Rewriting—and Redating—Prehistory

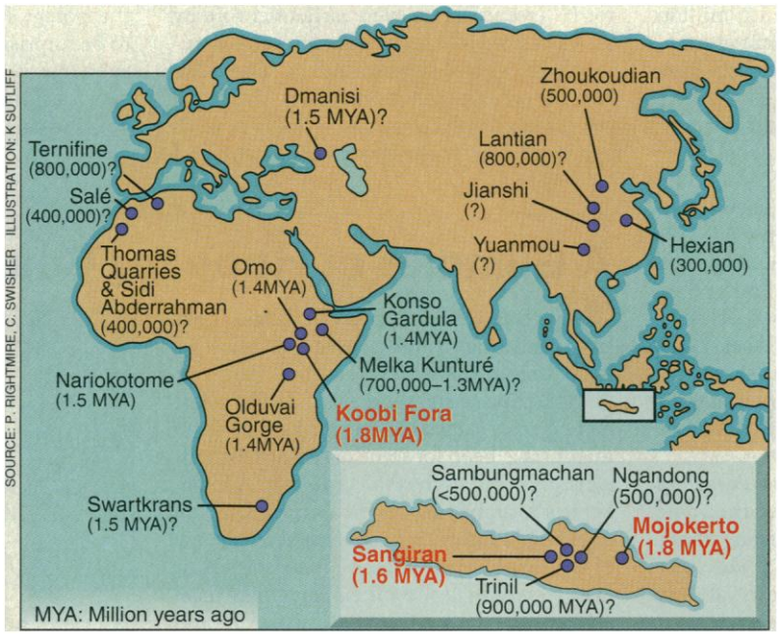
New dates for the travels of *Homo erectus*, a forerunner of humans, have anthropologists scrambling to explain how and where we evolved

The long, puzzling story of human evolution, clouded by contradictory interpretations, used to have at least one chapter that was a straightforward read. Based on some widely accepted fossil dates, most anthropologists agreed that early human ancestors called *Homo erectus* arose in Africa about 2 million years ago. They ventured beyond that continent for the first time 1 million years later, soon after inventing some fancy stone handaxes that gave them a food-gathering edge, and spread to Asia and southern Europe. On one of those three continents, *H. erectus* eventually gave rise to *Homo sapiens*.

Now a pair of highly regarded geochronologists has managed to complicate even this straightforward chapter of the protohuman epic. Using state-of-the-art methods to redate two *H. erectus* sites in Java, Indonesia, Carl Swisher and Garniss Curtis of the Institute of Human Origins (IHO) in Berkeley report on p. 1118 of this issue that these sites are as old as the oldest *H. erectus* site in Africa: 1.8 million years. Not only is that 800,000 years older than the previously reported dates for the Java sites, it moves *H. erectus* out of Africa almost 1 million years before they were supposed to hit the road in the accepted version of the story.

This new date "opens a whole new vista" on this period, says University of California, Berkeley, anthropologist Clark Howell. In this new view, a number of anthropologists see *H. erectus* leaving Africa for Asia much earlier than was previously believed—leaving, in fact, before the invention of the new Acheulean tools, which some researchers have argued were a breakthrough technology, the reason this species became the first globe trotters among our forerunners.

But beyond that, adds University of Liverpool paleoanthropologist Bernard Wood, if the dates are accurate, it means "the whole pattern of human evolution is much more complicated than a simplistic linear explanation." With two *H. erectus* populations of equal age on different continents, no one knows which one was ancestral to modern humans, or even if they are truly both *erectus*. "It might well be that what we have called *erectus* is a separate species in Africa and Asia," muses Berkeley archeologist Desmond Clark.



Where and when. Of all the *H. erectus* sites, Indonesian sites now seem to be as old as African ones, implying there were two roots on the family tree.

The first of the newly redated fossils causing such confusion is the skullcap of a young child. That fossil was discovered in 1936 at a site called Mojokerto and is thought to be about 1 million years old, based on rough geologic estimates of the age of the sediment layer associated with it. The other redated fossils, a crushed face and a partial cranium from two different individuals, were found in the late 1970s in Sangiran and estimated to be 700,000 to 900,000 years old.

