user" trajectory. *Erectus* was in fact taller and slimmer than *Homo habilis*. Indeed, a nearly complete *erectus* skeleton seems to have belonged to an 11 year old boy who stood around 5 feet 4 inches tall. This would be quite tall for today's 11 year olds, though the *erectus* boy may have been unusual. Erectus fossils have not indicated that they were significantly larger than today's humans, so it may be that they matured more quickly than we do.

Homo erectus had a much larger brain than the *habilis types*, ranging from to CC, a range which overlaps with the bottom end of modern brain sizes. There is some evidence that erectus brain sizes increased during their long tenure on earth. *Erectus* types may have been the first to lose their body hair, so they may have looked very much like us–from a distance. Up close, their protruding faces, low forehead, and large brow ridges would have given them away.

Homo erectus seems to have expanded out of Africa shortly after it evolved, as shown by fossils from the Middle East and Southeast Asia which may date back as far as 1.8 million years. This doesn't mean that any one individual made the entire trip from Africa to Java, of course. The population simply expanded over the generations, until it spread into Eurasia. Other large mammals seem to have been expanding their ranges at the same time, probably following the changing vegetation zones of the erratic Pleistocene climate. It has been suggested that the alternating drying and moistening of the Sahara may have helped push populations out of Africa. When the Sahara was habitable, *erectus* and other creatures would move in. When it dried up, they were pushed out. The ones who went northeast found themselves cut off from the rest of Africa, with nowhere to go but Arabia and Asia.

Homo erectus populations boomed not because they were bigger or stronger than their predecessors, but because they were much cleverer. While they inherited the simple Oldowan toolkit of their ancestors, by around 1.5 million years ago a new culture was spreading through

Africa, parts of western Europe, and Southwest Asia. This new culture, the Acheulian, was much more sophisticated than the Oldowan. Starting with a large central core, *erectus* would knock off flakes about the size of an axe handle, then shape them into a symmetrical object known as a hand axe. As the name suggests, hand axes were held in the hand, not hafted to a stick to make a spear or hatchet. They were extremely effective tools for digging, cutting wood, and butchering large animals, as modern archeologists have demonstrated by trying them out for these purposes. Some hand axes were specially designed, with sharp points for puncturing, or flat edges for cleaving bones and scraping hides. Acheulian technologies evolved and diversified far more than the earlier Oldowan. By 400,000 years ago at least, people were fashioning well-balanced spears by carving long poles, tapered at each end. East Asian erectus populations seem not to have used stone as much as their western relatives, possibly because they worked with bamboo, which left fewer fossils.

Though they surely engaged in scavenging, as their ancestors had, *Homo erectus* was probably the first human species to truly hunt. Their remains have been found associated with the bones of large animals such as horses, bison, and even elephants. Some of these they may have simply come across when they were dead or dying. For example, *erectus* sites in Spain are near swamps along the migration routes of elephants and horses (elephants lived in Europe during warm periods). It may be that they drove these animals into the swamps with fire, or it may be that they simply waited for them to come along, hoping that one would get stuck in the swamps. Later sites offer clearer evidence for hunting, suggesting that Homo erectus became a more proficient hunter over the millennia. Still, chances are that *Homo erectus*, like most hunter-gatherers of more recent history, made their living mostly by gathering roots, nuts, and fruit, and supplemented their diet with meat from animals they had found or killed.

RECENT HUMANS

Multiregional Origins, or Out of Africa?

Our species, *Homo sapiens*, probably evolved from *Homo erectus*, or perhaps from *Homo ergaster*, the early *erectus* types that stayed in Africa. Exactly how this happened is quite

controversial. There are two main hypotheses. According to one, known as the **Multiregional Hypothesis**, *Homo erectus* populations all over the Old World gradually evolved into *Homo sapiens* over the last several hundred thousand years, perhaps with a small flow of genes between these far flung populations. This idea suggests that differences between human populations, such as between East Asians and Europeans, are very old. Supporters of this hypothesis point to apparent similarities in the anatomy of modern humans in each area with the *erectus* fossils found in that area.

