Caustic Comfort

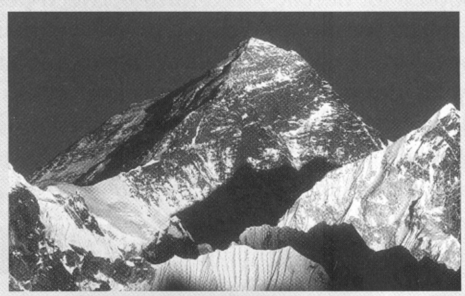
Compared with a great many microorganisms, people live in fairly boring conditions. But imagine taking a turn as a hyperthermophile basking in an undersea thermal vent, or swapping spots with an acidophile lounging in the equivalent of battery acid, or trading places with an extreme alkalinophile whiling away the hours in a bath of oven cleaner.

George S. Roadcap, a hydrogeologist at the Illinois State Water Survey, and his colleagues could tell you something about that last scenario. They recently discovered a microbial community thriving in what seems to be a record-breaking caustic solution. At a century-old iron slag dump in the Lake Calumet area of Chicago, the groundwater registers a pH of 12.8. That makes it nearly a million times as alkaline as a neutral solution. The Chicago microorganisms' closest competitors for surviving the world's most caustic conditions live in a pH of "only" 11. (www.geosociety.org/news/pr/03-38.htm) —*Aimee Cunningham*

RAISING MOUNTAINS

Even in the Himalaya, not all mountains are created equal. The Higher Himalaya, which form the northern part of the range, include the world's tallest peaks—Mount Everest, for instance, exceeds 29,000 feet. In contrast, the Lower Himalaya, to the south, are generally no more than a third as high. Dense forests have long obscured the transition between the two ranges, preventing geologists from understanding the abrupt change in elevation.

Enter modernization: Road-building crews in north-central Nepal near the Marsyandi River, at the heart of the "transition zone" between the Higher and Lower Himalaya, stripped away some of the vegetation and exposed first-rate geologic outcrops. Seizing the opportunity, Kip V. Hodges of the Massachusetts Institute of Technology and a host of colleagues descended on the Marsyandi.



Mount Everest

The investigators found that the transition zone is marked by major, recently active faults. It also seems to have exceptionally high rainfall during summer monsoons—possible evidence, the geologists speculate, of the "self-organization" of the system.

Formed by the collision between the Indian and Eurasian tectonic plates over the past 45 million years, the Himalayan ranges store excess potential energy. Hodges and his colleagues suggest the excess energy is dissipated by both the fracturing of the crust and intense, rain-driven erosion. The rapid erosion weakens the crust and leads to rapid uplift; the uplift, in turn, creates even more rainfall as clouds meet the abrupt transition between the Lower and Higher Himalaya. That positive feedback may have been shaping the ranges for millions of years. ("Quaternary deformation, river steepening, and heavy precipitation at the front of the Higher Himalayan ranges," *Earth and Planetary Science Letters* **220**: 379–89, April 15, 2000) —*David Forest*

CO_2: Still Guilty As Charged

In 1845 a forward-thinking French chemist and mining engineer named Jacques Joseph Ebelmen set forth in print the concept that increasing levels of carbon dioxide in the atmosphere could bring about global warming. Yet today, after a century and a half of industrial productivity and population growth, the question of whether increased atmospheric CO_2 causes higher temperatures still often takes center stage in debates about the future of Earth.

Cores extracted from glaciers and ice sheets show that increases in atmospheric CO_2 do coincide with increases in global temperatures—at least for the past 420,000 years. But most ice formed in earlier times probably melted long ago, and so the earlier CO_2 levels must be estimated from geologic proxies or mathematical models. As for the temperatures of such distant epochs, one way to estimate them is to look at geologic formations that bear the telltale traces of advancing glaciers (colder eras) or retreating glaciers (warmer eras).

Another way to estimate surface temperatures of the distant past is to measure the ratios of certain oxygen isotopes in the sediments of shallow seas. But temperature estimates derived from oxygen isotopes have posed a big problem of inconsistency. Not only do they not match the estimates from the glacial records; they don't correlate with the estimates of CO_2 levels yielded by the proxies and mathematical models. Instead, the isotopic temperature estimates seem to rise and fall with the cycles of cosmic rays reaching Earth. Is CO_2 therefore blameless for global warming?

No, say Dana L. Royer, a paleoclimatologist at Pennsylvania State University in University Park, and his colleagues. Shallow water absorbs more CO_2 from the atmosphere and is therefore more acidic. That acidity can create misleading isotopic temperature estimates. When the estimates are corrected for acidity, and compared with the well-accepted, glacier-based temperature estimates, as well as with the mathematically modeled CO_2 estimates and with the investigators' compilation of a wealth of available geologic estimates of CO_2 in fossils and soils, the consistency of all four measures returns.

Royer and his colleagues conclude that cosmic rays play second fiddle to CO_2 as a driver of long-term climate change. Sorry, you'll have to keep apologizing for driving that SUV after all. ("CO_2 as a primary driver of Phanerozoic climate," *GSA Today* **14**:4–10, March 2004) —*Stéphan Reebs*

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