

MOUNTAIN MEADOWS SURVIVOR? A MITOCHONDRIAL DNA EXAMINATION

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ON SEPTEMBER 11, 1857, A BAND of Indians, joined by local residents from southern Utah, attacked a party of approximately 140 men, women, and children in the valley of Mountain Meadows, near Cedar City. The victims of the tragedy were part of the Baker-Fancher wagon train, a group of emigrants on their way from Arkansas to California. Only a small number of young children survived the assault, and were given to neighboring Mormon families to care for. In 1859, government officials investigating the incident gathered all the surviving children who could be identified and returned them to relatives in the east.

The mass murder that took place at Mountain Meadows is known as the Mountain Meadows Massacre and has been the focus of numerous publications, each one attempting to bring new light to an event whose details are likely to remain obfuscated. Because many of the original journals and letters have been destroyed or lost, various anecdotes have replaced first-hand written accounts. One of the mysteries embedded in this episode is the exact number of children who were spared during the attack. Early accounts reported the figure to

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be seventeen, based on the total number of children eventually returned to relatives in Arkansas.¹ Other versions state that eighteen or more children survived the massacre,² implying that some of the families who received the children hid them when civil authorities made attempts to reclaim them. Family historian Anna Jean Backus has reported that a young blond girl, purportedly the youngest child of Alexander Fancher and Eliza Ingram Fancher, was given into the care of Philip Klingensmith and his wife, Betsy Cattle Klingensmith.³ They named her Priscilla and said she was born March 20, 1855, two and a half years before the massacre. According to these accounts, Priscilla grew up as a Klingensmith and married John Urie, on November 24, 1873. The couple lived in Cedar City most of their lives.⁴

This article describes a type of DNA testing utilized to reveal the biological maternal parentage of Priscilla Klingensmith Urie. DNA samples were obtained from one of Priscilla's descendants and from two additional maternally linked lineages in an attempt to reconstruct genetic data that would confirm or exclude Betsy Cattle Klingensmith as Priscilla's birth mother.

¹William Bishop, *Mormonism Unveiled; or the Life and Confessions of the Late Mormon Bishop, John D. Lee*, 1887, as cited in Will Bagley, *Blood of the Prophets: Brigham Young and the Massacre at Mountain Meadows* (Norman: University of Oklahoma Press, 2004), 154. Bagley lists the surviving children on 159, 388–89. See also Charles W. Penrose, *The Mountain Meadows Massacre* (1884; rpt. Roy, Utah: Eborn Books, 2000), 12. According to Richard E. Turley Jr., “Recent Mountain Meadows Publications: A Sampling,” *Journal of Mormon History* 32, no. 2 (Summer 2006): 220–21, points out that the Eborn version is reprinted from the 1899 edition, not the 1884 (first) edition, but that the differences are “minor copying editing.”

²Sally Denton, *American Massacre: The Tragedy at Mountain Meadows, September 1857* (New York: Alfred A. Knopf, 2003), 139, 151, 196. Turley, “Recent Mountain Meadows Publications,” 215–16, lists numerous “factual errors and shallow research,” but does not specifically identify errors in the survivor list.

³Anna Jean Backus, *Through Bonds of Love: In the Shadows of the Mountain Meadows Massacre* (Orem, Utah: Self-published, 1998), 21.

⁴Juanita Brooks, *The Mountain Meadows Massacre*, 2d ed. (1950; rpt., Norman: University of Oklahoma Press, 1987), 101–5; Anna Jean Backus, *Mountain Meadows Witness: The Life and Times of Bishop Philip Klingensmith* (Spokane, Wash.: Arthur H. Clark Company, 1995), 15–21, 141, 144.

