he ancient residents of Dmanisi had brains one-third to one-half the size of modern humans'. © KEN GARRETT

Meet the frail, small-brained people who first trekked out of Africa

By **Ann Gibbons** | Nov. 22, 2016 , 9:00 AM

On a promontory high above the sweeping grasslands of the Georgian steppe, a medieval church marks the spot where humans have come and gone along Silk Road trade routes for thousands of years. But 1.77 million years ago, this place was a crossroads for a different set of migrants. Among them were saber-toothed cats, Etruscan wolves, hyenas the size of lions—and early members of the human family.

Here, primitive hominins poked their tiny heads into animal dens to scavenge abandoned kills, fileting meat from the bones of mammoths and wolves with crude stone tools and eating it raw. They stalked deer as the animals drank from an ancient lake and gathered hackberries and nuts from chestnut and walnut trees lining nearby rivers. Sometimes the hominins themselves became the prey, as gnaw marks from big cats or hyenas on their fossilized limb bones now testify.

"Someone rang the dinner bell in gully one," says geologist Reid Ferring of the University of North Texas in Denton, part of an international team analyzing the site. "Humans and carnivores were eating each other."

> **"What was it that allowed them to move out of Africa without fire, without very large brains? How did they survive?"**
>
> *Donald Johanson, Arizona State University*

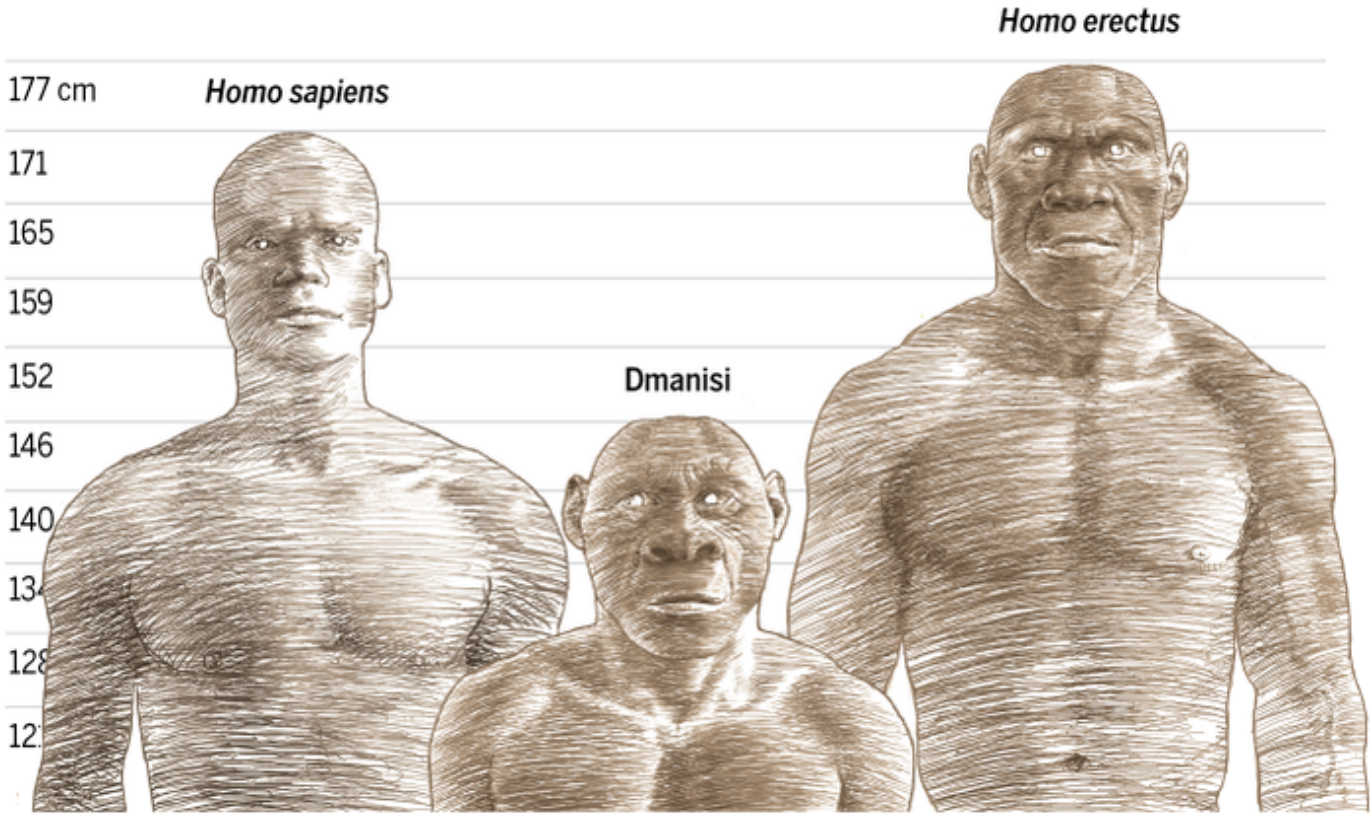
This is the famous site of Dmanisi, Georgia, which offers an unparalleled glimpse into a harsh early chapter in human evolution, when primitive members of our genus *Homo* struggled to survive in a new land far north of their ancestors' African home, braving winters without clothes or fire and competing with fierce carnivores for meat. The 4-hectare site has yielded closely packed, beautifully preserved fossils that are the oldest hominins known outside of Africa, including five skulls, about 50 skeletal bones, and an as-yet-unpublished pelvis unearthed 2 years ago. "There's no other place like it," says archaeologist Nick Toth of Indiana University in Bloomington. "It's just this mother lode for one moment in time."

