Eggshells help date ancient human sites

The use of a controversial technique to date an underappreciated type of ancient refuse – ostrich eggshells – may help resolve questions about modern human origins. A new study indicates that the technique, known as amino acid racemization (AAR), can provide reliable dates for eggshells found at early human sites from Africa to China.

AAR yields accurate ages of up to 200,000 years at tropical sites and up to 1 million years at cold-weather sites, asserts a research team led by anthropologist Alison S. Brooks of George Washington University in Washington, D.C., in the April 6 SCIENCE. Radiocarbon dates extend back only about 40,000 years.

After an organism dies, its amino acids realign themselves at a slow, relatively uniform rate to form a mirror image of their original molecular structure. AAR uses the proportion of the two structures as a biological clock. Because the realignment occurs more quickly and unpredictably in warm or moist climates, AAR dates are more accurate and extend back farther in cold regions. The method thus requires good estimates of a site's temperature history.

In laboratory tests, Brooks' team found ostrich eggshells prime candidates for AAR dating. Early humans apparently ate ostrich eggs and used the shells as water containers. The hardy shells are virtually impervious to chemical contamination through leaching, the scientists maintain. In the past, researchers have questioned AAR dates for bones and mollusks, citing possible contamination from groundwater and other sources.

Age estimates for eggshells at two African sites, one in the Kalahari desert and the other in the Sahara, closely match radiocarbon dates extending back as far as 35,000 years at the same sites, the scientists report. Eggshells found in older sediment layers at the Kalahari site date to between 65,000 and 85,000 years ago, according to AAR analyses based on temperature estimates going back about 200,000 years. Such "pre-radiocarbon" dates are harder to establish at the Sahara site, where the temperature history remains unclear, says study coauthor Gifford H. Miller of the University of Colorado in Boulder.

Ostrich eggshells at a South African cave containing anatomically modern human bones yield AAR ages of between 78,000 and 110,000 years, according to a recent analysis directed by Miller. However, another technique called electron spin resonance (SN: 4/29/89, p.263) yields an age estimate of only about 60,000 years at the same cave. Scientists have no consensus as to which date is more accurate.

– B. Bower

CFC replacements: Better but not ideal

The 1985 discovery of an ozone "hole" over Antarctica awakened the world to the dangers of chlorofluorocarbons (CFCs) after decades of their widespread use. Today, as companies fashion replacements for CFCs, scientists want to ensure the environmental safety of the new compounds *before* they build up in the atmosphere.

The first broad study of CFC substitutes shows that they should indeed cause less damage to Earth's ozone layer and contribute less to the greenhouse effect than the CFCs. But the new analyses, based on computer models of the atmosphere, also reveal that the substitutes are far from harmless.

"They're to be used with some precautions. They don't answer all the concerns we have," says Donald A. Fisher, an atmospheric scientist at Du Pont in Wilmington, Del., the world's largest producer of CFCs. With colleagues from several U.S. and Norwegian research institutions, he describes the study's results in the April 5 NATURE.

CFCs harm the protective ozone layer because their long atmospheric life spans allow them to drift up to the stratosphere, where ultraviolet light breaks them apart and frees ozone-destroying chlorine. In addition, CFCs contribute to greenhouse warming by absorbing infrared radiation emitted by the Earth.

Their replacements address the ozone problem in two ways (SN: 4/9/88, p. 234). Some lack chlorine altogether, while others include a hydrogen atom that presumably shortens their atmospheric life span, preventing them from reaching the stratosphere in large amounts.

The atmospheric models verify that assumption, showing that the chlorine-containing replacements have less than 10 percent the ozone-destroying potential of CFCs. But the same models indicate that these compounds, while an improvement over CFCs, can still harm stratospheric ozone, whereas those without chlorine cannot.

And both kinds can add to the greenhouse effect, the computer models show. Though many of the substitutes are better than CFCs by a factor of 10 or more, they would still exert a strong warming effect on Earth's climate if allowed to build up.

Fisher says the modeling results underscore the need to view this first generation of replacements as an intermediate measure to help wean the world from CFCs as quickly as possible.

– R. Monastersky

Microwaving microorganisms: Salty shield?

Microwave mania has turned frozen dinners into fast food. Pop the entree into the microwave, set the time and temperature, and presto – in minutes, you get a hot meal that might have taken hours to prepare from scratch.

But just *how* hot is an important safety question. British researchers suggest microwaving may not heat the centers of foods – especially heavily salted foods – enough to kill toxic bacteria.

Richard W. Lacey and Stephen F. Dealler at Leeds University in England parceled out 300-gram servings of refrigerated mashed potatoes both with and without added salt, then microwaved them for 1 minute and measured their core temperatures. They found that increasing concentrations of the salts sodium chloride, potassium chloride, ammonium chloride or monosodium glutamate led to lower core temperatures. Mashed potatoes containing 600 milligrams of these salts failed to reach the core temperatures of unsalted samples, which heated uniformly all the way through.

This suggests that if a food contains *Salmonella* or *Listeria* bacteria – major causes of food poisoning – microwaving may heat the microorganisms to a temperature that spurs their growth rather than kills them, Dealler says.

In measuring the core temperatures of frozen dinners microwaved according to package directions, the researchers noted similar results. The core temperature increase of dinners containing 200 to 1,000 mg salt averaged 62 percent that of comparable unsalted foods, they report in a letter in the April 5 NATURE.

The team proposes that microwave radiation induces the flow of an ionic current on the surface of foods with high salt concentrations. The ions may absorb the microwave energy and act as a shield, reducing the waves' penetration, Dealler says. This would explain why microwaved food often boils on its surface but remains cool on the inside, he adds.

Theodore Labuza, a food scientist at the University of Minnesota in St. Paul, says other research indicates significant amounts of salt and sugar tend to change the way food absorbs microwave energy. He suggests the mechanism may be more complex than the British team postulates. Both Labuza and Dealler recommend microwaving foods longer and at lower power than the package instructs, then letting them sit for a few minutes to help ensure that harmful bacteria have been killed.

– C. Decker