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BACKGROUND WHITE PAPER ON THE STUDY INVOLVING JOSEPHINE LYON'S BIOLOGICAL PATERNITY

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In 1999, Mormon philanthropist James Levoy Sorenson (1921–2008) and BYU Molecular Biologist Scott R. Woodward met with the objective to combine resources and expertise in building a database of correlated genealogical and genetic data. The project was at that time known as the BYU Molecular Genealogy Research Project, and it was housed in the Eyring Science Center on the BYU–Provo Campus. In 2001, a new location was dedicated to the project in Salt Lake City. By 2003, all the research operations moved to the Salt Lake location, and the project was renamed Sorenson Molecular Genealogy Foundation (SMGF). With the passing of Mr. Sorenson in January 2008, the project gradually downsized its operations and scope, until its assets were fully acquired by Ancestry.com by July 2012.

I began working on this project for Scott Woodward as a graduate student from its inception. My responsibilities initially were limited to administering the Eyring Science Center lab resources and personnel, collecting the pedigree information and the biological samples, dealing with legal and ethical approvals, and the PR aspects of the project. Eventually, a number of smaller DNA projects found their way to my desk, leading to more complex ones and to a PhD in Genetics and Biomolecular Sciences (2010) at the University of Pavia (Italy) in Professor Antonio Torroni's mitochondrial DNA lab (while maintaining my employment with SMGF). I left SMGF in July 2012, when Ancestry.com made the acquisition mentioned above.

One of the first projects I began to work on dealt with Joseph Smith Jr.'s family. Dr. Woodward gave me a folder with notes from meetings he had in the past with individuals belonging to the Smith family and with others who were studying Joseph Smith's life and his family genealogy. The issue pertained to the origins of the Smith line. Genealogical records were robust all the way back to a Robert Smith who ventured alone to New England in 1638 at twelve as an indentured servant.[1] No one has been able to identify with certainty the exact location and family where Robert Smith came from in England. The objective of that project was to find descendants of Joseph Smith willing to submit a DNA sample and use that data to reconstruct a genetic profile for the Smith family that could be compared to the DNA of other Smiths from England until a match could be found and a link made between the two families. The molecular approach was based on the male-inherited Y chromosome, which is passed nearly unchanged from father to son following the surname line in many western countries. In due time, an accurate Y chromosome profile for the Smith family was reconstructed and utilized to shed light on Joseph Smith's ancestry and to study a number of cases involving possible sons ascribed to him through polygamous relationships.[2]

It was at this time, at the beginnings of the Sorenson-sponsored genetic genealogy project, that I was approached by descendants of Josephine Lyon Fisher. Josephine was born in Nauvoo, Illinois, on February 8, 1844, to Sylvia Sessions, who was married to Windsor Lyon, but apparently to Joseph Smith, as well (although details of the latter union

[1] Elaine C. Nichols, "Corrections to Joseph Smith's English Ancestry" *Utah Genealogical Journal* 19, nos. 3–4 (1991): 138–43.
[2] Ugo A. Perego, "Joseph Smith, the Question of Polygamous Offspring, and DNA Analysis", in *The Persistence of Polygamy Vol. 1*, eds. Newell G. Bringhurst and Craig L. Foster (Independence, Missouri: John Whitmer Historical Association, 2010), 233–56.

is not clear). In 1882, at the end of her life, Sylvia told her daughter Josephine that she was the daughter of Joseph Smith. This statement was eventually recorded in an affidavit signed by Josephine in 1915.[3] Some of Josephine's descendants were interested in learning whether the statement should be taken literally or if other implications were involved. Mormon historians were wondering the same things. Their question was whether DNA could decide the issue.

