A MAGAZINE REFRACTION OPHTHALMOSCOPE,

BY

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FOR

PICKARD and CURRY,

(*Sole Makers of this* NEW OPHTHALMOSCOPE),

OPHTHALMIC OPTICIANS.

195, Great Portland St., London, W.

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By John Couper, F.R.C.S.

The inconveniences of discs in the refraction ophthalmoscope as at present arranged, are obvious enough. In order to obtain a sufficient number of glasses, we must either use numerous discs and submit to the trouble of changing them frequently, or we must use a pair of superposed discs and must add lens to lens, or subtract lens from lens, to obtain the higher glasses. The latter alternnative involves the addition of an index wheel of a certain complexity, showing the focal length of the combined lenses, and it is further objectionable in that two masses of glass and four refracting surfaces are interposed precisely in the very cases where such interposition is undesirable. Discs, being close to the mirror, make the upper end of the instrument bulky, and bring the finger that works them close to, and frequently in contact with, the patient's face.

In the ophthalmoscope which I am about to describe, it is proposed to obviate these disadvantages by the total abolition of discs and the substitution of a new plan of construction. The handle of the instrument is converted into a magazine, containing a series of separate lenses, each of which can be brought in succession to the sight-hole of the mirror by means of a direct-action driving wheel. The mechanism is of the very simplest kind, and will be readily understood from the accompanying woodcuts.

In Fig. 1 the lid of the magazine is omitted so as to show the internal arrangement of the latter, and the method of direct propulsion. Fig. 2 shows the complete instrument in its more and recent improved form. The magazine consists of a shallow metal box, three quarters of an inch broad by ten inches long, containing seventy-two lenses. A central rib or projection divides the box lengthways into two parallel grooves which join at the ends, thus forming a continuous circuit for the lenses. The latter touch each other edgeways, but are not articulated as in a chain. The focal length of each glass is engraved on the metal disc which bears it, and can be read off at the sight-hole. Within the box, and on the spindle which carries the driving wheel, is a smaller wheel with six teeth. The lenses, being caught by the teeth, are propelled round the box. The back of the driving wheel is also notched at suitable intervals, and the point of a metal spring, falling into a notch, centres each lens as it arrives at the sight-hole.

The swing mirror of my former instrument has been retained. The axial line of its hinge is as nearly as practicable a tangent to the back of the mirror at a point close to the sight-hole on the one hand, and on the other to the edge of each lens as it becomes centred at the sight-hole.

By this arrangement the upper end of the instrument, being unencumbered by discs, is conveniently flat and narrow, and lies well under cover of the observer's brow. There is no lateral projection to touch the patient's face and prevent close approximation of eye to eye. The driving wheel is below the level of the patient's chin. The mirror can be so tilted as to reflect light into the eye under examination without including the lens, and with a minimum separation of lens from the sight-hole.

The utmost proximity of lens to sight-hole is *desirable* (when lenses of fine millimetres diameter are employed) as giving a wide angular aperture to the instrument, and is *necessary* for direct examination in high grades of

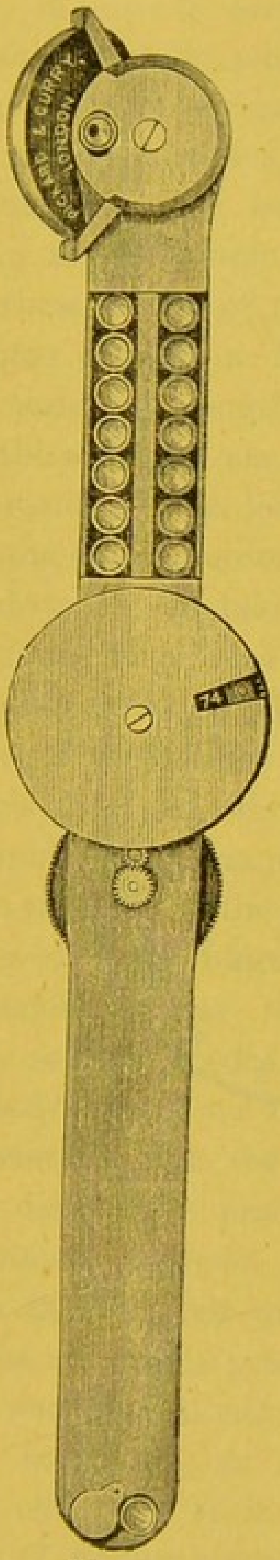

Fig. 2.

