CHAPTER

10

The First Dispersal of the Genus *Homo: Homo erectus* and Contemporaries

OUTLINE

CHAPTER 10

Focus Question

Who were the first members of the human family to disperse out of Africa, and what were they like (behaviorally and anatomically)?

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Introduction

Today it's estimated that upward of 1 million people daily cross national borders. Some individuals travel for business, others for pleasure, and others to find new homes. Regardless, it seems that modern humans have wanderlust—a desire to see distant places. Our most distant hominin ancestors were essentially homebodies, staying in fairly restricted areas, exploiting the local resources, and trying to stay out of harm's way. In this respect, they were much like other primate species.

One thing's for sure: All these early hominins were restricted to Africa. When did the first hominins leave Africa? What were they like, and why might they have left their ancient homeland? Did they differ physically from their australopith and early *Homo* forebears, and did they have new behavioral and cultural capabilities that helped them successfully exploit new environments?

It would be a romantic misconception to think of these first hominin transcontinental emigrants as "brave pioneers, boldly going where no one had gone before." They weren't deliberately striking out to go someplace in particular. It's not as though they had a map! Still, for what they did, deliberate or not, we owe them a lot.

Sometime, close to 2 mya, something decisive occurred in human evolution. As the title of this chapter suggests, for the first time, hominins expanded widely out of Africa into other areas of the Old World. Since all the early hominin fossils have been found *only* in Africa, it seems that hominins were restricted to this continent for perhaps as long as 5 million years. Later on, the more widely dispersed hominins were quite different both anatomically and behaviorally from their African ancestors. They were much larger, were more committed to a completely terrestrial habitat, used more elaborate stone tools, and were capable of adapting culturally to the demands of the new environments into which they spread.

Anthropologists continue to debate how to classify biological variations among the different geographical groups of these highly successful hominins. Moreover, discoveries of hominin fossils and artifacts are ongoing. New fossil finds from Europe are forcing a major reevaluation of exactly which kind of hominin was the first to leave Africa (Fig. 10-1). And recent artifact and fossil discoveries in Asia are also greatly expanding our understanding of the earliest hominin inhabitants and questioning conventional thinking that Asia was a "passive recipient" rather than an active donor in the earliest transcontinental hominin dispersals (e.g., see Dennell and Roebroeks, 2005).

Nevertheless, after 2 mya, there's less biological diversity in these hominins than is apparent in their pre-australopith and australopith predecessors. Consequently, there is universal agreement that the hominins found outside of Africa are all members of genus *Homo*. Thus, taxonomic debates focus solely on how many species are represented. The species for which there is the most evidence is called *Homo erectus*. Furthermore, this is the one group that most paleoanthropologists have recognized for decades and still agree on. Thus, in this chapter we will concentrate our discussion on *Homo erectus*. We will, however, also discuss alternative interpretations that "split" the fossil sample into more species.

On the cultural side, the archaeological evidence of the earliest hominins in Europe and Asia is more diverse than that of their African ancestors but generally reflects African

roots. While much of the diversity of Lower Paleolithic tool assemblages and sites can be explained as cultural adaptations to the new habitats into which these hominins spread, these early humans were not yet cultural beings in the same sense as modern humans.

Around 1.4 mya, well after the initial dispersal of hominins, the Lower Paleolithic stone tool industry called **Acheulian** developed across parts of Africa, western Asia, and eventually Europe. Technologically more advanced than Oldowan (see p. 226), the Acheulian tool kit provides us with convincing evidence of increasing tool dependence by hominins, who by this time inhabited several tropical and temperate regions of the Old World.

Throughout this part of the Lower Paleolithic, whether viewed in Africa or beyond, the archaeological record shows that hominins were slowly constructing the basic elements of human culture. And as with the study of the hominin fossils, the archaeology of this dispersal outside of Africa is a quickly changing area of research, about which archaeologists still have much to learn.

A New Kind of Hominin

The discoveries of fossils now referred to as *Homo erectus* began in the nineteenth century. Later in this chapter, we will discuss in some detail the historical background of these earliest discoveries in Java and the somewhat later discoveries in China. From this work, as well as presumably related finds in Europe and North Africa, a variety of taxonomic names were suggested.

It's important to realize that such taxonomic *splitting* was quite common in the early years of paleoanthropology. More systematic biological thinking came to the fore only after World War II and with the incorporation of the Modern Synthesis into paleontology (see p. 62). Most of the fossils that were given these varied names are now placed in the species *Homo erectus*—or at least they've all been lumped into one genus (*Homo*).

In the last few decades, discoveries from East Africa of firmly dated finds have established the clear presence of *Homo erectus* by 1.8 mya. Some researchers see several anatomical differences between these African hominins and their Asian cousins (the latter recognized by almost everybody as *Homo erectus*). Thus, they place the African fossils into a separate species, one they call *Homo ergaster* (Andrews, 1984; Wood, 1991).

While there are some anatomical differences between the African specimens and those from Asia, they are all clearly *closely* related and quite possibly represent geographical varieties of a single species. We'll thus refer to all these hominins as *Homo erectus*.

All analyses have shown that *H. erectus* represents a different **grade** of evolution than their more ancient African predecessors. A grade is an evolutionary grouping of organisms showing a similar adaptive pattern. Increase in body size and robustness, changes in limb proportions, and greater encephalization all indicate that these hominins were more like modern humans in their adaptive pattern than their African ancestors were.* We should point out that a grade only implies general adaptive aspects of a group of animals; it implies nothing directly about shared ancestry (organisms that share common ancestry are said to be in the same *clade*; see p. 104). For example, orangutans and African great apes could be said to be in the same grade, but they are not in the same clade (see p. 209).

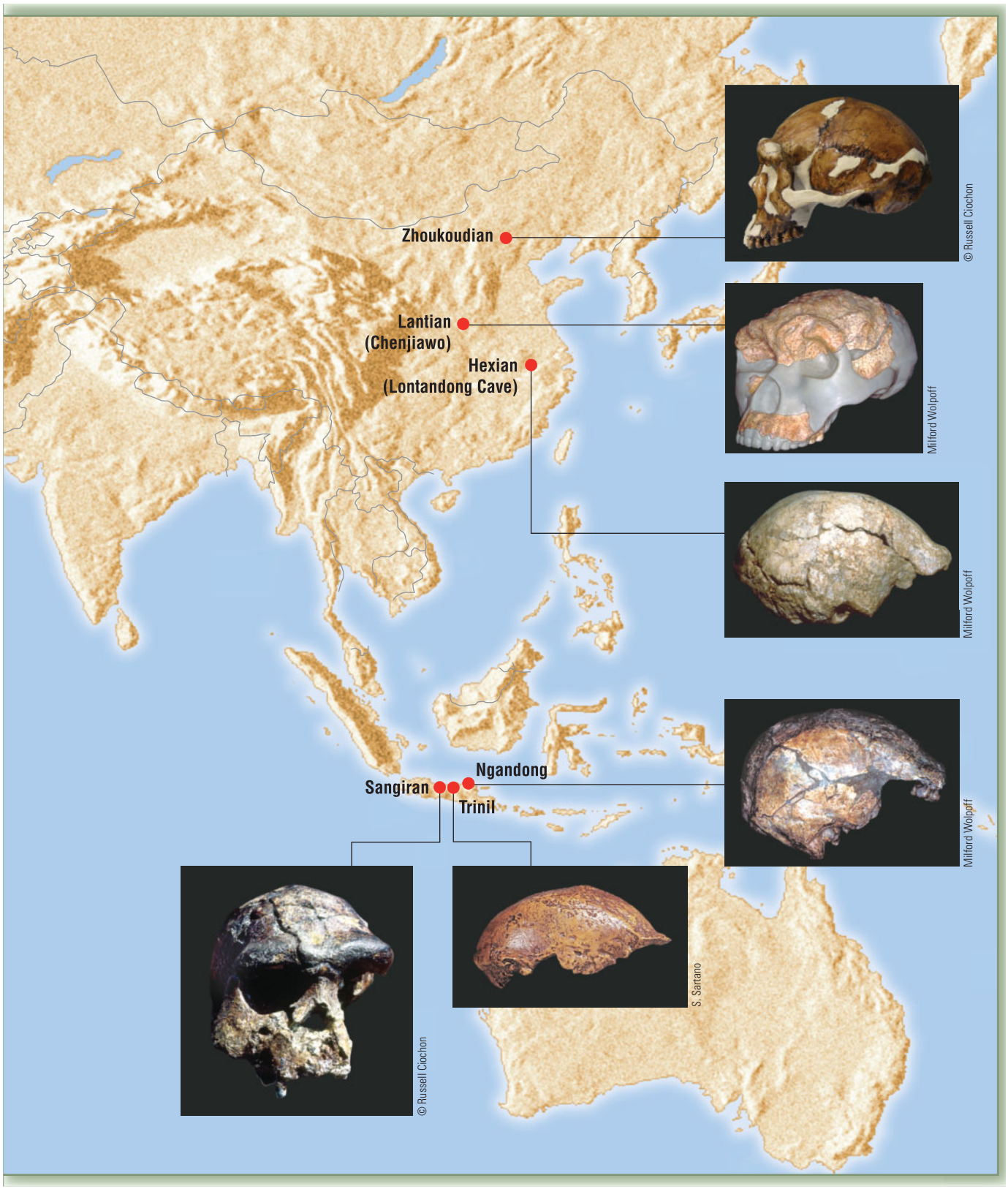
The hominins discussed in this chapter are not only members of a new and distinct grade of human evolution; they're also closely related to each other. Whether they all belong to the same clade is debatable. Nevertheless, a major adaptive shift had taken place—one setting hominin evolution in a distinctly more human direction.

