puter defenses, although the agency says its classified databases have not been breached.

Still, lab employees were surprised by the far-reaching shutdown, which the three lab directors reportedly proposed to Richardson in late March. Indeed, when one Los Alamos researcher heard rumors of the plan, he "thought it was an April Fool's joke," he said. Like others interviewed by *Science*, he requested anonymity because of the tense political atmosphere.

The extent of the shutdown varied by laboratory. Los Alamos and Livermore idled their Blue Mountain and Blue Pacific supercomputers, which run simulations of nuclear weapons' explosions. At Sandia, however, researchers were able to keep running some nonclassified programs, such as weapons safety models, on Sandia's Red supercomputer and allied machines. "The nonclassified work goes on," says lab spokesperson Rod Geer.

Keeping busy. DOE's security stand-down didn't disrupt Sandia software engineer Ron Brightwell's nonclassified work.

During the pause, staff members at Los Alamos and Livermore, which do the bulk of the nation's secret weapons science and also have classified contracts with law enforcement and intelligence agencies, were required to attend or view broadcasts or video tapes of a security briefing. Lab director John Browne led the 90-minute Los Alamos briefing, which featured descriptions of potential threats and prevention measures. Employees with security clearances also attended additional sessions that took up to a day to complete, according to lab sources. Although Sandia managers only required attendance of staff with some connection to secret material, that group included artists who create images for classified projects.

In some briefings, lab officials asked employees for ideas on how best to accomplish nine security goals set by DOE, including making it impossible to transfer classified information from secured to unsecured computer networks. The agency also wants to reduce the number of people with access to highly classified information, institute more rigorous scanning of e-mail, and require two or more people to approve file transfers.

Lab scientists had mixed reactions to the stand-down. One Livermore researcher called it "distracting" but said security "is an issue that can't be ignored." However, others fear that DOE may go too far in erecting barriers to electronic data transfer. "They may overreach if they think they can make it physically impossible to transfer classified information ... without impairing everyday activity," says one Los Alamos scientist. Another computer researcher wondered if the proposed measures "will make life more difficult for a spy—or for us."

The classified computers were expected to be back in service this week once Richardson signs off on the three labs' new security protocols. But Browne reassured his staff that the new plan won't crimp science. "We can't raise the bar so high we can't get any work done," he said in a prepared statement. "That affects national security, too."

–DAVID MALAKOFF

CREDIT: (TOP) SANDIA

STEM CELL RESEARCH

NIH Plans Ethics Review of Proposals

The National Institutes of Health (NIH) last week inched forward on its commitment to fund research on human embryonic stem cells despite a barrage of criticism from the antiabortion movement. Some researchers believe very early stem cells will be valuable for research and as a source of human transplant tissue; others say it's inappropriate to use any material taken from aborted fetuses or unwanted embryos. In addition, more than 70 members of Congress have told Secretary of Health and Human Services Donna Shalala that language in an appropriations bill forbids support for studies of human embryonic stem cells.

Mindful of the controversy, NIH director Harold Varmus has offered a technical solution. Appearing on 8 April before a special panel of advisers in Bethesda, Maryland, Varmus proposed that an outside committee review grant proposals to square them with criteria set by Congress. Essentially, the NIH would block funding of research that involves direct use of embryos or aborted fetuses but permit some carefully vetted research on stem cells derived from these sources. An outside body would examine highly rated grant proposals and approve only those that comply with NIH's guidelines.

The 13-member advisory panel assigned to help draft the rules—chaired by molecular biologist Shirley Tilghman of Princeton University and Ezra Davidson, associate dean of the Charles R. Drew University of Medicine and Science in Los Angeles—took no immediate action, but heard comments from critics and supporters of the NIH plan. One opponent, Richard Doerflinger, a staff representative of the U.S. National Conference of Catholic Bishops, argued that federal officials were wrong to make a distinction between embryos and stem cells derived from embryos, and that doing research on either destroys human life. Representatives of the Society for Developmental Biology, the American Society for Cell Biology, and the National Alliance for Aging Research were among those who spoke up for the NIH plan.

The Davidson-Tilghman panel considered adding some terms to the NIH guidelines that might make the process of screening grants more intricate. They proposed, for example, that legal restrictions already in force on the use of fetal tissue also be adapted to stem cells. And the panel seemed ready to require any researcher receiving federal funds for embryonic stem cell research to certify that donors had given proper consent for the use of their embryos.

Meeting this standard could be difficult, one observer says, because scientists are not likely to know where the embryos came from or how consent was obtained. Furthermore, donated embryos typically come from clients of private fertility clinics, which are not covered by federal rules on informed consent. Although documenting ethically correct

Co-chairs. Ezra Davidson and Shirley Tilghman head panel devising guidelines for stem cell research.

sources of stem cells is the "hardest issue to deal with," says Wendy Baldwin, assistant NIH director for extramural research, she predicts that people who are intent on doing this research will find suppliers who can provide all the documentation NIH requires.

At least one observer grew impatient with the discussion because it implied a more prolonged review than he'd anticipated. Stem cell researcher John Gearhart of The Johns Hopkins University in Baltimore said he's thinking of dumping plans to file for an NIH grant and going in search of private money.

The public will have 60 days to comment on draft guidelines that NIH plans to issue by summer before the topic is taken up by another high-level NIH advisory panel. That suggests the first grants, if Varmus decides to proceed, could be at least a year away.

