THE HISTORY OF THE GROWTH AND DEVELOPMENT OF COLOR TELEVISION

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by

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CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

The idea of mass communication has been in the minds of men for centuries, beginning with the earliest of men who felt a need to reach as many people as possible and tell all peoples of their discoveries and rich experiences. Mass communication began at its earliest inception, as a medium from person to person purely by word of mouth, and has continued throughout history with numerous developments providing simultaneous communication with many people. Three great developments in this area have been the printed page, the spoken word on radio, and finally, the most nearly instantaneous and generally perceptible medium of all--television. Television, although not at all new, has, during the past few years, developed into a rapidly growing medium, and will unquestionably continue to grow as men find additional ways of applying old communication techniques in this newer area of electronic transmission of ideas and entertainment.

I. THE PROBLEM

Statement of the problem. The purpose of this study is to observe the pattern of development of color television from its inception, to discern that the conflicts and prob-

lems of development of this medium of mass communication have been the problems of application and utilization of this medium, and to ascertain what the workers engaged in its development are doing in the field.

Importance of the study. The author feels that this subject is particularly appropriate at this time because of the increased development and promotion of this medium by the television networks during the years 1954 and 1955. The general viewing public has been exposed to more color television during the past few months than has ever been the case before. The public is, as is shown later in the text of this paper, accepting color television with great interest and enthusiasm, although the inability of the manufacturers to supply sets for purchase and the high costs of sets have limited the number available.

The author feels that this subject is particularly valuable for investigation and study because there has been virtually nothing done toward gathering together the fragments of information concerning color television development. No complete, or comprehensive, text has been compiled to date, to the knowledge of the author; only sporadic papers and articles have been published in trade journals and have been concerned with individual fields of research in color development and expansion.

II. DEFINITION OF TERMS USED

Compatible color television, or color compatibility, is that system of electronic transmission of color television signals which enables the viewer to receive in his own home the electronic signal from a program in color, either on a color receiver or on a black and white receiver.

Other terms used will be clarified in the context in which they are used within the body of this paper.

III. ORGANIZATION OF THE THESIS

In the hope that the reader may be able to gain some insight into the progress of this relatively new means of mass communication, this paper will discuss the many aspects of color and television in an effort to present a relatively coherent picture of the development of color television. The individual chapters will deal with such topics as a general introduction to the subject of television, followed by a statement on color so that the reader might begin to realize the importance of color in his life and the role it plays in his likes, dislikes, preferences, and enjoyment of things with which everyone associates every day.

The paper will also present information on the methods of transmitting the television signal; several proposals pertaining to color television sets and equipment for telecasting color programs; color psychology; production techniques

and ideas for color programs; lighting for color programming; several aspects in regard to color films and their uses and acceptance in color television; some of the reactions to color; credit for the development of color television; and finally, the future of the industry in color engineering and programming in color television.

IV. PRESENT STATUS OF THE PROBLEM

Very little has been done by the industry in connection with compiling information on the many aspects of color television, presumably because of the rapid day-by-day changes that have been occurring in this field. For this reason writers have apparently preferred to postpone publishing such papers until the color industry has become more stable. However, this author believes it important that he trace and summarize the many developments to date, so as not to lose sight of the many factors that have contributed so greatly in making color television what it is today; he further realizes that the current and previous developments are those which will open up new areas for investigation and greater utilization of this mass medium.

V. LIMITATIONS OF THE STUDY

The discussion of television in this paper will be limited to color television and will not refer to black and

white television. The author presents material obtained from research materials, and references obtained from networks, manufacturers, speeches, and various magazines.

VI. SOURCES OF INFORMATION

The author has found it necessary to rely almost entirely upon current periodicals and technical journals from the broadcasters, from national magazines, from newspapers, speeches, and other scattered sources of periodical information. The authorities relied upon are referred to in the Bibliography section of this thesis.

CHAPTER II.

GENERAL HISTORY OF TELEVISION

This chapter will deal with the actual background and growth of television, and discoveries pertaining thereto. Major electronic developments will be explained briefly so as to present a coherent picture of the assembling of knowledge and material that have produced the present-day medium called television.

The chapter will present also a pattern of the development of television in this country to illustrate the growth of this medium as a powerful influence in society.

The development of the chapter will include early electronic discoveries and the development of color television.

I. EARLY ELECTRONIC DISCOVERIES

Television as an idea can be carried back a little over a hundred years to May 26, 1884, when the first successful test of electronic communication was made by the sending of the now famous telegraphic message from Washington to Baltimore by means of electric impulses.[1]

As early as 1847, experiments were suggested for sending visual as well as telegraphic messages by electrical

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[1] Television: 1948 (New York: E. W. Axe & Co., Inc., 1948), p. 3.

impulses. These experiments were continued for fifty years. Television systems began to appear as ideas early in electrical history as a result largely from the discovery in 1873, by a British telegrapher, named May, that the chemical element selenium possessed the property of transforming changes in light to corresponding charges in electricity. Further interest in the possibilities in transmitting light by electricity was stimulated by the transmission of sound by electricity through the medium of the telephone, invented in 1876.[2]

One of the first television ideas based on the properties of selenium was a set designed in 1877 by a Frenchman, Senlecq, who built a mosaic of selenium cells, each of which was connected by a separate circuit to a shutter which dropped when its cell was illuminated. Behind the shutters was a source of light which shone through when the shutters were operated. This system produced crude silhouettes.[3]

The next stage of development worthy of note was the invention by a German, named Nipkow, of a rotating disc which examined the scene and directed it into points of light which were conveyed successfully over a single electric circuit. Following Nipkow's invention, Sutton proposed

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[2]Ibid.

[3]Ibid.

a system for a television receiver using a scanning disc and an electrically controlled source of light.[4]

While selenium and rotating discs played their parts in stimulating the growth of television and were not improved upon for forty or fifty years, neither selenium nor rotating discs are used in modern television; both have been replaced by the development of the photoelectric effect.

II. DEVELOPMENT OF COLOR TELEVISION

In color television much the same process of monochrome television is followed except that each picture is transmitted in three primary colors--red, blue and green. These colors are sent in sequence.

Details of the method are complex. In the "field sequential" system, which is the adopted standard of the United States, the colors are changed at the end of each scanning of the field of dots, or 144 times per second.[5] Thus, the odd lines in the first field are scanned in red; in the second field the even lines are scanned in blue; in the third field the odd lines are scanned in green; in the fourth field the even lines are scanned in red; in the fifth field the off lines are scanned in blue; and in the sixth field

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[4]Ibid.

[5]"ABC of Radio and Television," Broadcasting-Telecasting, (Washington, D.C.: Broadcasting Publications, Inc.), March 30, 1953, p. 13.

the even lines are scanned in green. Six complete fields are required to complete one picture. However, twenty-four color pictures are transmitted each second.[6]

Color television has been the subject of study and experimentation for over a quarter of a century. In 1928, Bair, an Englishman, demonstrated an early system. In 1929, color pictures were sent over wire in a test at the Bell Telephone Laboratories in New York. The Radio Corporation of America gave an experimental color television demonstration in February, 1940, and the Columbia Broadcasting System tested color in August of the same year.

The question of color television was considered initially by the Federal Communications Commission in 1941, when it proposed alternative standards for monochrome and color. In 1945 it allocated certain frequencies for experimentation in developing color and high-definition black and white. It was not until 1946 that it received a formal proposal for the adoption of color. In denying the CBS petition for adoption of their system of scanning-disc color television in 1947, the Commission urged further experimentation with particular reference to making color transmission possible in the 6-megacycle band width used by monochrome television.

Three competitive color systems were offered for the

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[6]Ibid.

Commission's consideration in the general television proceedings which started in 1949. These were the CBS "field sequential" system, the RCA "dot sequential" system, and the Color Television Incorporated "line sequential" system. Each of these systems required special converters to receive color. The CBS system could not be received in black and white on existing receivers without adapters; the two others claimed they could.

On the basis of testimony and demonstrations, the Commission on September 1, 1950, found that the field sequential system was the only system meeting the criteria for color operation. However, in view of the fact that this system could not be received in monochrome on existing sets, generally, the Commission proposed postponing a color decision and adopting monochrome "bracket standards" which would enable future black and white sets incorporating those standards to receive color transmissions in black and white.[7] This proposal was continued upon receiver manufacturers agreeing to equip new television sets with a switch and an appropriate circuit for that purpose.

But the response from manufacturers was insufficient and, in accordance with its September announcement, the Commission on October 11, 1950, adopted the "field sequential" system

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[7] Ibid.

for color broadcasting to become effective November 20, 1950. In doing so it held open the door for consideration of competitive systems or developments on the basis of practical tests and actual demonstrations.