Acheulian (ash´-oo-lay-en) A Lower Paleolithic stone tool industry that includes bifacially worked hand axes and cleavers and many kinds of flake tools. It began as early as 1.4 mya in Africa, spread across many parts of the temperate to tropical parts of Europe and Asia, and ended roughly 200,000 ya. Also spelled Acheulean.

grade A grouping of organisms sharing a similar adaptive pattern. Grade isn't necessarily based on closeness of evolutionary relationship, but it does contrast organisms in a useful way (e.g., *Homo erectus* with *Homo sapiens*).

*We did note in Chapter 9 that early *Homo* is a partial exception, being transitional in some respects.

Figure 10-1
Major *Homo erectus* sites and localities of other contemporaneous hominins.


Zhoukoudian
Lantian
(Chenjiawo)
Hexian
(Lontandong Cave)
Ngandong
Sangiran
Trinil
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We mentioned that there is considerable variation in different regional populations of hominins broadly defined as *Homo erectus*. New discoveries are showing even more dramatic variation, suggesting that some of these hominins may not fit closely at all with this general adaptive pattern (more on this presently). For the moment, however, let's review what *most* of these fossils look like.

The Morphology of *Homo erectus*

Homo erectus populations lived in very different environments over much of the Old World. They all, however, shared several common physical traits that we'll now summarize briefly.

BODY SIZE

As conclusively shown by the discovery of the nearly complete skeleton of "Nariokotome Boy" (from **Nariokotome**, on the west side of Lake Turkana in Kenya), we know that *H. erectus* was larger than earlier hominins. From this and other less-complete specimens, anthropologists estimate that some *H. erectus* adults weighed well over 100 pounds, with an average adult height of about 5 feet 6 inches (McHenry, 1992; Ruff and Walker, 1993; Walker and Leakey, 1993). Another point to keep in mind is that *H. erectus* was quite sexually dimorphic—at least as indicated by the East African specimens. For adult males, weight and height in some individuals may have been considerably greater than 100 pounds. In fact, if the Nariokotome Boy had lived to adulthood, he probably would have grown to an adult height of over 6 feet (Walker, 1993).

Increased height and weight in *H. erectus* are also associated with a dramatic increase in robusticity. In fact, a heavily built body was to dominate hominin evolution not just during *H. erectus* times, but through the long transitional era of premodern forms as well. Only with the appearance of anatomically modern *H. sapiens* did a more gracile skeletal structure emerge, and it still characterizes most modern populations.

BRAIN SIZE

While *Homo erectus* differs in several respects from both early *Homo* and *Homo sapiens*, the most obvious feature is its cranial size—which is closely related to brain size. Early *Homo* had cranial capacities ranging from as small as 500 cm^3 to as large as 800 cm^3. *H. erectus*, on the other hand, shows considerable brain enlargement, with a cranial capacity of about 700* to 1,250 cm^3 (and a mean of approximately 900 cm^3). However, in making such comparisons, we must bear in mind two key questions: What is the comparative sample, and what were the overall body sizes of the species being compared?

As for the first question, you may recall that many anthropologists are now convinced that more than one species of early *Homo* existed in East Africa around 2 mya. If so, only one of them could have been the ancestor of *H. erectus*. If we choose the smaller-bodied sample of early *Homo* as our presumed ancestral group, then *H. erectus* shows as much as a 40 percent increase in average cranial capacity. But if the comparative sample we use is the larger-bodied group of early *Homo* (for example, skull 1470, from East Turkana), then *H. erectus* shows a 25 percent increase in cranial capacity.

As we've discussed, brain size is closely linked to overall body size. We've focused on the increase in *H. erectus* brain size, but *H. erectus* was also considerably larger overall

*Even smaller cranial capacities are seen in recently discovered fossils from the Caucasus region of southeastern Europe.

Nariokotome (nar´-ee-oh-koh´-tow-may)

than earlier members of the genus *Homo*. In fact, when we compare *H. erectus* with the larger-bodied early *Homo* sample, their *relative* brain size is about the same (Walker, 1991). What's more, when we compare the relative brain size of *H. erectus* with that of *H. sapiens*, we see that *H. erectus* was considerably less encephalized than later members of the genus *Homo*.

CRANIAL SHAPE

Homo erectus crania display a highly distinctive shape, partly because of increased brain size, but probably more correlated with increased body size. The ramifications of this heavily built cranium are reflected in thick cranial bone, large browridges above the eyes, and a projecting **nuchal torus** at the rear of the skull (Fig. 10-2).

The braincase is long and low, receding from the large browridges with little forehead development. Also, the cranium is wider at the base compared with earlier *and* later species of genus *Homo*. The maximum cranial breadth is below the ear opening, giving the cranium a pentagonal shape (when viewed from behind). In contrast, the skulls of early *Homo* and *H. sapiens* have more vertical sides, and the maximum width is *above* the ear openings.

Most specimens also have a sagittal ridge (also called a sagittal keel) running along the midline of the skull. Very different from a sagittal crest, the keel is a small ridge that runs front to back along the sagittal suture. The sagittal keel, along with the browridges and the nuchal torus, don't seem to have served an obvious function in the life of *H. erectus*, but most likely reflect bone buttressing in a very robust skull.

The First *Homo erectus: Homo erectus* from Africa

Where did *Homo erectus* first appear? The answer seems fairly simple: Most likely, this species initially evolved in Africa, probably in East Africa, where its remains are associated with artifacts of the Oldowan stone tool industry (see p. 226). Two important pieces of evidence help confirm this hypothesis. First, *all* the earlier hominins prior to the appearance of *H. erectus* come from Africa. What's more, by 1.8 mya, there are well-dated fossils of this species at East Turkana, in Kenya, and not long after at other sites in East Africa.

Still, there's a small wrinkle in this neat view. Around 1.8 mya, in addition to *H. erectus* in East Africa, similar populations were already living far away in both southeastern Asia and in southeastern Europe. Nevertheless, it is very likely that *H. erectus* first arose in East Africa but very quickly migrated to other continents far away from their African homeland. So let's begin at the beginning.

Fossils identified as *H. erectus* have been found at several locales in East Africa. As mentioned, the earliest *H. erectus* fossils come from East Turkana, from the same area where earlier australopith and early *Homo* fossils have been found (see Chapter 9). Indeed, it seems likely that in East Africa around 2–1.8 mya, some form of early *Homo* evolved into *H. erectus*.

