Bones recovered from a Czech cave are among the oldest modern human remains yet found in Europe.

PHOTO: ALEXANDR KOMAŠKO

PALEOANTHROPOLOGY

Study reveals kinship among first modern humans in Europe

Ancient DNA links people across hundreds of kilometers

By **Andrew Curry**

In 1950, researchers found a skull and spine fragments at the bottom of a Czech cave called Zlatý kůň. Stone tools and mammal fossils found nearby suggested the bones were very old, and the skull's shape led archaeologists to guess it belonged to a woman. Her age was a mystery, however, as the organic glue conservators had used to piece her bones together threw off radiocarbon dating techniques.

Now, researchers have found her relatives by analyzing DNA from the bones of six individuals buried in a German cave called Ranis 230 kilometers away. The findings, out this week in *Nature*, pin down when the Zlatý kůň woman lived to about 45,000 years ago and shed light on the remarkably mobile lifestyle of the earliest groups of modern humans to enter Europe. And the new data add to evidence that soon after modern humans left Africa, just a few thousand years earlier, they began extensive, enduring trysts with Neanderthals, the human cousins who had occupied Europe for hundreds of thousands of years.

Teasing these genetic details from multiple individuals buried so deep in prehistory required a "Goldilocks situation," says Michelle Langley, an archaeologist at Griffith University who was not involved with the research. "You need the right location, the right time period, and the right level of preservation where you can get DNA. … It's a really remarkable find."

Perhaps the most poignant discovery came from a delicate collarbone found in the Ranis cave. Dubbed Ranis 6, it belonged to a young girl who was between 2 and 4 years old when she died. Nearby, the researchers found additional bones that ancient DNA confirmed belonged to the girl's mother. "This was the most mind-blowing part of the paper for me," says Arev Sümer, a paleogeneticist at the Max Planck Institute for Evolutionary Anthropology (EVA) who was the lead author of the new research. "I didn't think they would be so close."

The DNA also showed the mother was related to the woman who died 230 kilometers away at Zlatý kůň. Because stretches of DNA get broken up and shortened with each new generation, the team could use the length of identical segments in the widely separated individuals to estimate how many generations had passed since they had a common ancestor. "We can not only say they're genetically quite close, but we can tell they lived within six generations of each other, at most," says EVA geneticist Kay Prüfer, a co-author of the *Nature* paper. The Ranis pair, radiocarbon dated to between 42,000 and 49,000 years ago, were likely distant cousins of the Zlatý kůň woman. Together, their DNA would represent the earliest modern human genomes yet sequenced.

Extensive genetic similarities between all the individuals, meanwhile, suggest they belonged to a population numbering only about 200 people at any given time. Archaeologists think they probably lived in small, scattered bands that came together occasionally to exchange mates but ranged all across Europe, leaving distinctive, leaf-shaped stone tools from what is now the United Kingdom all the way to Poland. "That tells us they were highly mobile, following herds of mammoth and reindeer across the landscape according to the seasons," says EVA geneticist Johannes Krause, a co-author on the *Nature* paper.

The Zlatý kůň skull was largely intact, allowing them to reconstruct the shape of the woman's face. She and others shared genes for dark skin and eyes, and lacked genes for lighter pigmentation. "This group is among the earliest to split from the lineage that left Africa," Sümer says. "It makes sense that they reflect the phenotypical characteristics of sub-Saharan African groups."

The new genomes confirm that close to the time these immigrants arrived in Europe, they met and mated with Neanderthals who occupied the continent. By analyzing the proportions and lengths of the Neanderthal DNA segments in the DNA of these ancient Europeans, the researchers were able to estimate that just 80 to 100 generations, or about 2000 years, had passed since their ancestors last mated with Neanderthals. The result, which dovetails with a parallel study released earlier this year in a preprint and published today in *Science*, suggest a major episode of mixing took place some 45,000 years ago—far more recently than scientists had thought.

"This gives us a lot of new data to figure out when, where, and how many times there was contact between modern humans and Neanderthals," says Damien Flas, an archaeologist at the French national research agency CNRS who was not involved in the research. "It's a really nice discovery."

Both studies show the Neanderthal DNA—which makes up between 2% and 4% of the genes in all modern humans living outside of sub-Saharan Africa—resulted not from a few dalliances, but many generations of mixing. "About 45,000 years ago, you had to have a population that stayed together long enough for everyone in the group to have some Neanderthal ancestry," Prüfer says.

The ancient genomes delivered one more poignant finding: The ancient family tree the researchers traced at Zlatý kůň and Ranis soon withered, leaving no trace in modern people's DNA. Based on when their tools disappeared, archaeologists think these pioneers died out about 40,000 years ago. "A lot of the oldest *Homo sapiens* DNA we have in Eurasia doesn't seem to have left a lot of inheritance in modern populations," Flas says. "It was a lot of small populations, facing a lot of environmental and climate change. Some just vanished." ■