eventually become fossils are often transported quite considerable distances before reaching their place of burial. Usually they are moved by water—swept along in floods, or moved downhill by heavy rains.

Sometimes, other agents of accumulation are involved. Thus, hyenas were apparently responsible for the preservation of a large number of important human fossils. Hyena dens are places to which adults bring back parts of animal carcasses to feed their offspring. Moreover, they are often places in which any accumulated bones are subsequently protected from erosion. Leopards, too, have been important hominid bone accumulators, as a result of their habit of stashing their prey in favorite trees. On rare occasions, these trees happen to be growing in humid cracks in the ground that lead down to underground cavities, within which falling body parts may be preserved. At one South African site, a partial skull of an early human was found bearing a pair of holes that perfectly match a leopard's dagger-like canine teeth! Even porcupines have been implicated in ancient human bone accumulations. The upshot of all this is that if you want to reconstruct an ancient human milieu, you have to be able also to reconstruct the history of the fossil bones after the deaths of their owners. This is the realm of a group of specialists known as taphonomists, who study exactly what can happen to an individual after death, and how that history inscribes itself on the remains.

Rarely is a human fossil found in isolation. Mostly human fossils are found as a rather small part of a larger fossil fauna that, to a greater or lesser degree, samples the animals that shared the environment with them in life. Different faunas are characteristic of different kinds of habitats, with the result that not only are paleontologists of other specialties needed to identify the species concerned, but paleoecologists are needed to help decipher what those animals are telling us about what the ancient environments were like. Geologists of various kinds may also contribute to paleoenvironmental reconstruction. From the general nature of the sedimentary rocks in which fossils are found, it is possible to say a lot about the general setting in which those rocks were laid down, and microscopic examination of ancient soils also yields valuable information about the environments in which they were formed.

Dating the Past

But the most important subspecialty of geology involved with paleoanthropological fieldwork is stratigraphy, the study of the sequences in which the sedimentary rocks that often contain fossils were laid down. [Figure 11] Younger rocks lie on top of older rocks, so the higher in a rock pile the fossils occur, the younger they are. But not so fast: although one of the basic rules of stratigraphy is that sedimentary rocks are laid down in horizontal layers, subsequent earth movements can play havoc with the original "layer-cake" arrangement, and, in some cases, strata can even become folded over so that the older fossils lie above, creating a nightmare of reconstruction for the stratigrapher. Another problem the stratigrapher faces is correlating rocks of the same age from one area to another. Sedimentary rocks are formed from particles that are eroded from older rocks and then washed or blown away, to settle eventually in the bottom of depressions known as sedimentary basins. Each sedimentary basin has its own unique history. Traditionally, fossil faunas were used to correlate between basins, on the principle that faunas are not only characteristic of particular places, but of particular times, as well.

