

From Albert Way, Esq. An impression on gutta percha of a royal seal of Edward IV., for the Chancery of Monmouth as parcel of the Duchy of Lancaster.

Among the objects for exhibition were the following :—

By John Hartnup, Esq. Delineations of Saturn, as observed by a Newtonian Equatorial of 13 inch aperture, Nov. 1852, and March 27th and 29th, 1856; also a representation, on a large scale, of the Lunar Crater "Copernicus," taken at the Observatory at Rome, 19th Nov., 1855.

By the Rev. Dr. Hume. A curious tobacco pipe from the Crimea, with figures, &c., carved by a Sardinian Officer.

An impression from the small state seal of Oliver Cromwell.

Mr. Mayer, with a view to promote a better mutual acquaintance of the members of the Society, invited their attendance at his Museum in Colquitt-street, on Thursday evening, the 27th November.

The Paper for the evening was, ON BINOCULAR VISION, AND THE THEORY OF THE STEREOSCOPE, by John Newton, Esq.

That the right and left eye pictures of all near solid objects must be dissimilar appears so self-evident, and is so readily observed, that it seems useless to dwell on so plain a truth. And yet, until Wheatstone published his celebrated essay in the Philosophical Transactions for 1838, this great fact had remained barren of any result to the theory of vision. He drew right and left eye pictures of simple solids, such as a cube; and, on viewing them by an instrument which should unite the two dissimilar pictures optically (just as we do habitually by the convergence of the optic axes) he found that the two flat pictures vanished, and in their place appeared a single picture of startling solidity. The instrument itself he called a stereoscope; but the form he invented has given place to a simpler one contrived by Sir D. Brewster, and in place of the black diagrams of simple geometric solids, at first employed, Photography now enables us to take right and left eye pictures of the most complex kind, with an accuracy and beauty formerly quite unattainable. Portraits, domestic scenes, the glories of nature and art, are all presented to us in the stereoscope with a solidity and reality that has made it one of the most popular—as it is assuredly one of the most interesting discoveries of this age. Thus a main use of two eyes in vision is at once rendered capable of proof to every one, and it is now taught as a fundamental truth, established by Wheatstone, "that all our perception of solidity derived through the visual sense is consequent upon the mental combination of the two dissimilar pictures upon the two retinae."\* Again, the single vision which we enjoy with two eyes has been also attempted to be explained on various theories, as that of "corresponding points on the retinae producing but one impression on the sensorium," and the so-called "law of visible direction." Now, I believe it will not be difficult to shew that all these are at best but imperfect theories, containing partial truths. They leave out of view the action of the single eye. The two eyes frequently differ in the same individual, both in optical perfection and in focal length. Such persons have much difficulty in using the ordinary stereoscopes. Again, in the majority of animals—even those most resembling man—the eyes do not converge, but are placed sideways to the front of the head. All the three theories therefore mentioned cannot apply to such. Yet we have every reason to believe that single vision with two eyes, and the power to appreciate distance and solidity must be as perfect with them as in man. Wheatstone's theory of solid vision fails also in not explaining solid vision with one eye; yet this most certainly exists. Many pass through life with but the use of one eye, yet I have seen such a person play at cricket, snuff a candle, thread a needle, and perform many similar acts, which, if the theory above quoted be true to its full extent, should have been physical impossibilities. Any one who has been obliged to employ but one eye for a considerable period, must have perceived how rapidly he improved in "monocular vision." Again, many pictures,

\* Carpenter's Human Physiology, 5th Edition, p. 919, &c.

especially photographic copies, taken with striking contrast of light and shade, or, better still, the beautiful miniature copies of nature seen on the ground glass of the camera obscura, look extraordinarily solid. Yet all pictures are really "monocular" representations of objects as viewed with one eye. How is this, if the visual perception of solidity be entirely dependent on binocular vision? Again, in viewing distant objects or scenes, the optical parallax is so small that we have really two similar pictures (that is monocular, merely repetitions of the single-eye picture) on the two retinae. Yet we appreciate the most distant view intensely, and readily distinguish it from a flat representation. To give the single eye the same advantages in viewing photographic pictures that the two eyes have in the best stereoscopes, I made a single eye instrument, substituting for the two semi-lenses one large lens. On viewing thus fine collodion positive pictures, some appeared to project in bold relief, especially portraits and copies of white statuary, but I did not find nearly so much illusion in the best views or landscapes I could take.

