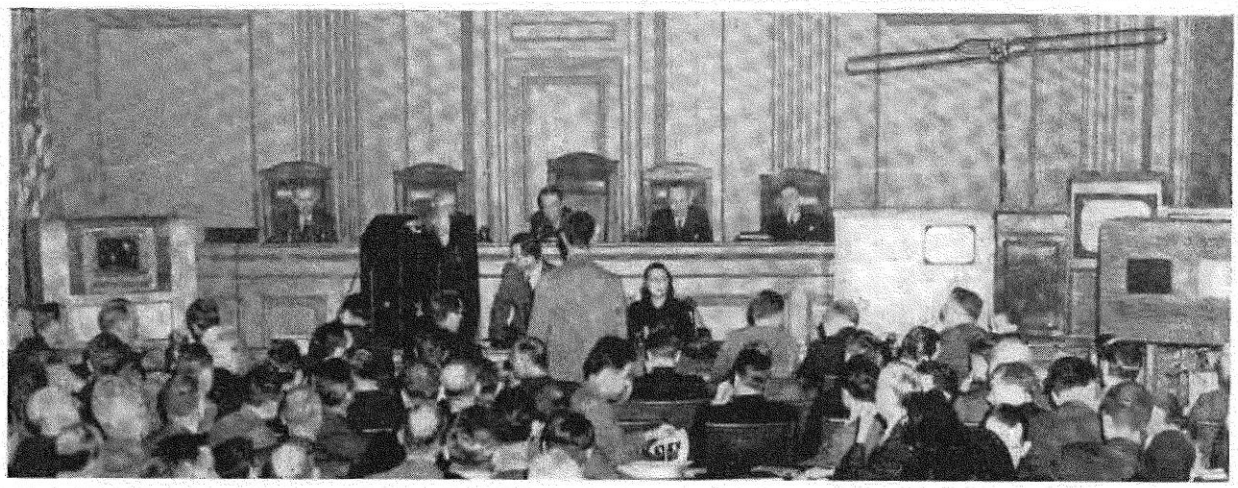


Flanked by color and black and white receivers, FCC opens Round 2 of its public hearings looking to establishment of standards for color transmission, with Commissioners Hyde, Walker, Chairman Denny, Wakefield and Chief Engineer Jett on the bench

Color TV Demonstrations Reveal Engineering Progress

CBS sequential and RCA simultaneous color reception before FCC hearings indicate need for further development work before standards can be set up

• The first round before the FCC in Washington concluded with CBS placing in the record, in a masterly fashion, all evidence available that would support their claim that the standards they propose for commercial color TV should be adopted. At the same time, the majority of the industry, both individually and collectively, gave reasons why these same recommended standards should not be approved. The CBS system produces a tri-color sequential, 48 frame per second, 525-line, interlaced television picture. This would be radiated, together with the sound, in a 16 mc channel in the uhf band, 480 to 920 mc. At Columbia, a technical staff of over 100 headed by Dr. P. C. Goldmark, have developed such a system. This excellent piece of work, done under high-pressure, is lauded as an outstanding achievement by all in the engineering world who realize the planning, inventing and developing necessary to produce an operating system that shows pictures of the quality exhibited by CBS.

The Score at the End of Round 1. CBS had testified that their system would produce pictures 7½ x 10 in. of good color fidelity. Using their transmitter in NYC on 490 mc, they had made reception tests at 188 locations and were satisfied that suitable broadcast coverage could be obtained. This experimental system embodied all of their proposed standards. Although lacking in camera equipment for certain uses they said they could put on commercial programs in a matter of weeks if so authorized by the FCC. Supporting the CBS petition were Westinghouse, Bendix, Cowles Broadcasting Co., Zenith and Federal.

On the other side appeared RCA, Emerson, Farnsworth, TBA, Philco and others. DuMont's appearance was made later. The industry committee of RTPB-RMA reported that by majority vote, it was decided that more experimental work was necessary before color TV standards could be adopted.

