Eyespot for an eye: Algae and animals share visual pigment

Although it is but a single cell, the green alga *Chlamydomonas* has a complete visual system. It sports an eyespot that focuses light on a patch of membrane containing about 100,000 pigment molecules. Because the cell rotates as it swims, its eyespot scans a pattern of light. The eyespot then produces physiological changes that control the steering of the cell by its propelling flagella. Now scientists report that the pigment that detects light for the simple alga is the same as the pigment, called rhodopsin, used in vision by animals.

"This is the first demonstration of a rhodopsin photoreceptor in an alga or eukaryotic protist [unicellular, nonbacterial organism]," report scientists in the Oct. 25 NATURE. They have evidence indicating that this rhodopsin is common among certain types of marine and freshwater algae. Its presence in both algae and animals indicates that the pigment "may indeed be quite ancient," say Kenneth W. Foster and Jureepan Saranak, now at Syracuse (N.Y.) University; Nayana Patel and Toni Kline of Mt. Sinai School of Medicine in New York City; and Gerald Zarilli, Masami Okabe and Koji Nakanishi of Columbia University in New York City.

The scientists used a "blind" mutant alga to demonstrate the presence of animal-style rhodopsin. This mutant could not produce the pigment molecule's light-capturing portion — the chemical named retinal — and thus did not respond to normal levels of light. When the scientists provided the algae with synthetic retinals, the cells did move away from light — the natural response. The wavelength of light that caused a maximal response varied for different retinals, and this pattern is similar to the light-absorbing properties of bovine rhodopsin, the most extensively studied visual pigment. The pattern is markedly different from that encountered with another pigment, called bacteriorhodopsin, found in the purple bacterium *Halobacterium*.

"The report ... that the green alga *Chlamydomonas* can see with the aid of a bovine-like rhodopsin foreshadows a renaissance in studies of eukaryotic photoreception," says Howard C. Berg of California Institute of Technology in Pasadena. Commenting in NATURE, he says he now expects to see significant advances in the knowledge of how light absorption generates physiological changes in a cell. The alga, unlike more complicated animals, is amenable to powerful genetic techniques. "There is nothing like the right mutant to open the door to fresh discovery," Berg says, "to reveal an unsuspected component or process essential to the function of a complex biological machine."

The behavior of "blind" algae whose "vision" was restored in a variety of ways is the first published report of such a behavioral shift caused by the addition of synthetic retinals to an organism higher than a bacterium. Nakanishi told a recent meeting at the National Institutes of Health in Bethesda, Md., of preliminary experiments with the tropical seawater clown fish. The vision of this fish is also altered, as detected by its behavior, when it is fed an unusual retinal, Nakanishi reports.

The scientists look forward to performing a more detailed comparison of rhodopsin molecules. An unusually close correspondence between human and bovine rhodopsins was reported by Jeremy Nathans and David Hogness of Stanford University in the August PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Number 15). The coding sequences of the rhodopsin gene are identical at 90 percent of the sites, they found, and the amino acids of the protein match at 93 percent of the locations. The coding regions of the genes are interrupted at precisely the same positions with noncoding introns of comparable lengths.

The locations of perfectly conserved protein regions indicate structures important in the pigment's function. The rhodopsin molecule winds back and forth across the cell membrane, leaving three loops and a tail on each side. None of the differences among the amino acids occurs in any of the loops that extend into the cell. The scientists conclude that these regions must serve an important role — perhaps in producing the electrical signal that results from the pigment's absorption of light.

—J. A. Miller

Reagan signs bill urging space pact renewal

In 1972, the United States and the Soviet Union signed a five-year agreement to work toward peaceful cooperation in space. Renewed in 1977, the pact was allowed to lapse by President Reagan in 1982 (SN: 3/27/82, p. 214), as part of the U.S. response to Soviet activities in Poland. Although limited exchanges of information such as biomedical and planetary data have continued to take place, usually on an essentially scientist-to-scientist basis, the termination of the agreement has prevented formal activities such as exchanges of scientists and mutual assistance in planning planetary missions.

Last week, Reagan signed a joint congressional resolution — which had been passed unanimously by both houses — urging him to "endeavor, at the earliest practicable date," to renew the pact again.

The bill does not restore the agreement, and the President's signing of it does not even bind him to do so. But Sen. Spark M. Matsunaga (D-Hawaii), the resolution's chief initiator, said, "I am relieved that President Reagan shares my view that East-West space cooperation is worth pursuing as a bipartisan foreign policy objective. There are bound to be disagreements over how much we can expect from such a policy, but we should all agree on the need to give it a try.... At a certain point, anything other than international cooperation in space exploration will cease to make any sense at all."

In signing the measure, Reagan described some of its language as "very speculative." (The resolution notes that in the present climate, the two superpowers "could soon find themselves in an arms race in space," a prospect that "has aroused worldwide concern.") But he did reiterate the view that "we are prepared to work with the Soviets on cooperation in space in programs which are mutually beneficial and productive."

Some U.S. space scientists maintain that the agreement, if renewed, could in fact be more productive now than during the decade when it was originally in effect. At that time, technical details and scientific results of Soviet interplanetary missions, for example, were still relatively hard to come by. But the situation has seemed to be changing in response to what some researchers believe is increased Soviet optimism about their improved space science capabilities. "I think they're very confident in their data and the quality of the science that they've done," says Laurel Wilkening of the University of Arizona in Tucson, chairman of the American Astronomical Society's Division for Planetary Sciences. "We have more to gain now than we had in the past." Adds U. of Ariz. astronomer Bradford Smith, a member of the Voyager mission, "It's a whole different story now."

The Soviets have been relatively forthcoming, for example, with results from their latest interplanetary missions, the Venera 15 and 16 radar mappers in orbit around Venus, and have provided selected U.S. scientists with uncharacteristically detailed descriptions of their two upcoming flybys of Comet Halley. Whereas U.S. researchers once had to guess at some results of even successful Soviet missions, the Soviets themselves have lately provided advance information about plans for a 1988 rendezvous with Mars and its moon Phobos even before the mission's final approval. Meanwhile, the United States is at work on a geology-and-climatology-oriented Mars orbiter that would be launched in 1990, only two years after the Soviet Phobos flight. "It makes no sense," says Matsunaga, "*not* to coordinate the two missions so as to insure maximum scientific return."

—J. Eberhart