At present a fierce conflict is raging amongst photographers, which seems as far from settlement as ever, viz.: the distance at which the two cameras should be placed asunder in taking the double picture for the stereoscope. Many follow Sir D. Brewster, who stoutly maintains that the two lenses employed should be separated the same distance as that betwixt the human eyes, viz.: two and a half inches, and should converge upon the object. Undoubtedly in this way we get sufficient relief for very near objects, as portraits; but it is equally certain that we cannot thus get the effect of distance in landscapes. M. Ferrier, whose stereoscopic transparencies are so famous, separates his lenses to far greater distances. Thus, in a panoramic view of Paris, taken from the top of Notre Dame, he took one picture from one of the towers, the second from the other. How shall we reconcile these apparent discrepancies? I think this will not be difficult by giving its due value to monocular vision. Two monocular pictures of near objects—as a group of statuary—that is, two pictures taken without moving the camera, unite in the stereoscope to give an appearance of decided relief, as I have ascertained—though not so great, of course, as when the camera was moved. Also, for near objects a slight separation of the cameras produces a considerable angle of parallax. Now, I have shown that in viewing distant objects our eyes unite two monocular pictures. These pictures, indeed, are perfect, with all the atmospheric effects, the ever varying grades of light, and shade, and colour, which constitute natural perspective. But in the best photograph there is no atmosphere. The shadows are opaque. The varying tints of colour are wanting; worse still, they are rendered entirely wrong, green and red appearing as black, whilst even dark blues appear as whites in the resulting pictures. To make up for these, and innumerable other defects and shortcomings, it is found absolutely necessary to exaggerate greatly the optical parallax before the effect of distance can be duly witnessed in the stereoscope, for all views except very near ones. The lenses of our cameras have a focal length of about five inches, those of our eyes of not quite one inch; so that our stereoscopic cameras may rather be compared to the eyes of giants, which would be placed about twelve inches asunder. Thus, Sir D. Brewster is evidently wrong both as to theory and practice. The fact is, no exact rule can be laid down for taking stereoscopic pictures, and practice alone can determine the optical parallax which will give the effects desired. To recapitulate, solid vision cannot be accounted for by any known optical law. It is not a blind instinct born with us, but the result of the impressions—the education of a lifetime. The infant sees only flat pictures, all objects appearing at the same distance, and it gropes like a blind man for many months, during which the other senses, especially that of touch, are continually used to correct the evidence of the eyesight. Such has, we know, been the case with those who have recovered the sight of both eyes later in life, after operations for cataract. Another use of binocular vision, besides that pointed out by Wheatstone, is, no doubt, to intensify the image by repetition of the sensory effect on the two retinae. Muller, and other physiologists, have, indeed, denied that anything is gained in illuminating power by the use of two eyes. If one eye only be used the pupil is said to dilate so as to admit double the quantity of light. This I believe to be an error. The united picture in the stereoscope always appears brighter and more distinct than either

separately. I took two photographs in rapid succession, of the same individual, one eye being closed in the first instance, and on measuring the diameter of the pupil with a micrometer microscope, there appeared extremely little difference in the two cases.

We have, then, two eyes, first, that the impression on the sensorium may be intensified by repetition; secondly, as a safeguard, that if the use of one be lost, so precious a sense may still be retained; thirdly, that the two dissimilar impressions may afford data for estimating more perfectly the distances and directions of near objects; besides other less important uses.

It is deeply interesting to notice the many analogies between the senses of hearing and of sight. Thus, we have single hearing with two ears,—binaural hearing,—the result of the union by the sensorium of the two dissimilar impressions. And if the brain be disordered, as by intoxication, or bodily ailments, double vision, as well as confused hearing, are common results. Nay, the musical pitch of the two ears often differs, say half a note, just as the focal length of the two eyes often differs. Binaural hearing also enables us to judge of the direction and distance of sounds—solid hearing. The axes of the two auditory apparatus are not opposite each other, but form an obtuse angle directed forwards and outwards. According to Buchanan, the direction of this angle exercises a remarkable influence on the auditory sensibility. Monoaural hearing will give us a partial appreciation of distance by the perspective, as it were, of sounds; their varying intensity, their light and shade; whilst the dissimilar impressions on the two ears render this determination far more perfect.

To conclude, the eye and the ear are to us what the instruments of the surveyor are to him; they are widely separated to give us a base line, at the ends of which are stationed our most perfect instruments of observation. At first we judge of the dimensions, forms, and distances of objects by the sense of touch. We grope about the world. After a time, and very slowly, we transfer the information thus gained to the eye and the ear, which, as they become more highly educated, enable us to judge of distance and direction without actual contact.

[This paper was illustrated by a large number of Stereoscopic views, and various instruments, including several forms of Brewster's Lenticular Stereoscope; Knight's Cosmoramaic Stereoscope; a new form of Stereoscope, with lenses of large size, by Abrahams, Lord-street; and a very large Wheatstone's reflecting Stereoscope.]

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4th December, 1856.—ARCHAEOLOGICAL SECTION.

J. TOWNE DANSON, F.S.S., V.P., in the Chair.

The minutes of the last ordinary meeting were read and confirmed.

After the usual ballot, the following were declared duly elected as members of the Historic Society:—

Sir J. P. Kay Shuttleworth, Bart., Gawthorp Hall, Burnley.  
 John Ansdell, Esq., St. Helens.  
 Frederick Broughton, Esq., Ulster Railway, Belfast.  
 W. G. Crory, Esq., 7, Upper Duke Street.  
 Walter W. Driffield, Esq., York Buildings, Sweeting Street.  
 Robert Evans, Esq., Eldon Grove, Rock Ferry.  
 John O'Donnell, M.D., 34, Rodney Street.  
 Rev. Philip Frost J. B. Hains, The Parsonage, Hoylake.  
 Edward Howell, Esq., Church Street, Liverpool.

The following donations were laid upon the table:—

From Lord Londesborough. *Miscellanea Graphica*, No. ix.

From the Author, Chas. R. Smith, Esq. *Collectanea Antiqua*, vol. ii, pts. 1 and 2.