The New York Times **Science** September 9, 2003

OBSERVATORY

Symbiotic Ne'er-Do-Wells

By HENRY FOUNTAIN

Symbiotic relationships are often thought of as idyllic situations, mini-utopias where the I-scratch-your-back-you-scratch-mine ethos functions perfectly, to both parties' satisfaction.

The reality, though, is that there are slackers everywhere. Even among symbionts there are cheats that give nothing, letting their neighbors do all the work, but get plenty from their hosts in return. So in cases like these, what keeps the symbiotic relationship from falling apart?

Researchers from the University of California at Davis and the University of Edinburgh have investigated one relationship from the plant world with an eye on that question. Their answer is: The host plant cracks down on the ne'er-do-wells.

The researchers studied the interaction between soybean plants and bacteria called rhizobia that thrive in nodules in their roots. The bacteria turn atmospheric nitrogen into a form that the plant can use and get nutrients in return. But among the rhizobia that exist on soybean plants there are many strains that cheat, producing little or no nitrogen.

In their experiments, described in the current issue of Nature, the researchers created cheater bacteria by replacing normal air with an almost nitrogen-free mix of gases. These bacteria thus produced very little nitrogen for their plants, and the researchers found that they were penalized accordingly. After a few days, the nonproducing bacteria had reproduced far less successfully than nitrogen-producing ones.

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The researchers suggest that the soy plants punish the slackers by limiting their oxygen supply. Such punishment, they say, is how the host favors cooperative behavior on the part of its guests.

4-Legged Fish Unmasked

Among those who study evolution, Ichthyostega, popularly known as the "four-legged fish," holds a special place as a transitional creature between aquatic and land animals. Fossil specimens dating back 360 million years to the Devonian period were first discovered in Greenland 70 years ago, and until the mid-1980's Ichthyostega was the earliest known tetrapod.

It has since been supplanted by earlier finds from the Devonian, but Ichthyostega still intrigues paleontologists, in part because they have been unable to explain some of its odd anatomical features, particularly its ears.

Now, Jennifer A. Clack of Cambridge University, with colleagues from the Natural History Museum in London and the University of Texas, has gone a long way to solving some of the mysteries. Using newer fossil material and high-resolution CAT scans, she has determined that the ears were probably specialized for hearing underwater.

Her studies, described in Nature, show that the animal's middle-ear cavity was much larger than those in other early tetrapods and primitive fishes, and that the stirrup bone, or stapes, was in a different position. She suggests that the cavity was filled with air, not fluid. When Ichthyostega had its head in the water, sound waves would put pressure on this air sac, causing the stapes, embedded in soft tissue, to vibrate and transmit the sound to the inner ear.

The finding is consistent with current thinking about Ichthyostega, that despite its limbs it was more of an aquatic than a terrestrial creature. Such a specialized anatomical feature also shows that, even at the earliest stages of tetrapod development, there was much diversification, both in form and function.

Hail and Farewell

You might want to pause in what you're doing shortly before 3 p.m. (Eastern time) on Sunday, Sept. 21, and turn your thoughts skyward. Half a billion miles away, the Galileo spacecraft will be ending its nearly 14-year mission to Jupiter, disintegrating as it plunges into the planet's thick atmosphere.

Galileo made its last flyby, of the tiny moon Almathea, last November, and has been effectively shut down since February.

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