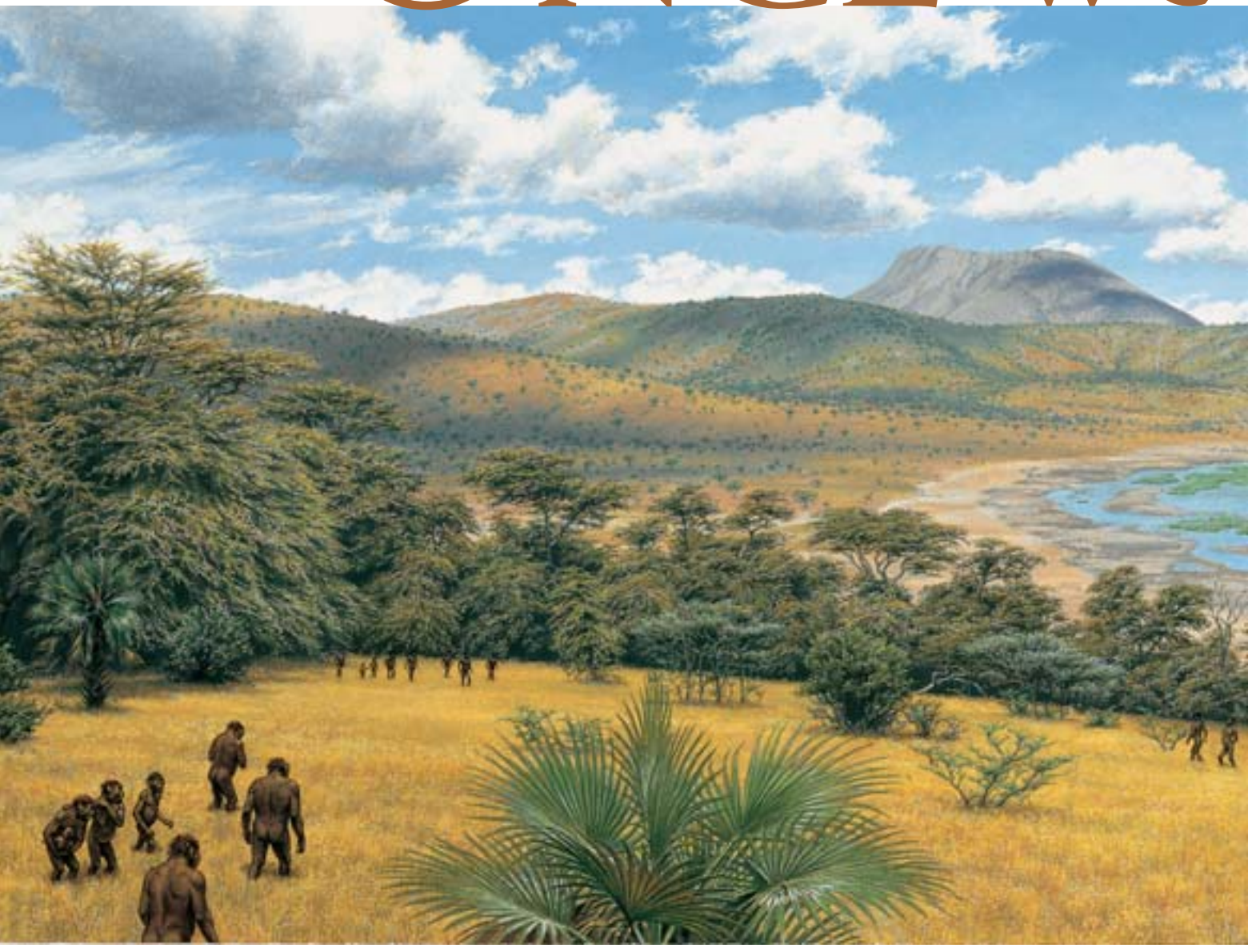
TODAY WE TAKE FOR GRANTED THAT *HOMO SAPIENS*

