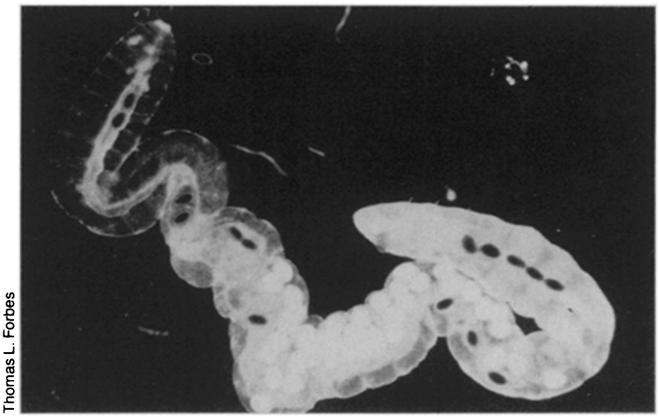
Sulfide Searchers

Recent experiments showing that certain larvae are attracted to sulfides are opening a whole can of worms in other research areas

By STEFI WEISBURD



Thomas L. Forbes

Larvae of Capitella sp. I *tend to settle in areas rich in sulfides. In this picture of a female worm, magnified 19 times, the white spots are eggs and the darker objects are fecal pellets containing sediments that are being passed through the worm's gut.*

Even in the most lush marine environments, all it takes is a few bad elements like sulfur and the whole neighborhood goes down the tubes. Every ecologist knows that sulfides are deadly to most living things.

But now it appears that at least one hardy species of marine worm not only seeks out and survives in sulfide-rich, oxygen-poor locales but also performs a kind of urban renewal by creating tubes that carry sulfide-neutralizing oxygen into the sediments. M. Carmela Cuomo, a geologist and benthic (seafloor) ecologist at the State University of New York at Stony Brook, has discovered that larvae of this centimeter-long, shallow-water worm of the *Capitella* genus find and settle into the desolate patches brimming with sulfides by somehow tracking the sulfide molecules that escape into the water. Cuomo suspects that in the process of burrowing down into these spots, the worms eventually alter the environment to make it more habitable for other species.

Cuomo's research is the first demonstration that larvae of any species respond to a geochemical cue. "Her work is of first-order importance," says Donald C. Rhoads at Yale University in New Haven, Conn. It could have implications, he and others say, in a remarkably wide range of subjects including hydrothermal vent communities, the evolution of early life, stratigraphy, oil production and mariculture.

Capitella worms have long been tagged as pollution indicators; they hang out near pulp mills, for example, and any place abundant in decaying organic matter, upon which they feed. Researchers also know that when organic matter decomposes, oxygen is used up and phosphates, sulfides and ammonia are released — but no one had ever linked the worms specifically to the sulfides. In a series of experiments described in the February-March BIOGEOCHEMISTRY, Cuomo found that among the chemical factors associated with organic decay, only sulfides prompted larvae to colonize a region. She also found that sulfides attracted larvae even in the absence of sand. She believes, but has yet to prove, that sulfides do not nourish the worms but only flag the presence of organic food.

How these animals thrive in sulfide-rich waters that would kill most other organisms is a mystery. Because the worms do die at very high sulfide concentrations, Cuomo concluded that they are not fundamentally anaerobic (able to live without oxygen). This led her to theorize that the worms — like many animals found near hydrothermal vents — might be protected by sulfur-oxidizing bacteria in their tissues. But a biologist was unable to find such bacteria in the worms. "That opened up a whole new ball game," says Cuomo, who is now searching for other possible survival mechanisms.

Another intriguing question is how the worms detect sulfide molecules; Cuomo suspects that they have a sulfide receptor cell. Whatever the actual mechanisms, Cuomo and other scientists believe that the worms' ability to sense and resist the toxic effects of sulfide give them a competitive edge in finding space and food.

The recent experiments also showed that 24 hours after the worms had settled into sulfide-rich sand, the concentrations of sulfides in the overlying water column dropped by a factor of 10. Cuomo thinks this drop is due to the worms' tubular homes, which create a passage for oxygen in the seawater to get down into the sulfide-rich anoxic (without oxygen) sediment, oxidize the sulfides and make the first centimeter or so of sand benign to other life.

Cuomo's work may prove relevant to many other research areas. For example, says Rhoads, researchers have long wondered how hydrothermal vent animals find those sites. It is entirely possible that these organisms use a sulfide cue as well, he adds. Cuomo wants to see how many other animals might respond to sulfides, although she doesn't expect the number to be very large.

Cuomo also plans to submit a paper to SEDIMENTARY PETROLOGY on the geological aspects of the *Capitella* worms. "The anaerobic environments where *Capitellae* are found are important areas," she says, "because they are usually regions of upwelling zones, organic-rich areas — which are also regions in the geological record that are source rocks for oil." Because these anoxic basins are thought to have dominated early earth, and since the worms congregate in very high densities, the worms themselves could have been a significant source of carbon and oil, she suggests.

If evidence of worm communities could be found in the fossil record it might help both to locate oil and to reconstruct the past ecology of basins by showing where low-oxygen areas or upwelling zones might have been. Unfortunately, the worms are too soft and small to leave fossils. The prevailing view among stratigraphers is that worms leave traces by *disrupting* the laminae or lines of carefully layered sediments. But Cuomo discovered, by compacting the sediments that the laboratory worms had lived in, that the fecal pellets of the worms aligned under consolidation to form laminae of their own.

She then went to the Catskill Basin in New York and found traces in Devonian shale (deposited 345 to 395 million years ago) that were similar to what she had created in the laboratory — indicating that a community of *Capitella*-like organisms might once have lived there, even though conventional stratigraphy would indicate that there had been no life. In the Chesapeake Bay, Rhoads has found similar traces in rocks located just where the water changes from aerobic to anaerobic. "Worms are probably one of the first organisms to have evolved . . . so these kinds of traces can be used to identify some of the earliest fossil communities," Cuomo told SCIENCE NEWS.

All of these findings open up a lot of possibilities, says Rhoads. "Cuomo has a whole lifetime of work in front of her, following up all these leads." □