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TO MEASURE FUSION POWER OF EYES.

BY W. A. DIXEY.

HALF an hour is, I understand, the time allowed for the introduction and discussion of my subject. It is little enough, but I think it will suffice for presenting to your consideration an ophthalmic instrument which I have recently made to the design of Dr. Maddox, and which, though it does not embody any new optical or mechanical principle, may, I think, be not entirely without points of interest to some of my fellow Opticians. The instru-

ment is called "The Prism Verger"; and if you allow me the use of the word vergence as a generic term to cover the four kinds of vergence, viz., convergence, divergence, right supra-vergence, and left supra-vergence, the word verger will naturally follow to denote an instrument whose function is to induce vergence of the ocular axes.

To appreciate the use of the instrument you should understand that it is a necessary condition of binocular sight that, when the two eyes are directed to a distant

object, the visual axes should be parallel. The Prism Verger is a device for increasing the angle of deviation from the parallel, firstly, in the horizontal direction, and secondly, in the vertical direction. These two involve all directions, for an oblique direction can always be resolved into its horizontal and vertical elements.

If you hold a prism, say of 6° deviation, with its edge up in front of your eye, and look through it at a distant object, the object will be apparently displaced in a vertical upward direction. If you now rotate the prism through a small angle, so that its edge points not vertically upward, but in an oblique direction, say 10° from the vertical, the object will still be displaced to the same extent as before, but in a direction corresponding to the angle of rotation of the prism.

This oblique displacement can be expressed as a vertical and horizontal displacement, and you will see that the horizontal displacement is proportionate to the sine of the angle of rotation, and the vertical displacement is proportionate to the co-sine of the angle. This is what happens with the Prism Verger. When the prisms are in the zero position with both edges up, the visual lines are deflected equally and in the same direction, and the effect upon the vergence of the eyes is nil. By turning the milled head we rotate the prisms in opposite directions with a result that, while the vertical deviation remains equal and similar in phase for the two eyes, the horizontal deviation is opposite in direction; so that the net result is a graduated effect upon the vergence of the two eyes in a horizontal direction only.

For the chief factor in determining the alignment of the ocular axes is an intolerance of the confusion that is caused by the duplication of the objects looked at, or, in other words, the desire to maintain fusion; and as by the rotation of the prisms the visual lines are gradually deflected from the parallel, the desire to maintain fusion will compel a corresponding alignment of the ocular axes. It is obvious that in this way the limits of the power of fusion in the two horizontal directions may be ascertained. Similarly by adjusting the prisms with both edges pointing horizontally in the same direction, so that the horizontal deflections are equal, and then by rotating them as before, we can measure the fusion power in the vertical directions.

This measurement of the fusion power of the eyes should not be confused with the measurement of heterophoria, or the static balance of the ocular muscles. That also is a useful measurement in sight testing. But the measurement of fusion power affords a safer and more useful pointer when it comes to a question of treatment for muscular insufficiency.

The treatment of muscular insufficiency offers some of the most difficult problems in ophthalmic practice. The correction of defects of accommodation and of refraction is more or less subject to measurement and rule, but I suppose that the proper treatment of defects of vergence is more than any other dependent upon medical knowledge and experience, knowledge which ensures a correct diagnosis of the cause of the defect, and judgment founded on experience which indicates its most advantageous treatment. For there are always two ways of treating a weak muscle; one is to rest it, and the other to exercise it; and those two methods are, as applied to vergence defects, exactly opposite.

I would have you notice that this instrument is equally adapted to either treatment. It is obviously useful for exercising the muscle in the reverse direction to the weakness; and if the relief of the weakness is indicated by the conditions of the case, the fusion area may be measured under the desired condition of accommodation, and a prismatic assistance applied in accordance with a recognised rule. I venture, however, to caution the younger members of the Society that it is not safe to recommend either of these methods of treatment without medical sanction and supervision.

Finally, the instrument may be used with a Maddox rod to measure heterophoria, and if one prism be slipped out of its setting and the other set edge up, it will measure, with a tangent chart, the latent excess or insufficiency of convergence at a reading distance.