New Evidence Ages Modern Europeans

Seven bits of charcoal, excavated from two caves in northern Spain and analyzed with a recently developed variation of radiocarbon dating, may herald a major shift in the debate over the origins of anatomically modern humans in Europe. A new study suggests that stone tools and other remains of the Aurignacian culture, generally attributed to the handiwork of the earliest European *Homo sapiens sapiens*, date to nearly 40,000 years ago in western Europe – about 6,000 years earlier than previously thought.

The results challenge the widespread assumption that a gap of several thousand years existed between the end of western Europe's Mousterian culture, characterized by simple stone tools linked to the Neanderthals, and the Aurignacian entrance into the same region, says James L. Bischoff of the U.S. Geological Survey in Menlo Park, Calif. Bischoff and four Spanish colleagues report their findings in the December JOURNAL OF ARCHAEOLOGICAL SCIENCE.

Aurignacian technology apparently spread westward from eastern Europe, where it dates to about 43,000 years ago, much faster than usually thought, the researchers contend. Thus, modern humans may have abruptly replaced Neanderthals in southwestern Europe.

Disputes over the evolutionary relationship of Neanderthals to modern humans remain far from settled (SN: 2/27/88, p.138), but the new evidence "opens the debate to a wide variety of possibilities," says Lawrence G. Straus of the University of New Mexico in Albuquerque. For example, he writes in the Nov. 30 NATURE, if Aurignacian skills developed at roughly the same time throughout Europe, Neanderthals may have evolved directly into anatomically modern Cro-Magnons with little or no interbreeding with Asian and African populations of *H. sapiens sapiens*.

This contrasts with the currently popular view that Neanderthals were a dead-end branch of humanity replaced by modern humans, who originated in Africa and spread throughout the world.

"If the Spanish dates are accurate, they represent something revolutionary," says Randall White of New York University in New York City. What emerges is a "more mosaic, complicated picture" of the European transition from Neanderthals to modern humans, he notes.

But White says he will remain skeptical of Bischoff's findings until the same dating technique – known as accelerator mass spectroscopy (AMS) radiocarbon dating – is applied to other Aurignacian sites. Other researchers who recently used the AMS technique to study an early human site in France placed it at only about 34,000 years old, he points out.

AMS radiocarbon dating was developed about eight years ago, and its archaeological use began several years ago. It is considerably faster than the conventional method and handles much smaller samples, says physicist Douglas J. Donahue of the University of Arizona in Tucson, where Bischoff's charcoal was dated. The dating range of both methods is about 50,000 years, he adds.

Conventional radiocarbon dating measures the decay of carbon-14 atoms in chunks of organic material and calculates age from the ratio of carbon-14 to stable carbon atoms. For AMS dating, thumbnail-sized samples are placed in a high-energy mass spectrometer, where carbon atoms of different mass are separated and counted.

AMS allows investigators to confirm dating estimates on several samples from the same sediment layer, a luxury usually unavailable with the conventional technique because of the large amounts of material required for dating.

Bischoff's team obtained three AMS dates for the earliest Aurignacian layer at one Spanish cave and four dates at the second cave, all of which date to nearly 40,000 years ago. Charcoal from the second cave indicates the Mousterian culture ended about 40,400 years ago.

The new evidence suggests Neanderthals may have borrowed tool-making styles from modern humans in southwestern Europe and developed the distinct implements of the Chatelperronian culture, which disappeared around 33,000 years ago, Bischoff says. But whether Neanderthals and modern humans interbred remains an open question, he asserts. – *B. Bower*

Unstudied California fault poses hazard

Northern Californians can now worry about another deadly fault in their midst. Preliminary studies suggest the next major quake to hit San Francisco could come from a relatively unstudied fault that scientists have not considered in any hazard assessments to date.

Called the Rodgers Creek fault, the structure runs northward from San Pablo Bay to Santa Rosa and represents a continuation of the well-known Hayward fault, which also threatens Bay area residents (SN: 10/21/89, p.261).

If a major quake struck along the Rodgers Creek fault, "the whole north Bay area would really suffer a lot of damage," says geologist David P. Schwartz. The fault is half as far from San Francisco as the branch of the San Andreas that spawned the magnitude 7.1 Loma Prieta earthquake on Oct. 17.

Schwartz, Karin E. Budding and their colleagues at the U.S. Geological Survey (USGS) in Menlo Park, Calif., raised the warning flag over Rodgers Creek on the basis of studies this summer showing the fault has produced several major earthquakes in the past and appears to be nearing another rupture, possibly within the next few decades.

The geologists dug trenches near the fault, looking for broken sediment layers, which signify past earthquakes. By dating charcoal in the sediments, they found the fault has generated at least three or four major earthquakes in the last 1,270 years. These and other findings suggest the quakes occurred roughly 256 to 620 years apart. At last week's meeting of the American Geophysical Union in San Francisco, Budding said this estimate is a maximum and warned that the time between jolts might be shorter.

The researchers remain unsure of when the fault last broke. While records indicate an earthquake hit the north Bay area in 1808, geologists cannot determine whether it originated on Rodgers Creek or a nearby fault. Schwartz concludes Rodgers Creek has remained quiet for at least 181 years, perhaps much longer, and thus could break soon.

Other evidence supports the idea that the fault is storing energy for a quake. Seismologic records reveal it has not produced many "microearthquakes" in the past two decades. In addition, the opposite sides of the fault are not creeping past each other. This suggests they have locked together and strain will continue to build until an earthquake breaks the fault.

Scientists have long known of the Rodgers Creek fault, but the trenching analysis is the first to reveal its earthquake history, says Schwartz. He and his colleagues recommend that future hazard assessments include this fault. A 1988 USGS report did not consider Rodgers Creek when it forecast that the Bay area faces even odds of a magnitude 7 quake in the next three decades. Loma Prieta does not lower those odds.

A committee of earth scientists will meet next year to reassess the 1988 analysis. Schwartz says recognition of Rodgers Creek's quake potential will lead the group to increase its predicted odds of a destructive earthquake hitting the Bay area by 2020. – *R. Monastersky*