Do Ethiopian Jews share a common ancestor with Ashkenazi and Sephardic Jews? Could they possibly be descendants of King Solomon? With the recent advancements in biochemical technology, many have attempted to answer these questions through genetic analysis. A great deal of research has been done in the past few years to determine the common ancestries of different populations. Jewish populations have been the focus of much of this research because Jews had limited intermarriage and conversion with other groups, greatly preserving our genetic homogeneity. Genetic analyses have mainly focused on the inheritance patterns of mitochondrial DNA and of the Y chromosome. Before one can draw any conclusions about what genetic connections exist among Ethiopian, Ashkenazi and Sephardic Jews, it is first necessary to understand the mitochondrial DNA and the Y chromosome investigative techniques and the meanings of their applications to Jewish populations.

There are two places where genetic information, coded in the form of DNA, are found in animal cells: in the nucleus as part of the chromosomes, and in the mitochondria (a cellular organelle) in the form of a DNA loop. When fertilization occurs, an egg and sperm unite and mingle equal portions of chromosomes from both the father and the mother. However, when the sperm and egg merge, only the sperm nucleus containing its chromosomes enters the egg, with none of the sperm's cytoplasm and organelles entering. The sperm, in a sense, “injects” its DNA into the egg; however, the middle piece containing the sperm's mitochondria and its flagellum remain external of the egg. Therefore, the zygote that forms receives all of its cytoplasm and cellular organelles, including the mitochondria, from the mother, and none from the father. The mitochondrial DNA is thus entirely maternal and makes a fascinating study in hereditary research.

Mitochondrial DNA can be compared between individuals or groups of individuals to determine how much genetic information they have in common. Like all DNA, mitochondrial DNA includes coding regions called genes which may occur in different forms, called alleles. Two people who are closely related will have more of the same alleles in common. Since many genes occur in many different allelic forms, there is a wide range of variation even within a population with close hereditary ties. Therefore, writes Dr. K. Bacon, “by looking at the pattern of allelic forms of many genes in different populations, one can quantify the genetic similarities between them” and determine the degree by which they are related. One method for analyzing allelic variability employs enzymatic cleavage of DNA, resulting in DNA fragmentation. Within our DNA there are recognition sites at which specific enzymes cut the DNA into fragments. Since whether one has, or has not, a specific site for cleavage is hereditarily determined, by comparing the resultant DNA fragments one can determine the degree of similarity between two different DNA samples. That is to say, if two mitochondrial DNA samples are identical, the same fragment pattern will be attained by enzymatic cleavage.

As research techniques become more sophisticated, we can look towards a future when we can use genetic research to better understand biblical events.

In 1988, Dr. Bonne-Tamir used this technique to analyze the mitochondrial DNA from several groups, including Ashkenazi, Yemenite, and Ethiopian Jews, as well as Caucasians and several African tribes. Since mitochondrial DNA is preserved in the maternal line, one can compare different groups to determine if they have a common female ancestor. This technique can not be used to determine a paternal ancestor because mitochondrial DNA is passed down from mother to her child. Dr. Bonne-Tamir concluded that a certain pattern of DNA fragmentation, labeled the Bam Hpa/Morph3, was almost non-existent in Ashkenazi and Yemenite Jews, but was found in great amounts in Ethiopian Jews and non-Jewish Africans. Based on this and on other studies, many have concluded that it is more probable that Ethiopian Jews share a common maternal ancestor with Africans rather than with Jews [2]. This study, however, could not provide data on the Ethiopian Jews’ paternal ancestor. For that one must turn to research on the Y chromosome.

