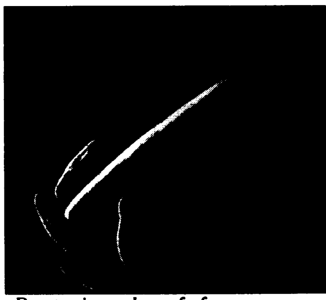
Biology

Monstrous microbes are just big bacteria



Angert/Indiana Univ.

Bacterium dwarfs four paramecia (a type of protozoan).

Eight years ago, biologists discovered a strange organism in the guts of surgeonfish. Visible to the naked eye, these single-celled, half-millimeter-long creatures should be classified as protozoans, or so scientists assumed. They were a million times larger than bacteria such as *Escherichia coli*; yet under the electron microscope, their insides looked so much like those of bacteria that microbiologists didn't really know what to make of them.

So Kendall D. Clements at James Cook University in Townsville, Australia, sent some fish guts from the Great Barrier Reef to the United States and asked Norman R. Pace and Esther R. Angert at Indiana University in Bloomington to have a look.

Pace and Angert isolated genetic material from the ribosomes (protein-building structures) of the unusual organisms and compared it with ribosomal RNA from other microbes. They also examined genetic material from similar bacteria found in surgeonfish in the Red Sea. Their analyses showed that the presumed protozoan, *Epulopiscium fishelsoni*, should instead consider gram-positive bacteria its closest kin. They report their findings in the March 18 NATURE.

Microbiologists thought bacteria could not grow very big because nutrients would not diffuse throughout giant cells. But these organisms, orders of magnitude bigger than any other known bacterium, prove otherwise. Bacteria probably organize their interiors to get around diffusion limitations, Pace says. Unfortunately, no one has succeeded in growing the giant bacteria in the lab, so they have not been studied further.

In the past, researchers have used size to classify organisms as eukaryotes or prokaryotes. The giant bacteria, however, will force scientists to reexamine the fossil record and to reevaluate their ideas about the evolution of eukaryotes, says Mitchell L. Sogin of the Marine Biological Laboratory in Woods Hole, Mass.

Key protein in sea urchin mating

For sea urchin sperm, locating the right egg to fertilize appears harder than finding a needle in a haystack. Females release eggs into the sea, where they float among a myriad of other materials, including eggs from many other invertebrates. Scientists know that chemistry plays a key role in getting the right egg and sperm together, and for 15 years they have known about the sperm's egg-recognition molecule, bindin.

Now, cell biologists have identified bindin's "mate," an unusual protein that spans the egg's cell membrane. A small piece extends into the sea urchin egg and a larger portion juts out so that it can bind to the sperm's bindin, says Kathleen R. Foltz of the University of California, Santa Barbara, who discovered the protein with William J. Lennarz and Jacqueline S. Partin from the State University of New York at Stony Brook. They describe their findings in the March 5 SCIENCE.

Once bindin binds to the egg surface, it activates the egg's development. With both receptor and bindin in hand, scientists hope to learn the details of this activation, Foltz says.

The researchers also observed that sea urchin sperm binds to plastic beads coated with this receptor protein and that antibodies to the receptor can block this binding. If human fertilization depends on a similar interaction, then it may be possible to develop contraceptive antibodies that block binding in humans, they suggest.

Earth Science

Disappointment in the deep Pacific

When a crew of scientists and technicians steamed out of Panama in late January, they had high hopes of reaching a long-sought goal: drilling into the bottom section of the triple-layer cake that makes up the ocean crust. The team, from the Ocean Drilling Program (ODP), had reason for optimism. A succession of expeditions over the last dozen years had already bored a 2-kilometer-deep hole into the floor of the eastern Pacific, stopping at a point that seemed within reach of the bottom crustal section, called layer three (SN: 11/23/91, p.324). The crew only needed to deepen the hole a few hundred meters.

But the recent drilling effort never broke into layer three. After penetrating only 111 meters, the drill became stuck in a region of relatively soft rock that is thought to be a fault. The team eventually freed most of the equipment, but the drill bit remained in the bottom of the hole. The crew tried to progress by grinding up the jammed bit, but they had to abandon that effort for lack of the necessary tools.

Although disappointed, ODP scientists did come back with a tantalizing hint that they had crossed a different type of barrier in the crust, defined by the speed of seismic waves. While geologists mark the boundary between layers two and three by rock type, seismologists label the boundary on the basis of the seismic speed in rock. Tests at the bottom 50 meters of the hole suggest that the current drill position may be within the seismically defined layer three, even though the rocks remain typical of layer two. This suggests that the seismic and geologic boundaries do not coincide. ODP scientists have yet to decide when or if they will return to this hole to continue drilling.

Carpets of algae over ancient ocean

A ship cruising through the eastern Pacific Ocean 10 million years ago might have found itself plowing through mats of green algae spread across vast areas of the ocean, according to two researchers who have found the fossilized remains of these ancient algal carpets. Alan E.S. Kemp of the University of Southampton in England and Jack G. Baldauf of Texas A&M University in College Station discovered numerous algal layers in cores of seafloor sediments pulled up from the eastern tropical Pacific. Evidence of such layers stretches across an area of the equatorial ocean several thousand kilometers in length, they report in the March 11 NATURE.

Formed by a single species of silica-shelled algae called diatoms, the mats developed when the long, thin cells tangled together in a mesh that blanketed the ocean surface in calm waters. The mats eventually sank and were preserved in the seafloor ooze that slowly accumulates over thousands of years. Kemp and Baldauf do not know how large these algal sheets grew. In one case, they detected evidence of the same distinctive layer in holes 2,000 kilometers apart, but they cannot tell whether the mats existed in these locations during the same year or even the same millennium. Kemp and Baldauf have found the algal layers in sediments going back 15 million years, which is as far as they have checked. The layers disappear in sediments younger than 4.4 million years old.

Oceanographers on cruises have seen diatom mats in the same area of the Pacific, a fertile region known for its high concentrations of nutrients. But researchers do not know how large the modern mats grow, or whether they rival the size of those that formed millions of years ago, says oceanographer Constance Sancetta of the National Science Foundation in Washington, D.C. Because evidence of the mats does not appear in sediments less than 4.4 million years ago, something in the ocean must have changed then, she says. Either vast algal sheets formed less often during the last few million years, or seafloor sediments failed to preserve them once they sank to the ocean floor.