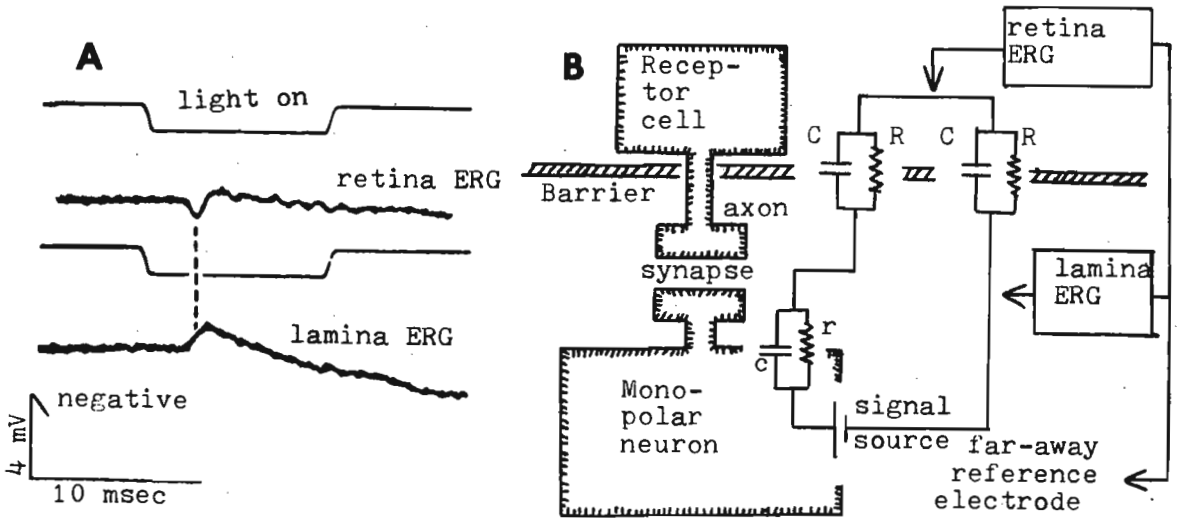
Stark, W.S. and G.S. Wasserman. University of Wisconsin, Madison, Wisconsin.

Temporal properties of the ERG on-transient recorded in the retina and lamina.

Recent intracellular recording work on Drosophila by Alawi and Pak and on Calliphora by Autrum, Zettler, and Järvilehto indicate that monopolar neurons in the lamina ganglionaris generate the on-transient in the ERG. A reversal in the polarity of the components of the extracellularly recorded ERG recorded in the retinular layer as opposed to the lamina was described by Pak, Grossfield, and White. The accompanying figure shows oscillographic tracings of the ERG for a 10 msec flash with the electrode in the retina and in the lamina. For both tracings white light of the same intensity was used on the same white-1 Drosophila melanogaster preparation. While the on-transient from both locations begins at the same time, it consistently peaks sooner in the retina. This evidence would seem to contradict the lamina origin of the on-transient since it makes sense that the signal arises where it is seen earliest.

Part b of the accompanying figure shows a model which may reconcile the presently reported finding with the convincing evidence of the origin in the lamina of the on-transient.



It takes into account the high resistance "receptor barrier" between the retina and lamina proposed by Heisenberg. There is a clear basement membrane associated with a barrier (through which receptor axons pass) made up of end feet of cells in the retina layer which may cause this high resistance barrier. If we assume that this barrier also has a high electrical capacitance, then the barrier might be expected to act as a high-frequency-pass-filter. Such a filter would preferentially pass rapid changes and reject slower changes. A signal, generated across the cell membrane of a cell in the lamina, must pass through resistors and capacitors in the barrier (R and C) and in the lamina cell membrane (r and c) in order to be recorded in the retina. Additional cytoplasmic and extracellular resistances are not shown since they would be relatively small. The resistances would divide the voltage between the source at one point on a lamina cell and the point where the circuit is completed at another point on the same cell. If the barrier resistance were high relative to the laminar cell membrane resistance, this sort of voltage divider might be expected to reverse the potential of the signal as it is reversed when it is recorded in the retina. And the high-pass-filter would make the signal peak earlier in the retina than in the lamina. This model can reconcile the laminar origin of the on-transient, the reversal of the on-transient as recorded in the retina, and the fact that the on-transient peaks earlier in the retina.

References: Alawi, A.A. and W.L. Pak 1971, Science 172:1055-1057; Autrum, H., F. Zettler and M. Järvilehto 1970, Z. vergl. Physiologie 70:414-424; Heisenberg, M. 1971, J. exp. Biol. 55:85-100; Pak, W.L., J. Grossfield, and N.V. White 1969, Nature 222:351-354.

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