AAAS

Butterfly colors: Alluring or alarming?

Like two men shaking their fists and shouting, male butterflies may flash their brightly colored wings at each other as a sign of aggression. And, as in the case of their human counterparts, one of the two insects may be so intimidated by his opponent's display that he'll give up the fight before it even starts. Robert Silberglied of the Smithsonian Tropical Research Institute in Panama suggested this after presenting data contradicting the popular idea that male butterfly color attracts females.

This traditional explanation for color, with roots in the writings of Charles Darwin, says that male wing color and pattern (including ultraviolet pattern not visible to the human eye) provides the female visual criteria to distinguish her species from others and to recognize the most genetically fit of her own kind. This belief is still popular among lepidopterists.

But Silberglied, who spoke at the AAAS meeting, has data indicating this is not true. He and Orley R. Taylor, at the University of Kansas, manipulated wing color and pattern on hundreds of male butterflies, mostly of the species *Colias philodice* and *Colias eurytheme*. Research focused on *Colias* both because they are abundant and easy to collect and because their ranges overlap in parts of the United States. An overlapping range in similar species means that females must be well-equipped to distinguish their own species in order to prevent mistakes. Silberglied and Taylor changed the wings by painting them red, green, blue, or black (*C. philodice* is normally yellow and *C. eurytheme* orange) and by transplanting them from one species to the other.

They found that females did not discriminate against males showing either incorrect colors or patterns. Females are selective when choosing a mate, says Silberglied, but probably reject unsuitable suitors only on the basis of pheromones. While he warns that it's "dangerous to generalize from [a few] species to 15,000," Silberglied told SCIENCE NEWS he believes this will turn out to be true with most butterflies.

To explain the bright colors common to males of so many species, Silberglied suggests that color is used as a threat signal between males in conflict over a female. Such ritualization of combat, which reduces the possibility that either opponent will get hurt, is common in the animal world but has not been demonstrated in butterflies before. It makes sense, says Silberglied, not only because male butterflies are aggressive toward other males, but also because they are very fragile. Avoiding physical combat would have an obvious advantage.

Although Silberglied's proposal runs counter to conventional belief, it has received an at least guardedly favorable response. "I've never thought about this specifically before, but it's possible," says Paul Opler, a lepidopterist with the U.S. Fish and Wildlife Service Office of Endangered Species. "It's true that territorial birds are the ones showing the brightest colors." "I think it's plausible," says John M. Burns, an associate curator of Lepidoptera at the Smithsonian Institution. But because his findings contradict what most butterfly experts have always believed, Silberglied plans more research. He will observe conflict between males of several species and then, with similar techniques used to investigate the effect of male color on female attraction, will test the impact of color changes on the outcome of male conflicts. —*L. Tangley*

AAAS

Aquaculture: Tips from deep-sea vents

Lewis Carroll's walrus, preparing to dine elegantly on shellfish (oysters), needed little more, chiefly, than a loaf of bread to complete his repast. Given new information gleaned from the submarine hydrothermal vent systems at spreading centers along the East Pacific Rise, a modern walrus instead might augment his bread with mussels nourished by bacteria grown in an artificial vent system.

At the AAAS meeting, Holger Jannasch of Woods Hole Oceanographic Institution described land-based experiments suggested by findings that clams and mussels growing in coastal waters off Massachusetts use bacteria in ways similar to those employed by giant clams and mussels discovered near some deep-sea hydrothermal vents. Both clams and mussels on the lightless seafloor derive their energy from bacteria that oxidize the hydrogen sulfide abundant at the vents (SN: 1/12/80, p.28). The bacteria use the energy produced in the course of the chemical reaction converting the H_2S to sulfate. They actually live in the clams in a little-understood symbiotic relationship, while mussels filter the bacteria and digest them immediately. Richard Lutz of Rutgers University in New Brunswick, N.J., attributes the high growth rates of shellfish at the vents more to the rich food source provided by the bacteria than to the low temperature or high pressure.

Scientists at Woods Hole are trying to duplicate this productive arrangement in an artificial vent system in which bacteria found in coastal waters are nurtured in water rich in hydrogen sulfide. As the bacteria in a controlled generator multiply and accumulate, they are removed and fed to common blue mussels that have been seeded in aquaculture tanks.

