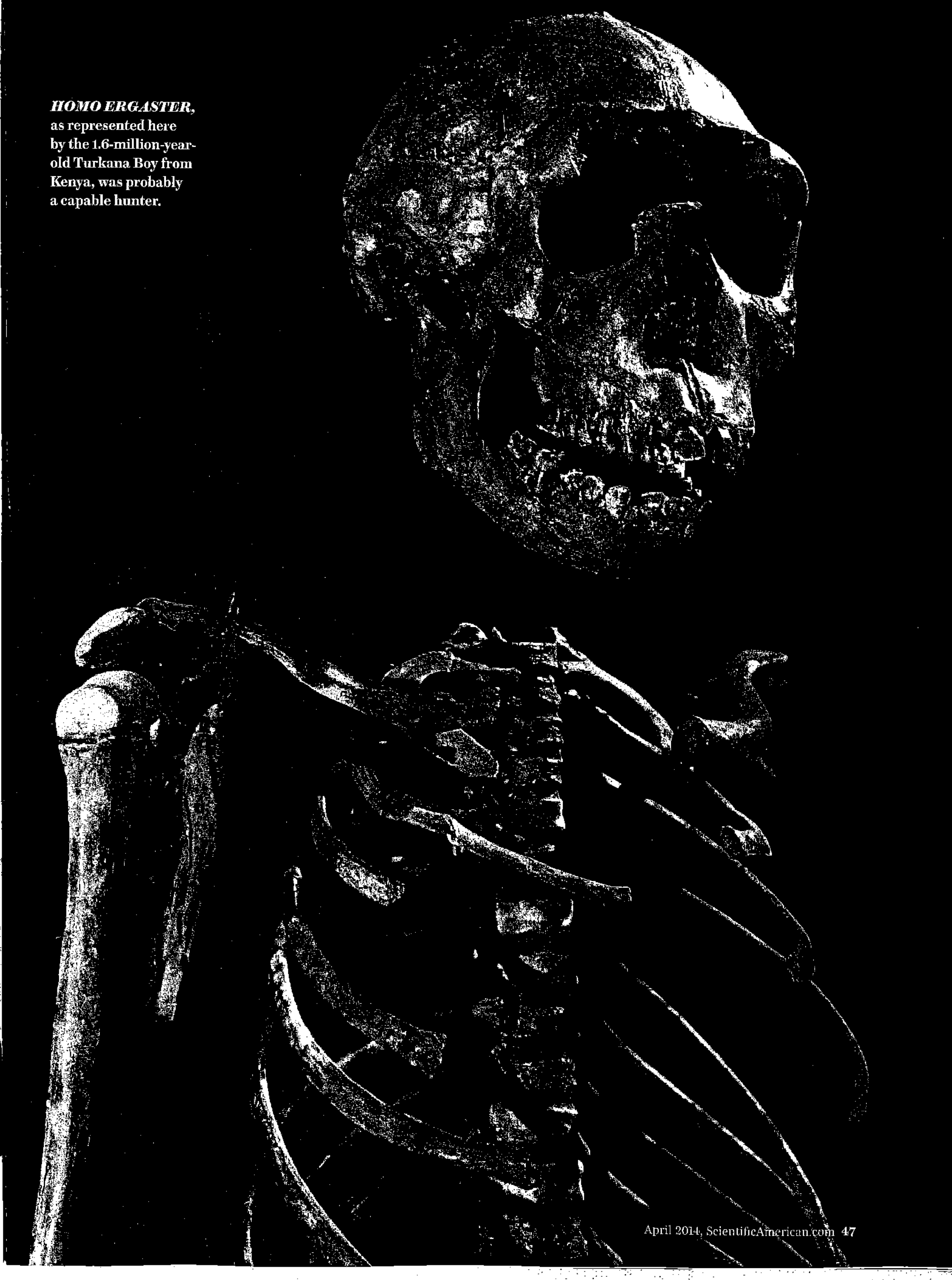
For decades anthropologists have debated when and how our ancestors became skilled hunters. Recent discoveries have yielded surprising new insights

By Kate Wong

EVOLUTION

Rise of the Human Predator

HOMO ERGASTER, as represented here by the 1.6-million-year-old Turkana Boy from Kenya, was probably a capable hunter.