The opposition attacked the CBS proposal from two angles; first, the system proposed was fundamentally so limited as to preclude future development; second, a better system not so limited, using simultaneous instead of sequential scanning, was in the early stages of development in the RCA laboratories. Specifically it was claimed that the CBS system was lacking in brilliance; in picture size; in freedom from flicker and color breakup; uneconomical of light because of necessary filters; not thoroughly tested as to propagation on the

uhf band to be used; not compatible with the present commercial black-white system so that there was no way to avoid costly obsolescence by a gradual changeover from the present standards to new color standards. The RCA simultaneous system was designed to overcome these alleged disadvantages.

A New Kind of FCC Hearing. This was the situation at the end of Round 1. At this time many thought that CBS had an even chance of having their petition granted. Then followed the history-making hearings of FCC in New York and Princeton which may be called "Round 2". These were for the purpose of witnessing tests of TV reproduction right in the courtroom, where cross-questioning could be placed in the record even as the pictures were on the screens of the receivers grouped beside the Commissioners who were hearing the petition.

Chairman Denny conducted this unusual part of the hearing in a most satisfactory manner. He gave all the interested parties full opportunity to ask for tests and to express their views. A surprising deviation from procedure of the historic past was to permit engineers to question witnesses. Heretofore, the technical men usually thought out the questions, relayed them to their lawyers, who after legal rephrasing, shot them at the witness. The reply, often in technical terms, was not always clear to the lawyer. Chairman Denny says that it saves time and is more direct to allow the engineers to ask the technical questions. The record for Round 2 will show that only a small percentage of its pages are due to the legal talent present, the engineers accounting for the bulk of it.

Round 2 opened in New York with a demonstration by Dr. Goldmark to substantiate his claim that it was contrast in the picture which one desired, not necessarily brightness. He used a simulated picture to show the improvement resulting from placing a neutral density filter in front of the picture when there is high ambient illumination in the room.

The demonstration was good when two photofloods were used to produce the ambient illumination, but when the regular room lights (rather amber in color) were substituted, the filter helped but slightly. It is true, however, that the CBS receiver, having a rotating color screen in front of the picture tube, gains somewhat in immunity to picture "washout" by room illumination. Of course, a neutral density filter (with its inherent light loss) can also be used in front of any picture source, if desired, to obtain this same effect of doubtful overall value.

Later in a side-by-side test with a bright DuMont receiver, it was evident to most observers that the image on this black-white receiver was usable after the increasing ambient light had wiped out the CBS picture. CBS did not win a point here.

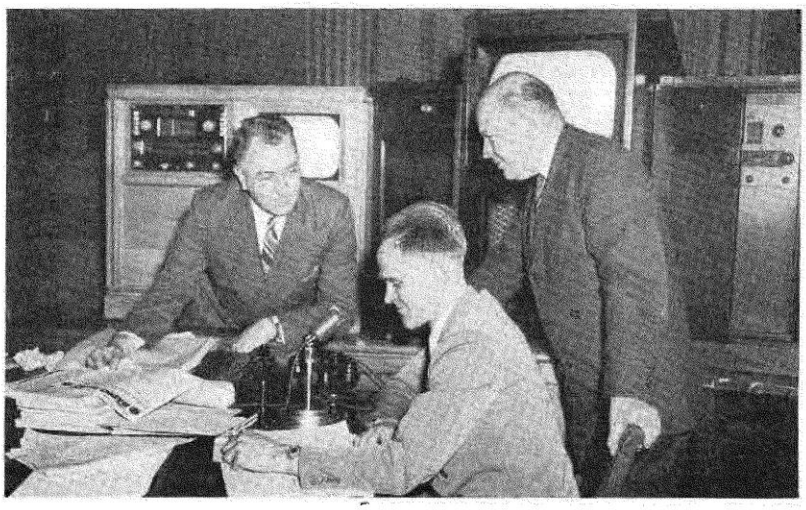
The CBS Color Demonstration. Brief description of the equipment follows: The transmitting studio was on the 5th floor, 485 Madison Ave. where an Orthicon camera was used for live pickup and a Dissector tube for slides. By coaxial cable the signal was taken to transmitter W2XCS, 480-492 mc, 1 kw peak power, antenna gain between 5 and 10, omnidirectional antenna, sound transmitted on a separate carrier. Broadband receiving antennas with small reflectors (gain 6 to 8) were placed in a courtroom window. This afforded line-of-sight transmission.

