The Thresholds for Visual Movement¹.

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I. Introduction.

When the velocity of any given moving object in the visual field is increased continuously from zero to a high velocity, let us say that of a rocket, the visual perception of this object shows several distinct states. Up to a certain point in the increasing physical velocity the object is seen as though it were at rest and the fact that it is moving can only be deduced from the fact that it changes its position in reference to other objects in the visual field. Suddenly with additional increase in the physical velocity it is seen as moving and the apparent rate of movement changes from very slow to very fast. Then comes a series of changes where movement is still recognized, but where the makeup of the object is apparently changed. Finally there is experienced only a streak in the visual field.

This investigation is concerned with the conditions under which these psychological changes occur, i. e. with what I shall call here the lower threshold for movement and the upper thresholds for movement. To define these thresholds more clearly let us consider an actual laboratory experiment.

¹ This investigation was undertaken when the writer was a National Research Fellow in the Biological Sciences. I am indebted to Prof. W. Köhler and the staff of his institute for the resources put at my disposal. My thanks are also due to Mr. Calavrezo, who helped me as assistant and subject.
Behind a diaphragm aperture $15 \times 5$ cm. a white paper band moves upward on which black squares of 1.6 cm. are pasted at 20 cm. intervals. Across the diaphragm aperture is stretched a black thread knotted in the middle. The paper band is lighted from behind the diaphragm, so that in the dark room only a white rectangle ($15 \times 5$ cm.) is seen through which a black square moves upward through the 15 cm. dimension. The subject, seated 2 m. from the diaphragm, fixates with one eye the knot in the black thread and reports what he sees. As the physical velocity of the moving square is increased continuously from 0 to 200 cm./sec. the following stages are reported.

1. No movement seen. The square, however, is known to be moving because after some time it is seen nearer the top.
2. The square is seen as moving in parts of the visual field but not in all.
3. *Slow movement throughout the visual field.
4. Gradually increasing velocity from slow to fast.
5. *The square moves to the top, apparently moves backwards to the lower edge of the diaphragm aperture and moves to the top again at a high speed.
6. *Instead of one square, two squares are seen. Also backward movement, as in 5.
7. *A light grey line with some darker sections is seen. Flicker and movement.
8. A smooth grey line fills the middle of the diaphragm aperture.$^1$

The first appearance of the starred stages as the physical velocity increases represent what I shall call the thresholds for movement in this paper. They represent psychologically distinct perceptions and correspond to certain physical velocity values for any definitely structured visual field.

Recently I demonstrated$^2$ that the apparent velocity of moving objects is conditioned equally as much by the structure of the visual field in which the movement occurs as by the physical velocity of the object. This raised the question as to whether or not the thresholds for movement are also conditioned by the same factors as the phenomenal velocity itself. Some evidence was gathered that they are. Also other investigators had found cases where the movement thresholds varied in accordance with field structure. The purpose of this paper is to test out the working hypotheses formulated previously, namely

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$^1$ For a more thorough phenomenological description of the changes undergone by moving objects at high velocities, see W. Metzger, Psychol. Forschg 8, 116, 125 (1926). The list of changes given here is perhaps not complete but for purposes of introduction can be looked on as typical.

$^2$ J. F. Brown, Psychol. Forschg 14, 199—232 (1930)).