

### Mood Bugs

#### Beetle changes color in fluid fashion

Color-changing animals, such as chameleons and squid, typically alter their hues when nerve signals or hormones spur pigment cells in their skin to expand or shrink.

The Panamanian golden tortoise beetle, however, changes color dramatically from metallic gold to matte red by a very different method, researchers report. It uses its body fluid to structurally alter the reflectivity of its shell—a trick that could one day be built into devices that would optically signal the presence of a liquid.

This color-change method is “something very rare,” says lead author Jean Pol Vigneron of the University of Numar in Belgium.

The 8-millimeter-long beetle, *Chari-*

*dotella egregia*, sports a transparent shell made of the biopolymer chitin, which forms insect exoskeletons. The shell normally reflects a metallic-gold color, but that sheen fades to reveal a red pigment when the beetle is disturbed.

Using electron microscopy, Vigneron and his colleagues found that the shell has a three-tiered structure, with each tier consisting of a number of closely packed layers. Each of the tiers—the thickest is at the bottom, the thinnest at the top—reflects a particular wavelength of light, and those wavelengths combine to produce the gold coloration. Beneath the tiers is a layer of red pigment.

The researchers’ high-resolution images also revealed randomly placed patches of nanosized grooves or channels in the layers that make up each tier. When the beetle’s body fluid fills these channels, the layers become smooth. Only then do the tiers act as “perfect mirrors” that give the beetle its metallic sheen, Vigneron says.

Absence of fluid “destroys the optical properties” of the mirrors, Vigneron says, because the irregular surfaces don’t reflect light cleanly. With no smoothing fluid, the tiers act not as mirrors but as windows to the red pigment below. Moreover, diffuse scattering of light by the shell takes away the beetle’s metallic shine, giving it a matte appearance.

To confirm that liquid is crucial to the color change, the team deep-froze a beetle while it was colored gold. The dead, frozen beetle turned red. Shortly after the beetle

was removed from the freezer, its color changed back to metallic gold. Later, when the dead beetle had dried out, it turned permanently red.

The findings appear in an upcoming *Physical Review E*.

“It’s a new mechanism that hasn’t been found in nature before,” says Andrew Parker of the University of Oxford in England, who studies color changes in animals. Parker says that most animals control color at the cellular level, but that the beetle’s ability to change color on a larger scale might have commercial potential.

“Nature never stops surprising us with elegant solutions to everyday problems,” says Radislav Potyrailo, an analytical chemist at the GE Global Research Center in Niskayuna, N.Y. Engineers could learn a lot from biological mechanisms, he says. “There are quite a lot of solutions in nature that we admire and would like to mimic.” —C. BARRY

### Calming Factor

#### DNA vaccine for MS passes initial test

An experimental vaccine for people who have multiple sclerosis has proved safe, clearing a necessary first hurdle toward regulatory approval. The results of this initial trial also suggest that the vaccine can indeed quell the self-destructive immune reaction that many scientists believe causes the disease.

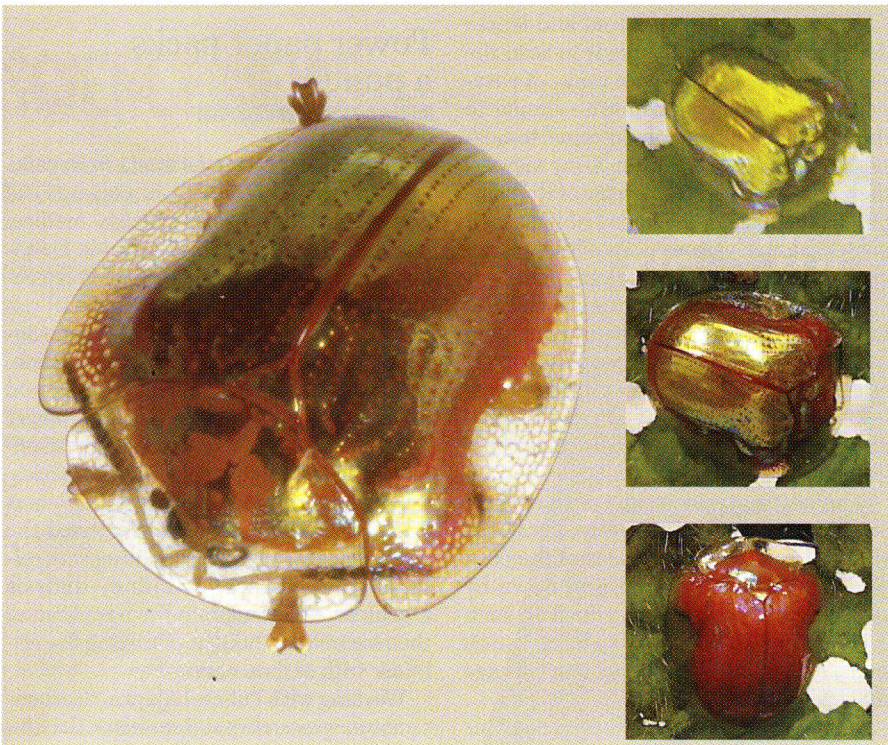
Despite this early promise, the researchers caution that the findings are based on data gathered from a small group over a limited time.

The researchers used a technique called DNA vaccination, which introduces a gene into the body to elicit an immune response. But rather than rile the immune system against a foreign foe, the new multiple sclerosis (MS) vaccine seeks to induce immune tolerance of myelin basic protein, a component of myelin. A fatty material that protects nerves, myelin is degraded in MS, robbing patients of muscle control.

For the vaccine, researchers at Stanford University and Bayhill Therapeutics in Palo Alto, Calif., designed a DNA ring that encodes a slightly altered version of myelin basic protein. The changes replaced immune-stimulating parts of the protein with immune-suppressing ones.

Scientists gave 30 MS patients four injections over 9 weeks and then tracked their progress for a year. The study was made public this week and will appear in the October *Archives of Neurology*.

Periodic magnetic resonance imaging of the patients’ brains showed that inflammation associated with the nerve damage of MS didn’t worsen as a result of the vaccine.



**COLOR ME BEETLE** The 8-millimeter-long golden tortoise beetle uses shell structures, rather than pigmented cells, to dramatically change color. Main image and top inset show reflective-gold state, which progresses to matte red at bottom.

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