Until the discovery of the first jawbone at Dmanisi 25 years ago, researchers thought that the first hominins to leave Africa were classic *H. erectus* (also known as *H. ergaster* in Africa). These tall, relatively large-brained ancestors of modern humans arose about 1.9 million years ago and soon afterward invented a sophisticated new tool, the hand ax. They were thought to be the first people to migrate out of Africa, making it all the way to Java, at the far end of Asia, as early as 1.6 million years ago. But as the bones and tools from Dmanisi accumulate, a different picture of the earliest migrants is emerging.

By now, the fossils have made it clear that these pioneers were startlingly primitive, with small bodies about 1.5 meters tall, simple tools, and brains one-third to one-half the size of modern humans'. Some paleontologists believe they provide a better glimpse of the early, primitive forms of *H. erectus* than fragmentary African fossils. "I think for the first time, by virtue of the Dmanisi hominins, we have a solid hypothesis for the origin of *H. erectus*," says Rick Potts, a paleoanthropologist at the Smithsonian Institution's National Museum of Natural History in Washington, D.C.

The trail of the little people

Short and small-brained, even compared with classic *Homo erectus*, the Dmanisi people or their immediate ancestors emerged from Africa and migrated thousands of kilometers into Asia.



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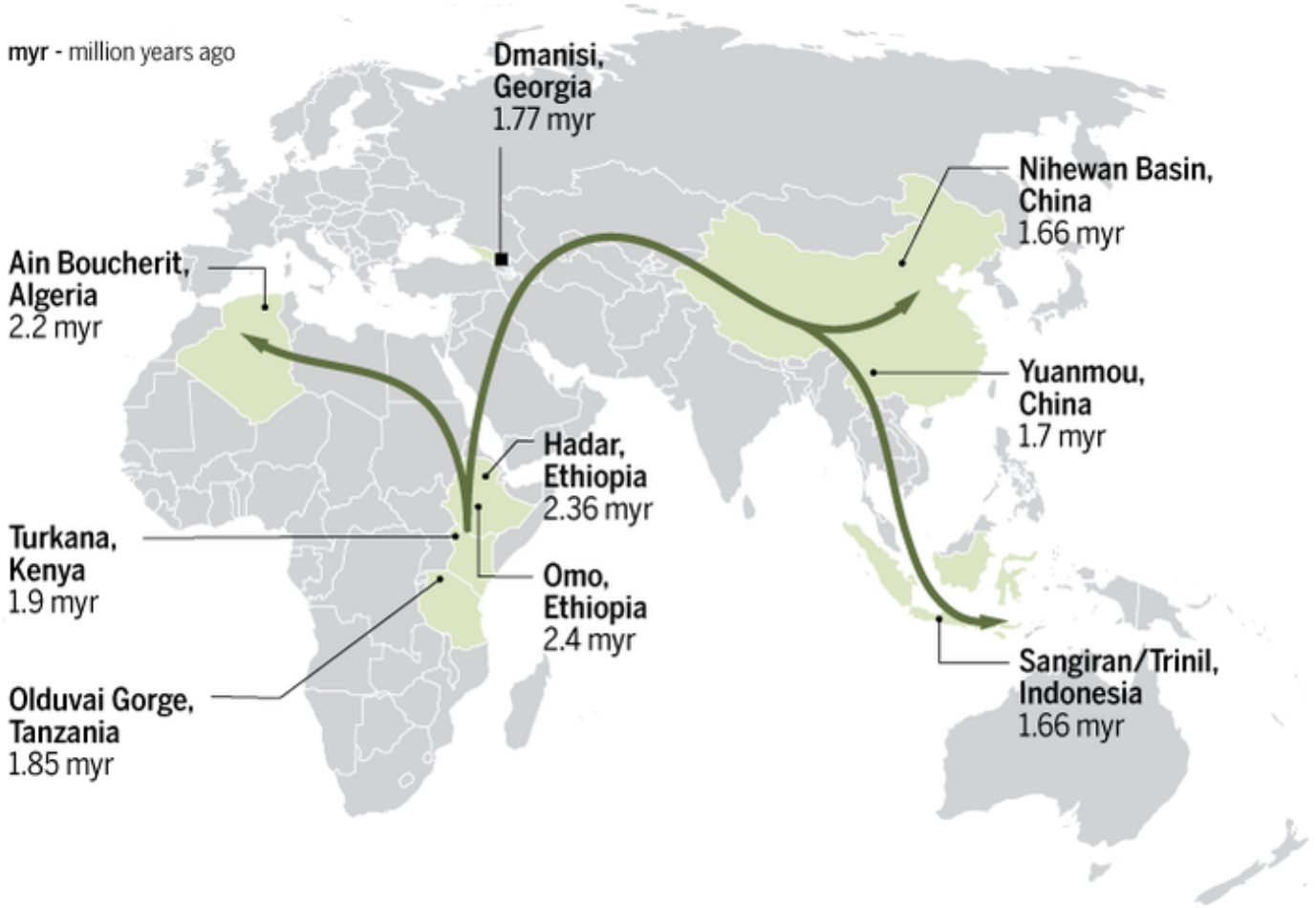