FOUR MILLION YEARS MANY HOMINID SPECIES

ONCE we

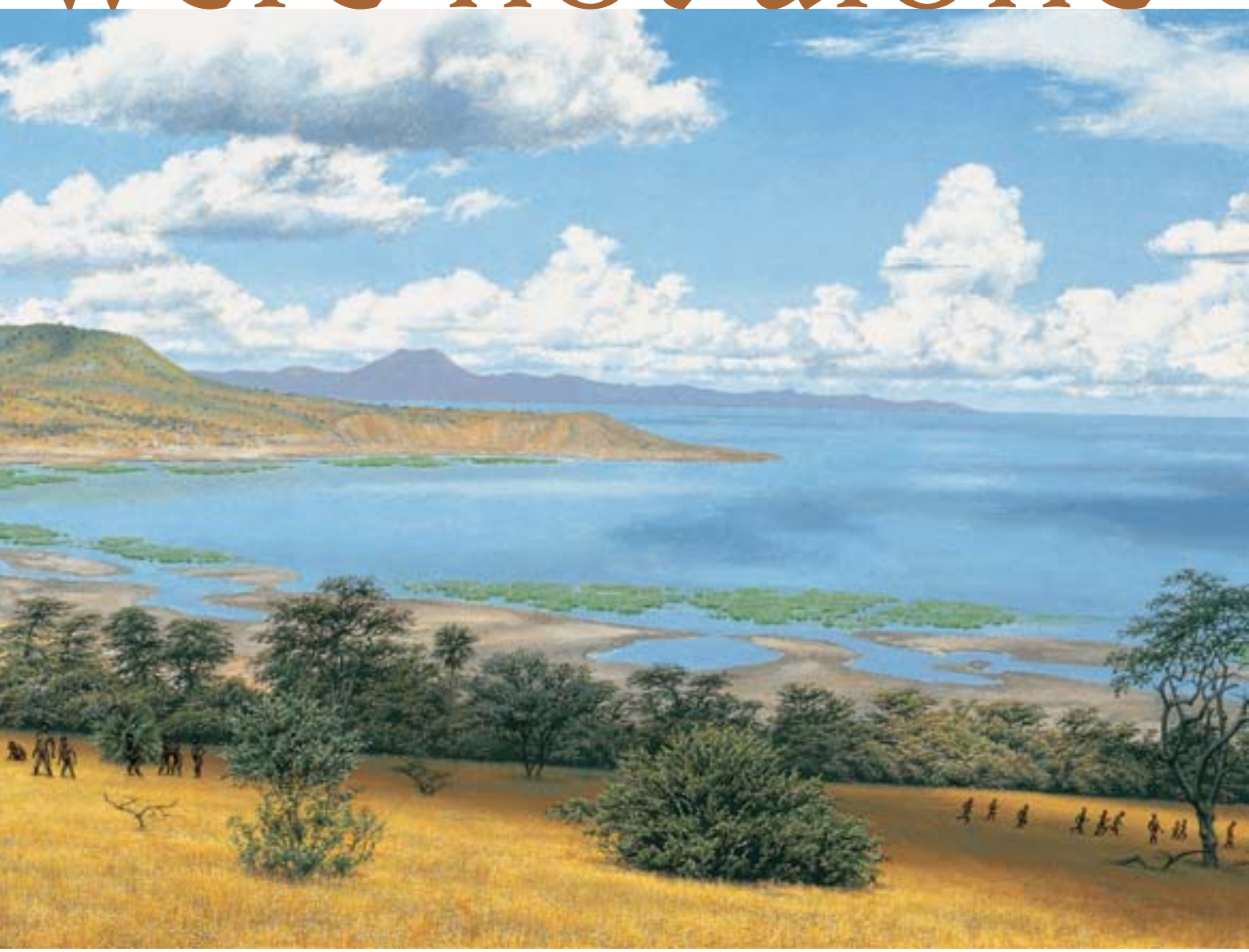


SHARING A SINGLE LANDSCAPE, four kinds of hominids lived about 1.8 million years ago in what is now part of northern Kenya. Although paleoanthropologists have no idea how—or if—these different species interacted, they do know that *Paranthropus boisei, Homo rudolfensis, H. habilis* and *H. ergaster* foraged in the same area around Lake Turkana.

