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LETTER TO THE EDITORS

DOUBTS ABOUT SCOTOPIC INTERACTIONS IN STABILIZED VISION[1]

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IF THE scotopic threshold for a small test stimulus is plotted as a function of the diameter of a set of concentric adapting fields, the threshold rises to a maximum at about 45′ dia. and then decreases (CRAWFORD, 1940; WESTHEIMER, 1965). Interpretation of this effect is made more difficult by the small eye movements and uncertainty of fixation position that characterize normal fixation, for these must cause the portion of the retina receiving the test stimulus to be exposed to a temporal pattern of adaptation that is different for different sizes of adapting fields. For this reason the principal observations were repeated in stabilized vision (TELLER, ANDREWS and BARLOW, 1966) and found to be unchanged. Under stabilized conditions, there is no reason to believe that the temporal pattern of adaptation would vary with the area of the adapting field and we therefore think this experiment indicated that the difference between large and small fields is a genuine spatial effect, and not an indirect effect of eye movements. But there is one incorrect conclusion that could be drawn from the stabilized image experiment, and the purpose of this note is to point it out.

Stabilized image experiments are technically very difficult to perform. Theoretically the retinal image does not change when the eye moves, but even assuming that there are no problems of lens slippage or optical alignment, the image is never held constant for a long time; before many seconds elapse the eye almost always strays from the fixation point far enough for the stabilized adapting field to move out of the field lens aperture. This is a major problem when attempting to obtain stabilized images and we have not found a way of preventing periodic extinction of the adapting fields as a result of temporary large excursions of the fixation position.

A second important problem results from the fading of the image that is experienced under stabilized conditions. Normally the subject sees the adapting field continuously, and he knows the test stimulus will be seen in its centre, if it is seen at all. When the adapting field fades in stabilized vision it no longer acts as a marker for the expected position of the stimulus, and the subject becomes very uncertain whether anything he may see really is the test stimulus. Usually the eye soon strays far enough from the fixation point for the stabilized image to be extinguished, the fixation position is then corrected, and the adapting field becomes visible again for a brief period. This is naturally the instant the subject chooses to look for the test stimulus, for he knows where it will be if it is present; a deliberate eye excursion may even be made to obtain favorable viewing after refixation, and one of the subjects was detected occluding the adapting field from time to time with his hand in order to remind himself of the expected position of the test stimulus. In both instances, the critical

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test stimuli used to determine threshold were probably those occurring no more than a few seconds after the adapting field had been temporarily extinguished and then restored.

In attempting to repeat the stabilized image experiments we found a difference of almost one log unit in the threshold of the small spot against the 3° and the 45′ adapting fields when we used deliberate eye movements or occlusion to facilitate observations. When we tried to make the threshold decisions without hand occluding or deliberate eye movements the effect was small (between 0 and 0·3 log units). Furthermore, when the adapting field was turned on and off for 1-sec periods, we obtained a large effect if the test stimulus was applied shortly after exposure of the adapting field and only a small effect if the test was applied later. Similar efiects may perhaps be found in the experiments of TELLER, MATTER, PHILLIPS and ALEXANDER (1971).

These observations make us uncertain whether the threshold would be lower for 3° than for 45′ adapting fields if they could be held stable in position and intensity for a period of many seconds or minutes. The point is important because WESTHEIMER (1968) has shown that, with after images, increasing the size above 45′ does not decrease their threshold elevating effect. He claims that in this instance dark light does not act exactly like real light of the same spatial distribution, but this may be because the dark light of the after image is exactly stabilized whereas adapting fields are not; we do not think this possibility is effectively excluded by the previously reported experiment.

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