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

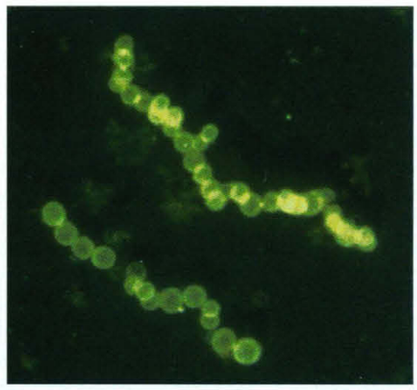
Giant Sulfur-Eating Microbe Found

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*).

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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

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