Updated from the January 2000 issue

IS THE ONLY HOMINID ON EARTH. YET FOR AT LEAST SHARED THE PLANET. WHAT MAKES US DIFFERENT?

were not alone



By Ian Tattersall • Paintings by Jay H. Matternes

Homo sapiens has had the earth to itself

for the past 25,000 years or so, free and clear of competition from other members of the hominid family. This period has evidently been long enough for us to have developed a profound feeling that being alone in the world is an entirely natural and appropriate state of affairs.

So natural and appropriate, indeed, that during the 1950s and 1960s a school of thought emerged that claimed, in essence, that only one species of hominid could have existed at a time because there was simply no ecological space on the planet for more than one culture-bearing species. The "single-species hypothesis" was never very convincing—even in terms of the rather sparse hominid fossil record of 40 years ago. But the implicit scenario of the slow, single-minded transformation of the bent and benighted ancestral hominid into the graceful and gifted modern *H. sapiens* proved powerfully seductive—as fables of frogs becoming princes always are.

So seductive that it was only in the late 1970s, following the discovery of incontrovertible fossil evidence that hominid species coexisted some 1.8 million years ago in what is now northern Kenya, that the single-species hypothesis was abandoned. Yet even then, paleoanthropologists continued to cleave to a rather minimalist interpretation of the fossil record. Their tendency was to downplay the number of species and to group together distinctively different fossils under single, uninformative epithets such as "archaic *Homo sapiens*." As a result, they tended to lose sight of the fact that many kinds of hominids had regularly contrived to coexist.

Although the minimalist tendency persists, recent discoveries and fossil reappraisals make clear that the biological history of hominids resembles that of most other successful animal families. It is marked by diversity rather than by linear progression. Despite this rich history—during which hominid species developed and lived together and competed and rose and fell—*H. sapiens* ultimately emerged as the sole hominid. The reasons for this are generally unknowable, but different interactions between the last coexisting hominids—*H. sapiens* and *H. neanderthalensis*—in two distinct geographical regions offer some intriguing insights.

A Suite of Species

FROM THE BEGINNING, almost from the very moment the earliest hominid biped—the first "australopith"—made its initial hesitant steps away from the forest depths, we have evidence for hominid diversity. The oldest-known potential hominid is *Sahelanthropus tchadensis,* represented by a cranium from the central-western country of Chad [*see illustration on page 26*]. Better known is *Australopithecus anamensis,* from sites in northern Kenya that are about 4.2 million years old.

A. anamensis looks reassuringly similar to the 3.8- to 3.0-million-year-old *Australopithecus afarensis,* a small-brained, big-faced bipedal species to which the famous "Lucy" belonged. Many remnants of *A. afarensis* have been found in various eastern African sites, but some researchers have suggested that the mass of fossils described as *A. afarensis* may contain more than one species, and it is only a matter of time

PARANTHROPUS BOISEI had massive jaws, equipped with huge grinding teeth for a presumed vegetarian diet. Its skull is accordingly strongly built, but it is not known if in body size it was significantly larger than the "gracile" australopiths.

HOMO RUDOLFENSIS was a relatively large-brained hominid, typified by the famous KNM-ER 1470 cranium. Its skull was distinct from the apparently smaller-brained *H. habilis*, but its body proportions are effectively unknown.

until the subject is raised again. In any event, *A. afarensis* was not alone in Africa. A distinctive jaw, from an australopith named *A. bahrelghazali,* was found in 1995 in Chad. It is probably between 3.5 and 3.0 million years old and is thus roughly coeval with Lucy, as is the recently named new form *Kenyanthropus platyops*.