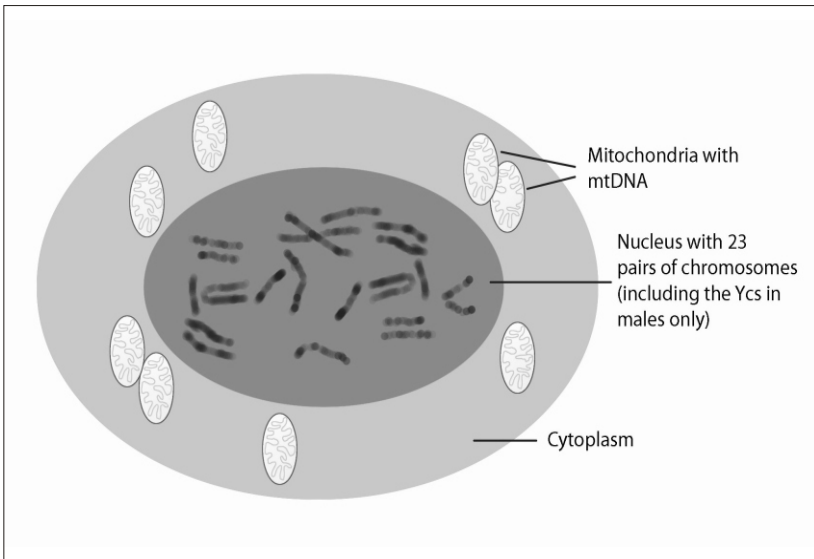


Figure 1. Cell diagram.

MITOCHONDRIAL DNA TESTING AND FAMILY HISTORY

The use of DNA to successfully reconstruct genetic information for genealogical and historical purposes⁵ has been demonstrated previously with three alleged children of Joseph Smith Jr. born to his plural wives.⁶ The DNA test used in the Smith case utilized Y chromosome markers, which are found only in males and are helpful in studying strict paternal lineages. However, a smaller segment of DNA found outside the nucleus of cells in organelles called mitochondria (see Figure 1), can also be used for testing familial relationships.

Each cell has hundreds of mitochondria and each mitochondrion contains multiple copies of mitochondrial DNA

⁵Ugo A. Perego, Ann Turner, Jayne E. Ekins, and Scott R. Woodward, "The Science of Molecular Genealogy," *National Genealogical Society Quarterly* 93 (December 2005): 245–59.

⁶Ugo A. Perego, Natalie M. Myres, and Scott R. Woodward, "Reconstructing the Y-Chromosome of Joseph Smith: Genealogical Applications," *Journal of Mormon History* 31 (Fall 2005): 42–60. The conclusion in all three examples (Moroni L. Pratt, Zebulon Jacob, and Orrison Smith) was that it was highly unlikely that Joseph Smith was their father.

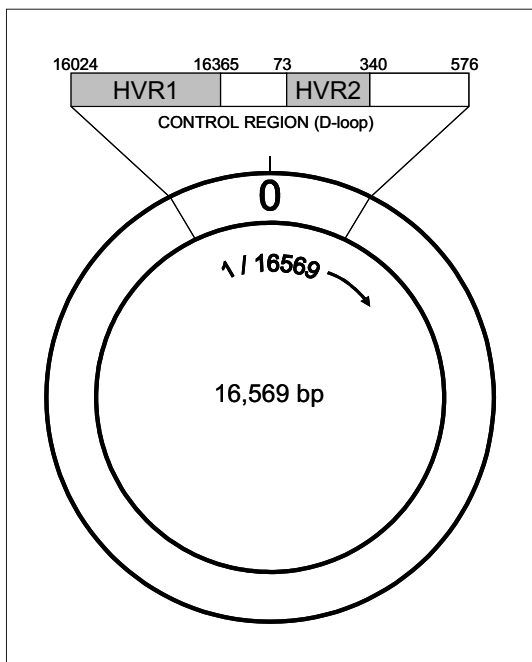


Figure 2. Mitochondrial DNA molecule with control region.