This fall, paleontologists converged in Georgia for "Dmanisi and beyond," a conference held in Tbilisi and at the site itself from 20–24 September. There researchers celebrated 25 years of discoveries, inspected a half-dozen pits riddled with unexcavated fossils, and debated a geographic puzzle: How did these primitive hominins—or their ancestors—manage to trek at least 6000 kilometers from sub-Saharan Africa to the Caucasus Mountains? "What was it that allowed them to move out of Africa without fire, without very large brains? How did they survive?" asks paleoanthropologist Donald Johanson of Arizona State University in Tempe.

They did not have it easy. To look at the teeth and jaws of the hominins at Dmanisi is to see a mouthful of pain, says Ann Margvelashvili, a postdoc in the lab of paleoanthropologist Marcia Ponce de León at the University of Zurich in Switzerland and the Georgian National Museum in Tbilisi. Margvelashvili found that compared with modern hunter-gatherers from Greenland and Australia, a teenager at Dmanisi had dental problems at a much younger age—a sign of generally poor health. The teen had cavities, dental crowding, and hypoplasia, a line indicating that enamel growth was halted at some point in childhood, probably because of malnutrition or disease. Another individual suffered from a serious dental infection that damaged the jawbone and could have been the cause of death. Chipping and wear in several others suggested that they used their teeth as tools and to crack bones for marrow. And all the hominins' teeth were coated with plaque,

the product of bacteria thriving in their mouths because of inflammation of the gums or the pH of their food or water. The dental mayhem put every one of them on "a road to toothlessness," Ponce de León says.