Those dates fit neatly with an evolutionary scenario being developed in Africa in the 1960s and 1970s. Louis and Mary Leakey had begun to find *H. erectus* fossils at Olduvai Gorge in Tanzania and then Richard Leakey had found the species at Koobi Fora in Kenya. The Olduvai finds were eventually pegged at 1.4 million years old, while Koobi Fora became the grand old man of *H. erectus* at 1.8 million years of age. No *H. erectus* fossils found in Asia or Europe broke the million-year barrier, and to many scientists, the conclusion was obvious: "It has been accepted for quite a while that *H. erectus* evolved in Africa and then made its way out about 1 million years ago," says anthropologist Philip Rightmire of the State University of New York at Binghamton.

One person who had some doubts, even back in the 1960s, was Curtis of IHO. Using potassium-argon dating, he attempted to date the volcanic soil at the skullcap site. This technique measures the amount of a potassium isotope that decays into argon, a process that starts in volcanic rock when the rock cools and continues at a steady rate, like a clock. Curtis obtained a date of 1.9 million years old, but was greeted with intense skepticism because the technique requires a large sample since potassium is scarce in Javan soil; this introduces a high degree of uncertainty. Another factor, Curtis says, is simply that "anthropologists didn't want to see anything that old from Java."

But Curtis never gave up. In the last decade, he and his fellow geochronologists have come up with more reliable dating methods, such as argon-argon dating. In principle similar to potassium-argon dating, this technique offers two significant advantages. It can be used on a single crystal, which yields more accurate isotope ratios than larger samples. And since it compares two argon isotopes, not potassium, the rarity of potassium in Java was no longer a problem.

With the new technique to back him up, Curtis returned to Java 2 years ago with Swisher, a former student, and a field team. In 1992, and again in 1993, the team collected volcanic pumice and minerals at the Mojokerto and Sangiran sites. The argon-argon method yielded a new date for the skullcap: 1.8 million years. The new date for the Sangiran fossils was about 1.6 million years. Says Swisher: "The dates are extremely reliable. I have high confidence in the analysis."

So do other researchers: "Their methods are super," says University of Utah geologist Francis Brown, an expert in the dating of archeological sites. "I'm sure the crystals are that old." He has one reservation, however: The fossils may have settled into soils con-

taining much older volcanic minerals that eroded from the surrounding terrain. If that were the case, then the Berkeley team may have dated those crystals and the skullcap itself could be younger. Swisher, however, points out that it's unlikely he would have picked out several unusually ancient crystals from both sites. "The fact that both sites gave similar ages supports our view that hominids were in Asia prior to 1.6 million years," he says. Still, he does plan to return to the sites this year to obtain more dates from the layers containing the fossils.

If the dates hold, one scenario to account for them, says Rightmire, is "that people were on the move out of Africa much earlier than we thought." The journey must have begun about 2 million years ago—roughly 600,000 years before the invention of the advanced Acheulean toolkit: handaxes and other bifacial stone tools that were superior to the previous crude choppers and sharp flakes. Louis Leakey, among others, had argued that these more efficient hunting and butchering tools allowed *H. erectus* to extend its range far beyond any earlier human ancestor.

An early departure date, however, makes this claim harder to support. At the same time, it helps to explain something that's long puzzled anthropologists: why the Acheulean toolkit never appears at any Asian *H. erectus* sites, no matter what their age. That's been hard to account for in view of a *H. erectus* that invented the tools in Africa and then pushed on to Asia. Why didn't the tools go along? Swisher points out that if some of the protohumans left the continent before the tools were invented, the absence makes more sense.

If *H. erectus* did make its move without the new toolkit, of course, the species must have had some other advantage over its ancestors that allowed it to travel, perhaps a physical one rather than a technological one. One possibility is that it was built for travel—it was larger than its predecessors and was fully bipedal. Wood suggests that "increased body size allowed them to tolerate water loss," because they had larger bodies that allowed them to store water and food longer. "Maybe they were better able to make it out in the open savanna grasslands. Maybe they were able to leave the shade and water sources for substantial periods of time," he says. Or, suggests University of Michigan paleoanthropologist Milford Wolpoff, there may have been other social and dietary changes that allowed these early colonizers to carry food long distances and move through unfamiliar terrain.

