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Humans Interbred With Hominins on Multiple Occasions, Study Finds

Carl Zimmer MARCH 17, 2016

Skulls of the Neanderthal man. Credit European Pressphoto Agency

The ancestors of modern humans interbred with Neanderthals and another extinct line of humans known as the Denisovans at least four times in the course of prehistory, according to an analysis of global genomes published on Thursday in the journal Science.

The interbreeding may have given modern humans genes that bolstered immunity to pathogens, the authors concluded.

“This is yet another genetic nail in the coffin of our over-simplistic models of human evolution,” said Carles Lalueza-Fox, a research scientist at the Institute of Evolutionary Biology in Barcelona who was not involved in the study.

The new study expands on a series of findings in recent years showing that the ancestors of modern humans once shared the planet with a surprising number of near relatives — lineages like the Neanderthals and Denisovans that became extinct tens of thousands of years ago.

Before disappearing, however, they interbred with our forebears on at least several occasions, and today we carry DNA from these encounters.

The first clues to ancient interbreeding surfaced in 2010, when scientists discovered that some modern humans — mostly Europeans — carry DNA that matches material recovered from Neanderthal fossils.

Later studies showed that the forebears of modern humans first encountered Neanderthals after expanding out of Africa more than 50,000 years ago.

But the Neanderthals were not the only extinct humans that our own ancestors found. A finger bone discovered in a Siberian cave, called Denisova, yielded DNA from yet another group of humans.

Research later indicated that all three groups — modern humans, Neanderthals and Denisovans — shared a common ancestor who lived roughly 600,000 years ago. And, perhaps no surprise, some ancestors of modern humans also interbred with Denisovans.

Some of their DNA has survived in people in Melanesia, a region of the Pacific that includes New Guinea and the islands around it.

Those initial discoveries left major questions unanswered, such as how often our ancestors interbred with Neanderthals and Denisovans. Scientists have developed new ways to study the DNA of living people to tackle these mysteries.

Joshua M. Akey, a geneticist at the University of Washington, and his colleagues analyzed a database of 1,488 genomes from people around the world. The scientists added 35 genomes from people in New Britain and other Melanesian islands in an effort to learn more about Denisovans in particular.

The researchers found that all the non-Africans in their study had Neanderthal DNA, while the Africans had very little or none. That finding supported previous studies.

But when Dr. Akey and his colleagues compared DNA from modern Europeans, East Asians and Melanesians, they found that each population carried its own distinctive mix of Neanderthal genes.

The best explanation for these patterns, the scientists concluded, was that the ancestors of modern humans acquired Neanderthal DNA on three occasions.

The first encounter happened when the common ancestor of all non-Africans interbred with Neanderthals.

The second occurred among the ancestors of East Asians and Europeans, after the ancestors of Melanesians split off. Later, the ancestors of East Asians — but not Europeans — interbred a third time with Neanderthals.

Earlier studies had hinted at the possibility that the forebears of modern humans had multiple encounters with Neanderthals, but until now hard data was lacking.

“A lot of people have been arguing for that, but now they’re really providing the evidence for it,” said Rasmus Nielsen, a geneticist at the University of California, Berkeley, who was not involved in the new study.

The Melanesians took a different course. After a single interbreeding with Neanderthals, Dr. Akey found, their ancestors went on to interbreed just once with Denisovans, as well.

Where that encounter could have taken place remains an enigma. The only place Denisovan remains have been found is Siberia, a long way from New Guinea.

It is possible that Denisovans ranged down to Southeast Asia, Dr. Akey said, crossing paths with modern humans who would later settle in Melanesia.

Dr. Akey and his colleagues also identified some regions of Neanderthal and Denisovan DNA that became more common in modern humans as the generations passed, suggesting that they provided some kind of a survival advantage.

Many of the regions contain immune system genes, Dr. Akey noted.

“As modern humans are spreading out across the world, they’re encountering pathogens they haven’t experienced before,” he said. Neanderthals and Denisovans may have had genes that were adapted to fight those enemies.

“Maybe they really helped us survive and thrive in these new environments,” he said.

Dr. Akey and his colleagues found that Neanderthal and Denisovan DNA was glaringly absent from four regions of the modern human genome.

That absence may signal that these stretches of the genome are instrumental in making modern humans unique. Intriguingly, one of those regions includes a gene called FOXP2, which is involved in speech.

Scientists suspect that Neanderthals and Denisovans were not the only extinct races our ancestors interbred with.

PingHsun Hsieh, a biologist at the University of Arizona, and his colleagues reported last month that the genomes of African pygmies contain pieces of DNA that came from an unknown source within the last 30,000 years.

Dr. Akey and his colleagues are now following up with an analysis of African populations. “This potentially allows us to find new twigs on the human family tree,” he said.