Some 279,000 years ago,

on a ridge overlooking a vast lake in central Ethiopia's Rift Valley, hunters painstakingly shaped chunks of greenish black volcanic glass into small, sharp points. After chipping the brittle material to create cutting edges, they attached each point to a shaft of wood, producing a sort of javelin. It might sound like a modest feat of engineering by today's standards. But the technology was nothing less than revolutionary. With it, members of the human lineage had at their disposal a weapon that would allow them to kill much more effectively from afar than a simple wooden spear could. Not only would that development enable our predecessors to hunt a broader range of animals, but it also upped their odds of emerging from the hunt unscathed by putting a safe distance between them and large, dangerous prey, perhaps including the hippos that would have lurked in and around the nearby lake.

As far as technological inventions go, this stone-tipped throwing spear was arguably humanity's crowning achievement at the time. But perhaps more remarkable than the hunting gains it afforded is the fact that the conceptualization, manufacture and use of this seemingly simple device were made possible only through the piecemeal acquisition, over tens of thousands of generations, of traits that helped our forebears acquire meat.

In our era of supermarkets and fast food, it is easy to forget that we humans are natural-born hunters. We certainly don't look the part. We are slow, we are weak, and we lack the killer teeth and claws that other carnivores wield against their quarry. Indeed, compared with other carnivores—from crocodiles to cheetahs—humans appear decidedly ill suited to procuring prey. Yet we are the most lethal predators on earth—a distinction earned long before the advent of vehicles to carry us to our targets and guns to dispatch them.

Over the course of millions of years evolution transformed our mostly vegetarian ancestors (creatures like the famous *Australopithecus afarensis* individual known as Lucy) into a singularly deadly primate. In fact, many of the characteristics that set us apart from our closest living relatives, the great apes—from our ability to run long distances to our oversize brains—may have arisen at least in part as adaptations to hunting. Recent discoveries have illuminated some previously murky phases of this metamorphosis, documenting among other things the debut of our throwing arm and the earliest known evidence of big game hunting. With these new insights, researchers now have the most detailed picture yet of the emergence of the traits that honed our hunting prowess—and in so doing made us human.

BRAVE NEW WORLD

To understand how important a role hunting played in our evolution, we must page back some three million years to a time when early hominins (creatures more closely related to us than to our closest living relatives, the chimpanzees and bonobos) were headed toward a crossroads. The climate was changing, and across Africa the forests and woodlands where our forebears had long foraged for fruit and leaves were giving way to more open grasslands, where such foods were harder to come by. The hominins would have to adapt or die. Some, namely the so-called robust australopithecines, seem to have coped with this environmental change by evolving massive jaws and teeth that could grind up grasses and other tough plant foods. The lineage that includes our genus, *Homo*, took a radically different tack, expanding its diet to include increasing amounts of animal protein and fat. Both approaches stood our predecessors in good stead for a long time. But eventually, around a million years ago, the robust australopithecines went extinct.

IN BRIEF

For decades researchers have been locked in debate over how and when human hunting began and how big a role it played in human evolution.

Recent analyses of human anatomy, stone tools and animal bones are helping to fill in the details of this game-changing shift in subsistence strategy.

This evidence indicates that hunting evolved far earlier than some scholars had envisioned—and profoundly impacted subsequent human evolution.