(mtDNA). MtDNA is a circular genome and contains 16,569 chemical bases called nucleotides. (See Figure 2.) Compared to the three billion nucleotides found in the nuclear genome, the mtDNA genome is quite small. In a segment of mtDNA called “control region,” random changes, called mutations, may occur in each new generation. (See Table 1.) Over the years, these mutations accumulate and create unique mtDNA profiles, called haplotypes, which are characteristic of specific ancestral origins and migration patterns. Mutations in the control region are harmless because they are not responsible for any life-sustaining activity.

The control region comprises 1,121 bases, which contains two segments known as hypervariable region I (HVR1) and hypervariable region II (HVR2) that are traditionally used for matching purposes. For simplicity, mtDNA sequences are compared to an industry standard called the Cambridge Reference Sequence (CRS) and only differences in the sequence are reported.⁷ MtDNA haplotypes with identical mutations may indicate a common ancestral and

⁷For the complete CRS sequence, see Human Mitochondrial DNA

TABLE 1
EXAMPLE OF TWO DNA SEQUENCES
WITH MUTATION AT BASE POSITION 7

<p><i>Reference Sequence:</i></p> <p>TAGCCGATACGACGATACGGACTAGACGTACACCCATCGTTACG</p> <p><i>Comparison Sequence:</i></p> <p>TAGCCGTTACGACGATACGGACTAGACGTACACCCATCGTTACG</p>
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geographical origin.

While Y chromosome testing as presented in the Joseph Smith study is traceable exclusively along the paternal lineage (from father to son),⁸ mtDNA follows the maternal line. Both males and females carry mtDNA in their cells; however, children inherit it from their mothers only. In addition, mtDNA does not recombine and, with the exception of small random mutations, is passed essentially unchanged from one generation to the next. This type of genetic testing became popular for genealogical purposes after it was used to identify the remains of Czar Nicholas Romanov's wife and children.⁹ Later, the same test was used to disprove the identity of Anna Anderson Manahan, who claimed to be Nicholas's daughter Anastasia.¹⁰

Using techniques similar to the Romanov study, we employed genetic testing to resolve the biological parentage of Priscilla Klingensmith Urie, the purported eighteenth surviving child of the massacre at Mountain Meadows.

THE CASE STUDY CANDIDATE

According to Anna Jean Backus, specific evidence that Priscilla was a Klingensmith by birth is lacking. First, her birth certificate was

Revised Cambridge Reference Sequence, updated August 25, 2006, <http://www.mitomap.org/mitoseq.html> (accessed October 2, 2006).

⁸Perego, Myres, and Woodward, "Reconstructing the Y-Chromosome of Joseph Smith."

⁹Peter Gill et al., "Identification of the Remains of the Romanov Family by DNA Analysis," *Nature Genetics* 6 (February 1994): 130-35.

¹⁰Peter Gill et al., "Establishing the Identity of Anna Anderson Manahan," *Nature Genetics* 9 (January 1995): 9-10.

never found; and second, she does not appear in the Utah Territory census returns of 1856.¹¹ Backus therefore concludes that, after the massacre, Philip Klingensmith took the child in, gave her a new birthday (March 20, 1855), and renamed her Priscilla.¹²

Priscilla's alleged mother, Betsy Cattle, was born September 9, 1835, in Foleshill, Warwickshire, England and married Philip Klingensmith on May 30, 1854, in Cedar City.¹³ In addition to Priscilla, Betsy had four children, all younger than Priscilla: Mary Alice, born on March 19, 1857, Betsy Ann, born on July 9, 1859, Margaret Jane, born on March 5, 1863, and William Cattle, born on April 16, 1865. To confirm Betsy Cattle's mtDNA haplotype, we identified and tested a descendant of her daughter, Betsy Ann, and of her sister Mary, Priscilla's alleged aunt.

COMPARING MtDNA HAPLOTYPES

Priscilla's mtDNA sequence was inferred by collecting a biological sample from one of her living descendants through an unbroken mother-daughter lineage. (See M1 in Figure 3.)¹⁴ To determine the mtDNA sequence of Betsy Cattle, we generated two additional mtDNA haplotypes from samples collected through descendants of Priscilla's alleged sister, Betsy Ann Klingensmith, who was born two years after the massacre, and also from Betsy Cattle's sister, Mary Cattle Bladen, and whose biological relationships to mother Betsy Cattle were unquestioned. (See M2 and M3 in Figure 3.)

