Neandertals make big splash in gene pool

Neandertals died out around 30,000 years ago, but their mitochondrial DNA has been resuscitated in a scientific effort that heralds a new phase in the study of humankind's evolutionary roots.

A team of German and U.S. investigators extracted a short segment of mitochondrial DNA—which is inherited from the mother—from a Neandertal fossil found in Germany in 1856. A comparison of the ancient genetic sequence to sequences from modern people indicates that Neandertals were not ancestors of *Homo sapiens*, contend geneticist Svante Pääbo of the University of Munich and his coworkers.

Moreover, inclusion of the Neandertal genetic sequence in a statistical reconstruction of genetic lineages suggests that Africa was the original source of human mitochondrial DNA patterns, the researchers report in the July 11 CELL. This evidence supports the theory that modern *H. sapiens* emerged in Africa around 100,000 years ago and then spread throughout the world, replacing Neandertals in the process.

Scientists familiar with the new finding hail it as the first successful recovery of Neandertal genetic material. Opinions differ about the ability of the DNA data to illuminate Neandertal evolution and human origins.

"This finding looks like the real thing," comments anthropologist Christopher B. Stringer of the British Museum in London. "On the basis of the new evidence, there doesn't appear to have been any interbreeding between Neandertals and modern humans."

Stringer, an ardent proponent of African origins for humans, had participated in prior attempts to recover mitochondrial DNA from Neandertal bones.

Milford H. Wolpoff, an anthropologist at the University of Michigan in Ann Arbor, offers a different perspective. He advocates the theory that humans evolved in several parts of the world over perhaps the last 2 million years and include at least some Neandertal ancestry.

"It's not possible to interpret the new evidence until we get additional [Neandertal DNA] samples and better understand the meaning of variations in this genetic material," Wolpoff asserts.

Stone Age humans may have lived in small groups that had infrequent contact with each other; this would have facilitated the loss of mitochondrial DNA lineages, perhaps including those of Neandertals, he argues. Furthermore, he says, Neandertals may have possessed many mitochondrial DNA arrangements, some of which fell closer to modern human patterns than the sample examined by Pääbo's group.

The researchers extracted and patched together a particularly variable strand of mitochondrial DNA from the Neandertal bone, which is at least 30,000 years old. They then copied and amplified the genetic material with the help of two primers, small pieces of human mitochondrial DNA that match the beginning of the Neandertal sequence.

When the 378 DNA nucleotides in the ancient specimen were compared to corresponding human and chimpanzee sequences, the Neandertal DNA often differed from the others at sites known to undergo frequent modification. There were, on average, 27 differences between human samples and the Neandertal, whereas human populations typically differ in seven positions.

The researchers then found that the German Neandertal sequence diverged about equally often from DNA samples of Africans, Europeans, Asians, Native Americans, Australians, and Pacific Islanders. If European Neandertals had interbred with modern humans, they should display a closer genetic match to modern Europeans, according to study participant Mark Stoneking of Pennsylvania State University in State College.

Statistical analyses conducted by Pääbo's group suggest that Neandertal and human mitochondrial lineages split around 600,000 years ago, whereas the founding mothers of modern human mitochondrial DNA lived between 120,000 and 150,000 years ago.

The Neandertal genetic data place human mitochondrial DNA origins in Africa, Stoneking asserts. However, other genetic studies support multiregional evolution rather than the out-of-Africa model, maintains biologist Alan R. Templeton of Washington University in St. Louis.

"Stoneking's conclusions are possible, but I'm dubious about using a sample of one [Neandertal DNA sequence] to make inferences about an entire population," says Templeton.

One point of scientific agreement does exist: Further studies are needed to isolate mitochondrial DNA from more Neandertal fossils, as well as from the remains of Stone Age *H. sapiens*. *—B. Bower*

Exposing chaos in a falling disk's flutter

The trick is to drop a playing card into a hat resting at your feet. If the card is held vertically when released, it flutters wildly and completely misses the target. Held horizontally, it settles gently, with little wayward motion, directly into the hat.

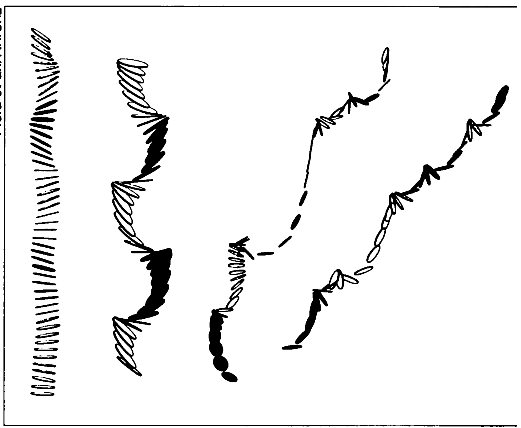
This phenomenon, sometimes displayed with coins dropped in liquids instead of cards in air, is not only the subject of amusements and bets, but also a topic of considerable interest to researchers studying chaotic dynamics. It has applications in chemical engineering, meteorology, sedimentology, and other fields.

Performing experiments on disks falling in liquids, researchers have now identified four distinctive types of behavior, which depend on such factors as the disk's diameter and density and the liquid's viscosity. The physicists also obtained the first experimental evidence of an unusual type of transition from periodic to chaotic motion that had been predicted but not observed.

Stuart B. Field of Colorado State University in Fort Collins, Franco Nori of the University of Michigan in Ann Arbor, and their coworkers report the results in the July 17 NATURE.

The work of Field and his colleagues follows up on a number of recent theoretical studies modeling the tumbling and drifting motion of a falling leaf, sheet of paper, or stiff card (SN: 9/17/94, p. 183). These efforts suggested that, under certain circumstances, the motion of falling bodies may be chaotic.

In the new experiments, steel and lead disks, ranging in diameter from 5.1 to 18.0 millimeters and in thickness from 0.076 to 1.63 mm, were dropped in water and mixtures of glycerol and water.



Field et al./NATURE

Video images of disks falling through a fluid show that different combinations of disk and fluid properties lead to different types of trajectories (from left to right): steady fall, periodic oscillation, chaotic motion, and tumbling. One side of the disk is white, the other black.

In a highly viscous liquid, a disk dropped with any orientation quickly settles into and maintains a horizontal position as it falls. At lower liquid viscosities, large-diameter disks oscillate with a well-defined period. A disk of smaller diameter and low density displays chaotic motion, swinging back and forth more and more widely until it flips over, tumbles, then returns to an oscillating mode. Disks of small diameter and high density tumble, continually turning end over end while drifting to one side. *— I. Peterson*