THREE DIMENSIONAL MOVIES

By ROBERT L. OGRAM

THE motion picture industry is one of the largest single industries in the world. There are, in the United States, 300,000 people directly connected with it, and 75,000,000 people pay $2,000,000 weekly in theater admissions. Considering these statistics it is evident that any new development in the motion picture industry would be of interest to the majority of people. This latest development is known as "Three Dimensional" motion pictures.

Very recently there was shown throughout the country a "short" known as "Audioscopics." This is the most simple and successful form of three dimensional movies yet developed. It consists of two images projected on the screen simultaneously, one in red and the other in green. These images represent pictures taken from points about two and one-half inches apart, or about the distance between a person's eyes. The audience views these images through color filters having one red lens and one green lens. The result is astonishing, and if you saw the demonstration you probably dodged when the baseball was thrown at you or the hose was turned in your direction. This type of projection is nothing new, however, for the same kind of pictures were shown in New York City thirteen years ago. Such pictures have not come into general use because of several glaring defects which will be pointed out later.

The principle of stereoscopic, or three-dimensional motion pictures is quite simple. It is based on a plaything called the stereoscope which was found in every parlor a few years ago. The stereoscope is a device through which it is possible to view two pictures at once, each eye seeing a different picture. The two pictures were taken from slightly different angles, and when each eye sees the picture intended for it the result is a picture in stereoscopic relief. It is the same as that old experiment in which a bird and a cage are drawn on a piece of paper, then another piece of paper is held vertically on edge between the eyes and between the bird and cage. Lo and behold, the bird is in the cage! From this it can be seen that there are two conditions absolutely essential for stereoscopic pictures: there must be two distinct images, and each eye must see but one of these images. In spite of these facts several attempts at stereoscopic motion pictures have been made without considering either of these conditions.

The most notable of these attempts was made by W. F. Alder, cameraman for the American Film Company, who claimed in 1935 that he had solved the problem of projecting motion pictures in relief. He began his research in 1912 when he noticed that some pictures he had taken from a moving automobile exhibited some stereoscopic qualities. Immediately he began experimenting by moving the camera back and forth while taking pictures. Again he got the same results, but this method was too cumbersome to be practical. His next thought was to move the lens back and forth, but such vibration damaged the lens and again he was stopped.

Finally he decided that the only solution to his problem was to move the image somehow as it was reflected onto the film. This he did and it solved his problem—but not the problem of motion pictures in relief.

Another attempt to solve the problem by special lighting was made. It was found that alternate lighting, first on one side of the subject, then on the other, improved photography immensely, and actually gave the pictures an appearance of depth. The trouble with this idea was that there was no good way of lighting in flashes at the rate of sixteen times per second. Lately, however, the mercury arc lamp has been perfected, and with this it is possible to get sharp flashes as rapidly as fifty-two times per second. This again did not solve the problem of stereoscopic movies, but it improved the photography so much that such lighting is being adopted by most of the studios.

There seems to be no way of overcoming the necessity for two distinct images, and the scientists are gradually confining their research to a practical method of using two or more images.

There are two types of stereoscopic projection using two or more images. The first of these is the type in which the images are separated at the eye. It can be divided into four sub-headings as follows: separation by color filters, separation by polarizing prisms, separation by prism or mirror viewer, and separation by shutters.

Separation by color filters is the simplest and is the type mentioned above. The first camera for taking such pictures had two lenses about two and one-half inches apart. The images were carried from the lens to a rotating mirror, silvered on both sides. As the mirror rotated it caught first the image from one side and reflected it onto the film; then it caught the image from the other side and reflected onto the next strip of film. The film was then developed, and the alternate pictures were colored red and green. When the film was projected on the screen and viewed through filters having one red lens and one green lens a stereoscopic view was obtained. Two disadvantages were the prohibitive cost of coloring part of the film red and part green, and the necessity of taking and projecting the pictures at twice the usual speed, or at a speed of thirty two exposures per second. The latter was necessary because each eye saw only every other picture, and flickering results if the eyes see pictures at a rate less than about sixteen per second.

These two difficulties have recently been overcome by taking two separate pictures from slightly different angles. One film is colored green and the other red, and one film is superimposed upon the other.

There are, however, two defects which cannot be overcome by the color filter method: first, this type of film cannot be adapted to natural color photography, and, second, continued use of the color filters would soon make a person color blind.

A recent development, based on the phenomenon known as "polarized light," eliminates the necessity for the color filters. As you know, light is made up of transverse waves. That is to say it vibrates like a string when one end is fixed and the other end is moved rapidly up and down. When light is passed through a tourmaline crystal, or through a thick layer of glass set at an angle, only those light waves are allowed to pass through which are vibrating in a certain direction. Now it can easily be seen that if another polarizing prism were put behind this, and it polarized light in the opposite direction, no light at all could pass through. Using this phenomenon and the camera mentioned above, stereoscopic pictures can be obtained. The pictures are taken as before but are not colored. The projector is equipped with a polarizing prism that moves so that the light from one image is polarized in one direction, and the light from the image is polarized in the opposite direction. The observer must, however, view these pictures through a viewer having polarizing prisms for lenses, adjusted so that each eye sees only the image intended for it. Here again we are confronted with the necessity of projecting the pictures at the rate of thirty-two per second. This is easily overcome by using two cameras and two projectors with polarizing prisms set at different angles. The difficulties here are the tremendous loss of light in the process of polarizing, and the necessity for designing a screen that will not depolarize the light.

