Thomas Eisner, a chemical ecologist at Cornell University, "It's a classic study. Charles Darwin would be proud."

The first beetles were not vegetarians—primitive beetles living today eat detritus and fungi—but it only took them 50 million years, or as Farrell says, "the evolutionary equivalent of about 50 seconds," to figure out they could survive on cycads, ferns, and conifers. Many of these earliest herbivores dined on the interior sappy bark or stems of such plants, while their larvae munched the nitrogen-rich, pollen-bearing structures inside the cones. Farrell thought that tissue-eating behavior could have prepared certain beetle species for the appearance of the juicy flowering plants, or angiosperms.

The idea that plants and insects might be dancing an evolutionary pas de deux was first suggested in 1964 by Stanford University ecologist Paul Ehrlich and Missouri Botanical Garden botanist Peter Raven. "They had this cool vision early on," says Farrell, "about how plants could be the driving force in insect evolution, and vice versa." The hypothesis made sense because many insects are restricted to feeding on certain groups of plants—and many plants have defenses targeting insects. The idea took a hit 5 years ago, when Conrad Labandeira of the National Museum of Natural History found that the appearance of angiosperms had no effect on the number of insect families (*Science*, 16 July 1993, p. 310). But the picture was different when Farrell applied a finer lens to the most successful insects of all, the beetles.

He analyzed highly conserved DNA sequences from 115 species of the herbivorous beetle subfamilies, sampling up to six species from each, to create a phylogenetic tree showing the likely evolutionary relationships of today's beetles and when they diverged from common ancestors. He mapped his tree on floor-to-ceiling charts hung in his office, compiling onto them data from fossils, species' dietary habits, and the biogeography of present-day beetles to identify which beetle ancestors ate which host plants on which continents and over what time periods. "I felt like a photographer in a darkroom," he says, "watching as the chemicals made a picture emerge."

The developing image revealed a tight link between plants and beetle diversity. While cycad and conifer-feeding beetles formed the family tree's trunk, angiosperm-eaters dangled from the top branches. Two related superfamilies, Chrysomeloidea (such as the Colorado potato beetle) and Curculionoidea (which includes weevils), seem to have benefited particularly from the blossoming of a leafy, green world. Together, their known 135,000 species comprise some 80% of all herbivorous beetles and almost half of all herbivorous insects. And their population boom coincides with the rise of angiosperms. "They show an increase in diversity by several orders of magnitude," Farrell says. "Well over 100,000 new species of beetles arose because of that move to angiosperms."

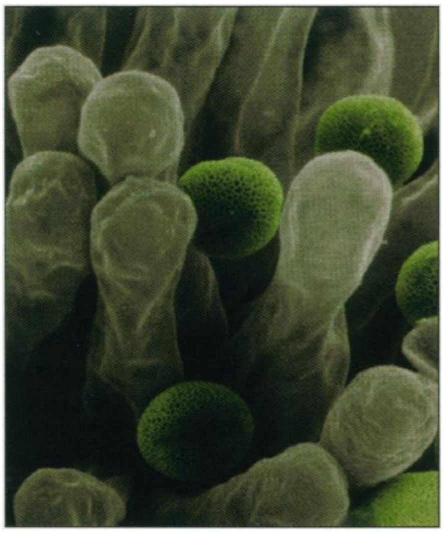
The findings, says Farrell, "show how moving into a new environment, where there's no competition, can free you for an explosive adaptive radiation." Or, as Eisner pithily puts it, "it shows what happens if you eat your vegetables." **–VIRGINIA MORELL**

DEVELOPMENTAL BIOLOGY

How Plants Pick Their Mates

Plants don't flirt. They don't gaze too long or blush. They produce flowers but don't show up at the door with a bouquet. Even without such behaviors, though, they are very choosy about their mates and rarely cross-fertilize with other species in the wild. Now, researchers have shown for the first time that the female parts of plants make snap judgments—good ones—about whether they have something in common with the pollen grains on their threshold.

At the Society for Developmental Biology meeting at Stanford University last month, Daphne Preuss, a plant geneticist at the University of Chicago, and her colleagues reported that the receptive female part, the stigma, of the experimental plant *Arabidopsis* grabs pollen of the same species and holds on so tightly that even the sheer force of a centrifuge can't separate the two. But pollen from a different species just falls off. What's more, the stigma apparently discriminates among its suitors by conversing with the cell wall of the pollen grain, a structure most scientists had deemed to be as uncommunicative as, well, a wall.



D. PREUSS

For keeps. Pollen grains (yellow), magnified 600 times, cling to female flower part.

Understanding how plants block inappropriate mating might allow researchers to "overcome those barriers and produce new hybrid crops," says Preuss. "For example, cold-tolerant plants could be crossed with plants that produce high-quality fruits."

Because plants can't move, many are literally at the mercy of the winds for introducing sperm, carried by pollen, to the eggs in the female part of flowers. Factors such as species-specific pollinators ensure that the right pollen ends up in the right type of flower, but pollen from other species often makes its way to the stigma as well. So, the female tissue raises many obstacles to hinder mismatched sperm on its way to the egg, explains Dina Mandoli, a plant developmental geneticist at the University of Washington, Seattle. But the earlier the female foils any interloping sperm, the better, and "no one had looked at the very first step before," she says.

To find out whether the female tissue assesses potential partners upon first contact, Greg Zinkl, a postdoc in Preuss's lab, brushed an *Arabidopsis* anther, which carries pollen, on a stigma. He dislodged unbound pollen by adding a solution containing detergent and centrifuging or vortexing the stigma. Then, he counted the pollen grains still attached—and found that many had made an instant connection. "This is very abusive treatment," says Preuss. "We'd expect things to pop off if they could, but amazingly, the pollen sticks very well." When Zinkl repeated the experiment with pollen from the unrelated petunia plant, the pollen fell off.

When the researchers looked at the plant surfaces through an electron microscope, they saw no physical structures that might explain how the plant parts embrace—no entangling hooks and loops. "Whatever it is has to be very small—some kind of molecular Velcro," says Preuss. "We're at the level of chemistry—not large cellular structures."

Although the group hasn't yet tracked down the sticky molecules, a preliminary search for mutant pollen cells that don't adhere properly suggests that structural defects in the cell wall ruin the attraction. This adds to a growing realization that cell walls play an active role in cell-cell signaling, researchers say. "People have always had this idea that the cell wall is an inert matrix—just cork, boxes that hold cells in place," says Scott Poethig, a plant developmental geneticist at the University of Pennsylvania, Philadelphia. "But it's becoming clear that the cell wall is a playground where a lot of molecules can interact and talk with each other."

Whatever the precise mechanism, it seems that the instant alliance between pollen and stigma is based on surface attraction. But among plants, at least, this type of union sticks. **–EVELYN STRAUSS**

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