Biology

Brighter birds bag bigger territories

Studies of closely related birds in the forests of Kashmir, India, have shed light on the role of habitat in the evolution of plumage color patterns. Birds living in dense woods tend to evolve bright patches that they keep hidden except when they want to show off to members of their species, says Karen Marchetti of the University of California, Davis.


Marchetti/Univ. Calif., Davis

Warbler's painted wing bar.

She compared patches in warblers belonging to the genus *Phylloscopus*. Depending on where they breed, each species of these small greenish birds sports a different pattern, ranging from a simple wing bar to two wing bars, a stripe across the head, a patch on the rump, and white outer tail feathers.

For several breeding seasons, she examined the role of patches by dividing males into three groups. She covered up part of the wing bars in one group with green paint and enlarged the bars of a second group with yellow paint. She coated some control birds' bars with clear paint to counter any effect caused by the paint itself.

After standoffs in which neighboring males display their wing bars at close range, the brighter bird always takes a chunk of the duller bird's space, she reports in the March 11 Nature. That also proved true when Marchetti added a crown stripe to some males, making them even more conspicuous.

Shedding light on the body's interior

Normally, shining a light through an animal — especially bulky ones like rats or people — reveals very little about what's inside. But a technique called optical time-of-flight and absorbance imaging (TOFA) lets researchers view not only organs, but also gas inside those organs.

The technique is one of several being developed that carefully process light to get more information from it (SN: 12/5/92, p.398). TOFA makes images by timing individual photons from three diode lasers. The time it takes for a given fraction of photons to pass through a part of the animal varies depending on the tissue in the path of the light, says David A. Benaron of Stanford University School of Medicine.

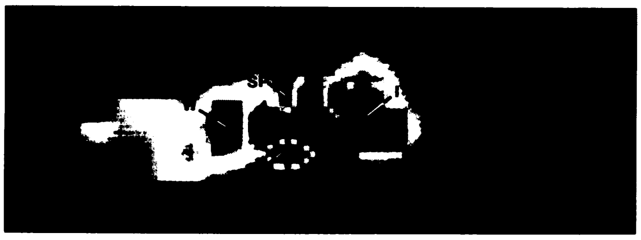

Benaron & Stevenson/Science

Image of rat reveals heart (H), liver (L), intestines (I), spleen and pancreas (SP), and gas in intestine (black).

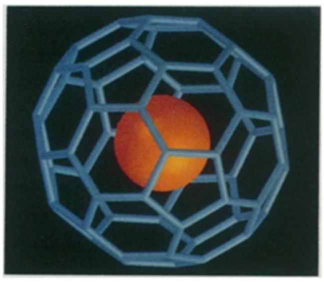
Through relatively simple computations, the instrument's microprocessor converts the variable time periods to a color scale and then generates the images, Benaron and Stanford colleague David K. Stevenson report in the March 5 Science.

The Stanford group is trying more powerful lasers to improve the speed and resolution of this technique, which they say shows promise as a portable, easy-to-use medical imaging tool. Already, TOFA seems capable of determining whether oxygen is reaching tissue deep in the body and consequently may aid in early detection of brain injury, Benaron says. In addition, it may one day monitor glucose and cholesterol in blood or be adapted for use in industry.

Chemistry

In the lab, fullerenes gobble gases

Researchers have worked zealously to stuff buckyballs with various atoms (SN: 12/14/91, p.391). Now it appears that some helium atoms quietly slip inside these cage-shaped molecules on their own during the standard synthesis procedure, which uses graphite electrodes in helium, Martin Saunders and his colleagues at Yale University report in the March 5 Science. By heating a commercial sample of buckyballs to 700°C to 900°C and using a mass spectrometer to measure the amount of helium released, the team determined that one in every 880,000 fullerene molecules houses a helium atom.


Saunders/Yale Univ.

Computer-generated image of a neon atom in a buckyball.

A heated buckyball belches its helium atom out through a "window" that appears when bonds temporarily break in the structure, the group proposes. The energy from such heating is not enough to squeeze the atom through any of the intact rings, explains Saunders. As predicted, the team found it could also open the window to insert gases. After heating a fullerene sample with pure helium-3 at 600°C for one hour, they found 5 million times as many of these atoms inside the buckyballs. Using the same technique, they also inserted a neon atom inside one of every 8.5 million buckyballs in a sample.

"These are the very first stable compounds of neon and helium that I know of," says Saunders. Those two noble gases generally form only loose, unstable complexes, he explains.

The Yale group hopes to boost its yields by increasing the pressure to 1,000 atmospheres in order to force more gas atoms through the windows during heating. The experimental results suggest researchers will be able to crack open buckyballs for stuffing, rather than filling them only during synthesis.

In the wild, a bolt of "bucky" luck

Last summer, geochemist Peter R. Buseck and his colleagues at Arizona State University in Tempe identified the first naturally occurring fullerenes in a rock from Russia called shungite (SN: 7/11/92, p.20). How the buckyballs got there remains a mystery, but the researchers noted parenthetically in their paper that few environments in nature — besides stellar interiors and lightning strikes — meet the extreme temperatures believed necessary for synthesis of the molecules.

Lo and behold, the team reports in the March 12 Science, it has discovered fullerenes forged by lightning. While it seemed a long shot, the team hit pay dirt after sampling glassy, lightning-seared rocks — known as fulgurites — from just five locations. Using mass spectroscopy to analyze a fulgurite from Sheep Mountain in southern Colorado, they detected the 60-carbon spherical buckyball and its larger, 70-carbon cousin.

Lightning struck this buff-colored rock — derived from volcanic ash — with voltages and heat well in excess of that used in laboratory synthesis. The bolt left a network of glassy, black channels running through the rock. The fullerenes occurred in a tubular blister near the surface, Buseck says. He speculates that pinecones and pine needles on the soil surface provided the necessary carbon building blocks.

Fullerenes found in nature may provide hints about the range of conditions and mechanisms that lead to their synthesis. So far, the Sheep Mountain fulgurite and the shungite — a coal-like sedimentary material — appear to have very different histories. Buseck is now widening his search to include even common rocks. "We don't know that the conditions have to be so extreme," he says. "I want to keep an open mind."