Study uses genetic evidence to trace ancient African migration

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Stanford University researchers peering at history's footprints on human DNA have found new evidence for how prehistoric people shared knowledge that advanced civilization.

Using a genetic technique pioneered at Stanford, the team found that animal-herding methods arrived in southern Africa 2,000 years ago on a wave of human migration, rather than by movement of ideas between neighbors. The findings shed light on how early cultures interacted with each other and how societies learned to adopt advances.

"There's a tradition in archaeology of saying people don't move very much; they just transfer ideas through space," said Joanna Mountain, PhD, consulting assistant professor of anthropology. Mountain and Peter Underhill, PhD, senior research scientist in genetics at Stanford's School of Medicine, were the study's senior authors. Their findings will appear in the Aug. 5 advance online edition of *Proceedings of the National Academy of Science*.

"We know that humans had to migrate at some point in their history, but we also know humans tend to stay put once they get someplace," Underhill said.

Instead of using archaeological evidence alone to guess whether people migrated, "all of a sudden, with genetics, you can actually address that question," Mountain said.

The researchers tracked genetic variation on the Y chromosome, the sex chromosome passed from father to son that encodes maleness, using a technique now widely used that was developed in the early 1990s by Underhill and colleagues in the lab of Luigi Cavalli-Sforza, professor emeritus of genetics. The method has given scientists a powerful window into ancient human migrations and prehistoric cultural shifts. The technique has also been adopted by some commercial genealogy services that offer Y-chromosome testing to the public.

Previous research suggested that prehistoric people in eastern and southern Africa had little contact, with only two known migrations between the regions about 30,000 and 1,500 years ago. After Bantu-language speakers migrated from eastern to southern Africa 1,500 years ago, agriculture took off in southern Africa. But the timing of the Bantu migration didn't quite match the 2,000-year-old anthropological evidence for the first sheep and cattle herds in southern Africa, so anthropologists were unsure whether the region's agricultural knowledge came from a bow-wave of ideas that spread in front of the migrating Bantu, or whether a separate migration brought the first herders.

"Africa has the most genetic diversity in the world, but it is one of the least-studied places," said Brenna Henn, a doctoral student in anthropology who was the study's lead author. "I've always felt like there were a lot of stories there that nobody's had the time or interest to look into."

The Stanford scientists picked the Y sex chromosome to examine for clues to migration because it changes very little from one generation to the next. Autosomes - the non-sex chromosomes - come in pairs, and the members of a pair can exchange bits of DNA during reproduction, making each autosome a mishmash of DNA from all of an individual's ancestors. But the Y chromosome is a singleton; males inherit one Y chromosome and one X chromosome, while women have two X chromosomes. In men, only a tiny region of the Y chromosome can swap DNA with the X chromosome. This means almost all of the Y chromosome moves intact from father to son, changing only infrequently when a new mutation arises. That allows researchers to examine several generations of ancestry by looking at the Y chromosomes of living men.

"The family tree of the Y chromosome is very, very clear," Mountain said.

The team analyzed Y chromosomes from men in 13 populations in Tanzania in eastern Africa and in the Namibia-Botswana-Angola border region of southern Africa. They discovered a novel mutation shared by some men in both locations, which implied those men had a common ancestor. Further analysis showed the novel mutation arose in eastern Africa about 10,000 years ago and was carried by migration to southern Africa about 2,000 years ago. The mutation was not found in Bantu-speakers, suggesting that a different group - Nilotic-language speakers - first brought herds of animals to southern Africa before the Bantu migration.

This new genetic evidence correlates well with pottery, rock art and animal remains that suggest pastoralists - herders who migrated to new pasture with their flocks - first tended sheep and cattle in southern Africa around 2,000 years ago. The genetic finding also helps explain linguistic similarities between peoples in the two regions.

"I like the fact that the linguistic, genetic and archaeological evidence all line up," Henn said. "When you see lines of evidence converge on a single model, it means that's probably something that actually happened."

Underhill and Roy King, MD, PhD, associate professor of psychiatry and behavioral sciences, published a similar paper in the June issue of the journal Antiquity. That study used Y chromosome evidence to examine how climate change drove prehistoric migration in the Middle East. They found that a shift in rainfall 10,000 years ago propelled a cultural split among genetically related people. Some stayed in rainy areas and grew crops, while others moved to arid regions and lived the nomadic life of pastoralist herders. The groups didn't intermingle much after the split, perhaps explaining the origins of modern Middle Eastern cultures.

Genetic evidence gives a degree of clarity to the study of prehistoric migration that's hard to achieve in other ways.

"So rarely do we get to pin down the questions raised by archaeology," Mountain said.

Source: Stanford University Medical Center

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