RADIO

Natural Color Television

This Is One of the Advances Made in 14-Year Period When Television Has Continued To Be "Around Corner"

By JAMES STOKLEY

FOR FOURTEEN years, television has been "just around the corner."

Recalling this, and the over-optimistic predictions of the closing years of the twenties, anyone is rash who makes a new guess as to when the television receiver will begin to be as common a feature of the home as the sound radio set is today. However, it seems likely that, with a go-ahead signal from the Federal Communications Commission, this year will see a really extensive development of "seeing at a distance."

War developments, of course, may affect it one way or the other. On the one hand, defense needs may so fully engage the attention of the experts that they will have little time left for improving television technique. But, then, it might turn out that military uses of television would give it a real impetus.

In any event, during the years that we have been waiting for television, great advances have been made. Today it has reached an extremely high stage of realism with considerable detail to the transmitted picture, which may be shown in full color.

Birth in Funeral Parlor

I recall one April afternoon in 1927 when a small group of us gathered in a made-over funeral parlor in Washington, but to mark a birth, not a death. Most eminent of the party was Mr. Herbert Hoover, then President Coolidge's Secretary of Commerce.

As we sat in front of the transmitter, our images were carried over telephone lines and members of another group, in the Bell Laboratories in New York City, were able to see and hear us. These pictures were small, and pink in color. If you knew a person, you could recognize him, but the detail was not as good as an ordinary one column newspaper halftone picture.

Later that year, on a visit to England, I saw, in the city of Leeds, a gentleman who was sitting at the other end of a telephone wire in London. This was with the Baird process, and the results were even cruder than those of the Bell apparatus. The criterion for the success of 1927 television was ably expressed by one experimenter with whom I talked.

"If we can tell a face from a fish," he explained, "we think we're doing pretty well!"

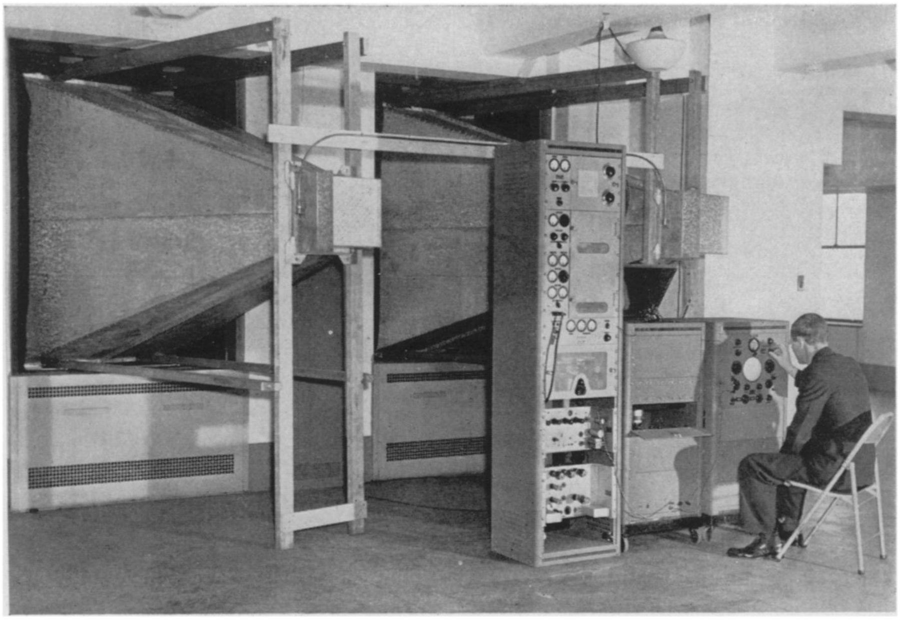
But now it is very different. The details are as clear as in most home movies. The other day a special group, including members of the F. C. C., sat in a New York theater. On a screen 15 feet high and 20 feet wide they saw reproduced scenes of soldiers marching at Camp Upton on Long Island, 68 miles away. These pictures were thrown from a special projector in the theater balcony, 60 feet from the screen.

