a clear image to a “ common sense ” which gave its aid equally to each eye,—this common sense being specially exerted when the object is placed much nearer to one eye than to the other, so that the sizes as well as the forms of the two retinal pictures are sensibly different. The sub­ject was merely touched by various other writers after Aguilonius until 1775, when Harris@@1 observes : “We have other helps for distinguishing prominences of small parts besides those by which we distinguish distances in general, as to their degrees of light and shade, and the prospect we have round them. Again, by the parallax, on account of the distance betwixt our eyes, we can distinguish, besides the front part, the two sides of a near object not thicker than the said distance, and this gives a visible rilievo to such objects, which helps greatly to raise or detach them from the plane in which they lie. Thus the nose on a face is the more remarkably raised by our seeing both sides of it at once.” This was undoubtedly a con­siderable step towards a sound theory of binocular vision, but it cannot be said to have anticipated the invention of the stereoscope. This instrument owes its origin entirely to the experimental researches of Sir Charles Wheatstone on binocular vision, and the following passage from Mayo’s *Outlines of Human Physiology,* p. 288, published in 1833, is the first clear enunciation of the principle on which it is constructed:—“A solid object, being so placed as to be regarded by both eyes, projects a different per­spective figure on each retina ; now if these two perspect­ives be actually copied on paper, and presented one to each eye, so as to fall on corresponding parts, the original solid figure will be apparently reproduced in such a manner that no effort of the imagination can make it appear as a representation on a plane surface.” Sir Charles Wheat­stone’s “ Contributions to the Physiology of Vision, Part the First” appeared in the *Philosophical Transactions* of 1838, but this paper was the result of investigations extending over a period of years, and there is evidence that reflecting stereoscopes were constructed for Wheat­stone by Newman, a well-known philosophical instrument maker, so early as the winter of 1832. Wheatstone no doubt also, as early as 1845, employed photographic pictures for his reflecting stereoscope. The subject was taken up by Sir David Brewster, and was developed more particularly in two papers read to the Royal Society of Edinburgh in January 1843 and April 1844. These re­searches led Brewster to the invention of the lenticular or refracting stereoscope. The discoveries of Daguerre and Talbot, and the rapid development of the art of photo­graphy, enabled photographs to be taken suitable for the stereoscope, thus superseding the geometrical drawings previously employed, and in 1849 Duboscq, a Parisian optician, began the manufacture of lenticular stereoscopes and executed a series of binocular daguerrotypes of living individuals, statues, bouquets of flowers, and objects of natural history. For many years the refracting stereoscope of Brewster was one of the most popular of scientific in­struments, and was to be found, along with an appropriate collection of pictures, in every drawing-room, but of late years it has somewhat fallen into the background, and the manufacture by photographers of stereoscopic views now forms but a small portion of their work. Whilst much credit is due to Brewster for his writings on binocular vision, and for the efforts he made to introduce the stereo­scope to the public, there is no doubt that Wheatstone was not only the real inventor of the instrument but he also laid down in his paper published in 1838, and in a second con­tribution which appeared in the *Philosophical Transactions* in 1852, the true principles of binocular vision.@@2

When we look at an external object with both eyes it is seen generally as a single object, although there must be two retinal pictures, one for each eye. This depends on the fact that the excitation of certain associated spots on the two retinæ is referred to the same point in space, or, in other words, that the luminous impression which originates by the irritation of two associated points appears as one point in the visual field. Such associated points or areas of the retina are said to be corresponding or identical. When an object is seen single by two eyes, the two images must fall on corresponding points of the retina. If one eye be pushed to the side, the image on the retina of that eye is displaced from its appropriate identical point, and a double image is the result. Now the term *horopter* is applied to represent an imaginary surface containing “all those points of the outer world from which rays of light passing to both eyes fall upon identical points of the retina, the eyes being in a certain position.” The horopter varies with the different positions of the eyes (see Eye, vol. viii. p. 826). But it is a familiar experience that we not only see a single object with two eyes, but the object, say a cube or a book lying on the table, is seen in relief, that is, we take cognizance of the third dimension occupied by the body in space, although the two retinal pictures are on a plane. It is clear that the two images of the object which do not coincide with the horopter cannot be completely united so as to furnish one single visual impres­sion. Further, it can readily be demonstrated that the two retinal pictures are dissimilar, and yet the two images are fused into one and give the impression of a single object occupying three dimensions. To explain these phenomena, Wheatstone put forward the theory that the mind completely fused the dissimilar pictures into one, and that whenever there occurs such complete mental fusion of images really dissimilar, and incapable of mathematical coincidence, the result is a perception of depth of space, or solidity, or relief. The objection to this theory as stated by Wheatstone is that complete fusion does not take place. It is always possible by close analysis of visual perceptions to distinguish between the two retinal pictures. Further, if the fusion is mental, as stated by Wheatstone, it is an example of unconscious cerebration. Another explanation has been suggested by Brücke.@@3 When we look at objects near at hand the optic axes are converged strongly, and they become less and less converged as we gaze at objects farther and farther away. There is thus a series of axial adjustments, the necessary muscular movements giving rise to definite sensations, by which we estimate the relative distance of objects in the field of view. A man with one eye cannot judge by this method. We habitually depend upon binocular vision for the guidance of all such movements as require an exact estimate of the respective proximity of two or more objects. “ A very good test experiment is to suspend a curtain ring in such a manner as to present its edge at the distance of four or five feet from the eye, and then to try to push sideways through its hoop the curved handle of a walking stick held by the lower end ; in this

@@@1 *Opticks,* vol. ii. pp. 41 and 245.

@@@2 See *Brewster on the Stereoscope,* 1856 ; Wheatstone’s *Scientific*

*Papers,* published by the Physical Society of London, 1879 ; and an article by the late Dr William Carpenter in *Edinburgh Review* for 1858.

@@@3 This theory is usually attributed to Brücke, but something very similar to it was taught by Brewster. Brewster, however, did not attach importance to muscular sensations as an element in the question, and was content with pointing out that, in looking at the stereoscopic pictures of a bust, for example, “ the eyes will instantly, by means of their power of convergence, unite the separated points of the eyes, and then the still more separated points of the ears, running over each part of the bust with the rapidity of lightning, and uniting all the corresponding points in succession, precisely as it does in looking at the bust itself.” See his article “Stereoscope,” in *Encyc. Britan.,* 8th ed., vol. xx. p. 689.