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FINDING LEHI IN AMERICA THROUGH DNA ANALYSIS

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THE BOOK OF MORMON BEGINS WITH LEHI AND HIS FAMILY LEAVING Jerusalem, making their way through the desert, crossing the sea, and eventually arriving somewhere in the Americas. Among those who are familiar with this narrative, there are some that have assumed the continent was uninhabited at their arrival. If this were true, then all Native Americans should be descendants from Book of Mormon peoples. However, is this an accurate assumption? A closer reading of the scriptures and recent scientific discoveries have shown that this interpretation could be too narrow. Genetic studies have been able to successfully describe broad population trends, and DNA collected from Native Americans revealed their origins in ancient Asia. These results do not necessarily mean that Lehi and his family never existed but only that whatever small genetic contribution they made to the whole indigenous population of the Americas has not been, or cannot be, identified by modern science. A DNA approach cannot prove or disprove the historical authenticity of the Book of Mormon or address the genetics of those who traveled with Lehi to the “promised land.”¹ Those who declare otherwise disregard the complexities and constraints of DNA research in population studies.

Have you ever wondered what Lehi, Mulek, and the brother of Jared encountered when their ships landed on the shores of America? Likely they each encountered different things since they arrived at different times and at different locations. The majority of the Book of Mormon covers a period of approximately one thousand years, from 600 BC to AD 400, but most of the details of the text focus on spiritual matters rather than historical ones, so we are left to guess what and who greeted these emigrants. Additionally,

the Book of Mormon portrays itself as a summary taken from other records, which contained a more complete history of the whereabouts of the people described within its pages. Studies of archaeology, linguistics, genetics, and anthropology can offer clues, but little has been discovered that can be tied specifically to the history of this group of colonizers. In regard to information gleaned from DNA studies of modern Native Americans, much of the research would seem to contradict the narrative of the Book of Mormon. Closer examination of the findings, however, reveals that while science can partially answer the question of what the Book of Mormon peoples would have found upon their arrival on the continent, it cannot address their genetic legacy.

THE EMPTY CONTINENT THEORY

Most early Latter-day Saints assumed that the Jaredites, Mulekites, and Lehites were the first to settle the Americas. The original Book of Mormon text, however, does not claim that the peoples mentioned in its narrative were either the predominant or the exclusive inhabitants of the lands they occupied. It provides only subtle and short references to possible cultural contacts between the peoples it describes and others who may have lived nearby.

Over time, this view that the American continent was empty at the time of the arrival of the Book of Mormon peoples has been perpetuated among some members of the Church. In more recent times and with the advance of DNA technology, it has also been assumed that Book of Mormon migrants should have carried the most typical genetic signatures found in the modern Middle East, implying that all Native Americans today should have a similar genetic makeup to their Israelite forefathers. If these two hypotheses were true, it would make sense to think that DNA should be able to *prove* the Book of Mormon to be a factual account. But this is not the case. In fact, to be able to successfully employ DNA research to demonstrate the truthfulness of the Book of Mormon, these additional conditions would also be required:

1. None of the Jaredites described in the Book of Mormon would have survived;
2. Mulek and his group, founders of the city Zarahemla, would meet the same genetic composition criteria as Lehi's group; and
3. Middle Easterners today, specifically those identifying themselves as Jews, carry the same DNA as their Israelite ancestors who lived in the same geographic region (Jerusalem) where Lehi lived 2,600 years ago.

Unfortunately, none of these circumstances can be verified by the text of the Book of Mormon. The summary made by Mormon on the plates does

not talk explicitly about others, but it also does not say that no one else was in the Americas. In fact, cultural and demographic clues in its text hint at the presence of other groups.

