Biology

Revenge of the placid protozoan

A mild-mannered, single-celled organism that lives in water-filled tree holes changes into a ruthless parasite when it detects the presence of predatory mosquito larvae, providing a new and unusual model for studying cell differentiation and regulation, new research shows.

According to a paper in the May 27 SCIENCE, mosquito larvae – which feed on the tiny organisms, called protozoan ciliates – unwittingly secrete a water-soluble factor that stimulates the normally free-living ciliates to undergo a rapid transformation into a parasitic form. As parasites, the ciliates infect the mosquito larvae and ultimately kill their would-be predators.

Such "inducible parasitism" is an extreme example of an antipredator defense in which prey becomes parasite and would-be predator becomes prey, the researchers report. More commonly, water-borne prey develop spines or other protuberances as defenses in response to predatory threats.

Entomologists from the University of California at Berkeley performed a series of experiments showing that the single-celled ciliates, which normally feed on bacteria and other microorganisms, undergo rapid cell division and morphological changes in the presence of predatory mosquito larvae. Moreover, they found the same changes could be stimulated by water previously inhabited by the larvae but from which all larvae had been removed – indicating the transformation is triggered by a secreted factor, as yet unidentified.

In their parasitic form, the ciliates may prove useful as biological controls against mosquitoes, the researchers suggest. And the identification of the chemical, or "morphogen," responsible for the parasitic transformation could add to an understanding of cell regulation.

Petrobia latens: A good mite gone bad

Drought conditions plaguing north central Montana for most of the past five years may be triggering more than the obvious problems for farmers there, plant pathologists report. *Petrobia latens,* a tiny spider mite found on cereal crops during stretches of dry weather but never before implicated in the spread of disease, now appears responsible for a new disease in barley.

Researchers at Montana State University in Bozeman have been searching since 1983 for the cause of the disease, first recognized in a Montana barley field in 1982. It has since infected crops in five contiguous counties. They report in the May 27 SCIENCE discovering long, filamentous virus-like particles (VLPs) in diseased leaves from infected barley plants, and provide evidence the particles are transmitted by the brown wheat mite. The scientists previously ruled out aphids, leaf hoppers and thrips – all known to transmit plant viruses – as carriers of the new disease. But electron microscopy of ultrathin sections of mites from infected plants showed the presence of similar VLPs in the mites' digestive tracts.

Although viruses of similar length (4,000 nanometers) have been identified in animals and insects, such long viruses have not previously been reported in plants, the researchers say. Indeed, they suggest, since the VLPs most resemble certain enveloped, filamentous viruses found in the animal kingdom, they may have originated in mites before developing their new penchant for residing in plants.

The researchers report mites can transmit the disease to healthy plants after feeding on leaves from a diseased plant, but not if they have fed previously only on healthy leaves. They also found young mites hatched from eggs of infected adults can transmit the disease – even if these youths never fed on diseased plants. This implies the VLPs may be passed to mite offspring via an infected mother's eggs, and that mite eggs may serve as an overwintering host for the disease-causing agent.

Earth Sciences

Richard Monastersky reports from Baltimore at the American Geophysical Union's spring meeting

Boring plains belie bounty beneath

Geologically speaking, the U.S. Midwest gets a bum rap While oil companies pursue their quarry in the uppermost rock that forms a veneer across the central states, the basement rocks beneath have never captured much attention from geologists. But researchers probing the midcontinent with seismic waves are now finding surprising, layered structures hidden within this basement. In southern Illinois and Indiana, the layered rocks extend at least 180 kilometers in an east-west direction and average about 6 km in thickness, says Larry Brown of Cornell University in Ithaca, N.Y. Brown is part of the Cornell-based Consortium for Continental Reflection Profiling (COCORP), a program aimed at exploring the crust of the entire continental United States.

Previous seismic work, partly by oil companies (which rarely release their information), had hinted such layered structures might exist in the basement. But scientists traditionally have regarded this area as a province of hard, deformed rocks without an organized structure.

COCORP also has found evidence in Texas of stratified regions in the basement, suggesting these structures may be part of one massive complex, says Brown. Researchers say the layered areas must have formed more than 1.3 billion years ago, but seismic work alone cannot reveal whether the rocks are sedimentary or volcanic in origin.

Since sedimentary structures are the bearers of oil and natural gas, these basement layers could represent a new source for fossil fuels. Conversely, if they are volcanic, the rocks are relics of ancient volcanic eruptions that were previously unknown to geologists. The only way to be sure is to drill into the structures, says Brown. In the meantime, COCORP will continue working from the surface to determine the size of the basement strata.

Estuaries awash in contaminants

Oceanographers have long realized that nutrients and pollutants from land sources travel downriver and collect in the waters of estuaries – the ecologically critical zone where river meets ocean. But new research suggests pollutants from the *ocean* also concentrate in estuaries – a finding that helps explain coastal pollution and may have implications for dumping practices in the ocean, says Curtis R. Olsen, a researcher at the Oak Ridge (Tenn.) National Laboratory who has studied the Savannah River Estuary on the Georgia-South Carolina border with colleagues from Oak Ridge and the Skidaway Institute of Oceanography in Savannah.

The researchers measured the estuarian concentration of several different isotopes of plutonium (Pu), which binds to small particles in the water. One isotope, Pu-238, is released upriver in minuscule amounts by the Department of Energy's Savannah River Plant, a nuclear facility. On the other hand, Pu-239 and Pu-240 are fallout from above-ground testing of nuclear weapons and therefore come predominantly from the ocean. When they measured the concentration of the three isotopes, the researchers found the estuaries enriched in the oceanic plutonium – meaning particles in the ocean must gradually migrate landward and concentrate whatever pollutants they carry within the estuaries, says Olsen. While people who study ocean sediments have known of such landward motion, he says, those who study contaminants in estuaries have not considered this process before.

This finding is not limited to plutonium, Olsen says, because particles also can bind and carry other pollutants such as heavy metals, the insecticide DDT and PCBs (polychlorinated biphenyls). As well, he adds, this transportation process may carry contaminants landward into such coastal environments as bays and fjords.