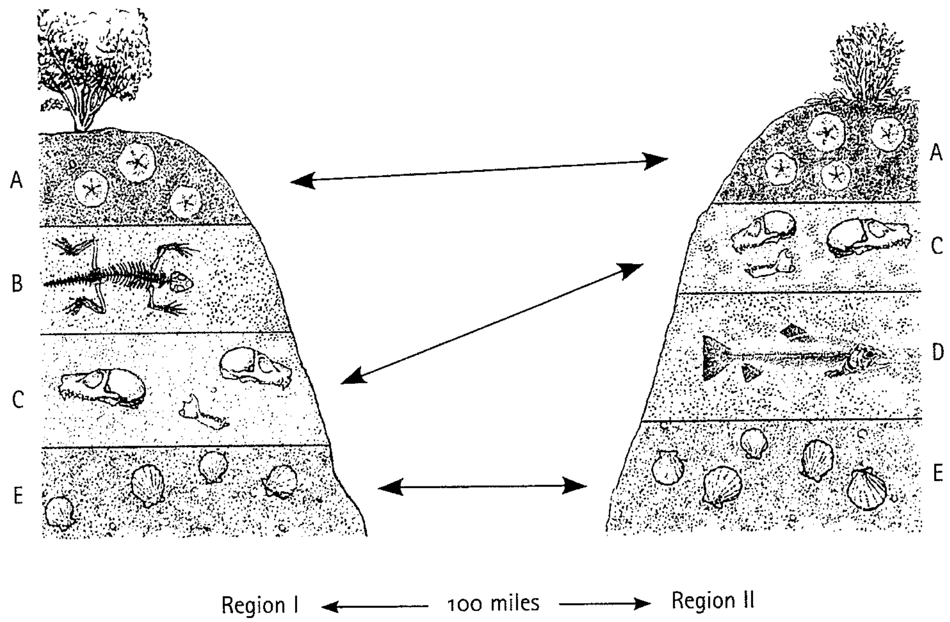

FIGURE 11. How biostratigraphic dating works. Sedimentary rocks build upward with time, but the record is seldom complete in any one place. This diagram shows how fossils can allow incomplete sequences from different areas to be integrated into a more comprehensive scheme. Illustration by Diana Salles.

Lately, a new approach has become available that can be used under certain circumstances and has proven extremely useful in unraveling the details of certain times and places in human evolution. This is "geochemical fingerprinting," which depends on the fact that the products of individual volcanic eruptions carry a unique chemical signal. Because volcanic ash can be blown over very wide areas before settling on Earth's surface and being incorporated into the accumulating rock record, it has been possible to tell that ashfalls found in places thousands of miles apart resulted from the same volcanic eruption and are therefore of the same age! Such marker beds provide a way of aligning rock sequences over enormous areas.

Faunal correlation permitted geologists to develop "relative" chronologies—rocks with faunas of this kind are older or younger than ones containing different faunas—and a reliable general sequence of periods of Earth history was worked out on this basis. [Figure 11] But until means became available for dating rocks in years, there was no way of accurately calibrating this succession. There was also vast uncertainty in correlating rocks separated by very long distances because, for instance, a tropical fauna looks very different from a temperate one of the same age. Enter the chronometricians, the geologists and geochemists who over the past half-century have developed methods of accurately dating certain kinds of rocks. In recent decades, a whole slew of chronometric dating methods, which yield dates in years, have become available. Most of these date the sediments (rocks or archaeological deposits) in which the fossils are found, but especially with recent advances in technology the most venerable of them, radiocarbon dating,

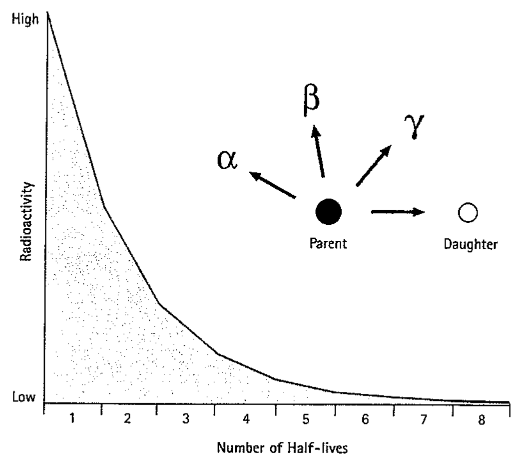

FIGURE 12. Radioactive decay. Radioactive isotopes (unstable forms of elements) "decay" into more stable "daughter" forms by emitting radiation or particles or both (upper right). The rate of such decay is expresssed as the "half-life," the time it takes for one-half of the atoms in a system to decay. The result is an exponential decay curve (lower left), which drops rapidly at first, then declines more slowly. Illustration by Diana Salles, after Tjeerd Van Andel, *New Views on an Old Planet: A History of Global Change*, 2nd edition (Cambridge University Press, 1994).

can sometimes be used directly on human fossils, in addition to other organic remains.

Unfortunately, radiocarbon dating can only be used on specimens that are less than about 40,000 years old. [Figure 12] Beyond this age, a variety of chronometric techniques is available, each of which has its own specific requirements. Nearly all chronometric methods depend in one way or another on radioactivity, the process by which "unstable" atoms "decay" to achieve a stable state. This happens at a steady rate that is conventionally quoted as the "half-life," i.e. the time it takes for half the atoms in a system to decay.