The start of commercial color broadcasting was delayed when the Radio Corporation of America obtained a preliminary injunction in the United States District Court at Chicago. On May 28, 1951, the Supreme Court of the United States upheld the validity of the Commission's action and the Columbia Broadcasting System began limited color broadcasting on June 25, 1951. Because of the shortage of materials, the National Production Authority on November 20, 1951, prohibited the manufacture of color television sets or attachments except for experimental, defense, industrial, and certain hospital and educational use. This ban was relaxed to some extent on July 24, 1952.

It is interesting to note that black and white transmission was originally effected by means of rotating discs which later gave way to the electronic method. The Federal Communications Commission in reviewing the two divergent opinions in March, 1947, denied application of the Columbia Broadcasting System for approval of standards for commercial television. The ruling was seen as the climax of a technical battle that had been waged by the industry since 1944, and as preventing the early outdating of the existing black and

white sets spurring production of such receivers.

CHAPTER III.

SIGNAL TRANSMISSION

This chapter will deal with the actual transmission and services in regard to color television signals. Since the color receiver tube is an integral part in the transmission-reception system it will be included in this chapter. The chapter will include also the color television camera and the American Telephone and Telegraph cable and microwave network for color transmission.

The material for this chapter is drawn from technical publications from the networks and producers of electronic equipment, as well as from trade journals which publish excerpts from these journals.

The development of the chapter will include principles of color transmission, color television tubes, color cameras, and network transmission service.

I. PRINCIPLES OF TRANSMISSION

The transmission of color television is accomplished in much the same manner as black and white video. The principal difference is that each picture is scanned three times, once for each of the three primary colors -- red, blue, and green.[1] The existing television transmitter sends only one

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[1]"TV Takes To Color," The New York Times Magazine, (New York: New York Times, Inc.) February 28, 1954, pp. 16-17.

type of picture information, brightness, which is the same as in the black and white signal. The color transmitter on the other hand must send not only brightness, but also hue, and saturation, or color intensity.[2] The color camera at the studio is really three cameras in one. By means of a system of mirrors, a scene is separated into three individual images, one for each color, and directed to three pickup tubes. In front of each tube is a correction filter. Each filter permits passage of the correct color value for the individual camera tubes.

From the three tubes come electrical impulses representing the three respective colors. The three primary color signals are sent in two directions. One set of these signals goes to an "adder" which puts them together in proper proportion to form the brightness, or black and white signal. The second set of these signals goes to an "encoder," which in effect combines them to produce a signal carrying the hue and saturation information. The two resulting signals, one for the brightness and one for the color information, are then transmitted together from the station. At the home of the television viewer the signals are picked up by the conventional aerial and sent down the lead-in wire into the receiver.

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[2] Ibid.

In the case of a black and white receiver the brightness signal, corresponding to the monochrome image, is the only one used. The signals containing hue and saturation information are rejected. As a result, an owner of a black and white set cannot tell whether the program is in color or not unless so informed in advance.

If it is a color receiver, two signals go to an electronic "separator" which separates the brightness information from the color information. The color information is then fed into a "decoder," which once again gives us the set of three individual signals, one for red, one for blue, and one for green. To each of these signals there is added the necessary amount of brightness information. When the three signals are applied simultaneously to the face of the color picture tube, which contains red, blue, and green phosphors that light up when hit by an electrical charge, there is reproduced the original full color scene picked up in the studio. Future color sets will probably be designed so that if a program is sent in color it will, of course, be reproduced in tints. If sent in black and white, it will be seen in monochrome.

II. COLOR TUBES

The work of the ordinary monochrome tube is to translate electrical impulses in minute areas of varying shades

of black and white to form, according to a pattern defined by the broadcast signal, an image on the tube's screen.

The function of the color tube is the same, except in addition to reassemble the picture by the placement and light graduation of the minute areas, it must do another job; it must reassemble the picture according to the color values of the minute areas. To do this the tube must be equipped to handle the three primary colors of red, blue and green. The phosphor screen of the set can be divided into these three primary colors, but the problem is to get the right combination in each of the three to reassemble the pattern of the color image.

Red, blue, and green are "additive" primaries, meaning that lights of these three colors can be so added as to produce white or any other color. The primaries of red (magenta), blue (cyan) and yellow are "subtractive" primaries as used in mixing paints. "Subtractive" here means that part of the white light is taken away or absorbed to produce variations in color.

An early approach to color television picture tubes, successful in small sizes, used a "masking technique" to be sure that electrons struck the right phosphor on the viewing screen. The outgrowth of this technique was the shadow-mask type of picture tube. The procedure was to shoot an electron beam from one or more electron guns to

strike a phosphor dot one one-hundredth of an inch in diameter on the face of the cathode-ray tube.

The "mask" was a perforated sheet with approximately 200,000 holes.[3] In one tube, for example, three electron guns shot their beams from different directions through these 200,000 holes on to 600,000 phosphor dots, 200,000 dots for each of the red, the blue, and the green.[4] These dots were so arranged in juxtaposition to the holes in the mask that a portion of the electrons fired from the "red" gun, for example, penetrated the mask only to the red dots on the screen, the green only to the green, and the blue only to the blue.

The masking technique sought to solve the problem of color registration and purity by erecting a wall in front of the phosphorus screen and putting a hole into this wall directly before the phosphor dots. If an electron were aimed properly to the phosphor dot it would pass through the hole and would strike the phosphor. On the other hand, if an electron from the "green" electron gun were incorrectly aimed to strike a "red" or "blue" phosphor dot it would be intercepted by the wall or mask.

Despite many years of intensive development, certain

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[3]The Lawrence Color Tube, (New York: Chromatic Television Laboratories, Incorporated), p. 4.

[4]Ibid.

limitations had proved inherent in this approach to color tubes. Some eighty-five per cent of the total electrons available were intercepted by the mask. The remaining fifteen per cent of the beam passed through the mask, and a minimum of electrons struck the phosphor-dotted screen to produce a color picture of low brightness.[5]

Again the mask tube was necessarily an extremely complicated device. The perforated mask required that it be adjusted and kept adjusted, and it was particularly difficult with the "masking" technique to keep the red, blue, and green beams in color registry.

Because the mask intercepted so many electrons, the energy absorbed turned to heat and could cause warping and hence color contamination because the holes were no longer properly aligned with the phosphors. The electron guns required careful positioning so that discrepancies between them would not result in color fringing.

To produce a picture comparable in size to the then present black and white sets, 21-inch and up, either required a tube of prohibitive length, since there was a very narrow deflection angle in the mask type tube, or additional components of a complicated and costly nature.

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[5] Ibid., P. 5

III. COLOR CAMERAS

Each network has its own special cameras and gear for breaking down the scene into the three primary colors. The National Television System Committee did not set up a new system but arranged a set of standards. These standards provided each network with the opportunity to streamline and modernize its own equipment as long as it falls within the standards established by the Committee. When the picture leaves the transmitter, it is the same for all networks, three color signals riding in close frequency to black and white and audio signals. All this information is picked up by the home color receiver.

IV. NETWORK TRANSMISSION SERVICE

Network color television, as well as black and white, as of August, 1954, was being outleted to about ninety-six stations in sixty-six United States cities, and the total was expected to reach approximately one hundred twenty-five stations in some ninety-five cities by the end of 1954, as estimated by the American Telephone and Telegraph Long Lines Department in August of 1954.

The sixty-six cities to which color programs could then be transmitted contained a total of one hundred forty-six network outlets. In the ninety-five cities where color was expected to be available by the end of 1954, there were

currently one hundred eighty-seven stations that received network service. Several other stations were expected to start receiving color service early in January of 1955.

Of the 59,000 channel miles of television facilities that were in service, approximately 31,000 had been re-engineered and reequipped to carry color as well as black and white.[6] The transformation required new equipment for transmission, testing and monitoring, plus additional specially trained employees to set up and maintain the channels.

The first public colorcast from coast to coast was carried on January 1, 1954, when the Tournament of Roses Parade in Pasadena was channeled to stations in eighteen cities. The year 1954 also marked the twenty-fifth anniversary of the first public demonstrations of color television. On June 27, 1929, a group of newsmen gathered in Bell Telephone Laboratories in New York to witness a colorcast of an American flag flying in the breeze.

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[6]Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Inc.), August 30, 1954, p. 88.

CHAPTER IV

COLOR SETS

This chapter will present some of the reactions to the color set development and sales in the race for set production and acceptance. The manufacture of color sets and the purchase of those sets have been an uncertain race among major corporations since they are basically determined by factors such as cost and amount of programming.

The material for this chapter was drawn from statistical reports published in trade-press magazines and technical journals.

The points to be covered in this chapter will include color set status, color television set production, leasing plans, merchandising, price and buying trends, and color set manipulation.