The most significant *H. erectus* discovery from East Turkana is a nearly complete skull (Fig. 10-3). Dated at 1.8 mya, this specimen is the oldest *H. erectus* ever found. The cranial capacity is estimated at 848 cm^3, in the lower range for *H. erectus* (700 to 1,250 cm^3), which isn't surprising considering its early date. A second very significant new find from East Turkana is notable because it has the smallest cranium of any *H. erectus* from anywhere in Africa. Dated to around 1.5 mya, the skull has a cranial capacity of only 691 cm^3. As we'll see shortly, there are a couple of crania from southeastern Europe that are even smaller. The small skull from East Turkana also shows more gracile features (such as

nuchal torus (nuke´-ul) (*nuchal*, meaning "pertaining to the neck") A projection of bone in the back of the cranium where neck muscles attach; used to hold up the head.

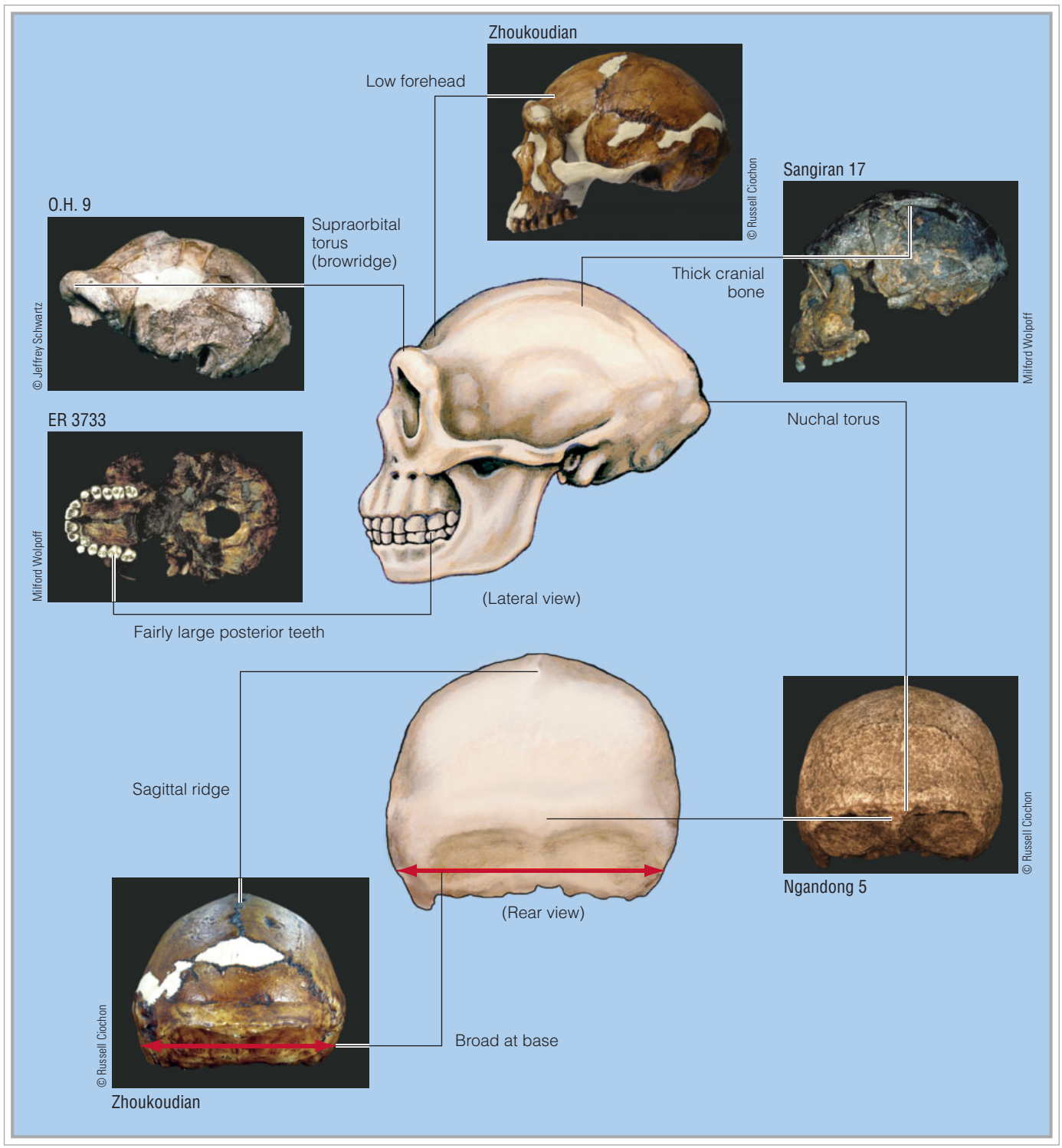


Figure 10-2
Morphology and variation in *Homo erectus*.

smaller browridges) than do other East African *H. erectus* individuals. It's been proposed that perhaps this new find is a female and that the variation shown indicates a very high degree of sexual dimorphism in this species (Spoor et al., 2007).

Other important *H. erectus* finds have come from Olduvai Gorge, including a very robust skull discovered there by Louis Leakey back in 1960. The skull is dated at 1.4 mya and has a well-preserved cranial vault with just a small part of the upper face. Estimated

at 1,067 cm^3, the cranial capacity of the Olduvai *H. erectus* skull is the largest of all the African *H. erectus* specimens. The browridge is huge, the largest known for any hominin, but the walls of the braincase are thin. This latter characteristic is seen in most East African *H. erectus* specimens; in this respect, they differ from Asian *H. erectus*, in which cranial bones are thick.

Another remarkable discovery was made in 1984 by Kamoya Kimeu, a member of Richard Leakey's team known widely as an outstanding fossil hunter. Kimeu discovered a small piece of skull on the west side of Lake Turkana at the site known as Nariokotome. The careful excavations that took place there were a resounding success. In fact, the work produced the most complete *H. erectus* skeleton ever found (Fig. 10-4). Known properly as WT 15000, the almost complete skeleton includes facial bones, a pelvis, and most of the limb bones, ribs, and vertebrae. Such well-preserved postcranial elements make for a very unusual and highly useful discovery, because these elements are scarce at other *H. erectus* sites. The Nariokotome skeleton is quite ancient, dated chronometrically to about 1.6 mya. The skeleton is that of a boy about 12 years of age with an estimated height of about 5 feet 3 inches. Had he grown to maturity, it's estimated that his height would have been more than 6 feet—taller than *H. erectus* was previously thought to have been. The postcranial bones look very similar, though not quite identical, to those of modern humans. The cranial capacity of WT 15000 is estimated at 880 cm^3; brain growth was nearly complete, and the boy's adult cranial capacity would have been approximately 909 cm^3 (Begun and Walker, 1993).

Figure 10-3
Nearly complete skull of *Homo erectus* from East Lake Turkana, Kenya, dated to approximately 1.8 mya.

Figure 10-4
WT 15000 from Nariokotome, Kenya: the most complete *H. erectus* specimen yet found.

Two other sites, both from Ethiopia, have yielded *H. erectus* fossils, the most noteworthy coming from the Bouri locale in the Middle Awash region. As you've seen, numerous remains of earlier hominins have come from this area (see Chapter 9 and Appendix B). The recent discovery of a mostly complete cranium from Bouri is important because this individual (dated at approximately 1 mya) is more like Asian *H. erectus* than are most of the earlier East African remains we've discussed (Asfaw et al., 2002). Consequently, the suggestion by several researchers that East African fossils are a different species from (Asian) *H. erectus* isn't supported by the morphology of the Bouri cranium.

At a Glance

Key *Homo erectus* Discoveries from Africa

DATES	SITE	EVOLUTIONARY SIGNIFICANCE
1.4 mya	**Olduvai**	Large individual, very robust (male?) *H. erectus*
1.6 mya	**Nariokotome W. Turkana**	Nearly complete skeleton; young male
1.8 mya	**E. Turkana**	Oldest well-dated *H. erectus*; great amount of variation seen among individuals, possibly due to sexual dimorphism

Who Were the Earliest African Emigrants?

The fossils from East Africa imply that a new grade of human evolution appeared in Africa not long after 2 mya. Thus, the hominins who migrated to Asia and Europe are generally assumed to be their immediate descendants. This conclusion makes good sense on at least three levels: geography, anatomy, and behavior. As noted, geographically, Africa is where *all* the earlier hominins lived, so *H. erectus* would probably have first appeared there (and East Africa especially would have been a likely locality). Moreover, these were now bigger, brainier hominins capable of traveling longer distances. Finally, these tool-assisted hominins were culturally capable of exploiting a wider range of resources.