In southern Africa, scientists reported evidence in 1999 of another primitive bipedal hominid species. As yet unnamed and undescribed, this distinctive form is 3.3 million years old. At about three million years ago, the same region begins to yield fossils of *A. africanus,* the first australopith to be discovered (in 1924). This species may have persisted until not much more than two million years ago. A 2.5-million-year-old species from Ethiopia, named *Australopithecus garhi* in 1999, is claimed to fall in an intermediate position between *A. afarensis,* on the one hand, and a larger group that includes more recent australopiths and *Homo,* on the other. Almost exactly the same age is the first representative of the "robust" group of australopiths, *Paranthropus aethiopicus*. This early form is best known from the 2.5-million-year-old "Black Skull" of northern Kenya, and in the period between about 2 and 1.4 million years ago the robusts were represented all over eastern Africa by the familiar *P. boisei.* In South Africa, during the period around 1.6 million years ago, the robusts included the distinctive *P. robustus* and possibly a closely related second species, *P. crassidens*.

I apologize for inflicting this long list of names on readers, but in fact it actually underestimates the number of australopith species that existed. What is more, scientists don't know how long each of these creatures lasted. Nevertheless, even if average species longevity was only a few hundred thousand years, it is clear that from the very beginning the continent of Africa was at least periodically—and most likely continually—host to multiple kinds of hominids.

The appearance of the genus *Homo* did nothing to perturb this pattern. The 2.5- to 1.8-million-year-old fossils from eastern and southern Africa that announce the earliest appearance of *Homo* are an oddly assorted lot and probably a lot more diverse than their conventional assignment to the two species *H. habilis* and *H. rudolfensis* indicates. Still, at Kenya's East Turkana, in the period between 1.9 and 1.8 million years ago, these two species were joined not only by the ubiquitous *P. boisei* but by *H. ergaster,* the first hominid of essentially modern body form. Here, then, is evidence for four hominid species sharing not just the same continent but the same landscape [*see illustration on opposite page and below*].

The first exodus of hominids from Africa, presumably in the form of *H. ergaster* or a close relative, opened a vast prospect for further diversification. One could wish for a better record of this movement, and particularly of its dating, but there are indications that hominids of some kind had reached China and Java by about 1.8 million years ago. A lower jaw that may be about the same age from Dmanisi in ex-Soviet Georgia is different from anything else yet found [see "Out of Africa Again … and Again?" by Ian Tattersall, on page 38]. By the million-year mark *H. erectus* was established in both Java and China, and it is possible that a more robust hominid species was present in Java as well. At the other end of the Eurasian continent, the oldest-known European hominid fragments—from about 800,000 years ago—are highly distinctive and have been dubbed *H. antecessor* by their Spanish discoverers.

About 600,000 years ago, in Africa, we begin to pick up evidence for *H. heidelbergensis,* a species also seen at sites in Europe—and possibly China—between 500,000 to 200,000 years ago. As we learn more about *H. heidelbergensis,* we are likely to find that more than one species is actually represented in this group of fossils. In Europe, *H. heidelbergensis* or a relative gave rise to an endemic group of hominids whose best-known representative was *H. neanderthalensis,* a European and western Asian species that flourished between about 200,000 and 30,000 years ago. The sparse record from Africa suggests that at this time independent develop-

HOMO HABILIS ("handy man") was so named because it was thought to be the maker of the 1.8-million-year-old stone tools discovered at Olduvai Gorge in Tanzania. This hominid fashioned sharp flakes by banging one rock cobble against another.

HOMO ERGASTER, sometimes called "African *H. erectus,*" had a high, rounded cranium and a skeleton broadly similar to that of modern humans. Although *H. ergaster* clearly ate meat, its chewing teeth are relatively small. The best specimen of this hominid is that of an adolescent from about 1.6 million years ago known as Turkana boy.

