THE BEHAVIOR OF THE AMBLYOPIC EYE UNDER REDUCED ILLUMINATION AND THE THEORY OF FUNCTIONAL AMBLYOPIA

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The clinical characteristics by which a diagnosis of functional amblyopia is made - low visual acuity in the absence of ophthalmoscopically visible lesions, but frequently associated with anomalies of fixation, and in general susceptible to improvement by treatment - tell us by themselves nothing about the mechanism or mechanisms producing amblyopia, or about the seat of the lesion.

Consequently, numerous theories have been evolved over the decades, based on varied clinical observations, which have attempted to account for the amblyopia found in strabismus and anisometropia. Heredity ('congenital' amblyopia, disuse (amblyopia ex anopsia), arrest of development (amblyopia of arrest), inhibition of visual function (amblyopia ex inhibitione), binocular sensory anomalies, and motor anomalies have all been alleged to be the cause of amblyopia. Some of these theories have been abandoned, some are still being held, none are entirely satisfactory.

It is clear, however, that regardless of the mechanism of amblyopia, the result is primarily a loss of the physiologic superiority of the fovea. Now, since there are characteristic physiologic differences between the central retinal region and the retinal periphery, it is reasonable to inquire into the functioning of these areas in amblyopic eyes and to compare them to those of normal eyes.

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The techniques can be either psychophysical or electrophysiological. If one is interested in the question of the seat of the lesion in amblyopia, electrophysiologic methods applied to the retina and to the cortical areas should be, in principle, the most promising in providing an unequivocal answer. Unfortunately, as has been pointed out in my report to this symposium on ERG in amblyopia, at the present time the methods at our disposal are still not fully adequate to offer a definitive solution to the problem.

Psychophysical methods involve a response of the individual and comprise of necessity the whole of the visual system. This has great advantages, but it also limits their value with regard to the localization of the lesion. The psychophysical methods include the study of absolute thresholds, spectral sensitivity, flicker fusion, color vision, visual fields, visual acuity, and summation and contrast phenomena. All of them have a bearing on the subject assigned to me in this symposium; some of them are being discussed by other members of the panel in greater detail. I shall touch upon them insofar as they are pertinent to my subject.

A very useful way of investigating the responses from various retinal areas is the study of their absolute threshold in the dark adapted state. They offer a first, promising approach to the amblyopia problem.

BJERRUM (1884) and others had already stated that the function of dark adaptation of the amblyopic eye did not differ from that of the dominant eye. The methods employed by these authors were either very primitive or did not allow a detailed study of the thresholds. The problem was taken up by WALD & BURIAN (1944) with a highly critical and flexible method. They found, using a 2° white test field exposed as flash of 40 msec duration that the dark adaptation curves of the normal and the amblyopic eye could be superimposed. They also found that the threshold contours or retinal profiles (i.e., thresholds obtained with 1° stimuli at the fovea and at various distances above and below it) were very similar in the amblyopic and the dominant eye. In a third series of experiments the spectral sensitivity of amblyopic eyes was determined in the fovea with a 1° centrally fixated target, and peripherally with a 2° target placed 8° below the fovea. The amblyopic eyes yielded the typical responses and the typical differences between center and periphery expected from normal eyes. WALD & BURIAN concluded from all this that the threshold of the amblyopic eye is essentially normal, foveally and peripherally, in cones and rods, and that the entire apparatus of simple light perception is, therefore, virtually normal in these eyes.