The **Out of Africa Hypothesis**, on the other hand, claims that *Homo sapiens* evolved in Africa, and then spread into other parts of the world, displacing existing populations of *Homo erectus*. This idea is based in part on studies of the genetics of modern humans around the world, which suggests that we are all descended from common African ancestors, and diverged less than 200 thousand years ago. Most paleoanthropologists today are leaning heavily toward the Out of Africa model, which is also supported by fossil evidence. This, therefore, is the scenario that we will stick with in this book. But keep in mind that, while the multiregional hypothesis seems to be falling on hard times, it is not quite dead yet. Personally, I think it is on its way out, but I could be wrong.

Homo Heidelbergensis: Archaic People

While the Out of Africa model suggests that modern humans are less than 200 thousand years old, the story of *Homo sapiens* begins well before that. By around 600 thousand years ago, a new species seems to have split off from *Homo erectus* (or *ergaster*). For many years, this species was called "archaic *Homo sapiens*" because its features seemed to be midway between *Homo erectus* and *Homo sapiens*. Today, many paleoanthropologists agree that it should be given its own species name, *Homo heidelbergensis*, after the first fossil specimen, found near Heidelberg, Germany[3]. *Homo heidelbergensis* would not look so strange to us as *Homo erectus*

[3]If *heidelbergensis* is considered a subspecies of *Homo sapiens*, then its scientific name would be *Homo sapiens heidelbergensis*. We are of the sub-species *Homo sapiens sapiens*. However, most people are leaning toward the idea that modern humans are the only members of the species *Homo sapiens*. If this is true, the subspecies designation is unnecessary.

would. Its face protruded a little less, its brow ridges were not quite so pronounced, and its cranium was a little larger. Not surprisingly, *heidelbergensis* seems to have been a bit more clever than erectus, and seems to have been a very skillful hunter. *Heidelbergensis* lived in Africa, the Middle East, and Europe. While it could have evolved in any of these places, the most likely scenario is that it evolved in Africa, and then spread outward from there, as *Homo erectus* had before, and *Homo sapiens* would in the future.

The Neanderthals

By 200 thousand years ago, humans in Europe and the Middle East had taken on a very distinct appearance. They had very large brains, larger in some cases than our own, but their crania were low and long, instead of high and round, as in modern humans. In profile, their faces traced a semicircular curve from sloped forehead to receding chin, interrupted by a large, round nose. These people tended to be short but extremely powerful, with thicker bones and much larger muscles than our own. These were Homo neanderthalensis[4], the Neanderthals.

Contrary to common conception, the Neanderthals were an extremely sophisticated type of human, far more sophisticated than any before. The idea of Neanderthals as atavistic brutes got started because one of the first Neanderthal skeletons to be discovered was an older, arthritic individual, which gave the impression that Neanderthals were somehow stunted. In fact, Neanderthals were quite nimble; bodily, manually, and probably mentally. They had their own styles of tools, which were far more sophisticated than earlier Acheulian types, and mark the transition from the Lower to the Middle Paleolithic. Both the Levallois culture and its successor, the Mousterian, resembled earlier forms in that sharp blades were struck from a larger core. These new technologies, however, relied on careful preparation of that core, allowing many more blades to be obtained from a single core. These blades were then modified for different purposes. Some were bound to the end of spears, with which the Neanderthals hunted reindeer, wild horses, and perhaps the occasional mammoth.

The shape of the neanderthal larynx, as well as the inside of the part of the cranium

[4]*Homo sapiens neanderthalensis*, if they were a sub-species of *Homo sapiens*.

covering the language areas of the brain, suggests that they may have had a capacity for language, though it may have been much cruder than our own. Certainly they were able to communicate well enough to be very successful cooperative hunters. They occasionally buried their own dead. Some of these graves contain tools, or the remains of flowers. This may mean that the Neanderthals had an idea of an afterlife, which would indicate some rather sophisticated abstract thinking. None of these sites clearly show that such objects were deliberately buried, so we can't be sure. As the last glacial cycle grew more severe, European neanderthals became even more "neanderthal like" with round faces and thick bodies. Most likely, their short, thick stature was a physical adaptation for retaining heat in a frigid climate. The last known Neanderthal fossil dates from about 28,000 years ago, in Europe. We don't know for certain why they disappeared, but all the signs suggest that they just couldn't compete with the latest, even cleverer, wave of African immigrants.