At another demonstration, the following day, television in color was shown to the group. Living actors, and color movie films, were used as subjects. One of the latter was from a football game. Shown in black and white, the play was most difficult to follow, since one could hardly tell the teams apart. With color transmission, however, the different hues of the uniforms were easily apparent and the teams were clearly distinct, even in the most complicated tangle.

This is not the first time that color television has been accomplished. The scientists at the Bell Laboratories did it in 1929, about the same time that J. L. Baird did it in England. But their process was a complicated one. It required, in effect, three complete television systems. One transmitted the reds of the original, another the greens, and the third the blues. At the receiver each picture was formed separately, but an arrangement of mirrors recombined them, so that the looker saw them fused together.

Kinemacolor Process

The new process was worked out by engineers of the Columbia Broadcasting System under the direction of Dr. Peter C. Goldmark. In its fundamentals, it goes back to the first commercially successful method of color movies. This was the "Kinemacolor" process, by which Americans saw the colors of the coronation ceremonies of King George V, in 1910, and the Durbar at Delhi, in 1911, when he was crowned Emperor of India.



RECEIVER

Horn antennas were installed in windows of a New York skyscraper to pick up the NBC television signals from Camp Upton by way of Hauppauge and Bellmore. Similar horns were used at the relay stations.

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FOR COLOR FILM

Dr. Peter C. Goldmark, chief television engineer of CBS, with the experimental transmitter used for broadcasting motion picture film in color. He has also televised living actors in color.

In the special Kinemacolor camera, the film was run through at 32 pictures per second, twice the speed then standard for black and white. (With the coming of sound films, the standard speed was increased to 24 frames per second.) Red-sensitive panchromatic film, now common, but then unusual, was employed. Revolving behind the camera lens was a color filter, half red, half green. One picture was taken in red light, the next in green, and so on.

Combine Colors Mentally

In the projector, also operating at 32 frames a second, was a similar revolving filter. The pictures taken in red light were projected with red light; and those photographed with green were shown in green. Since, on account of the persistence of vision, we continue to see an object for about a tenth of a second after it has disappeared, and since two pictures were shown every sixteenth of a second, the two separate color pictures were mentally combined into one.

Since there are three, not two, fundamental colors, with only red and green, or any other pair, it is impossible to reproduce all colors of the spectrum. Consequently, Dr. Goldmark divides his picture up into red, green and blue. A circular filter, with three such segments, revolves in the television camera, 40 times a second. Thus, in this period, there is formed successively, on the screen of the iconoscope tube that corresponds to the film in a movie camera, images in red, green and blue.

Every 120th of a second, the electron beam which controls the television transmitter sweeps over the iconoscope screen. Just as in black and white television, the currents from this screen are amplified, and modulate the radio transmitter.

The signals are received, and fed into the cathode ray viewing tube, where another electron beam, precisely in step with the one in the transmitter, sweeps to and fro over a screen which glows where it strikes. Thus, during one interval of 1/120th second, the red picture is painted, next the green and then the blue.

Color Added by Disk

As the screen glows white for all of them, no color is seen at this point until another spinning color disk, synchronized with the first, is made to revolve in front of the tube. Then the onlooker sees each picture in its proper color, and they merge together to form a complete picture, which faithfully reproduces the hues of the original. In case the receiving disk is not in step with the transmitting one, the colors are wrong, roses are green and their leaves red, for example. But pushing a button on the receiver halts the disk for an instant, and brings it into synchronism.

Fringes in Fast Action

One of the disadvantages of such a process, which was particularly marked in the Kinemacolor pictures, is what are called "color fringes." If an actor moved his hand rapidly, for instance, it would be in one place when the red picture was photographed, and a different position when the green one was taken. This would show on the screen as a blur of red and green, instead of a clearly defined hand. The faster the camera operates the less likely this is to occur. Whereas, in the Kinemacolor process, a complete picture, with both color components, required 1/16th second; the Goldmark television process completes a picture, with three colors, in 1/40th second, so it is 250 per cent faster.

