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Volume 18 No. 1 *March 1959*

Made in United States of America

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HOW SEEN MOVEMENT APPEARS IN THE FROG'S OPTIC NERVE, Part I. H. Maturana,* J. Y. Lettvin, W. H. Pitts,* W. S. McCulloch. Research Laboratory of Electronics, M.I.T., Cambridge, Mass.

The receptive field of a single optic nerve fiber (plotted by the on and off responses to small fixed spots) is often divisible into concentric zones. This suggests that the response of the fiber to a moving spot may be polar with respect to a reference point in the receptive field. Movement is indeed polarly encoded and there exist at least the following four types of fibers whose rate of firing depends on the centrifugal component of a movement with respect to some point internal to the receptive field (centripetal and tangential movements never cause discharge):

1. Some fibers have wide receptive fields and low sensitivity. Of these some prefer the moving object darker than background, others prefer it lighter.
2. A second group has constricted fields and high sensitivity.
3. A third set shows a directional heavy weighting of the response.
4. A fourth kind has annular fields.

A fifth variety measures inversely the average intensity of illumination in a region. Its maximum rate is in the dark.

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The coding of movement described in Part I suggests that the frog's eye is designed (at least for land operation) to abstract the vector and size of a moving object and extrapolate the path. Because our evidence implies that there exists a coordinate system built into the retina and that the coding allows coordinates and velocity to arise from general operations on the whole output of the optic nerve, we propose some alternative guesses to account for Sperry's results on dislocated eyes. We do not propose that his notion of specific reconnection is wrong but that it is not necessary.

We also present the law by which there is a point-to-point correspondence from receptors to optic nerve, viz., if an object is moved within the visual field in a circular path of any diameter, the only fibers that show no response at any time are those that have the centers of their receptive fields at the center of the circle described.