Us: *Homo sapiens*

These immigrants, of course, were biologically modern humans, the same species to which you and I belong–*Homo sapiens*. Modern *Homo sapiens* seem to have originated in eastern or southern Africa sometime after 200,000 years ago, according to molecular and fossil evidence. The oldest known fossil of a modern human dates to about 160,000 years ago. The earliest fossils have larger teeth and a more pronounced brow ridge than most modern people do, but their craniums have the high, bulbous look of our own, in contrast to the low, bun-shaped craniums of earlier humans. The biggest difference between modern humans and previous species was not anatomical. It was behavioral. The tools and other archeological records of *Homo sapiens* clearly show a much more innovative species than any that had gone before. While other species had been conservative with their cultures, *Homo sapiens* was progressive, adapting newer and more complex tool sets in an accelerating fashion. This innovative character served them well, and their population began to grow. Eventually, population and other pressures would cause *Homo sapiens* to spread out of Africa in an even more thorough diaspora than *Homo erectus* had made so many millennia before.

THE DIVERSITY OF MODERN HUMANS: CULTURE AND BIOLOGY

If modern humans did in fact originate in Africa less than 200,000 years ago, as is very likely, then we are a rather young species. But if you walk down the street in one of the world's more metropolitan cities, such as Washington D.C., Rio de Janeiro, or Singapore, what is astonishing is how diverse people are. In just a few blocks you may pass people of African, East Asian, Indian, European, or Middle Eastern descent, as well as those with multiple heritages. You may hear snatches of Hindi, Arabic, Cantonese, German, Spanish, or Swahili. There may be Sikhs wearing turbans, Hindus in Saris, and people of all heritages in blue jeans and business suits. There are Muslims, who might be Sunni or Shiite, and Buddhists who might be Theravada or Mahayana. Modern humans may be a single species, but the ways of being human are myriad.

Of course, this diversity has different sources. Some differences between people, such as hair color, blood type, or skin tone, are biological. Others, such as religion or style of dress, are cultural. Though some people think otherwise, it is clear that culture has contributed far more to human diversity than biology has. The reason is simple–culture can change so much faster than biology, and since the origin of modern humans, culture has had time to evolve and diversify to a far greater extent. Biologically speaking, we are a very homogenous species. This is an empirical fact--most species are far more genetically diverse than human beings.

Now, this is not to say that biology is unimportant. The biology that all humans share is the very foundation of our humanity. But the pace of biological change is so slow as to be, for all practical purposes, a constant. The real action is in cultural change, and the next few chapters will be devoted to plotting its ever-accelerating path. But first, let's take a last look at human biology, at the genetic diversity that has appeared since humans went their separate ways in their great colonization of the globe.

BIOLOGICAL DIVERSITY

PROBLEMS WITH THE IDEA OF RACE

Of all the pathological fixations that have held people in their grip throughout history,

none has been more harmful than the obsession with race. Ever since people first became aware of the great variety of humankind, they have tried to categorize humans into various races. Given the human urge to categorize, this is not surprising. But when categorization was combined with another human tendency–to like what is familiar, and fear or loathe what is not–it has also been tragic. People have gone beyond categorizing various groups of people, and decided to rank them according to which they perceive to be more "highly evolved" or "morally advanced". Almost invariably, they place their own group at the pinnacle, and consign others to inferior ranks. Such notions of racial supremacy and inferiority have served as a rationale for some of the gravest atrocities ever, from the slave trade to the Holocaust.

It is this rank ordering of human kind is the main source of such horrors, though, not the categorization itself. If people had simply divided humanity into races, without assigning them ranks, the damage would have been much less severe. So, let me make myself clear. While I will be talking about categorizing groups of humans, I am not ranking them. There is no reason to think that any group of humans is biologically superior–morally or intellectually–to any other. While it's true that different groups of people have had more complex societies or greater technological sophistication than others, this can be explained in terms of cultures taking different directions in different environments, not in terms of innate differences between peoples.