Radiocarbon dates are determined by measuring how much is left of the original unstable form; other approaches measure the accumulation of the "daughter" products of decay. The most widely used example of accumulation dating is the potassium/argon method (K/Ar, recently metamorphosed into a variant known as Ar/Ar dating), which exploits the decay of radioactive potassium into the noble gas argon. This technique dates mostly volcanic rocks, which are particularly good stratigraphic indicators because they are typically laid down over short periods of time. Of course, volcanic rocks are not found everywhere, but where they are, they are a godsend to a stratigrapher or paleoanthropologist, especially where they bracket the sediments in which a fossil is found. If fossil-rich sediments are interlayered with volcanic rocks, as is often the case in places like eastern Africa, the fossils will be slightly older than the dated rocks above them, and younger than those below. Since the half-life of radioactive potassium is very long, the K/Ar method can be used to date very old rocks indeed, but with recent refinements it can now also be used on rocks as young as a couple of hundred thousand years or even less.

A third basic approach is furnished by "trapped-charge" dating. This measures the numbers of free electrons that are trapped in defects in the crystal structures of minerals that are associated with fossils, and the number of electrons trapped is again a function of time. Materials in which this can be done range from flint to redeposited lime to dental enamel, all of which may be found in association with fossils, and which, in the case of the last, involve fossils themselves. Examples of this approach include thermoluminescence (TL) dating, for which flint tools and fragments burned in campfires are favorites, because heating empties the electron traps and resets the "clock" to zero, and electron spin resonance (ESR) dating, which can be used on fossil teeth as well as on the flowstones that sometimes cap fossiliferous deposits in limestone caves. Both of these approaches have proven very valuable in dating archaeological deposits and materials; TL works well back to 200,000 years or so, and ESR very much farther.

The emergence of chronometric methods has revolutionized our understanding of the timing of events in human evolution. When, in 1961, Jack Evernden and Garniss Curtis of the University of California at Berkeley used K/Ar to date Louis Leakey's first human fossil finds from Olduvai Gorge, Leakey himself was guessing that his fossils were maybe 600,000 years old. When the K/Ar date came in at three times that age, not only Leakey himself but the entire profession was flabbergasted!

Forty-five years down the line, we can be confident that we have, by now, a pretty good handle on the general timing of major events in human evolution, although some individual dates are pinned down remarkably tightly while others are bracketed by wide ranges of uncertainty. And since new instrumentation and new chronometric methods are coming on-stream all the time, we can hope that eventually we will be able to derive accurate dates on all of the fossils we find, rather than merely a large portion of them. But even then, the exact ages of some fossils found long ago may well always remain a mystery.

Identities and Relationships

With luck, you know how old your fossils are and, at least in general terms, the kinds of environments they lived in. Now you need to know, if you don't already, what species those fossils belonged to and how they are related to other species in their groups. For, although many paleoanthropologists scorn it as "an argument about names," knowing what to call your fossils is not only the most fundamental piece of knowledge you need to have, but is also one of the toughest things to figure out.

All living organisms, and thus all fossils, belong or belonged to a species. Unfortunately, exactly what species are is one of the most hotly argued topics in all of biology. In a general way, it is agreed that species are reproductively limited groups: As the basic "packages" that exist in nature, they are the largest populations within which all members can at least potentially interbreed. But after that, all hell breaks loose. From a paleontologist's point of view, there's no way you can tell reproductive behavior from looking at a fossil, while in the living world, some groups that look like perfectly good species may interbreed and even produce apparently fertile offspring. A striking recent example of this phenomenon is provided by polar bears and grizzly bears—two species that have been recognized as such for a long time. Every once in a while, a polar bear shows up with brown patches of fur on a normal snow-white pelage. When these bears are examined more closely, they also show the long claws and humped back of a grizzly bear. Because the polar bear and grizzly bear have different gene sequences, by examining their genetics one can clearly determine that these funny-looking polar bears are, in fact, the result of hybridization events between polar bears and grizzly bears.

So, while there can be no doubt that Nature is packaged in some meaningful way, this packaging is evidently very untidy; and as a result, at our last count scientists were using well over 20 different theoretical definitions of what species are. If there is that much division in theory, imagine what differences there are in practice! Still, even allowing for the undoubted fact that all species are variable (in the sense that their members differ from each other in a host of features), it is clear that the recent tendency among paleoanthropologists has been to minimize the number of species in the human fossil record.