I. COLOR SET STATUS

Research for color television has been under way for a great many years; the Zenith Corporation has been a pioneer in the field of color experimentation. As far back as 1939, Zenith Laboratories started experimental work on the field sequential system which was a prototype of the first color method later adopted by the Federal Communications Commission. Zenith was also the first manufacturer to produce

and sell commercially receivers of the now obsolete CBS disc system.

Many national magazines have published articles concerning color television compared to black and white television in regard to set sales, programming, appeal, etc. Among these articles such questions have been proposed as "Is your black and white television set soon to become obsolete?" or "If you are thinking about buying a set, should you wait for color?" and "What about the cost?" and "When will we have regular color programs?." In regard to these questions, Dr. W. R. G. Baker, Chairman of the National Television System Committee, made the following statement:

> Color television will come as an evolution and not as a revolution. Color will prove to be a supplementary service and will not quickly, or perhaps ever, completely replace black and white service. Black and white receivers will continue to be the backbone of television for at least five years to come.[1]

That is not to say, however, that color television is not a great scientific achievement. A two-hour show in New York in October, 1953, designed to convince the Federal Communications Commission that the National Television System Committee color system was solved, represented the result of one million man-hours of work by two hundred scientists from ninety-one companies. These figures in themselves represent a very convincing display of scientific

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[1]"Color Television," American Home, (New York: The American Home Publishing Corporation) September, 1954, p. 85.

achievement in scientific research. At the same time in New York, in October, 1953, several hundred broadcasters, congressmen, set manufacturers, newspaper men, and magazine editors watched as thirteen companies demonstrated color receivers picking up programs put on by CBS, NBC, and DuMont.

II. COLOR SET PRODUCTION

The members of the National Television System Committee, certainly the best informed on color television, estimated that 50,000 to 75,000 color sets would be built in 1954. Many of these sets which would run off the initial production line would naturally fall into the hands of television personnel, and even though every set produced would reach a customer, there would still be only one color set to every one hundred black and white sets. The National Television System Committee estimated that in 1955 color set production would climb to 1,500,000 units.[2]

A very interesting article in the March, 1954, issue of Fortune Magazine, "Upheaval In Home Goods," based upon a survey for the magazine by consulting economists Boni, Watkins, Mounteer and Company, Inc., 36 Wall Street, New York, predicted eighteen million color sets in use by the end of 1959, or one out of every three sets in use at

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[2]Television Digest, (Washington, D.C.: Radio News Bureau), February 27, 1954, p. 8.

that time.[3]

The year by year breakdown is as follows: About one million color sets will be sold at retail in 1955, at an average price of $700; 2,500,000 at $540 in 1956; 4,000,000 at $450 in 1957; 5,300,000 at $400 in 1958; and 5,000,000 at $350 in 1959. The report estimated that about 200,000 color sets would be turned out in 1954.

The report also predicted that sales of black and white sets would gradually decline during the next five years until they reach about 1,000,000 units per year, at the average retail price of $200 in 1959. The total combined color and monochrome sales during the five-year period would be well over the two million figure annually.

Some 53,000,000 sets will be in use by 1959, not taking into consideration any widespread development of the two-set market. The report predicted that less than six million families would own both color and black and white sets in 1959.

An earlier forecast by the same firm estimated that 50,000 color sets would be sold by 1954, 800,000 in 1955, 1,600,000 in 1956, and 3,500,000 in 1957.

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[3]"Upheaval In Home Goods," Fortune Magazine, (New York: Time, Incorporated) (February, 1954) pp. 71-78.

III. LEASING PLAN

Emerson Radio and Phonograph Company announced on March 1, 1954, that it had developed a plan for leasing its color sets rather than selling them.[4]

The rental plan, announced in a letter to distributors throughout the country, was seen as an innovation in introducing color television receivers nationally. The letter, signed by Benjamin Abrams, President, stated that the rental plan was adopted because Emerson did not believe that a color television set would give the customer maximum satisfaction for his investment during a time when color telecasts were limited.

A plan was instituted in March, 1954, by Emerson Radio and Phonograph Company, whereby a monthly charge would be made to those wanting a color receiver, and they would continue to pay this monthly fee as long as they chose to keep possession of the receiver. The fee included installation and service of the set while it was in the home. Very little response was found for this new plan, and subsequently the Emerson was priced for retail sale at $695.

IV. MERCHANDISING

Color television hit the big New York department stores

4Broadcasting-Telecasting, (Washington, D.C.: Broadcasting Publications, Inc.), March 8, 1954, p. 81.

the week of February 13, 1954, with Macy, Gimbel and Wanamaker all heralding demonstrations of color receivers with big newspaper advertisements.[5] For its sixth Annual TV-Musical Festival, Macy's took six pages in The New York Times. The advertisements told consumers precisely what the salesmen later told them in the stores, "Black and white is your best buy."

The sales story as told by the Wanamaker salesmen clearly presented the facts concerning color. Color sets then had twelve-and-one-half-inch pictures, compared to black and white sets with up to twenty-seven-inch pictures. The colorcasts averaged less than two hours a week at that time, as against seven channels telecasting all day and most of the night. Color sets then ranged from $700 to $1,200, compared to twenty-one-inch monochrome sets priced under $200. Delivery of color sets was set between three and six months, compared to immediate delivery on nearly all black and white sets. The service and warranty costs on color sets were about four times the cost of monochrome, with only a few technicians trained to service the existing color sets.

The results of these facts resulted in the people's looking at color, and then buying black and white sets. The three basic reactions to color by the public were that

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[5] Television Digest, (Washington, D.C.: Radio News Bureau), February 13, 1954, pp. 11-12.

the price was too high, the pictures were too small, and that delivery of color sets was too small for consumer demands.

Color sets at Macy's were labeled at the following prices, some clearly illustrated as estimated prices. CBS Columbia $1,200, Emerson $700, Hallicrafters $1,200, Hyde Park (Macy's private brand assembled by Tele-King) $989, RCA $1,000, Spartan $1,150, Stewart-Warner $1,000, Westinghouse $1,295. Service and warranty charges on these sets ranged from $200 to $300. The average delivery was three months, though Westinghouse, which had channeled all its sets to New York through distributor Times Appliance Company, announced they could make delivery to customers immediately.

V. PRICE AND BUYING TRENDS

The history of black and white television development persuaded many people that the pattern would be repeated with color television receivers, perhaps even more rapidly with color than with black and white.

The swift development and acceptance of black and white television led the public to expect the following standards for color receivers: first, that there should be a large picture tube; second, a price within the means of a mass market; third, that the tube and set would be simple enough to assure minimum maintenance expense.

VI. MANIPULATION OF A COLOR SET

The manipulation of the color television monitor for the home user presents new and complex problems. A typical color set has five or six knobs, four being the familiar ones on the standard monochrome set: channel selector, brightness, contrast and focus control. One control that was new with the color set was the "chroma control." When the control is turned all the way to the left, the color faded to a washed out picture resembling a badly over-exposed color transparency. When the knob is turned to the far right, color jumps out in a dense intensity and brilliance, with startling but hardly "true" color. In between are subtle shadings of color to suit individual taste.

There is also a "convergence control," a delicate adjustment for aligning the three color signals so that they strike the face of the color tube in perfect register. If this adjustment is off, people on the screen develop green or red ears, or purple halos.

Actually, color television and black and white signals are identical, but instead of a single image, the three independent signals must be perfectly matched for comfortable viewing on the home receiver.

CHAPTER V

COLOR EQUIPMENT

This chapter will present material concerned with equipment for telecasting color. The chapter will present a discussion of some of the equipment developed for color use, servicing of color sets, and new equipment under development which will improve and facilitate greater production results.

The material in this chapter has been drawn from technical journals which reported the new developments as they occurred.

The development of the chapter will include a discussion of: equipment for color telecasting, General Electric transmitters, RCA transmitters, closed circuit television, color checking equipment, and magnetic tape.

I. EQUIPMENT FOR COLOR TELECASTING

The race for station color equipment sales became fervid during the week of February 8, 1954, as RCA levelled two attacks at competition during a UHF-Color Seminar for consulting engineers in Washington, D. C., on February 11, 1954:

1. RCA announced it would equip without charge for rebroadcast of network color all stations using its trans-

mitters. Furthermore, the thirty-odd stations already solely equipped would not be billed. Since cost of modifying stations ran up to $25,000, this meant an RCA outlet of several million dollars. In addition to equipping existing stations for color, RCA would henceforth ship all new transmitters already modified for color or accompanied with kits.