Biological samples were gathered using a mouthwash rinse procedure and DNA was extracted from the cellular material using the Gentra Systems' Puregene[®] DNA Purification Kit protocol (<http://www.gentra.com/pdf/400128-000.pdf>). MtDNA sequences were generated by Sorenson Genomics Laboratories (<http://www.SorensonGenomics.com>) using ABI 3700 automated genetic analyzers and sequenced using Gene Codes' Sequencher[®] software (Gene

¹¹Backus, *Mountain Meadows Witness*, 144.

¹²Backus, *Through Bonds of Love*, 54.

¹³Backus, *Mountain Meadows Witness*, 85.

¹⁴Names of participants in this study have been withheld to protect their privacy.

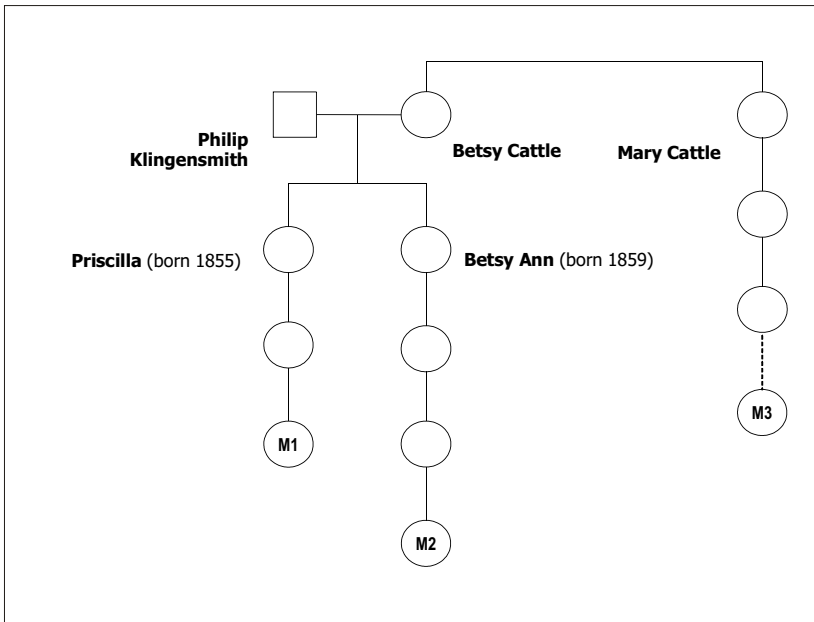


Figure 3. Pedigree showing the maternally linked lineages of Priscilla, Betsy Ann, and Mary Cattle.

Codes, Ann Arbor, Michigan).¹⁵

MtDNA haplotypes representing mutations from the CRS are summarized in Table 2. The three haplotypes inferred for Priscilla Klingensmith, Betsy Ann Klingensmith, and Mary Cattle Bladen show identical mutations in the control region: 16224 (C), 16311 (C), 16320 (T), 16519 (C), 73 (G), 146 (C), 152 (C), 263 (G), indicating that the three women share a common maternal ancestor. The genetic data generated from this study, combined with available historical and genealogical sources, support a matrilineal relationship between Priscilla Klingensmith Urie and Betsy Cattle Klingensmith.

To evaluate the frequency of the observed haplotype in the general population, we used this haplotype to query the online Federal

¹⁵Walter Bär et al., "Guidelines for Mitochondrial DNA Typing," *Vox Sanguinis* 79 (2000): 121–25.