Before we explain what we mean by this, some background: Closely related species are grouped into units called genera. This gives each species a two-part name: The first part is the name of the genus; the second is that of the species within it. This is why we identify ourselves as *Homo sapiens*, the species *sapiens* of the genus *Homo*.

In the years before World War II, practically every new human fossil that came along was given its own species name. Not unusually, it was given its own genus name as well, rather as each of us has given and family names. For example, in 1928, a skull found in 1921 at the site of Kabwe, in what is now the African country of Zambia, was given the name of *Cyphanthropus rhodesiensis*. When the Modern Synthesis came along in the mid-20th century, its proponents pointed out the critical fact that all animals belong to variable populations, and that fossils did not deserve new species names simply because they were not identical to something else already known. As a result, most authorities today would classify the Kabwe skull not only in our own genus *Homo*, but in the species *Homo heidelbergensis*, meaning that it doesn't even differ at the species level from fossils already described from elsewhere. Now, the notion that all populations are variable and that this has to be taken into account when classifying new fossils was an entirely laudable point to make. But as with all good ideas, this one was taken to a crazy extreme. At one point, under the influence of the Modern Synthesis, paleoanthropologists were cramming the whole human fossil record into a mere three species (*Australopithecus africanus, Homo erectus,* and *Homo sapiens*). As more and more fossil humans became known, this minimalist scheme rapidly began to bulge at the seams, and the number of species recognized had to multiply. But in our view, the pendulum has not yet swung far enough. We are still recognizing too few human species (or even, probably, genera) to properly reflect the amazing anatomical variety that we see in the human fossil record.

The big practical problem in reaching agreement on how many species are represented in the human fossil record lies in the fact that, as we'll see in more detail later, two major elements are involved in the evolutionary process. On the one hand lies structural change, and on the other is speciation, the origin of new reproductive communities. These events, as it turns out, don't necessarily occur at the same time. If you look around the living world today, you can find widespread species that have developed an enormous amount of variation within and among local populations that are still more than happy to interbreed if given the chance. But at the same time, you can find populations that are reproductively distinct that you can barely, if at all, tell apart by eye. When you're dealing with fossils, all you have to go on is what they look like; and even if you are making apparently commonsensical comparisons based on the amount of physical difference you tend to find among similar species in the living world, there is still plenty of room for argument. So argument there is, aplenty.

The family tree of humans and pre-humans contains just those species that most (though not all) paleoanthropologists would recognize as valid today. To us, there could well be more; but the point here is that until you have general agreement on how many evolutionary units you are dealing with, it is hard to come up with a coherent story, just as it's hard to make sense of what's going on in a play if you don't know who all the actors are. This is a major reason why paleoanthropology is such a famously argumentative science. Still, with each argument we inch a little closer to a more accurate description of the past worlds we see so fuzzily reflected in the available record.

Analyzing Evolutionary Histories

As we've just noted, by around 1950 the Modern Synthesis was preaching the notion that there were a mere three species in all of known human and pre-human history. What's more, these species were arranged into a single, gradually modifying lineage. But early in the 1970s a realization emerged that the overwhelming signal in the evolutionary record was one of stability and discontinuity, rather than of steady change. Species originate and then tend not to change much, at least directionally, until, after a variable tenure, they finally disappear—often to be replaced by a close relative.

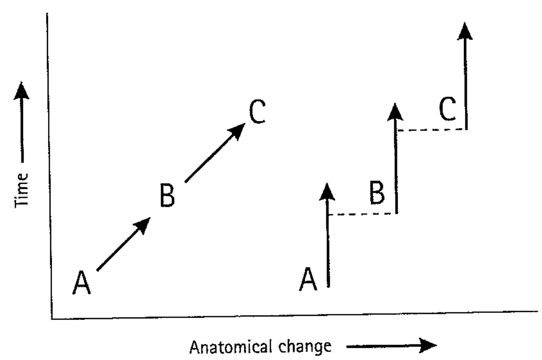

FIGURE 13. Two views of how evolution occurs. Represented on the left is "phyletic gradualism," whereby species gradually transform over time into other species. In contrast, the notion of "punctuated equilibria" (right) sees change as episodic, species being essentially stable entities which give rise to new species in relatively short-term events. Illustration by Diana Salles.

