characteristics of the rod and cone pigments in the goldfish [455, 530, and 625 nm for the cones (5) and 522 nm for the rods (6)], this behavior is spectacular to observe experimentally. With the wavelength set at 520 nm and the spot of light covering the center of the receptive field, one can observe the response changing from ON to OFF, or from OFF to ON, as one changes from a dark-adapted condition to a light-adapted one. The phenomenon is so clear that a misclassification is impossible.

This association of the rods with the red cones is not limited to the goldfish. The finding is in agreement with Purkinje-shift studies done at the single-unit level, but in most cases recordings involved noncolor opponent cells. This is true in the fish (7), the frog (8), the cat (9), and the monkey (10), where the rod input has the same sign as the long-wavelength cone input. However, care must be taken when two cone pigments are known to exist on the long-wavelength side of the rod pigment. Only data indicating a shift to the longest-wavelength peak should be considered as supporting evidence. For retinas that have opponent color cells the data are rare. It is interesting to note that the ground squirrel retina, which has no red cone, has no rod either (11). Three opponent color cells have been found in the lateral geniculate of the cat (12). Two of them show rods with the same type of input as the blue cones; the third cell shows the rod input with the same sign as the long-wavelength cone input. In the monkey geniculate (13), 6 out of 25 cells were found to have a rod input. Four of them were type I cells, which are characterized by having a different spectral sensitivity in the center and in the surround. In one cell, the rod input had the same sign as the green cone input; the type of cone input in the three others was not mentioned. The last two cells that had a rod input were of type III, receiving inputs for possibly all three cones, and the rod input had the same sign as the cone input.

The finding that, in double opponent cells in the goldfish, the sign of the rod input is similar to that of the red cone input can be considered an extension of the Purkinje-shift rule to opponent color cells. However, the few cells that have been found to be exceptions to the rule have to be considered as evidence against a universal generalization that the rod input always has the same sign as the long-wavelength cone input.

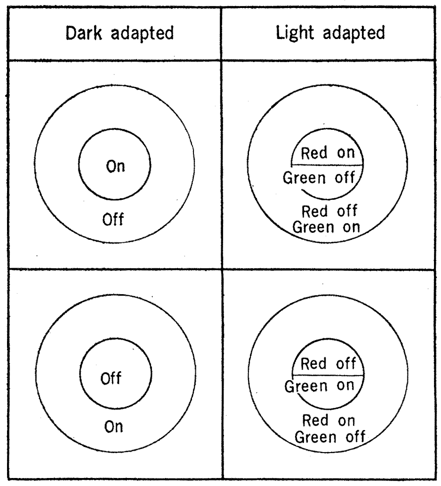

Fig. 2. Receptive field organization in the two states of light adaptation of the opponent color cells, which codes simultaneous color contrast. Note that the rod response is always similar to the red cone response.

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On Carpenter and Smith

We recently published a report on the occurrence of plastic particles on the surface of the open ocean (1). We noted that since many plastics contained polychlorinated biphenyls (PCB's) as plasticizers, the plastics could be a source of some of the PCB's found in oceanic organisms. On the basis of new evidence, we wish to add to this statement.

Infrared spectrophotometry of the white cylindrical pellets, the commonest form of plastic on the sea surface, shows that they are polyethylenes. Polyethylenes are not made with PCB's as plasticizers. Polyethylene often contains low concentrations of PCB's as contaminants (one major American manufacturer's polyethylene contains 0.2 part PCB's per million, apparently absorbed from river water with which it comes into contact in its production), but these concentrations are so low that it is unlikely that these plastics are a significant source of the PCB's found in the open ocean.

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