2. RCA talked down cost-performance claims for CBS-type field-sequential camera equipment being made by General Electric. About all RCA would concede to the CBS-GE camera set-up was its light weight--120 pounds compared to 300 pounds for RCA's three-tube camera. Aside from that, RCA Engineer Andrew Inglis told consultants that the system had innumerable drawbacks. He said that initial cost could favor either type of equipment, depending upon the number of cameras; and that the field-sequential type would likely require thirty to one hundred per cent more light at the studio source.[1]

Inglis refuted a common belief that the three tubes in RCA cameras must be perfectly matched. He said that camera controls compensate for the difference. He made a surprising statement that tubes last longer for color than for black and white, because each gets less illumination. He estimated that the image orthicon tubes in color cameras

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[1] Television Digest, (Washington, D.C.: Radio News Bureau), February 13, 1954, p. 5.

would function at least 750 hours. Customary life of tubes in monochrome cameras was about 500 hours.

II. GENERAL ELECTRIC TRANSMITTERS

All transmitters shipped after February, 1954, by General Electric required only the addition of in-put equipment in order to handle National Television Systems Committee color signals. The equipment required to convert an existing station for the rebroadcast of color network programs cost $13,800, with deliveries scheduled to begin in February, 1954. General Electric also announced plans to make available, by the middle of 1954, a flexible line of color slide and film handling equipment. It included a film scanner, 2" x 2" slide scanner, scanner pickup channel and color monitor.[2]

The system was designed on a block-building plan, providing operation for film only, slide only, or both, depending upon the broadcaster's requirements. The system was easily extended from slide to film, or from film to slide.

The company had under development a new film projection system embodying an Eastman continuous motion projector movement.

A station could start with the slide projection system

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[2]Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Incorporated), February 1, 1954, p. 72.

for $32,500 and could add the film system for an additional $35,760. The total investment for both would be $68,260.[3]

III. RCA TRANSMITTERS

RCA would modify without charge all of its existing post-war television transmitters so that they could carry color programs properly. This announcement was made in the latter part of January, 1954, by E. C. Tracey, Broadcast Equipment Sales Manager, at a consulting engineers' seminar at the Hotel Statler in Washington, D. C.[4]

When color terminal equipment was added, RCA would ship a kit of modification parts to such station, and an RCA engineer would be supplied to make the modification. The purchase of new RCA color equipment would not be necessary.

Announcement was also made at this meeting of consulting engineers of RCA's new twelve-kilowatt UHF transmitter which was scheduled for delivery in the fall of 1954. The RCA twelve-kilowatt transmitter was the second placed on the market by a major transmitter manufacturer. The only other twelve-kilowatt transmitter was General Electric's. DuMont had a five-kilowatt UHF transmitter, but declined

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[3] Ibid.

[4] Ibid., p. 87.

comment on when it would have a higher-powered unit.

Broadcast Planning Manager, Merril A. Trainer, announced that, in addition to modifying transmitters for color, RCA would modify all of its microwave relay equipment at the factory fee of $1,000.

IV. CLOSED CIRCUIT TELEVISION

The entry of General Electric Corporation into the closed circuit television field was announced June 7, 1954. Using the CBS-developed field-sequential system, General Electric planned to offer a $26,800-package for closed circuit color television for business, education, and industry.[5]

William Morlock, General Manager of General Electric's Commercial Equipment Department, made the announcement and said that the field-sequential color apparatus offered users a lower initial investment and lower operating costs than other types offered.

The GE package was composed of four basic elements: color camera, camera control console, rack-mounted power supply, and receiver. All of the equipment except the camera could be located remote from the scene being televised. For an extra fee a large screen receiver could be

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[5]Ibid., June 14, 1954, p. 76.

substituted for the home-type console receiver. This would throw a picture on a six-foot by four-foot screen. The camera and the receivers contained the color disc which added the color to the black and white picture.

V. COLOR CHECKING EQUIPMENT

A novel technique for checking color signal and equipment was suggested to the Federal Communications Commission by Telechrome, Inc., Amityville, New York, makers of color equipment. President Ray Clurman proposed that networks and stations be permitted to transmit ten to twelve lines at the top of the picture in color bars, and at the bottom ten to twelve lines in other components of color picture, simultaneously with regular color or black and white programs.[6]

The purpose of such transmission was to give everyone--from origination point, to interconnecting facilities and stations, to servicemen and the viewer--the same standard of comparison to check performance. This would not only assure accurate transmission of color but would eliminate such complex and expensive checking instruments by all "links" in the color chain.

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[6]Television Digest, op. cit., December 19, 1954, p. 10.

VI. MAGNETIC TAPE

Brigadier General David Sarnoff announced that RCA's Princeton, New Jersey, scientists had perfected a method of storing color signals on half-inch magnetic tape.[7] It did away with all chemical processing. A color program could be stored indefinitely and played back at any time. The tape could also be erased and reused.

In 1953, Frank C. Healey, Executive Director of the Electronics Division of Bing Crosby Enterprises, after viewing the Princeton, New Jersey, RCA demonstration of recording television programs on magnetic tape, was of the opinion that color posed no problem for the Bing Crosby magnetic tape recorder. However, there was no immediacy for its use since color television to any great degree was several years away.[8]

Refusing to reveal what the technical improvements for the recorder consisted of, Healey stressed that future showings to the press would be scheduled. He repeated his statement that the Crosby VTR (Video Tape Recorder) method of magnetic tape recording and color television would be ready as soon as manufacturers could provide transmitting equipment to television stations and receivers to the

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[7] Broadcasting-Telecasting, op. cit., December 14, 1953, p. 92.

[8] Ibid., p. 93.

general public.

Mr. Healey declared that tape recording in color would cost little more than any live television on tape, and that video tape recording promised to be about two-thirds less costly than any other process then used with film or kinescopes.

The Crosby tape operated at one hundred inches a second while the RCA system in color tape operated at three hundred sixty inches per second. Both systems used a half-inch wide tape. As in the RCA development, pictures under the VTR process could be viewed instantly. The tape under both systems could be "wiped off" and reused many times. Under the Crosby VTR system a half-hour television show used thirty thousand feet of tape, while the RCA system used ninety-six thousand feet of tape.

Two additional methods of recording television programs, not on film but on magnetic tape, were described by Mr. H. F. Olson of RCA, and Mr. J. T. Mullen of Bing Crosby Enterprises.[9] The RCA method could record and reproduce both black and white and color television programs, utilizing a quarter-inch tape with two channels--one for the video signal and one for the audio--for monochrome pictures and half-inch tape with five channels--one for each color plus

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9Ibid., March 29, 1954, p. 34.

a synchronizing channel and an audio channel--for colorcasts. A tape speed of thirty feet per second required the utmost care and precision to avoid distortion; this meant that a reel of tape seventeen inches in diameter was needed for a four-minute program. Work was being done to reduce the speed so that a quarter-hour program could be put onto a nineteen-inch reel.

The VTR method of tape recording used by Bing Crosby Enterprises, recorded twelve tracks simultaneously for monochrome picture recording with ten tracks handling the video signal through a multiplexing process by which each channel sampled it in succession at a rate of three hundred thirty-nine thousand samples per second, and one track for synchronization, and one for audio. This method permitted a tape speed of one hundred inches per second, which made possible a reasonable reel size; a seventeen-inch reel would thus hold tape with sixteen minutes of running time and provide a convenient fifteen-minute program length plus adequate overlap time.

CHAPTER VI

COLOR FILM

This chapter will present material concerned with color film as a problem in its application and use in the color television system.

Trade-press publications which have presented the material as released by various persons engaged in film production and research have served as source material for this chapter.

The development of the chapter will include a discussion of: color transcriptions, film tests, problems with film, commercial presentation, color slides, and color film production.

I. COLOR TRANSCRIPTIONS

Color television experts have much to learn about color transcriptions and color films, but these problems are being solved. That was the conclusion reached by the National Television System Committee panel 11-K which, on February 13, 1954, released a two-hundred-page report on the subject compiled by its members after ten thousand man-hours of work over a two-year period.[1]

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[1] Television Digest, (Washington, D. C.: Radio News Bureau), February 13, 1954, p. 10.