Consider the following reasonable hypothesis: *Homo erectus* first evolved in East Africa close to 2 mya and with its new physical and behavioral capacities soon emigrated to other areas of the Old World. This hypothesis helps pull together several aspects of hominin evolution, and much of the fossil evidence after 2 mya supports it. Nevertheless, recently discovered evidence seriously challenges this tidy view.

First, while 1.8 mya is a well-established date for the appearance of *H. erectus* in East Africa, similar hominins also appear at about the same time in southeastern Europe and in Indonesia (see Fig. 10-1).

Radiometric dates of sediments on the island of Java have recently placed *H. erectus* there at 1.6 mya. No stone tools or other artifacts can yet be definitely linked to the earliest Indonesian fossils. It's possible for us to explain these hominins in Asia at this early date *if* we assume that *H. erectus* evolved in East Africa by 1.8 mya (or slightly earlier) and, in just a few thousand years, expanded rapidly to other regions.

Elsewhere in Asia, the earliest evidence, all of which remains controversial and the object of continuing research, comes from the discovery of stone artifacts, not hominin fossils. For example, several excavated sites in northern China have yielded modified flakes, cores, and other artifacts. Goudi, a recently excavated site, is estimated by paleomagnetic methods and stratigraphic analysis to date to 1.66–1.36 mya (Gao et al., 2005). Claims of even older stone tools, found in contexts dated as early as 1.9 mya by paleomagnetic and other methods, have also been made for sites in northern Pakistan (Dennell et al., 2004).

Dmanisi (dim´-an-eese´-ee)

Far to the west and at an even earlier date than the Asian sites, hominins associated with Oldowan-like stone tools were present in the Caucasus region of easternmost Europe. Newly discovered fossils and artifacts from the **Dmanisi** site in the Republic of Georgia (see Fig. 10-1) have been radiometrically dated to 1.75 mya. Not only do the Dmanisi hominins show up early, but they also look different from the usual *H. erectus* we've just briefly described.

In some respects, the Dmanisi crania are similar to those of *H. erectus* (for example, the long, low braincase, wide base, and sagittal keeling; see especially Fig. 10-5b, and compare with Fig. 10-2). However, other characteristics of the Dmanisi individuals are

Figure 10-5
Dmanisi crania discovered in 1999 and 2001 and dated to 1.8–1.7 mya.
(a) Specimen 2282.
(b) Specimen 2280.
(c) Specimen 2700.

(a)

(b)

(c)

different from other hominin finds outside of Africa. In particular, the most complete specimen (Fig. 10-5c) has a less-robust and thinner browridge, a projecting lower face, and a relatively large upper canine. At least when viewed from the front, this skull is more reminiscent of the smaller early *Homo* specimens from East Africa than it is of *Homo erectus*. Also, this individual's cranial capacity is very small—estimated at only 600 cm^3, well within the range of early *Homo*. In fact, the four Dmanisi crania so far described have relatively small cranial capacities—the other three were estimated at 630 cm^3, 650 cm^3, and 775 cm^3.

Probably the most remarkable discovery yet from Dmanisi is a fourth skull that researchers excavated in 2002 (and published in 2005). This nearly complete cranium is of an older adult male; and surprisingly for such an ancient find, he died with only one tooth remaining in his jaws (Lordkipanidze et al., 2006). Because his jawbones show advanced resorption of bone, it seems that he lived for several years without being able to chew his food (Fig. 10-6). David Lordkipanidze, who leads the excavations at Dmanisi, and his colleagues have suggested that this individual required a fair amount of assistance to survive in an era when the only way to process food was to use your teeth (Lordkipanidze et al., 2005, 2006). However, this contention requires more detailed investigation before it can be confirmed.

David Lordkipanidze

Figure 10-6

Most recently discovered cranium from Dmanisi, almost totally lacking in teeth (with both upper and lower jaws showing advanced bone resorption).

The newest evidence from Dmanisi includes several postcranial bones, coming from at least four individuals (Lordkipanidze et al., 2007). This new evidence is especially important because it allows us to make comparisons with what is known of *Homo erectus* from other areas. The Dmanisi fossils have an unusual combination of traits. These hominins were not especially tall, with an estimated height ranging from about 4 feet 9 inches to 5 feet 5 inches. Certainly, based on this evidence, they seem much smaller than the full *H. erectus* from East Africa or from Asia. Yet, although very short in stature, they still show body proportions (such as leg length) like that of *H. erectus* (and *H. sapiens*) and quite different from that seen in earlier hominins.

Based on these recent, startling revelations from Dmanisi, we can ask several questions:

1. Was *Homo erectus* the first hominin to leave Africa—or did an earlier form of *Homo* migrate even earlier?
2. Did hominins require a large brain and sophisticated stone tool culture to disperse out of Africa?
3. Was the large, robust body build of *H. erectus* a necessary adaptation for the initial occupation of Eurasia?

Of course, since the Dmanisi discoveries are very new, it's important to view any conclusions as highly tentative. But in any case, the recent evidence raises important and exciting possibilities. The Dmanisi findings suggest that the first hominins to leave Africa were quite possibly a very early form of *H. erectus*, possessing smaller brains than later *H. erectus* and carrying with them a typical African Oldowan stone tool culture. As we mentioned, newly discovered remains of the postcranial skeleton show that the Dmanisi individuals were quite small. In fact, they average not much more than five feet in height. Certainly, based on this evidence, they seem much smaller than the full *H. erectus* from East Africa or from Asia.

What we do have so far shows that the Dmanisi hominins were generally very short and small-brained hominins, having none of the adaptations many researchers thought to be essential to hominin migration—that is, being tall and having relatively large brains. It's possible we may find that there were *two* migrations out of Africa at this time: one consisting of the small-brained, diminutive Dmanisi hominins and an almost immediate second one that founded the well-recognized *H. erectus* populations of Java and China. All this evidence is so new, however, that it's too soon even to predict what further revisions may be required.

Homo erectus from Indonesia

S. Sartano

Figure 10-7
The famous Trinil skullcap found by Eugene Dubois in Java.

After Charles Darwin published *On the Origin of Species* in 1859, debates about evolution were prevalent throughout Europe. While many theorists simply stayed home and debated the merits of natural selection and the likely course of human evolution, one young Dutch anatomist decided to go find evidence of it. Eugene Dubois (1858–1940) enlisted in the Dutch East Indian Army and was shipped to the island of Sumatra, Indonesia, providing him his chance to look for what he called "the missing link."

In October 1891, after moving his search to the neighboring island of Java, Dubois' field crew unearthed the upper portion of a skull (called a "skullcap") along the Solo River near the town of Trinil—a fossil that was to become internationally famous (Fig. 10-7). The following year, a human femur was recovered about 15 yards upstream in what Dubois claimed was the same level as the skullcap, and he assumed that the skullcap (with a cranial capacity of slightly over 900 cm^3) and the femur belonged to the same individual.

H. erectus fossil remains have thus far been found at six sites in Java. The most precise chronometric dating estimates suggest that the earliest fossils are close to 1.6 million years old, and very late *H. erectus* survivors from Ngandong, Java, may be as young as 27,000 years old. The earliest *H. erectus* fossils from Java come from the central part of the island. Beginning with Dubois' famous discovery at Trinil, over 80 fossil specimens have been located, with many coming from an area called the Sangiran Dome, located just west of Trinil. Several crania have been found, although only one preserves the face. Cranial capacities range between 813 cm^3 and 1,059 cm^3.

By far, the most recent group of *H. erectus* fossils from Java come from Ngandong, in an area to the east of the other finds already mentioned. At Ngandong, an excavation along an ancient river terrace produced 11 mostly complete hominin crania. Two specialized dating techniques, discussed in Chapter 8, have determined that animal bones found at the site—and presumably associated with the hominins—are only about 50,000–25,000 years old (Swisher et al., 1996). These dates are controversial, but further evidence is now establishing a *very* late survival of *Homo erectus* in Java, long after the species had disappeared elsewhere. So these individuals would be contemporary with *H. sapiens*—which, by this time, had expanded widely throughout the Old World, even into Australia around 60,000–40,000 years ago (ya). As we'll see in Chapter 12, even later—and very unusual—hominins have been found elsewhere, apparently evolving while isolated on another Indonesian island.

