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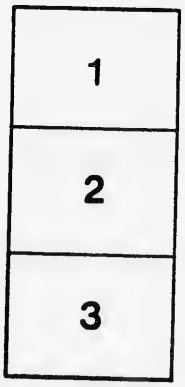

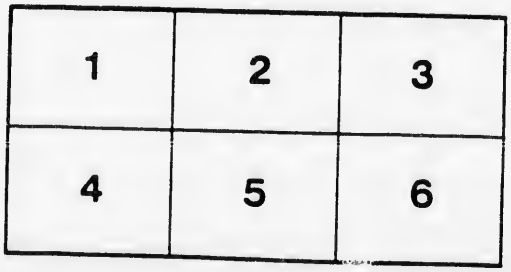

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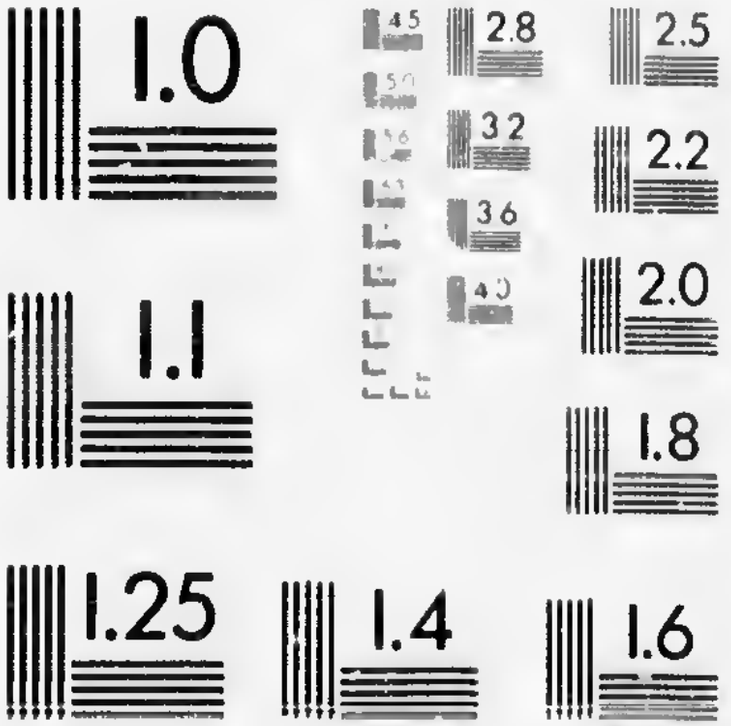

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STEREOSCOPIC VISION.

BY

G. P. GIRDWOOD, M.D., M.R.C.S., Eng.,

Professor of Chemistry, McGill Medical Faculty; Consulting Surgeon Montreal General Hospital; late Asst.-Surgeon Grenadier Guards, F.R.S.C., F.C.E., F.I.C., etc.

Reprinted from the Montreal Medical Journal, July, 1900.

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When looking around us, if we have good vision with both eyes, we see surrounding objects in their normal position as regards distance from us, and are able to say that one object is nearer than the other; but if we have only one eye, the other being blind or temporarily covered, the picture presented to us appears flat, and the relative distance of objects is not preserved to us. On investigating this phenomenon, we find that the two eyes are normally about 2½ inches apart from centre to centre, and that we converge the axis of the two eyes on different objects, and thus view the whole picture, the object converged upon being the prominent feature in the picture for the moment, and we really see two pictures, one with each eye, the central object of which is the object on which convergence is made, and that these two pictures are blended by means of the perceptive faculty of the brain, and we see only one picture. The two pictures as presented by the two eyes are not identical, and this may be readily shown by taking two pictures with a lens placed in two positions 2½ inches apart and comparing the two pictures. They will not be tracings one of the other, but the point of convergence will be the centre of each, and other objects will take their place accordingly. This will be easily proven if we place two objects in line with our nose, and alternately converge on the nearer object and the distant one.

If we converge the eyes on the distant object, it will be seen that there are two images of the near object visible, and in like manner, if we converge our eyes on the near object, two of the distant objects will be visible.

If now, whilst converging the eyes on the distant object, and the two images of the near object are both visible, one eye, say the right eye, be closed or covered, the left-hand image of the near object will be obliterated, and if the left eye be closed or covered, the right-hand image of the near object disappears. (Fig. 1.)

Again, if whilst converging the eyes on the near object two images of the distant object are visible, and if, whilst converging on the near object, and the two images of the distant object are visible, the right eye be closed or obscured, the right-hand image of the distant object disappears, and if the left eye, the image on the left disappears.

