Lehi's DNA: What's missing?

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Editor's note: Second of four articles

It is possible that the Book of Mormon prophet Lehi came to the Americas and left many descendants — but no traceable DNA. To understand what may have happened to Lehi's DNA, it is necessary to understand how population geneticists track populations.

According to Ugo Perego, senior researcher at Sorenson Molecular Genealogy Foundation, the nucleus of the human cell contains about 3.2 billion pieces of genetic information. This "nuclear DNA" is harder to use for population studies because it changes too quickly from generation to generation — almost like shuffling a huge stack of cards.

Outside of the nucleus, but still in the human cell, is something called mitochondrial DNA, or mtDNA for short. MtDNA contains only 16,569 pieces of genetic information. Perego said mtDNA is good for tracing populations because, unlike nuclear DNA, it doesn't recombine with other DNA every generation. However, every once in a while, a random mutation — a slight mistake in copying the mtDNA — will be passed on to the next generation.

Compare mtDNA to a 16,569-word book. Occasionally, a word or two might be changed by accident in an edition — such as "an" being changed to "a." That mistake will then be in every subsequent edition. Over time, in other editions, other changes happen. Some editions are printed in different areas with their own unique mistakes.

Now imagine a scholar gathering various editions of the book. All the cumulative

mistakes leave a trail of when and where an edition was published and how it is related to other editions. Population geneticists do a similar thing when they look at the various mutations in mtDNA.

Large groups of people that share similar mtDNA mutations are called haplogroups. "A haplogroup is a group of genetic lineages sharing common characteristics. The reason they share this common characteristic is because they share a common origin or female ancestry," Perego said.

This "female ancestry" thing about mtDNA may seem strange. It only passes from a mother to her children. You have your mother's mtDNA. She has her mother's. And because changes in mtDNA are infrequent, it is likely that your mtDNA is nearly identical to your great-great-great-great-grandmother's mtDNA. There could be millions of people with similar mtDNA — and not a one of them got that mtDNA from a man. If a woman only had sons, her mtDNA ends with them. It goes no further.

Perego used the example of a family he knows in Italy. The father had five daughters. How many of those daughters have his mtDNA? None. Those daughters gave him 28 grandchildren. If that Italian father had married an African woman, all these grandchildren would be classified as African using their mtDNA.

The father in Perego's example was genealogically related to all his grandchildren but left no trace of his mtDNA in any of them. In fact, his grandchildren's mtDNA could have more in common with complete strangers from other centuries than with the father's mtDNA.

Perego points out the immediate way this information could affect looking at the Book of Mormon. "Let's say 20 people came with Lehi and 10 were men and 10 were women. The next generation you already lose 50 percent of the mitochondrial DNA just because all the men will not pass it on. Lehi's mitochondrial DNA is gone. Ishmael's mitochondrial DNA is gone. Zoram's mitochondrial DNA is gone. Period. That's just how it works."

This leaves two women to pass on mtDNA: Ishmael's wife and Lehi's wife, Sariah.

But wouldn't the women in Lehi's group have similar mtDNA to Lehi's?

"That is a very wrong assumption to make," Perego said. "You can find in any population a great variety of mitochondrial DNA lineages. You would find a higher frequency of certain lineages and a lower frequency of other lineages, but in most populations you would find a very good variety."

Most of the studies done on Native Americans to date utilized only a small part of the mtDNA. In the book edition analogy, this is like looking for changes in only the first 300 to 500 words in our 16,569-word book.

Perego calls studies that look at only a small portion of mtDNA "low resolution." A complete sequence of a person's entire mtDNA is "high resolution" and can give greater information. But so far, these complete sequences are rare — and expensive. According to Perego, in the entire world, there have been about 6,000 complete sequences of mtDNA samples — and less than 300 on Native Americans.

In the early 1990s, low-resolution studies of Native American mtDNA samples identified four Native American haplogroups. These groups were given the utilitarian names A, B, C and D and were identified as originating in Asia.

"These studies are based on samples collected from modern people. We are reconstructing the history of mankind … based on the DNA we observe in today's population," Perego said. "Are all lineages that ever existed throughout any given point through history available today for testing? No. Did we test every single lineage available today? … No. … We are really at the beginning of population genomics. We are not at the end, like some people like to believe. We are at the beginning."

Next week: The three inescapable principles of population genetics.

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