Research suggests a more complex evolution and spread of modern humans

By Walter Gilberti
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New research into the genetic pedigree of modern humans may lead to a modification of the widely accepted "out of Africa" theory that explains the origin and worldwide expansion of people, who looked and behaved much like ourselves.

A study by Dr. Alan Templeton, a population biologist at Washington University in St. Louis, casts doubt on the notion that modern *homo sapiens* completely replaced other human populations as they "migrated" out of Africa some 100,000 years ago. "It's mostly out of Africa but not exclusively," Templeton said in a recent interview. "Humans expanded again and again out of Africa, but these expansions resulted in interbreeding, not replacement, and thereby strengthened the genetic ties between human populations throughout the world."

It is generally accepted that modern humans first appeared in the African continent from about 70,000 to 130,000 years ago, as indicated by fossil evidence from Border Cave and Klasies River in southern Africa. Tantalizing remains of "archaic" *homo sapiens*, a human that exhibited a combination of primitive and modern characteristics, have been dated as ancient as 300,000 years.

The "out of Africa" theory has largely supplanted the multi-regional hypothesis, which held that humans evolved in different parts of the world, from the more primitive *homo erectus* to the fully modern, more or less simultaneously. One of the negative aspects of the multi-regional hypothesis was that it lent itself to a racialist analysis of human origins, behind the conception that there existed a continuity of the so-called racial characteristics of currently living populations with those of distant evolutionary ancestors in each geographical region.

In the late 1980s, molecular biologists advanced the mitochondrial "Eve" hypothesis, which further bolstered the idea that all presently living humans are the descendants of an exclusively African lineage. The "Eve" hypothesis traced the human line to a hypothetical female residing in Africa, by extrapolating back in time the rate of mutation of the DNA in the mitochondria of human cells.

Found in large numbers in the cytoplasm of human cells, the mitochondria are membrane-bound compartments or organelles that are responsible for cellular respiration. Since the mitochondria reside in the cytoplasm rather than in the cell nucleus, their DNA can only be passed on from one generation to the next through the female. Male sperm cells contain virtually no cytoplasm, and are thus lacking in mitochondria. Mitochondrial DNA plays no role in the human genotype; however, its existence suggests that the mitochondria were once free-living bacteria-like organisms that became incorporated into more complex cells as life evolved.

As the "out of Africa" theory became more widely accepted, the seemingly sudden appearance of *homo sapiens*, and its rapid expansion led many paleoanthropologists to conclude that previously existing humans in Europe and Asia had been completely replaced by biologically and culturally superior moderns. Ongoing molecular genetics research had tended to confirm this scenario of human expansion out of Africa, and resulted, in one example, in the re-designation of *homo neanderthalensis* (formerly *homo sapiens neanderthalensis*), the famous Neanderthal "cave man" of Europe, as a separate species, and its removal from consideration as a contributor to the modern human genome.

However, Templeton's research calls the total replacement explanation into question. Using a computer program called GEODIS, Templeton analyzed mitochondrial DNA, Y-chromosome DNA inherited from the father, and the DNA from eight other regions of the human genome, including two on the X chromosome. Templeton also examined genes (segments of the DNA molecule) from a diverse sampling of populations. The program is designed to determine genetic relationships among and within populations by examining haplotypes, clusters of genes that are inherited as a unit. What is unique about Templeton's research is that his analysis covered 10 DNA regions rather than the usual one; mitochondrial DNA, for example.

Templeton created the GEODIS program, which was later modified with the help of David Posada and Keith Crandall at Brigham Young University. The program employs a statistical approach that requires no prior model of human evolution to serve as a template for the data, thus decreasing the temptation to make the data fit a preconceived construct.

Their findings reveal the presence of DNA signatures whose origins are far more ancient than would have been expected had *homo sapiens* not intermingled with other human groups.

Templeton's work suggests that there were at least two major expansion events out of Africa—the older one being between 420,000 and 840,000 years ago, and the more recent one between 80,000 and 150,000 years ago.

