

Reply to the Letter Above

The recent letter by Mr. L. Dudley, director of the Laboratory, Odeon Theatre, London, indicates his confusion in reading my paper "Three-Dimensional Motion Picture Applications," published in the June 1951 issue of this *Journal*. I would therefore like the opportunity to set forth in more detail the explanation of certain phraseology and certain technical aspects with which Mr. Dudley was confused.

He points out that "there are three main groups of processes, which might conceivably, but should not be referred to as the "composite or lenticulated system," as I did on page 599 in the *Journal*. Although he listed the three main groups, he didn't give any indication of how that type of three-dimensional photography could intelligently be referred to. As I see it, each of the groups has one thing in common: namely, that a viewing device on or near the eyes is not needed to vision the three-dimensional results. Each depends on a medium near the picture surface to selectively direct the proper views of the subject to their respective eyes. To produce a stereoscopic vision in the brain, this medium is dependent, in all cases, on one basic fact, that the eyes are displaced. Since the groups, as Mr. Dudley refers to them, are therefore more or less related, there should, in my opinion, be some definite means of referring to them.

I could not find anything in the literature which seemed to suitably express this phase of stereoscopy, and as a result chose to refer to the latest refinements of it as the "composite or lenticulated" system. As to the source of the expression "composite," it appears in the reference book *Medical Physics*, edited by Otto Glasser, Ph.D., Year Book Publishers, Inc., Chicago, 1944-1950, on page 1326 in a treatise on three-dimensional photography. The article under a paragraph heading "Trivision" reads "Early in 1941, the Winnek Laboratory introduced a new process of composite stereography, now called "Trivision." Composite photography, as defined in Webster's New International Dictionary, means a photograph or portrait made by a combination, or *blending* of several distinct photographs, either made one over the other, or made

on one print from a number of negatives." This, in my opinion, comes very close to describing the condition that exists in the present picture emulsion of the French "Portrait en Relief," the British "Deep Pictures," or the American "Trivision," and other trade processes, all of which stem from the pioneering efforts of H. E. Ives (1902), Lippman (1908) and, of course, Berthier (1896).

These refinements of which I speak, consist in segregating and resolving (within limits), by means of a lenticulated surface in front of the emulsion, a continuous changing view, or an infinite number of views of the subject. Thus, when the composite picture is viewed through the same or an identical lenticulated surface, left and right views are selectively projected to their respective eyes. Reasonable freedom of movement of the viewing position either laterally or perpendicularly to the picture is possible, because any two views of the composite, within the angle of coverage of the lenticulation formula employed, will always be a left and right view of the subject, and will be directed to the left and right eyes, respectively.

The reason, thus, that I referred to this phase of three-dimensional photography as the "composite" or "lenticulated" system is because, in my opinion, this phraseology most adequately describes this process of three-dimensional photography which in turn has enjoyed limited recent popularity as a result of a more efficient combined use of these two basic features.

I chose to use "Focus reaction" rather than "accommodation" in listing my interpretation of the basic factors of depth perception, because it seemed to me that this expression would be more easily understood by the layman, rather than the more technical expression "accommodation," used almost exclusively in ophthalmic practices. Also, I intended to imply that it is not, in my opinion, the difference in the character of the focus of objects which notifies the brain of their relative positions in space, but on the other hand the reaction due to the tensing of the ciliary muscles.

In connection with my use of "Stereoscopic vision" as the sixth factor, instead

of the commonly used phrase "Binocular vision," I reasoned that it is possible to use "two eyes" in certain cases, but not to be able to see stereoscopically. For example, the conventional binocular microscope has two oculars, but only one objective; and thus when using such a microscope binocularly, one does not see stereoscopically. This is also true of some binocular viewers for single Kodachrome transparencies; also when viewing any single photograph or painting binocularly the subject matter cannot be seen stereoscopically. Thus it would seem that the only requirement to actually view subject matter stereoscopically is to change the angle of convergence of the eyes for different planes of depth.

We view present two-dimensional color motion pictures on the screen with both eyes, or binocularly, but we cannot see the subject matter stereoscopically because of the absence of the requirement to change convergence for different planes of depth. This would be a case where all the factors that Mr. Dudley would like listed could be activated, but we still could not see the subject matter stereoscopically. This is the reason I chose to use "Stereoscopic vision" rather than "Binocular vision" as the sixth factor of depth perception.

It seems to me that his reasoning "that stereoscopic vision is the net result of the various contributing factors" is based on a fallacy. Stereoscopic vision is achieved in the "Anti-Aircraft stereoscopic height finder" without any of the contributing factors Mr. Dudley mentions, except the "faculty of convergence." The determination of the slant range of aircraft in this case, depends solely on this factor, and as I chose to say "Stereoscopic vision."