But even the traditional attempts at categorization, the historical ideas of race itself, are problematic, and for several reasons. First of all, "race" has never been well defined. Some racial divisions have been entirely misconceived. Hitler's notion of an "Aryan" race, for example, was entirely without historical or scientific foundation. Sometimes race has referred to a group distinguished mostly by culture, not biology. One hears of the "Jewish race" or the "Arab race". These two groups are very different culturally, but hardly different at all genetically. It would be better to call such divisions ethnic groups, with the understanding that ethnicity refers mostly to culture, not biology.

But the idea of race is problematic even when it is used to distinguish groups with clear (if slight) biological differences, such as Europeans and East Asians. The biggest problem is that traditional divisions have been based entirely on highly visible traits, such as skin tone, facial features, or hair color or texture. But these superficial features are just that–superficial. Other differences between human populations, such as blood type, are less visible, but just as important.

Outward appearance is a poor way of distinguishing human groups. The only way to differentiate humans biologically is in terms of differences in genes, which are the basis for all those other traits. But even if we think entirely in terms of genes, we have to be careful. Very seldom will every member of one group, and no members of another group, have a certain gene. What changes across populations is the percentage of people who have certain genes.

Thinking in this way, we see how subtle human diversity actually is. Different populations may split up differently depending on which genes you look at. For example, one gene may show a gradient of frequency across Eurasia, becoming less common from east to west. Another might be more common from north to south, or most frequent around one spot, and decreasing radially away from that spot. Also, there is a great deal of variation *within* different geographic populations of people, not just *between* them. If you compared the genes of two randomly chosen Europeans, they could be more different than those of a European and an African. Based on all these considerations, most students of human diversity prefer to jettison the word "race" in favor of "population". Not only does it lack the historical baggage, but it is a reminder that human diversity is a matter of continuous changes, not sharp boundaries.

Now, with all those caveats noted, and necessarily so, it is still true that there are real differences between human populations. Africa has a different genetic character than Japan. And some populations, such as Japanese and Koreans, are more alike than others, such as Africans and native Americans. Geneticists have been able to sample genes from peoples all over the world, and put together a tree of relationships, showing how each population has branched away from others since we first went our separate ways (Figure 1.3). If we compare this tree with the archaeological record, we can piece together a fairly reliable story of our colonization of the globe (Figure 1.4). **(Awaiting permission for images)**

THE GREAT DIASPORA AND THE ORIGIN OF HUMAN POPULATIONS

AFRICAN ROOTS

The first evidence of modern humans outside of Africa comes from the Middle East, which seems to have been colonized by 100,000 years ago, at least 60,000 years after modern

humans first evolved. Afterward, Africans south of the Sahara were isolated from people in other parts of the world, and the two groups began to diverge somewhat. This matches well with the tree of human diversity in Figure , which shows that the deepest genetic division in humankind is between Sub-Saharan Africans and other populations. The archeological evidence and the genetic evidence both support the Out of Africa hypothesis.

Further genetic support for this hypothesis is that sub-Saharan Africans are the world's most genetically diverse people. People commonly think of all native sub-Saharan Africans as "black". This is not only simplistic, it is incorrect. First, black Africans are an extremely diverse group, and those from different parts of Africa may have very different features. Second, while black Africans are a recognizable population, and the most widespread one in Africa, there are other native African populations. One is the pygmies of the central African forests. Pygmies have curly hair and dark skins, like blacks, but they are genetically distinct. Their most obvious distinction is that they tend to be very short–under 5 feet tall–but they also look distinct in other ways, with wider noses and more body and facial hair than blacks.