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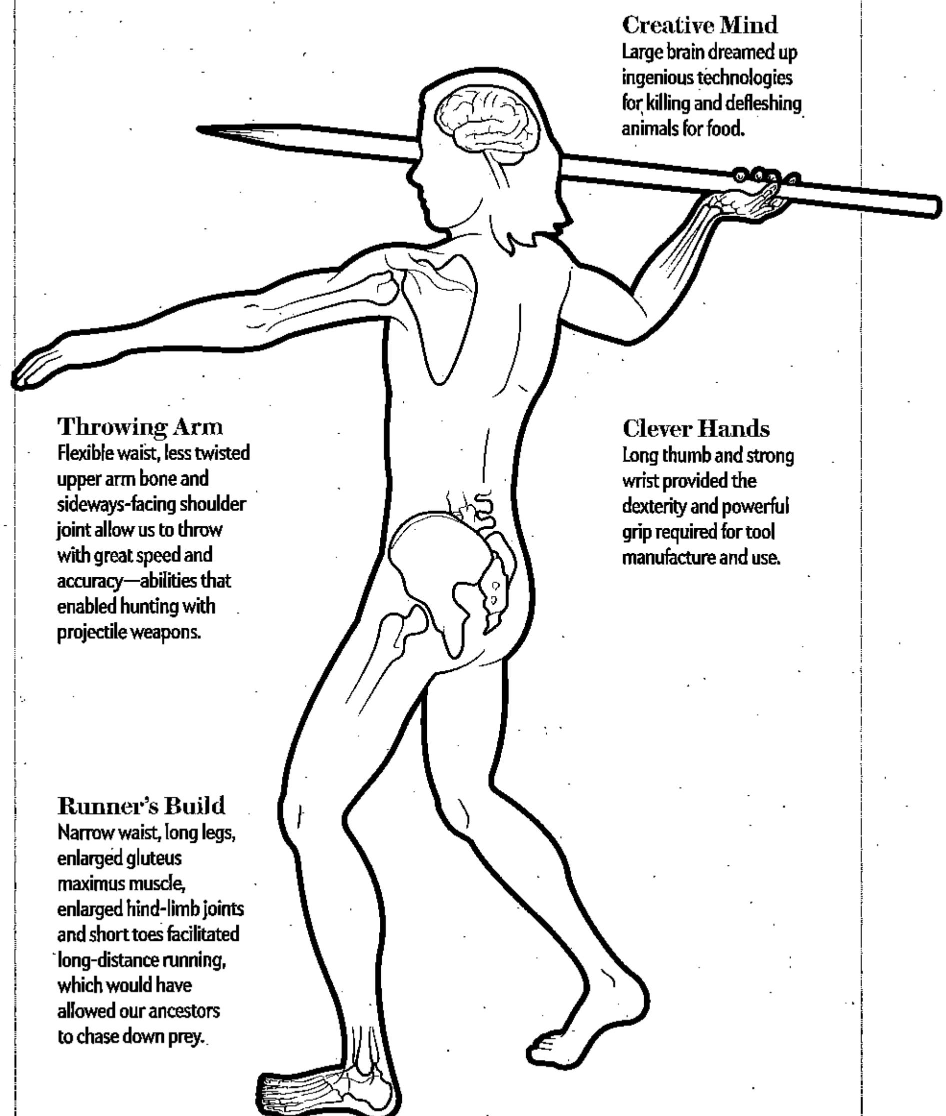
Anatomy of a Hunter

Unlike most predators, we humans are slow, weak and lacking in lethal fangs and claws. But our ancestors evolved a suite of other traits (*representatives of which are shown below*) that more than make up for those shortcomings.



Scientists may never learn exactly why the robusts died out. Perhaps they had become so specialized that when environmental conditions changed again, they could not shift gears and effectively exploit other menu options. Or maybe *Homo* outcompeted them. What is abundantly clear, however, is that in turning to animals for sustenance, the *Homo* lineage hit on a winning strategy, one that would help fuel its rise to world domination.

Numerous changes to the anatomy of our hominin ancestors conspired to make them formidable competitors on the savanna, where sabertooth cats and other large-bodied carnivores had long reigned unchallenged. One important suite of characteristics compensated for our lack of speed. Although, to this day, we humans, with our bipedal form of locomotion, are lousy sprinters compared with quadrupeds, we excel at long-distance running. No other living primate even comes close to this level of running ability. Daniel Lieberman of Harvard University and Dennis Bramble of the University of Utah have proposed that this capability evolved to help hominins hunt, allowing them to pursue their prey until it slowed or collapsed from exhaustion. Judging from the relevant traits that are preserved in the fossil record—such as enlarged hindlimb joints and short toes, among many other characteristics that improved running performance—endurance running originated in *Homo* by around two million years ago.