Great advantage of the Goldmark method is its simplicity, for it requires no fundamental change from black and

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IN THE THEATER

Television projector used in the RCA demonstration recently in a New York theater. The steel jacketed projector is in the foreground. The receiving tube faces a large concave mirror, which reflects the image to the screen 60 feet away.

white television. Essentially, all that is needed to convert the older system to color is the addition of the color disks in the camera and the receiver. It does not, therefore, seem too much to hope that color television will come almost as soon as television of any kind.

The great development of sound broadcasting came with the growth of the chains, for then the great expenses of producing programs could be spread over many stations. In the case of sponsored programs, an audience was provided large enough to make the advertiser willing to invest large sums. And since television is even more complicated than ordinary broadcasting the expenses for comparable programs would be even greater.

Unfortunately, inter-city telephone lines, perfectly satisfactory for sound, are entirely inadequate for acceptable sight programs. Practically all the sounds which we hear, whether from a single speaker or a symphony orchestra, consist of vibrations ranging from 50 to about 15,000 per second. It is relatively simple to devise circuits that will transmit corresponding electrical vibrations.

A single television picture is built up of some 200,000 elements, each one analogous to one of the tiny dots that make up the half-tone picture on this page. With 30 pictures per second, the standard for black and white television, there are thus 6,000,000 separate impulses to be transmitted each second, or two hundred times as many as the limit of the sound system.

By special equalizers and amplifiers, good telephone circuits can be made to carry about 3,000,000 cycles per second. This is satisfactory over short distances; within a single city, for instance. For transmission from city to city, better circuits are needed, and the coaxial cable provides the answer, though an expensive one. Each cable consists of a copper tube about the size of a lead pencil with a copper wire running through it and held in the center by disk insulators, every three-quarters of an inch. Two such cables, in a single sheath, were installed by the American Telephone and Telegraph Co. between New York and Philadelphia in 1936, partly for television, and partly for telephone purposes, since it will carry simultaneously 800 long distance conversations.

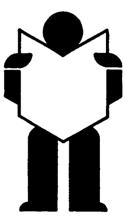
Used for Convention

This cable was used last June for the first inter-city television broadcast when people with television receivers around New York were able to watch the proceedings of the Republican National Convention in Philadelphia. The coaxial cable carried the signals between the two cities; telephone lines carried them from the Convention Hall to one end of the cable and from the other end to the N. B. C. transmitter on the Empire State Building.

A few weeks ago, members of the Institute of Radio Engineers in New York saw another demonstration of this cable. Motion pictures shown in the Bell Laboratories were sent to the meeting in the Hotel Pennsylvania over two paths. One was a direct telephone connection, the other was by the coaxial cable loop to Philadelphia and back, a path of 190 miles, the longest distance that television has yet been sent over wires. The received pictures were virtually as clear over this path as over the shorter one.

Engineers have estimated that it would cost $20,000,000 to install a coaxial cable from New York to Los Angeles, so it is unlikely that there will ever be a network like the present telephone network that connects several hundred radio stations

Solve the Problem of Visualizing . . .



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throughout the country. Radio links may be used, perhaps entirely, perhaps in conjunction with coaxial trunk lines.

The General Electric Co., early in 1940, began to use such a link. At a receiver 1700 feet above sea level in the Helderberg Mountains near Schenectady, 129 miles from the Empire State Building, the N. B. C. television signals are received, then relayed by radio a mile and a half to the G. E. transmitter, W2XB. Half a million persons in the Albany-Schenectady area can receive these on home receivers, which would be incapable of catching the direct signals from New York.

The Radio Corporation of America has made similar developments. At the recent display of theater television, for instance, the views from Camp Upton on Long Island, 68 miles from New York, were relayed in three radio jumps. The N. B. C. mobile transmitter, contained in two large trucks, sent the signals to Hauppauge, Long Island, 17 miles away. Here they were automatically received and sent 23 miles to another station at Bellmore. This retransmitted them 28 miles more to a receiver on the 62nd floor of the R. C. A. building in New York City. Telephone wires carried them to the theater.

