IN DEPTH

HUMAN EVOLUTION

Ancient jaw gives elusive Denisovans a face

New protein method identifies first Denisovan outside of Siberia, on Tibetan Plateau

By **Ann Gibbons**

Thirty-nine years ago, a Buddhist monk meditating in a cave on the edge of the Tibetan Plateau found something strange: a human jawbone with giant molars. The fossil eventually found its way to scientists. Now, almost 4 decades later, a groundbreaking new way to identify human fossils based on ancient proteins shows the jaw belonged to a Denisovan, a mysterious extinct cousin of Neanderthals.

The jawbone is the first known fossil of a Denisovan outside of Siberia's Denisova Cave in Russia, and gives paleoanthropologists their first real look at the face of this lost member of the human family. "We are finally 'cornering' the elusive Denisovans," paleoanthropologist María Martinón-Torres of the National Research Center on Human Evolution in Burgos, Spain, wrote in an email. "We are getting their smiles!"

Together, the jaw's anatomy and the new method of analyzing ancient proteins could help researchers learn whether other mysterious fossils in Asia are Denisovan. "We now can use this fossil and this wonderful new tool to classify other fossil remains that we can't agree on," says paleoanthropologist Aida Gomez-Robles of University College London, who reviewed the paper, which appears in *Nature* this week.

The international team of researchers also reports that the jawbone is at least 160,000 years old. Its discovery pushes back the earliest known presence of humans at high altitude by about 120,000 years.

A massive search for Denisovans has been underway ever since paleogeneticists extracted DNA from the pinkie of a girl who lived more than 50,000 years ago in Denisova Cave and found she was a new kind of human. Max Planck Society researchers have since sequenced DNA from several Denisovans from the cave (*Science*, 1 February, p. 438), but the fossils—isolated teeth and bits of bone—were too scanty to show what this enigmatic hominin looked like. Denisovans must have been widespread, because many living people in Melanesia and Southeast Asia carry traces of DNA from multiple encounters between modern humans and Denisovans (*Science*, 5 April, p. 12). But although intriguing fossils across Asia could be Denisovan, they have not yielded the DNA that could confirm their identity.

The proteins in this lower jawbone, which was found by a Chinese monk in a holy cave high on the Tibetan Plateau (top), identify it as Denisovan.

Enter the new jawbone, found by an unidentified monk in Baishiya Karst Cave in Xiahe county in China at an altitude of 3200 meters on the margins of the Tibetan Plateau, according to co-author Dongju Zhang, an archaeologist at Lanzhou University in northwestern China. She traced the jawbone's discovery by interviewing local people in Xiahe, who told her they remembered human bones from the large cave, which is next to a Buddhist shrine and is still a holy place as well as tourist attraction. Recognizing the jaw's unusual nature, the monk gave it to the sixth Gung-Thang living Buddha, one of China's officially designated "living Buddhas," who consulted scholars and then gave the jaw to Lanzhou University. The jawbone was so "weird" that researchers there didn't know how to classify it, and it sat on shelves for years, Zhang says.

She and geologist Fahu Chen, also from Lanzhou University and the Institute of Tibetan Plateau Research in Beijing, showed the jaw to paleoanthropologist Jean-Jacques Hublin of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. After seeing its large molars—as big as ones found in Denisova Cave—Hublin immediately suspected it was Denisovan.

PHOTOS: DONGJU ZHANG/LANZHOU UNIVERSITY

Max Planck paleogeneticists couldn't get DNA from the jaw, but Hublin's graduate student Frido Welker had found in his doctoral work that Neanderthals, modern humans, and Denisovans differ in the amino acid sequence of key proteins. Welker, now a postdoc at the University of Copenhagen, was able to extract collagen, a common structural protein, from a molar of the Xiahe jawbone. He found its amino acid sequence most closely matched that of Denisovans.

Other team members dated a carbonate crust that had formed on the skull by measuring the radioactive decay of uranium in the carbonate. They got a date of 160,000 years ago—a "firm minimum date" for the skull, says geochronologist Rainer Grün of Griffith University in Nathan, Australia, who is not a member of the team.

The date suggests Denisovans would have had tens of thousands of years to adapt to the altitude of Tibet by the time modern humans arrived in the region, some 30,000 to 40,000 years ago. Encounters between modern humans and Denisovans adapted to high altitude could explain how the Tibetans of today came by a Denisovan gene that helps them cope with thin air (*Science*, 30 November 2018, p. 1049). "It seems likely that ancestral Tibetans interacted with Denisovans, as they began to move upslope," archaeologist David Madsen of the University of Texas in Austin wrote in an email.

