EVOLUTIONARY BIOLOGY

On Ant Farm, a Threesome Coevolves

One of nature's oddest partnerships is that between certain ants and the fungi they cultivate. The two have evolved in synchrony for millions of years. But there is a third wheel in this relationship—a pathogen that infects the fungi. And now Cameron Currie of the University of Kansas, Lawrence, and his colleagues report on page 386 that, in terms of evolutionary history, this pathogen is as tightly entwined with the other two as they are with each other.

The data show that "almost immediately after this unique and beautiful cooperative system [between ants and cultivated fungi] evolved, the fungal parasites were there, and they've never gone away," says Koos Boomsma, an evolutionary ecologist at the University of Copenhagen, Denmark.

Attine ants, which include leaf-cutter ants that can defoliate a tree in one night, can't digest plant matter themselves. But they retrieve leaves and other detritus from their surroundings and heap them up in their nests as offerings for hungry fungi. Thus nourished, the fungi send out nutrient-filled threads that are eaten by their faithful keepers.

Six years ago, researchers demonstrated that ant farming of fungi developed 50 million years ago. Since then, the ants and fungi have maintained their intimate symbiosis even as new species of both arose. Other research has shown that early on in evolutionary history, it's likely that the ant species weren't that picky about which fungal species they grew. But today, many of the 210 attine ants are faithful to a particular fungus.

This happy relationship can be wrecked by the pathogen *Escovopsis*. Infections of this microfungus can reduce both the size of the "farm" and the ant workforce; some have destroyed entire colonies. The ants fight back by weeding out infected bits of fungi and removing the pathogen's spores.

To better understand the pathogen, Currie and his colleagues analyzed DNA from 17 strains, focusing on 2600 bases from several genes. Using the differences in the bases, they built an evolutionary tree. It pointed to a common ancestor that dated back to the days of the first cultivation of fungi by ants.

The researchers are not sure how *Escovopsis* initially got involved with this pair. Currie and his colleagues at first suspected that it was once an insect pathogen and switched hosts when the ants started cultivating fungi. But now they think *Escovopsis* started out as a pathogen of the free-living ancestors of the fungi currently farmed.

The evolutionary history also revealed that different branches of *Escovopsis* appeared in parallel with new branches of ants and fungi. "It looks to me as if the pathogen was locked into the relationship" early on, notes Daniel Janzen, an evolutionary biologist at the University of Pennsylvania in Philadelphia. Today, there are four lineages of the microfungus, and each is associated with a particular ant-fungi system. "It's a nice, clean example" of coevolution, Janzen adds.

The social circle isn't complete, however. Currie showed previously that there's a fourth partner that has yet to be studied. Many of the ants host bacteria on their bodies that produce antibiotics targeted against the pathogens. These too are likely to show some signs of coevolution, and DNA studies should help reveal their relationship to the ant and the fungi, he predicts.

Bountiful harvest. A queen ant presides over her workers as they tend their fungal garden.

CREDIT: AINSLIE LITTLE/UNIVERSITY OF KANSAS, LAWRENCE

Rod Page, a theoretical systematist at the University of Glasgow, U.K., knows of only one other instance in which researchers have attempted to understand a three-way partnership: that between a fig, a fig wasp, and a nematode that infects the wasp. Now, he adds, the ant-fungus-microfungus threesome "might encourage people to think about how many layers are in these associations and what [species] they are tracking" as these organisms evolve.

–ELIZABETH PENNISI

ScienceScope

California Universities Face More R&D Budget Cuts

State research funding took another body blow in the 2003–04 budget request released last week by California Governor Gray Davis (right). The plan would reduce the University of California's (UC's) research activities by 10%, to $259 million. That's on top of a 10% hit already doled out for the current fiscal year that ends in June (*Science*, 20 December 2002, p. 2305).

Science isn't singled out in the $3.4 billion system—administrators, libraries, educational outreach, and student services would all take a hit. Faculty and staff would have their salaries frozen, and student fees would increase substantially to make up for the shortfall.

The proposed cuts are "devastating," says UC president Richard C. Atkinson. But given the state's deficit—$30 billion and climbing—legislators will have few options when they begin debating Davis's proposal this spring. In the meantime, UC officials are mulling over where to apply the knife.

–ANDREW LAWLER

French University Threatens Closure Over Cash Crunch

PARIS—A major research university hopes that its threat to temporarily shut down will force the government to cough up money for needed repairs and renovations. University of Orsay officials last week said they are planning to close the university, which employs some 3000 researchers and conducts nearly a third of France's basic physics research, for up to 3 weeks in February. The pause would reduce utility bills and help the school finish safety-related improvements, says president Xavier Chapuisat. "I am fed up with working in these lousy conditions," says one scientist.

The plan "took us by surprise, even though we knew there were problems," Research Minister Claudie Haigneré told *Science*. She says the government is now exploring ways to avoid the shutdown, which researchers say will disrupt research and teaching.

–BARBARA CASASSUS