Editorial: The schematic eye

The schematic eye is the average eye. The optical data given for a schematic eye depend upon several factors. There must be a close relationship between the accepted anatomical measurements of the normal eye and the schematic eye. For example, if by reason of race, sex, or age, the normal eye of a Caucasoid were to differ from that of a Mongoloid, then the schematic eye must be further qualified. Although such variations do occur, they are of insufficient importance for anatomical reasons to merit several schematic eyes for the human species.

The author of a schematic eye has to commence with some data. In the 19th century, anatomical and optical measurement began to have some accuracy. The schools of Helmholtz, Listing, Donders, Gullstrand, and Tschering, by the end of the century, had refined the earlier instruments and accumulated a large amount of data. The curvature of both cornea and lens could be measured. The relative positions of the various optical surfaces in the eye were known. It therefore remained for each worker to state what was the average for the normal and to design a schematic eye about the data. In recent times, in an attempt to simulate the truth, some workers have even included data for several layers of the crystalline lens. At the other extreme Donders reduced the schematic eye to the simplest form. He considered basically only the total power in one plane, one nodal point, and a homogenous refractive index of 1·33 (water). Thus the reduced eye did not include the problem of the lens, but the cardinal points held a relationship to the normal phakic eye. Such a reduced schematic eye was of the greatest value in teaching and is a philosophical approach to the resolution of geometric optical problems concerning the eye. But to understand the function of the eye better, the more complicated schematic eyes have to be used.

In this issue Drasdo and Fowler remind us that sphericity of the cornea is a property of most classical schematic eyes. Helmholtz knew the cornea to be ellipsoid, since he measured the curvature of the anterior corneal surface with an instrument borrowed from astronomy, which is still used in modern keratometers. But the significance of the variation in corneal power of an ellipsoid as compared with a sphere was not considered. Thus, if for retinal areas the projection can be described as linear, then our present perimetry charts are valid. But workers on the spatial projection of the retinal image have shown that it is not linear and this is not new knowledge. Therefore a schematic eye which can take account in a mathematical analytical way of the degree of non-linearity must be of some value to clinicians and research workers, especially since the projection of the peripheral retinal image has a value, according to Drasdo and Fowler, which is almost 50 per cent. of that of the foveal area. The description of lesions on the non-linear chart would appear, therefore, to be nearer the truth for the average human eye.

It remains to be seen whether, in fact, this large degree of error previously accepted by
clinicians is of importance. There are other factors which tend to reduce the margin of error in peripheral retinal measurements. From the instrumental viewpoint, the subjective neurological servo-motor mechanism for recording function may have a lag at the retinal periphery greater than that at the centre. The non-linear field is based upon optical and anatomical data, whereas functional data may give other results. In field measurement, factors such as the light threshold and scotopic and photopic states of adaptation are important when considering the peripheral retina and affect the projection of the retinal image. From the viewpoint of plotting peripheral retinal areas, the clinician may argue that he prefers a chart that will exaggerate the size of the area at the periphery to make the recording easier. The telescoping of the peripheral field, although of altruistic interest, does not necessarily help him to locate a lesion or draw it in detail and, furthermore, it does not help to visualize the anatomical linear distances of the retina. Subjectively and subconsciously the clinician may be less interested in recording optically accurate areas of the retina where measurement is confused by a variance between functional, optical, and anatomical data. Nevertheless, there are those who from a neurological viewpoint would be interested in understanding a more accurate retinal projection relating the optical properties to the anatomical data. But in the first instance this theoretical advance in presenting the average eye will have to be proven by diligent practical application.
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