The story of life on Earth thus appeared not as a gradual unfolding, but as an episodic affair in which the origin of new species, and competition among them, has played a key role. This has turned out to be as true in the case of fossil humans as elsewhere, and the notion of human evolution as a single-minded slog from primitiveness to perfection has been replaced by a much more interesting story, in which successive radiations of hominid species have competed for space on the ecological stage.

This has had major implications for the ways in which evolutionary histories have been reconstructed. [Figure 13] For if evolution consisted purely of gradual generation-by-generation change under the beneficent hand of natural selection, then figuring out evolutionary histories was largely a matter of discovery. After all, if fossils were more or less like links in a continuous chain, then to know more about the evolutionary history of any group, all you needed to do was to go out and find more of them, and their age would tell you pretty much where they fitted in. But if species as wholes in fact play a crucial role in the evolutionary process, and if the evolutionary history of any successful group tends to consist not simply of successions of slowly changing species but of changing diversities of coexisting species, then understanding those evolutionary histories became a matter of analyzing the relationships among those species, rather than one of simply discovering the links in a chain. And as it happened, more explicitly grounded techniques for doing this were becoming available as the 1970s began. In particular, a method known as cladistics was adopted. It involved recognizing relationships between pairs of species on the basis of innovations inherited from their most recent common ancestor. The pairs could then be grouped with others, using the same criterion, until you had a large branching diagram that expressed the relationships among all the members of a large group, ultimately radiating out to include all living things.

But all that a cladogram does is to express the closeness of relationships among species, based on recency of common ancestry. It says nothing about ancestry and descent, which are, in fact, more difficult, if not impossible, to demonstrate. If you add these in, you are moving away from what Karl Popper would call testability, but you are getting closer to a more interesting formulation – the more familiar "evolutionary tree," in which you plot both the relationships and the geological age of fossil species. The free can then form the basis for a narrative account known as a "scenario," in which you throw in everything you know about adaptation, ecology, behavior, and so forth. Popper would say that this is the least testable proposition of all, but it is at the same time the most interesting – and it is just fine to dream up scenarios, provided you are explicit about the evolutionary tree and, most importantly, about the testable cladogram on which it is based. Forty years ago, paleoanthropologists just dived in at the deep end with the scenario; now many of them are acutely aware of the need to get there the hard way, by doing the prior analyses. This, of course, brings us back to the genomic trees we introduced earlier, which are conceptually a slightly different creature, because they are based on the comparison of (almost exclusively) living forms.

Fossils as Living Creatures

So now we know who our fossils are, where they are from, how old they are, what kind of environment they lived in, and what other animals they shared that environment with. An obvious next question to ask is exactly how they made their living.

When we're dealing with ancient humans, there is a number of approaches to this. One is to study how our precursors functioned as mechanical contraptions. We use the word "contraption" advisedly, because although, for example, we like to think of ourselves as well adapted to the upright walking that comes to us so naturally, a lot of compromises were in fact involved in converting an ancestral quadruped into the striding bipeds we are today. Our high frequencies of slipped discs, fallen arches, and wrenched knees are only a few of what have been called the "scars" of human evolution. Nonetheless, like all other successful organisms, we are pretty good at what we do, and our adaptations for our unusual way of moving around are evident in our skeletons. This means that, to a large extent, we can read back from the structure of ancient bones to how their original possessors had used them in life. Functional anatomists are adept at doing this, and it turns out that by studying such things as limb proportions and the shapes of individual bones and bony complexes, it is possible to get a pretty good idea about the way fossil forms moved around when they were parts of vibrant living ecosystems.