The biggest problem was that Josephine was a female and the Y chromosome that was reconstructed for Joseph Smith was useless to resolve this particular family case. The only DNA Josephine would have received from her biological father would be autosomal, and technology in 2000 was not available that could address her paternity. However, since autosomal DNA is lost at the rate of 50% at each generation, collecting biological specimens with the hope that they could be used at some future time started among the living descendants of both the Smith family and Josephine's descendants. At that time, a number of Josephine's grandchildren were still alive, each carrying approximately 25% of her autosomal DNA.

As this was a new type of study, we did not know the best approach to go about collecting and preserving these samples. Initially, we collected pedigree charts showing the genealogical connection between Josephine and the descendant donating a sample. Samples were collected first as buccal swabs preserved in paper envelopes that were clearly labeled and linked to the corresponding family tree information. Later, we went back to the

[3] Affidavit of Josephine R. Fisher, February 24, 1915, LDS Church History Library, Salt Lake City, Utah, MS 3423, folder 1, images 48–49; see also http://josephsmithspolygamy.org/plural-wives-overview/sylvia-sessions (accessed on June 11, 2016) and references within.

same donors and recollected a sample using mouthwash, which provided a much larger amount of DNA. Consent forms were also gathered for each participant in the study.

The first autosomal DNA approach was based on microsatellites (STR's or short tandem repeats). STR's were widely used for Y chromosome studies, but considerably new when it came to autosomal DNA. These are short segments of DNA that are passed from one generation to the next, but their validity for extended genealogical studies was still uncertain. Data from this initial experiment was presented at the American Society of Human Genetics conference in 2003 (see Figure 1). However, at that time, only a small number of STR could be ascribed to either Josephine or her husband and no connection to the Smith family was yet possible.

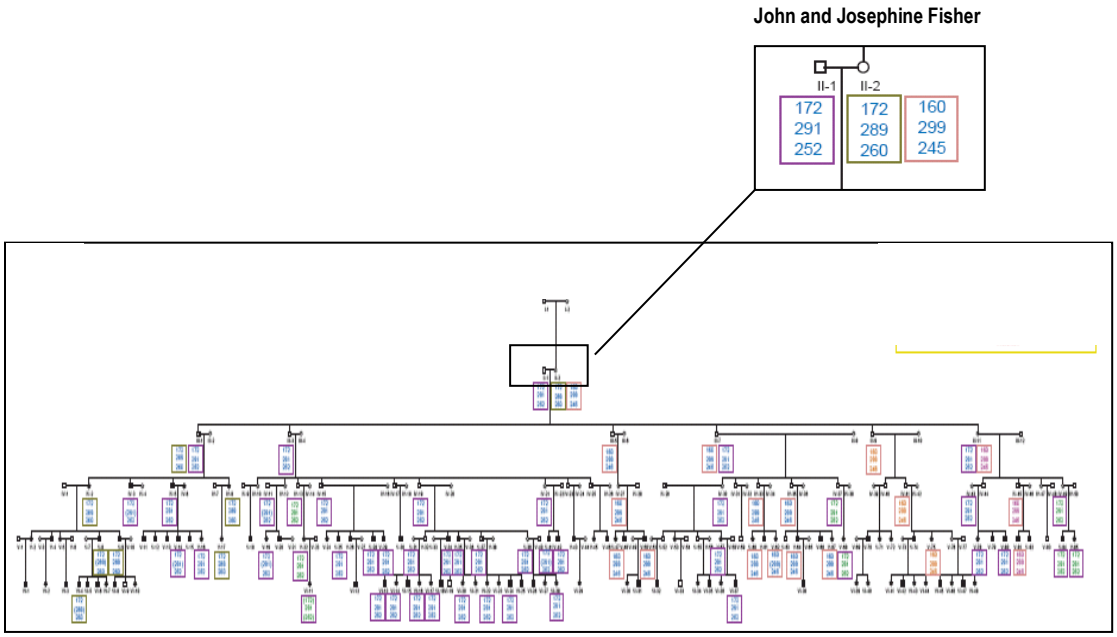

Figure 1 – Pedigree reconstruction for descendants of Josephine Lyon and John Fisher (presented at American Society of Human Genetics 2003)

