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An Explanation of Black-and-White TV And of C. B. S. and R. C. A. Color

THE technical differences between the Radio Corporation of America and the Columbia Broadcasting System methods of transmitting color television lies in two main points:

(1) The method of injecting the basic colors of red, blue and green at the transmitter and receiver.

(2) The manner in which the individual signals of the red, blue and green colors are sent out on the air.

This is how black-and-white television works:

The scene to be televised is scanned by the camera. The scanning is done by having the camera tube sweep the scene line by line from the top to the bottom of the image, much as the human eye reads a printed page.

During the scanning process the tube in the camera picks up the shadings in black-and-white and translates them into electrical impulses. These impulses alternately represent first a black dot and then a white dot of the picture.

In all, the camera scans the scene sixty times per second, each scanning sending black and white impulses in sequence. It takes two such scannings to make a complete picture, which is known as a frame. Thus each second there are thirty frames, or complete pictures, in black-and-white television.

In the actual transmission, however, what goes out on the air might be likened to a continuous "ribbon" composed of black and white impulses. At the receiving end this ribbon is laid across the face of the tube, one strip—or line—underneath each other until the original image in the studio is duplicated on the home screen.

In black and white television, the picture consists of 525 of these lines.

This is how C. B. S. color works:

The scene is scanned in the same manner as in black-and-white. But the picture passes through a rotating disk containing filters for the primary colors of red, blue and green. In non-technical language, it can be said that first a red field reaches the tube in the camera, then a blue field and finally a green field.

These fields, in turn, are translated first into a series of impulses representing the red scene, then a series for the blue and, finally a series for the green. These separate fields are sent out over the air in sequence, hence the C. B. S. method is known as a "field sequential system."

In C. B. S. color the scene is scanned a total of 144 times per second—forty-eight times in red and a like number in blue and then in green. In other words, the C. B. S. has a total of 144 fields. But the C. B. S. requires two fields for each color, or six fields for a completed picture. This, in turn, means that C. B. S. produces twenty-four frames—or complete pictures—per second.

In the actual transmission of the C. B. S. color picture, it is necessary to go back to the series of red, blue and green impulses. When these are sent over the air, again the result is a "ribbon," but of a different sort. First there is a strip of "ribbon" which corresponds to red field impulses, then a strip for the blue and finally a strip for the green.

At the receiver this "ribbon" is laid across the face of the tube and the original picture reconstituted. This finished picture is seen through a second revolving disk which is synchronized with the disk in the studio cameras. As the red portion of the filter disk passes in front of the tube the strip of ribbon responsive to red is seen by the eye. The same thing happens when the blue and green filters pass by. It is the persistence of human vision which gives the continuously complete color picture.

The whole operation involving the filters happens so quickly—the disk turns at a rate of 1440 revolutions per minute—that to the human eye the image appears as a single color picture.

The C. B. S. system consists of 405 strips—or lines.

The fact that C. B. S. color has 144 fields, as contrasted with sixty for black-and-white, and 405 lines, as contrasted with 525 for black-and-white, is what makes it incompatible with present TV.

This is how the R. C. A. system works:

The scene is scanned. In the camera there are three separate pick-up tubes each of which is equipped with its own fixed color filter, one for red, blue and green. Each tube produces impulses which represent a red, blue and green dot in the picture.

In all, the camera scans the scene sixty times per second, or provides sixty fields. By an electronic mixing method, however, the total number of frames—or completed pictures—is thirty.

In the transmission of the pictures, the red, blue and green impulses are sent out in sequence. At the receiving end the resultant "ribbon" is laid across the face of the tube, one strip—or line—at a time in the same manner as in black-and-white. In short, each strip contains its own components of red, blue and green dots, instead of one strip containing only one color, as in the C. B. S. method.

In the R. C. A. system it is the face of the tube which injects the color elements in the receiver. This is done by the insertion of very small phosphors in the face of the tube.

A phosphor is a chemical compound which, when struck by a stream of electronic impulses, glows in a color characteristic of the combination of chemicals of which it is composed. Different combinations of the chemicals produce the desired, red, blue and green.

As the "ribbon" falls across the tube's face, the appropriate individual phosphor is activated by the impulse representing a given color. When viewed as a whole the face of the tube provides a complete color picture.

The R. C. A. color consists of 525 strips—or lines—and is known as the "dot sequential system."

It is because R. C. A. color does provide the same number of frames—thirty—and the same number of lines — 525 — as black and white that it is compatible with present TV. A picture transmitted in color will show up as black-and-white on a black-and-white receiver and as color on a color receiver. A color receiver, in turn, can receive both color and black-and-white.