A very important part of making a living is what you eat, and this is something that can be read very broadly from an organism's teeth. [Figure 14] There is no mistaking a carnivore for a grass-eater, for example. More subtle variations in diet are less easy to read from the form of the teeth, but close scrutiny can still tell you a lot; this is particularly true if you add the fact that teeth wear as they are used, and that at the microscopic level the traces of wear on your teeth may be very different, depending on the

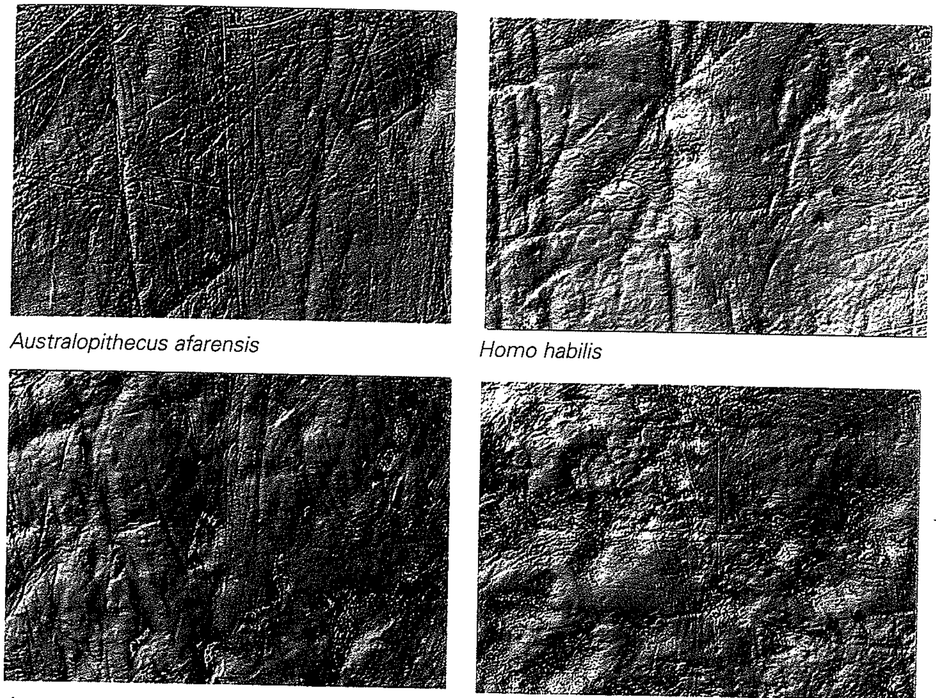

FIGURE 14. Confocal micrographs at high magnification showing areas on the crushing/grinding facets of the molar teeth in four different kinds of hominids. The gouging and pitting seen on the *Paranthropus* tooth indicates a diet of tough and possible gritty objects such as seeds or tubers; the striations on the other teeth suggest a predominance of softer foods such as fruit and possibly leaves. The scale is 10 microns. Courtesy of and © Peter Unger.

substances you are masticating. If you look at the wear-surfaces of teeth at high magnifications using a scanning electron microscope, for example, you find that the striations and pitting seen on, say, the chewing teeth of an animal that eats roots and tubers, are very different from anything you see on the teeth of fruit-eaters. Knowing what you see on the teeth of living forms with known diets helps you to read back to what ancient animals were eating.

Moreover sometimes, particularly among ancient humans, tooth-wear can tell you about more than just diet. Occasionally teeth are used as tools, to hold or process things that are not eaten; and that shows up in tooth-wear too. Neanderthals, for example, typically show extremely worn front teeth, worn in a very characteristic way that suggests they may have been used to process hides, or to hold them as they were being held taut with one hand and scraped with a tool held in the other.

Conversely, teeth aren't the only thing that can tell you about diet. Isotopic chemists have recently begun using the ratios of certain stable isotopes (alternative forms of elements, particularly of carbon and nitrogen) that may be preserved in fossil bone, to help clarify the diets of ancient humans. They have come up with some surprising results, including the suggestions that certain very early humans may have eaten more meat than had been supposed, and that some Neanderthals, at least, were very heavily carnivorous, possibly even specialists on such fearsomely large herbivores as woolly rhinoceroses and mammoths. The abundance of some trace elements in bone may also be useful as dietary indicators; at present, both stable-isotope and trace element studies are in their infancy, but chances are that we'll see rapid developments in the near future.

