Spineless predators 'learn': Prey can cause emesis in nemesis

Savvy bluejays, it is known, avoid eating monarch butterflies, which sequester in their bodies packets of poison capable of sending a naive predator into fits of violent retching. Eleven years ago, scientists cited that phenomenon as a slick evolutionary trick that shields monarchs and any bug remotely resembling them from voracious birds (SN: 2/10/73, p. 89). Now, a surprise finding from the University of Illinois at Champaign-Urbana: The trick works against hungry insects, which, like the bluejays, seem to "learn" to avoid such prey.

"For years it was assumed that invertebrates are stupid and can't learn [from their feeding experience]," says May R. Berenbaum, who fed a type of praying mantis snacks of milkweed bugs and watched as the predators vomited and refused a second round. "Obviously they're not so stupid," she says. "They will reject noxious prey. They not only perceive differences between edible and inedible bugs, but they learn to generalize."

Other scientists have shown that spineless creatures ranging from scorpions to spiders can be trained to avoid distasteful prey, but Berenbaum believes hers is the first study to show that such "learning" might be an important selective force that has permitted some insect species to survive through the ages.

To test the theory, Berenbaum and graduate student Eugene Miliczky raised milkweed bugs on two different diets. One group was fed a natural diet of milkweed, a plant that grows commonly in fallow midwestern fields and contains a high concentration of cardenolides, potent chemicals known to be toxic to animals. A second group of identical bugs was fed a special diet of innocuous sunflower seeds.

Results of their study, published in the current issue of THE AMERICAN MIDLAND NATURALIST showed that a mantis encountering milkweed bugs for the first time showed no reluctance in pursuing, capturing and devouring them. Bugs fed sunflower seeds produced no deterrence in subsequent mantis feeding. But after milkweed-fed bugs triggered vomiting in the mantis, the sadder but wiser predator learned to avoid even a harmless beetle painted to look like a milkweed bug.

T. Eisner

Cornered milliped (upper right) secretes a Quaalude-like substance that sedates its hungry foe, the Wolf spider.

James E. Carrel, a biologist at the University of Missouri (Columbia), cites Berenbaum's work as especially important for the insight it offers into the little-studied ways insects and other invertebrates guard themselves against bigger bugs. His own work, published in the February PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (No. 3) hints at still another possible mode of defense: Millipeds may ward off enemy Wolf spiders by sedating them with a chemical similar to that used in the human sedative, Quaalude.

Spiders in Carrel's study that bit off a mouthful of milliped also ingested a few drops of the chemical glomerin in a sticky secretion from glands along the milliped's sides — enough to sedate the spider for hours, or even days. The sedation, characterized by the usually agile spider's inability to right itself when flipped on its back, had a surprisingly slow onset of 4 to 12 hours, Carrel told SCIENCE NEWS. He and collaborator Thomas Eisner of Cornell University in Ithaca, N.Y., are in the midst of follow-up experiments to see if the spiders learn from their experience to avoid millipeds. —*D. Franklin.*

May R. Berenbaum

Mantis casts aside foul-tasting prey.

Bacteria with a sweet tooth for pollutant

Microbiologists hunting in sewage sludges, soil samples and lake sediments for bacteria that degrade man-made chemicals have found two species with keen appetites for a widespread pollutant called polyethylene glycol (PEG). The bacteria are among the first examples of anaerobes (organisms that live without oxygen) that can degrade a highly resistant synthetic polymer like PEG.

Daryl F. Dwyer and James M. Tiedje, both at Michigan State University in East Lansing, say they became interested in anaerobes because oxygen-using microbes cannot degrade some chemicals. Another reason to study anaerobes, says Tiedje, is that anaerobic processes already being used for some waste treatment are cheaper than those that rely on aerobic bacteria.

Billions of pounds of glycols are produced each year for use in antifreeze, detergents, explosives, plastics and cosmetics, Dwyer notes. "Nobody knew what happened to these long polymers," he says. "They could have gone through the sewage treatment plant, been dumped into a lake or stream, and never been degraded." The recent findings indicate to the researchers that PEG, and perhaps other polymers like it, probably are being biodegraded at some waste treatment facilities or wherever these anaerobes inhabit the environment. The scientists announced their results at the recent meeting of the American Society of Microbiology. They isolated both a *Desulfovibrio desulfuricans* microbe that consumes short chains of ethylene glycol, and a member of the Bacteroidaceae family, that breaks up larger chains. Both bacteria produce acetate and ethanol in the process. When other microbes are added, methane is also made. Tiedje urges companies with large amounts of PEG waste to consider using the bacteria for the production of these useful chemicals, as well as for waste management. The microbes can also be used, he says, to control the lengths and branching of PEG chains as they are first synthesized.

More work is needed to unravel the details of anaerobic processes, say the researchers. For example, a West German group, which last year discovered another PEG-degrading bacteria, believes the microbes break up the polymer inside the cell body; Tiedje and Dwyer think the bacteria excrete an enzyme that cleaves the PEG chain outside the microbe. The Michigan group hopes to verify their theory by isolating extracellular enzymes that attack PEG. Dwyer says that scientists still view anaerobes as a black box. "We're just starting to take the pieces apart," he says. —*S. Weisburd*

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