Physiological changes accompanied these anatomical shifts. With higher activity levels compared with those of their predecessors, hominins needed a way to avoiding overheating. As Nina Jablonski of Pennsylvania State University has theorized, the loss of fur and the gain of special glands in the skin that promote sweating helped our ancestors keep cool while in hot pursuit. With this built-in cooling system, the evolution of which Jablonski estimates was well under way by the time of *Homo ergaster* 1.6 million years ago, humans can outrun a horse in a marathon.

Catching up to fleet-footed prey was only half the battle, however. To close the deal, the hunters needed to be able to deliver the deathblow, preferably with a heavy or sharp object lobbed from a safe distance. Could early *Homo* manage this feat? Modern humans shine at throwing with speed and accuracy. Chimpanzees, in contrast, perform this task dismally. Recently Neil T. Roach of George Washington University and his colleagues set out to determine why we humans are so much better at throwing than chimps are and when this ability evolved. The key to our throwing skills, it turns out, lies in the elastic energy in our shoulder muscles: Studying college baseball players, Roach and his coworkers identified three features present in modern humans but not in chimps that greatly enhance our upper body's range of motion and thus its ability to store and release this energy: a flexible waist, a less twisted upper arm bone and a shoulder socket that faces out to the side rather than upward as it does in apes.

Turning to the fossil record, Roach's team was able to identify when these traits that permitted high-speed throwing evolved. They did not emerge in lockstep but rather in mosaic fashion. The longer waist and straighter upper arm bone appeared early on, in the australopithecines; the shift in shoulder-socket orientation, for its part,debuted some two million years ago in *Homo erectus.*

It is admittedly difficult to establish with certainty that natu-

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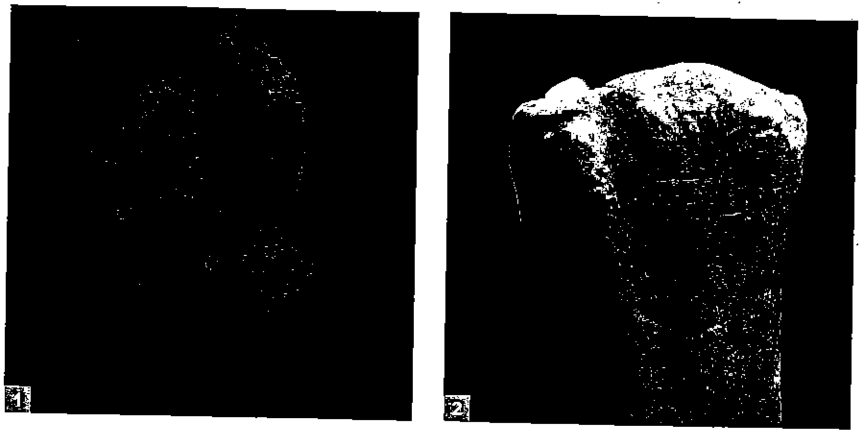
Illustration by Brownbird Design

ral selection favored any given trait for a particular purpose, such as endurance running or throwing as a means to hunt. In some cases, selection might have initially promoted the trait for a different reason altogether—only to subsequently see it co-opted for another activity. Our tall waist, for example, seems to have originated as part of a package of traits that facilitated upright walking. But later, with the addition of other, complementary features, it took on a new role, helping our ancestors increase their torque production so as to hurl an object at a target with greater force.

Nevertheless, Roach suspects that selection for throwing was driving the shoulder changes that emerged around two million years ago. He thinks so in part because those changes were making our ancestors worse at another important activity: climbing trees, which had long furnished hominins with food and safe haven from ground-dwelling predators. "When you give up going up into trees easily, you need to be getting something else," Roach remarks. A better throwing arm would have afforded *Homo* improved access to animal foods rich in calories while allowing hominins to drive off predators that tried to attack them or steal their kills.



