THE BRITISH JOURNAL OF OPHTHALMOLOGY

MARCH, 1919

COMMUNICATIONS

A NEW FORM OF BIFOCAL LENS*

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THERE has arisen a school of ophthalmologists who teach [that in early life myopia should be fully corrected, and that this full correction, however high it may be, should be continuously worn under all the conditions of modern life with its many hours of strenuous close work. 19 11

The argument of this school is, that the eye correction only turns the child or young adult with myopia into a person with normal vision, and thereby the accommodation is called into play as is the accommodation of an emmetrope or hypermetrope. Moreover, they state boldly that if this full correction is not given certain dire results will follow. The accommodative power will be lost; and, far worse, rapid progressive myopia will take place. 19 11

This terrible result is stated by one section to be due to the flexing of the neck and head over books, and the consequent bulging of the eyes, and is illustrated by suspending rabbits by

*Read in the Section of Ophthalmology of the Royal Society of Medicine on June 12, 1918.

their tails for several days; other sections ascribe the result to pressure on the globe from undue use of this or that rectus or oblique muscle; other sections again explain this result by one of the numerous unverified hypotheses of the causation of myopia, the one which happens to be popular at the moment.

This statement that lack of full correction of myopia increases the myopia, is asserted with a dogmatism worthy of a Cameronian Covenanter but no real evidence thereof is given to us.

We are assured that the teaching is novel, which it well may be, for the last generation indulged less in unproved assumptions.

This school forgets that, like the poor, myopes have been always with us, or at least ever since Nero wore his monocle. The giants of thirty years ago were quite as familiar as we are with all forms of myopia and with inconvenience to the wearer of frequently changing his glasses for near or far vision.

They seldom insisted on the myopes reading with full correction, and they did not *imagine* that evil results followed.

The writer has had the fortune or misfortune, from whichever standpoint it may be regarded (and he certainly does not regard it altogether as the latter), to have been myopic since early childhood.

Though the myopia was not high, and has increased very little since, he objected, both in boyhood and youth, to prolonged study in glasses of full correction. This objection was not due to lack of accommodative power, nor did any weakness of accommodation result therefrom. When well over forty years of age his accommodation was tested at an Ophthalmological Congress at Oxford, and found to be more powerful than any recorded up to that date.

The writer found that fully correcting glasses did not place him in the same position as the emmetrope, but introduced him into a microcosmos; and this every myope discovers for himself. In this contracted world the diminished image of the reading types produced a retinal fatigue that made him rejoice to go back to the larger image of the weaker glasses. On this personal evidence, he would ask, why should myopes be robbed of their privilege of reading without using their ciliary muscles? The more so since, above others, they love their books!

The preference of the writer for weaker reading glasses led him early in adult life to adopt bifocals. These were at first of the ordinary pattern. Shortly after commencing the study of ophthalmology, it was brought home to him, that in looking down through the lower glass of the ordinary bifocals, considerable distortion of the image was produced.

It may surprise the reader to be informed that a sphere of 4D. tilted 20° produces a cylinder of 0.5D.

Now, in the ordinary bifocals when the upper glass is set at right

angles to the visual axis, the lower glass is tilted not less than 20° and probably nearer 30° , to that axis, with the eyeballs rotated downwards for reading.

A tilt of 30° is equal to a cyl. of 0.31D. for every degree of sphere, *i.e.*, in a sphere of 10D., a cylinder of 3D. is introduced.

To overcome this cylindrical effect I, the writer, angled my bifocals. They were made of separate pieces of glass slightly bevelled against one another where the pieces met.

At first I had the line of division straight across thus :

This arrangement, while simple to make, labours under the great disadvantage that it bestows an exaggerated importance on the reading glass and blurs much of the lower temporal field for distance. This is a grave handicap in walking, especially up and down stairs, and is sufficient to deter many patients from wearing bifocals.

Next I angled circular bifocals thus :

Here the difficulty was to bring the edges of upper and lower glass into continuous contact. This difficulty was overcome by grinding a toric curve on the upper lens, and a double concave or convex on the lower lens. I obtained immense satisfaction and

comfort from these glasses and have worn them continuously for over twenty years. It may be well to mention here that it is rarely possible to angle the glasses above 20° owing to the configuration of the cheeks; but as the cylindrical effect of tilting a sphere rises in a geometrical and not an arithmetical proportion to the angle of tilt this is of small moment. For example: suppose the lower lens is a 4D. sphere and the angle of tilting is 30° , the cylindrical result will be 1.24D. Now, if the lens is angled 20° , only 10° of the tilting will remain, and the cylindrical effect will be only 0.11D.

The curved angular bifocals mentioned above possess the following faults:

1. They are expensive, because the opticians find them troublesome to put together, and are apt to crack the lenses in doing so. After prolonged use they tend to work loose and fall out.
2. The dividing line between the lenses is pronounced, and although some patients soon learn to ignore it, some nervy ones are unable to. Dust also settles on the line of union and accentuates it.
3. The most ardent admirer of this type of bifocals could not deny its ugliness.

For these reasons I have long been striving to solve the problem of making these angular bifocals in one piece of glass. Some eight years ago I placed the problem before Mr. J. B. Rayner, of Vere Street. Mr. Rayner has hit on a solution of the difficulty which gives us almost all that we require.

A thick blank is obtained from one of the patentees of the invisible bifocal lenses, with a reading sphere (say, a 2D. sphere) ground, fused, or cemented upon its lower part.

Thus:

This is then ground off along the line to give the angle of 15° to 20° .

On the inner surface the refraction curve is ground common to both lenses.

The writer has worn a pair of these bifocals for several months and they leave little to be desired. They are perfectly comfortable, easy to clean and almost invisible as bifocals.

To anticipate a few obvious objections:

1. At present these angular bifocals cannot be made in convex glasses, but only in concave combinations. Mr. Rayner is sanguine that later he will discover a method of angling convex circular bifocals.

2. The faint line straight across the lens where the angling takes place does not impede walking, for the power of the lower temporal glass below the line is the same as above. The diffraction from the line is very slight and very quickly ignored.

3. A cylinder can be ground in with the common curve and, if vertical or horizontal, is correct for the two centres. If the cylinder is at 45° it can still be made common to the two centres, but the centres are not directly in the vertical line. This can be overcome and the lower centre brought vertically under the upper by slightly tilting the horizontal angular line.

4. When a myopic patient can read comfortably in full distance correction, angular bifocals of equal power will be an advantage. They will do away with the prismatic effect produced by looking below the centre of a high lens, and give a properly centred reading portion.

In conclusion :

5. I am not a sufficiently good mathematician to be certain of the verity of my tables of the cylindrical effect of tilting a sphere. I therefore sought the help of an old friend of mine, Prof. A. H. Fison, an astronomer, and a lecturer on physics at Guy's Hospital School. Prof. Fison has worked out tables which are accurate to a second of arc. His results show that my figures are too low and the amount of cylindrical error produced by tilting is somewhat greater than I have given in my paper.*

* We hope to publish Dr. Fison's paper at a later date.