Over the next few years, new technology became available even commercially to test for large numbers of autosomal SNPs (single nucleotide polymorphisms). The technology was promising, but database sizes and tools to interpret them were limited. SMGF collaborators at the University of Utah agreed to test a small number of samples for both the Smith and the Lyon families. A genetic score was produced for each pair compared, and the genealogy was checked. This experiment was inconclusive with regard to answering the question of Josephine's paternity particularly because other marriages between the two families took place in more recent years and the observed shared DNA was probably the result of these more recent unions, rather than the alleged Joseph/Josephine relationship. Results of that preliminary study based on SNP data was published as part of a review in 2009. (See Figure 2).

Figure 7.6D — Genetic Score 77.83
Smith (S–633895) and Lyon (S–693351)

Common Ancestors and Birthdates	*Generations*	*Relationship*
Joel Hills Johnson (23 Mar. 1802)	9	3C1R
Anthony Johnson Stratton (11 Jan. 1824)	10	4C
William Sabin (11 Oct. 1609)	22	9C2R
Edward Griswold (1607)	24	11C
John Emery Sr. (29 Sept. 1598)	24	11C
Thomas Scott (1594)	25	11C1R

Figure 7.6E — Genetic Score 58.88
Smith (S–633895) and Lyon (S–693375)

Common Ancestors and Birthdates	*Generations*	*Relationship*
Sanford Porter (7 Mar. 1790)	10	4C
Thomas Scott (1594)	24	10C2R

Figure 7.6A — Genetic Score 185.98
Smith (S–623328) and Lyon (S–693396)*

Common Ancestors and Birthdates	*Generations*	*Relationship*
Mon (Mans) Monson (22 July 1862)	7	2C1R
Thomas Scott (1594)	24	10C2R

Figure 7.6B — Genetic Score 179.74
Smith (S–623328) and Lyon (S–681833)*

Common Ancestors and Birthdates	*Generations*	*Relationship*
Mon (Mans) Monson (22 July 1862)	7	2C1R
Thomas Scott (1594)	24	10C2R

Figure 2 – Preliminary and inconclusive data generated at University of Utah (Perego, in The Persistence of Polygamy, Vol. 1*)*

In 2012, all the DNA samples collected under the auspices of the Sorenson project were acquired by Ancestry.com. A verbal, informal understanding that DNA samples could still be accessible in order to complete ongoing projects was discussed. However, that was not the case, even after several attempts were made to convince Ancestry.com leadership to cooperate.

In 2012, I changed employment and relocated to Rome, Italy. In addition to my new job, I started a non-paid position as a visiting scientist for the University of Perugia's Life Sciences department. I still had files and papers from past, unfinished projects, including those regarding Josephine's case study. However, I no longer had access to the DNA samples, research funding, and lab equipment. For nearly two years, I worked on other projects that had data already produced and only required analysis and publication. I

seriously abandoned the idea that I was going to be able to address Josephine's biological paternity again, even though new technology seemed quite promising for that specific project.

It was thanks to the patience and insistence of some Josephine's descendants that in 2014 I decided to take another look at this case. After a number of preliminary conversations online, we had a meeting in Provo, Utah, on June 2015, where we outlined a plan of action and a budget. Josephine's descendants would take care of identifying the best candidates under my direction to donate a new DNA sample to the family study, as well as to raise funding to pay for it. At the same time, I began a crowdfunding effort (www.gofundme.com/JosephSmithDNA) and gathering DNA samples among Joseph Smith descendants. Nearly 10,000 dollars was donated to help with this and other projects involving Joseph Smith's DNA. Results from this project, addressing the biological paternity of Josephine, were presented at the Mormon History Association conference in Snowbird, Utah, on June 11, 2016. The research paper will be submitted for publication shortly after the MHA conference and supplemental material is available online.[4]

[4] www.JosephSmithDNA.com/Josephine-Lyon.