The Third Dimension in the Projection of Motion Pictures
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mental conditions. Thus the various sociometric techniques may now be studied and related to various clinical problems of the classroom. A program of research dealing with this problem is now being organized and will be reported at a later date. The procedure further lends itself to certain types of rote learning required in vocational, trade, and military schools where simple 'factual' relations must be memorized. Here the salutary feature is that the learner is tested immediately and the test thus truly becomes a part of the learning situation.

THE THIRD DIMENSION IN THE PROJECTION OF MOTION PICTURES

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In 1906, I pointed out that some moving pictures gave directly the impression of the third dimension without stereoscopic vision and I explained their operation and the psychological phenomena involved.[1] Since then the problem of depth in the projection of pictures has been of particular interest to me. In 1914, I described the impression of relief in the projection obtained by superimposing the images of the right and left eyes on the screen, each image being in a color complementary to the other—green and red.[2] The spectator was required in that instance to wear spectacles made of filters of the same colors, hence each eye saw only its corresponding image.

At present I have another method in mind. In the belief that stereoscopic vision is possible, not only in the simultaneous presentation of the images of the two eyes but also by their successive presentation, I attempted to develop a practical method of obtaining tridimensionality in moving pictures that would make the use of filters and other devices by the spectator unnecessary.

The impression of depth can be obtained in moving pictures by alter-

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[1] August Pi Suñer, La inférence perceptive du relief dans certaines cinématographies, *C. R. Soc. biol.* 60, 1906, 86 ff.

[2] Pi Suñer, El relleu cinematografic, *Treballs de la Soc. de Biologia de Barcelona.* 2, 1914, 1 ff.

nately projecting right and left stereoscopic pictures, but to achieve it, it is necessary to use a device which restricts each eye to its own picture. This method is not different in principle, therefore, from the simultaneous projection of two pictures with each eye being restricted to its own image. When stereoscopic pictures are alternately projected without those restrictions, *i.e.* when the successively projected pictures are seen by both naked eyes simultaneously, a very poor or no perception of depth results. The pictures do not fuse; they vibrate, blur and show distortion.

By experimenting with the alternate method of projecting right and left pictures, we discovered that the distortion is corrected and the perception of depth results when the projection is viewed simultaneously by both eyes through the openings of an episkotister that is rotating at a speed above the flicker-rate. Viewed through this apparatus, some parts of the projection-screen are visible to both eyes, *V;* some are invisible to both eyes, *I;* some are visible only to the right eye, *R;* and some only by the left eye, *L.* The components at any instance are *R V L I* and we have, as the projection is continued, a sequence of *R V L I—R V L I—R V L I,* etc.

The parts of the projection common to both eyes, *V* and *I,* and the parts seen exclusively by each eye, *R* and *L,* are equal to each other; *i.e.* $V = I$ and $R = L$. At optimal conditions of perception, the 'common' parts and the 'exclusive' parts are equal, *i.e.* $V + I = R + L$. The relation between the 'common' and 'exclusive' parts varies, however, with (a) the position of the episkotister between the observer and the projection-screen and (b) the size of the sectors in the episkotister, which should be equal for the best effect.

If the distance between the observer and the episkotister is changed without a corresponding change being made in the distance between the episkotister and the projection-screen, the relation of the 'common' to the 'exclusive' parts is changed: $V + I$ becomes greater or less than $R + L$, as the distance is increased or decreased. The relation of the parts in each pair is not, however, changed; the equations, $V = I$ and $R = L$, still hold.

It will be readily understood, therefore, that when the projection sequences are given separately for each eye (showing only the parts seen)

Right eye: *—R V—, —R V—, —R V—,* .....

Left eye: *— —V L, — —V L, — —V L,* .....

each eye will see the visible 'common' part and its own 'exclusive' part, and will fail to see the invisible 'common' parts and the part exclusive to the other eye.

The episkotister through which the projection-screen is viewed successively covers and uncovers different parts of the picture. This fragmentation and production of 'exclusive' portions of the alternately projected right and left pictures give the perception of depth. The fact that the opaque sectors of the episkotister are not perceived—due to the speed of rotation in our device—does not suppress the phenomena of fragmentation, selection, and psychological synthesis which produce the perception of depth. Although we are not dealing here with two superimposed stereoscopic pictures, as in the case of the stereoscope, the succession of right and left images and the vision of both eyes are required to produce the perception of depth.

The projection of an ordinary film does not, when viewed through our device, yield the perception of depth. When right and left pictures are alternately projected and are viewed through the episkotister, the perception of depth disappears when the observer closes one eye.

Slides of right and left pictures and films with alternate pictures demonstrate the possibility of creating the perception of depth in still and in motion pictures by our simple method which does away with the necessity of using individual devices such as glasses, etc.

Our method represents an interesting technical advance, but just as important as the demonstration of the possibility of achieving the perception of depth through the processes of fragmentation and selection, is the theoretical significance of the facts.