Some incorrectly insist that the Church has taught for years that the American continent was uninhabited until the arrival of Book of Mormon people and that only recently this position has changed. This is incorrect. The Church has never expressed an official opinion with regard to either Book of Mormon geography or population dynamics.² This, of course, does not mean that members, leaders, and scholars have not shared their personal opinions one way or the other, including several instances in which the concept of an already inhabited continent was shared even before scientists began to bring forth the DNA evidence.³ At the April 1929 general conference, President Anthony W. Ivins of the First Presidency cautioned: “We must be careful in the conclusions that we reach. The Book of Mormon . . . does not tell us that there was no one here before them. It does not tell us that people did not come after.”⁴

The argument about the Church’s supposed change of position on the issue seems to stem from the introduction added in 1981 at the beginning of the Book of Mormon, which read that “after thousands of years, all were destroyed except the Lamanites, and they are the *principal* ancestors of the American Indians” (emphasis added). Although the term “principal” already presupposes the existence of other ancestors, this was recently changed. The current edition of the Book of Mormon now reads: “All were destroyed except the Lamanites, and they are *among* the ancestors of the American Indians” (emphasis added).

This change does not drastically affect the concept of heritage and ancestry of modern Native Americans in relation to ancient Lamanites because of the change in the meaning of the term *Lamanite* as used in the latter part of the Nephite history. In 4 Nephi, the writer explains that following the visitation of the Savior to the Americas, the formerly warring people became united, without genetic or ethnic distinction among them: “There were no robbers, nor murderers, *neither were there Lamanites*, nor any manner of -ites; but they were in one, the children of Christ, and heirs to the kingdom of God.”⁵

The record continues by stating that eventually there “were a small part of the people who had revolted from the church and *taken upon them the name of Lamanites; therefore there began to be Lamanites* again in the land.”⁶ It is very likely that this choice of designation was social or religious rather than genealogical in nature, based on the character of the Lamanites prior to Christ’s visit. In fact, 4 Nephi 1:36–39 reports that, in a similar fashion, others decided to use the term “Nephites” again to distinguish themselves as “true believers of Christ,” restating that those that “rejected the gospel were called Lamanites” and were “taught to hate the children of God, even as the

Lamanites were taught to hate the children of Nephi from the beginning.”⁷ Here the use of the word “even” underscores the practice of choosing a name that had a specific social meaning in the past.

Another reference to ancestry is recorded toward the end of the Nephite civilization. Mormon twice declares his ancestry: as a genealogical descendant of Nephi⁸ and a “pure descendant” of Lehi,⁹ possibly implying the existence of outside populations contributing to the ethnicity of the people of the Book of Mormon in Mormon’s day.¹⁰ Because the term “Lamanite” lost its genetic meaning in the latter part of the Book of Mormon narrative, attempts to define original Lamanite ancestry would be nearly impossible, as the modern remnant of this ancient population would have to include both true descendants of Lehi’s original party as well as others already inhabiting the land.

DNA AS A GENEALOGICAL TOOL

The early 1990s marked the beginning of the DNA era in the study of human diversity and the clarification of the genetic relationships and origins of different world populations. With newly developed technology, scientists were able to analyze segments of female-inherited DNA found in organelles called mitochondria and to identify small but important genetic differences that could uniquely be linked to specific populations. Mitochondria are structures within cells that convert energy from food into a form that cells can use. This DNA, called mitochondrial DNA or mtDNA, is separate and in addition to the larger amount of genetic material found within the cell’s nucleus in structures known as chromosomes (called nuclear DNA). Nuclear DNA has also been employed in more recent years in the study of population migrations. One particular chromosome found only in males is inherited exclusively along the father-to-son line and it is called the Y chromosome (Ycs for short). The remaining non-gender-related chromosomes constitute the majority of a person’s DNA and may reveal distinct insights into human history and expansions. Therefore, when talking about DNA studies, one essential component is to be aware of the existence of these three different genetic approaches following separate inheritance patterns, with their own strengths, differences, and limitations.