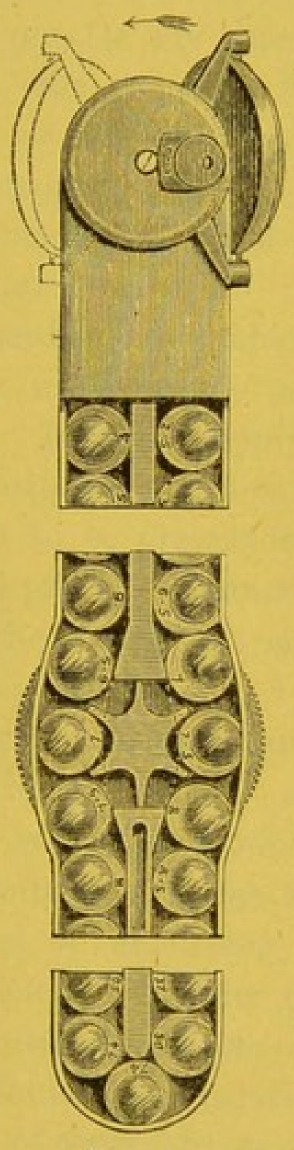

Fig. 1

myopia, in order to bring the eye of the ophthalmoscopist nearer to that of the patient than the far point of the latter.

The series of seventy-two are divided equally between minus and plus lenses, and in each section ranges from 0·5 D. to 74 D. I have chosen seventy-two merely as affording a very ample series, and not by any means as the furthest limits of number. On the contrary, in the instrument shown in Fig. 2 it is as easy to employ a larger series by lengthening the magazine, as it is to curtail the series by shortening the magazine. The effective diameter of each lens is five millimetres.

If the ophthalmoscope is to be used as an optometer it must obviously contain at least as many lenses as are usually found in clinical trial boxes. It must supply the measure not merely of any possible ametropia in the patient, but also of that which may happen to be present in the observer's eye, and when the ametropia of examiner and the examinee is the same in kind, the instrument should supply a measure of the sum of these quantities.

It is but a poor argument against this easily attainable completeness to say that higher lenses of the series are but seldom needed. Whoever takes the trouble to make daily use of an instrument containing a lens series commensurate with the whole range of ametropia, will speedily discover its practical convenience. Let me quote one common example. The treatment of myopia often presents this difficult question—Is the myopia progressive, and is the amblyopia present a result of central hyperæmia, or other such nutritional disturbance which is amenable to medical treatment, or is it an incurable result of old textural change? It is unnecessary to insist on the importance of finding a true answer to this question, and on the light to be thrown on it by a good direct view of the fundus, displaying as it does in the higher grades of myopia a much amplified image of the fine pigmentary and other changes at the macula. These changes are only too easily overlooked in the inverted image, owing to its small size. The higher the grade of myopia the greater is the difficulty of obtaining a satisfactory direct view; each case is measured by one particular lens, and that lens alone gives the best image. In the highest grade, direct inspection is impracticable without a lens of adequate power, and even with it, if placed too far distant from the sight-hole. It is in such cases that the proximity of the lens to the sight-hole comes to tell. With a minus glass of three quarters of an inch focal length I have obtained a satisfactory direct view of the fundus of a myope, using for full correction a glass of one and a third inches. The far point of this eye can have little more than two inches from the cornea.

In the ophthalmoscope shown in Fig. 1, the metal ring in which each lens is framed has margin enough at the inner side to carry a figure denoting the power of the lens, which becomes visible at the sight-hole. This arrangement, although extremely simple, has certain drawbacks:

1. The large size of the frame of each lens adds to the length of the magazine.

2. In order that the figures may present in proper position at the sight-hole the broader part of each metal ring must point inward. Free rotation, therefore, of one ring on another is inadmissible. A facet ground on the outer edge of each, while it secures a due position of the number, at the same time increases friction by hindering the mutual free play of contiguous rings. This increase is an inappreciable quantity with a magazine of forty or even fifty lenses. It begins to tell, however, with seventy-two lenses.

To meet these difficulties I had constructed the instrument represented in Fig. 2, which answers its purpose admirably. It will be seen from the woodcut that the metal frames are reduced to rings of no greater thickness than suffices to protect the lenses. They carry no figures, and, being absolutely circular, each is free to roll on its neighbours. The mechanism resembles in principle the ball bearings of a bicycle wheel, the design of which is to minimise friction. In the present instance this object is fully attained, as is shown by the ease with which the whole series of seventy-two is propelled round the box. The finger on the driving wheel is not sensible of more resistance than in the ordinary disc instrument. With the lessened size of the individual pieces a smaller driving wheel (A. Fig. 2) and a shorter stroke suffice for propulsion.

The numbers are transferred to an index wheel (B. Fig. 2) which being geared to the driving wheel, keeps pace therewith and with the lens series. Minus glasses have their rings coloured white, and are denoted by white figures on the wheel. Plus glasses have dark rings and are indicated by red figures. To economise space the white and red figures are arranged concentrically on the wheel. In order to show at any given moment which way the driving wheel must turn to bring up plus or minus lenses to the sight-hole, a portion of the lid of the box is made of glass. Through this window the relative position of the plus and minus series is seen at a glance owing to their difference of colour.

Messrs. Pickard & Curry, the makers of the instrument, have taken incredible trouble in embodying my ideas. I desire to thank especially Mr. Paxton of that firm, without whose ingenuity and skill as a mechanician success would not have been possible.

(*May 10th*, 1883.)