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XLII. *On Colour-vision at different points of the Retina.*

It has long been known that near that point of the retina where it is intersected by the axis of the eye there is a yellowish spot, the existence of which can be shewn not only by the ophthalmoscope, but by its effect on vision. At the Cheltenham Meeting in 1856 the author pointed out a method of seeing this spot by looking at that part of a very narrow spectrum which lies near the line *F*. Since that time the spot has been described by Helmholtz and others; and the author has made a number of experiments, not yet published, in order to determine its effects on colour-vision.

One of the simplest methods of seeing the spot was suggested to the author by Prof. Stokes. It consists in looking at a white surface, such as that of a white cloud, through a solution of chloride of chromium made so weak that it appears of a bluish-green colour. If the observer directs his attention to what he sees before him before his eyes have got accustomed to the new tone of colour, he sees a pinkish spot like a wafer on a bluish-green ground; and this spot is always at the place he is looking at. The solution transmits the red end of the spectrum, and also a portion of bluish-green light near the line *F*. The latter portion is partially absorbed by the spot, so that the red light has the preponderance.

Experiments of a more accurate kind were made with an instrument the original conception of which is due to Sir Isaac Newton, and is described in his *Lectiones Opticæ*, though it does not appear to have been actually constructed till the author set it up in 1862, with a solid frame and careful adjustments. It consists of two parts, side by side. In the first part, white light is dispersed by a prism so as to form a spectrum. Certain portions of this spectrum are selected by being allowed to pass through slits in a screen. These selected portions are made to converge on a second prism, which unites them into a

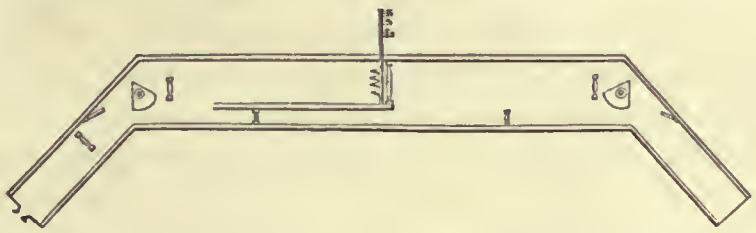
single beam of light, in which state they enter the eye. The second part of the instrument consists of an arrangement by which a beam of light from the very same source is weakened by two reflections from glass surfaces, and enters the eye alongside of the beam of compound colours.

The instrument is formed of three rectangular wooden tubes, the whole length being about nine feet. It contains two prisms, two mirrors, and six lenses, which are so adjusted that, in spite of the very different treatment to which the two portions of a beam of light are subjected, they shall enter the eye so as to form exactly equal and coincident images of the source of light. In fact, by looking through the instrument a man's face may be distinctly seen by means of the red, the green, or the blue light which it emits, or by any combination of these at pleasure.

The arrangement of the three slits is made by means of six brass slides, which can be worked with screws outside the instrument; and the breadth of the slits can be read off with a gauge very accurately.

In each observation three colours of the spectrum are mixed and so adjusted that their mixture is so exactly equivalent to the white light beside it, that the line which divides the two can no longer be seen.

It is found that in certain cases, when this adjustment is made so as to satisfy one person, a second will find the mixed colour of a green hue, while to a third it will appear of a reddish colour, compared with the white beam.



But, besides this, it is found that the mixed colour may be so adjusted that, if we look directly at it, it appears red, while if we direct the eye away from it, and cast a sidelong glance at it, we see it green. The cause of this is the yellow spot, which acts somewhat as a piece of yellow glass would do, absorbing certain kinds of light more than others; and the difference between different persons arises from different intensities of the absorbing spot. It is found in persons of every nation, but generally stronger in those of dark complexion. The degree of intensity does not seem to depend so much on the

colour of the hair or the iris of the individual, as to run through families independent of outward complexion.

The same difference is found between different colour-blind persons; so that in the comparison of their vision with that of the normal eye, persons should be selected for comparison who have the yellow spot of nearly the same intensity.

In my own eye the part of the spectrum from *A* to *E* is seen decidedly better by the central part of the retina than by the surrounding parts. Near *F* this is reversed, and the central part gives a sensation of about half the intensity of the rest. Beyond *G* the central part is again the most sensitive, and it is decidedly so near *H*.

Before I conclude I wish to direct the attention of those who wish to study colour to the exceedingly simple and beautiful series of experiments described by Mr W. Benson in his works on colour. By looking through a prism at the black and white diagrams in his book, any one can see more of the true relations of colour than can be got from the most elaborately coloured theoretical arrangements of tints.