they are generally placed. This provides further evidence to support the contention of Berrill (*13*) and others that the polycitorid aplousobranchs (*Eudistoma* and close allies) have clear affinities with the diazonid phlebobranch ascidians. Further studies of the distribution of metals in ascidians are continuing (*14*).

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9 January 1961

Wave-Guide Modes in Retinal Receptors

Abstract. Retinal receptor wave-guide modal patterns have been photographed. The inner and outer segments of the rod and cone receptors of albino rats, rhesus macaque monkeys, and human beings have been studied. The wave-guide modal pattern is believed to be the normal form of energy transfer in these parts of the retinal receptors in these species.

Since 1933, when Stiles and Crawford (*1*) discovered the directional sensitivity of the retina, increased interest has been directed toward the optical properties of the retinal receptors. In the past few years, with the rapid development of fiber optics, the retinal receptors have been viewed with interest because they are, in fact, a functioning and highly efficient fiber bundle. That is, the resolution capacity of the retina is essentially limited in the fovea by the diameter of the individual receptors (*2*).

Inasmuch as the diameters of the components of the receptors begin to approach the wavelength of light, it has been assumed that the inner segment, ellipsoid, and outer segment of the retinal receptors act as dielectric wave guides (*3*). If this assumption is accepted, it then becomes logical to look for, identify, and determine the role played by wave-guide modal patterns in the retinal receptors. At this time, wave-guide modes have been seen (*4*), they are being identified under various conditions, and first thoughts have been given to the possible roles they play in the visual mechanism (*5*).

Electromagnetic waves are guided in a wave-guide. The modal pattern shown in Fig. 1 is the result of interactions which have occurred in the receptor acting as a wave guide. A wave-guide modal pattern may be defined as a distribution of field which propagates down a wave guide with a well-defined phase velocity. These patterns result in a nonuniform distribution of energy in the receptor.

While the apparatus needed for visualization of these modal patterns is rather simple in principle, the accomplishment of the goal presents serious problems. In essence, one creates a schematic eye with a piece of retina placed in a special chamber (in normal saline) and oriented as it might be *in situ*. An intense source of light is imaged by a lens upon the retinal tissue. Since a modal pattern may change when the wavelength, the angle of incidence of the luminous energy, or both the wavelength and angle of incidence are varied, it is useful to control the wavelength composition of the light and to insert a diaphragm (analogous to the iris of the eye) to limit the angular subtense of the incident cone of light. A microscope is situated above the flat retinal preparation, and hence one observes the light which has passed through the receptors. The limiting resolution of the microscope, the maintenance of receptor orientation, the elimination of vibration effects during time exposures, the graininess of the film, and the need for rapid dissection of the specimen present the major problems to the investigator.

Similar wave-guide modal patterns have been observed by focusing upon the outer segments of the receptor of albino rat, rhesus macaque monkey, and human retinas. All receptors studied exhibited the mode form of energy transfer. An example of such a pattern recorded from a cone receptor located in the macula area of a monkey is shown in Fig. 1.

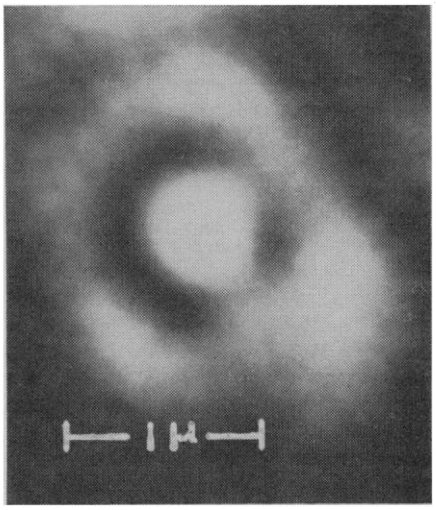

Fig. 1. A wave-guide modal pattern recorded from the outer segment of a cone in the macula of a monkey.

In some receptors the perceived modal pattern changes when wavelength is varied. The patterns also often change when the focal plane within the receptor is varied. In any given mosaic of outer segments a dominant modal pattern is seen. Some departures from the dominant pattern are due to differences in diameters, cross-sectional shape, and orientation. In all three species, when the outer segments of the receptor were viewed, only a small number of different patterns were seen. When the pattern changed as wavelength was varied, only one or two changes occurred within the range of 450 μ to 600 mμ. Rods and cones may be readily differentiated in monkey and human retinas. In some receptors modal patterns vary in the intensity of their excitation, their transmissivity as a function of wavelength, or both. The directionality of the retinal receptors is readily observed.

The role(s) played by wave-guide modes in vision may be many fold. The differential transmissivity of modal patterns as a function of wavelength obviously influences the result. The modal patterns themselves give rise to regional nonuniformities in energy concentration in the outer segments of the receptor. It is important to know, particularly in receptors responsible for color vision, whether there are corresponding nonuniformities in pigment concentration (and how many pigments are involved), or in potential to evoke a response. It also becomes necessary to explore further electro-physiological and psychophysical correlates.