Dating through the use of mtDNA and Y chromosomes is concerned mostly with the divergence between two lineages sharing a common ancestor. It reveals only how far back in time the split took place, not where the split occurred or the geographic locations of these lineages today. At the present time, thanks to the complete sequencing of large numbers of mtDNA genomes, scientists performing research of worldwide populations are dissecting individual mtDNA lineages to discover important details missed in the past. Though mtDNA can reveal much about genetic background, it is not fail proof.

Before discussing the DNA markers in Native Americans, it may be helpful to consider how relying on genetic information alone can lead to incorrect conclusions. To demonstrate these principles, I will use my personal family history. I was born in Italy into a multi-generational Italian family and consider myself full-blooded Italian. As a geneticist, I have studied my genetic markers, or scientific genealogy, very closely. From this approach, I have learned that my autosomal DNA makeup is nearly one hundred percent European,¹¹ but surprisingly my paternal line (found on my Y chromosome) is typically shared with individuals from Asia, North America, and Oceania. The frequency of this particular genetic lineage in the Mediterranean Basin is close to zero. A plausible explanation for the introduction of Asian-like DNA in my paternal family line could be the invasions of barbaric groups in Europe (all the way to Northern Italy) between the fifth and seventh century. There is no family tradition or genealogical record to confirm this information, only speculation based on history and the available DNA in my particular family.

The reason this is important is that if I were to relocate to Asia today, and someone were to find my skeleton and extract my DNA two thousand years from now, based on the Y chromosome data alone, they would believe that I was indigenous to Asia and not a migrant from Europe. This error would be made because I had an ancestor of Asian origins whose Y chromosome markers persisted for many generations but whose autosomal DNA failed to survive in my current genetic makeup. As my personal DNA illustrates, and based on the inheritance properties of autosomal DNA, if a single individual or a relatively small number of people from Asia would mix with a large pool of Southern Europeans, their autosomal DNA would likely disappear over time.¹²

ORIGINS OF NATIVE AMERICANS

With regard to mtDNA studies, the first analyzed samples came from Native American populations. The data showed that nearly all the mtDNAs could be clustered into one of four groups, which were initially labeled A, B, C, and D, and later groupings identified in other populations proceeded alphabetically with alphanumerical subsets.¹³

These earlier studies utilized a small section of the mitochondrial genome, often limited to just a few hundred DNA bases. Genetic studies are conducted on both modern and ancient samples, but the latter are more difficult to collect and the DNA could be damaged. The benefit of working with ancient samples would be to glance directly into the history of Native American populations rather than trying to reconstruct them from the DNA that has randomly survived to the present time. Three significant findings were published during the 1990s based on mtDNA diversity that help us understand Native American origins:

1. The highest level of mtDNA variation was observed in sub-Saharan African groups, indicating that all humans shared a common female ancestor from Africa and that human colonization of the planet started from there. The existence of a common maternal ancestor from Africa for all mtDNA lineages does not mean that she was the only female alive at that time, but merely the lucky one in perpetuating her genetic lineage.
2. Four distinct lineages named A, B, C, and D were observed in the Americas as well as in modern Asian populations, supporting the theory that the ancient maternal ancestors of Native Americans were of Asian origins, surviving the last Ice Age on the continent-sized land bridge called Beringia that once connected northeast Siberia to Alaska.¹⁴
3. A fifth lineage was observed in Native American populations from the Great Lakes area and in a few other North American groups. This new mtDNA was labeled X because it was different from the previously known Native American mtDNA lineages. It was also observed in many modern European, African, and Middle Eastern populations,¹⁵ as well as in a small region of Central Asia.¹⁶

ARRIVING ON THE CONTINENT

The first and major genetic clue to the ancestry of Native Americans is the presence of mtDNA lineages labeled A, B, C, and D on both sides of the Bering Strait, which once connected Siberia to Alaska. This is in agreement with data from different disciplines and has helped scientists conclude that thousands of years ago, a relatively small group of hunter-gatherers made their way across East/North Asia all the way to Beringia where they were eventually trapped because of the worsening of the climate conditions.¹⁷

During the following millennia, they probably survived by living in a manner similar to modern-day Arctic natives. Population growth was probably halted because of scarcity of resources. They were physically separated from their source population, gradually developing their own unique linguistic, cultural, and genetic characteristics.¹⁸ Eventually, the climate began to improve again, and the large glaciers on each side of Beringia started to withdraw.