The jaw's features could be a template for spotting other Denisovans. "Its distinct large molars and premolar roots differ from those of Neanderthals," and the jawbone "is very primitive and robust," says Hublin, who sees a resemblance to a jawbone found off the coast of Taiwan known as the Penghu mandible.

What anatomy can't confirm, proteins might. "The protein analyses allow us to see landscapes where DNA cannot reach"—from warmer climates or much more ancient sites where fragile DNA doesn't persist, Martinón-Torres says. Other researchers have a half-dozen fossils they want to test for proteins or compare with the Xiahe jaw.

The implications are far-reaching. "Forget the textbooks," says archaeologist Robin Dennell of the University of Sheffield in the United Kingdom. "Human evolution in Asia is far more complex than we currently understand, and probably does involve multiple lineages, some of which probably engaged with our species."

Meanwhile, Chen and Zhang did their first excavation at the cave in December 2018, with permission from local villagers and Buddhists. They dug two small trenches where they have already found stone tools and cut-marked rhino and other animal bones. "We do have hope we'll find more Denisovans," Zhang says. ■

FUNDING

Austerity cuts threaten future of science in Argentina

Young scientists are left with few career options while labs scramble to pay for equipment, reagents, and cleaning

By **Lindzi Wessel**

Thousands of scientists from labs across Argentina stayed home on 30 April, joining a nationwide strike against the government's latest round of austerity measures, according to estimates from research leaders. One of their key rallying points: a call to restore lost opportunities for young researchers who began their education during a time of high investment in science but now have little hope of continuing their careers in Argentina.

In the latest blow, the National Scientific and Technical Research Council (CONICET), headquartered in Buenos Aires, announced on 5 April that it had a mere 450 new first-time investigator positions available for this year's roughly 2600 graduates of Ph.D. and postdoctoral programs—leaving a record number of trainees without jobs. The previous government had projected that about 1400 new jobs would be available. Without a position with CONICET, which employs more than 20,000 researchers in hundreds of centers around the country, young scientists have few opportunities.

> ***"You think 100 times before running an experiment and you pray it won't fail."***
> **Juan Pablo Jaworski**, National Institute of Agricultural Technology

CONICET institute directors themselves are fighting the cuts. On 13 April, 140 paid their own way to the city of Córdoba for an emergency meeting. "The number of directors attending was significant evidence of the crisis we are facing right now," says biological anthropologist Rolando González-José, an institute head at the National Patagonian Center in Puerto Madryn. (CONICET did not respond to emails from *Science*.)

The meeting resulted in a manifesto demanding "the immediate implementation of a plan to rescue CONICET," including a scholarship extension for the trainees who missed out on a job and are now scrambling for other opportunities. It also called for an emergency budget increase for CONICET. The group has yet to receive a response from the government.

The plight of science reflects a broad economic crisis in Argentina, where massive inflation and a slipping peso have forced many government agencies and private businesses to tighten their belts. The nation recently received a bailout package of more than $57 billion from the International Monetary Fund that comes with stiff requirements, including a commitment to cut the deficit to zero this year.

The impact on science has already been dramatic. Investment in R&D was just 0.26% of gross domestic product in 2018, down from 0.53% just 3 years earlier. Many CONICET institutes have cut back on such basic needs as cleaning and security services, as well as on research operations. The peso's drop has made imported equipment and reagents virtually unaffordable. "You think 100 times before running an experiment and you pray it won't fail," says Juan Pablo Jaworski, a CONICET virologist at the National Institute of Agricultural Technology.

The dismal job prospects for young researchers are bound to accelerate Argentina's brain drain, says Alberto Kornblihtt, head of CONICET's Institute for Physiology, Molecular Biology, and Neurosciences. Kornblihtt recently saw two junior principal investigators leave his institute to find labs abroad after struggling to make ends meet for a year. "We can't just say you don't have any place in this country, go abroad," he says.

The protests will continue. CONICET directors are planning their own push for public support at a 22 May national *cabildo abierto*, or open council, a form of protest structured around public debate. Yet González-José can't help but feel pessimistic, because the scientific community has been ignored before. The resistance is getting stronger, he concedes, but "the resistance is getting stronger because the problems are getting worse." ■

Lindzi Wessel is a freelance journalist in Santiago.