An optical illusion

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Frequently while making models of crystal structures from spokes and connectors, we have observed the following optical effect. When a polyhedron, outlined in light-colored rods and strongly illuminated, is rotated against a dark background, a pattern of black lines is seen inside the polyhedron, firmly located in space, but moving slightly as the viewing position is changed with respect to the axis of rotation. Figure 1 shows an example: here an icosahedron is rotated about a five-fold axis.

If the background is made bright and the model dark, the same system of lines appears, identical in position but now light against a darker ground.

Since finding an early letter asking for an explanation (Pendred, 1938), we now attempt to give one.

The phenomenon is due to the stroboscopic occultation by the nearer rods of the light reflected from the further rods and is related to that exploited in the zoetrope of about 140 years ago. Because of the persistence of vision, both the further and the nearer rods give continuous sheets of illumination, so that the resultant is normally the sum of the two intensities, except where the front and back rods overlap. At such points the illumination is only that due to the nearer rod.

The dark trace is seen located in space because each of the two eyes of the O sees it in a different direction. Figure 2 shows the simplest case.

AA' represents a rod at the side of the polyhedron remote from the O and moving toward the right. Suppose the eyes are focused

Fig. 1. Photograph with 1-sec exposure of an icosahedral framework rotating at about 6 rev per sec.

Fig. 2. Diagram of the apparent movement in space of the point of intersection of a rod AA' moving to the right and a rod BB' moving to the left when viewed with both eyes.

on, and are also convergent onto, this plane. Suppose also that there is a rod BB' on the side nearer to the O moving to the left, and that BB' represents it as projected onto the plane AA' from a point midway between the O's eyes. The locus of the intersection of the two rods then moves upward along C'C. But the projections of the nearer rod from the right and left eyes are different and are represented by B'R-BR and B'L-BL, respectively. The eyes thus see the point of intersection as moving along the lines C'R-CR and C'L-CL, which have a parallax of δ . However, as the two views of the nearer rod have a parallax of δ , the black line appears to be midway between the nearer and the further rods.

Time exposure photographs (such as Fig. 1) show the black lines; flash photographs, under the same conditions, do not.²

REFERENCE

PENDRED, L. An optical illusion. *Nature*, 1938, 141, 1018.

NOTES

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2. We are grateful to Mr. D. D. Parry for taking these photographs.

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