LETTER TO THE EDITOR

# Localized Adaptation within the Rhabdomeral Lobe of *Limulus* Ventral Photoreceptors

Dear Sir:

Recent papers published in this journal (Stern et al., 1983; Calman and Chamberlain, 1983) have modified our understanding of the structure of *Limulus* ventral photoreceptors. The receptor's light-sensitive rhabdom has been found to be restricted to one or more specialized lobes termed R (rhabdomeral) lobes. In the light microscope, the R lobes can be distinguished from the A (arhabdomeral) lobe only after glial tissue has been removed from around the photoreceptor (Stern et al., 1983).

Following these discoveries, previous studies of photoreception by the ventral eye may require revision. In particular, Stern et al. (1983) discuss the work of Fein and Charlton (1975) in which adaptation of the photoreceptor was shown to be localized within the cell. In this work, two spots of light were focused onto a cell having intact glia. Prolonged stimulation at one spot did not adapt the response to the other spot when the spots were separated by >50 μm. Stern et al. point out that the two spots may have been placed in separate R lobes within the same cell. This possibility leaves unresolved the question of whether adaptation is localized within a single R lobe.

We have therefore repeated Fein and Charlton's (1975) experiment, using cells stripped of their glia so that the R lobes were clearly visible (Stern et al., 1983). After the glia and connective tissue had been removed from a ventral photoreceptor cell body (Stern et al., 1983), the axon remained the only part of the cell still attached to the ventral nerve. The free-floating cell body was held in place for intracellular recording by the use of a suction electrode (see Fig. 1A). The cell shown in Fig. 1A has a single R lobe and was chosen to illustrate our findings because the separation between the A lobe and the R lobe of the photoreceptor is clearly delineated by a prominent indentation (Stern et al., 1983). The R lobe is located to the right of the indentation. The region of this cell having the highest sensitivity to light is indicated in Fig. 1B and corresponds to the location of the R lobe (Stern et al., 1983). Figs. 1C and D show that each of the two regions that are illuminated by small spots in Fig. 1A can be independently desensitized. Thus, adaptation within an R lobe is localized over a distance less than the 60-μm separation of the spots in the experiment of Fig. 1. Extension of the time of adaptation from 9 to 70 s did

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not affect the outcome of this experiment. As the separation between the spots was decreased to <40 μm, some spread of desensitization was consistently observed between the regions. At the present time we cannot say how much of this spread was due to light scatter and how much was due to the diffusion of an intracellular transmitter of adaptation (for example, see the review by

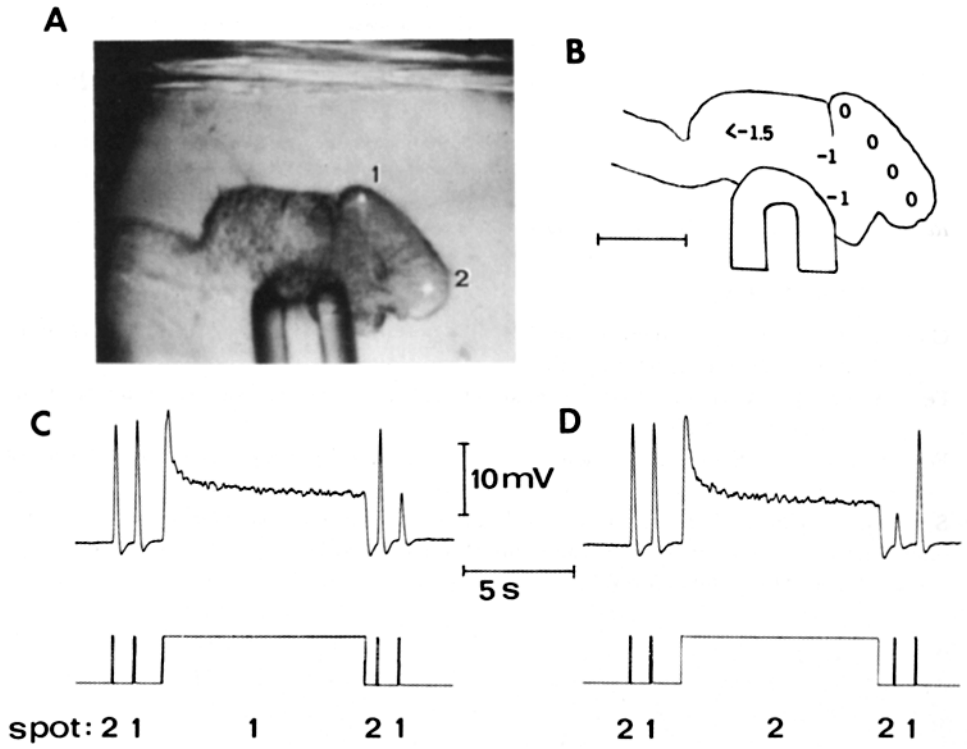


FIGURE 1. Localized adaptation in the R lobe of a ventral photoreceptor. (A) Photomicrograph of a photoreceptor after it has been stripped of its glia. The photoreceptor is being held in place by suction applied to a glass electrode, the tip of which is visible in the micrograph. A portion of the cell can be seen protruding into the suction electrode. The intracellular microelectrode used for recording from the cell is not visible in the plane of focus. Two spots of light can be seen illuminating separate regions of the R lobe. (B) Map of sensitivity to light of the cell shown in A. The numbers give the log relative sensitivity of this area when stimulated by a spot of light. The region of highest sensitivity defines the approximate location of the R lobe. (C) Localized desensitization of region 1 illuminated by the upper spot in A. (D) Localized desensitization of region 2 illuminated by the lower spot in A. The desensitization seen in C and D corresponds to about a sixfold reduction in sensitivity. In C and D the lower trace indicates the occurrence of the light stimuli at regions 1 and 2 in A. The two spots had the same relative intensity. The adapting stimulus in a given region had the same intensity as the test flash in that region. The test flash duration was 100 ms; intensity, 0.3 μW $cm^{-2}$. The scale in B is 50 μm. Refer to text for further details.

Fein and Szuts, 1982). Results similar to those shown in Fig. 1 were observed in a total of four other cells similarly studied.

These findings unequivocally demonstrate that adaptation is localized to a region surrounding the site of photon absorption that is significantly smaller than the dimensions of an R lobe.

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