We can't say much about the *H. erectus* way of life in Java. Few artifacts have been found, and none of them are directly associated with the earliest Javanese fossils (Corvinus, 2004). Later *H. erectus* fossils are possibly associated with a tool industry based on small flakes. This industry lacks large stone tools and differs greatly from the Oldowan and Acheulian tool assemblages of Africa and western Asia.

Homo erectus from China

The story of the first discoveries of Chinese *H. erectus* is another saga filled with excitement, hard work, luck, and misfortune. Europeans had known for a long time that "dragon bones," used by the Chinese as medicine and aphrodisiacs, were actually ancient mammal bones. Scientists eventually located one of the sources of these bones near Beijing at a site called **Zhoukoudian**, which would go on to become the most intensively investigated Chinese Paleolithic site. Serious excavations were begun there in the 1920s, and in 1929, a fossil skull was discovered. The skull turned out to be a juvenile's, and although it was thick, low, and relatively small, there was no doubt that it belonged to an early hominin.

Zhoukoudian (Zhoh´-koh-dee´-en)

Figure 10-8
Zhoukoudian cave.

Figure 10-9
Composite cranium of Zhoukoudian *Homo erectus*, reconstructed by Ian Tattersall and Gary Sawyer, of the American Museum of Natural History in New York.

ZHOUKOUDIAN *HOMO ERECTUS*

The fossil remains of *H. erectus* discovered in the 1920s and 1930s, as well as some more recent excavations at Zhoukoudian (Fig. 10-8), are by far the largest collection of *H. erectus* material found anywhere. This excellent sample includes 14 skullcaps (Fig. 10-9), other cranial pieces, and more than 100 isolated teeth, but only a scattering of postcranial elements (Jia and Huang, 1990). Various interpretations to account for this unusual pattern of preservation have been offered, ranging from ritualistic treatment or cannibalism by the hominins themselves to the more mundane suggestion that the *H. erectus* remains are simply the leftovers of the meals of giant hyenas (the fossil remains of which have also been found at Zhoukoudian).

At a Glance

Key *Homo erectus* Discoveries from Asia

DATES	SITE	EVOLUTIONARY SIGNIFICANCE
50,000–25,000 ya	**Ngandong** (Java)	Very late survival of *H. erectus* in Java
670,000–410,000 ya	**Zhoukoudian** (China)	Large sample; most famous *H. erectus* site; shows some *H. erectus* populations well adapted to temperate (cold) environments
1.6 mya	**Sangiran**	First discovery of *H. erectus* from anywhere; shows dispersal out of Africa by 1.6 mya

At any rate, the hominin remains belong to upward of 40 adults and children and together provide much evidence. Because of meticulous analysis done on the original fossils (before they were lost), the Zhoukoudian fossils have led to a good overall picture of Chinese *H. erectus*. Like the materials from Java, they have typical *H. erectus* features, including a large browridge in front and a nuchal torus behind. Also, the skull has thick bones, a sagittal keel, and a protruding face and, like the Javanese forms, is broadest near the bottom. These specimens have been dated at various times to between 670,000 and 410,000 years old.

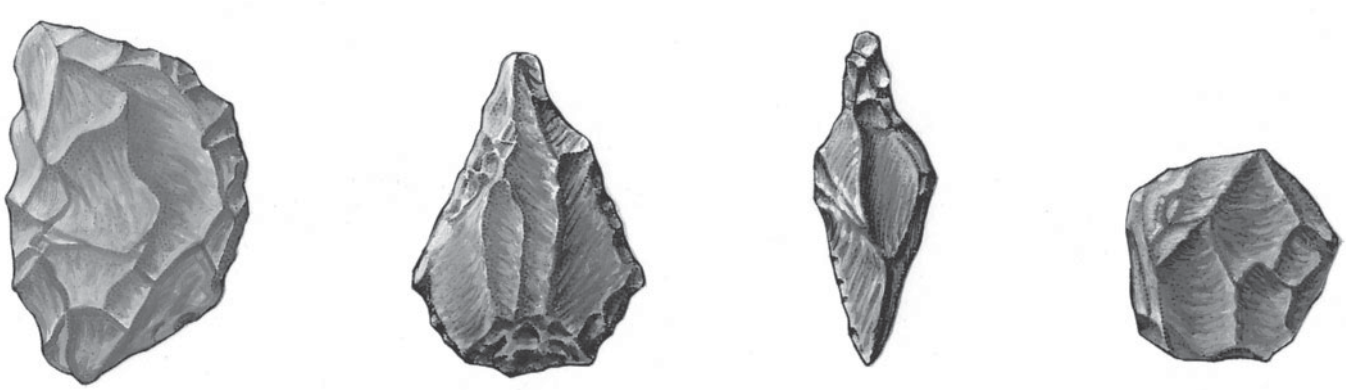
Cultural Remains More than 100,000 artifacts have been recovered from this vast site, which was intermittently used by hominins and other animals for many thousands of years. Common tools include choppers and chopping tools, as well as small quartz flakes that were fashioned into scrapers, points, burins, and awls (Fig. 10-10).

In the mid-twentieth century, paleoanthropologists believed that Zhoukoudian's *H. erectus* inhabitants were hunter-gatherers who killed deer, horses, and other animals and gathered fruits, berries, tubers, and ostrich eggs. This site was also widely recognized at the time as one of the earliest examples of the controlled use of fire. (Other even older potential instances of hominin fire use were subsequently discovered at sites in Africa and the Near East.) A tremendously important innovation in human prehistory, the controlled use of fire provided warmth, protection from other animals, a means of cooking, and an aid to the toolmaking process.

Further research, including new excavations in the 1990s and the reanalysis of older excavations, refuted or cast considerable doubt on many of these inferences. The current view is that much of the Zhoukoudian material likely accumulated from the activities of now-extinct giant hyenas that used the cave as a den and less from early hominin use of the site. Boaz and Ciochon (2004) also hypothesize that most of the *H. erectus* remains found at Zhoukoudian were deposited as hyena food refuse. Stone tools and the discovery of cut-marked bones demonstrate that *H. erectus* frequented the site and likely did occasionally use fire in it, but the evidence points more to a scavenger than a hunter mode of existence in which *H. erectus* competed with giant hyenas and other large predators and scavengers for meat from their kills (Binford and Ho, 1985; Binford and Stone, 1986a, 1986b).

Evidence for the controlled use of fire at Zhoukoudian continues to be controversial. Recent investigations of the cave deposits found that burnt bone was only rarely found in association with tools, and in most cases the burning appeared to have taken place *after* fossilization—that is, the bones were not cooked (Weiner et al., 1998). Chemical analyses of "ash" layers identified by earlier researchers as evidence of hominin use of fire at the site proved not to be ash, but naturally accumulated organic sediments. Other studies also showed no sign of wood having been burnt inside the cave and revealed that features

Figure 10-10
Chinese tools likely made by *Homo erectus*.



Quartzite chopper | Flint point | Flint awl | Graver, or burin

earlier identified as hearths or fireplaces contained no evidence of burning and were of natural origin. Nevertheless, the cave does contain evidence, such as burned bones and fire-cracked rocks, that cannot be easily explained except as the result of hominin use of fire inside the cave (Boaz and Ciochon, 2004).

OTHER CHINESE SITES

While Zhoukoudian will continue to be viewed as an important Chinese *H. erectus* site, research conducted over the past half century has revealed older examples of *H. erectus* fossils at other Chinese sites, from Lantian County (including two sites, often simply referred to as Lantian), Yunxian County, and Hexian County (with several discoveries, usually referred to as the Hexian finds).

Before the excavation of two sites in Lantian County, Shaanxi Province, in the mid-1960s, Zhoukoudian was widely believed to be the oldest hominin fossil site in China. Dated to 1.15 mya, Lantian is older than Zhoukoudian (Zhu et al., 2003). From the Lantian sites, the cranial remains of two adult *H. erectus* females have been found in association with fire-treated pebbles and flakes as well as ash (Woo, 1966; Fig. 10-11a). One of the specimens, an almost complete mandible containing several teeth, is quite similar to those from Zhoukoudian.