If now two objects be placed in line with the nose and the eyes con-

verged on the distant object, a card may be held up on the same line so as to obliterate the near object altogether, and the distant object remains visible as one object. (Fig. 1.) But if eyes are converged on near object, two images of the distant object will be seen, and if the right eye be closed or obscured, the right image of distant object will be obliterated, and if the left eye, the left image will be obliterated, and if two cards be gradually pushed in from outside towards the median line, both distant images can be obliterated whilst the near object remains visible. (Fig. 2.)

These experiments show that two distinct pictures are seen by the two different eyes, and that, therefore, to obtain true stereoscopic vision, two distinct pictures must be presented to the two eyes, the left to the left and the right to the right eye.

If, however, the pictures be reversed and the left picture put to the right eye, and the right picture to the left eye, the reverse effect is produced, and the distant object or portion of object appears near, instead of distant. In Foster's Physiology a drawing is given, from which the drawings produced are copied A. In this the foreshortening is given on the inside of the two pictures, and in B, I have reversed the sides; that is, I have put the right picture of A to the left eye in B, and the left eye picture of A to the right eye of B, and now they appear reversed in A. The object when viewed in the stereoscope appears as a solid truncated cone, whilst in B the effect of looking into a hollow truncated cone is produced.

On viewing any of these pictures with the stereoscope, they appear as if seen in relief or as solid objects, because the instrument gives to each eye its proper picture and the brain blends the two pictures into one.

It is quite possible, and most people with a little practice can see these pictures stereoscopically, the centres are placed 2½ inches apart, and if held opposite their respective eyes, and the axis of the two eyes be made parallel, each eye will see its own picture, and the brain will blend them together. On looking at one of these pictures with the eyes parallel, that is, converged on infinity, three pictures will be seen, a central picture which appears solid, and a picture on either side which appears flat and wanting in solidity.

If whilst looking at one of these cards and seeing the three pictures, a card be passed up between the eyes, it will be found that the two outside pictures are cut off but the central one remains visible and appears solid.

If when looking at the card and the three pictures are visible, either eye be obscured, the centre solid object becomes flat and loses its rotundity and the third image on the side opposite to the obscured eye is lost.

If when looking at the card and the three pictures are visible, the card be altered in its horizontal level so as to raise one picture above the

other, the centre picture no longer appears solid, but is seen to consist of two images, which move as the level is altered.

From these experiments it is clear that when the card is looked at with the axis of the two eyes converging on infinity, in reality an image of each drawing is seen by each eye, so that in reality there are four pictures presented to the brain, but the two which are opposite to the respective eyes are blended into one solid object, by the brain, and the other two pictures are seen by the respective eyes to the inside of the picture which is opposite to the eye, and hence when the card is placed between the two eyes it is the two lateral pictures which are cut off, and the central solid object is still seen.

The practical use of these observations is that if a picture be taken stereoscopically and mounted so as to have left picture opposite left eye and right picture opposite right eye, the solidity will appear as correct from the point of view taken, but if the pictures be reversed, the view appears to be from the opposite side. And if the eyes can be practiced to look straight before them, that is, parallel axes or even a little divergent, and an object be placed before one eye and a blank sheet of paper before the other eye, it will be perfectly possible with a little practice to draw on the blank sheet with one eye what is seen with the other eye; hence it is possible to look down a microscope with the left eye and draw on a sheet of paper by the side of the microscope with the right eye what is seen by the left; and in like manner, if a mark be made on a piece of paper opposite the left eye, and looked at stereoscopically, that is with paralleled vision, a line can be drawn on the paper exactly under the line seen by the left eye which will be found to be $2\frac{1}{2}$ inches apart from the first line, a second and a third, or as many as are desired can be drawn equidistant.

In skiagraphy the advantage of these observations is that a picture may be taken stereoscopically, and by reversing the picture a view of both sides may be obtained as the parts, even the bones are so largely transparent.

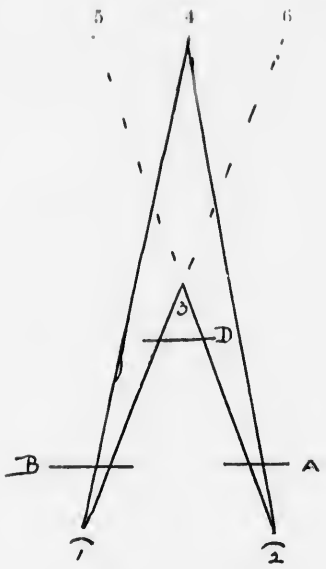


FIG. I.