Two direct-view receivers were used. One was built by Bendix, one by CBS. The light output for the resolution chart was 7 to 8 footlamberts. The picture size, 7½ x 10 in., resulted from the use of a magnifying lens in front of 10 in. diam. tube. (Incidentally, this lens, it is believed, caused more trouble than it was worth. For example, it limits the angle of view, and in a very annoying way it reflected the overhead room lights.) At the studio about six times more light intensity is needed here than for black-white pick-up.

The demonstration program opened with a girl in the studio showing colored scarfs. Also shown were girls dancing, a boxing bout, and the announcer. The writer was seated about 55 ft. from the receivers. At this distance the picture at its best was too dim, and too small, but no flicker was noted. Yet on previous occasions in the CBS viewing room the same receiver gave objectionable flicker at viewing distances of less than 10 ft. when the highlight brightness was about 19 ft. l. For a good bright picture, viewed at the normal viewing distance, 48 frames per second produce an annoying flicker for most observers.

Chairman Denny asked for tests from those present. The effect of increasing the room illumination was tried. Due to the dimness of the picture, increasing the room lighting noticeably degraded the picture quality. Mr. Shelby, to show color fringing and breakup, asked for such tests as waving a white handkerchief before the camera. No trouble due to color fringing

At Federal Courthouse FCC hearing on color TV, Dumont Counsel Col. Wm. Roberts, Director of Research Dr. T. T. Goldsmith, Jr., and Dr. Allen B. Du Mont confer



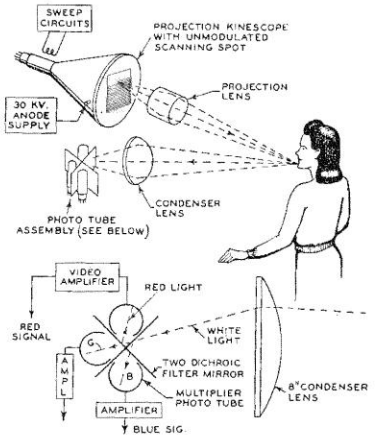
was noted by the writer. The Bendix receiver developed some trouble and it was turned off until the afternoon session.

Mr. Roberts asked for the girl in the studio to move around so that the detail furnished by the system could be better estimated. Dr. Murray suggested the showing of the resolution chart. Later, this was done, and Mr. Fink, who was called upon to read the chart, reported about 300 lines resolution.

The next demonstration was a monochrome movie. At this time and throughout all the tests the CBS receiver reproduced white as purplish blue, never white. In this test the picture again was too dim to be satisfactory. During the switching from movies to slides to studio, the pictures on both receivers were very stable. There were no synchronism troubles. However, the two CBS engineers operating the receivers transgressed one unwritten rule of TV demonstration etiquette, namely that one should not touch the controls unless absolutely necessary. The CBS men were making adjustments almost continuously. This gave a bad audience impression. It was stopped at intervals later by Mr. Denny announcing that the next test would be made with no receiver readjustments.

Color Transmission Over Coaxial Cable. The ability to transmit a usable picture over the Am. Tel. & Tel. coaxial cable linking TV stations is very important. At present, this cable passes a band about 2.7 mc wide. CBS is using a band about 9 to 9.5 mc wide for their system. It has been claimed that their pictures in color can be transmitted by cable to Washington and return, 480 miles, with no observable change in quality. To actually see this test with their own eyes, some of the engineers in the audience had traveled many miles.