–ELIOT MARSHALL

MICROBIOLOGY

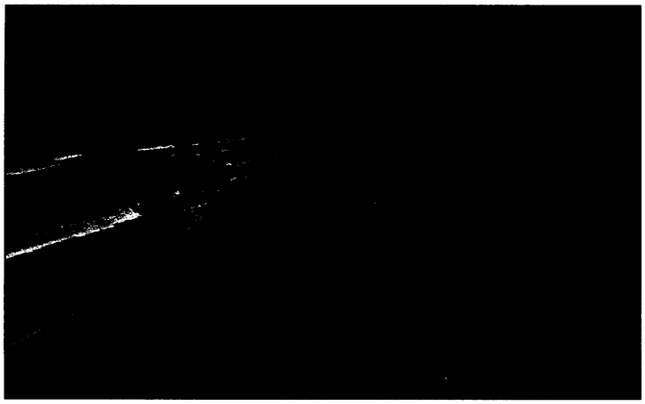
Giant Sulfur-Eating Microbe Found

In the sediment below the waters of Namibia's Skeleton Coast—named for the storm-tossed ships that litter the sea floor there—scientists have made a dazzling find: a giant new species of bacterium, the world's largest, that grows as a string of pearly white globules. As reported on page 493, cells of *Thiomargarita namibiensis*, the "Sulfur pearl of Namibia," reach three-quarters of a millimeter in diameter—100 times larger than that of the average bacterium. "They were so large, at first we could not believe they were bacteria," says discoverer Heide Schulz, a microbiologist at the Max Planck Institute for Marine Microbiology in Bremen, Germany.

This oddball microbe consumes both sulfide and nitrate, linking the ecological cycles of these two key coastal compounds. Although many bacteria utilize one or the other, few have been identified that rely on both. But it now seems that "this kind of metabolism is much more widespread than previously thought," says co-author Bo Barker Jørgensen of the Max Planck Institute. Other researchers note that such bacteria might one day help clean up coastal waters that have been polluted by excess nitrates from agricultural runoff.

Schulz found *Thiomargarita* while trying to determine whether an unusual species of sulfide-eating microbe common off the coast of Chile could be found elsewhere. She chose the Skeleton Coast for her research cruise because, like Chile, it is fed by a strong upwelling current that brings nitrate-rich water to the surface, nourishing an abundant food chain. The teeming life of the surface waters produces a rain of organic matter, which bacteria on the sea floor decompose, producing hydrogen sulfide, a compound that is toxic to most organisms.

While examining sediment cores from below 100 meters of water, Schulz was struck by the presence of many pearly spheres. They were far too big to be any known bacteria, but under the microscope she recognized the familiar glow of a sulfur microbe, caused by light refracting off tiny globules of elemental sulfur just below the cell's surface. Later Schulz and her team realized that the bacterium doesn't live by sulfur alone, as they measured large concentrations of nitrate within the cells as well.



Namibian pearls. Strings of giant sulfur bacteria (*top right*), with individual cells up to 0.75 millimeter in diameter, grow in sediments below Namibia's often stormy coastal waters (*above*).

CREDITS: (LEFT TO RIGHT) MICHAEL FOGDEN/EARTH SCENES; SCHULZ *ET AL.*

After measuring both sulfide and nitrate in the cell, Schulz and her colleagues reasoned that *Thiomargarita* gets its energy by stripping the electrons from sulfide. To do so it needs an electron acceptor, a role that falls to oxygen in most sulfur microbes. But in the oxygen-free world of the sea floor, the only potential electron acceptor is nitrate suspended in the seawater. Because *Thiomargarita* is stuck in the sediment, it relies on occasional storms to stir nitrate-rich water into the loose sediment. And it needs a way to last out the intervals between storms.

That's where the microbe's bulk comes in: About 98% of its volume is storage space, allowing it to hoard large reserves of nitrate under a thin layer of cytoplasm. Like a big bacterial balloon, "*Thiomargarita* can hold its breath for months at a time between storms," Jørgensen says. Most bacteria have a size limit, because they rely on diffusion to exchange chemical compounds with their environment, and a small size ensures a high surface area compared to volume. *Thiomargarita* skirts this problem by being hollow inside—the living cytoplasm is confined to a thin layer surrounding the nitrate.

Researchers don't yet know how common or widespread *Thiomargarita* is, but it thrives in high densities off the Namibian coast. "It's exciting," says Jay Grimes, a marine microbiologist at the University of Southern Mississippi in Ocean Springs. "Sitting off the coast in nutrient-rich anoxic upwellings, it plays a very important ecological role," removing hydrogen sulfide and so detoxifying the environment for other forms of life.

Indeed, biologists are realizing that bacteria with this kind of metabolism play a critical role in keeping some coastal bottom waters habitable for higher organisms. Two species of bacteria, *Thioploca* and *Beggiatoa*, are known to oxidize sulfide with nitrate, although they have adopted other solutions to the problem of finding these compounds, and both are much smaller than *Thiomargarita*. They, too, are found in areas fed by upwelling, nutrient-rich currents, off the Pacific coast of South America and in the Arabian Sea near Oman.

Grimes suggests that such sulfide-oxidizing, nitrate-reducing organisms could be introduced to other coastal waters to clean up pollution caused by agricultural nitrate, which nourishes algal blooms that deplete the waters of oxygen and lead to massive fish kills. Indeed, some species of *Beggiatoa* are spreading on their own to the sea floor along the European and Baltic Coasts, which are polluted by agricultural nitrate, Jørgensen says. If *Thiomargarita* or its kin can clean up polluted coasts, one extreme of evolution may someday help balance perturbations caused by excesses of another kind.

–BERNICE WUETHRICH

Bernice Wuethrich is an exhibit writer at the Smithsonian's National Museum of Natural History in Washington, D.C.