

Lucy's Uncommon Forebear

The first systematic studies of pygmy chimpanzees suggest that this isolated and nearly extinct ape may provide the best model for understanding the evolution of arboreal ape into primitive man



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By WRAY HERBERT

In 1928, Harvard University zoologist Harold J. Coolidge was examining a collection of chimpanzee skulls at the Congo Museum in Terveuren, Belgium, with a mind to revising the taxonomy of living apes. Having already examined similar collections in Stockholm, London, Berlin, Paris and Brussels, Coolidge felt quite comfortable with the existing evidence of African chimpanzees. He expected nothing untoward.

This past summer, while addressing the International Primatological Society in Atlanta, Coolidge recalled that day: "I shall never forget, late one afternoon, I casually picked up from a storage tray what looked like a clearly juvenile chimp's skull from south of the Congo [River], and, to my amazement, the [bones] were totally fused. It was clearly an adult! I picked up four similar skulls in adjoining trays and found the same condition, which I measured up for my future paper on revision of chimpanzees."

The "future paper," published in 1933, contained no minor revision of ape taxonomy. For what Coolidge had stumbled upon in Terveuren was the first evidence of a previously unknown species of living ape, a pygmy chimpanzee. The new species, which he named *Pan paniscus*, immediately attracted the attention of the

scientific community, and pygmy chimpanzees were soon identified in several zoo populations. What struck observers most about these apes was how unlike common chimpanzees they were in demeanor and behavior. They were less robust in body build and facial features; more versatile in movement; and, by some reports, more communicative and sociable. Without knowing he was describing a pygmy chimpanzee, Yale zoologist Robert M. Yerkes had a few years before written of the extraordinary alertness, sociability and intelligence of a diminutive chimp called Prince Chim. He titled his book *Almost Human*.

If Coolidge was unprepared for his zoological coup, he must certainly have been unprepared for the revisions that his discovery would push upon the theory of human evolution. How would such an uncommon ape fit into the existing phylogenetic tree, which at the time had humans evolving on a separate branch from all the living apes? Raymond Dart had only a few years before discovered the first Australopithecine, or ape-man, in South Africa, and anthropologists were quickly converging on the idea that all living apes (including humans) must have shared a common ancestor — the so-called "missing link." But what would such an animal have looked like before it speciated into such different creatures as chimpanzees, gorillas and man?

For some, the newly discovered pygmy chimpanzee, graceful and human-like, provided the perfect answer: *Pan paniscus*, Coolidge declared in 1933, offered the best model for understanding the missing common ancestor. By observing an extant beast, Coolidge suggested, scientists could actually catch a glimpse of what the earliest humans must have looked like in action.

Despite the boldness of Coolidge's evolutionary model, it languished, neither accepted nor discredited, until quite recently. The reason the pygmy chimpanzee had gone undiscovered for so long is that it lives only in an inaccessible jungle region of equatorial Africa — part of what is now the Republic of Zaire. For the same reason the pygmy chimp (or "bonobo," as it is known in that region) continued relatively unobserved and unstudied for another generation; and the "bonobo model" of human evolution obscured itself in the scientific literature.

All of that changed in recent years, as a new generation of anthropologists dusted off the Coolidge model and began an intensive search for data to support or reject it. Beginning in the 1960s, young scientists turned increasingly to pygmy chimpanzees as the focus of their research: Vincent M. Sarich undertook a biochemical study of living apes; Donald C. Johanson concentrated on the teeth; Adrienne L. Zihlman studied the post-cranial skeleton; Douglas L. Cramer, the skull; and Randall L. Susman headed for Zaire to find out how pygmy chimpanzees actually behaved in the wild. A decade later, these scientists remain embroiled in an ongoing dispute about *Pan paniscus* and its importance to an understanding of human origins.

Sarich, now at the University of California at Berkeley, was the first in the fray. Using new techniques to compare the proteins (and the genetic material) of the living apes, he and biochemist Allan C. Wilson (also of Berkeley) demonstrated in the 1960s that the structure of DNA of humans, chimpanzees and gorillas varied by less than 2 percent; humans, that is to say, were shown to be as biochemically intimate with gorillas and chimps as they are with each other. The implication of this work was that the three apes had split, or speciated, at the same time, and using the biochemical data the scientists devised a "molecular clock" to estimate the timing of that evolutionary split: contrary to the generally accepted estimate of 15 million years ago, they put the date at 4 to 5 million years. Echoing Coolidge's declaration

of 1933, Sarich suggested again that the common ancestor (now not nearly so ancient as believed) must have looked something like a small chimpanzee.

Given this start, other scientists began to ask: what is there in the anatomy and behavior of living pygmy chimps, and in the fossil evidence of ancient hominids, to support such a view? Along with Sarich, Zihlman (of UC Santa Cruz) and Cramer (of New York University) have become the champions of the bonobo model, and they have based their claims primarily on studies of the anatomy of living apes and fossilized hominids. Sarich's biochemical data indicate that the two species of chimpanzee split about 2 to 3 million years ago, so that the pygmy chimp is fundamentally a chimp; but according to Zihlman, a comparative study of the limb bones reveals that the pygmy chimp is more "primitive" than its common cousin. In other words, it has gone through fewer specialized adaptations and therefore most closely resembles the ancestral condition.