TUC D'AUDOUBERT CAVE in France was entered sometime between perhaps 11,000 and 13,000 years ago by *H. sapiens*, also called Cro Magnons, who sculpted small clay bison in a recess almost a mile underground.

ments were taking place there, too—including the emergence of *H. sapiens*. And in Java, possible *H. erectus* fossils from Ngandong were dated to around 40,000 years ago, implying that this area had its own indigenous hominid evolutionary history for perhaps millions of years as well.

The picture of hominid evolution just sketched is a far cry from the "*Australopithecus africanus* begat *Homo erectus* begat *Homo sapiens*" scenario that prevailed 40 years ago—and it is, of course, based to a great extent on fossils that have been discovered since that time. Yet the dead hand of linear thinking still lies heavily on paleoanthropology, and even today quite a few of my colleagues would argue that this scenario overestimates diversity. There are various ways of simplifying the picture, most of them involving the cop-out of stuffing all variants of *Homo* of the past half a million or even two million years into the species *H. sapiens*.

My own view, in contrast, is that the 20 or so hominid species invoked (if not named) above represent a minimum estimate. Not only is the human fossil record as we know it full of largely unacknowledged morphological indications of diversity, but it would be rash to claim that every hominid species that ever existed is represented in one fossil collection or another. And even if only the latter is true, it is still clear that the story of human evolution has not been one of a lone hero's linear struggle.

Instead it has been the story of nature's tinkering: of repeated evolutionary experiments. Our biological history has been one of sporadic events rather than gradual accretions. Over the past five million years, new hominid species have regularly emerged, competed, coexisted, colonized new environments and succeeded—or failed. We have only the dimmest of perceptions of how this dramatic history of innovation and interaction unfolded, but it is already evident that our species, far from being the pinnacle of the hominid evolutionary tree, is simply one more of its many terminal twigs.

The Roots of Our Solitude

ALTHOUGH THIS is all true, *H. sapiens* embodies something that is undeniably unusual and is neatly captured by the fact that we are alone in the world today. Whatever that something is, it is related to how we interact with the external world: it is behavioral, which

HOMINIDS of modern body form most likely emerged in Africa around 150,000 years ago and coexisted with other hominids for a time before emerging as the only species of our family. Until about 30,000 years ago, they overlapped with *H. neanderthalensis* (*left*) in Europe and in the Levant, and they may have been contemporaneous with the *H. erectus* (*right*) then living in Java.

means that we have to look to our archaeological record to find evidence of it. This record begins some 2.5 million years ago with the production of the first recognizable stone tools: simple sharp flakes chipped from parent "cores." We don't know exactly who the inventor was, but chances are that he or she was something we might call an australopith.

This landmark innovation represented a major cognitive leap and had profound long-term consequences for hominids. It also inaugurated a pattern of highly intermittent technological change. It was a full million years before the next significant technological innovation came along: the creation about 1.5 million years ago, probably by *H. ergaster,* of the hand ax. These symmetrical implements, shaped from large stone cores, were the first tools to conform to a "mental template" that existed in the toolmaker's mind. This template remained essentially unchanged for another million years or more, until the invention of "prepared-core" tools by *H. heidelbergensis* or a relative. Here a stone core was elaborately shaped in such a way that a single blow would detach what was an effectively finished implement.

Among the most accomplished practitioners of prepared-core technology were the large-brained, big-faced and low-skulled Neandertals, who occupied Europe and western Asia until about 30,000 years ago. Because they left an excellent record of themselves and were abruptly replaced by modern humans who did the same, the Neandertals furnish us with a particularly instructive yardstick by which to judge our own uniqueness. The stoneworking skills of the Neandertals were impressive, if somewhat stereotyped, but they rarely if ever made tools from other preservable materials. And many archaeologists question the sophistication of their hunting skills.