As far as reconstructing ancient behaviors is concerned, though, paleoanthropology has one huge advantage over studies of other extinct creatures. Humans alone have left us a direct material record of their ancient behaviors, rather than merely their bones. This is the archaeological record and it starts some 2.5 million years ago, when human precursors began to make stone tools. Because they are readily recognizable and are more or less indestructible, stone tools are abundantly known. What's more, a series of technological innovations over the time since stone tools were first made gives us some insight into the cognitive advances made by successive kinds of early humans.

The period of human prehistory covered by this book lies more or less entirely within the Paleolithic period, or the Old Stone Age (roughly 2.5 million to 10,000 years ago). This is a long expanse of time, during which ancient humans were gatherers and scavengers, then hunter-gatherers, always pretty consistently on the move.

Not until close to the end of the Paleolithic did human precursors begin to build shelters, at least of the kind that might be expected to be preserved, and so most archaeological sites of the period are pretty modest. The earliest sites are, indeed, no more than spots on the landscape where early humans butchered animal carcasses that they had more probably encountered than hunted. With time, Old Stone Age archaeological sites become a bit more complex; and early humans began to return repeatedly to favored camping spots, often accumulating large thicknesses of archaeological deposits over the millennia. Such deposits consist basically of what early people threw away, or simply left behind. Not for nothing has archaeology been called "the study of ancient garbage."

Still, there's a lot you can learn from ancient garbage (and from modern garbage too, as the "garbagologists" who trawl through the trash of celebrities can attest: People's garbage does not always confirm what their PR agents say about their lifestyles). Moreover, you can learn not just from the garbage itself, but from where it is found. The places where archaeological sites are situated, and the ways in which they were distributed across ancient landscapes, tell archaeologists an awful lot about the lifestyles of the people that made them. Even the tools themselves are not useful simply as witnesses to the development of human technology, but have broader implications about the lives of the people who made them.

Sadly, stone tools are only part of the technological story, and they give us only a very indirect glimpse of the full toolkit of the people who made them, still less of their intelligence or of the way they perceived the world, or of the social aspects of their lives. Nonetheless, its durability makes the stone tool record a very complete record of one limited aspect of human activity. For this reason, even where archaeologists are essentially limited to the contemplation and characterization of ancient stone tool "industries," they often broaden these designations to the cultures and societies that made them.

For example, the first period of modern human occupation of Europe is known as the "Aurignacian." Technically, the Aurignacian is defined by a characteristic assemblage of stone tools (with the addition, in this case, of a slender split-based spearhead made of bone). Strictly speaking, then, it is the technological assemblage that is Aurignacian, not the people who made it. But archaeologists liberally speak of "Aurignacian people," on the perfectly reasonable assumption that making the diagnostic tools of the Aurignacian industry was something learned, and that this learned knowledge was passed on within societies that were united by many more cultural elements than simply these particular stone working techniques. In this sense, it is entirely justifiable to talk of an "Aurignacian culture."

Like paleoanthropology itself, as Paleolithic archaeology has evolved it has co-opted a range of specialists into its activities. The lead archaeologist on a site will typically be a generalist, organizing and coordinating its excavation, which will be done by individual excavators, frequently students, each of whom has responsibility for a particular part of a site. The excavated area will normally be defined by a grid against which the position of everything found is mapped in three dimensions. Once the material is discovered, the specialists come into play. Archaeometrists concern themselves with dating archaeological deposits, using many of the dating methods we described earlier, as well as technological comparisons and their own version of stratigraphy – for archaeological deposits accumulate one on top of another, just as do geological sediments. Other scientists also look at the biochemistry of bones and perform physical and chemical analyses of artifacts of all kinds. Archaeozoologists study the animal bones found at each site, identifying the remains to discover the diet, subsistence patterns, and butchery practices of the people who lived there. Archaeobotanists study the much rarer plant remains found at sites, including seeds, fibers, and even hardened mud impressions where such things are found. Palynologists study the plant pollen found in archaeological deposits, which can reveal a great deal about the surrounding environment.

