APPLIANCES

THE FIXATOR*

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THE apparatus described here has been designed to afford an accurate test of binocular fixation, and to allow a comparison of visual acuities in the two eyes at reading distance.

Fig. 1 illustrates the principle of the fixator. The two pictures are represented diagrammatically by two arrows. In front of the pictures is a pair of 20 D biconvex lenses, and each of these lenses forms an inverted image of one of the pictures. The two inverted images are made to coincide on the plano face of a plano-convex lens placed 33 cm. in front of the observer. This lens does not appreciably alter the position of the images.

It will be observed that each eye sees only the image of the picture of the opposite side. The two pictures may be the same, with control marks added. Three of the clues which normally enable the position of an object in space to be perceived operate here to locate the images on the surface of the lens; these are the stereoscopic clue of binocular parallax, the parallax due to head movements, and the vergence of the light.

Function of the Plano-Convex Lens

This is of such a strength, 13 D, that it forms images of the biconvex lenses in the pupils of the observer so that these lenses cannot be seen. If the plano-convex lens is removed from the apparatus, the position of the superimposed images is scarcely affected, but now however the two biconvex lenses and their surrounds are clearly visible behind the images; and, since the images do not obstruct the view of anything behind them, there is a strong psychological stimulus to think that the images are in or behind the biconvex lenses. With the plano-convex lens in position, nothing behind it is visible, and the two superimposed images lying in its plano surface are perceived in their correct position.

A second function of the plano convex lens is to reduce distortion. Fig. 1 (opposite) shows that only that portion of the biconvex lens which is imaged on the pupil is in use at any one moment. For a pupil diameter of 4 mm. this will be $\frac{10}{3} = 4 \times 1.3$ mm. The head, however, is free to move anywhere, provided that the eyes remain in the images of the biconvex lens. These meet in the mid line, and so have a diameter of 65 mm. From this it follows that no adjustment for inter-pupillary distance is required.

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FIG. 1.—Optical system of the fixator.

Errors of Fixation

Fig. 2 (overleaf) shows a perspective drawing, in which the path of the central ray from each of the letters of the two pairs is shown by a dotted line. Square lenses are used. The two visual axes are shown by continuous lines accurately converged upon a mark on the front face of the plano-convex lens.

Consider the pair of letters LF, the images of which are formed in the upper part of the front lens. The F is on the right and is seen by the right eye; the L is on the left and is seen by the left eye. Suppose now that the eyes diverge from correct fixation; the visual axis of each eye will come nearer to the letter seen by that eye, and the result will be that the two letters will appear to the subject to approach each other. However, the opposite is the case for the bottom pair of letters, for here each eye sees only the letter of the opposite side, so that when the eyes diverge each directs its visual axis further away from the letter perceived by it, with the result that the letters appear to separate. Thus the position of the letters as reported by the patient indicates the direction of any error of fixation. The principle of this test is the same as that of the T.I.B. double mirror test.

FIG. 2.—Diagrammatic drawing of the fixator. The path of one ray from each letter to the eye is drawn.

Nature of the Test

It must be emphasized that this apparatus does not measure latent squints. In a latent squint measurement there is nothing common to the view of the two eyes; in this apparatus, the common element in the two fields which provides a fusion stimulus, is under the control of the operator. Fig. 3 (a)–(c) shows three cards. In (a) the central lines afford a fusion stimulus, in (b) the square frame-work to the letters supplies a weaker peripheral stimulus, and in (c) the only stimulus to fusion is that provided by the edge of the lens and the outline of the front of the apparatus. An alternative to using a central fusion stimulus on the cards is to make a mark on the face of the front lens to act as fixation point. Alternatively, any small object such as a pin may be held on the surface of the front lens to act as a fixation target. The position

FIG. 3.—Cards to show how the amount of fusion stimulus may be controlled.

of the letters will indicate the accuracy with which these entirely natural fusion stimuli may be fixed.

Preliminary results show that, as would be expected, the nature of the fusion stimulus has a considerable effect on the accuracy of binocular fixation.

Use of the Instrument

It is possible that the symptoms of eyestrain, which frequently occur in cases of latent squint, may be due, not directly to the latent squint itself, but to errors of fixation induced by it; this instrument will afford a method of detecting such errors.

After operation and or orthoptic treatment for squint, it is hoped that the instrument may supply a more accurate indication of binocular function than is afforded by the cover test or the stereoscope.

After full correction for distant vision has been given, comparison of visual acuities at the reading distance will reveal the rare condition of unequal accommodation in the two eyes.

My thanks are due to Mr. A. E. Turville for stimulating me to design this instrument, and to Mr. Jameson Evans, Dr. R. H. Bolton, Miss I. M. Whitney, Miss M. E. Wesson, and Miss H. Kilmister for preliminary trials with the instrument and for many helpful suggestions.

It is hoped that Messrs. Newbold and Co., Ltd., 46 Osnaaburgh St, N.W.1., will shortly be able to supply this instrument.