EARLIEST SIGNS **of hunting are two-million-year-old cutting tools (*1*) and cut-marked animal bones (*2*) from the site of Kanjera South in Kenya. Over time our ancestors invented deadlier hunting weapons, including 500,000-year-old stone-tipped spears from Kathu Pan in South Africa, reconstructed here (*3*), and 71,000-year-old arrowheads or dart points from Pinnacle Point in South Africa (*4*).**

BUTCHERED BONES

ALTHOUGH THE FOSSIL RECORD indicates that hominins had evolved a suite of anatomical features well suited to hunting by two million years ago, it does not establish that they were in fact systematically killing animals for food at that time. To do that, scientists must find telltale traces of hunting in the archaeological record—no easy task. Stone tools and cut-marked bones show that early humans started butchering animals by 2.6 million years ago. But did our ancestors kill the prey themselves, or did they let big cats and other carnivores do the heavy lifting?

For decades experts have debated whether early *Homo* hunted or scavenged. The earliest unequivocal evidence of hunting—wooden spears and animal remains from the German site of Schöningen—was just 400,000 years old. But over the past few years compelling evidence of much earlier hunting has emerged from studies of large assemblages of butchered animal remains from sites in East Africa that date to the time of early *Homo*.

One of these assemblages comes from a site in Tanzania's famed Olduvai Gorge known as FLK Zinj. Some 1.8 million years ago hominins transported carcass after carcass of wildebeest and other large mammals there to carve up and eat. British paleoanthropologist Mary Leakey excavated most of the bones in the 1960s, and scholars have been arguing ever since about whether the animals there were hunted or scavenged. Henry T. Bunn of the University of Wisconsin–Madison was thinking about the problem of distinguishing hunted animals from scavenged ones when it dawned on him that the tactics should leave different signatures in what is called the mortality profile of the bones. For instance, when it comes to hunting large game, such as waterbuck, lions tend to pick off a disproportionately high number of old individuals relative to their frequency in a typical living herd. Thus, if early humans were scavenging kills by lions or other large carnivores at FLK Zinj, the assemblage should show a similar overrepresentation of old individuals. Instead Bunn and his colleagues found, the butchered large mammal remains at the site skew much more heavily to individuals in their prime than to old or juvenile animals, exhibiting the pattern one would expect to see if humans were selecting the animals they wanted and killing them themselves.

In fact, the FLK Zinj pattern closely resembles that of prey hunted nowadays by the Hadza hunter-gatherers in Tanzania and the San in Botswana using bows and arrows. So far as is known, *Homo* had yet to invent long-range projectile weapons such as the bow and arrow at this point. But Bunn thinks that the hominins may have engaged in ambush hunting by parking themselves in trees near water sources and launching sharpened wooden spears at unsuspecting animals at close range as they passed below en route to drink.

Even older traces of hunting have come from western Kenya, at a site called Kanjera South on the shores of Lake Victoria, where Joseph Ferraro of Baylor University, Thomas W. Plummer of Queens College, C.U.N.Y., and their collaborators have unearthed thousands of stone tools and animal bones that were stripped of their flesh and marrow. Most of the bones, which date to about two million years ago, come from small, young antelopes and show little carnivore damage, which supports the idea that hominins hunted the prey rather than acquiring carnivore leavings. Moreover, Plummer says, the antelopes were small enough that if large carnivores had killed them, they would have completely consumed the carcasses rather than leaving any tissue behind.

The Kanjera remains are "the oldest solid evidence for hunting so far," Plummer asserts. Most important, the hominins at this site clearly did not merely prepare an experimental steak dinner only to return to a vegan lifestyle. The bones hail from sediment layers representing hundreds or perhaps thousands of years of

COURTESY OF THOMAS W. PLUMMER (1); COURTESY OF JOSEPH FERRARO (2); COURTESY OF JAYNE WILKINS (3); COURTESY OF TOVE RUTH SMITH AND SIMEN OESTMO (4)

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what the team calls "persistent hominin carnivory." These individuals had committed to routine consumption of substantial amounts of animal tissue. It is not the only thing they ate—analyses of the tools from the site show that they were also processing plants, including tubers—but it formed a mainstay of their diet.

