This Week's Citation Classic

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Brown K T. The electroretinogram: its components and their origins. *Vision Res.* **8**: 633-77, 1968.

This paper summarizes the author's microelectrode studies of the ERG (electroretinogram) in the vertebrate retina. The resulting identification of ERG components, and their cellular origins, has provided a basis for new applications of the ERG to both physiological and clinical problems. [The *SCI*® indicates that this paper has been cited 153 times since 1968.]

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"The ERG (electroretinogram) has always offered the advantages of a readily recorded electrical activity of the retina that can tell much about retinal functions. But to fully exploit these advantages, it is necessary to analyze the ERG into its components and to identify the cells that generate each component. It appeared that microelectrode techniques would be required to clarify this subject, but early results in lower vertebrates had yielded conflicting interpretations. I began studying these problems in 1955, when they seemed especially crucial to further progress in retinal physiology. This work was initiated at The Johns Hopkins School of Medicine with the collaboration of Torsten Wiesel. After moving to San Francisco in 1958, my collaborators were Kyoji Tasaki, Kosuke Watanabe, Motohiko Murakami, Geoffrey Arden, and Peter Gage.

"This work proceeded by a series of steps. Techniques were first developed for using microelectrodes within the retina of an intact cat eye. A variety of methods was then used to analyze the ERG into 4 major components, and the amplitude of each component was plotted as a function of electrode depth in the retina. One component was thus shown to be generated by the pigment epithelium, while another was generated by the receptors, and the remaining two were from second-order cells of the inner nuclear layer.

"In San Francisco the microelectrode techniques were further developed and applied to the macaque monkey. Then in 1962 the receptor component of the ERG was successfully isolated by selectively clamping the retinal circulation and by using mild light adaptation to remove the pigment epithelial component. This provided the first clear isolation and identification of receptor potentials in the vertebrate retina. Beginning in 1962, study of these isolated receptor potentials also showed that cone and rod responses have characteristically different time courses, a fundamental aspect of the duplicity theory. In 1964, a very rapid light-evoked receptor response was then discovered. This was called the 'early receptor potential' and was proved to be generated by the visual photopigment. In 1965, similar rapid responses were shown to be generated when light was absorbed by melanin in the retinal pigment epithelium.

"The paper discussed here represented a final review and summary of the work just described. I believe that the frequent citing of this paper results from its summarization of work providing both techniques and results that have proved useful in a variety of subsequent studies. Some of this further work has concerned retinal physiology, especially that of the photoreceptors and pigment epithelium, while other work has applied the ERG to the diagnosis of retinal disorders."