Evaluating the highly-technical study, Chairman Dr. Alfred N. Goldsmith said: (1) Acceptable color film recordings and color release prints of live programs could be produced by direct photography and be transmitted successfully. (2) Color kinescope-recording information available was insufficient to enable firm conclusions to be drawn as to the commercial possibility of this process; however, progress in this field was rapid and the ultimate successful utilization of color kinescope-recording was a definite possibility. (3) The color transcription art was rapidly developing in all its branches, and should enable the successful recording, transmission and reception of transcribed programs in the foreseeable future.[2]

II. FILM TESTS

Color television tests of film made by means of three processes were conducted on May 19, 1954, on a closed circuit at NBC studios by Screen Gems, Columbia Pictures subsidiary. Mr. M. Peter Keene, Screen Gems' Technical Director, gave representatives of twenty-seven advertising agencies the following evaluation: (1) 16 mm Kodachromes as the lowest priced original film had excellent definition and color quality. The principal disadvantage of their use was their

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[2]Ibid.

limitation of optical effects to "dissolves" and "fades," a more noticeable color loss in release prints, a high release print cost, and a less satisfactory sound track. (2) 35 mm Eastman negatives reduced to 16 mm positives had the advantages of larger film, the values derived from making prints from negatives, ability to be made into optical effects, and better resolution than most other processes. (3) The 35 mm Technicolor three-strip process reduced to 16 mm dye-transfer permitted greatest control of color saturation and optical effects, better sound track, and lowest release print cost.[3]

III. PROBLEMS WITH FILM

There were three principal problems, Mr. M. Peter Keene made haste to point out, which would probably be soon solved because all the film manufacturers, laboratories, and optical effects companies were working together to perfect their techniques.

Problem number one concerned the criticism of audiences of familiar objects, such as packages in color rather than in black and white.

Problem number two concerned the inability of the photographic dyes to reproduce exactly all colors in packages,

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[3]Television Digest, op. cit., May 29, 1954, p. 8.

clothing, and cosmetics.

Problem number three concerned the difficulty of incorporating the travelling matte and duplicate negative techniques in the production of color television commercials.[4]

IV. COMMERCIAL PRESENTATION

Packages could be redesigned in color to fall within the reproduction ability of various color films and television systems.[5] The trouble with this redesigning process would be that advertisers would have to give up the great variety of presentation that they now enjoy, and would have to limit themselves in the choice of colors for their packages and products. Improved readability and color harmony would be important considerations in the redesigning of packages.

Another major problem relating to the production of television commercials in color revolves around the nature of television commercials themselves. Television commercials, because of their brief showing period, are designed to contain all the possible information the advertiser can get across in that short period. To do this, the producer uses photographic techniques that make it possible to compress all this information into a short period of time, i.e.,

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[4]Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Inc.), March 8, 1954, p. 68.

[5]Ibid.

optical effects and dissolves that bridge one scene to the next, overlaid titles used to double the impact on the viewer so that important parts of the advertisers' message reach the viewer through sight as well as sound, and split screen effects in which two or more separate pictures are combined in one motion picture frame. These devices which involve the use of the travelling matte process, are in common use in black and white film production but are not so easily accomplished in color.[6]

V. COLOR SLIDES

In making color slides, it must be remembered that color receivers have the French oval screen, which masks off some of the corners.[7] This aspect ratio will rule out in color, as it does in monochrome, most slides made vertically.

Color slides made from under-exposed negatives should be avoided. Under-exposure generally takes on a blueness in the slide which is accentuated in the color system.[8]

In scenic slides, large dark areas, such as trees in the foreground, may not show all the color they do in

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[6] Ibid.

[7] Broadcasting-Telecasting, op. cit., August 23, 1954, p. 74.

[8] Ibid.

natural projection because of the weaker light source of the scanner.

Maximum readability of title and caption slides is secured from white lettering. Black is less effective because of the added interest of the background color.[9]

Slides should be made well in advance of contemplated use in order to check density and aspect ratio. This check should be made with the projector.

VI. PRODUCING COLOR FILMS

The compatible television system reproduces any good color film faithfully and effectively, and can handle all the colors and hues of the film spectrum. But if the original lighting, camera work, and color harmony are not done professionally, then no degree of perfection on the part of the television system is going to make that film look good.[10]

While individual firms will present individual problems, Mr. Parlan, NBC Color Film Consultant, offered these general suggestions for the making of films for color television programs: (1) Use flat lighting with plenty of fill light in the shadow areas. Avoid large dark areas on the screen.

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[9] Ibid.

[10] Broadcasting-Telecasting, op. cit., March 1, 1954, p. 66.

(2) Use plenty of close-ups and avoid sustained long shots. The color system is extremely effective on close-ups. (3) Avoid the use of optical effects as much as possible. (4) Use complementary colors in achieving color harmony, and positive color separation between foreground objects and their background. (5) The color prints for broadcast should have a relatively low maximum density to achieve what might be considered as a rather "light" or "thin" print.[11]

In making color film commercials for commercial programs, NBC recommends the use of 35 mm cameras. Reasons, Mr. Parlan stated, included: The quality of both picture and sound will be superior; greater control can be exercised in the laboratory processing and printing; the majority of color film commercials and programs used for network broadcasting will be on 35 mm film; 16 mm reduction color prints for local station use can be made from the original 35 mm material; 35 mm black and white prints can easily be made from the original color material for use on current black and white programs, enabling immediate amortization of the production costs.[12]

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[11] Ibid.

[12] Ibid.

CHAPTER VII

COLOR PRODUCTION

This chapter will present material pertaining to the elements of producing the color programs which present problems not necessarily inherent in black and white television such as varying the costs of production, problems in producing colored lighting, experimenting in color production, and planning for some of the network productions.

The material for this chapter was taken from production reports submitted to the industry and subsequently published in technical journals as an avenue of information for other telecasters.

The development of the chapter will include: production costs, color agency, color experiments, costuming, make-up, criteria for color use, color impact, uses of color, personnel, color matching, color fidelity, placing of color, and color pecularities.

I. PRODUCTION COSTS

One NBC-TV executive estimated that in some cases the increased cost for the use of color would be about ten per cent. The executive added that NBC's new rate manual, number three, did not represent a rate increase for black and white television, but actually reduced the costs for

most of the programs because of a different method of charges.[1]

In response to questioning, one official ventured the estimate that the rate for time and color, as distinguished from the color production charges, would be no greater than the time charges for black and white; but it was added that in the case of color there might be a special "interconnection" charge.[2] Color time costs, it was generally felt, would depend upon the intercity relay costs eventually established by the American Telephone and Telegraph Company for color.

Upon the issuance of a new rate manual, Sylvester L. Weaver, Jr., President of NBC, offered the following appraisal of its highlights:

1. It placed a premium on efficiency in usage so that advertisers could control and reduce their television production costs.

2. The rate structure was simplified by eliminating former separate charges for camera rehearsals and dry-run rehearsals, and hourly charges applied to total time in the studio, beginning with dry rehearsal and continuing through the end of the telecast.

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[1]Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Inc.), June 21, 1954, p. 92.

[2]Ibid.

3. Manpower costs would be determined by the number of men used and the duration of their use in both black and white programs and color programs, with the only differential for color prescribed for studios, mobile units, and extra equipment.

4. It established a small cost for film originations, so that the cost of facilities would be distributed more equitably among users.[3]

In the production area, there would be some differential in costs for color, to the extent that the hourly studio rates were somewhat higher for color studios and that more technical personnel would be required in the production of a color show. However, the differential in total costs of time, talent, and production would be moderate, considering the value received; it, of course, would vary from program to program, depending upon the client's requirements of the particular program.[4]

An analysis of eighteen leading magazines showed that magazines charged, on the average, forty-one per cent premium for color over black and white advertising, Mr. Bellville, NBC Director of Research of the American Marketing Association, reported, with a variation for individual magazines

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[3]Ibid.

[4]Ibid.

from thirty-five per cent to fifty per cent. Indications were that color advertising was studied by about forty per cent of the viewers, thus justifying the increased cost.[5]

II. COLOR AGENCY

Lester Lewis, one of the organizers of the firm, announced on November 22, 1954, the establishment of a design organization named Video Colors, Incorporated, New York, to serve advertisers who plan or use color television.[6]

He stated that it was the first organization created solely to stage-manage the presentation of products on color television, and when necessary his firm would assist in altering or creating new package designs for the medium.

In explaining the reason for setting up the new organization, Mr. Lewis stated:

> The color television camera does not necessarily see the same color effects as the human eye. Some problems can be handled by the experienced color mixer, the electronics engineering studio, but much can be accomplished for the color-wise advertiser by preparing his product in advance.[7]

III. COLOR EXPERIMENTS

To provide criteria for color selection, which would

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[5]Broadcasting-Telecasting, op. cit., March 1, 1954, p. 89.

[6]Ibid. p. 61

[7]Ibid.

answer in advance questions of the choice of the right shade of blue velvet and without the necessity of going through the time-consuming trial and error process, NBC's Art Director and Color Consultant, Norman Grant, was placed in charge of a program of developing standards for make-up, costumes, scenery, and product displays that were to be used in color television.[8]

These standards would serve as guideposts to any qualified artist, enabling him to make his way around in color television as well as in the world of painted and printed art.