Two badly distorted crania were discovered in Yunxian County, Hubei Province, in 1989 and 1990 (Li and Etler, 1992). A combination of ESR and paleomagnetism dating methods gives us an average dating estimate of 800,000–580,000 ya. If the dates are correct, this would place Yunxian between Lantian and Zhoukoudian in the Chinese sequence. Due to extensive distortion of the crania from ground pressure, it was very difficult to compare these crania with other *H. erectus* fossils; recently, however, French paleoanthropologist Amélie Vialet has restored the crania using sophisticated imaging techniques (Vialet et al., 2005). And from a recent analysis of the fauna and paleoenvironment at Yunxian, the *H. erectus* inhabitants are thought to have had limited hunting capabilities, since they appear to have been restricted to the most vulnerable prey, namely, the young and old animals. This interpretation agrees with the recent reinterpretation of Zhoukoutian *H. erectus* as more a scavenger-gatherer than a hunter-gatherer.

In 1980 and 1981, the remains of several individuals, all bearing some resemblance to similar fossils from Zhoukoudian, were recovered from Hexian County, in southern China (Wu and Poirier, 1995) (Fig. 10-11b). A close relationship has been postulated between

Figure **10-11**

(a) Reconstructed cranium of *Homo erectus* from Lantian, China, dated to approximately 1.15 mya. (b) Hexian cranium.

Milford Wolpoff

(a)

Milford Wolpoff

(b)

the *H. erectus* specimens from the Hexian finds and from Zhoukoudian (Wu and Dong, 1985). Indeed, some date the Hexian remains to 400,000 ya (Wu et al., 2006), making it contemporaneous with Zhoukoudian; these dates are disputed, and others experts place the age at only 190,000 ya.

The Asian crania from both Java and China share many similar features, which may be explained by *H. erectus* migration from Java to China perhaps around 1 mya. African *H. erectus* forms are generally older than most Asian forms, and they're different from them in several ways.

Asian and African *Homo erectus*: A Comparison

The *Homo erectus* remains from East Africa show several differences from the Javanese and Chinese fossils. Some African cranial specimens—particularly the skull from East Turkana (ER 3733), presumably a female, and WT 15000, presumably a male—aren't as strongly buttressed at the browridge and nuchal torus, and their cranial bones aren't as thick. Indeed, some researchers are so impressed by these differences, as well as others in the postcranial skeleton, that they're arguing for a *separate* species status for the African material, to distinguish it from the Asian samples. Bernard Wood, the leading proponent of this view, has suggested that the name *Homo ergaster* be used for the African remains and that *H. erectus* be reserved solely for the Asian material (Wood, 1991). In addition, the very early dates now postulated for the dispersal of *H. erectus* into Asia (Java) would argue for a more than 1-million-year separate history for Asian and African populations.

In any case, this species division has not been fully accepted, and the current consensus (and the one we prefer) is to continue referring to all these hominins as *Homo erectus* (Kramer, 1993; Conroy, 1997; Rightmire, 1998; Asfaw et al., 2002). So, as with some earlier hominins, we'll have to accommodate a considerable degree of intraspecific variation within this species. Wood has concluded, regarding variation within such a broadly defined *H. erectus* species, that "it is a species which manifestly embraces an unusually wide degree of variation in both the cranium and postcranial skeleton" (Wood, 1992, p. 329).

Later Hominins from Europe

Because of the recent discoveries from Dmanisi (see p. 242), the time frame for the earliest hominin occupation of Europe is being dramatically pushed back. For several decades, researchers assumed that hominins didn't reach Europe until late in the Middle **Pleistocene** (after 400,000 ya) and were already identifiable as a form very similar to *Homo sapiens*. So they concluded that *H. erectus* (and contemporaries) never got there. But as the new discoveries are evaluated, these assumptions are being discarded, and radical revisions concerning hominin evolution in Europe are becoming necessary.

While not as old as the Dmanisi material, fossils from the Atapuerca region in northern Spain are significantly extending the antiquity of hominins in western Europe. There are several caves in the Atapuerca region, two of which (Sima del Elefante and Gran Dolina) have yielded hominin fossils contemporaneous with *H. erectus*; another cave has somewhat later remains, similar in many ways to Neandertals (and will be discussed in Chapter 11).

Pleistocene The epoch of the Cenozoic from 1.8 mya until 10,000 ya. Frequently referred to as the Ice Age, this epoch is associated with continental glaciations in northern latitudes.

The earliest finds from Atapuerca (from Sima del Elefante) have been recently discovered and date to 1.2 mya, making these clearly the oldest hominins yet found in

western Europe (Carbonell et al, 2008). So far, just one specimen has been found here, a partial jaw with a few teeth. Very provisional analysis suggests that its closest resemblances are with the Dmanisi fossils. There are also tools and animal bones from the site. Like Dmanisi, the implements are simple flake tools similar to what we've called Oldowan. Some of the animal bones also bear the scars of hominin activity with cut marks indicating butchering (similar to what we discussed in Chapter 9 for Olduvai). Gran Dolina is a later site; based on specialized techniques discussed in Chapter 8 (see p. 194), it is dated to approximately 850,000–780,000 ya (Parés and Pérez-González, 1995; Falguéres et al., 1999). Because all the remains so far identified from both these caves at Atapuerca are fragmentary, assigning these fossils to particular species poses something of a problem. Spanish paleoanthropologists who have studied the Atapuerca fossils have decided to place these hominins into another (separate) species, one they call *Homo antecessor* (Bermúdez de Castro et al., 1997; Arsuaga et al., 1999). However, it remains to be seen whether this newly proposed species will prove to be distinct from other species of *Homo* (see p. 252 for further discussion).

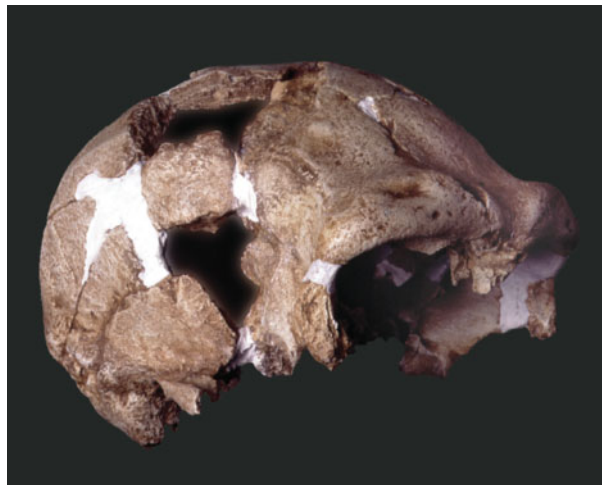


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Figure 10-12
The Ceprano *Homo erectus* cranium from central Italy, provisionally dated to 800,000–900,000 ya. This is the best evidence for *Homo erectus* in Europe.

Finally, the southern European discovery of a well-preserved cranium from the Ceprano site in central Italy may be the best evidence yet of *H. erectus* in Europe (Ascenzi et al., 1996). Provisional dating of a partial cranium from this important site suggests a date of 900,000–800,000 ya (Fig. 10-12). Phillip Rightmire (1998) has concluded that cranial morphology places this specimen quite close to *H. erectus*. Italian researchers have proposed other views. The exact relationship of the Ceprano fossil to *H. erectus* remains to be fully determined.

After about 400,000 ya, the European fossil hominin record becomes increasingly abundant. More fossils mean more variation, so it's not surprising that interpretations regarding the proper taxonomic assessment of many of these remains have been debated, in some cases for decades. In recent years, several of these somewhat later "premodern" specimens have been considered either as early representatives of *H. sapiens* or as a separate species, one immediately preceding *H. sapiens*. These enigmatic premodern humans are discussed in Chapter 11. A time line for the *H. erectus* discoveries discussed in this chapter as well as other finds of more uncertain status is shown in Figure 10-13.