According to Templeton, genes from these earlier movements are present in the human genome, and are specific to certain geographical regions. Thus, there may be residual Neanderthal genes in the genetic makeup of Europeans, and perhaps, *homo erectus* genes in some Asian populations. Templeton writes; "If there had been a replacement event, the three significant genetic signatures of the older expansion event and the six significant genetic signatures of older recurrent gene flow would have been wiped away."

Templeton's reference to gene flow, the movement of genes either in or out of a population due to the movement of people over time, helps to explain the wide range of dates, especially for the older expansion. It is indicative of the difficulties paleoanthropologists encounter when attempting to reconstruct what amounts to a protracted evolutionary process. Rather than a migration of peoples, in the modern sense, from an original homeland to a new one—the Bantu migration across Africa, for example—these early humans slowly radiated, establishing themselves in new areas of the world over many tens of thousands of years.

What triggered these pulses of humanity across the globe probably involved a combination of biological and cultural evolution, with more favorable climatic conditions. Driven by an increasingly complex social structure, the human line evolved in the direction of bigger brains, which, in turn, allowed for more advanced communication, perhaps in the form of rudimentary speech. Concomitant with increased cranial capacity were subtle cultural advances that provided these humans with a more successful lifestyle, leading to an increase in population and its accompanying pressures. By the time of the second great migration—called "out of Africa 2" by biologist Paul Ehrlich—real language may have already emerged.

In some respects, Templeton's conclusions seem to lend some credence to a current variant of the multi-regional hypothesis, which likens the evolution and spread of *homo sapiens* to a "trellis." This model of human evolutionary expansion has it origin in the 1930s in the work of Franz Weidenreich, one of the great paleoanthropologists of the twentieth century, and the man chiefly responsible for the original excavations that uncovered so-called "Peking Man," now recognized as a *homo erectus*, at Zhoukoudien in China.

Weidenreich's model of human evolution resembled the "candelabra," thus making him a strict multi-regionalist. However, Weidenreich, unlike some of his contemporaries, rejected the notion that the characteristics that one associated with human "races" are anything other than recent and ephemeral. Weidenreich tried to explain the seeming contradiction between isolated regional development and the unity of the human species by advancing the notion of orthogenesis, or directed evolution. Weidenriech theorized that once the human line emerged it was internally programmed to evolve in a particular way—toward having larger brains, for example.

A parallel conception focused on the impact of the evolution of culture, which served to mediate biological evolution, by reducing the importance that the variation in physical characteristics would have had in distinguishing one human population from another. An obvious example would be the fact that today darker-complexioned people can successfully survive in colder, less sunny climates, even though they cannot produce adequate amounts of vitamin D through the absorption of the sun's energy. Rather, they can obtain the necessary amount of the vitamin through supplements or the consumption of dairy products.

The present-day adherents of the multi-regional hypothesis, University of Michigan anthropologist Milford Wolpoff and Australian anthropologist Alan Thorne, advance the "trellis" model of human evolution, which combines regional development with continuous gene flow—the result of contact with newly arrived populations over hundreds of thousands of years.

Wolpoff and Thorne cite compelling evidence in the fossil record that suggests regional continuity, and are critical of the mitochondrial "Eve" hypothesis. They emphasize what they call the relationship between the "center and edge" in populations, or species. While they acknowledge Africa as the probable "center" of *homo sapiens* evolution, Wolpoff and Thorne insist that peripheral or "edge" populations would have developed regional homogeneity due to variations in gene frequencies caused by adaptations to new environmental challenges, combined with a certain degree of geographical isolation.

Templeton, however, has maintained that the genetic makeup of modern humanity is overwhelmingly African, despite indications that local populations persisted and contributed to the modern gene pool. While Templeton's research has added new fuel to the debate over the evolution and spread of modern humans, it has once again revealed how astonishingly rich and complex the process has been.