BIOLOGY

Eye Has Compartments

Single quantum of light acting on a single molecule of visual pigment can activate eye, Dr. George Wald proposes in a new theory he tested by use of a glass replica of the eye.

➤ THE HUMAN eye is such a superbly organized compartmented structure that it is activated by a single quantum of light shining on a single molecule of visual pigment.

This new idea of Dr. George Wald of Harvard University is reported in *Science* (June 25).

The theory explains the chemistry of vision and why the sensitivity of the dark adapted eye is lost in such big jumps when exposed to such small amounts of light.

The rods of the eyes, which are the cells used in night vision, are made up of compartments, Dr. Wald believes. Each compartment contains a considerable amount of rhodopsin, the visual pigment. Any single molecule of the rhodopsin, on absorbing a single quantum of light, can "discharge" the compartment.

This compartment cannot then take any further part in the visual process until all its rhodopsin is restored. It can go on absorbing light, just as before, but the light will have no other effect than to delay the eventual recovery of the compartment.

To test out his theory, Dr. Wald had a replica of a human eyeball blown from glass. This has a short neck closed with a ground-glass stopper and through this neck it can be filled with water.

The "water eye" closely mimics the optical system of the human eye. On the front surface is a spherical blister like the cornea of the eye.

The "water eye" was placed behind a screen that holds a disk pierced with circular holes of various sizes to serve as pupils. Close against the back of the "water eye," which is slightly flattened, is a small absorption cell containing a solution of cattle rhodopsin.

With this apparatus, Dr. Wald measured the rate at which the rhodopsin was bleached when exposed to light.

Then the place of the "water eye" was taken by a human subject. With eyes previously dark adapted, she looked through the artificial pupils. She was then exposed to light and her dark adaptation measured. Measurements from both the human eye and the "water eye" were used to determine the rate of bleaching of rhodopsin.

Exposure of the eye to 10 millilamberts of light for five seconds raises the threshold, that is, decreases sensitivity, of the eye about 8.5 times. It bleaches a relatively small amount, at most 1,200 molecules of rhodopsin per rod, Dr. Wald found. A lambert is a unit of light brightness.

Reason why our ability to see in dim vision is recovered at such a slow rate—it takes about 30 minutes—is also explained by Dr. Wald's experiments. After high light adaptation, no compartment comes back into function until its last rhodopsin molecule has been regenerated.

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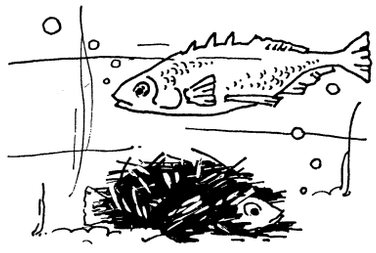
ICHTHYOLOGY

NATURE RAMBLINGS



Sticklebacks

➤ STICKLEBACKS ARE small fish with sharp spines sticking up on the back. These spines vary in number from two or four to nine, depending on the species.

The stickles bristling from the fishes' backs have a distinctly thorny and belligerent appearance. This is not a deception, since sticklebacks are not at all backward in using the spines as deadly weapons, especially during the breeding season.

This takes place during the spring and early summer. At this time, the males take on bright nuptial colors with which to be-dazzle their future mates.

Full of confidence in the magnetism of his new courting colors, the male first sets to work building a home. Properly speaking, it is not a home but a love nest, for it is destined to be no more than the transitory hideaway where a stickleback brings to fruition his mid-summer "dream."

Transistory or no, the male builds the nest with extreme care. Bits of roots and stems of aquatic plants are his building blocks, and for mortar he uses a sticky substance secreted in his kidneys which he wipes off by swimming against the part to be cemented.

The nest so constructed is barrel- or muff-shaped. The fish constantly tests the strength of his structure, butting against it here and there, reinforcing any section that dissatisfies him. To secure the nest he scoops up sand in his mouth and scatters it about the floor of the nest.

When the nest is finally just the way he wants it, possibly after as much as several days' steady work, the stickleback goes in search of a mate. When he finds one, he leds her to his nest and then either gently coaxes or rudely pushes her inside. There she lays her eggs and swims off, and the male promptly fertilizes them.

And then with the same singlemindedness that has characterized all his actions up to now, off he goes to find another mate, to repeat the cycle again, and again, and possibly still again, until there are enough eggs to satisfy him.

From then on until the small fry are big enough to fend for themselves, Mr. Stickleback keeps an endless vigil. He circles the nest, keeping it in repair, and violently attacking any other fish, large or small, that ventures in the vicinity.

Even after the eggs hatch out, he continues the watch, keeping the tiny offspring in the nest, warding off all dangers. It is only when the young sticklebacks have become strong swimmers and stand some chance of eluding capture that the sentinel indifferently takes leave forever.

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VITAL STATISTICS

Birth-Death Imbalance Threatens Technical Aid

➤ ECONOMIC GAINS due to technical aid to so-called "underdeveloped countries" are gravely endangered by a lack of balance between births and deaths, Robert C. Cook, director of the Population Reference Bureau, Washington, has warned.

While technical programs are drastically reducing death rates almost overnight by use of modern medicine and technology, traditionally high birth rates remain high because no effort is made to lower them, he pointed out.

The economic gains are gravely endangered in those areas and the plight of the people may worsen rather than improve.

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