Engineers emphasize that in no case did the power of the intermediate stations exceed 5 watts, an accomplishment which they attribute in part to the highly directional horn antennas used. These point directly to the transmitter. From their 4 x 6 foot openings, they taper along their 8 foot length to an apex about a foot and a half square, where a small two-pole antenna is located.

With such developments, and with corresponding improvements in the home receivers that have also been made, it seems that television is now much more ready to appear around that corner than it has ever been since the pioneering days of 1927. Soon, perhaps, it will do so.

Science News Letter, March 8, 1941

• RADIO

Dr. Sanford V. Larkey, librarian of the William H. Welch Medical Library will tell how medical science is being mobilized through the National Research Council and national medical societies as guest scientist with Watson Davis, director of Science Service, on "Adventures in Science," over the coast to coast network of the Columbia Broadcasting System, Thursday, March 13, 3:45 p.m. EST, 2:45 CST, 1:45 MST, 12:45 PST. Listen in on your local station. Listen in each Thursday.

PSYCHOLOGY—PHYSIOLOGY

Spinning of Fliers May Help To Train Their Sense of Balance

Experiments With Pigeons Indicates Reduced Nystagmus Is an Aid in Keeping Equilibrium Under Difficulty

A METHOD for preliminary aviation training by spinning students in a rotating chair or pleasure park device may be developed as a result of recent experiments showing that spinning increases ability to keep one's balance.

The difficulty of flying a course parallel to the earth's surface is increased for the pilot flying at high altitudes. Objects on the earth appear small and flattened. Vision no longer gives a clear clew to up and down. The pilot who wants to keep his plane in balance or to judge the angle of his bank or climb must depend to a greater extent on his own equilibrium.

The importance of equilibrium to the airplane pilot was recognized during the World War when selection tests included spinning the recruit in a revolving chair and then measuring the length of time over which involuntary movement of the eyes persisted. If the time were unusually short, this was considered a sign of some abnormality and the applicant was rejected. Later, however, it was discovered that some of the aviators who had been active fliers had a shorter duration of this involuntary eye movement known as nystagmus than some of the rejected candidates.

Drs. G. K. Yacorzynski, Ward Halstead, and Franklin Fearing, working at Dr. Fearing's laboratory at Northwestern University, decided to explore the possibility that, instead of being a handicap, reduced nystagmus might actually aid the pilot in maintaining his equilibrium. It has been previously noticed that toe dancers who whirl about in dances that would make the ordinary individual sick with dizziness are able to maintain their balance perfectly. They show a reduced nystagmus. This is also the case with figure skaters.

Their laboratory test was made on pigeons, the ear labyrinth of these birds being similar to that of man. One group of 24 birds had their nystagmus reduced by rotation on a turntable. Another group of 24 did not.

Then the birds were tested for ability to keep their balance on a rotating perch. Results of the experiment are published in the *Journal of Psychology*. (January)

The birds who had been spun to reduce their nystagmus were superior in keeping their balance.

The investigators suggest that perhaps it is not the reduced eye movement itself that improves the equilibrium. Perhaps it is a reduction of other effects such as nausea, dizziness, and a sense of falling that commonly accompany nystagmus. These reactions, if they came when the bird (or the aviator) was trying to balance himself, would disrupt his ability to hold to his position.

Should these results be shown to be true for human beings, it might prove advisable to reduce the nystagmus of the prospective flier before he takes to the air. The feeling of dizziness which accompanies rapid movements of the body in space, such as, for example, when the airplane banks, would then be absent. The functional use of the labyrinth would be intact, but the secondary sensations which disrupt equilibrium would not be present.

It would be possible to duplicate the plane's maneuvers in a ground instrument that would give the student the "feel" of flying.

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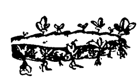

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