Letters to the Editor

Re: Three-Dimensional Motion Picture Nomenclature

I have read with great interest Major Bernier's article on "Three-Dimensional Applications" which appeared in the *Jour. SMPTE, 56:* 599–612, June 1951.

Major Bernier is to be congratulated on his paper and also on the interesting experimental work which he and his unit are conducting. The writer would, nevertheless, like to draw attention to a few points in the paper in connection with which there seems to be some confusion.

On page 599 in the *Journal*, reference is made to "the composite or lenticulated system," but just what Major Bernier is endeavoring to convey by this terminology is not clear. There are three main groups of processes (embracing hundreds of different modes of application) which might conceivably, but should not, be referred to in this way. These three groups comprise: (1) integral processes, which had their genesis in the idea conceived by Gabriel Lippman and disclosed by him in 1908 (*Compt. rend., 146:* 446–51); (2) parallax stereogram processes, all of which are derived from the principle described in Frederic Ive's U.S. Pat. 725,567 (application date, Sept. 25, 1902); and (3) parallax panoramagram processes, which depend on the principle of C. W. Kanolt, described by him in his U.S. Pat. 1,260,682 (application date, Jan. 16, 1915).

The problems involved in producing spherically lenticulated film as proposed by Lippman were not solved during the inventor's lifetime, but the earliest practical process (for still photography) employing a cylindrically lenticulated screen with which the writer is acquainted was described by Walter Hess in 1911 in his Brit. Pat. 13,034.

The most important of Dr. Herbert Ive's ideas relating to stereo kinematography are those embodied in Brit. Pat. 348,118 (application date, Feb. 7, 1930) and his corresponding U.S. application (convention date, Feb. 9, 1929). Very many other processes involving the use of line or lenticular grids, for both still and motion pictures, were evolved between 1911 and 1929.

In discussing, on page 601 of the *Journal*, the various factors contributing to depth perception, Major Bernier has again departed from accepted terminology, and this may be confusing to some with limited knowledge of the subject. For example, factor No. 4, in Major Bernier's list should read "Accommodation," not "Focus reaction," and factor No. 6 should read "Binocular vision," not "Stereoscopic vision."

The word "stereoscopic" means (freely translated from the Greek), of course, "seeing solid" or, as we are accustomed to say, three-dimensionally or stereoscopically. Accordingly, the term "stereoscopic vision" applies to the net effect resulting from the various contributory factors. In compiling a "short list" of these factors, it is, in the writer's opinion, difficult to improve on the custom of dividing them into two groups: (1) monocular factors; and (2) binocular factors. In the first group the chief factors are accommodation and perspective, and in the second group we have parallax and the faculty of convergence. There are numerous subsidiary factors, some of which are mentioned by Major Bernier.

Referring to the comments in the second paragraph of page 601, whilst it is, of course, true that accommodation becomes of decreasing importance with increasing distance of the object, neither this fact nor any other warrants definition of a distance of 20 ft as "optical infinity."

The reasoning on the next paragraph of the paper is based on a fallacy. It can best be demonstrated experimentally that the faculty of accommodation is stimulated practically always when one is watching projected motion pictures. The apparent size of the image is no less important than the distance of the screen in determining the degree of stimulation. Let us suppose, for example, that the film being projected depicts an object moving toward or away from the observer so that it is progressively either increasing or decreasing in size. If the object depicted is a familiar one, and the apparent size of the image corresponds to a distance within the normal range of accommodation, the eye will attempt to accommodate for that distance. This momentarily throws the screen out of focus, so the eye then re-accommodates for the plane of the screen. If, by that time the image of the object — assumed to be still moving — is at a different "apparent" distance within the range of accommodation, the eye will attempt to accommodate for the new distance, thereby again throwing the screen out of focus. This cycle of events recurs with great rapidity, and is sometimes the cause of headaches amongst elderly cinema patrons, whose ocular sensory organs and muscles are, naturally, less responsive than those of younger people.

With regard to the main subject discussed in Major Bernier's paper, namely, the development of alternate-frame stereo techniques, it is, perhaps, worth drawing attention to the fact that the majority of the basic problems involved were investigated in England by the writer, Edwin Wright and others several years ago. Work on such processes has been abandoned by most workers in this country, mainly owing to recognition of the fact that the disadvantages resulting from "time parallax" are inherent in all alternate-frame systems.

There are several known methods of overcoming the flicker problem, that developed by Wright being as satisfactory as any; the writer considers it preferable to the use of the more complex Morgana shuttle movement. A description of Wright's method is given in the writer's book, *Stereoptics — An Introduction*, Macdonald & Co. Ltd., London, 1951.

Major Bernier's comments concerning the flicker problem are made somewhat difficult to follow by this use of phrases such as "a flicker frequency of 72 frames/sec, or 36 frames/sec per eye," which do not really convey what the author intended, as the important matter is the number of *occultations* per second rather than the number of frames.

To understand the nature of the flicker problem it is essential to appreciate that with any projection system, whether stereoscopic or planoscopic, the rate of flicker per second is equal to the number of times per second that light is occulted from each eye. Thus, in ordinary planoscopic projection, the flicker rate is equal to the product of the number of frames projected per second and the number of blades in the shutter. When projecting planoscopically at 16 frames per second, for example, the flicker rate is 32 or 48 per second according to whether a 2-blade or 3-blade shutter is employed. In neither of these two cases is flicker perceptible to the eye, so the term "flicker" is really a misnomer in such instances. It is readily demonstrable that the minimum rate of occultation necessary to prevent the occurrence of objectionable flicker is about 24 frames/sec, this rate being achieved at a projection speed of 12 frames/sec with a 2-blade shutter or 8 frames/sec with a 3-blade shutter.

Now, with stereoscopic systems of the type in question, light is occulted from each eye every time a picture intended for the other eye is projected. This means that in addition to the faster, imperceptible occultations produced by the shutter, there occur occultations at a slower rate numerically equal to one-half the number of frames projected per second. Accordingly, in order to provide the necessary minimum of 24 occultations per second for each eye, a projection rate of 48 frames per second must be adopted, regardless of the number of blades in the shutter. As this is generally impractical, it becomes necessary to adopt some arrangement such as those used by Wright and Major Bernier. The writer ventures, nevertheless, to express the opinion that such arrangements are not really worth while owing to the facts that "time parallax" errors are still present and that the apparatus is somewhat complex. He would like, in conclusion, to draw attention to the new single-film polarized light process some particulars of which are given in his paper "Stereoscopy in the Telekinema and in the Future," which appeared in *British Kinematography, 18, No. 6:* 172–181, June 1951. This would appear to be the most satisfactory polarized light process so far developed.

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