

ADDRESSING QUESTIONS SURROUNDING THE BOOK OF MORMON AND DNA RESEARCH

John M. Butler

What is DNA?

Our cells contain a genetic code known as deoxyribonucleic acid, or DNA. It provides a blueprint for life, determining to a great extent our physical attributes and appearance. We inherit half of our genetic code from our mother and half from our father. The diversity we see among people results from unique combinations of nucleotides, the building blocks of DNA that exist in every living organism. Because of the many different ways these nucleotides can combine, all humans, with the exception of identical twins, differ from each other on a genetic level.

How are DNA ancestry studies performed?

Examining the DNA of an individual and comparing it with the DNA of close relatives can reveal the source of different genetic patterns contributed by parents, grandparents, or other shared ancestors. Genetic markers on the Y-chromosome that are transferred exclusively from father to son are used to examine paternal lineages, while maternal lines are traced by analyzing genetic material called mitochondrial DNA, which is only transferred from mother to offspring.

On 16 February 2006 the *Los Angeles Times* ran a front-page article questioning the authenticity of the Book of Mormon based on studies of human DNA. Citing DNA “evidence” that

How do DNA ancestry studies compare to forensic DNA testing used in court cases?

The information derived from any DNA analysis does not work in a vacuum. Test results always compare genetic information from a source in question with the same type of information from a known source. In the case of forensic DNA testing that is widely accepted in courts of law, DNA from a suspected criminal is compared with DNA collected from the scene of a crime.¹ When the DNA matches at the regions examined, then it is likely that the suspect was indeed the person who was involved in the crime. In forensic DNA testing there is a one-to-one correlation of DNA results—the individual’s DNA either matches or does not match the evidence.

In ancestry studies, DNA information from multiple modern population groups is projected over many generations between populations tested. Even though the same genetic markers may be used as in forensic DNA testing, in ancestry testing, there is usually not a one-to-one unique match being made. Instead, scientists are often guessing at what genetic signatures existed in the past based on various assumptions—with a bit of educated “storytelling” to fill in gaps.² These stories of human migration patterns are constantly being refined with new genetic research. As noted by John Relethford in his book *Genetics and the Search for Modern Human Origins*, “Although working in such a young and developing field is exciting, it is also frightening

suggests an Asian ancestry for people native to the Americas, critics of the Church of Jesus Christ of Latter-day Saints have for the past several years claimed that these DNA studies demonstrate that the Book of Mormon account of a group of colonists coming from the Middle East in 600 BC cannot be authentic. The following article briefly addresses questions surrounding the applicability of DNA studies to the peoples whose story is told in the Book of Mormon. Points of view expressed here are mine and in no way reflect the official opinion of the Church of Jesus Christ of Latter-day Saints or the U.S. Department of Commerce or National Institute of Standards and Technology. This was originally posted in February 2006 on the FARMS Web site at farms.byu.edu/publications/dna/ButlerBofMandDNA_Feb2006.php (accessed 24 April 2006).

1. See John M. Butler, *Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers*, 2nd ed. (New York: Elsevier, 2005).

2. David B. Goldstein and Lounès Chikhi, “Human Migrations and Population Structure: What We Know and Why It Matters,” *Annual Review of Genomics and Human Genetics* 3 (2002): 129–52, at 143.

because the knowledge base changes so rapidly.”³ Since the methods for examining DNA in this way are far from perfected, drawing final conclusions about the ancestry of a people from current data would not be prudent. In addition, it is important to keep in mind that *reference samples are always needed to provide relevant results* with any kind of DNA testing. If a reliable reference is not available, confident conclusions cannot be made.

What current data exist on Native American DNA?

To date there have been more than one hundred scientific articles describing the examination of DNA from thousands of modern-day Native Americans. These studies have shown that almost all Native Americans tested thus far possess genetic signatures closely resembling modern-day Asians, and thus conclusions are usually drawn that these populations are related to one another. Since no Israelite genetic connection has yet been made with Native Americans, critics of the Book of Mormon are quick to point out that this information seems to contradict a statement made in the modern introduction to the book that the Lamanites are “the principal ancestors of the American Indians.”

What do we know about the genetic background of Book of Mormon peoples?