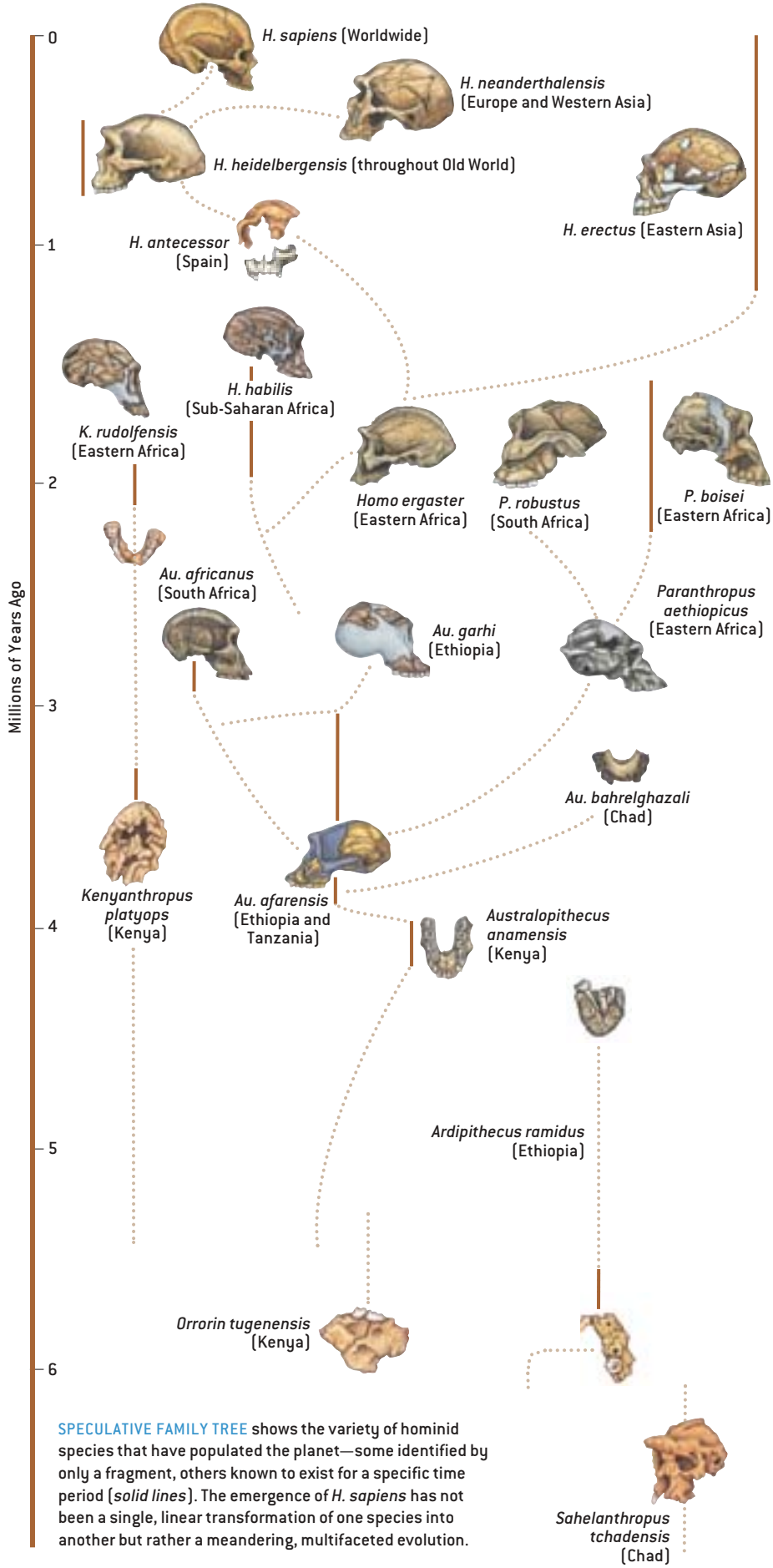
Further, despite misleading early accounts of bizarre Neandertal "bear cults" and other rituals, no substantial evidence has been found for symbolic behaviors among these hominids or for the production of symbolic objects—certainly not before contact had been made with modern humans. Even the occasional Neandertal practice of burying the dead may have been simply a way of discouraging hyenas from making incursions into their living spaces or have a similar mundane explanation. This view arises because Neandertal burials lack the "grave goods" that would attest to ritual and belief in an afterlife. The Neandertals, in other words, though admirable in many ways and for a long time successful in the difficult circumstances of the late ice ages, lacked the spark of creativity that, in the end, distinguished *H. sapiens.*

