# Biology

## Ancient fungal farmers

Long before ancient humans picked up a hoe, ants cultivated food. About 50 million years ago, these six-legged agriculturists began developing a strong, mutually beneficial partnership, or symbiosis, with a species of fungus. Today, many of the 200 species of attine ants still farm that fungus, even though the ants have spread north to New Jersey and south to Argentina, says Ulrich G. Mueller, an evolutionary ecologist at Cornell University.


Schultz/ Cornell Univ.

*Fungus-tending ant.*

The ants pass the fungus along by allowing new queen ants to pack some starter fungi in their mouths. They use this package to clone a new crop in their own nests. Worker ants quickly expand the crop to a room-size "field" that provides essential nourishment for larvae, if not for all the ants, Mueller says. The fungus does not propagate on its own.

Though entomologists have known about these ant farmers since 1874, biologists are only now figuring out the history of this symbiosis. At Cornell, Ted R. Schultz and Rudolf Meier examined and categorized 51 attine ant species. Then the Cornell group and Ignacio H. Chapela of the U.S. Department of Agriculture in Beltsville, Md., used genetic techniques to work out the taxonomic relationships of 19 fungi from ant nests and 16 samples of free-living fungi from the wild.

The 200 ant species share a common fungus-farming ancestor, Chapela and his Cornell collaborators report in the Dec. 9 SCIENCE.

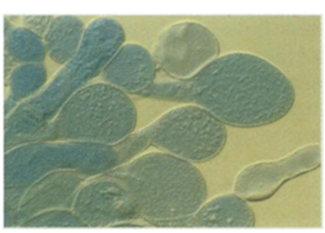
The genealogy of the fungi is not as clear. In many, but not all, cases, the original fungus evolved into new species in parallel with their ant farmers. Today, the fungi divide into three groups, which coincide well with groupings of ants based on the shape and structure of the ant larvae, the researchers note.


Mueller/Cornell Univ.

The most recently evolved group consists of the leaf-cutting species, infamous for defoliating 20 percent of the tropical forests in the Western Hemisphere. Only their fungi can use fresh plant material, and both the ants and their fungi seem to come from a single ancestor, Mueller explains.

Fungi in the two other groups rely on decaying organic debris. One group contains ants and fungi descended from an ant that definitely found a new — and different — fungal partner at some point. The final group includes ants that seem closely related to the early symbiotic ants. The partnerships in this last group exhibit less parallel evolution than those in the other two, Mueller notes.

In the same issue of SCIENCE, a second team independently reported similar results. Gregory Hinkle and Mitchell L. Sogin of the Marine Biological Laboratory in Woods Hole, Mass., and their colleagues analyzed fungi from five attine ants and two samples of free-living fungi. They studied a different gene, one that evolves more slowly than the one analyzed at Cornell. The existence of this ancient partnership implies that concerns about species preservation must consider not only organisms big enough to see, but their microbial partners, too, Sogin asserts.


Mueller/Cornell Univ.

*Leaf-cutting ants (above) depend on a special fungus that grows threads with swollen, nutrient-rich tips (left).*

# Biology

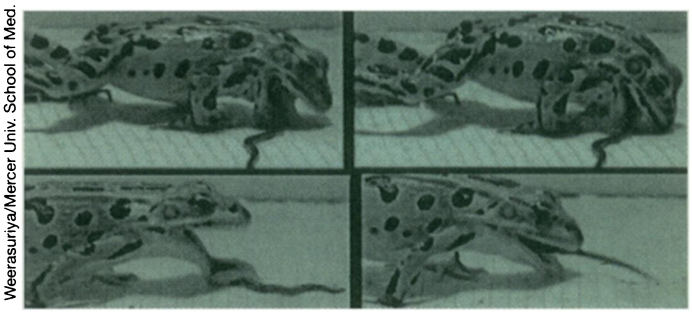
*Elizabeth Pennisi reports from Miami at the annual meeting of the Society for Neuroscience*

## More than one way to catch a worm

With a flick of its tongue, a frog snares a fly. But what does it do when its prey is a large earthworm?

Ananda Weerasuriya of Mercer University School of Medicine in Macon, Ga., has answered this question as a first step toward understanding how an organism mobilizes many joints and muscles quickly. Unlike slow, deliberate movements, which the brain orchestrates with input from the muscles and the senses, catching prey requires the activation of built-in nerve and muscle patterns, Weerasuriya explains. He wants to know more about these patterns.

He and Chet R. Baker and Nathan A. Ball, two students at Mercer, filmed small, medium, and large *Rana pipiens* hunting earthworms or mealworms. They tested four to seven frogs of each size, observing 33 to 52 worm captures per size class. All frogs first contact the worms with the tongue. Small frogs then tend to move in over the worms, especially the larger earthworms. They need their jaws to pull the worm into their mouths. Bigger frogs sometimes do the same, but they more often extend their tongue fully and let it do the snagging. "The bigger the frog is, the more likely it is to use a complete protraction," Weerasuriya reports.


Weerasuriya/Mercer Univ. School of Med.

*Gotcha! Jaws can aid capture of an earthworm (top); often, a quick, fully extended tongue is enough to snag one (bottom).*

## Getting down to basics

Key mechanisms and messengers in cancer and development are now proving important in the progression of neurological diseases.

Researchers know that apoptosis, the orderly death of a cell that takes place during development, occurs in Lou Gehrig's disease (SN: 3/26/94, p.203). Apoptosis also plays a role in damage caused by stroke, says Byoung Joo Gwag of Washington University in St. Louis. After a stroke, many nerve cells degrade in a process called necrosis. By blocking that destruction, Gwag demonstrated that other brain cells eventually undergo apoptosis. Treatments for stroke will need to prevent both kinds of cell fatalities, he notes.

Researchers know that the activation of a gene called bcl-2 can prevent apoptosis (SN: 1/15/94, p.44). Several teams have now found that bcl-2 can protect vulnerable nerve cells, including those affected by stroke.

One group, led by Dennis W. Choi, also of Washington University, genetically altered nerve cells growing in a laboratory dish. Those cells make extra bcl-2. As a result, they survive exposure to the normally toxic beta-amyloid fragments that accumulate in the brains of people with Alzheimer's disease. Bcl-2 does not prevent cell death initiated by increases in calcium within the cell, Choi adds.

Finally, the tumor-suppressor gene p53, which is often defective in cancer cells, seems involved in some nerve cell death, says Shahin Sakhi of the University of Southern California School of Medicine in Los Angeles. However, rather than prevent cell division — p53's normal role — activation of this gene in nerve cells leads to apoptosis, Sakhi reports.