Following this glacial era, temperatures increased and sea levels began to rise again, gradually submerging Beringia and most of the world's coastlines. At that time, at least one and perhaps two entryways became available to the ancestors of American natives moving eastward into a pristine and empty American continent.¹⁹ Lack of competition for resources allowed a quick spread southward. Populations began to grow, and by the time the Europeans arrived after Columbus's discovery of the Americas in 1492, at least 20 million people lived in the Americas.²⁰

DISTINCT MTDNA DEVELOPS

Starting within the isolated Beringian enclave and later on the separate American double-continent, the ancestor of modern Native Americans did not have meaningful contact with their Asian "cousins." This is when genetic divergence occurred as well as the gradual but significant introduction of random DNA dissimilarities; these resulted in a uniquely distinct Native American gene pool. It is also commonly accepted that if a non-Native American mtDNA lineage is observed in the Americas, even in tribal groups considered deeply indigenous, the atypical DNA was introduced more recently, after the discovery of the New World by Europeans.

Although this may be accurate in most instances, it is not a verifiable assumption. The variant in the DNA could just as likely have been introduced in another manner. This is a critical and often overlooked limitation in using DNA to try to isolate a migration by a small group to the Americas in the recent past. Simply stated, if the proper testable circumstances are missing, the estimates to calculate rare genetic contributions, such as the one that would have been represented by Lehi's group, are not sufficiently sensitive and accurate.

A NATIVE AMERICAN IN ICELAND

At the present time, scientists performing research on worldwide populations are dissecting individual mtDNA lineages to discover important details missed in the past. This microgeographic approach is revealing a number of peculiar situations that, for the most part, are still not fully explained. For example, a majority of people living in Iceland today are just a small representation of the people that lived there only three hundred years ago.²¹ Most interesting to this discussion is that mtDNA associated with Native Americans has been identified in relatively small quantities in Iceland.²²

The natural question is, how did the distinct subset of Native American DNA end up in Iceland? The most accepted hypothesis is that Vikings took a Native American female, or females, with this distinct genetic marker with them when they left the Western Hemisphere; this genetic legacy persists today in the Icelandic population. Interestingly, although this distinct DNA marker originated in the New World, it has not been found in the Americas. Either the genetic marker failed to perpetuate, it was eliminated with the genocide following the European invasion, or it is extremely rare and has yet to be located on American soil. It is possible that scientists would be unaware that the sublineage existed if it was not located in Iceland. In simple terms, the example of the Native American mtDNA genome found in Iceland but not in America indicates that it is not unreasonable that genetic types once found in the Americas are no longer present.

LEHI'S DNA

Many have wondered why no DNA associated with Middle Easterners has been identified in Native American groups. Finding such DNA could be powerful scientific evidence supporting the validity of the Book of Mormon. There are several factors that limit scientists' ability to accomplish this task. One major problem identifying Lehi's DNA is that we don't know what it looked like. The small group that left Jerusalem to embark on a journey to a new land was not selected based on their genetic uniqueness or because they represented the typical genetic signature found in their homeland. These people were unaware of their genetic profile, and so are we. This fact alone seriously compromises any effort to bring forth DNA as evidence that these people existed or that the Book of Mormon is the religious and historical record it claims to be.