In connection with Mr. Dudley's objection to my use of the expression "Optical infinity," and that I indicated that it could be considered as 20 ft, I would like to point out that this is a common expression in the field of ophthalmology and optometry, and to all American trained optometrists the expression immediately suggests 20 ft, since this theory for many years has been and is being taught in American colleges and universities (see textbook *Outline of Optometry* by I. M. Borish, page 36, Sec. 8 A1, or *Physiological Optics* by W. D. Zoethout, 4th ed., Pro-

fessional Press, Inc., Chicago, 1947, page 38, paragraph titled "Principal Foci.")

The next paragraph of my paper, contrary to Mr. Dudley's opinion, is based on the fact that there is a direct relationship between accommodation and convergence. Namely, that when converged at a certain distance, the eyes in a normal individual will also automatically focus for that distance and vice versa. This relationship is thoroughly discussed on pages 431 and 432 of A. C. Hardy and F. H. Perrin's *The Principles of Optics*, first edition, ninth impression, Camera Craft Publishing, San Francisco, 1943. Thus, if what Mr. Dudley says is true it would seem to me that referring to the examples he gives of a film depicting objects moving toward or away from the observer, that the eyes would also want to change convergence. If they change their convergence to follow the apparent position of this moving object, the result would be double imaging. This also should occur "with great rapidity," but I don't believe it does. I maintain, as indicated in my paper, that as long as subject matter in the three-dimensional motion picture appears no closer than 6 or 8 ft from the observer, accommodation errors will not result. I cannot agree with Mr. Dudley on the cause of headaches amongst some older people who go to the movies, since it is common knowledge in ophthalmic practice that they lose their power of accommodation as a result of progressive hardening of the crystalline lens as they grow older. This would indicate to me that as long as they were wearing glasses corrected for the screen distance, the subject matter on the screen would remain always in focus. Therefore it is interesting to note that when this be the case, especially with three-dimensional motion pictures, they will see subject matter clearly even when required to converge on three-dimensional screen objects, which could conceivably appear as close as two or three feet in front of their faces. As an added prediction, they will quickly realize that for such a phenomenon, they will not need to "peer" through their "bifocals."

I prefer not to disclose as yet what improvements have been made in connection with the alternate frame system. However, I would like to assure Mr. Dudley that the

"time parallax" problem has been completely solved, and that the alternate frame principle with the latest modifications shows promise, in my opinion, of being the most all-around satisfactory stereoscopic motion picture method to date.

In regard to my use of the phrase "a flicker frequency of 72 frames/sec, or 36 frames/sec per eye," I would like to clear up Mr. Dudley's apparent confusion in respect to the action of the Morgana movement. This movement, I made quite clear in my paper, actually transports frames of film in and out of the film gate at the rate of 72 frames/sec. This rate of frame transport is, therefore, exactly coincident with the shutter-blade rate, and therefore is also identical to the total "occultation" rate. Thus the right frames, for example, are transported in and out of the film at the rate of 36 frames/sec, which also equals the "occultation" rate for that eye, per second. Since, then, the actual framing rate is also equal to the flicker rate, I believe it reasonable to express the flicker frequency in terms of "frames per second." As I pointed out in my paper, since every third transport consists in moving a "frame backwards" out of the gate, the net result is a "progression of the film through the projector at standard sound speed."

Again I cannot agree with Mr. Dudley's contention that "the minimum rate of occultation necessary to prevent the occurrence of objectionable flicker is about 24 per second." If this were true it would not be necessary to use a two-bladed shutter in standard theater-type projectors, which in turn doubles the occultation rate with respect to the "24/sec" frame rate.

When the film *3 D Motion Pictures* was screened at the SMPTE 1951 Spring Convention, some may recall that there still remained some flicker. This was due to the comparatively slow flicker frequency of 36 frames/sec per eye. This frequency was somewhat objectionable, and to bring it up to present standards, improvements had to be made. A new projector, which will incorporate important changes will be ready to demonstrate in the near future.

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Obituary

Charles Ross died in June at the age of 63. He was President and sole owner of Charles Ross, Inc., a business which he started 30 years ago.

He began working for motion picture studios in New York City when a boy, one of his early employers having been the Biograph Studios. He was an electrician and he gradually built up stocks of everything from cables to equipment which eventually included every type of lighting or grip equipment for motion picture production.

He was educated in the New York public schools and some time after he had begun his business he and Pete Mole discovered in mutual reminiscing that they had

grown up in the same New York City neighborhood and gone to the same schools without then being acquainted. Charles Ross, Inc., has now for long been sole eastern agents for Mole-Richardson equipment. The firm's headquarters at 333 W. 52 St., New York 19, N.Y., is in the same neighborhood where Mr. Ross had offices and warehouse during his decades in business.

Besides being an Active Member of this Society, Charles Ross was a member of Motion Picture Pioneers, Theatre Equipment and Supply Manufacturers' Association, Stage Employeecs' Local #1 of the IATSE and Motion Picture Studio Mechanics Local #52 of the IATSE.