To make her point, Zihlman compares the pygmy chimpanzee to "Lucy," one of the oldest hominid fossils known, and finds the similarities striking. They are almost identical in body size, in stature and in brain size, she notes, and the major differences (the hip and the foot) represent the younger Lucy's adaptation to bipedal walking (Lucy, officially called *Australopithecus afarensis*, has been dated at 3.6 million years, although that date has recently been challenged [SN: 1/11/83, p. 5]). These commonalities, Zihlman argues, indicate that pygmy chimps use their limbs in much the same way that Lucy did—and that they inherited those habits from the same ancestor.

In contrast to the shared traits of pygmy chimps and early hominids, Zihlman says, the common chimpanzee has legs that are shorter and arms that are longer, relative to its body size. Zihlman also made estimates of the muscle and tissue mass of an animal like Lucy and compared it to that of modern apes: only the pygmy chimpanzee, with its strong legs, smaller arms and slender chest, closely matches Lucy. What this suggests, according to Zihlman, is that the pygmy chimpanzee is more flexible than other modern apes; a common ancestor would have to be flexible—somewhere between a strict quadruped and a strict biped—in order to evolve simultaneously into man and ape.

The major critics of the pygmy chimpanzee model have been Johanson, dis-

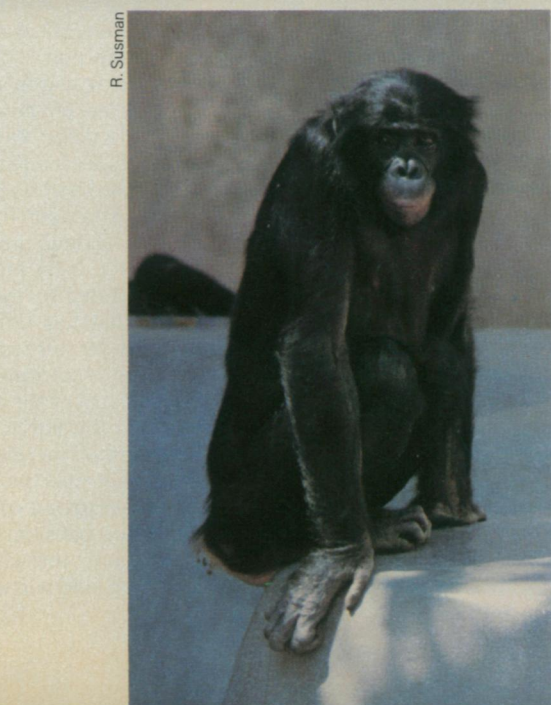


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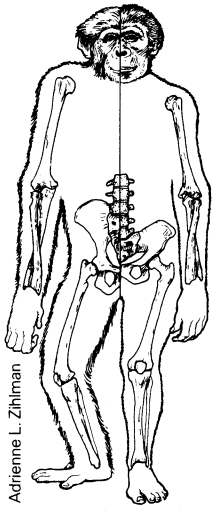


N. Badrian



R. Susman

After months spent observing the rare pygmy chimpanzees in the Lomako Forest of Zaire, scientists are debunking the idea that this diminutive ape is "human" in character. But the pygmy is unique among African apes, more flexible in its diet and more acrobatic in the trees.



An anatomical comparison of a living pygmy chimpanzee (left) and a reconstructed *Australopithecine* hominid (right) shows similarities in cranial capacity, overall size and relative size of the leg bones, suggesting to some scientists that early hominids might have evolved from a small chimp-like ancestor.

Adrienne L. Zihlman

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coverer of Lucy, and his co-workers—Tim D. White of Berkeley, C. Owen Lovejoy of Kent State University and Bruce Latimer of the Cleveland Museum of Natural History. They say that Zihlman has gone far beyond the fossil data in her interpretation. Johanson, who is director of the Berkeley-based Institute of Human Origins, argues that the pygmy chimpanzee may actually be a specialized, derived form of ape, whose anatomy is adapted specifically to the isolated jungle habitat that it now inhabits. Zihlman's anatomical comparisons Johanson says, reveal only a similarity in size and say nothing about common locomotive adaptations or taxonomic proximity; the same comparisons, he says, would show the pygmy chimp to be related to an American black bear.

Furthermore, Johanson and his colleagues say, the proponents of the pygmy chimpanzee have failed to explain some significant contrasts between bonobos and Lucy. Specifically, they note, the pygmy chimpanzee's teeth are much smaller and less rugged than those of the early hominids; and secondly, the male and female bonobos differ very little in anatomy, whereas the earliest hominids were extremely sexually dimorphic.

Zihlman and Sarich both concede that these differences exist. But in putting forth the bonobo model, they say, they were not trying to reconstruct the hominid *A. afarensis*; they were trying to reconstruct the common ancestor of chimpanzees, gorillas and *A. afarensis*. "That's one step further back," says Sarich. "We assume that *afarensis* is highly derived in certain features. Specifically it's an open country ape, which makes it much different. The common ancestor was almost certainly not an open country form." Lucy's rugged dentition, they say, could have evolved very rapidly as the species moved from the forests into the savannas and began dealing with heavy, rough food.