The angel Moroni informed the Prophet Joseph Smith during his first visit on the evening of 21 September 1823 that the Book of Mormon record gave “an account of the former inhabitants of this continent, and the source from whence they sprang” (Joseph Smith—History 1:34). The Book of Mormon mentions three different groups that journeyed to the New World: the Lehites (1 Nephi 18), the Jaredites (Ether 6:12), and the Mulekites (Helaman 6:10; 8:21), sometimes referred to as the people of Zarahemla (Omni 1:14–16; Alma 22:30).

The title page of the Book of Mormon proclaims that the Lamanites are a remnant of the house of Israel. Lehi found on the plates of brass

3. John H. Relethford, *Genetics and the Search for Modern Human Origins* (New York: Wiley-Liss, 2001), 205.

recovered from Laban a genealogy of his fathers in which he learned that he was a descendant of Joseph (1 Nephi 5:14), specifically from the tribe of Manasseh (Alma 10:3). Mulek is mentioned in Helaman 8:21 as a son of Zedekiah who was king of Judah when Jerusalem fell to the Babylonians (2 Kings 25:7). The Jaredites descended from multiple families who were led by the Lord from the Tower of Babel to the promised land (Ether 1:33).

The prophets who contributed to the Book of Mormon record focused on religious teachings rather than on geographical or genetic details; they provided only a partial picture of the events of their days and usually within the confines of their family lineage. Thus, the Book of Mormon record does not supply sufficient information to provide a reliable calibration point in the past that may serve as a reference for modern-day DNA comparisons. DNA information alone therefore cannot disprove or prove the Book of Mormon.

Could other people have lived in ancient America concurrently with Book of Mormon peoples?

Careful examination and demographic analysis of the Book of Mormon record in terms of population growth and the number of people described implies that other groups were likely present in the promised land when Lehi's family arrived, and these groups may have genetically mixed with the Nephites, Lamanites, and other groups.⁴ Events related in the Book of Mormon likely took place in a limited region,⁵ leaving plenty of room for other Native American peoples to have existed.

Does DNA testing of modern individuals detect all previous genetic lineages?

Another way to state this question is "could a group of people vanish without a genetic trace as measured by Y-chromosome and mito-

4. See John L. Sorenson, "When Lehi's Party Arrived in the Land, Did They Find Others There?" *Journal of Book of Mormon Studies* 1/1 (1992): 1-34.

5. See John L. Sorenson, *An Ancient American Setting for the Book of Mormon* (Salt Lake City: Deseret Book and FARMS, 1985).

chondrial DNA testing and yet be the ancestors of someone living today?” It is important to realize that examination of Y-chromosome and mitochondrial DNA genetic markers permits only a small fraction of an individual’s ancestry to be tracked.

Most genetic analysis studies of human history involve comparing a group of samples of living individuals to another group of living individuals without any detailed knowledge of the genealogy of the individuals in the groups being tested. These types of DNA studies make assumptions about the average time for each generation in the past along with a fixed mutation rate whereby genetic variation may occur over time. Similarities in the modern populations examined are then used to claim a shared origin between the two populations with an estimated time for divergence between the populations.

An interesting study reported in the June 2003 issue of the *American Journal of Human Genetics* leads me to believe that it is possible for Book of Mormon peoples to be ancestors of modern Native Americans and yet not be easily detected using traditional Y-chromosome and mitochondrial DNA tests. This study, conducted by a group of scientists from a company called deCODE Genetics, used the extensive genealogies of people from Iceland combined with probably the most massive population study ever performed. They traced the matrilineal and patrilineal ancestry of all 131,060 Icelanders born after 1972 back to two cohorts of ancestors, one born between 1848 and 1892 and the other between 1742 and 1798.⁶

Examining the same Y-chromosome and mitochondrial DNA markers used in other genetic studies, these 131,060 Icelanders “revealed highly positively skewed distributions of descendants to ancestors, *with the vast majority of potential ancestors contributing one or no descendants and a minority of ancestors contributing large numbers of descendants.*”⁷ In other words, the majority of people living today in Iceland had ancestors living only 150 years ago that could not be detected based

6. Agnar Helgason, et al., “A Populationwide Coalescent Analysis of Icelandic Matrilineal and Patrilineal Genealogies: Evidence for a Faster Evolutionary Rate of mtDNA Lineages than Y Chromosomes,” *American Journal of Human Genetics* 72/6 (2003): 1370–88.