The other historically distinct group of Africans are now known as the Khoisan, though some people may know them by the older, less preferable terms "Bushmen" or "Hottentots". The name Khoisan is a compound term for two groups now confined to southern Africa, the Khoi (Hottentots) and the San (Bushmen). Historically, the Khoi were herders and the San were hunter-gatherers, though few now follow their traditional lifestyles. The Khoisan are quite physically distinct from black Africans, with more tightly curled hair, lighter, yellow-tinted skin, and eyelids rather like east Asians. The Khoisan language is famous for its click sounds, which are, except for some words which have been borrowed by neighboring peoples, unique among all the world's languages. Today, the Khoisan, and their languages, are mostly confined to southern Africa. However, Khoisan languages still survive in isolated pockets in east Africa, which suggests that Khoisan peoples once covered a far larger territory than they do today. In fact, both Pygmies and Khoisan were probably once more widespread, before they were pushed back or surrounded by black Africans, in a great expansion that we will discuss later.

The great genetic diversity among Africans makes sense in light of the Out of Africa hypothesis. Africa is the continent modern humans have occupied for the longest time, so human populations there have had the longest time to diversify. African languages are also the world's

most diverse. Since languages also branch and diverge, this suggests that languages in Africa have been diversifying for longer than they have on other continents. (The presence of language in all human populations, inside and outside Africa, means that language almost certainly originated well before modern humans first left Africa 100,000 years ago.)

SOUTHERN ASIA AND THE PACIFIC

After modern humans first left Africa around 100,000 years ago, they began to spread eastward across Asia. They seem to have kept to the south at first, spreading across India to Southeast Asia by around 60,000 years ago. Interestingly, the last known *Homo erectus* fossils, which date from as recently as 50,000 years ago, come from the lowermost corner of Southeast Asia, in Java, where that species was first discovered. Perhaps Java was where *erectus* made their last stand, driven back or out-competed by the new arrivals. We don't know this for sure, but such takeovers have certainly been common in more recent human history, as we will see.

The diaspora of modern humans occurred almost entirely within the last glacial cycle, when sea levels were much lower than today. This means that many islands and continents that are now separated by water were connected by dry land. Sumatra, Borneo, and Java were connected in a great peninsula now called Sunda. New Guinea, Australia, and Tasmania were also connected, forming a continent called Sahul. While there were many islands between Sunda and Sahul, they were never directly connected. Nonetheless, humans seem to have colonized Sahul by 40,000 years ago, which indicates that they must have had boats seaworthy enough to cover over 100 kilometers of open water by that time. What may have happened is that people on simple fishing boats were blown out to sea, landing a few days later on a new continent.

However they got there, they would remain isolated for tens of thousands of years. This is clear from looking at the tree of human diversity in Figure . Australians and New Guineans are very distinct from other populations of humans, in appearance as well as genetics. Since Australia and New Guinea have been separated for the last ten thousand years or so, the two populations have diverged somewhat. Both have dark skin, although Australians tend to be darker. New Guineans tend to have curly hair, while native Australians often have straight hair, which sometimes bleaches blonde. Many Australians have wide noses, like those of Africans.

Wide noses and dark skin are both well suited to hot climates. People in more northern areas have longer noses and thinner nostrils, which seem to help warm and humidify cold air. Anyone who has ever breathed in a lung-full of intensely cold air will know why warming it up could be useful. In warm climates, where this is not a problem, it is better to have wide nostrils to take in air as freely as possible. Skin color is also correlated with climate. Most people think of dark skin as an adaptation to prevent sunburn and the skin cancer that can result from it. It is true that dark skinned people can expose themselves to the sun for longer periods, but there is a problem with the idea that dark skin evolved to prevent skin cancer. Skin cancer usually shows up late in life, when people have already reproduced. In other words, people with a high risk of late-life skin cancer have the same reproductive fitness as those who don't. Like many maladies of old age, skin cancer is more or less immune to natural selection. A more important reason for differences in skin color has to do with vitamins. Vitamin D is produced in the skin with the help of sunlight. If the skin doesn't absorb enough sunlight, vitamin D deficiencies, which can cause problems such as rickets, may result. On the other hand, too much sunlight can cause the breakdown of folate, another essential vitamin. Studies have shown that skin color in native people in various parts of the world is dark enough to maintain folate, but light enough to synthesize vitamin D. Since people originated in sunny climates, chances are that the first modern humans had dark skin. Those who colonized northerly climates with less sunlight developed lighter skin in order to maintain vitamin D.

