Novel bacteria have a taste for aluminum

Although aluminum is the most abundant metal in Earth's crust, no living organism has been known to utilize it. In fact, this ubiquitous element is often considered toxic: Aluminum-contaminated soil can dramatically reduce yields of many crops, for example.

Now, as a result of a chance encounter on a hike in Yellowstone National Park, a research group believes it has found a bacterium that requires aluminum to thrive.

Some scientists are less convinced, drawing caution from a history of unconfirmed claims of a biological role for the metal. "Skepticism is the best place to start," says microbiologist Simon D. Silver of the University of Illinois at Chicago. "Anyone with sense or experience, or both, will think this is exceedingly unlikely to lead to a biology of aluminum."

The bacterium stirring this debate came to light when Judy E. Brown of the University of Maryland Biotechnology Institute in Baltimore was hiking near a geyser. She noticed bright flecks in water running over a greenish microbial mat and later identified them as the mineral aluminum silicate.

Brown collected a sample from the mat and, working with her Maryland colleagues, eventually isolated a bacterium whose growth seems to depend upon having access to sufficient aluminum. Like many bacteria found in or near Yellowstone's geysers, this one is a thermophile, which lives and prospers at high temperatures. In fact, the microbe grows fastest at 70° Celsius, Brown and her coworkers reported last week at a meeting of the American Society for Microbiology in Atlanta.

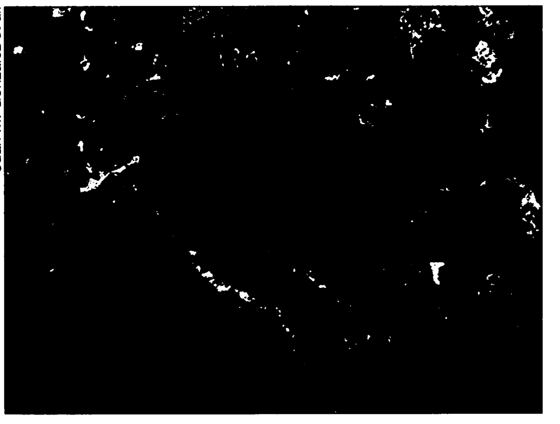
Curiously, the bacterium seems to need more aluminum when grown at higher temperatures, notes Brown's colleague Frank T. Robb.

The bacterium's apparent demand for aluminum has its limits, however. If exposed to high concentrations of the metal, the microorganism will not grow.

The scientists have noticed dense inclusions inside the bacteria and are investigating whether they contain aluminum. Meanwhile, the role of the aluminum in the microbe remains mysterious. One possibility, says Robb, is that the metal is incorporated into enzymes used by the bacterium, a function performed by other metals, such as magnesium. If the bacterium instead relies on aluminum as a source of energy, it might someday be used to clean up soil contaminated by the metal, he further speculates.

Silver doubts that the bacterium studied by Robb and his colleagues employs aluminum directly. He suggests that the metal may alter the biochemistry or environment of the microbes in a way that affects growth. Aluminum "could be freeing up something that is a nutrient," he says.

Still, not all microbiologists are so willing to dismiss the idea of aluminum-dependent bacteria. "The finding would be, in principle, quite interesting for basic biology. It would bring to life, literally, a previously almost ignored element," says Carlos Cervantes of the University of Michoacana in Mexico. —*J. Travis*



Juan M. Gonzalez et al.

The microbial mat, marked by bear pawprints, from which the aluminum-dependent bacteria were isolated.

Analysis shatters cathedral glass myth

A new study debunks the persistent belief that stained glass windows in medieval cathedrals are thicker at the bottom because the glass flows slowly downward like a very viscous liquid.

Edgar Dutra Zanotto of the Federal University of São Carlos in Brazil calculated the time needed for viscous flow to change the thickness of different types of glass by a noticeable amount. Cathedral glass would require a period "well beyond the age of the universe," he says.

Suffice it to say that the glass could not have thickened since the 12th century. Zanotto reports his finding in the May American Journal of Physics.

The study demonstrates dramatically what many scientists had reasoned earlier. "You would have to bring normal glass to 350° Celsius in order to begin to see changes," says William C. LaCourse, assistant director of the NSF Industry-University Center for Glass Research at Alfred (N.Y.) University.

Viscosity depends on the chemical composition of the glass. Even germanium oxide glass, which flows more easily than other types, would take 10^{32} years to sag, Zanotto calculates. Medieval stained glass contains impurities that could lower the viscosity and speed the flow, but even a significant reduction wouldn't alter the conclusion, he remarks, since the age of the universe is only 10^{10} years.

D. Skripkar

A piece of stained glass from a cathedral.

The difference in thickness sometimes observed in antique windows probably results from glass manufacturing methods, says LaCourse. Until the 19th century, the only way to make window glass was to blow molten glass into a large globe then flatten it into a disk. Whirling the disk introduced ripples and thickened the edges. For structural stability, it would make sense to install those thick portions in the bottom of the pane, he says.

Later glass was drawn into sheets by pulling it from the melt on a rod, a method that made windows more uniform. Today, most window glass is made by floating liquid glass on molten tin. This process, developed about 30 years ago, makes the surface extremely flat.

The origins of the stained glass myth are unclear, but the confusion probably arose from a misunderstanding of the amorphous atomic structure of glass, in which atoms do not assume a fixed crystal structure. "The structure of the liquid and the structure of the [solid] glass are very similar," says LaCourse, "but thermodynamically they are not the same."

Glass does not have a precise freezing point; rather, it has what's known as a glass transition temperature, typically a few hundred degrees Celsius. Cooled below this temperature, liquid glass retains its amorphous structure yet takes on the physical properties of a solid rather than a supercooled liquid.

"At first, I thought that the [sagging window idea] was a Brazilian myth," Zanotto wrote, but he soon learned that people all over the world share the belief. Repeated in reference books, in science classes, and recently over the Internet, the idea has been repeatedly pulled out to explain ripply windows in old houses. "For the layperson, it makes a lot of sense," says LaCourse.

In 1989, Robert C. Plumb of Worcester (Mass.) Polytechnic Institute suggested in the Journal of Chemical Education that definitive proof might require an instruction book written in the Middle Ages advising glaziers to install glass panes with the thick end at the bottom. Now if only such a handbook could be found. —*C. Wu*