There are two other devices for viewing stereoscopic pictures, but they are of small consequence. One consists of two screens upon which the two images are projected. A prism or mirror viewer is necessary so that each eye will see but one screen.

The other device shows, alternately, pictures that were taken from slightly different angles, and the viewer consists of two shutters that cut off the vision of the eyes alternately. Here again we meet the problem of projecting at twice the usual speed, and the problem of timing the shutters with the projector.

It can be seen that the one common defect of all these plans is the fact that the audience must be inconvenienced with some sort of a viewer, whether it be prisms, colored glasses, or shutters. One other common defect, although it hardly need be reckoned with, is the fact that, in the absolute meaning of the word, these pictures are not stereoscopic. That is to say that every person sees the same thing no matter where he may sit in the theater; if you see the right side of the actor's face, everyone else in the theater sees the right side of his face; or if the ball appears to be coming toward you, each other person sees it coming toward him. In true stereoscopic pictures, if you were sitting on one side of the theater and saw the actor's face, those on the other side would see the side of his face; or if you saw the ball coming toward you, the rest of the people would see it coming, not toward them, but toward you.

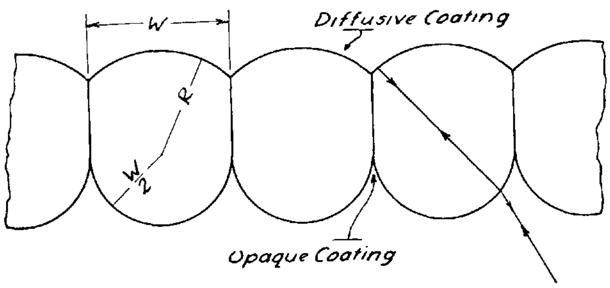
On first thought this seems impossible, but true stereoscopic pictures have actually been projected on a small scale in the Bell Telephone Laboratories. Theoretically, there is no reason why this will not work on a large scale, but, practically, difficulties have arisen that seem almost insurmountable.

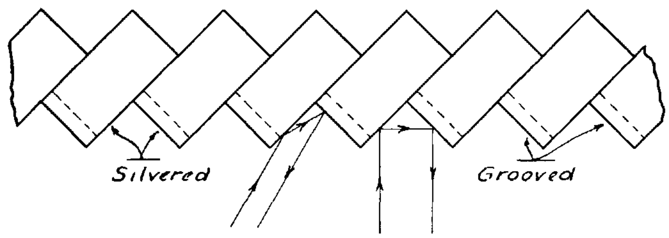
This second type of pictures differ from the first in that the images are separated at the screen, not at the eye. It is based on an invention of Dr. Herbert E. Ives called "parallax panoramagrams." No doubt you have seen a display window in which there was a picture that seemed to stand out in relief. That is, on walking by you saw views that were taken from slightly different directions. This is done by building a picture up of narrow strips of the pictures taken from different angles, and then viewing the pictures through a grating of opaque lines. The opaque lines cover all but the strips necessary to make a complete picture, and there is a different group of panoramic strips for all angles. This gives the picture the stereoscopic appearance.

In order to project such pictures on a screen it is necessary to take the pictures with a battery of cameras arranged in an arc about the subject. The pictures must be projected on the screen by a battery of projectors in the same relative position with the screen as the cameras were with the subject. In front of the screen is a grating with opaque lines running vertically. Now, no matter where the observer sits he will see only the picture from the projector directly on line with him and the screen. If he changes his position he sees a picture taken from a different angle. The result is pictures in stereoscopic relief. Two disadvantages of this arrangement are the loss of light, and the striped effect caused by the grating.

Recently, however, Dr. Ives has been able to overcome these difficulties by the use of special screens requiring no grating. He decided that his problem would be solved if he could find a screen that would reflect light directly back to its source, diffusing it vertically but not horizontally. After much work he was able to find two screens that met with these requirements.

One of these screens was built up of long, narrow





strips of celluloid or glass. The front edges of these strips were rounded off with a diameter equal to the width of the strips. The backs of the strips were also rounded but the diameter depended on the index of refraction of the material used. The back edges were painted with a diffusive paint, and the sides were painted with a black, opaque paint. These strips were then glued or clamped together and the screen was ready.

Another type of screen was built up of long, narrow glass strips, silvered on two adjacent sides, and grooved horizontally on one of these sides. The silvered edges reflect the light back to the source, while the horizontal grooves diffuse it vertically.

Either one of these screens eliminates completely the loss of light, and almost completely, the striped effect. Also, either one works excellently on a small scale, but if either were to be applied to a modern theater an accuracy of one fifty-thousandth of an inch would be necessary. Such a degree of accuracy seems almost impossible now. There is, however, a greater problem to solve. It is estimated that, for a theater fifty feet wide, a battery of three hundred projectors would be necessary. This would necessitate a corresponding number of cameras to take the picture.

If these difficulties are overcome, the big question is whether or not Hollywood can profitably adopt this type of projection. It will increase tremendously the cost of production; it will require much better photography and acting, as an infinite number of angles will have to be considered; and it will eliminate all close-ups. If the 75,000,000 weekly theater-goers want this type of pictures, however, Hollywood will think twice before saying "No."