feat, which can be readily accomplished under the guidance of binocular vision, large odds may be laid that success will not be attained when one eye is closed, until a suc­cession of trials shall have enabled the experimenter to measure the distance of the ring by the muscular move­ments of his arm.”@@1 According to Brücke, the two eyes are continually in a state of motion, and their position of convergence, now greater now less, passes from one side to the other, so that the observer combines succes­sively the different parts of the two pictures, thus giving rise to sensations of depth of space and of subjects stand­ing out in relief. Brücke’s theory, in short, is that our perception of depth depends on the fusion of muscular sensations, or rather of nervous impressions arising from the muscles of the eyeballs. It was, however, pointed out by Dove that the sensation of relief, solidity, or per­spective is perfect even when natural objects or stereo­scopic pictures are seen momentarily by an electric flash lasting only 1/24,000 of a second during which time it is in­conceivable that there can be any change in the degree of convergence of the optic axes. This experiment is fatal to Brücke’s theory, and Wheatstone was right in asserting that the sensation of relief is instantaneous. A third theory is that of Joseph Le Conte, advanced in 1871, and thus stated by himself :—“All objects or points of objects either beyond or nearer than the point of sight are doubled, but differently,—the former homonymously, the latter heteronymously. The double images in the former case are united by less convergence, in the latter case by greater convergence, of the optic axes. Now, the observer knows instinctively and without trial, in any case of double images, whether they will be united by greater or less optic convergence, and therefore never makes a mistake, or attempts to unite by making a wrong movement of the optic axes. In other words, the eye (or the mind) in­stinctively distinguishes homonymous from heteronymous images, referring the former to objects beyond, and the latter to objects this side of, the point of sight.”@@2 Thus, according to Le Conte, the mind perceives relief *instantly* but not *immediately,* and it does so by means of double images. This theory does not possess the merit of simpli­city, and, whilst it may explain the phenomenon of relief as experienced by those who have been specially trained to the analysis of visual perceptions, it does not satis­factorily account for the experience of everyday life. We are therefore obliged to fall back on the theory of Wheatstone, somewhat modified, namely, that there are, behind the phenomena referred to the retina, psychical operations, unconsciously performed, which fuse together the results of the retinal impressions. In the language of Hermann, “corresponding points are therefore such points as furnish images, which, as experience teaches, are habitually combined or fused. But, as it appears necessary to effect these combinations in order to obtain correct impressions of objects, we get into the habit of fusing also the images of the two not perfectly corresponding points which, under ordinary circumstances, we should perceive as double. It can easily be demonstrated that simultaneous images which fall upon corresponding points are not united, although it is true that they do not form second images. When the mind must unite images which do not fall upon corresponding points, the process must be associated with the conception that the corresponding points in the object occupy the situation for which the eye would have to be arranged, in order that the image should coincide.”@@3

To obtain binocular pictures suitable for the stereoscope, the camera must be placed successively in two points of the circum­

ference of a circle of which the object is the centre, and the points at which the camera is so placed must have the angular distance representing the convergence of the optic axes when the object is to be viewed in the stereoscope. For example, if the pictures are to be seen in the stereoscope at a distance of 8 inches before the eyes, the convergence will be 18°, and the camera must be stationed at two points on the circle at the same angular distance. This *distance* of the camera from the object only affects the *magnitude* of the picture. Usually two cameras are employed, fixed at the proper angular positions. Wheatstone gives the following table of the inclination of the optic axes at different distances, and it also shows “ the angular positions of the camera required to obtain binocular pictures which shall appear at a given distance in the stereoscope in their true relief.”

Inclindation of the optic axes 2° 4° 6° 8° 10° 12° 14° 16° 18° 20° 22° 24° 26° 28° 30° Distance in inches 71·5 35·7 23·8 17∙8 13·2 11·8 10∙l 8∙8 7·8 7∙0 6∙4 5·8 5·4 5∙0 4·6 “The distance is equal to 1/2*α* cotang 1/2*θ*,—*α* denoting the distance between the two eyes and *θ* the inclination of the optic axes” (Wheatstone, *Scientific Papers,* p. 270).

Suppose two stereoscopic pictures thus taken are presented to the two eyes ; it is possible by an effort so to converge the eyes as to throw the im­ages on corres­ponding points, and when this is done the ob­jects are seen in relief (fig. 1).

Such an effort, however, soon causes fatigue, and few persons can so control their eyes and keep them in the forced posi­tion as to view the pictures in their natu­ral perspective with any com­fort. The object of all stereoscopes is to throw the two pictures on corresponding points with the eyes in an ordinary position.

The principle of Wheatstone’s reflecting stereoscope is illustrated in fig. 2. It consisted of two plane mirrors, about 4 inches square, fixed in frames

and so adjusted that

their backs form an

angle of 90° with each

other. These mirrors

are fixed to an upright

against the middle line

of a vertical board cut

away so as to allow the

eyes to be placed be

fore the mirrors. On

each side there is a

panel bearing a groove

above and below into

which the correspond­

ing pictures can be

slid. Mechanical ar­

rangements also exist for the purpose of moving the pictures to or from the mirrors and also for inclining the pictures at any angle (fig. 3). There is one position in which the binocular image will be immediately seen single, of its pro­per size, and without fatigue, “ because in this position only the ordinary relations be­tween the magnitude ... .

of the pictures in the retina, the inclination of the optic axes, and the adaptation of the eve to distinct vision at different distances are preserved ” (Wheatstone). Although somewhat cumbrous, the reflecting stereoscope is a most useful instrument, and enables one

@@@1 Carpenter, *Edinburgh Review,* 1858.

@@@2 *American Journal of Science and Arts,* vol. ii., 1871.

@@@3 Hermann’s *Physiology,* translated by Gamgee, p. 430.