1 and 2 are eyes, 2½ inches apart, 3 a near object, 4 a distant object in line with the nose, convergence of eyes on distant object 1, 2 images of near object are visible a a at 5 and 6. Card placed at A cuts of 4 and 5 from 2, leaving 4 and 6 visible by 1, If card placed at B, 4 and 6 are cut off from 1, but 5 and 4 are visible. Card placed at D cuts off 5 and 6 but 4 is visible to both eyes.

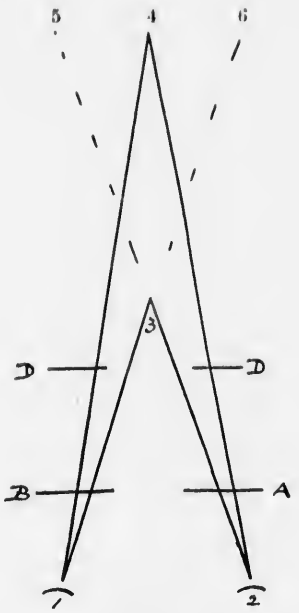
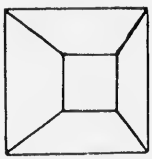
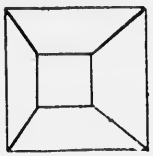


FIG. II.

1 and 2 are eyes, 2½ inches apart, 3 a near object, 4 a distant object in line with nose. Eyes converge on 3, two images of 4 are seen one on either side of 3. Card placed at A, 4 and 5 will be cut off from 2, if at B 4 and 6 will be cut off from 1, if 2 cards are held at D, 4 will be cut off from 2, or 4 will be cut off from 1, whilst 3 will be seen by both eyes.





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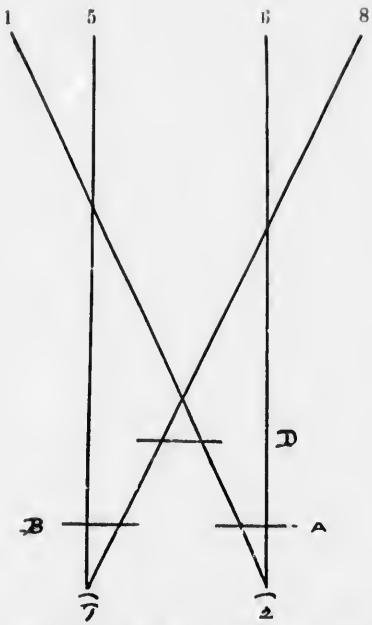
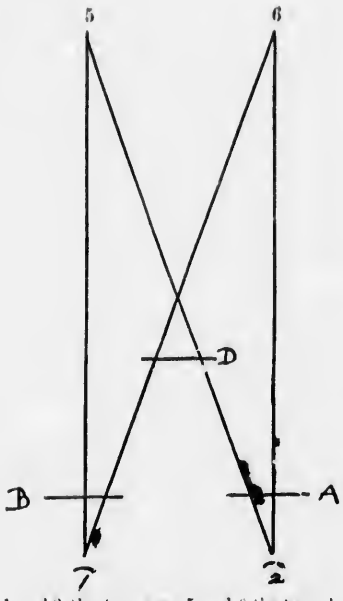
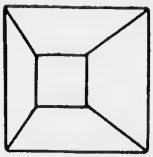
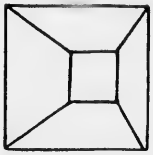


1 sees 5 opposite to itself and 6 as at 8. 2 sees 6 opposite to itself and 5 as at 7. Brain puts 5 and 6 together in middle and solid. Card at A cuts off 6, making middle picture flat and cuts off 5 as seen at 7. Card at B cuts off 5 making middle picture flat, and cuts off 6 as seen at 8. Card at D cuts off the images of 5 and 6 as seen at 7 and 8, whilst 5 and 6 are seen by 1 and 2 respectively and are seen as a solid object.



1 and 2 the two eyes, 5 and 6 the two pictures opposite the eyes. 1 sees 5 opposite to it and also sees 6 to the inside or right side of it. 2 sees 6 opposite to it and also sees 5 to the inside or left side of it. The Brain puts 5 and 6 together solid and in the middle, 5 is seen by 2 to the left of the conjoined figure and 6 is seen by 1 similarly to the right of conjoined picture. Card at A cuts off 6 and 5 from 2, at B cuts of 5 and 6 from 1. At D cuts off side pictures of 5 and 6 from opposite eyes 2 and 1, but 5 and 6 are seen solid around the edges of card.





B