At this time it can be said that the wave-guide mode form of transmission is probably the normal form of energy transfer in these species, and that the response of a given receptor may be modified by the presence of the mode form of transmission (*6*).

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29 November 1960

Does the Male Stimulate Oestrogen Secretion in Female Canaries?

Abstract. Female Border canaries treated with oestrogen during the nonbreeding season may build nests, regardless of winter lighting, temperature, and absence of partner. Incubation may follow completion of the nest although ovulation is suppressed. Reactions obtained in the breeding season suggest that the male does not initiate but accelerates oestrogen production through the stimulation he provides.

In seasonally breeding birds cyclical aspects of the environment have been associated with periodic changes in the gonads (*1*). It is also well known that the sequential changes in breeding behavior depend on changes in the hormonal state (*2*). The sequence of physiological and behavioral events does not depend on one environmental factor, but on several which occur simultaneously or in succession. Thus increasing day-length, a prime factor in inducing gonadal growth in many temperate zone species (*3*), may be less effective unless other changes also occur.

One factor of importance is the interaction between male and female (*4*): for example, stimuli from the male are important in inducing ovulation in female pigeons (*5*). In domesticated canaries nest building and egg laying in the spring are delayed when females are kept visually isolated from males (*6*). Since nest building can be induced by injections of oestrogen (*7*), it therefore seemed probable that one function of the male is to accelerate oestrogen production in the female. If this is the case, the presence or absence of the male should not affect the occurrence of nest building if the level of oestrogen is controlled. Accordingly, equal quantities of oestrogen were administered during the nonbreeding season to female canaries (i) kept in visual isolation from males, (ii) paired with untreated males, and (iii) paired with males treated with androgen.

Canaries were of the Border variety, purchased from a dealer. Eighteen females and twelve males were used. Three groups of birds were set up as follows: Group A, six females housed individually and visually isolated from other birds. Group B, six females each paired and housed with an untreated male. Group C, six females each paired and housed with a male receiving 2.0 mg of testosterone propionate three times a week.

All females in each group were given 0.5 mg oestradiol benzoate (oestroform aqueous BDH) in 0.05 cm^3 of solution injected into the pectoral musculature thrice weekly.

Each cage was supplied with a felt-lined nest pan as a nest site. Two baskets of nesting material, one containing grass and the other feathers, were hooked to the outside of the cages. The baskets were so arranged that the birds could peck out grass or feathers at will. The supply of grass and feathers was replenished daily or when needed.

Birds were killed after the experiment to be sure of sex identity. The oviducts of the first four birds that completed nests regardless of group were compared with those of birds from the same group which had had an equal number of oestrogen injections but did not build.

The testosterone-treated males, unlike the untreated ones, were seen to sing, show courtship behavior, and mount. No attempt to compare quantitatively their sexual activity with that of males in the spring was made.

There were no apparent differences between groups in the nest building behavior of the females, or in the interval between the start of oestrogen injections and the occurrence of nest building. The results for each group were as follows:

Group A (isolated females). Four out of six showed building activity. Three of these built good nests. The fourth built an incomplete nest and was found to be a male on autopsy. Of the three females, each had four injections prior to the start of nest building (that is, before several scraps of nest material were found in the nest). Nests were completed in 7, 7, and 9 days from the start of building. The bird which took 9 days incubated the eggless nest when it was complete.

Group B (females with untreated males). Three out of six showed nest-building behavior after two, seven, and eight injections, respectively. Only one bird completed a nest, 15 days from the start of building activity. The other two nests were not completed. The bird that completed construction also incubated the eggless nest.

Group C (females with testosterone-treated males). Two of the six females started to build, one after the fourth and the other after the sixth injection, and completed nests in 6 and 5 days, respectively. Only the latter bird incubated.

Although only about half of the birds in each group built nests, resistance to exogenous oestrogens, especially with respect to behavioral effects, has frequently been reported elsewhere (*8*). Indeed, the quantity of hormone required to induce nest building under the conditions of this experiment cannot be withstood by some individuals (*7*). That the oestrogen was effective in influencing reproductive accessories even when it did not induce nest building was shown by observations of oviduct weight. Table 1 shows that these were comparable for birds that did and did not construct nests after equal numbers of injections.

Table 1. A comparison of the weights of oviducts after 11 oestrogen injections between birds that did (first four birds) and did not build nests. Groups A, B, and C represent females in isolation, with untreated males, and with treated males, respectively.

Group	Built nest			No nest		
	Females (No.)	Oviduct weight (mg)	Body weight (g)	Females (No.)	Oviduct weight (mg)	Body weight (g)
B	30	304	21.6	12	404	21.6
A	31	454	20.1	27	220	20.8
C	33	284	20.5	1	370	24.0
A	22	325	22.0	28	424	23.2

These results indicate that during the nonbreeding period exogenous oestrogens will cause female canaries to show nest-building behavior with equal rapidity whether they are paired with a male or not, even if the male is showing courtship behavior. Thus neither the visual presence of the male, nor the temperature and light conditions of spring, are necessary for nest-building activity, providing certain levels of oestrogen are reached. These results thus support the view that, during the breeding season, the male acts together