DEEP IMPACT

IT IS HARD TO OVERSTATE the impact of *Homo*'s shift to a meaty diet. Trends evident in the fossil and archaeological records indicate that it established a feedback loop in which access to calorie-packed food fueled brain growth, which led to the invention of technologies that permitted our ancestors to obtain even more meat (as well as high-quality plant foods), which in turn powered further expansion of gray matter. As a result, between two million and 200,000 years ago brain size swelled from roughly 600 cubic centimeters on average in the earliest representatives of *Homo* to around 1,300 cubic centimeters in *Homo sapiens*.

Carnivory also would have radically changed the social dynamics among our ancestors, particularly once they began hunting larger prey that could be shared with other members of the group. Travis Pickering of the University of Wisconsin–Madison explains that this development ultimately led to greater social organization in early *Homo*, including a division of labor whereby men hunted large game and women gathered plant foods and both groups returned to a central meeting place at the end of the day to eat. By the time our ancestors were hunting large game such as the wildebeest at FLK Zinj, he thinks, they were organizing themselves in this way. And although today it might sound like an antiquated arrangement, that divvying up of responsibilities between the sexes proved to be a remarkably successful hominin adaptation.

Pickering furthermore suspects that the shift toward meat eating fostered self-control in our forebears. Although conventional wisdom holds that hunting promoted aggression in humans—a view based on observations of chimps hunting aggressively—he believes it cultivated level-headedness. Unlike chimps, which have brute strength and lethal teeth, early humans could not merely overpower their quarry with an aggressive attack. Instead, Pickering argues, "they gained emotional control" and acquired prey using brains not brawn. In his view, the advent of tools that enabled hominins to kill from a distance helped them decouple aggressive emotions from hunting.

Support for this hypothesis comes from Iowa State University primatologist Jill Pruetz's studies of an unusual population of grassland-dwelling chimpanzees in Senegal. Unlike their forest-dwelling counterparts, which hunt large, dangerous monkeys with their bare hands, the Senegalese chimps mostly target tiny nocturnal primates known as bush babies using sharpened sticks that they jab into tree hollows where the tiny primates sleep during the day. Pickering notes that the Senegalese chimps go about their hunting in a far more subdued manner than the forest chimps, which subject their prey to frenzied beatings. Perhaps the "spears" used by these chimps help them keep their cool.

Hunting also made us human in another respect. *H. sapiens* is unique among primates in having colonized every corner of the globe. For the first five million years of hominin evolution, our predecessors remained within the bounds of Africa. But sometime after two million years ago, *Homo* began to expand its reach into other parts of the Old World. Why the sudden wanderlust? Theories abound, but it may well be that hunting led hominins out of the motherland. Back then, much of Eurasia was covered by savanna grasslands similar to those in which *Homo* was accustomed to foraging in Africa. Thus, hominins might have been pursuing game when they took those first fateful steps out of Africa.

Many more hominin migrations ensued in the millennia that followed, each driven by its own unique circumstances. And although our predecessors may not have always been tracking game on these trailblazing journeys, their ability to colonize far-flung places and thrive under wholly new ecological conditions hinged on the physical and behavioral traits that helped *Homo* become the least likely, most successful predator the world has ever known. ■

Kate Wong is a senior editor at Scientific American.

MORE TO EXPLORE

Earliest Archaeological Evidence of Persistent Hominin Carnivory. Joseph V. Ferraro et al. in *PLOS ONE*, Vol. 8, No. 4, Article No. e62174; April 25, 2013.

Elastic Energy Storage in the Shoulder and the Evolution of High-Speed Throwing in *Homo*. Neil T. Roach et al. in *Nature*, Vol. 498, pages 483–487; June 27, 2013.

Prey Mortality Profiles Indicate That Early Pleistocene *Homo* at Olduvai Was an Ambush Predator. Henry T. Bunn and Alia N. Gurtov in *Quaternary International*, Vols. 322–323, pages 44–53; February 16, 2014.

FROM OUR ARCHIVES

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