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Whenever light strikes the eye of an animal there is a voltage difference produced between the front and back of the eye. This voltage difference originates in the retina of the vertebrate eye and in the sense cells of the compound eye. A record of the voltage change may be obtained by means of an oscillograph and is referred to as an electroretinogram (ERG). The electroretinogram may be used for the study of various visual phenomena. These are:

1. Relative sensitivity of the eye to different wave lengths of light. This may be obtained by plotting the magnitude of the electrical response against wave length of stimulating light or by plotting the intensity necessary to give a certain magnitude of response against wave length.

2. Color vision. By means of microelectrodes the response from individual ganglion cells in the vertebrate retina can be measured. The sensitivity-wave length curves for various ganglion cells of an animal are different, and this difference is apparently the physical basis of color vision.

3. Rate of dark adaptation. After continued exposure to a bright light the response of an eye to brief exposures is very small. As dark adaptation proceeds the response increases. In the case of simple responses the magnitude of the ERG is a measure of the sensitivity of the eye and when plotted against time is a measure of the dark adaptation process. This is a measure of the rate at which the visual pigment (visual purple in vertebrates) is regenerated after being decomposed by light.

4. Light adaptation. The sensitivity may be determined at various times during the process of light adaptation, and the rate at which the visual pigment is decomposed by light may be calculated.

5. Threshold sensitivity. The minimum amount of light which will barely give a detectable electrical response can be measured. For the Dytiscus beetle this threshold differs by a factor of 1000 between day and night. The eye is about a thousand times more sensitive at night even when maintained under conditions of constant darkness (except for test flashes), temperature, and humidity. This is evidence of an inherent diurnal rhythm which is ap-

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parently governed by some undetermined biological clock in the animal.

6. Flicker fusion frequency. If an eye is subjected to a flickering light of variable frequency, fusion of ripples in the ERG will occur at a definite frequency which is apparently directly related to the frequency at which fusion of the visual image occurs. By measuring this frequency at different intensities a flicker fusion contour for the animal may be obtained. In Dytiscus this contour is different during the day and during the night under comparable conditions of adaptation—more evidence of the biological clock.

7. The ERG of insects very often contains high frequency oscillations (5 to 60 per second) which originate in the optic ganglion. These oscillations are of many types and apparently result from stimulation of different types of sense cells in the eye, some of which are active during illumination, some only at the beginning of illumination, and some only at the cessation of illumination. As recorded from either the eye or ganglion these oscillations are directly comparable to the cortical potentials of vertebrates.

In the study of human vision, measurements of visual phenomena may be made more easily by use of the sensations of the subject. However, in the case of certain diseases of the eye where sensations are not perceived, it will apparently become possible to determine electrically the functional state of the eye independent of the sensations of the individual. Nevertheless, it is among the lower animals that the electrical method will be of greatest usefulness, because it completely eliminates the necessity of studying the reactions of the animal to various stimuli. It is a purely objective method for which we need only the eye of the animal and the appropriate electrical equipment.

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