While showing slides and live talent, this loop of coaxial cable to Washington and return was switched into and out of the circuit at the CBS control room. For this test it was desirable to have a sharper, clearer, brighter picture than was available in the demonstration, but observation both at a distance of 55 ft. and closer, actually indicated that there was no observable loss of picture quality. This was true whether the subject was a movie, a slide, or a person in the studio. This interesting observation makes a television engineer stop and ask himself "Why work so hard to secure a broadband system responsive up to 9 mc when observers would see no difference if it is cut off at only 2.7 mc?"



Schematic of flying spot studio pickup for simultaneous color television

It has always been believed that for really high-definition pictures the full band does have to be transmitted, therefore it seemed to the writer that there was no fine detail in the pictures used for the tests. This was confirmed when Mr. Fink was called to read the resolution from a transmitted chart that did have plenty of fine detail. He, observing from the distance of 4 ft., reported:

	CBS RECEIVER	BENDIX RECEIVER
Studio Camera (Orthicon)		Horizontal Resolution in lines
Without Coax Loop	325 (av.)	Up to 250; again at 300
With " "	Less than 100	Less than 100
Slide Camera (Dissector)		
Without Coax Loop	275 (av.)	275 (av.)
With " "	Less than 100	Less than 100
Highlight Intensity	4 ft/l	5 ft/l

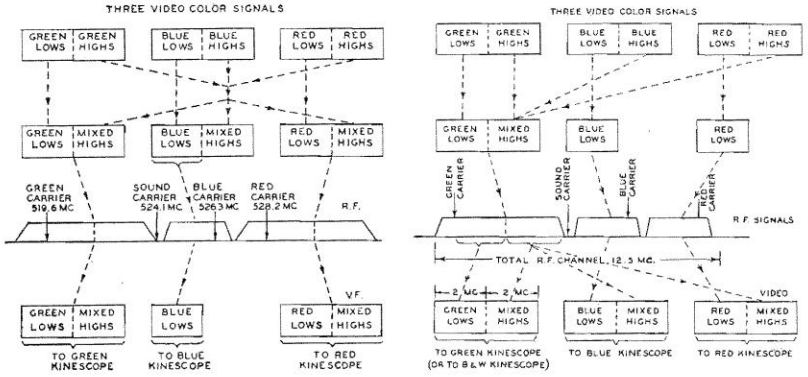
This is reassuring because it shows that a restricted bandwidth does affect picture quality. It also shows how important it is to check picture quality with a resolution chart if dependable scientific observations are desired.

Testimony by Bell Tel. Labs. At the invitation of the FCC testimony was given by Mr. Affel for Bell Telephone Labs. concering the NYC-Washington coaxial cable. A summary follows: The cable itself is the size of a pencil. It has low-loss and is shielded from external disturbances. Amplifiers appear at 5-mile intervals; they have automatic regulators to overcome line variations due to time or temperature. The transmission band is somewhat more than 2.7 mc. Transmission is flat within 1 db; the phase delay is kept at a low value and the linearity is such that undesired modulation components are at least 40 db below the desired signal. In a few years it is hoped facilities for transmitting bands 7 mc wide will be available.

CBS Table Model Receiver. Just before the hearing adjourned for the day, Dr. Goldmark demonstrated a table model color receiver. This was used with the CBS butterfly antenna that was fastened to the window glass by vacuum cups. A 5-in. cathode ray tube made by Rauland was placed behind a 11¼-in. color disc rotated by a synchronous motor.

Comparative Tests of Color and Black-White Pictures. On the sec-

Left diagram indicates the channel reduction effected by using "mixed highs" in simultaneous color TV. Right, method used to demonstrate effect of using "mixed highs"



ond day of the hearing in New York, DuMont monochrome receivers, which had been installed in the hearing room, were operated for side-by-side comparisons with the CBS receivers. The same picture was shown simultaneously on all sets. This was achieved by broadcasting the same slide or movie from the CBS color transmitter on uhf and from WNBT in black-white on hf. The DuMont equipment consisted of a very elaborate receiver with a 20-in. direct-view picture tube, a set with a 15-in. tube and a receiver having a 10-in. tube. The latter, placed beside the Bendix color receiver, gave a picture approximately the same size. The brilliance of this black-white picture tube was outstanding. It was operating at 450 ft.l. and could be run more than 50% brighter.

