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RETINAL IRRADIATION AND ANISEIKONIA*

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NEW attempts have recently been made to elucidate the mechanism underlying the Pulfrich effect. Observed most easily when a pendulum swinging in the fronto-parallel plane is viewed through a neutral density filter in front of one eye, this effect is a stereo-phenomenon. The pendulum bob appears to make rotatory excursions, previously described as ellipses. Trincker (1953a) has shown that the path is not really an ellipse but is flattened on the side facing the observer, and, more important still, that the principal axis of this figure is so inclined as to put one end nearer to the unobstructed eye. He called this the asymmetry phenomenon.

The stereo-effect was explained by Pulfrich (1922) in terms of the difference in the latent periods of the dimmed and unobstructed eyes respectively. In its original form, the explanation will account neither for the fact that the effect is hardly observable when the pendulum bob is fixated nor for the asymmetry phenomenon. Recent binocular measurements (Arden and Weale, 1954) have shown that the intensity variation of the visual latent period is small in the fovea but large outside it, and that this is consistent with the virtual disappearance of the effect when the bob is fixated. The asymmetry phenomenon, however, is observed also with stationary targets, such as vertical rods. When three rods are viewed binocularly (one eye being again obstructed with a neutral density filter) and an observer is asked to arrange them in a fronto-parallel plane, the subjective will differ from the objective plane. Trincker (1953b) concludes from this that the asymmetry phenomenon found in conjunction with the Pulfrich effect cannot have anything to do with the latent period of vision.

In an attempt to explain this effect, it should be emphasized that the perceptual size of a retinal image depends not only on the object size, diffraction, and aberration effects, but also on its luminance. Of two equally large objects, the brighter will appear to be the larger. Using a spectrometric slit of width 2 mm., it is found at a luminance level of 800 e.f.c. that the least contrast producing this illusion is 0·16 log unit and that the extent of the angular increase is about 1′ of arc, *i.e.* is comparable with the accepted value for visual acuity. A suitable arrangement makes it possible to detect retinal irradiation also binocularly. Thus if two equal slits are equally illuminated

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and each is visible to one eye only, then, on placing a neutral density filter in front of one eye, the darker image appears to be the smaller. On placing the filter in front of the other eye the effect is reversed (the threshold contrast in this case is about 0·3 log unit). If only one slit is viewed in a like manner, the conditions of Trincker's second experiment are reproduced: a tilting of the fronto-parallel plane is observed. This may well be the expression of an aniseikonia produced by the fusion of two different images of the same object and due to differential retinal irradiation (*cf.* Miles, 1953).

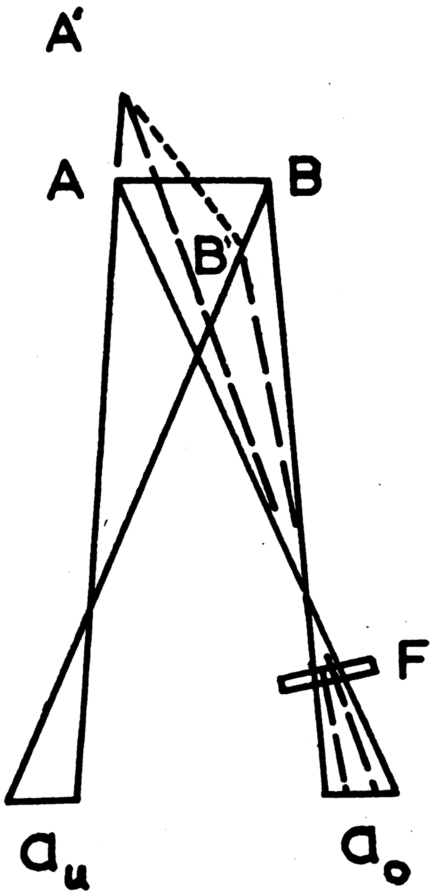

FIGURE.

A simple theory of this luminance aniseikonia is shown in the Figure. Let AB be a white object on a dark background, and a_u and a_o be the images in the unobstructed and obstructed eyes respectively. The presence of the filter F in front of the right eye will reduce the apparent size of AB owing to the reduction of retinal irradiation. The projection of the boundaries of the smaller image into space will intersect those of the other (left) image at A′ and B′ respectively. The result will be a distortion of space. The effect will be reversed for a black object on a white background.

Trincker used a black pendulum bob and black rods in his dynamic and static experiments respectively. The above theory accounts both for the sense and the amount of space distortion which he observed. The non-ellipticity of his tracings, however, cannot be explained in terms of dissimilar retinal illuminations: it is due to variations in the latent period of vision and forms part of Pulfrich's original explanation. It is hoped to deal with this point in another contribution.

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