At a Glance

Key *Homo erectus* and Contemporaneous Discoveries from Europe

DATES	SITE	EVOLUTIONARY SIGNIFICANCE
900,000–800,000 ya	**Ceprano** (Italy)	Well-preserved cranium; best evidence of full *H. erectus* morphology from any site in Europe
850,000–780,000 ya	**Gran Dolina** (Atapuerca, Spain)	Oldest evidence of hominins in western Europe; likely not *H. erectus*
1.75 mya	**Dmanisi** (Republic of Georgia)	Oldest well-dated hominins outside of Africa; not like full *H. erectus* morphology, but are small-bodied and small-brained

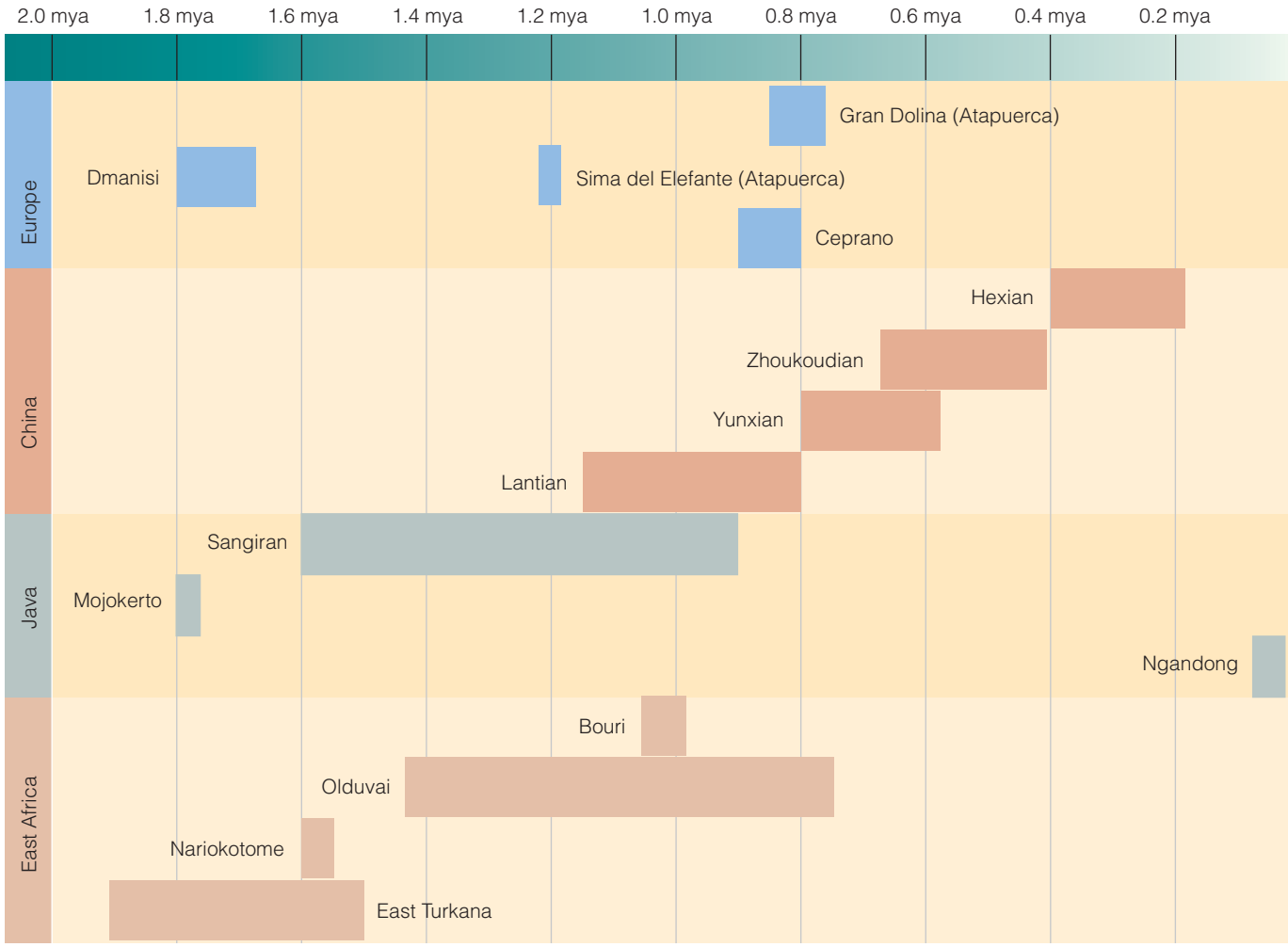

Figure 10-13
Time line for *Homo erectus* discoveries and other contemporary hominins.

Archaeology of Early Hominin Dispersal

The first hominins to leave Africa were tool-assisted scavenger-gatherers who carried with them the basic concepts and technological capabilities of the Oldowan tool industry. As such, they differed greatly from modern humans. They began their extraordinary journey without the benefit of language, the controlled use of fire, or projectile weapons and other killing tools. They were also culturally ill equipped, at least in the beginning, to cope with the climatic seasonal extremes of life outside the tropics and southern temperate regions. Nevertheless, archaeological and fossil evidence offers convincing proof of their extraordinary success in invading new habitats across the Old World, from the Atlantic to the Pacific.

Evidence of butchering is widespread in early *H. erectus* sites, and in the past, such evidence has been cited in arguments for consistent hunting. Researchers formerly interpreted any association of bones and tools as evidence of hunting, but many studies now suggest that cut marks on bones from this period often overlay carnivore tooth marks. This means that hominins were gaining access to the carcasses after the carnivores and were therefore scavenging the meat, not hunting the animals. It's also crucial to mention that these hominins gained most of their daily calories from gathering wild plants, tubers, and fruits.

Just as with the fossil evidence of their dispersal, the stone tools and other artifacts found in the earliest sites are not the same everywhere. While the stone tool assemblages of Oldowan sites in East Africa and such early sites as Dmanisi in Georgia and Atapuerca in Spain reflect a similar grasp of technology, some of the early Southeast and East Asian sites contain small flake tool assemblages that do not appear to have their roots in the Oldowan stone tool industry. The problem, of course, is how to explain the differences. Did stone tool industries other than Oldowan leave Africa with the earliest emigrants? Or did new industries develop in Southeast and East Asia as early hominins adapted to new habitats and resources? We have the questions, but finding the answers requires more research.

By 1.4 mya, a new stone tool industry called Acheulian is found in Africa and, soon after, at sites in the Near East and even farther east on the Indian subcontinent, if not also into parts of East Asia (Corvinus, 2004). The Acheulian tool kit was both more diverse and more complex than the Oldowan. It represented several new concepts about making stone tools. First, Acheulian toolmakers invented the idea of a *bifacial* stone tool—one that has been worked to create two opposing faces. A notable example of an Acheulian bifacial tool is the hand axe (Fig. 10-14), thousands of which have been found at Lower Paleolithic sites from Africa to Europe and eastward to India.

Figure 10-14
Hand axe (left) and cleaver (right), both of which were basic tools of the Acheulian tradition.

Second, Acheulian toolmakers developed a new way to knock flakes from stone cores, which gave more predictable results than the *"hard hammer" percussion* method (see p. 229) used by their Oldowan predecessors. **"Soft hammer" percussion** employs a hammer made of a somewhat flexible material, such as wood, bone, or antler. When struck against a core, the soft hammer absorbs some of the striking force, giving an experienced stone toolmaker greater control over the length, width, and thickness of the resulting flakes (Fig. 10-15). While this may sound like a small change, it was an era during which such small technological changes could make big differences in how stone tools were made and how they looked when finished.

Finally, some kinds of Acheulian tools tend to reflect shared notions of form, or what they should look like. In other words, not only did Acheulian toolmakers create new stone

Figure 10-15
Soft hammer percussion. Here the stone tool maker uses a more flexible (bone) hammer which allows more precise removal of flakes of the desired size and shape.

"Soft hammer" percussion A direct percussion method of making stone tools that uses a resilient hammer or billet to gain greater control over the length, width, and thickness of flakes driven from a core.

