BIOLOGY

Polyester linings by bees

A smooth, transparent layer of waterproofing coats the broad cells made in damp earth by bees of the genus *Colletes.* Snug in the cell, an egg and its provision of pollen and nectar are protected from water, fungi and soil microorganisms. Since 1835 a gland in the bees, Dufour's gland, has been suspected as the source of the lining material. Now scientists report the chemical composition of the gland secretion and of the lining. They conclude the lining is a polymer, knit of the gland material.

Abraham Hefetz and Henry M. Fales of the National Heart, Lung and Blood Institute and Suzanne W. T. Batra of the Department of Agriculture suggest that a bee uses its tongue (glossa) and legs to apply and spread the secretion. Once the material is deposited, an unknown, possibly enzymatic, mechanism polymerizes the layer. The resultant polyester is so water-resistant that a fine layer of air forms around a sample in water. That resistance probably is the key to the lining's ability to remain intact for more than a year in soil.

"This appears to be the first report of a naturally occurring linear polyester," the investigators say in the April 27 SCIENCE. They propose a name for natural polyester membranes — laminesters.

Flies in the laboratory

Black flies are breeding in an Amherst, Mass., laboratory — and the resident scientists are happy about it. Laboratory colonies are necessary to research on control of the flies and of the diseases they carry, such as river blindness, which is a barrier to productive use of many of Africa's fertile valleys. At the University of Massachusetts John Edman and Kenneth Simmons report a successful laboratory colony, now in its eighth generation of black flies. Simmons duplicated a fast-flowing river habitat with a chambered tank with water bubblers. For simplicity the entomologists chose a variety of fly that doesn't need a blood meal to produce eggs. But the flies can feed on blood, so research on parasite transmission will be possible.

Botanical litmus test for radiation

Japanese geneticist Sadao Ichikawa is promoting flowering spiderwort as a people's radiation monitor. He has planted the common wildflower around nuclear reactors in Japan and has distributed it for use in Europe and the United States. A special spiderwort variety, which must be reproduced by cloning, reveals radiation dosage in the hairs associated with its pollen-bearing stamens. When radiation disrupts the genes responsible for the normal blue pigmentation of a stamen-hair cell, the cell appears pink instead of blue under a microscope. Ichikawa, who is now at Saitama University in Japan, says the plants can indicate radiation doses as low as 150 millirems. But Victor Bond of Brookhaven National Laboratory argues that the spiderwort cannot reliably demonstrate doses less than 300 millirems, which is far beyond the exposure permitted by the Nuclear Regulatory Commission. Because the spiderwort also responds to environmental, chemical pollutants, Bond believes data from the plants will not be able to determine radiation alone. In the May-June GARDEN, the magazine of the New York Botanical Garden, Ichikawa contends that in measurements of spiderworts near nuclear reactors, the number of pink cells closely corresponds to periods of reactor operation, distance from the facility and wind direction. Ichikawa believes the spiderwort is more reliable than standard dosimeters, because like a person the plant can accumulate radiation effects. However, spiderworts show the damage in less than two weeks, he says, whereas a human population may take decades.

PHYSICAL SCIENCES

QED is QED at high energy

Given the world's most energetic apparatus for producing collisions and annihilations of electrons and antielectrons, what is the first thing you would do with it? This is a multiple choice question for physicists, and there is no single best answer, but the one project that would make everybody nod and say, "oh, yes," is a high-energy test of the theory of quantum electrodynamics (QED).

The news from one of the first uses of the Mark J detector at the PETRA storage ring in Hamburg is that QED works up to total energies of 17 billion electron-volts. QED is the theory of electric and magnetic behavior on the subatomic level, and its history of precise success in predicting what happens is legendary. Nevertheless new tests at higher energy are necessary. Higher energy means effects that take place in shorter distances, and many physicists suspect there may be a level of narrowness at which space becomes grainy and quantized like matter and energy at the distances where particle physics now works. There our notions of continuous motion and smooth paths (implicit in QED) would break down.

It is not yet. The advantage of using the electron-antielectron collisions in PETRA is that they provide a purely electrodynamic occurrence for study: the collision of an electron-antielectron pair that goes by way of a virtual photon with a very fleeting existence to an antielectron-electron pair (that is, an exchange of identities). QED gives rather clear predictions of the probability that the daughter pairs will come away at one angle or another to the axis of the original pairs.

A group of 38 physicists from institutions in West Germany, France, the United States, the Netherlands and the People's Republic of China compared the angles measured in Mark J at two total collision energies (center-of-mass energies), 13 billion electron-volts and 17 billion electron-volts, and found good correspondence with the predictions of QED. The report is in the April 23 PHYSICAL REVIEW LETTERS (D. Barber et al.).

Matter-wave beats to make a laser

Ordinary lasers work by energizing a lot of electrons, usually with a flashlamp, and then getting them to reradiate with coherent amplification by means of multiple reflections of the radiation. As Helmut Schwarz of Rensselaer Polytechnic Institute points out in the April 23 PHYSICAL REVIEW LETTERS, "Conventional lasers ... are limited to single characteristic wavelengths that cannot be changed at will."

A laser that uses free electrons, electrons not bound to atoms or molecules, would not be bound to a characteristic wavelength but would be tunable. Schwarz proposes a free-electron laser based on wave-mechanical beats between two beams of electrons. On the subatomic level material objects exhibit the characteristics of both particles and waves. A beam of electrons is at the same time a train of waves, and the wavelength depends on the energy of the electrons.

Schwarz proposes that two beams of electrons of slightly different energy (and therefore wavelength) be brought together. This should produce an interference phenomenon, just as if two light beams of slightly different wavelength were brought together. Interference here means a periodic bunching and debunching of the electrons. That should cause electromagnetic radiation at a particular frequency. The frequency should be variable by varying the energy difference between the electron beams. Schwarz says this kind of device should have a gain similar to the previously demonstrated kind of free-electron laser that uses a cyclic magnetic field to induce radiation, but it does not require a high-energy linear accelerator to energize the electrons.

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