Humans have 23 pairs of chromosomes that are all similar, except for the sex chromosomes which are a pair of chromosomes la-
beled X and Y. Females have two X chromosomes and males have an X and a Y chromosome. A mother passes on one of her X chromosomes to her child, and a father passes on either his X or his Y chromosome to his child. If a child receives two Xs it will develop into a female, and if it receives an X and a Y it will be a boy. Since the Y chromosome is only inherited from father to son it can be studied to determine if two groups share a common paternal ancestor. A great deal of research has been done on the Y chromosome because it is unique among the chromosomes. While other chromosomai pairs commonly exchange DNA during recombination in meiosis, the Y and X chromosomes rarely exchange chromosomai segments. The Y chromosome, therefore, is mainly altered by random genetic mutations. "Mutations occur in a random fashion and can accumulate over time," which allows scientists, who can "estimate the rate of mutation," to be able to estimate "how long two groups have been separated". The longer two groups have been separated, the greater the differences will be between their DNA sequences on the Y chromosome.

In a study done on the Y chromosome in the mid 1990's, Dr. Skorecki of the Technion Medical School was able to identify certain DNA sequences called haplotypes. A haplotype is a series of designated DNA markers on a chromosome which are linked and thus are transmitted as a unit. He studied 112 different haplotypes and identified the "Cohen Model Haplotype" (CMH) as a specific haplotype more prevalent in the Jewish subgroup of Ashkenazi and Sephardic Cohens than in Israelites and Levites. Skorecki, by further analysis, estimated that this CMH arose from a common priest ancestor shared by present day Cohens, who lived approximately 2650-3180 years ago. This time period "falls between the time of the exodus from Egypt and the destruction of the First Temple" which coincides with the time period when Aaron, the biblical father of all Cohens, lived. Since the the status of Cohen is passed from father to son it makes sense that the majority of modern day Cohens share a genetic link. So to, since Levites and Israelites trace their heritage to other biblical tribes, it is understandable that they do not have a great frequency of the CMH haplotype.

While the CMH haplotype was found in a greater percentage in Cohens, Israelites and Levites were found to have a higher than normal percentage of this haplotype when compared to non-Jewish males. The frequency of finding the CMH in Cohens was 50%, in non-Cohen male Jews it was 12%, while in non-Jewish males it is almost undetectable [3]. This has led many to conclude that the higher the frequency of the CMH in a population, the greater the probability that the population had a Jewish ancestry, since in the population there would undoubtedly have been some Cohen ancestors.

Other studies have shown that there are other haplotypes on the Y chromosome which link many male Jews. According to Dr. Hammer's study, Jewish male populations exhibit a higher frequency of the Med and YAP+2S haplotypes than other male populations. Interestingly, male Ethiopian Jews do not exhibit a high frequency of these haplotypes, and instead show a high frequency of haplotypes shared by other male non-Jewish African populations. Dr. Hammer's study therefore concluded that Ethiopian Jews do not share a common paternal ancestor with other Jews [3].

If Ethiopian Jews do not share with most Jews a maternal ancestor based on mitochondrial DNA research, and do not share a paternal ancestor based on Y chromosomal research, is there any chance they can be descendents of King Solomon? Yes, it is all a matter of how one interprets the data. In Kings I the Queen of Sheba makes a request of King Solomon, which, according to Midrash Avoth, was a requested for him to give her a child. Their union produced a daughter, as seen in Kings 1 10:13. Many have speculated that from this child descended the Ethiopian Jews. As the child produced was a daughter, King Solomon did not pass on his Y chromosome, since a Y chromosome is only passed from father to son. Therefore, it makes sense that research done to trace lineage based on the Y chromosome would show that Ethiopian Jews do not have a Jewish ancestor, since their progenitor did not receive the "Jewish" Y chromosome. Likewise, it makes sense that research done on mitochondrial DNA would find no link between Ethiopian Jews and lay Jews, since the Queen of Sheba was not Jewish and therefore could not pass on "Jewish" mitochondrial DNA. While there is no way currently to demonstrate conclusively whether Ethiopian Jews are the descendents of King Solomon, current research can also not disprove the contrary. The only conclusion we are left with is that the Jewish ancestor of the Ethiopian Jews is unlikely to be male. While modern research in could not be used to come to a definitive answer, it is not done in vain. As research techniques become more sophisticated, we can look towards a future when we can use genetic research to better understand biblical events. ■

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**References**