To the ends of earth

By following a trail of stone tools and fossils, researchers have traced possible routes for the spread of early *Homo* out of Africa to the far corners of Asia, starting about 2 million years ago.



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They did, however, have tools to supplement their frail bodies. Crude ones—but lots of them. Researchers have found more than 15,000 stone flakes and cores, as well as more than 900 artifacts, in layers of sediments dating from 1.76 million to 1.85 million years ago. Even though *H. erectus* in East Africa had invented hand axes, part of the so-called Acheulean toolkit, by 1.76 million years ago, none have been found here at Dmanisi. Instead, the tools belong to the "Oldowan" or "Mode 1" toolkit—the first tools made by hominins, which include simple flakes for scraping and cutting and spherical choppers for pounding. The Oldowan tools at Dmanisi are crafted out of 50 different raw materials, which suggests the toolmakers weren't particularly selective. "They were not choosing their raw material—they were using everything," says archaeologist David Zhvania of the Georgian National Museum.

That simple toolkit somehow enabled them to go global. "They were able to adjust their behavior to a wide variety of ecological situations," Potts says. Perhaps the key was the ability to butcher meat with these simple tools—if hominins could eat meat, they could survive in new habitats where they didn't know which plants were toxic. "Meat eating was a big, significant change," says paleoanthropologist Robert Foley of the University of Cambridge in the United Kingdom.

Even with their puny stone flakes, "these guys were badass," competing for meat directly with large carnivores, Toth says. At the meeting, he pointed to piles of cobblestones near the entrance of an ancient gully, which suggest the hominins tried to fend off (or hunt) predators by stoning them.

Simple stone flakes, like those removed from this core, enabled the Dmanisi hominins to butcher meat. MALKHAZ MACHAVARIANI, © THE GEORGIAN

They set their own course as they left Africa. Researchers had long thought that *H. erectus* swept out of their native continent in the wake of African mammals they hunted and scavenged. But all of the roughly 17,000 animal bones analyzed so far at Dmanisi belong to Eurasian species, not African ones, according to biological anthropologist Martha Tappen of the University of

Minnesota in Minneapolis. The only mammals not of Eurasian origin are the hominins—"striking" evidence the hominins were "behaving differently from other animals," Foley says.

Perhaps venturing into new territory allowed the hominins to hunt prey that would not have known to fear and flee humans, suggests paleoanthropologist Robin Dennell of the University of Exeter in the United Kingdom. Tappen calls that an "intriguing new idea" but thinks it should be tested. Checking the types of animal bones at other early Homo fossil sites out of Africa could show whether the mix of prey species changed when hominins colonized a new site, supporting a "naïve prey" effect.

Whatever impelled them, the migrants left behind a trail of tools that have enabled researchers to trace their steps out of Africa. There, the oldest stone tools, likely fashioned by the first members of early Homo, such as small-brained *H. habilis*, date reliably to 2.6 million years ago in Ethiopia (and, possibly, 3.3 million years in Kenya). New dates for stone tools and bones with cutmarks at Ain Boucherit, in the high plateau of northeastern Algeria, suggest that hominins had crossed the Sahara by 2.2 million years ago when it was wetter and green, according to archaeologist Mohamed Sahnouni of the National Centre for Research on Human Evolution in Burgos, Spain. His unpublished results, presented at the Dmanisi meeting, are the earliest evidence of a human presence in northern Africa.

The next oldest tools are those from Dmanisi, at 1.85 million years old. The trail of stone tools then hopscotches to Asia, where Mode 1 toolkits show up by nearly 1.7 million years ago in China and 1.6 million in Java, with *H. erectus* fossils. "We pick up little fractions of a current" of ancient hominin movements, Foley says.

