Founder effect, genetic drift, bottlenecks and the Book of Mormon

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Published: 2010-04-12 00:18:55

As explained last week in our discussion of DNA and the Book of Mormon, although mitochondrial DNA (mtDNA) is passed from mother to child, certain markers (known as "haplotypes," which help define "haplogroups") can disappear in subsequent generations. A bottleneck, for example, can occur when a large portion of a population dies from war, famine or disease and the haplotypes of the surviving group don't accurately represent the diversity of the larger group from which they emerged. This type of bottleneck likely occurred when diseases introduced by the Spaniards wiped out millions of Native Americans -- perhaps up to 80 percent of pre-Columbian populations.

In fact, non-LDS molecular anthropologist Michael H. Crawford wrote that the Spanish Conquest "squeezed the entire Amerindian population through a genetic bottleneck. ... This population reduction has forever altered the genetics of the surviving groups, thus complicating any attempts at reconstructing the pre-Columbian genetic structure of most New World groups," (The Origins of Native Americans, 1998).

Another effect on population dynamics, known as the "founder effect," happens when few individuals -- the founders -- leave a larger group and carry with them only a small fraction of the genetic markers from the original cluster, which could be significantly different and not adequately represent the source population. This may have happened with the founding Book of Mormon peoples. They were all smaller groups who came from larger groups.

Then we have the problem caused by "genetic drift," which basically boils down to "lucky genes." As the number of generations increase from a founding mother to her descendants, the chance of her DNA disappearing increases with each generation. For example, if you go back two generations (to your grandparents), there are four individuals (two parents for each of your parents), two of which are female (grandmothers on both sides). Only one of these grandmothers will have passed on her mtDNA to you, regardless of whether you are male or female. You will not have the mtDNA of one of your grandmothers.

If we go back 10 generations, you have 1,024 ancestral slots, or number of possible contributors to your genetic makeup. The actual number of progenitors is actually lower than the number of slots because some of these people will show up in several places of the available 1,024 ancestral slots. Of these 1,024 potential ancestors, 512 are females. Only one of them has contributed your mtDNA.

Because there are about 70 to 90 generations between modern Native Americans and Sariah, there are more ancestral slots than there have been people on the Earth. The likelihood that Sariah's mtDNA would have disappeared in an already-populated geographic region is extremely probable. Drs. Beth Shook and David Smith, two non-LDS scientists, claim genetic drift among Native Americans has "altered haplogroup frequencies and

caused the loss of many haplotypes" (American Journal of Physical Anthropology, 2008).

Some LDS critics claim that Y-chromosome DNA (Ycs), inherited from the father, supports the lack of "Israelite" DNA among Native Americans. Y-chromosome markers, however, can have the same problems as mtDNA markers. Population geneticist Ugo Perego, who currently lives in Utah, was born and raised in Italy, where he traces his ancestry back to the mid-17th century. His Ycs, however, is rare among Europeans and is mostly found in east Asia. Perego has three young sons, all of whom carry this same Ycs marker. If data was collected from Perego, his sons and other Italians in his Utah neighborhood, this "founder effect" would incorrectly suggest that a large portion of Italians are paternally related to eastern Asian populations.

For an example of disappearing DNA we note the recent DNA study of more than 131,000 modern Icelanders, which discovered that many DNA markers disappeared in just over a century. According to DNA tests, more than 86 percent of Icelandic males descended from just 26 percent of potential male ancestors in their family tree who were born between 1848 and 1892 and also lived in Iceland. Among the female population, nearly 92 percent descended from only 22 percent of potential female ancestors in their family tree who were born between the same years as the male ancestors.

Thus we see that the vast majority of the Icelandic ancestors -- from just 150 years ago -- did not contribute mtDNA or Ycs to their descendants. Conversely, a small minority of Icelandic ancestors from the same 150 years ago contributed the bulk of DNA markers to their now-living descendants. Most of the Icelandic people living today who have genealogical records showing that their ancestors lived in Iceland 150 years ago could not detect DNA for those ancestors.

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It is not an official publication of The Church of Jesus Christ of Latter-day Saints.