The physical features of Australians and New Guineans may be unchanged since the first humans arrived there, or they may be the product of adaptation in their isolated homeland. Both are probably factors. However, it may be that the original inhabitants of southeast Asia looked more like Australians and New Guineans than today's southeast Asians do. This idea is supported by the fact that there are isolated populations in Southeast Asia, such as the Andaman Islanders off the coast of Myanmar, who rather resemble New Guineans and Australians. These may be remnants of earlier populations which have since been surrounded. Still, as figure shows, however, today's southeast Asians, including people from Cambodia, Thailand, and most of Indonesia, are the widespread peoples closest to the Australians and New Guineans.

The last colonization of previously uninhabited lands was that of the Polynesians, an originally southeast Asian people who colonized islands across the Pacific Ocean between about

3,000 B.C. and 1000 A.D., when New Zealand was first colonized. The Polynesians were different from others we have discussed so far, however, because they were an agricultural people, so we will save their story for later.

The relationship between New Guineans, Australians, and Southeast Asians brings us to a surprising fact. While many Westerners lump everyone from eastern Siberia to Southeast Asia together into one "east Asian" race, this grouping is not genetically valid. While people across this area do have some features in common, especially dark, straight hair and epicanthic folds, this grouping conceals some major differences. In fact, as Figure shows, it seems to contain two very different lineages. Southeast Asians are more closely related to Pacific islanders and native New Guineans and Australians than to Northeast Asians. Northeast Asians, on the other hand, are more closely related to Arctic peoples such as the Inuit, to native Americans, and even Europeans and other "Caucasoids" such as North Africans and Asian Indians. The tree of diversity for non-African peoples has two main branches, and "East Asians" occupy each one. Broadly speaking, the top branch could be labeled "Southeast Asian and Pacific", while the bottom branch could be labeled "Northern Eurasian and American". This division seems to suggest that, early in the colonization of Eurasia, populations split into northern and southern divisions, isolated by differences in environment–warm, wet forests to the south, and cold steppes, tundra, and coniferous forests to the north.

EUROPE, NORTHERN ASIA, AND THE AMERICAS

Parts of northern Eurasia are inhospitable now, but during the last ice age they would have been downright hostile. Europe had glaciers as far south at times as London. Northern Asia was too dry to be extensively glaciated, but it would have been an intensely cold, windswept place. It is no surprise, then, that these areas were colonized later than southern Asia. Europe seems to have been colonized between 35,000 and 40,000 B.C. by the people sometimes called Cro-Magnons, who were the first modern humans in Europe. At the same time, the Neanderthals began to decline, and the last known Neanderthal dates from 28,000 B.C. We don't know if the Neanderthals were driven to extinction by modern humans, either actively (we killed them off) or passively (we out-competed them ecologically). The timing suggests that we did them no favors.

Modern humans reached Siberia a little later than Europe, some time before 30,000 B.C. We don't know exactly when or where Northeast Asians and Europeans began to diverge, or which the first Siberians most resembled. Northeast Siberia, however, was first colonized by Northeast Asians around 18,000 B.C. We can be fairly sure that these were Northeast Asian people, because those are the closest relatives of the native Americans, who almost certainly are descended from them. 18,000 B.C. was the very height of the last ice age. At the time, water locked up as ice had caused the sea to retreat from the Bering Strait, connecting Siberia and Alaska in a land bridge between the two continents. Archeologists agree that the first humans in the Americas got there by this frigid northern route, though they do not agree on when. At the earliest, they were likely to have spread through North America by 13,000 B.C.E., and into South America by 10,500 B.C.E. Of course, people may have crossed into North America more than once. It seems that Inuit (formerly called Eskimo) people are more closely related to Northeast Asians than are other Native Americans. The ancestors of the Inuit may have lived around the Bering Strait and Alaska by 9,000 B.C., and expanded into the Aleutian Islands by 6,000 B.C. They began to spread further around 4,000 B.C., having developed a sophisticated way of life based on fishing and hunting marine mammals and birds, often from kayaks. Today they can be found from Eastern Siberia to Greenland, which they had reached by 2000 B.C.