Bacteria under ice: Some don't like it hot

Hordes of bacteria can thrive in the seemingly inhospitable environment underneath glaciers, a region formerly considered devoid of much biology. This finding by glaciologists working in Switzerland could help solve some puzzles of the last ice age and point the way for finding life on other planets.

Bacteria with odd lifestyles have come under increasing scrutiny of late, with most research focused on the so-called thermophilic species, which prefer scalding homes. The new study shifts attention to the other end of the thermometer. "The exciting thing is the idea of pushing the window of acceptable microbial environments a little bit farther open," comments William H. Schlesinger, a biogeochemist at Duke University in Durham, N.C.

Researchers have previously collected small numbers of bacteria from ice in Antarctica and Greenland, but they could not determine whether these were active microbes or just frozen cells blown in by wind. In contrast, sediments beneath two Swiss glaciers harbor large colonies of bacteria—hundreds of millions of cells per gram of gravel—that appear to be growing at 0°C, according to a report in the February GEOLOGY.

Martin Sharp of the University of Alberta in Edmonton and his colleagues from the United Kingdom began searching for cold-loving bacteria after finding that something was causing chemical reactions beneath the ice of a Swiss glacier. At certain times of year, nitrate showed up in water flowing into the glacier but not in the water exiting from beneath it. In other environments, bacteria are known to break down nitrate.

Sharp and his coworkers followed up on these findings by taking samples of ice, water, and sediment at two mountain glaciers. Sediments beneath the glaciers contained much larger populations of bacteria than did surface or interior ice, the researchers report.

That finding indicates that the bacteria were growing at the bottom of the glacier and are not contaminants washed in while the scientists drilled through the ice, says Sharp.

Looking at the bacteria under a microscope, the researchers found that many were in the process of dividing, providing further evidence that the microbial colonies are alive and healthy under the ice. The bacteria might break down minerals and plant remains originally buried beneath the glacier or subsequently washed in by water percolating through the ice, says Sharp.

This possibility intrigues climate researchers who can't determine the whereabouts of more than 150 billion tons of carbon during the last ice age, which peaked 20,000 years ago. Sharp and his colleagues suggest that the northern ice sheets blanketed large quantities of carbon-rich vegetation in the forests and tundra. Glaciologists had formerly rejected this idea because they could find no sign of the pre–ice age forests, but the new results suggest that bacteria could have slowly decomposed such organic matter, Sharp says.

"Some of the assumptions we have made in the past now must be seriously questioned," says Richard B. Alley, a glaciologist at Pennsylvania State University in State College.

If bacteria can live underneath glaciers on Earth, why not on other planets? The new study, says Sharp, "points out in many ways that the bottoms of glaciers are probably quite good environments from the point of view of bacteria. So, maybe looking at the bottom of the Martian ice sheets would be a sensible place to try if you're going to look for life on Mars." *—R. Monastersky*

Sharp

Microbes flourish under this Swiss glacier.

Lab-grown bladders prove a success in dogs

Foreshadowing a time when a patient's own cells may be harvested, multiplied, and fashioned into a replacement organ, researchers in Boston have successfully transplanted laboratory-grown bladders into six beagles.

"This is the first demonstration that you can engineer a complete organ and replace the native organ with [it]," says David J. Mooney of the University of Michigan in Ann Arbor, who is attempting to grow artificial livers.

For a century, physicians have replaced diseased or damaged bladders by removing sections of a person's intestines and shaping them into a substitute bladder. While the procedure offers some relief to patients, complications often develop because nature designed intestinal tissue for a purpose—absorbing nutrients—other than holding urine. "You start absorbing stuff that should be excreted," says Anthony Atala of the Children's Hospital in Boston.

Other physicians have turned to human-made materials to create artificial bladders, but those efforts have also run into problems. Consequently, to build a better bladder, Atala and his colleagues decided to employ the organ's own cells.

The bladder is essentially a hollow vessel with an outer layer of muscle cells and an inner lining of urothelial cells, which form an impermeable reservoir for urine. While bladder-muscle cells grow readily in the laboratory, urothelial cells have frustrated scientists for many years.

"The big step forward was finding the right soup—the right combination of growth factors—that would make these cells grow," says Atala. Indeed, he and his colleagues can now take a bladder sample no larger than a postage stamp and, within 6 weeks, grow enough urothelial cells to cover a football field.

To turn the cells into an organ, the researchers first mold biodegradable plastic into a bladder-shaped shell. They then coat the outside with layers of muscle cells and the inside with urothelial cells.

To test this strategy, Atala's group procured bladder tissue from beagles and grew it into organs. After removing the dogs' bladders, the investigators implanted the artificial ones derived from the beagles' own cells. Within a month, the organs began to perform like normal bladders, the researchers report in the February NATURE BIOTECHNOLOGY.

Within 3 months, the plastic shells had degraded, and the transplanted organs were hard to distinguish from natural ones. Blood vessels quickly grew into them. Moreover, nerves seem to form proper connections with the new organs, allowing the dogs to regain normal control of their bladders. Some dogs have had the artificial bladders for nearly a year without any problems.

The beagles' recovery of bladder control was a pleasant surprise for Atala, who had expected that any dog receiving the artificial organ would need a catheter to drain away urine buildup. People with bladders made from intestinal tissue must use such catheters, he notes.

The new artificial bladders may prove useful for the many thousands of people whose own organ has been ravaged by cancer or damaged by an infection or injury. Even people born with defective bladders might have a healthy one grown from their own cells, says Atala.

While the bladders of dogs closely resemble those of people, Atala cautions that more testing of this transplant strategy must occur before artificial bladders are ready for the clinic. "If you're a dog with a bladder problem, you may be set, but it's always a significant challenge to translate things you can do in an animal model to things you can do in people," agrees Mooney. *—J. Travis*