It is too soon to know whether the cultured mussels will display the same spectacular growth rates as those in the deep sea, but the project has the potential to please just about everyone. People who culture shellfish in enclosed systems may find a way to grow their wares faster and to larger size per individual animal. The aquaculture process provides a positive application for what now is a nagging pollutant—hydrogen sulfide is a troublesome byproduct of processing and use of coal, oil and gas, and is most familiar to residents of Canada and the northeast and central states for its role in producing acid rain. And scientists welcome the opportunity not only to study chemosynthesis and the workings of a vent-like community, but to demonstrate a commercial application for their basic research at the hydrothermal vents.

Jannasch is confident that the cultured shellfish will taste good, unlike their deep-sea counterparts, which sometimes smell and taste of rotten eggs — a sign of their H_2S-rich environment. "Shellfish at the vents are surrounded by hydrogen sulfide, but they don't require it," Jannasch told SCIENCE NEWS. The shellfish grown in feeding experiments needn't come into contact with H_2S at all. By the time the bacteria are fed to the mussels, the H_2S is oxidized completely. —*C. Simon*

AAAS

Embryo issued biochemical disguise

The embryo is a foreigner in its mother's body. As early as its two-cell stage it displays on its surface molecules characteristic of its paternal, as well as of its maternal, heritage (SN: 12/19 & 26/81, p. 392). Yet the maternal immune system does not attack the developing fetus, as it would attack a graft from so dissimilar an individual. Anil B. Mukherjee of the National Institute of Health, speaking at the meeting in Washington of the AAAS, proposes a new explanation of the embryo's protected status. He suggests that the uterus biochemically masks the surface molecules of the embryo.

Two proteins play a specific role in disguising the foreignness of developing rabbit embryos during implantation, Mukherjee finds. In the earliest stages of rabbit pregnancy the uterus produces increased amounts of the active form of an enzyme called transglutaminase and of another protein called uteroglobin. Mukherjee's experiments indicate that transglutaminase catalyzes the linkage of uteroglobin to the surface of the embryo. Immune system cells from the female rabbit do not recognize young embryos as foreign if the embryos have been treated with either fluid from a pregnant rabbit's uterus or a mixture of uteroglobin and transglutaminase.

The same mechanism may protect

ejaculated spermatozoa during coitus, Mukherjee suggests. Sperm, although they display foreign surface constituents, do not normally elicit an antibody response in the female genital tract. Mukherjee says, "Interestingly, the rabbit prostate also contains uteroglobin and transglutaminase." In his experiments, sperm taken from the rabbit epididymis, before they had any contact with secretions of the prostate gland, were exposed to immune system cells from a female rabbit. The immune system cells responded as they would to any foreign cells. However, exposure to fluid from the prostate gland or to a mixture of uteroglobin and transglutaminase dramatically suppressed the reaction. Other experiments demonstrated that the uteroglobin was bound to the sperm surface. Whereas other mammals do not produce uteroglobin, they have other uterine proteins that may serve the same function.

"Although these data suggest an antigenic masking role of uteroglobin in combination with transglutaminase *in vitro*, this may not be the only mechanism of nonrejection of the mammalian embryo or the sperm by the mother," Mukherjee says. "It is possible that various other mechanisms for nonrejection ... are sequentially active in fetomaternal relationship during implantation, placentation and gestation in a viviparous animal." Among the other suggested mechanisms are hormonal suppression of the maternal immune system and blockage of maternal antibodies.

Mukherjee suggests that an understanding of the mechanism by which the female mammal tolerates sperm and embryos may aid the development of antifertility drugs and treatments for some forms of infertility. Furthermore, it may provide information about the other obvious example of mammalian tolerance of genetically dissimilar "grafts." Mukherjee predicts, "It may help us understand the mechanism as to how the malignant tumors defy immunological rejection by the affected hosts." —*J. A. Miller*

Fine structure finely measured

The fine structure constant is one of those numbers that physicists are always trying to measure more and more accurately. It is one of the fundamental constants whose values cannot be calculated from theoretical principles but must be determined experimentally. These constants are usually central to important sections of physics, and by a kind of calculational domino effect small variations in, say, the ninth decimal place can have sizable repercussions.