Although the source of *H. sapiens* as a physical entity is obscure, most evidence points to an African origin perhaps between 150,000 and 200,000 years ago. Modern behavior patterns did not emerge until much later. The best evidence comes from Israel and its surrounding environs, where Neandertals lived about 200,000 years ago or perhaps even earlier. By about 100,000 years ago, they had been joined by anatomically modern *H. sapiens,* and the remarkable thing is that the tools and sites the two hominid species left behind are essentially identical. As far as can be told, these two hominids behaved

THE AUTHOR AND THE ARTIST

IAN TATTERSALL and *JAY H. MATTERNES* have worked together since the early 1990s, notably on the Hall of Human Biology and Evolution at the American Museum of Natural History in New York City and at the Gunma Museum of Natural History in Tomioka, Japan (where the Tuc d'Audoubert mural on the opposite page is installed). Tattersall was born in England and raised in East Africa. He is a curator in the department of anthropology at the American Museum of Natural History. His books include *Becoming Human: Evolution and Human Uniqueness* (Harvest Books, 1999) and *The Last Neanderthal: The Rise, Success, and Mysterious Extinction of Our Closest Human Relatives* (Westview Press, 1999, revised).

Matternes is an artist and sculptor who has for more than 40 years specialized in fossil primates and hominids. In addition to his museum murals, he is well known for his illustrations for books, periodicals and television, including Time/Life Books and *National Geographic.* The research for his depictions has taken him to many parts of the U.S., Canada, Mexico, France, Colombia and Africa.



SPECULATIVE FAMILY TREE shows the variety of hominid species that have populated the planet—some identified by only a fragment, others known to exist for a specific time period (*solid lines*). The emergence of *H. sapiens* has not been a single, linear transformation of one species into another but rather a meandering, multifaceted evolution.

in similar ways despite their anatomical differences. And as long as they did so, they somehow contrived to share the Levantine environment.

The situation in Europe could hardly be more different. The earliest *H. sapiens* sites there date from only about 40,000 years ago, and just 10,000 or so years later the formerly ubiquitous Neandertals were gone. Significantly, the *H. sapiens* who invaded Europe brought with them abundant evidence of a fully formed and unprecedented modern sensibility. Not only did they possess a new "Upper Paleolithic" stoneworking technology based on the production of multiple long, thin blades from cylindrical cores, but they made tools from bone and antler, with an exquisite sensitivity to the properties of these materials.

Even more significant, they brought with them art, in the form of carvings, engravings and spectacular cave paintings; they kept records on bone and stone plaques; they made music on wind instruments; they crafted intricate personal adornments; they afforded some of their dead elaborate burials with grave goods (hinting at social stratification in addition to belief in an afterlife, for not all burials were equally fancy); and their living sites were highly organized, with evidence of sophisticated hunting and fishing. The pattern of intermittent technological innovation was gone, replaced by constant refinement. Clearly, these people were *us*.

