Genetics& Society
Garriga lecture notes 3/16/09

The Jefferson/Hemings debate; Using mtDNA to study history

Was Thomas Jefferson the father of Sally Hemings' children?
What follows is an abbreviated account of the Jefferson/Hemings controversy. For more information, see http://www.monticello.org/plantation/hemingscontro/hemings-jefferson_contro.html. Sally Hemings, a slave of President Thomas Jefferson, had six or seven children. Thomas Woodson claimed to be the son of Sally Hemings, but there is no record of this at Monticello, the house where Jefferson lived. Her six documented children were Harriet, who died in infancy (1795), Beverly (1798), and unnamed child who died in infancy (1799), Harriet (1801), Madison (1805) and Eston (1808). In 1802 James Callender, a scandalmonger, published an article accusing President Jefferson of fathering the Hemings' children.

There are two oral histories. The Jefferson/Randolph oral history passed down by the families of Thomas Jefferson's daughters claimed that Peter and Samuel Carr, Jefferson's nephews fathered Sally's children. The Hemings oral history passed down by the families of Thomas Woodson, Madison Hemings and Eston Hemings Jefferson claimed that Thomas Jefferson fathered Sally's children.

The arguments made against Jefferson being the father are Jefferson's denial, Jefferson's personality, the difference in age between Jefferson and Hemings, Madison and Eston were born after the scandal and the statement of a former Monticello manager claiming that another man was often seen leaving Sally's quarters. The arguments made for Jefferson being the father were the children looked like Jefferson, Jefferson and Hemings were in France or at Monticello together nine months before the birth of each of the children, Jefferson freed Sally's children and other members of her family before he died and Madison claimed that Sally told him that Jefferson was his father and the father of his five siblings.

In 1998, Eugene Foster, a retired professor of pathology at Tufts University and The University of Virginia addressed the question of whether Jefferson or his nephews had fathered Sally Hemings' children by examining the Y chromosomes of living paternal descendents of Thomas Woodson, Eston Hemings Jefferson, Field Jefferson, the paternal uncle of Thomas Jefferson, and John Carr, the paternal grandfather of Peter and Samuel Carr. The Y chromosomes of the living relatives were analyzed using PCR. The authors analyzed seven regions of the chromosome that can exist in two forms (biallelic markers) and twelve regions of the chromosome that contain satellite DNA, which contains simple sequences that are repeated many times. The number of these repeats at a particular site can vary between different chromosomes. The authors found that the male descendent of Eston Hemings Jefferson had the same Y chromosome as the four male descendents Field Jefferson. The Y chromosomes of a fifth Field Jefferson descendent and the Eston Hemings Jefferson descendent differ at a single microsatellite. This difference was probably caused by mutation in the lineage that gave rise to the Field Jefferson descendent. The Jefferson chromosome is rare, occurring in only 1.5% of the population. It has never been observed outside of the Jefferson family. The Y chromosomes of the Woodson and Carr descendents, by contrast, are different from those of the Jefferson descendents. Together, these findings are consistent with Thomas Jefferson being the father of Eston Hemings Jefferson and possibly the other Hemings' children but not the father of Thomas Woodson. They are inconsistent with the Carr brothers being the father of Eston Hemings Jefferson.

After the Foster paper was published, the Thomas Jefferson Foundation formed a research committee to access the DNA evidence. This is a nonprofit organization that runs Monticello. In January 2000, the committee reported that from the known evidence--the DNA study, the original documents, the written and oral historical accounts, and the statistical data -- it was likely that Thomas Jefferson was the father of Eston Hemings Jefferson and possibly the father of all six of Sally Hemings' documented children, but acknowledge that we will never be certain. The Thomas Jefferson Foundation is nonprofit organization that owns and operates Monticello, the home of Thomas Jefferson. A commission appointed by the Thomas Jefferson Heritage Society, by contrast, concluded that the allegation that Thomas Jefferson fathered Sally Hemings is not proven, which is true. With the exception of one dissenter, the opinions range from skepticism to the charge being false, which is an extreme view. The Thomas Jefferson Heritage Society was established by descendents of Thomas Jefferson's daughters.

Mitochondrial DNA and history (read 91-93 in the text)

Mitochondria are organelles of cells that can oxidize carbon sources, a form of metabolism that is very efficient. Because of this function, mitochondria are known as the "powerhouses of the cell." Cells that need lots of energy, like muscle cells and neurons, are chocked full of mitochondria. Unlike the other organelles of animal cells (the nucleus is the exception), mitochondria have there own DNA. Human mitochondria have a small circular DNA of 17,000 base pairs that encodes two rRNAs, a complete set of 22 tRNAs and 13 proteins that are involved in energy metabolism. The mitochondria have their own ribosomes that are distinct from those in the cytoplasm of the cell. The cytoplasmic ribosomes translate mRNAs that are encoded on genes in the nucleus, whereas the mitochondrial ribosomes translate the mRNAs of the 13 mitochrondrial proteins encoding genes. Ribosomes are made up of structural RNAs and many proteins. The mitochondrial ribosomes are made up of the two structural RNAs encoded in the mitochondria, but all of the mitochondrial ribosomal proteins are encoded in the nucleus. The proteins are synthesized and then transported into the mitochondria. Almost all of the proteins that are necessary for mitochondrial function are encoded in the nucleus.

What a strange way of doing things. Why do mitochondria have their own genome? Why would the mitochondrial genome encode only a few RNAs and proteins? In the 1980s, Lynn Margulis provided an evolutionary explanation for this situation that is known as the endosymbiont theory. She noticed that mitochondria were similar to bacteria in many ways. The lipid composition of mitochondrial membranes were similar to those in bacteria but distinct from other membranes in the cell. Like bacterial chromosomes and unlike nuclear chromosomes, the mitochondrial chromosome is circular. It is also packaged like bacterial chromosomes. Translation in bacteria and mitochondria is also similar. The structural rRNAs are similar and drugs that inhibit bacterial translation also inhibit mitochondrial translation but not translation on cytoplasmic ribosomes. Drugs that poison cytoplasmic ribosomes do not affect mitochondrial or bacterial ribosomes.

To explain these observations, Margulis proposed that eukaryotic cells, that is cells that have a nucleus, were originally unable to oxidize carbon sources and fermented them, an inefficient form of metabolism known as anaerobic metabolism. These cells took up bacteria that were capable of aerobic metabolism, a more efficient way of producing energy. The eukaryotic cell benefited from the new efficient form of metabolism that the bacteria provided, and the bacteria gained a more stable environment. With time, genes were transferred from the bacterial genome to the nucleus, and with this gene loss, the bacteria became dependent on the eukaryotic cell. The theory goes on to propose that chloroplasts, the organelles of plants that are responsible for photosynthesis, evolved from photosynthetic bacteria in a similar way. This theory has gained additional support since it was proposed. Investigators have documented the transfer of genes from these organelles into the nucleus.