Biology

John Travis reports from Bar Harbor, Maine, at the Symbiosis 96! meeting

Live long and prosper

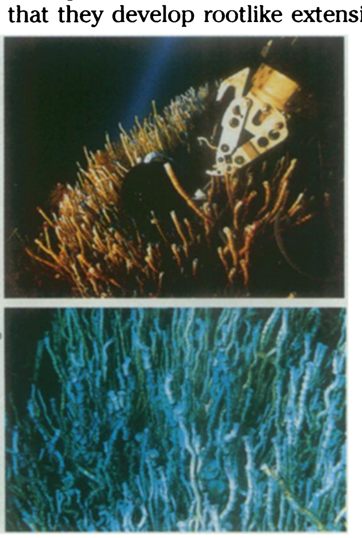
Hydrothermal vents, those fissures where hot, mineral-laden water spews into the cold sea, aren't the only places on the ocean floor that host a surprising bounty of life. Many of the unusual life-forms spotted there—clams, tubeworms, mussels, and crabs, for example—also reside at ocean seeps, sites where methane, oil, and other fluids ooze out of the sediment and into the surrounding water (SN: 9/27/86, p. 198). Yet tubeworms at seeps pursue a far different lifestyle from that of similar worms at vents, says Charles Fisher of Pennsylvania State University in State College.

Tubeworms, notes Fisher, are "basically a big bag of bacteria stuck inside an animal." The worms, which provide a safe haven for the bacteria, derive all of their energy from the microorganisms, he explains. At vents, these bacteria live off hydrogen sulfide in the hot plume. By diving to hydrothermal vents, Richard A. Lutz of Rutgers University in New Brunswick, N.J., and his coworkers have found that tubeworms can grow so rapidly—almost a meter a year—they may be the fastest-growing of all marine invertebrates. "They live hard, live fast, and die young," jokes Fisher.

Fisher and his colleagues monitor tubeworm growth with an instrument they nicknamed "the hair dryer." They place the device, which resembles the large hair dryers used in salons, over a group of tubeworms and signal it to release a permanent dye. When the investigators return to the site a year later, they gauge how much the tubeworms grew by measuring the creatures' undyed tips.

While hydrothermal vents are usually short-lived, often lasting only a year or two, ocean seeps last longer and may offer a more stable environment, says Fisher. Perhaps not surprisingly, then, his group has found that the tips of seep tubeworms in the Gulf of Mexico advance by less than a centimeter a year. "They grow incredibly slowly," says Fisher, who estimates that seep tubeworms live a century or more.

Seep tubeworms also differ from their vent counterparts in that they develop rootlike extensions up to half a meter long, says Fisher, who notes that most sulfur-containing compounds at seeps are not found in the water but in the sediment. "We're postulating that [the tubeworms] are using their roots to mine sulfides from the sediment. They are animals that live a very full life with deep roots," laughs Fisher.



J. Blair/HBOI

A.F. Medioni and C. Caddigan/HBOI

A device nicknamed the hair dryer (top) stains tubeworms blue. Any growth after the staining is white (bottom). These tubeworms live at seeps in the Gulf of Mexico.

Tackling sleeping sickness from within

Throughout sub-Saharan Africa, the tsetse fly is the bearer of bad news. When it feeds, this blood-sucking insect can transmit parasites called trypanosomes into humans. The parasites cause sleeping sickness, a disease that attacks the nervous system and can lead to death.

Trypanosomes aren't the only guests residing inside tsetse flies. Several kinds of bacteria also have symbiotic relationships with the flies, notes Serap Aksoy of Yale University School of Medicine. The insects provide organelles that comfortably house the bacteria; in return, the microorganisms synthesize compounds that supplement the tsetse fly's limited diet.

Aksoy and her coworkers have recently learned how to maintain a population of one of these bacteria in the laboratory, an ability that has enabled the researchers to add foreign DNA to the microbes. The genetically engineered bacteria can still live symbiotically with tsetse flies. Aksoy plans to modify the bacteria by adding genes that encode trypanosome-destroying compounds. If researchers can spread such bacteria through the tsetse fly population, they might rid the insects of the disease-causing parasites, says Aksoy.

A nicer side of a bacterial enzyme

Diphtheria, cholera, and pertussis (whooping cough) share a common origin. These diseases are caused by bacteria that secrete enzymes into the cells of animals they infect. The enzymes, known as ADP-ribosyltransferases, modify cellular proteins and in the process cause the symptoms of the diseases.

Investigators had assumed that all forms of these enzymes cause disease, but they have now found a bacterium, *Vibrio fischeri*, that secretes ADP-ribosyltransferases and is nonpathogenic. This bioluminescent bacterium forms a symbiotic relationship with squid (SN: 9/14/96, p. 167).

V. fischeri makes two forms of ADP-ribosyltransferase, says Karl A. Reich of the Howard Hughes Medical Institute at Stanford University School of Medicine. He and his colleagues are mutating the gene for each form in order to study the roles of the enzymes. Preliminary results from bacteria with one of the genes mutated suggest its enzyme helps the bacteria persist inside the host squid, says Reich.

Partners for life . . . and perhaps death

Talk about a long-lasting relationship. Some 100 to 250 million years ago, bacteria infected an aphidlike insect, says Nancy A. Moran of the University of Arizona in Tucson. They apparently never left. All modern-day aphids now carry these bacteria, which belong to the genus *Buchnera*.

In fact, the two organisms are virtually inseparable. The bacteria, transmitted to future aphid generations within the insect's eggs, can no longer grow outside of symbiosomes, the cellular vesicles created by their hosts. As for the aphids, they apparently need the bacteria to supplement their diet of plant sap, which lacks essential amino acids and other nitrogen-carrying compounds.

Moran

These aphids need bacteria to supplement their diet of plant sap.

The symbiosis has lasted so long that *Buchnera* have even evolved to meet the nutritional needs of their host aphids, says Paul Baumann of the University of California, Davis. He and other scientists have recently found that the *Buchnera* in many species of aphids contain extra copies of genes that encode the enzymes used to make amino acids such as tryptophan.

Moran, who studies the evolution of genes from the aphids and their bacteria, warns that this symbiosis may not last forever. Her data suggest that the populations of *Buchnera* in each aphid are too small for natural selection to weed out harmful mutations. The fitness of the bacteria may eventually decay to the point where neither they nor the aphids that depend upon them can survive, she speculates.