Temperature not key to biodegradation

Environmental cleanup experts often contend that organisms living in warm soil and water degrade chemicals faster than microbes that reside in cold climes. After all, microorganisms become less active when their surroundings get cooler.

On the other hand, reasoned Paul M. Bradley and Francis H. Chapelle of the U.S. Geological Survey in Columbia, S.C., microbes adapt to their environment, so organisms living in constantly cool regions may perform as well in these cold environments as those accustomed to warm areas do in theirs.

To test their idea, the scientists examined microbes from aquifers in Adak, Alaska, that were contaminated with jet fuel and had a men temperature of 5°C and from aquifers in Hanahan, S.C., that were contaminated with petroleum and had a mean temperature of 20°C. The researchers clocked the speed at which the soil microbes created carbon dioxide by digesting toluene, a compound in petroleum. The Alaskans won, by a hair.

"There's going to be a lot of variability in the environment that's going to control the [degradation] rate, but temperature itself is not particularly important," Bradley contends. The type and quantity of nutrients, toxins, and microbes in the soil or water help determine degradation rates.

This new finding could change how bioremediation experts tackle cold, contaminated sites, says James M. Tiedje of Michigan State University in East Lansing.

In their experiment, Bradley and Chapelle added radiolabeled toluene to soil from the aquifers. They then measured the rate at which the microbes produced radiolabeled carbon dioxide at several temperatures. For each sample, the rate at 20°C was greater than at 5°C.

At the mean temperature for their respective aquifers, the Alaskan population turned 16.3 percent of the toluene into carbon dioxide per day, while the South Carolinian microbes converted 5.1 percent, the team reports in the November ENVIRONMENTAL SCIENCE AND TECHNOLOGY. They consider this difference to be small. The researchers demonstrated that the overall metabolism in the soil samples was similar, so none had an unfair number of microbes on the job.

Local oil-eating bacteria and fungi helped clean Alaskan beaches in 1989 after the *Exxon Valdez* spill (SN: 4/17/93, p.253). However, that example did not demonstrate the superiority of cold-dwelling microbes, because organisms from more southern climes were not tested. — *T. Adler*

Brain evolution: Climate shifts into gear

Scientists have generally assumed that stable savanna environments allowed human ancestors to evolve the big brains that made possible such mentally complex feats as tool making and organized foraging. Now, new evidence indicates that our Stone Age forebears encountered a surprising amount of climate change, forcing them to cope with unfamiliar habitats.

Frequent, jarring environmental shifts over the past 2 million years may have provided the fundamental evolutionary spur to human brain expansion, contends Richard Potts, an archaeologist at the Smithsonian Institution in Washington, D.C.

"I'm suggesting that the genus *Homo* evolved by a process of accommodating to habitat variability and disruption," Potts asserts. "This accounts for increased density and plasticity of neural connections, as well as specialized brain functions that enable mental and social flexibility."

Potts presented data in support of this theory at the annual meeting of the American Anthropological Association in Washington, D.C., last week.

Analyses of oxygen isotopes in soil extracted from the ocean floor and of fossil pollen found in Europe and China indicate that a gradual large-scale shift to a cooler, drier climate, which led to savanna conditions, began around 5 million to 6 million years ago. At this time, the first members of the human evolutionary family appeared. Many substantial climate fluctuations occurred within that overall trend, Potts argues. The largest oscillations in global climate within that period coincided with the evolution of *Homo* species over the past 2 million years, he maintains.

Research at Olorgesailie in southern Kenya, for example, has uncovered evidence of dramatic environmental changes negotiated by hominid tool makers who inhabited the area from 1.2 million to 500,000 years ago. Climate shifts and earthquakes took particular liberties with a large lake that now dominates the site, says Potts, who directs the Olorgesailie project.

Excavations suggest that the lake expanded significantly around 1 million years ago, but over the next 500,000 years it shrank, shifted its position numerous times, and even disappeared occasionally. Many animals, such as elephants, zebras, and baboons, that had previously flourished near the lake met extinction in that period, Potts notes. However, abundant stone tools and debris reveal that hominids survived those habitat shifts.

The ratio of brain size to body size in early hominids had remained similar to the ratios for other primates, Potts notes. But then, as a result of the repeated climate and habitat shifts, hominid brains began to bulge. "Hominids had to adapt to environmental extremes that altered the conditions of natural selection under more stable conditions," says Potts.

This conclusion dovetails with preliminary evidence that Stone Age groups responded to recurring crisis situations by pooling information and making effective collective decisions (SN: 11/18/95, p.328). — *B. Bower*

Device goes for the glow

Silicon, already the staple material of computers and electronics, would become even more useful if it could be made to glow. But its crystalline wafers, though friendly to electrons, turn a cold shoulder to photons, emitting light only weakly.

Zheng H. Lu, a materials scientist at the National Research Council of Canada in Ottawa, and his colleagues, however, have found a way to coax the stubborn crystals into luminescence. In the Nov. 16 NATURE, they describe a method of stacking alternating layers of silicon and silicon dioxide to create a structure that can convert electron energy into light.

The scientists layered extremely fine sheets of the two materials—like sheets of filo dough—to create a "silicon superlattice." The light emission, they explain, arises from "quantum confinement" of electrons in the material's layers.

Quantum confinement occurs when electrons become penned into nanometer-sized spaces. Thus confined, they behave more like trapped waves than particles. Transitions between trapped wave states can then lead to emission of photons.

Given the increasing importance of optoelectronics for computing, telecommunications, compact disks, and holography, such silicon-based light generators could prove "an attractive option," says David A.B. Miller, who is a materials scientist at AT&T Bell Laboratories in Holmdel, N.J.

These new results show "strong evidence" that quantum confinement occurring in such superlattices may "allow us to turn silicon into a shining example of an optoelectronic material," Miller says in NATURE. "This work will surely stimulate more activity in this field and may yet give silicon an even brighter future." — *R. Lipkin*