Competing Scenarios

IN ALL THESE WAYS, early Upper Paleolithic people contrasted dramatically with the Neandertals. Some Neandertals in Europe seem to have picked up new ways of doing things from the arriving *H. sapiens*, but we have no direct clues as to the nature of the interaction between the two species. In light of the Neandertals' rapid disappearance and of the appalling subsequent record of *H. sapiens*, though, we can reasonably surmise that such interactions were rarely happy for the former. Certainly the repeated pattern found at archaeological sites is one of short-term replacement, and there is no convincing biological ev-

PATRICIA J. WYNNE (*drawings*)

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idence of any intermixing of peoples in Europe.

In the Levant, the coexistence ceased—after about 60,000 years or so—at right about the time that Upper Paleolithic–like tools began to appear. About 40,000 years ago the Neandertals of the Levant yielded to a presumably culturally rich *H. sapiens,* just as their European counterparts had.

The key to the difference between the European and the Levantine scenarios lies, most probably, in the emergence of modern cognition—which, it is reasonable to assume, is equivalent to the advent of symbolic thought. Business had continued more or less as usual right through the appearance of modern bone structure, and only later, with the acquisition of fully modern behavior patterns, did *H. sapiens* become completely intolerant of competition from its nearest—and, evidently, not its dearest—co-inhabitors.

To understand how this change in sensibility occurred, we have to recall certain things about the evolutionary process. First, as in this case, all innovations must necessarily arise *within* preexisting species—for where else can they do so? Second, many novelties arise as "exaptations," features acquired in one context before (often long before) being coopted in a different one. For example, hominids possessed essentially modern vocal tracts for hundreds of thousands of years before the behavioral record gives us any reason to believe that they employed the articulate speech that the peculiar form of this tract permits.

And finally, it is important to bear in mind the phenomenon of emergence—the notion that a chance coincidence gives rise to something totally unexpected. The classic scientific example in this regard is water, whose properties are wholly unpredicted by those of hydrogen and oxygen atoms alone. If we combine these various observations, we can see that, profound as the consequences of achieving symbolic thought may have been, the process whereby it came about was unexceptional.

We have no idea at present how the modern human brain converts a mass of electrical and chemical discharges into what we experience as consciousness. We do know, however, that somehow our lineage passed to symbolic thought from some nonsymbolic precursor state. The only plausible possibility is that with the arrival of anatomically modern *H. sapiens,* existing exaptations were fortuitously linked by a relatively minor genetic innovation to create an unprecedented potential.

Yet even in principle this deduced scenario cannot be the full story, because anatomically modern humans behaved archaically for a long time before adopting modern behaviors. That discrepancy may be the result of the late appearance of some key hardwired innovation not reflected in the skeleton, which is all that fossilizes. But this seems unlikely, because it would have necessitated a wholesale Old World–wide replacement of hominid populations in a very short time, something for which there is no evidence.

It is much more likely that the modern human capacity was born at—or close to—the origin of *H. sapiens,* as an ability that lay fallow until it was activated by a cultural stimulus of some kind. If sufficiently advantageous, this behavioral novelty could then have spread rapidly by cultural contact among populations that already had the potential to acquire it. No population replacement would have been necessary to spread the capability worldwide.

It is impossible to be sure what this innovation might have been, but the best current bet is that it was the invention of language. For language is not simply the medium by which we express our ideas and experiences to one another. Rather it is fundamental to the thought process itself. It involves categorizing and naming objects and sensations in the outer and inner worlds and making associations between resulting mental symbols. It is, in effect, impossible for us to conceive of thought (as we are familiar with it) in the absence of language, and it is the ability to form mental symbols that is the fount of our creativity. Only when we are able to create such symbols can we recombine them and ask such questions as "What if...?"

We do not know exactly how language might have emerged in one local population of *H. sapiens,* although linguists have speculated widely. But we do know that a creature armed with symbolic skills is a formidable competitor—and not necessarily an entirely rational one, as the rest of the living world, including *H. neanderthalensis,* has discovered to its cost. SA

MORE TO EXPLORE

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