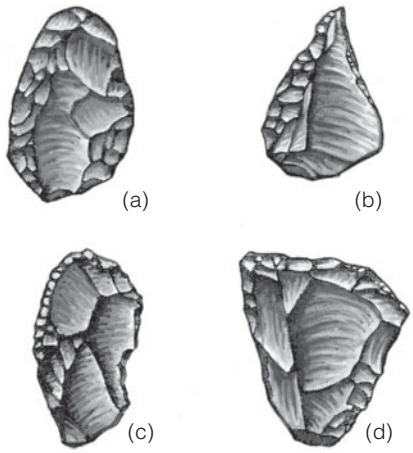

Figure 10-16
Small tools of the Acheulian industry.
(a) Side scraper.
(b) Point. (c) End scraper. (d) Burin.

tools and ways to make them; they were also capable of developing *and communicating to each other* ideas of form and design. For example, pretty much everything was a "Swiss Army knife" to an Oldowan toolmaker; but when an Acheulian toolmaker sat down to make, say, a hand axe, he or she clearly expected to end up with a stone tool that was bifacially worked, often about 6 to 8 inches long, and possessing a pear or teardrop shape with a point at one end and a rounded base at the other (see Fig. 10-14). Conceptualizing tools in this way was something new.

The most distinctive Acheulian artifacts were hand axes, which we just described, and cleavers, which are much like hand axes except that they end in a broad straight edge rather than a point. While we still don't have a clear idea what cleavers were used for, hand axes show wear patterns and other evidence of having been used for many different kinds of tasks, especially cutting and chopping.

The Acheulian tool kit was not just hand axes and cleavers. It also included many kinds of flake tools (Fig. 10-16), which were used for cutting, abrading, scraping, piercing, and other tasks, as well as hammerstones, cores, and other artifacts, many of which would also have been familiar to an Oldowan toolmaker.

Seeing the Big Picture: Interpretations of *Homo erectus*

Several aspects of the geographical, physical, and behavioral patterns shown by *H. erectus* (broadly defined) seem clear. But new discoveries and more in-depth analyses are helping us to reevaluate our prior ideas. The fascinating fossil hominins discovered at Dmanisi are perhaps the most challenging piece of this puzzle.

Past theories suggest that *Homo erectus* was able to emigrate from Africa owing to more advanced culture and a more modern anatomy as compared to earlier African predecessors. Yet, the Dmanisi cranial remains show that these very early Europeans still had small brains; what's more, *H. erectus* has been found in Java at 1.6 mya.

So it seems that some key parts of earlier hypotheses are not fully accurate. At least some of the earliest emigrants from Africa didn't yet show the entire suite of *H. erectus* physical and behavioral traits. How different the Dmanisi hominins are from the full *H. erectus* pattern remains to be seen, and the discovery of more complete postcranial remains will be most illuminating.

Going a step further, the four crania from Dmanisi are extremely variable; one of them, in fact, does look more like *H. erectus*. It would be tempting to conclude that more than one type of hominin is represented here, but they're all found in the same geological context. The archaeologists who excavated the site conclude that all the fossils are closely associated with each other. The simplest hypothesis is that they all are members of the *same* species. This degree of apparent intraspecific variation is biologically noteworthy, and it's influencing how paleoanthropologists interpret all of these fossil samples.

This growing awareness of the broad limits of intraspecific variation among some hominins brings us to our second consideration: Is *Homo ergaster* in Africa a separate species from *Homo erectus*, as strictly defined in Asia? While this interpretation was popular in the last decade, it now is losing support. The finds from Dmanisi raise fundamental issues of interpretation. Among these four crania from one locality (see Fig. 10-5), we see more variation than between the African and Asian forms, which many researchers have interpreted as different species. Also, the new discovery from Bouri (Ethiopia) of a more *erectus*-looking cranium further weakens the separate-species interpretation of *H. ergaster*.

The separate-species status of the early European fossils from Atapuerca in Spain is also not yet clearly established. We still don't have much good fossil evidence from this site; but an early date of 1.2 mya is well confirmed. Recall also that no other hominin

fossils from the southern or western part of Europe are known until at least 300,000 years later (Bischoff et al., 2007). It's quite apparent that later in the Pleistocene, the possible descendants of these hominins are well established both in Africa and in Europe. These later premodern humans are the topic of the next chapter.

When looking back at the evolution of *H. erectus*, we realize how significant this early human's achievements were. It was *H. erectus* who increased in body size with more efficient bipedalism; who embraced culture wholeheartedly as an adaptive strategy; whose brain was reshaped and increased in size to within the range of *H. sapiens*; and who became a more efficient scavenger. In short, it was *H. erectus*, committed to a cultural way of life, who transformed hominin evolution to human evolution. As Richard Foley states, "The appearance and expansion of *H. erectus* represented a major change in adaptive strategy that influenced the subsequent process and pattern of human evolution" (1991, p. 425).

Summary

Homo erectus remains are found in geological contexts dating from about 1.8 mya to at least 200,000 ya—and probably much later—and spanning a period of more than 1.5 million years. While the nature and timing of migrations are uncertain, it's likely that *H. erectus* first appeared in East Africa and quickly migrated to other areas. This widespread and highly successful hominin defines a new and more modern grade of human evolution.

Historically, the first fossil finds were made by Dubois in Java, and later fossil and artifact discoveries came from China and Africa. Differences from early *Homo* are notable in *H. erectus*' larger brain, taller stature, robust build, and changes in facial structure and cranial buttressing.

The long period of *H. erectus* existence was marked by a remarkably slow rate of technological change, certainly compared to modern human culture. Even so, *H. erectus* and contemporaries developed new tools and new ways of making tools. Given these achievements, along with the controlled use of fire and the growing cultural capacity to adapt to new habitats and environments, they spread quickly across much of the Old World.

It's generally assumed that certain *H. erectus* populations evolved into later premodern humans, some of which, in turn, evolved into *Homo sapiens*. Evidence supporting such a series of transitions is seen in the Ngandong fossils (and others discussed in Chapter 11), which display both *H. erectus* and *H. sapiens* features.

There are still many questions about *H. erectus* behavior. For example, did they hunt? What was their relationship to later hominins? Was the mode of evolution gradual or rapid, and which *H. erectus* populations contributed genes? The search for answers continues.

In the What's Important feature on page 254, you'll find a useful summary of the most significant hominin fossils discussed in this chapter.

Critical Thinking Questions

1. Why is the nearly complete skeleton from Nariokotome so important? What kinds of evidence does it provide?
2. Assume that you're in the laboratory and you're going to compare the Nariokotome skeleton with a skeleton of a modern human. First, given a choice, what age and sex would you choose for the human skeleton, and why? Second, what similarities and differences do the two skeletons show?

3. What fundamental questions of interpretation do the fossil hominins from Dmanisi raise? Does this evidence completely overturn the hypothesis concerning *H. erectus* dispersal from Africa? Explain why or why not.
4. What are the main differences between Acheulian and Oldowan tool industries? What do these differences tell us about the evolution of human culture? Why did Lower Paleolithic culture change so slowly?
5. You're interpreting the hominin fossils from three sites in East Africa (Nariokotome, Olduvai, and Bouri)—all considered possible members of *H. erectus*. What sorts of evidence would lead you to conclude that there was more than one species? What would convince you that there was just one species? Why do you think some paleoanthropologists (splitters) would tend to see more than one species, while others (lumpers) would generally not? What kind of approach would you take, and why?

What's Important Key Fossil Discoveries of *Homo Erectus*

Dates	Region	Site	The Big Picture
1.6 mya–25,000 ya	**Asia** (Indonesia)	Java (Sangiran and other sites)	Shows *H. erectus* early on (by 1.6 mya) in tropical areas of Southeast Asia; *H. erectus* persisted here for more than 1 million years
600,000–400,000 ya	China	Zhoukoudian	Largest, most famous sample of *H. erectus*; shows adaptation to colder environments; conclusions regarding behavior at this site have been exaggerated and are now questioned
900,000–800,000 ya	**Europe** (Italy)	Ceprano	Likely best evidence of full-blown *H. erectus* morphology in Europe
1.8–1.7 mya	(Republic of Georgia)	Dmanisi	Very early dispersal to southeastern Europe (by 1.8 mya) of small-bodied, small-brained H. erectus population; may represent an earlier dispersal from Africa than one that led to wider occupation of Eurasia
1.6 mya	**Africa** (Kenya)	Nariokotome	Beautifully preserved nearly complete skeleton; best postcranial evidence of *H. erectus* from anywhere
1.8 mya		East Turkana	Earliest *H. erectus* from Africa; some individuals more robust, others smaller and more gracile; variation suggested to represent sexual dimorphism