The side-by-side test proved that the black-white picture was superior in brightness (450 vs. 8 ft/1), superior in detail, and superior in non-flicker charcteristic (60 vs. 48 frames per sec.). The color picture was superior in artistic appeal when certain colored scenes were transmitted. This fact caused some of the audience to report that they liked color better, although they admitted some superior aspects of the monochrome image. To the majority of the 250 persons that crowded the room, the small size of the color picture compared with the easily-seen 20-in. DuMont picture meant a great deal.

Testimony by DuMont Labs. Testimony offered by Dr. DuMont can be summarized as follows: (a) more knowledge is needed regarding propagation in the band proposed; (b) networking of the CBS system is difficult due to the wide band. A simultaneous system can use three separate coaxial cables with better results. (c) Color standards should be integrated into present black-white standards. This cannot be done in the case of the CBS proposal. (d) Less expensive and less complicated receivers are required. He concluded with the recommendation that the FCC dismiss the CBS petition.

Dr. Goldsmith next testified. Some of the points he mentioned that were pertinent to color TV: deficiencies in the CBS propagation tests; need for line-of-sight for uhf transmission; considerations concerning ambient light; and the advantages of the simultaneous system. He estimated a time schedule for color in which 4½ years would elapse before the FCC approves color standards.

The New York hearing ended with a request (or a challenge) from DuMont Labs. to CBS to: (1) Provide a pickup of a sporting event, for example, from Madison Square Garden, (CBS reported they cannot do this); (2) Test color reception at a number of locations where satisfactory pictures on black-white sets are now being obtained, (cooperative tests were planned later using the CBS truck and receiving equipment); and (3) Provide color pictures 12 by 16 in. with a brightness of 200 ft/1, (CBS said they cannot do this). There are other requests but the three above were the ones discussed at the hearing, which was resumed the following day at Princeton, N. J.

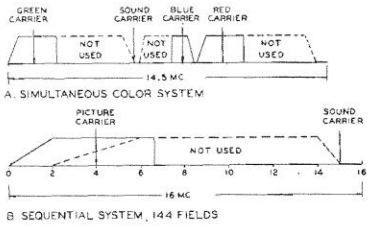


Diagram showing utilization of rf channels when color signals are transmitted by cable limited to 2.7 mc

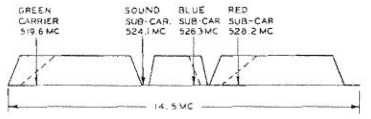


Diagram showing positions of rf carriers, sub-carriers and sidebands in simultaneous color TV Princeton demonstration

The Princeton FCC Hearings on Color Standards. RCA acted as host to the visitors and Dr. Engstrom, as master of ceremonies, did an excellent job. Following a well-laid plan he described the demonstrations as they took place. RCA has been working on color TV for some years, progressing toward a system that would have these characteristics: (a) no flicker; (b) an all-electronic system (no revolving filters); and (c) no forced obsolescence. The principle of operation of the RCA simultaneous color system, which fulfills these requirements, has been described in current technical articles. The fact that the demonstration for this hearing was a laboratory experiment was stressed. It happened that the transmission link was completed just three days before the hearing.

Diagrams reproduced on these two pages were those that were introduced by RCA as part of the testimony given before the FCC hearing in Princeton by Dr. C. B. Jolliffe, E. W. Engstrom and Ray D. Kell.

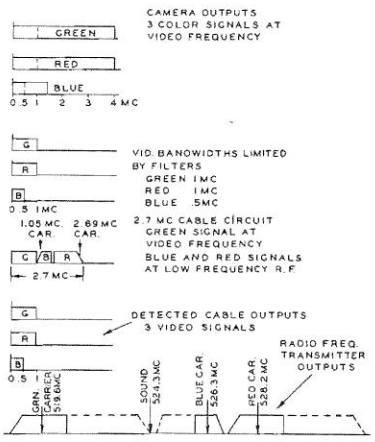


Diagram of networking method for simultaneous color TV by single 2.7 mc cable

Equipment and Test Conditions. On each side of a low stage was placed one black-white receiver and one experimental color receiver. Both were of the projection type, showing pictures measuring 15 by 20 in. In the center of the stage was a table model receiver, black-white, for direct viewing of a 10 in. tube.