Another possibility is that *H. erectus* did not make a quick exit from Africa after all. Perhaps it was an earlier ancestor, such as *Australopithecus* or *H. habilis*, which moved out of Africa before 2 million years ago—and then gave rise to *H. erectus* in Asia. "These dates could reopen the question of where did *erectus* originate," says paleoanthropologist Christopher Stringer of London's Natural History Museum.

There is, however, one big problem with this idea: "I don't see any fossil evidence for *Australopithecus* or an earlier *Homo* in Asia, like we see in Africa," says Rightmire.

Both these scenarios—a quick departure for *H. erectus*, or an even earlier venture by an ancestor—do leave human origins researchers with a large quandary. There are two different populations of *H. erectus* in two different places almost 2 million years ago. And now, it's anybody's guess which of those two groups gave rise to modern *H. sapiens*—or whether a separate, still-undiscovered species was ancestral to modern humans. Some scientists, such as Liverpool's Wood, question whether the Asians and Africans are even the same species. Almost anything, says Rightmire, is possible.

Stumbling on new possibilities, of course, is a regular feature of this field. "Paleoanthropology is always interesting and bound to be surprising," says Rightmire. "Just when everyone is comfortable with something, a new fossil is found or a new date. It certainly keeps us on our toes."

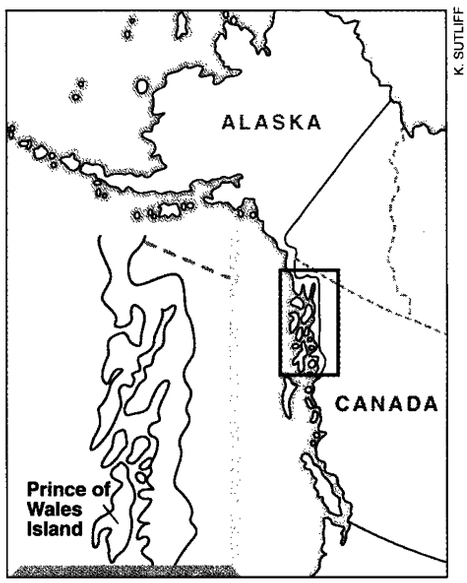
–Ann Gibbons

EARLY AMERICANS

A Glimmer of Hope for Coastal Migration

On the map, Prince of Wales Island looks like a stepping stone—one of a chain of islands stretched along the coast of Southeast Alaska. And a stepping stone is just what archeologist James Dixon thinks the island might have been for some of the first Americans, as early as 14,000 years ago. Dixon, curator of archeology at the Denver Museum of Natural History, believes that at least some of the first humans entering North America from Asia didn't follow the inland route most archeologists have advocated. Instead, he and a few other archeologists think they hopped along the coast by boat.

One reason Dixon's view has been in the minority is that existing geological wisdom holds that the Alaskan coast was locked up in ice during the late ice age, when most archeologists believe the first humans entered North America. But Dixon and his like-minded colleagues are now being cheered by recent fossil finds from a cave on Prince of Wales Island, which imply that not all the coast was ice-bound at that time. That lends plausibility to the coastal migration theory, Dixon says, because it implies that migrants might have found game-rich coastal havens. And there are plenty more caves on the island, offering hope that relics of the first American travelers might be somewhere in the cave system.




TIMOTHY HEATON

Ice-age refuge. Prince of Wales Island and the bear fossils found there *(left)*.

That hope, along with a threat to the caves by logging, is now spurring a major effort to comb them for evidence of human occupation. Caves are always good places to look for artifacts, notes Dixon, because of their alkaline minerals and protection from the elements. "These caves provide a really unique window into the prehistoric past."

The first glimpse through that window came 2 years ago, when an amateur caver stumbled on a fossil deposit in one of the Prince of Wales caves. Paleontologists Timothy Heaton of the University of South Dakota and Frederick Grady of the Smithsonian Institution excavated the deposit and identified the skeletons of four black and grizzly bears, the oldest of which was carbon-dated to 12,300 years ago, as they reported last year in *Current Research in the Pleistocene*. Says Jim Baichtal, a geologist with the U.S. Forest Service on Prince of Wales Island, "If bears were living here, then chances are pretty good that we were not overridden by a blanket of ice as the textbooks have been telling us."

This finding gave coastal migration advocates like Dixon their first evidence of a coastal region that might have been suitable for human occupation at that time, and it revitalized an idea popularized in the 1970s