With DNA studies, it is possible to determine a genetic lineage that could approximate a typical ancestor living in Jerusalem during approximately 600 BC, but we have no way of determining if Lehi carried typical ancient Israelite mtDNA. In addition, virtually any individual DNA profile can be found in any population, although at varying levels. From a genetic viewpoint, anyone from any region of the Old World could have carried practically any mtDNA lineage to the Americas during the post-Columbus conquest era. The problem with not knowing the DNA of Lehi and his group is categorized as the absence of specific information, meaning it would be impossible to recognize their DNA even if it survived evolutionary forces and cultural isolation because we don't know what we are looking for.

Population genetic studies are based on statistical evidence, so they are weak when evaluating rare occurrences in the sampled population. If we were trying either to detect or measure the amount of genetic contribution from Book of Mormon peoples to the current indigenous population, the hypothesis to be tested would not be how much Middle Eastern DNA is observed in native populations but rather how much DNA from Lehi or other Book of Mormon peoples survived to our day. In other words, how many lineages could be confidently assigned to them?

Unfortunately, no matter how large or small they eventually became as a people in the American continent, Lehi's family still was a very small initial group with extremely limited genetic variation that would not constitute a large enough sample of their native population to ensure that their genetics would be properly represented in the New World.

INTERMINGLING DNA

Even if Lehi and the members of his family carried the most representative modern Middle Eastern genetic profiles, the only way these Middle Eastern markers would have survived past the first few generations in the American

continent would be in the unlikely event that Lehi's descendants were successful in maintaining an isolated population with limited mixing with the hosting population.

The abridged history contained in the Book of Mormon gives only a few sporadic details about the whereabouts of its people with regard to potential interactions with other groups. For instance, Nephi set out to build a temple when his adult male relatives would have numbered less than five, which would be insufficient to build such a structure.²³ After twenty-five years in the land, there were great wars between the Nephites and Lamanites.²⁴ How could armies be mustered from such a small number of initial emigrants? Additionally, several times in the Book of Mormon the Lamanites are said to have been far more numerous than the Nephites.²⁵ This observation seems inconsistent with the early Nephite descriptions of them as savage hunters, who normally require much more land per person than farmers require.²⁶ So where did all these extra Lamanites come from? One possible answer is from indigenous settlers of Asiatic ancestry.²⁷

From these passages, it is not unreasonable to assume there was some intermingling. The initial group of emigrants accompanying Lehi consisted of his family, Ishmael's widow and her children, and Zoram—the servant of Laban—which would have been about thirty to forty individuals. Henry C. Harpending, distinguished professor of anthropology at the University of Utah, commented on how this type of scenario would have affected the persistence of their DNA in the Americas. He was asked, "If a group of, say, fifty Phoenicians (men and women) arrived in the Americas some 2,600 years ago and intermarried with indigenous people, and assuming their descendants fared as well as the larger population through the vicissitudes of disease, famine, and war, would you expect to find genetic evidence of their Phoenician ancestors in the current Native American population? In addition, would their descendants be presumed to have an equal or unequal number of Middle Eastern as Native American haplotypes?" Professor Harpending's reply was, "I doubt that we would pick up [evidence of the Phoenicians] today at all, but it does depend on how they intermixed once they were here. If they intermixed freely and widely, and if there were several millions of people here in the New World, then the only trace would be an occasional strange stray haplotype. Even if we found such a haplotype we would probably assume it was the result of post-Columbian admixture."²⁸

The natural process of DNA markers disappearing in populations over time is called "genetic drift." The concept of genetic drift is partly based on the inheritance properties of DNA. With regard to markers received from one parent only (Y chromosome and mitochondrial DNA), inheritance is contingent on the gender of offspring. If a couple has only girls, none of them (and therefore no posterity) will receive the father's Y chromosome. If a couple has only boys, they will all receive the mother's mitochondrial DNA, but none of the grandchildren will inherit it.