Even those who limit themselves to the study of stone tools come at their data from a variety of perspectives. Some of them are concerned with the "typology" of stone tools, categorizing the types of tools that were made in particular times and places; others with the techniques by which the tools were made, and by the "reduction sequences" by which a piece of fresh stone is converted into a brand-new tool and then resharpened until its shape is completely transformed; others by the ways in which the tools were actually used, and how those particular uses inscribed themselves on the tools that have come down to us. In this last connection, experimental archaeologists indulge in extreme behaviors, such as butchering entire elephants using tiny sharp stone flakes, just to see what is possible. New approaches are being discovered all the time, and indeed, the variety of archaeological preoccupations is as inexhaustible as human behavior itself.

What Does It Mean to Be Human?

Up to now we have been throwing around the term "human" pretty loosely, which is perhaps excusable because people have been describing themselves as human since long before anyone had the slightest idea that we had relatives out there as close as the apes, let alone much closer relatives that are now extinct. But it does beg the question of what, exactly, we mean by this vernacular term. If we could avoid this problem by retreating to technical jargon, that would be great. But it turns out that taking refuge in scientific terminology doesn't help much. One way of addressing what it means to be human, which we will explore in detail in Chapters 8 and 9, is to look at those things that make us unique relative to all other organisms. For now, though, we will use a second approach, which is to detail how humans are related to other organisms, living and extinct, on this planet.

Order:	Primates (Lemurs and lorises, tarsiers, monkeys, apes, humans)
Suborder:	Haplorhini (Tarsiers, monkeys, apes, humans)
Hyporder:	Anthropoidea (Old and New World monkeys, apes, humans)
Infraorder:	Catarrhini (Old World Monkeys, apes, humans)
Superfamily:	Hominoidea (great and lesser apes, humans)
Family:	Hominidae (humans and their extinct relatives)
Genus:	*Homo*
Species:	*Homo sapiens*

FIGURE 15. **Classification of the human species. The rules of zoological classification produce an inclusive, rather than an exclusive, hierarchy, so that a taxon (group) belongs to all of the larger categories that lie above it. Thus our species *Homo sapiens* belongs to both the Infraorder Catarrhini and to the Order Primates.**

Traditionally, modern human beings and their extinct relatives have been classified in the zoological family Hominidae, a division of the order Primates that also contains the apes, monkeys, lemurs, and bush babies. [Figure 15] All of the apes were classified together in the family Pongidae. But molecular studies back in the late 1960s began to suggest that, in fact, modern humans and their fossil relatives might actually be more closely related to one of the apes (most people's favorite candidate is the chimpanzee) than they are to the other apes. That, of course, placed the simple two-family dichotomy in doubt. Nowadays, the family Hominidae is often taken to include the chimpanzees, as well as humans and their extinct relatives.

In this book we prefer to sidestep the issue by adopting a "bottom-up" classification. There are now far more known extinct human relatives than there are species of living or fossil apes – so many species, indeed, that by any criterion this diverse group deserves family status. That is why we are sticking with the traditional use of Hominidae, and its derived adjective "hominid," to include just *Homo sapiens* and those extinct forms that are more closely related to it by recency of common ancestry than to any ape – though you will see plenty of alternative classifications elsewhere. We will look in detail at the place of Hominidae in the larger tree of life in Chapter 5.

Still, even with this under our belt we are left with ambiguity in the meaning of "human." And, to be quite frank, we ourselves are pretty sloppy about this, using the term differently in different contexts. When we speak of "human evolution," we and most others are referring to the evolution of everything within the family Hominidae, as used here. But from now on, when we use "human" as a descriptor, we will limit it to members simply of our genus *Homo*, only one of several hominid genera. Furthermore, the extinct species of *Homo* are not what we could properly describe as "fully human" in any functional sense: Our living species appears to be unique in the way it interacts with the world around it, and in a cognitive sense, only *Homo sapiens* can be characterized in this way. But that's not all. The very first *Homo sapiens* were "anatomically modern humans," because they looked just like us. But (to give away the plot early) they were not "behaviorally modern humans." This status, it seems, was only attained some time later. So while our choice of terms represents a consistent usage, reading the literature makes it evident that it's not an obligatory one. Finally, as to when "hominids" became "people," well, you just pays your money and you takes your choice.