Antagonistic components of the late receptor potential in the barnacle photoreceptor arising from different stages of the pigment process

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Abstract:

The late receptor potential \((\text{LRP})\) recorded in barnacle photoreceptor cells exhibits, at high light levels, a strong dependence on the color of the stimulus and of the preceding adaptation. Most strikingly, red illumination of a cell previously adapted to blue light results in a depolarization which may last for up to 30 min after the light goes off, while blue illumination of a cell previously adapted to red light cuts short this extended depolarization or prevents its induction by a closely following red light. Comparison of the action spectra for the stimulus-coincident \((\text{LRP})\) and for the extended depolarization and its curtailment with those previously measured for the early receptor potential \((\text{ERP})\) confirms that these phenomena derive from the same bi-stable pigment as the \((\text{ERP})\). The stimulus-coincident response and the extended depolarization appear to arise from substantial activation of the stable 532 nm state of the pigment, while activation of the stable 495 state depresses or prevents the extended depolarization and probably also depresses the stimulus-coincident response. Since either process can precede the other, with mutually antagonistic effects, one is not simply the reversal of the other; they must be based on separate mechanisms. Furthermore, comparison with \((\text{ERP})\) kinetics shows that both processes involve mechanisms additional to the pigment changes, as seen in the \((\text{ERP})\). A model is proposed and discussed for the \((\text{LRP})\) phenomena and their dependences on wavelength, intensity, and duration of illumination based on excitator-inhibitor interactions.

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