The demonstration opened with black-white picture broadcast from WNBT in New York and received on a folded dipole antenna 100 ft. high. This was followed by color transmission from RCA Labs. located about one-half mile away. The directive transmitting antenna, operating broadband at 520 mc was 35 ft. high. Its gain was 100. The peak power fed to it was 50 watts, hence the total radiated power was 5000 watts; but this of course was divided between the

(*Continued on page 128*)

TV DEMONSTRATIONS

(Continued from page 69)

four channels, viz. red, green, blue and sound. The receiving antennas were dipoles with reflectors, affording a gain of 10, located at a height of 66 ft.

For the first time the simultaneous system RCA showed studio pickup. This was accomplished by flying spot scanning from a cathode ray tube. The reflected light from the subject's face was collected by a lens, split into the desired three colors by mirrors, and passed on to three photo tubes, responding respectively to variations of red, blue and green light. In this experiment the area that could be scanned naturally was limited. It is imagined that performing in a dark studio is a little trying for the performers. But certainly it is a cool studio. The eyes and the coloring of the girl we saw by television did not appear natural but the experiment was a success.

Impressions of An Observer. The writer was seated at the same distance from the receivers that he was on the preceding day, about 55 ft. He observed the color fidelity was satisfactory, the shades of red were deep and especially pleasing; when producing a black-white picture the whites were really white. The pictures were larger, (15 by 20 in. vs. 7½ by 10 in.). They were about the same brilliancy as the CBS pictures, (8 ft/l). There was no flicker or color breakup even when viewed at a distance of 4 ft. The lights in the room were dim. When they were raised to give an ambient illumination of 2.6 ft/l the pictures were somewhat washed out but still usable. When the receiver controls, including the electrical controls for registration of the three images, were purposely thrown out of adjustment, the time required to readjust was short. A resolution chart was not shown so the actual resolution could not be compared with that demonstrated by CBS. The special NBC-RCA color movie made a good impression on the audience. Suggested improvements would be more power on the sound channel and increased picture brightness. The RCA engineers, once the demonstration started, left the receiver

control knobs alone during the tests. This was a relief after the CBS experience in this regard. The majority of the visitors agreed that all in all it was a very satisfactory demonstration.

Technical Considerations Regarding Transmission. It was proven that when the RCA simultaneous color system is operating, a standard black-white receiver can obtain satisfactory monochrome pictures by using a small converter to change the received uhf signal to the proper hf signal. The receiver is tuned to the green channel which also carries the synchronizing signal. Conversely a color receiver with an adapter can receive monochrome transmissions in black and white. This proves the compatability of this system with the present standards.

In the demonstration a bandwidth of 14.5 mc was utilized. This can be reduced to 12.5 mc by mixing the high frequency components of the three colors, as explained and demonstrated by Dr. Engstrom. There was no noticeable change in picture quality when this was done. For network operation a bandwidth of 4 mc would be assigned to green and red, with 1.5 mc alloted to blue. If necessary the bandwidth for each color could be restricted so that about the same definition can be expected for this system as for the sequential system when transmitted by coaxial cable.

RCA's Simplified Color Receiver. Parts for a low-cost color receiver of the projection type were shown. The receiver will use 35 tubes. The light source consists of three 1½ in. diam. projection tubes, operated at a plate voltage of 15 kv, spaced 90 degrees around an optical system, the projection lens of which is an f2. The picture brightness will be 15 to 20 ft/l.

In reporting the RCA demonstration it should be mentioned that several observers, mostly from CBS, found faults in the pictures such as: non-uniform lighting, poor sound, yellow halation, lack of sharpness, lack of exact color registration, etc. The answer made by RCA to most of these criticisms was that the system now is only experimental. It will take several years to develop it to the commercial stage.