Similarly, Zihlman says, the sexual dimorphism of *A. afarensis* could have evolved very rapidly; as the ape-like race emerged from the jungle to take advantage of the resources of the savanna mosaic, she says, the male of the species probably became larger to provide the necessary protection against predation. Sexual di-

morphism is one characteristic, Zihlman says, that can evolve rapidly in either direction, so that the extreme male-female differences of *A. afarensis* could easily appear in a brief period of evolutionary time—2 million years—and then disappear (as they have) in modern humans. Another possibility, however, is that *A. afarensis* is not as dimorphic as Johanson and his colleagues maintain; what they interpret as males and females of the same species, Zihlman says, may very well be two different species.

Susman rejects the extremism of both the Zihlman and the Johanson arguments, suggesting that, while the bonobo may not be a living replica of Lucy's predecessor, it nevertheless has a special role to play in illuminating that animal's nature. The idea of evolutionary modeling, he says, is to construct a mosaic of anatomical features, drawing on all the living apes to piece together a unique hypothetical ancestor; the pygmy chimpanzee might indeed be the best model for that ancestor's stature, but the common chimpanzee might be a more appropriate model for the sexual dimorphism of the species. (Susman agrees with Johanson that the small and large *A. afarensis* fossils are anatomically similar, most likely representing a single species.) In any case, he says, in order to make sense of the anatomical differences and similarities between living and long-dead apes, it is necessary to observe living apes in the forest—the ecological setting in which the common ancestor was most likely to have lived. The bonobo is the only true forest dweller among modern apes, and as a result it alone can model what the common forebear was doing 5 million years ago.

Only recently, with the completion of Susman's 18-month study of pygmy chimpanzees in the Lomako Forest of Zaire, has such evidence been available. Because almost all previous observation of pygmy chimpanzees had involved the dozen or so animals in captivity, it was unclear how much of the observed "human" behavior was a consequence of scientists' tendency to humanize their laboratory animals; much of it is, Susman concludes. But hours of observation along the Zaire River have confirmed that the bonobo is a unique ape—if not more human, then at least more flexible in its behavior than gorillas, humans or common chimpanzees.

Susman and his colleagues Noel and Alison Badrian have found, for example, that the pygmy chimpanzee is different from the other African apes in terms of sexual behavior; specifically, the females have extraordinarily long periods of sexual receptivity, like humans, and like humans they tend to mate front to front. From an evolutionary point of view, this evidence suggests one of two things: that humans and pygmy chimpanzees, once on their own evolutionary tracks, developed this behavior separately or that such sexual behavior was once an ancestral

characteristic.

Susman also discovered that pygmy chimps have a unique style of locomotion. Like modern gorillas they tend to be knuckle-walkers on the ground, yet they seem to be natural bipeds, too, frequently walking upright both on the ground and in the trees. And even more important, Susman says, is that when they are in the trees, the pygmy chimps are by far the most acrobatic of the apes, capable of arm swinging, leaping and diving. This documented behavior is consistent with Susman's own anatomical studies, which have shown that the bonobo's shoulder blade, arm and hand are well adapted for arboreality—the primitive condition, according to Susman. Where it is difficult to conceive of a well-adapted terrestrial biped evolving into an agile arboreal animal, an animal with the locomotor flexibility of a pygmy chimpanzee could reasonably have speciated into both the arboreal African apes and the highly specialized human biped.

Susman's group has also gathered extensive data on social and feeding behaviors of living bonobos, and they are beginning to piece together a picture of what the hypothetical 5-million-year-old ancestor might have looked like. "What we have is a unique animal that didn't behave like any animal does today," Susman says. "It climbed trees and probably nested in trees. It weighed 60 pounds. It ate mostly fruit but perhaps some meat. It spent its nights and early mornings in trees, but it probably moved between patches of forest during the day by walking bipedally. It did not have tools or a tool-making hand, and it had a small brain."

So what adaptive advantage would such an animal have as the Pliocene age came to an end—a time when, most agree, the forests were disappearing? What was it that propelled humans on their special evolutionary track while keeping chimpanzees and gorillas—with 99 percent of the same DNA—in the woods? If the answer remains unclear, Susman thinks it is because scientists have been looking in the wrong place; because it is easier to observe animals in the open savannas, he says, anthropologists have tended to think of evolution exclusively in terms of a human adaptation to the open country life. But to the extent that the pygmy chimpanzee is a helpful model, he says, it indicates that Lucy's ancestors spent a lot of time in the trees—even while they were adapting to bipedalism. "We ought to be thinking about pygmy chimpanzee ecology as an interesting source of information about early human ecology," Susman concludes. "Perhaps early humans used their bipedalism to walk from one riverine region to another during an era when the forests were shrinking. If you're a novice biped, a novice hunter and a novice eater and you don't have real great tools, it seems to me you could best do your apprenticeship in a forest." □