TABLE 2
MtDNA MUTATIONS FOR THE THREE INDIVIDUALS TESTED IN
THIS CASE STUDY

<i>HVR1</i>					<i>HVR2</i>			
	<i>16224</i>	<i>16311</i>	<i>16320</i>	<i>16519</i>	<i>73</i>	<i>146</i>	<i>152</i>	<i>263</i>
CRS	T	T	C	T	A	T	T	A
M1	C	C	T	C	G	C	C	G
M2	C	C	T	C	G	C	C	G
M3	C	C	T	C	G	C	C	G

Bureau of Investigation mtDNA database, which contains 4,839 mtDNA haplotypes.¹⁶ Because many records in this database report only base positions 16,024 through 16,365, the mutations observed at 16,519 and those in HVR2 for the maternally related Cattle haplotypes could not be compared. Considering only mutations at 16,224, 16,311, and 16,320, the frequency of matching haplotypes in the FBI database is 0.2% (9 of 4,839 haplotypes). It is possible that the frequency of matching haplotypes would be less than 0.2% if longer sequences were available to compare.

Comparison for HVR1 and HVR2 to the University of Pavia mtDNA database (10,667 sequences)¹⁷ yielded only four exact matches (0.04%), all from Iceland. A fifth sample, also from Iceland, matched the Cattle haplotype with an additional mutation at base position 150. Additional comparisons to the Sorenson Molecular Gene-

¹⁶Keith L. Monson et al., "The mtDNA Population Database: An Integrated Software and Database Resource for Forensic Comparison," *Forensic Science Communications* 4 (April 2002), electronic edition <http://www.fbi.gov/hq/lab/fsc/backissu/april2002/miller1.htm> (accessed May 4, 2006).

¹⁷We consulted the mtDNA database "Genetica Umana" of published and unpublished data belonging to the laboratory of Antonio Torroni, professor of Human Genetics, Department of Genetics and Microbiology, University of Pavia, Italy.

alogy Foundation mtDNA database¹⁸ (4,092 sequences) and to the Human Mitochondrial Genome Database¹⁹ (1,624 sequences) produced no exact matches, which further supports the conclusion that the haplotype is rare.

The low frequency of the haplotype shared by Priscilla Klingensmith, Betsy Ann Klingensmith, and Mary Cattle Bladen in available mtDNA databases strongly supports a close genetic relationship of the three women.²⁰

CONCLUSION

Priscilla Klingensmith Urie has been recorded as one of the surviving children from the Mountain Meadows Massacre following inconsistencies in the available genealogical records. As a consequence, the suggestion has been advanced that Philip Klingensmith and Betsy Cattle Klingensmith, who raised Priscilla as their daughter, might not have been Priscilla's biological parents. DNA testing performed on the mtDNA control region of descendants from Priscilla, her alleged younger sister Betsy Ann, and her alleged maternal aunt Mary Cattle Bladen, revealed three identical haplotypes. The matching mtDNA sequences provide a strong indication of a common maternal ancestor for the three lineages, supporting the conclusion that Betsy Cattle Klingensmith was Priscilla's biological mother.

This method of testing for familial relationships using the mtDNA control region does have some limitations, including in some cases a poor resolution.²¹ However, control-region haplotypes characterized by a well-defined mutational motif, such as that observed in this study, are clear indicators of a shared matrilineal ancestry. In this case study, the inferred haplotype of Priscilla was found at low to zero frequency in the available databases, thus making extremely unlikely that Priscilla Klingensmith and Betsy Cattle had a matrilineal link different from a direct mother/daughter relationship.

¹⁸Sorenson Molecular Genealogy Foundation, "Sorenson MTDNA Database," <http://www.smgf.org/mtdna/search.jsp> (accessed July 31, 2006).

¹⁹Uppsala University, "mtDB—Human Mitochondrial Genome Database," <http://www.genpat.uu.se/mtDB> (accessed on March 27, 2006).

²⁰Antonio Torroni, email to Ugo Perego, May 10, 2006.

²¹Antonio Torroni et al., "Harvesting the Fruit of the Human mtDNA Tree," *Trends in Genetics* 6 (June 2006): 339–45.