AFRICAN AMERICAN LIVES

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press information

PBS

The Science Behind the Series

AFRICAN AMERICAN LIVES

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A geneticist appearing in **AFRICAN AMERICAN LIVES***, Dr. Peter Forster is a Fellow and Praelector at New Hall College, University of Cambridge in England. His work traces and dates the prehistoric spread of human DNA across the world, and he has used DNA for genealogical, archaeological and forensic casework. Below, Dr. Forster discusses the basics of genetics and its application within* **AFRICAN AMERICAN LIVES***:*

Q: What is DNA?
A: Deoxyribonucleic acid is the substance which all forms of life carry within their cells as a set of instructions to recreate themselves. Its structure is a double helix, like a twisted ladder, with a pair of nucleotides forming each rung. The DNA in a human cell is about 3000 million nucleotides long.

Q: What are genes?
A: A gene is a specific stretch of DNA (often thousands of nucleotides long) which contains instructions for the cell to translate this DNA into an equivalent RNA copy. The cell then uses the RNA to make a protein, which are constantly needed for various cell functions. Humans have about 30,000 genes.

Q: What are chromosomes?
A: Higher life forms tightly wind their DNA around proteins called histones. These DNA-protein packages are the chromosomes, of which humans have 46 (two sets of 22 chromosomes, plus two X chromosomes for females, or an X and a Y for males).

Q: What is Y-chromosomal DNA? Mitochondrial DNA?
A: The first occurs only in males, because the Y chromosome is passed down exclusively from father to son. Mitochondrial DNA (mtDNA), on the other hand, is passed down exclusively through the mother to her children (both male and female).

Q: How does DNA change from generation to generation?
A: Human mtDNA is the female equivalent of a family name: it passes down from mother to offspring in every generation. But family names are not immutable across the centuries - in the last 800 years, for example, "Forester" has changed to "Forster" and then to "Foster" - nor are mtDNA types. A natural mutation modifying the mtDNA in the eggs of one woman will henceforth characterize her female descendants. The male biological equivalent of a family name is the Y-chromosome, which can also occasionally mutate in the course of millennia.

Q: How can we use DNA to determine our ancestry?
A: DNA tests analyzing mitochondrial DNA or the Y chromosome can provide information both

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on recent ancestry (such as verifying traditional family trees) and also on more ancient ancestry (such as tracing the descendants of African slaves back to parts of Africa, or by tracing the lineages of modern Europeans back to their Ice Age homelands). Most people can trace their family history back three or four generations; others have lost any record of even fairly recent ancestors and can only suspect from where their family originates - but until now have had no way of knowing for certain.

Q: Please explain what your database at Cambridge contains.
A: We curate the largest proofread mitochondrial DNA database in the world which can provide geographic information on the ancestry of an individual. The database currently contains mtDNA sequences ("signatures") sampled since 1981 from 35,000 volunteers, mostly anonymous, in the scientific literature. These samples include indigenous people from across the world, most of them still alive today. The database is constantly growing as a result of increasing scientific research on human historic and prehistoric ancestry.

Q: In AFRICAN AMERICAN LIVES, when you enter a participant's DNA into the database, what are you looking for?
A: In this study, we want to help African Americans in identifying native African tribes in our database which contain African individuals with matching maternal DNA. As explained above, this search is the biological equivalent of a case where a European American might look to Europe to find living Europeans who carry his family name, and who therefore may be distantly related.

Q: How do you know when you have a match, or multiple matches?
A: Starting off from a simple saliva sample, we analyze about 800 nucleotides of mtDNA from a participant. We can then search in the database for exact matches, that is, individuals who are identical across the entire 800 nucleotides. We then locate on a world map where precisely these anonymous individuals live, and can then identify which tribes they belong to, which languages they speak, and in which scientific study they were originally recruited. Sometimes we fail to find an exact match and then the database automatically continues searching for the next-best matches (just like finding Fosters instead of Forsters in the database), for which the same geographic and tribal information is provided.

Q: What can history tell us about DNA matches that are widespread, not clustered?
A: A widespread distribution can be the result of DNA dispersed in an ancient, gradual expansion from prehistoric origin, or in a recent, rapid population movement. For example, many African Americans have widespread matches across the Bantu-speaking areas of Africa, which is due to a recent dispersal from the Bantu homeland in Cameroon into southern Africa within the last 2000 years or so. In such a case, if a person's database results determine that his or her matches are indeed restricted to a particular African language such as Bantu, he or she might then carry out research on the prehistory of the Bantu peoples.

Q: How many ancestors does the mtDNA or Y-chromosome DNA type tell us about?
A: Only one ancestor each. The number of ancestors doubles in every generation we follow back, amounting to 1,024 African ancestors 10 generations (roughly 300 years) ago. This is only a maximum theoretical value, but as a rule of thumb, it will serve to remember that Y and mtDNA can point to only two out of 1,000 or so personal, direct ancestors living then.

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