Noting that color harmony is as much a matter of order as harmony in music, color being a visual sensation psychologically similar to the auditory sensation of music, Mr. Grant stated that his staff was basing its experiments with painted colors on a system of color harmony widely used by artists and designers.[9] NBC was also keying this system of color chips, which was used in matching painted colors, into the Munsell Gray Scale for light reflectant measurement.[10]

When the tests were completed NBC would have three

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[8]Ibid.

[9]Ibid.

[10]Ibid.

measurements for each color: First, its location on the gray scale for black and white telecasts (that would be very important as long as homes were equipped for black and white reception only); second, its appearance for the color system, and finally, its appearance to the naked eye.[11]

Similarly, work was going on with the ink and dye industry to establish television standards for the colors used in commercial packaging. Certain families of colors came across on camera differently than they looked to the eye when viewed directly, because of pigments in the dyes which the camera detected but the unassisted eye could not.[12]

IV. COSTUMING

Probably the most difficult field in which to set standards for telecast colors was that of fabrics, where the texture as well as the fabric was a factor. The color sensation derived from light reflected from the object to the eye, or camera, and texture as well as color was involved. If four different fabrics were all dyed the same color they would come out in four different shades because of the different weaves.[13]

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[11] Ibid.

[12] Ibid. p. 62.

[13] Ibid.

One of the most pressing fabric problems for color television came in the costume field. Costumes available for rental were mostly made for stage use, where they were brightly lighted and where they were seen at a distance. They were found to be too high in value for color television and had to be toned down by retrimming or even re-dying. In many cases the only thing to do was make new costumes for the program.[14]

V. MAKE-UP

Make-up was probably the most critical color problem of all those confronting the television producers.[15] The viewer at home didn't know what color an actress was wearing, and as long as it looked well the viewer did not care much whether it was pink or blue. He did know what color her face ought to be, and if it was blue he didn't need a television engineer to tell him something was wrong with the picture. For this reason colored lights could not be used to change costume colors, especially in close-ups in color-casting.[16] There was the added problem of getting flesh tones that looked well on black and white as well as color.

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[14] Ibid.

[15] Ibid.

[16] Ibid.

Working closely with Max Factor's Cosmetic House, naturally interested in what would undoubtedly develop into a large new market for its products, NBC reported that after about six months of testing, substantial progress had been made toward getting the proper type of cosmetics for color television.[17] The Max Factor Laboratory Technicians on the West Coast made up powders, creams, and rouges for the NBC make-up artists, who tried them out and sent them back reporting their reactions on the color camera with suggestions for further changes.[18]

As was the case with costumes, stage make-up was generally not suited to color television use, as NBC soon discovered. Instead of the high colors that were required on stage, subdued tones were best on the television camera. The compatible television system picked up the red of the skin and lips so well that in most instances it might be lightened rather than emphasized to appear natural to the home viewer. With men, the lips were blanked out completely and the women's lips were toned down. If women had fine, light complexions they needed almost no make-up, just a thin base coating.

With the new pancake base then available in place of

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[17] Ibid.

[18] Ibid.

the older pan-stick, make-up for color television was easier to apply and remove; and the process required less time than formerly.

VI. CRITERIA FOR COLOR USE

When all the standards under study were established, NBC would have yardsticks to tell what colors could be reproduced well as they were, what to do to change those that could not, what combinations of colors should be used, what combinations of colors and flesh tones, and what background colors to use. Distance was a factor, and backgrounds showed up more vividly on the television system than they did to the eye in the studio.

These standards would not replace or reduce the need for creative ability in the slightest. They would be merely yardsticks to help the artist measure the new aspects of the new medium of color television, and to let him go on with his creative function without wasting time on technical problems for which the answers could be given.

In no place would a creative man be more needed or more valuable than in the production of commercials for color television. A good graphic arts man would be an essential addition to the staff of every television station that wanted to provide color commercials for its local advertisers, even if only on slides and films.

With color, a black and white photograph of a product or of a magazine advertisement no longer provided the basis for a television commercial. Any art work used would need to be complete in design, detail and color, which would call for a high degree of color photographic skill to produce slides that give a desired effect. And, since color added a depth to the picture to produce a third dimensional effect that was not noticeable in black and white, the products themselves, particularly packaged goods, should be used wherever possible instead of flat pictures of the products. This called for proficiency in handling light, so that the shadows would not blot out parts of the package.

VII. COLOR IMPACT

There was no doubt among the NBC staff who had worked with color that commercials on color television were going to have an impact never before achieved by any advertising medium. After one color program, Reid Davis, Technical Supervisor of NBC's colorcasts, reported that a viewer had seen a sponsor's package in his kitchen a thousand times but had never <u>really</u> seen it until he viewed it on color television.

Color helped some programs more than others, but there has scarcely been a product that has not been presented more effectively in color than in black and white.

VIII. USES OF COLOR

According to NBC's color experienced producers, color has been good not only for foods, but also for cosmetics, dresses, drapes, floor coverings, furniture, and, in fact, every kind of product one can think of from automobiles to wallpaper.

Unlike monochrome television, in which the majority of packages would have to be repainted to show up well, color television has shown existing packages to advantage. Better than three quarters of the more than one hundred packages tested to date, March 1, 1955, came through the system with little or no retouching necessary. This was no small tribute to the country's commercial designers, that their work should stand up so well under the exacting eye of the color camera.

Backgrounds were very important to provide the right setting for the product. When "Zoo Parade" was colorcast, the blue, yellow, red, and white Ken-L Ration package looked fine before a neutral background, but almost all packages required the use of complementary colors to make them stand out properly and hold their natural color. Frequently, the proper product backgrounds were best obtained by use of colored lights or by neutral background material. There were cases of poorly designed packages which looked bad on color television as well as on the store shelf. In these cases, redesigning of the package was the only true solution.

IX. PERSONNEL

The only added personnel required for color were those needed in the control room. NBC assigned one video man in the control room for each color camera. That meant that if a program used three color cameras, two extra men were all that were needed. Otherwide, the same studio crew that handled black and white programs also handled the color-casts just as well.

Even the extra men--who were needed to control the contrast, brightness, and color matching so that all cameras delivered the same information to the monitors, and hence to the home viewing screens--wouldn't be needed long because technical improvements in the equipment would probably make more than one man in the control room unnecessary.

X. COLOR MATCHING

The job of color matching meant the balancing of each camera in accordance with color temperature in which it was to operate. This was relatively simple unless the temperature changed radically. For instance, Mr. Davis stated that if an actor were shown leaving an interior scene and going out of doors, the camera picking him up inside where the color temperature was 2,900 degrees Kelvin could not follow him outside into the color temperature of 6,500

degrees Kelvin without being rebalanced.[19]

However, a second camera, properly balanced for the outside temperature, could pick him up as he emerged and there would be no change from the inside pick-up in the color of his clothing, and so forth.

There was no particular problem for scenes of short duration, but for extended outside pick-ups, such as a football game, which began in hot sunshine and concluded in cool shade, rebalancing would be necessary. This would mean taking that camera out of operation while it was being rebalanced. What was needed, Mr. Davis pointed out, was a set of filters which the color television cameraman could use as a still photographer would when taking photographs under varying light conditions.

XI. COLOR FIDELITY

Color fidelity depends upon enough light, 300 to 400 foot candles, reaching the camera in evenly applied amounts.[20] The amount of light reaching the camera lens is regulated by an iris control on the video control console. Colors change as this iris is opened and closed. If the illumination on the brightest areas on the scene

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[19] Ibid.

[20] Broadcasting-Telecasting, op. cit., August 23, 1954, p. 70.

is just enough for faithful color reproduction with the iris wide open, the color of darker areas is bound to appear false since the iris can be opened no farther to expose them properly.

The color of the subject also changes as it moves along a horizontal light beam, either towards or away from a close-at-hand source. Overhead lights should therefore be beamed in at no angle flatter than forty-five degrees.[21] If floor spots are used, they should be on stands as high as possible and at some distance from the person walking towards them.

To light a given playing area adequately takes not only the sources immediately above it, but also as many as three rows of overhead lamps downstage of it.[22] This meant that the whole studio could not at one time have sufficient light for color pick-up. Playing areas must be restricted in size and located with reference to light positions.

Spots on floor stands, panning with the action, have proved helpful in reinforcing insufficient light areas at light levels.[23] Care must be taken, however, that they move with the camera so that the evenness of the illumination

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[21] Ibid.

[22] Ibid.

[23] Ibid.

shall not be unbalanced.

Backlighting is as effective in color as it is in monochrome.[24] Because of the intense front light, back light spots need to be focused down or supplemented to develop insufficient rim lighting. Back light is effective for enlivening bottled liquids, especially if in dense containers. Tests have indicated the possibility of tinting neutral backgrounds such as gray drapes with colored lights from scoops and spots equipped with gelatin and from strip light sections.[25] The white light used on the playing area must be prevented from washing out the colored background light, both by bringing performers out at least eight feet from the background, and by lighting them from a fairly steep angle. It is difficult to color a background evenly, because light that strikes it shades off rather sharply.