Over just a few generations, potentially all of a couple's genetic material will be diluted and lost, as they will represent an ever-smaller percentage of the ancestors contributing to the DNA of a single descendant. Simply stated, as with the previously-mentioned example of my autosomal DNA, there is a considerable difference between being genealogically related and having a genetic inheritance. In fact, it is estimated that at the tenth generation level, and given an equal chance to propagate their autosomal DNA, people would carry only DNA representing approximately 12 percent of their total possible 1,024 ancestors.²⁹ This phenomenon can be observed in as few as a couple of generations at a family level, but the effects of genetic drift at the population level are even more visible. Depending on the population size and the variety of DNA present in that population, over a time measured in generations, some of that variation will inevitably be lost due to chance.

From a numerical point of view, the arrival of Lehi and his group on the continent would be comparable to a grain of salt in a sandbox. Though the salt is in the sandbox, it would be nearly impossible to detect or distinguish from the grains of sand. This analogy does not extend perfectly to DNA and inheritance at the population level, but it does illustrate the difficulty in finding DNA remnants from a small population assimilated into a large one. Although the group of Old World migrants was small (a grain of salt), the DNA may or may not have survived to the present time due to social and evolutionary variables. If it disappeared, it would be as if someone removed the grain of salt from the sandbox such that it seemed never to have been there in the first place. Of course, this would be heavily dependent on the level of isolation the Book of Mormon party experienced—something not clearly stated and therefore not testable.

LACK OF DNA EVIDENCE PROVES NOTHING

By the time Christopher Columbus discovered the Americas in 1492, perhaps as many as one hundred million inhabitants could have populated the entire double-continent.³⁰ The clash with European settlers—followed by disease, slavery, and warfare—resulted in a population decline of tremendous proportions. In the unlikely scenario that the descendants of the few migrants described in the Book of Mormon were able to transmit a modest genetic signature to future generations, the devastating conquest by Europeans in the 16th and 17th centuries has created a situation in which even the most experienced researchers admit the limited knowledge available to properly infer the complete history of American colonization prior to that time.

This would not be the only event affecting the lack of Old World DNA found among Native Americans. The Book of Mormon itself describes at great length two additional major events that, presuming historical accuracy,

would have had a tremendous impact on the survival of any genetic lineages carried to the Americas by any of its original groups.

The first event took place after the biblical account of the crucifixion of Jesus Christ in Jerusalem. Only one of the Gospels of the New Testament briefly mentions the geological events experienced in the Holy Land following the death of Christ.³¹ Far greater destructive natural forces were witnessed in the Western hemisphere as recorded in 3 Nephi 8, with entire cities being destroyed and the geographical landscape becoming greatly changed. The extent of destruction over the whole American continent is not known, as the writer in the Book of Mormon was likely writing about his immediate vicinity. However, since this debate concerns the genetics of Book of Mormon people, it is not unreasonable to think that such devastation and loss of life would also have had a great effect on the survival and transmission of any Old World genetic lineages to future generations.

In addition to the natural destruction described in the Book of Mormon at the time of the death of Jesus Christ in the Holy Land, there is the targeted elimination of people referred to as Nephites through massive warfare starting in the fourth century AD. It is a difficult task to estimate the level of genetic intermingling experienced by the descendants of those that came from Jerusalem around 600 BC, but from the population growth described occasionally in the Book of Mormon, it could be that the Lamanites were more consistently absorbed with locals than the Nephites.³²

CURRENTLY UNANSWERABLE QUESTIONS

Genetic testing has been used over the last twenty years to establish informative genealogical links among world populations and to track migration patterns over millennia. However, as a tool for discerning where, how, and if the peoples of the Book of Mormon inhabited the American continents, it is of limited utility because of the lack of important data. In order to use genetic testing to establish or refute the existence of Old World ancestors, scientists will need to answer the following questions:

1. What did the DNA of the Book of Mormon people look like?
2. What was the typical DNA found in the population of Jerusalem in 600 BC?
3. Can Lehiite DNA from 600 BC be clearly differentiated from that of Europeans arriving after 1492?
4. Are the current estimates used in assessing the timing of ancient genetic events adequate to discern pre- from post-Columbian DNA to the New World?
5. To what extent did the people of Lehi intermingle with local natives?
6. How long were the people of Lehi an isolated population after their arrival in America?