Now the site of a medieval church, the promontory at Dmanisi has been a crossroads for humans and animals for at least 1.8 million years. KEN GARRETT

The identity of the people who dropped these stone breadcrumbs is a mystery that has only deepened with study of the Dmanisi fossils. The excavation team has classified all the hominins at the Georgia site as *H. erectus*, but they are so primitive and variable that researchers debate whether they belong in *H. erectus*, *H. habilis*, a separate species, *H. georgicus*—or a mix of all three, who may have inhabited the site at slightly different dates.

A new reanalysis of the Dmanisi skulls presented at the meeting added fuel to this debate by underscoring just how primitive most of the skulls were. Using a statistics-based technique to compare their shape and size with the skulls of many other hominins, Harvard University paleoanthropologist Philip Rightmire found that only one of the Dmanisi skulls—at 730 cubic centimeters—fits "comfortably within the confines of *H. erectus*." The others—particularly the smallest at 546 cc—cluster more closely with *H. habilis* in size.

Nor did the Dmanisi hominins walk just like modern humans. A new analysis of cross sections of three toe bones found that the cortical bone—the dense outer layer—wasn't buttressed in the same way as it is in the toes of modern humans. When these hominins "toed off," the forces on their toes must have been distributed differently. They may have walked a bit more like chimps, perhaps pushing off the outside edge of their foot more, says Tea Jashashvili of the University of Southern California in Los Angeles and the Georgian National Museum.

"If there are so many primitive traits, why are they calling it *H. erectus*?" asks Ian Tattersall, a paleoanthropologist at the American Museum of Natural History in New York City. "People are avoiding the question of what *H. erectus* is. Every time new stuff comes up, they're enlarging the taxon to fit new stuff in." Foley ventures: "I haven't the slightest idea of what *H. erectus* means."

Fossils and scientists mingle at the Georgian National Museum in Tbilisi. MIRIAN KILADZE, © THE GEORGIAN NATIONAL MUSEUM

Indeed, *H. erectus* now includes the 1-million-year-old type specimen from Trinil on the island of Java as well as fossils from South Africa, East Africa, Georgia, Europe, and China that span roughly 300,000 to 1.9 million years. "They're putting everything into *H. erectus* over huge geographical distances, essentially spread throughout the whole world, and over a vast number of years," Johanson says.

Yet no other species matches the Dmanisi specimens better, Rightmire says. For example, the shapes of their dental palate and skulls match those of *H. erectus*, not *H. habilis*. And the variation in skull size and facial shape is no greater than in other species, including both modern humans or chimps, says Ponce de León—especially when the growth of the jaw and face over a lifetime are considered.

Though the fossils' small stature and brains might fit best with *H. habilis*, their relatively long legs and modern body proportions place them in *H. erectus*, says David Lordkipanidze, general director of the Georgian National Museum and head of the Dmanisi team. "We can't forget that these are not just heads rolling around, dispersing around the globe," Potts adds. Like Rightmire, he thinks the fossils represent an early, primitive form of *H. erectus*, which had evolved from a *H. habilis*–like ancestor and still bore some primitive features shared with *H. habilis*.

Regardless of the Dmanisi people's precise identity, researchers studying them agree that the wealth of fossils and artifacts coming from the site offer rare evidence for a critical moment in the human saga. They show that it didn't take a technological revolution or a particularly big brain to cross continents. And they suggest an origin story for first migrants all across Asia: Perhaps

some members of the group of primitive *H. erectus* that gave rise to the Dmanisi people also pushed farther east, where their offspring evolved into later, bigger-brained *H. erectus* on Java (at the same time as *H. erectus* in Africa was independently evolving bigger brains and bodies). "For me, Dmanisi could be the ancestor for *H. erectus* in Java," says paleoanthropologist Yousuke Kaifu of the National Museum of Nature and Science in Tokyo.

In spite of the remaining mysteries about the ancient people who died on this windy promontory, they have already taught researchers lessons that extend far beyond Georgia. And for that, Lordkipanidze is grateful. At the end of a barbecue in the camp house here, he raised a glass of wine and offered a toast: "I want to thank the people who died here," he said.

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