XII. PLACING OF COLOR

The color of the subject is affected by that of surrounding and background areas. Thus, the color of skin and clothing may change as a performer moves from one background to another, particularly if these backgrounds differ widely in the amount of light they reflect.

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[24] Ibid.

[25] Ibid.

It is safer to keep backgrounds fairly plain and uniform, not only to avoid the result just mentioned, but also because color is of such interest itself that too much additional detail will make a confusing picture. Still, one must maintain enough value variations to keep the black and white picture interesting.

Large, glaring white, or extremely light areas of background or costumes darken the tones of everything nearby, and thereby alter its hue.[26] To be safe, backgrounds a shade or two darker than the subject are used.[27] For darkening a backing without repainting or substituting a new one, lights may be moved off, or back, or angled down, or shielded, so that the subject thus receives less light to reflect.

Reflectance is a substantial part of color appearances. The appearance of glossy surfaces is sometimes hard to predict. For example, a rose colored paper may register as a near white depending on the way it reflects light into the camera.[28] For the same reason, shiny faces may look pallid. Glitter is no problem, however jewelry and band instruments

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[26] Ibid.

[27] Ibid.

[28] Ibid.

produce no black halo as in monochrome.[29]

Almost always backgrounds need to be more desaturated than the subject of interest so that they will not overpower it.[30] In some cases, materials that seem dull to the direct observer will prove too bright on camera.

On the electronic system, as elsewhere, warm colors advance; the hotter, the more the advancement. Hence, strong reds, oranges, and yellow should not be used as background or in accessories where they will detract from the center of interest.[31]

In making a subject stand out from its background in monochrome, there was only one dimension to vary--that of value, or brightness. Now there are two additional dimensions--saturation and hue. If subject and background are similar in hue, at least one of the two remaining dimensions should show contrast in order to make the subject stand out.[32] Or if the subject and background are similar in value, then the saturation or the hue should be contrasted. For the hue contrasts, the artist cannot go wrong in selecting complementaries.[33]

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[29] Ibid.

[30] Ibid.

[31] Ibid.

[32] Ibid.

[33] Ibid.

XIII. COLOR PECULARITIES

Color appearance depends in part upon certain peculiar characteristics of the electron system. Color mixtures in which blue is present will be seen more blue on camera than in the studio.[34] Thus, blue-green, unless quite green, will look blue. A blue tint may show up in highlights such as those on a shiny human face. This color contrast between highlight and general flesh tone looks artificial and may exaggerate the modeling of undesirable facial features, which should be countered as much as possible by powdering to reduce shine.[35]

With some faces, the camera seems to exaggerate patches of red pigment on the nose and cheeks, or may call undue attention to the redness of backlighted ears. Bright red lipstick and nail polish should be avoided because they are exaggerated by the system.[36]

The color goes out of subjects as they recede into the distance, as during the long dolly-back, and one can see the color change. Close-ups produce the clearest pictures and the truest color.

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[34] Ibid.

[35] Ibid.

[36] Ibid.

Some colors are particularly hard to reproduce. Certain yellows, for example, may go to an orange or to a green.[37]

Large white, gray, or dark areas will tend to show up the clouds of spurious color that sometimes drift into the picture. If the artist can fill his picture with positive hues, these spurious effects will be obscured.[38]

After a period of use, the system will drift, the primaries become unbalanced and the three primary color images move out of registration.[39] For this reason, some time should be allowed before air time in order to readjust balance and alignment.

Lighting is responsible for about sixty per cent of all color effects, according to the NBC experts, who said three to four times as much light is used for color as for black and white.[40]

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[37] Ibid.

[38] Ibid.

[39] Ibid.

[40] Ibid., December 14, 1953, p. 69.

CHAPTER VIII

COLOR PSYCHOLOGY

This chapter will present material pertaining to color and its uses in the scientific understanding and uses of color for more effective use.

The material for the chapter is drawn from a report on color by Howard Ketcham, noted color stylist of numerous household items.

The development of the chapter will include: definition of color, understanding color, fields of color study, color and the sciences, and color in packaging and design.

I. DEFINITION OF COLOR

Much of the confusion surrounding the subject of color has stemmed from the fact that the world itself has a great variety of definitions in popular usage. A scientific definition, in keeping with the recommendations of the Optical Society of America, states the problem this way: Color is a psychophysical property of light; specifically, it is the combination of those characteristics of light which produces sensations of hue, saturation, and brightness in the normal human observer.[1]

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[1] RCA Color Television, (New York: Radio Corporation of America, 1953), p. 5.

II. UNDERSTANDING COLOR

When the scientific terms regarding color are explained, understanding of the properties of color and the importance of color comes easily.

The term hue refers to the attribute of color that permits it to be separated into groups designated as red, blue, green, yellow, purple, and so on.[2]

The term saturation refers to "vividness" of a color, or to the degree by which it departs from a natural or gray shade of the same brightness.[3] Therefore, saturation is described by such terms as pale, deep, pastel, and vivid. A neutral or gray color has zero saturation.

The term brightness refers to the intensity of a color, or to its position on a scale ranging from black to maximum white.[4]

The term psychophysical indicates that color is not a property of light that can be evaluated by considering the physical attributes alone, such as wave length and power, but is a property that must be evaluated by considering the effect of light on the vision of human observers.[5]

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[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Ibid., p. 6.

Since color is the property of light, it would be erroneous to describe it completely as a psychophysical sensation. While there is a very close relationship between color measurements and the color sensations of a normal observer under normal conditions, there may be cases where such relationships do not exist. Some colors, for instance, are perceived under certain lighting conditions to be entirely different from the way they appear on color charts.

III. FIELDS OF COLOR STUDY

A scientific investigation of color generally falls into three distinct fields of study: (1) The study of light, the physical stimulus which produces color sensations, in the realm of physics; (2) the study of the sensation itself, of the effect of the stimulus on the observer and the interpretations by the brain, leading to the fields of psychology and physiology; and (3) the field of study called psychophysics which supplies a link between the physical aspects of color and the psychological aspects.[6] It involves the evaluation of light in terms of the effect upon human observers.

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[6] Ibid., pp. 6-7.

IV. COLOR AND THE SCIENCES

Today, color uses converge on no less than six sciences: (1) philosophy, the use of color in various civilizations to symbolize moral and cultural phenomena, for example, the King's purple; (2) physiology, the impact of color on the eye in the nervous system; (3) physics, the way color is seen, depending upon the light source; (4) psychology, the association of color with ideas; for example, in England green automobiles are seldom seen because the English consider green unlucky; (5) psychophysics, the way color is interpreted in connection with a particular use; for example, red means stop; and (6) chemistry, the components of color as used in paint or dye.[7]

In dealing with color it is well to consider that color is a sensation conveyed to the mind by the intricate function of six million eight hundred thousand tiny cone-like structures located in the retina of the eye. Since no less than eighty-seven per cent of all impressions are gained through the eye, it is vital that one remember how powerfully color contributes to what is seen and how profoundly color influences needs.[8]

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[7]"Color Line Can Pull Customer Interest," Television Age, (New York: Television Editorial Corporation), January, 1955, p. 39.

[8]Ibid., p. 40.

There are only six important colors. They are magenta, yellow, blue, green, violet and red.[9] All of the other millions of colors the eye can detect are deviations of these six plus black and white. It is the correct derivation rather than a basic color that supplies the ingredient of unusualness which is so vital in providing a package with individuality and eye appeal. So it is far better to use unexpected and appealing combinations such as lime-yellow and blue, chartreuse and coral pink, orange and green, than to have conventional, widely imitated package color groupings such as red and white, blue and yellow, or red and green.[10]

V. COLOR IN PACKAGING AND DESIGN

What about color contrast in packaging? Contrast with color can be obtained in only four ways: First, by placing the light color, pink for example, against the dark color, such as maroon. A second way is to combine a grave color with a bright color, like an olive green against an emerald green. A third way is to combine color with a complement, such as red with green. And a fourth way to achieve contrast is to use a warm color with a cold color, possibly red with blue-green.[11]

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[9] Ibid.

[10] Ibid.

[11] Ibid.

A word of warning, however; color can affect design.[12] Blue combinations of the above-mentioned elements of color, together with basic design lines, influence the appearance of every package detail. It is significant to note, however, that color correctness is more important than packaging and design.[13] Certain colors and color groupings can make some packaging designs appear larger or smaller, weaker or bolder. Color speaks a universal language. Design exerts no influence over color.[14]

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[12] Ibid., p. 52.