Currently, there are too many unpredictable variables in order to use DNA effectively as a tool to test conclusively for the existence of Book of Mormon people. Geneticists can state that the DNA of Book of Mormon people has either disappeared or has not been detected through time, following very basic and widely accepted population genetics principles. However, they cannot honestly deny that such people never existed simply based on the lack of genetic evidence.

We need to be wary about any statement against or in favor of the historical accuracy of the Book of Mormon based on DNA and take the time to understand the difference between scientific data and claims people make about it. Scientists in general are extremely cautious to make statements based on the available data that point to a single conclusion and leave no room for an alternative explanation. As with other religious texts and topics, science is often an inadequate tool to corroborate spiritual or historical truths. Perhaps as technology improves and more DNA studies are conducted, we will learn more about the genetic origins of Native Americans, including possible genetic links between the Old and the New World.

ADDITIONAL RESOURCES

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NOTES

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2. Carrie A. Moore, "Debate Renewed with Change in the Book of Mormon Introduction," *Deseret Morning News*, November 8, 2007, <http://www.deseretnews.com/article/695226008/Debate-renewed-with-change-in-Book-of-Mormon-introduction.html?pg=all>.
3. John L. Sorenson, "When Lehi's Party Arrived in the Land, Did They Find Others There?" *Journal of Book of Mormon Studies* 1 (1992): 1–34; John L. Sorenson and Matthew Roper, "Before DNA," *Journal of Book of Mormon Studies* 12, no. 1 (2003): 4–23.
4. Anthony W. Ivins, in Conference Report, April 1929, 15–16.
5. 4 Nephi 1:17; emphasis added.
6. 4 Nephi 1:20; emphasis added.
7. 2 Nephi 5 is compelling. In verse 6, Nephi spells out who goes with him, referring to others not on the boat, and in verses 6 and 9, he goes on to say that those who are called Nephites are those who "believed in the warnings and revelations of God"—a religious designation.
8. Mormon 1:5.
9. 3 Nephi 5:20.
10. Note that Mormon may have been distinguishing himself as a descendant of Lehi rather than a descendant of the Mulekites. Of course, the presence of Mulekites and the lack of "-ite" designations for them at this time of the narrative already shows that there is an oversimplification of the genealogy and naming.
11. These figures come from a commercial ancestral DNA test based on more than 500,000 SNPs. 23andMe: The Largest Ancestry Service in the World, <https://www.23andme.com>.
12. The Coop Lab: Population and Evolutionary Genetics, UC Davis, "How Many Genetic Ancestors Do I Have?," <http://gcbias.org/2013/11/11/how-does-your-number-of-genetic-ancestors-grow-back-over-time/>.
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23. John L. Sorenson and Matthew Roper, "Before DNA," *Journal of Book of Mormon Studies* 12, no. 1 (2003): 14.
24. See 2 Nephi 5:34.
25. See Jarom 1:6; Mosiah 25:3; Helaman 4:25.
26. See Enos 1:20; Jarom 1:6.
27. Note that this approach is not unusual as many colonizers, including Europeans after 1492 employed local natives as allies against other native groups in their conquering efforts.
28. Henry C. Harpending, "What Happens Genetically when a Small Population is Introduced into a Larger One?" Signature Books: Publisher of Mormon and Western Americana, <http://signaturebooks.com/2010/06/dna-and-the-book-of-mormon>.
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30. Alan Taylor, *American Colonies: The Settling of North America* (New York: Penguin Books, 2002), 40.
31. Matthew 27:51.
32. James E. Smith, "How Many Nephites?: The Book of Mormon at the Bar of Demography," in *Book of Mormon Authorship Revisited: The Evidence of Ancient Origins*, ed. Noel B. Reynolds (Provo, UT: FARMS, 1997), chap. 10.