A group of physicists from Bell Laboratories in Murray Hill, N.J. (D. C. Tsui and A. C. Gossard) and the National Bureau of Standards (B. F. Field, M. E. Cage and R. F. Dziuba) report in the Jan. 4 PHYSICAL REVIEW LETTERS that they have used a new technique to determine the fine structure constant to an uncertainty of 0.17 parts per million.

This is not the finest measurement ever made of the constant. That was done at NBS in 1979 by E. R. Williams and P. T. Olsen and goes to 0.11 parts per million. But the new technique means that the two measurements are independent of each other and can be combined to give an even more accurate value, to 0.89 parts per million. According to an NBS announcement, success of the new technique also promises new possibilities for measurement science.

The fine structure constant is the number that measures the strength of electric and magnetic forces relative to other kinds of forces. It thus finds its way into many calculations in electromagnetics, electronics, particle physics, solid-state physics, etc. The measurement technique depends on an electrical resistance phenomenon that the NBS announcement calls the von Klitzing effect, which is a variation on the previously known Hall effect.

If an electric current is flowing in a conductor that happens to lie in a magnetic field, an electric potential will be induced across the conductor in a direction perpendicular to the flow of the original current. This is the so-called Hall potential or Hall voltage. The Hall potential wants to make a current flow across the conductor, and it is opposed by a corresponding resistance, the Hall resistance. The whole effect happens at extremely low temperatures (within a few degrees of absolute zero).

In most substances the Hall voltage and resistance change smoothly as the magnetic field is varied. In 1980, Klaus von Klitzing of the University of Würzburg in West Germany showed that in certain semiconductors the Hall effect is quantized. The Hall voltage and the Hall resistance in these materials change quantally, that is, stepwise, as the magnetic field is varied. The values of the steps can be calculated from an equation involving a few fundamental quantities: the number of the quantum step, the magnetic permeability of a vacuum, the speed of light and the fine structure constant. This opened a way for precise measurement of the fine structure constant independent of previous methods, such as Williams's and Olsen's which used the gyromagnetic properties of protons and the Josephson effect. According to the NBS announcement, by a procedure converse to the measurement of the fine structure constant the quantized resistance feature of the von Klitzing effect could lead to the development of a precise standard for electrical resistance, something that would be an important benefit to precision technology. —*D. Thomsen*

Muscular dystrophy: Promising treatment

Several years ago Scottish and Spanish scientists reported that a drug called allopurinol had helped a limited number of muscular dystrophy patients (SN: 7/19/80, p. 41). Unfortunately, other investigators have not been able to confirm their findings. Now, however, another treatment for muscular dystrophy is looking promising.

There is evidence that the muscle degeneration underlying muscular dystrophy may be initiated by proteinases (enzymes that break down protein). Joanna Hollenberg Sher and colleagues at the State University of New York Downstate Medical Center in Brooklyn, N.Y., found that the proteinase inhibitor leupeptin delayed muscular dystrophy in chickens. They then injected leupeptin dissolved in saline into 16 mice with a genetic susceptibility to muscular dystrophy. Fourteen other mice of the same strain served as one control group and received no treatment, while 10 other mice of the same strain served as a second control group and received only saline. The mice were observed during their first weeks of life for signs of muscular dystrophy-type weakness, then killed so that their muscles could be examined and compared.

As Sher and her co-workers report in the December PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, none of the treated animals showed muscular dystrophy-type weakness, but most of the untreated animals did. What's more, only one of the 16 treated animals experienced muscle degeneration and death, but 19 of the 24 untreated animals did. Some other indications of degeneration were also observed in the muscles of the control animals but not of the treated ones, such as a small diameter in muscle fiber.

In the opinion of Ralph Moss, director of research development for the national headquarters of the Muscular Dystrophy Association in New York City, leupeptin is an "interesting candidate" for the treatment of muscular dystrophy. The reason, he explains, is not just because it has delayed or prevented muscular dystrophy in two animal species, but because of the rationale for trying it in patients in the first place—because it inhibits muscle degeneration. Allopurinol, in contrast, was tried on muscular dystrophy patients only because it prevents the breakdown of adenosine triphosphate (an energy compound necessary for muscle contraction, growth and repair).

Sher and her team will give leupeptin to a handful of muscular dystrophy patients once the Food and Drug Administration approves their clinical trial. Leupeptin is already being tested on muscular dystrophy patients in Japan and is soon to be tested on them in Italy. —*J. A. Treichel*