7. Helgason et al., “Populationwide Coalescent Analysis,” 1370, emphasis added.

on the Y-chromosome and mitochondrial DNA tests being performed and yet the genealogical records exist showing that these people lived and were real ancestors. To the point at hand, if many documented ancestors of 150 years ago cannot be linked to their descendants through Y-chromosome and mitochondrial DNA tests from modern Iceland, then it certainly seems possible that the people who are reported in the Book of Mormon to have migrated to the Americas over 2,600 years ago might not have left genetic signatures that are detectable today.

Shouldn't we be able to detect Israelite DNA if the Lamanites are descended from Lehi and are the principal ancestors of modern-day Native Americans?

First, as discussed above, we do not have enough information from the Book of Mormon to confidently determine a source population for the Lehites or Mulekites, and so we cannot compare this population with modern-day Native American results. Another point to consider is that present-day Native Americans represent only a fraction of previous genetic lineages in the Americas because of large-scale death by diseases brought to the New World by European conquerors. As researcher Michael Crawford concludes in his book *The Origins of Native Americans: Evidence from Anthropological Genetics*, “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.”⁸ Again, without reliable reference samples from the past, we cannot proclaim the Book of Mormon true or false based on DNA data.

In forensic science, a documented “chain of custody” is crucial to verifying a link between the DNA profile produced in the lab with the original crime scene evidence. No such “chain of custody” exists with DNA or genealogical records connecting people from Book of Mormon times to people living today.

8. Michael H. Crawford, *The Origins of Native Americans: Evidence from Anthropological Genetics* (New York: Cambridge University Press, 1998), 261.

Part of the problem in this whole contrived controversy is the oversimplification of results from DNA studies that are being conducted by scientists in an effort to examine potential patterns of human migration throughout ancient history. The impact of this oversimplification is in many ways similar to the impact that the popular TV show *CSI: Crime Scene Investigation* has had over the past few years on forensic laboratories. In the name of entertainment, the *CSI* television shows have created a perception in which the general public now thinks that forensic scientists go to crime scenes, work in fancy and well-equipped laboratories, question suspects in a case, and obtain conclusive results on every complex case in a matter of a few minutes. The truth is that scientists work in poorly supplied labs, are underpaid, and in many situations have large backlogs of samples that prevent rapid responses to new individual cases. In addition, forensic scientists never interrogate the suspects of a crime, and many cases are never solved. The public perception of *CSI* has now created an expectation in many juries that DNA evidence should be present in every case.

Even with this oversimplification of its portrayal of forensic laboratories, there is some truth within the set of the *CSI* shows. For example, the instruments on the TV show are real. However, they do not collect data and generate results as rapidly as portrayed nor are complex cases solved so succinctly. Likewise, oversimplification of DNA results and what they are capable of revealing in examining the authenticity of the Book of Mormon has been greatly exaggerated by critics of the Church of Jesus Christ of Latter-day Saints. For the many reasons stated above, DNA testing results from modern Native Americans do not negate the possibility of Book of Mormon peoples having existed anciently on the American continent.

Can science ever provide a final answer to a religious question?

Today's society is impatient and wants quick and easy answers to everything. In science we make measurements and conduct studies hoping to advance knowledge. As an active DNA researcher for the past thirteen years, I can affirm that we are uncovering new information with each passing year that gives us a better picture of the

past and the present. But we must remember that that picture is in no way complete or comprehensive. Science can demonstrate that certain assumptions are unlikely, but it cannot prove that testimonies are false. I believe that science and religion can coexist as long as we remember that each measures different things (see Isaiah 55:8–9 and 1 Corinthians 2). The definitive proof of the Book of Mormon’s authenticity comes in the Lord’s laboratory of spiritual revelation by following the formula laid out in Moroni 10:3–5.⁹

9. See John M. Butler, “A Few Thoughts from a Believing DNA Scientist,” *Journal of Book of Mormon Studies* 12/1 (2003): 36–37.