[13] Ibid.

[14] Ibid.

CHAPTER IX

REACTIONS TO COLOR

This chapter will include a report of some of the reactions to color television by the viewing public, and the advertisers' ideas or opinions of this kind of television.

The material for this chapter has been drawn from published reports in trade-press magazines.

The development of the chapter will include: reactions to "Carmen," color in Hollywood, and how the advertisers will react toward the use of color.

I. REACTIONS TO "CARMEN"

Comments on the colorcast of "Carmen" by NBC-TV on October 31, 1953, from two highly critical television-radio critics tell their own story:

> (1) Jack Gould, New York Times, first non-industry observer to get a color set in his home. "The doom of black and white television seems only a question of time. Electronic reproduction of delicate shading seems pure magic. Color television in the home now is much better than the earliest black and white. Tuning was surprisingly easy. Color television seems certain to precipitate some lively family discussions. The hoots and howls that are set up when the husband insists he has the set properly tuned in magenta can be very disturbing to masculine dignity."

(2) John Crosby, New York Herald Tribune Syndicate, watching at NBC Center Theatre. "The addition of color to Carmen added about fifty per cent effectiveness. An eventually vivid and arresting experience. Color television is still a long way from the reach of most of us, but those who sample color television are going to get mighty restive with their old black and white sets. While Technicolor has never pushed black and white movie making off the market, I doubt the same parallel holds good for color television. Within a very few years, black and white may well be obsolete."[1]

II. COLOR IN HOLLYWOOD

There were two showings in Burbank, California, November, 1953, identical half hours, attended by a total of one thousand or more show folk, technicians, advertising men, and newsmen.[2]

The pictures were clear, sharp, and flawless to the untrained eye. Transmission covered some four thousand miles of zig-zagging microwave relays, which totaled one hundred twenty hops from station to station.[3]

III. SOME ADVERTISER REACTIONS

Most television advertisers started using the medium when set saturation was between twenty and thirty per cent,

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[1] Television Digest, (Washington, D. C.: Radio News Bureau), November 7, 1953, p. 16.

[2] Ibid., p. 1.

[3] Ibid.

though the range was from five to fifty per cent.[4] Though obviously, a colorcast will reach black and white sets, advertisers indicated they would buy color television on a higher saturation basis, when it reached thirty to forty per cent.[5] The range was from ten to eighty per cent. The advertisers were split on whether they thought color television will increase sales. About half thought it would, but increasingly, those that did not think it would thought it would be worth buying anyhow.

They would buy color television largely for two reasons: the impact of color television itself, and the belief that products would show to advantage in color.[6] A few said that a competitor's use of color would influence them to buy, and a few expressed interest in being among the first color television users.

On the other hand, sixty-five per cent of the advertisers said they would probably not be sufficiently interested in color television to use it if it should be first available during daytime.[7] About twenty per cent said they would.

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[4]"What Advertisers Will Do About The Most Ideal Medium," Tide, (Philadelphia: Periodical Press Corp.), January 2, 1954, p. 58.

[5]Ibid.

[6]Ibid.

[7]Ibid.

Half the advertisers reported they were carefully considering color television right now. Surprisingly, sixty per cent of the advertisers said they did not plan to change product packages for color television.[8]

These advertisers listed these media as the ones they would probably cut to pay extra color television costs: Magazines (mentioned by twenty per cent); newspapers; radio; outdoor, farm, business publications; point of sale; and dealer aids.[9]

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[8] Ibid.

[9] Ibid.

CHAPTER X

CREDIT FOR, AND FUTURE OF COLOR TELEVISION

This chapter will present material which illustrates the dispute for credit for developing the color system, and an estimate of what the future for color television might be.

The material has been drawn from trade-press magazines which have published excerpts from letters and talks in regard to this subject.

The development of the chapter will include: disputes on compatible color credits, and the future of color television.

I. DISPUTES ON COMPATIBLE COLOR CREDITS

A dispute over corporate credits for the development of compatible color television broke out December 28, 1953, suggesting that a battle over patent rights might become involved.

Commander E. F. McDonald, Jr., President of Zenith Radio Corporation, sent F.C.C. Chairman, Rosel H. Hyde, a letter charging that RCA was trying to create an impression that RCA alone developed the compatible system approved by the Federal Communications Commission.[1]

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[1] Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Inc.), January 4, 1954, p. 71.

Admiral Corporation President, Ross D. Siragusa, asserted as part of a general statement to Admiral Distributors that color television was an industry accomplishment, stemming from unprecedented cooperation by competitors who set aside their keen rivalry and pooled their knowledge to speed the perfection of the color medium for the public.[2] Philco Corporation earlier took advertisements proclaiming that the compatible color standards approved by the Commission were developed by the leading scientists of the electronic industry and were not the work of any one company.[3]

Accusing RCA of trying to create a patent position for itself in color television by claiming credit for itself, Mr. Siragusa noted that RCA's patent licensing agreements were to expire at the end of 1954. He stated that it was most regrettable that a company like RCA should seek publicity and unfair advantage by making such statements.[4]

In his letter to F.C.C. Chairman Hyde, Commander E. F. McDonald wrote:

> We were shocked when we saw the misleading manner in which RCA sought, through television announcements and full page newspaper advertisements published throughout the country, to create the impression that this

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[2]Broadcasting-Telecasting, (Washington, D. C.: Broadcasting Publications, Inc.), January 4, 1954, p. 71.

[3]Ibid.

[4]Ibid.

N.T.S.C. system of color television which we approved was the sole and entire product of RCA. Nothing could be further from the truth. The system was developed by the joint efforts of many television manufacturers, of which RCA was only one.[5]

RCA in its answer asserted:

> We reaffirm every statement we have made in a full page advertisement about color television to which Mr. McDonald refers, and which evidently he dislikes. Every statement we have made can be supported with solid proof of its accuracy.[6]

II. FUTURE OF COLOR TELEVISION

Color can be a failure in the immediate years ahead Philco's Donald Fink warned NARTB Engineers in a talk delivered by Hazeltine's Arthur Loughren.[7] Color will not fail because of inadequate standards, but because of unwillingness on the part of the industry to invest in research and test facilities, manpower, production tools, and selling effort. The competition situation, spurred by the public eagerness for color television, leaves no option. But it can fail if the television engineers do not meet the challenge of implementing the new service with equipment of such high performance and such low cost as to command public acceptance. This is the

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[5]Broadcasting-Telecasting, (Washington, D.C.: Broadcasting Publications, Inc.), January 4, 1954, p. 71.

[6]Ibid.

[7]Television Digest, (Washington, D.C.: Radio News Bureau), May 29, 1954, p. 5.

challenge the same engineers have met in monochrome television during the past eight years. But it cannot be met in color without an even greater effort, without profound understanding of the requirements imposed by the standards, without closer study of color vision than was ever given to monochrome vision. Not without much more hard work will color television become truly a successful medium.

CHAPTER XI

SUMMARY AND CONCLUSIONS

The purpose of this paper was to trace the growth and development of color television, and the author has endeavored to show the course of color television from its earliest beginning to the present. As this paper has illustrated, there have been a great many technical problems which have confronted those working in the industry, problems which in the course of time have been partially solved. The author states that they have been partially solved, because of the nature of television itself, wherein daily developments make the past developments obsolete in regard to current practices.

The material for this thesis basically was found through the reading and analysis of trade-press magazines and technical journals which have published the new developments as they have occurred.

The author has presented many sides of the subject in order that the reader may obtain a clearer insight into the complexity of the medium, and the importance it holds for the entire country and world. From the many facets of the material presented one can definitely assert that this is not a project of individual development, but an undertaking of great scope encompassing the lives and jobs of thousands of

people in various industries. The culmination of knowledge and skill of all these industries has developed, and will continue to develop, the medium of television for the enjoyment of all.

The industry, in all its facets, has developed much more rapidly than did that of black and white television because of the interest of the engineers, the scientists, and the people. Color television has already made a great impact upon the communications medium, and will continue to grow rapidly in the near future. Major developments in manufacturing and production will enable the general viewing public to enjoy this medium on a mass scale within a few short years.

Cooperation from competitive interests and all fields of science has been the keynot of the rapid development in color, and the continued cooperation and search for new and easier techniques of production and manufacturing will be required in order that color television continue to grow as rapidly in the future as it has in the past.

Because of the rapid pace of developments in this field, actual books or texts on this field of communications have not been published. The author has relied entirely upon magazines and information from networks, agencies, and newspapers.

The author, upon completion of this thesis, recommends

further research on the following in order that a complete and detailed understanding concept in the use and application of these fields may be known: lighting, staging, make-up, scenic design, costuming, electronics, psychology, and merchandising.

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