TELEVISION

THE EYES OF TOMORROW

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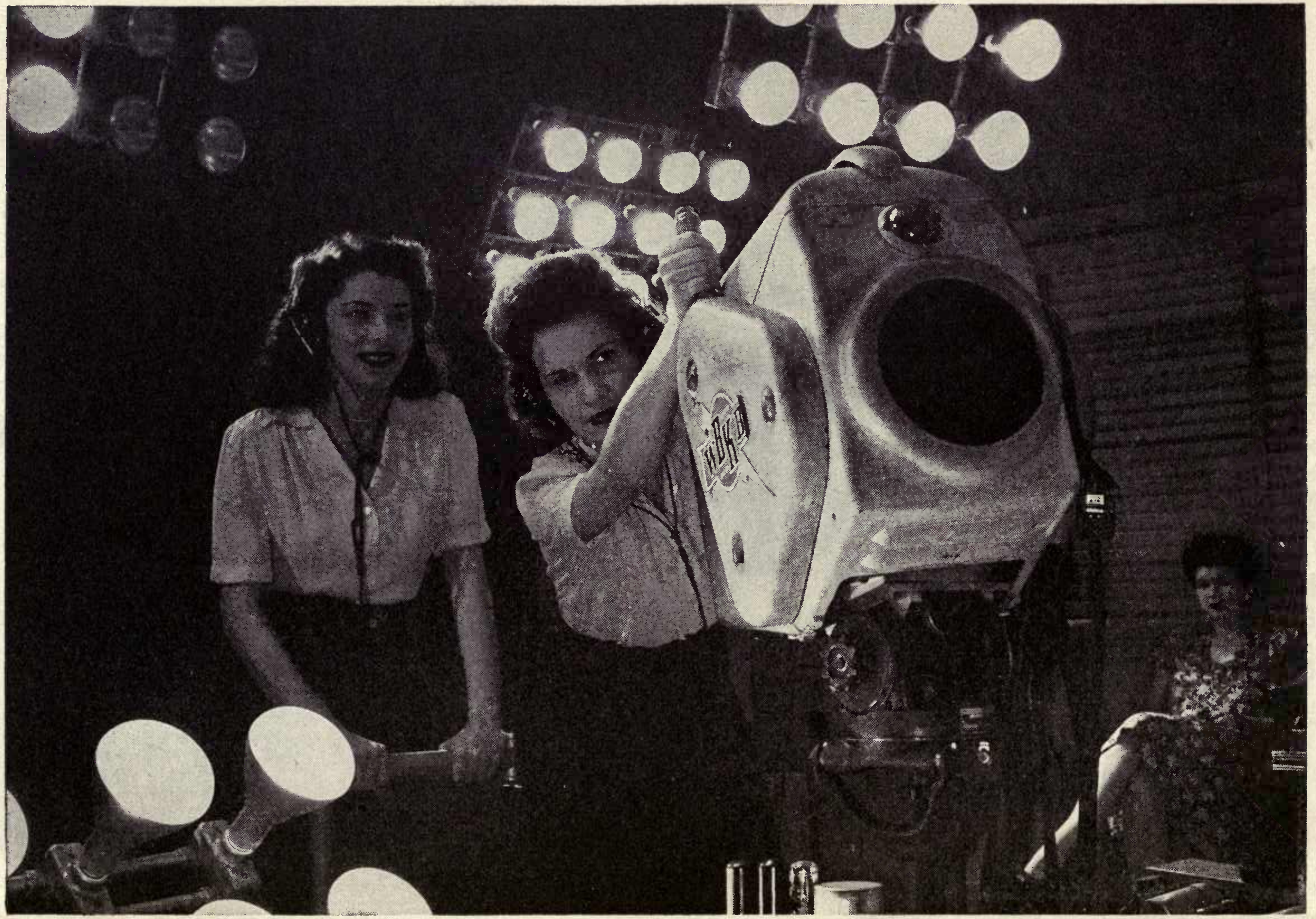
The Eyes of Tomorrow

A Bill Eddy Gadget
TRADE MARK REG.

TELEVISION ASSOCIATES
CHICAGO ILLINOIS



Courtesy MADEMOISELLE, *September 1944 issue*

TELEVISION

The Eyes of Tomorrow

by

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Dedication

To my wife, Chris, who has listened to the reading and re-reading of this story so many times during its preparation that she now refuses to own a copy.

Bill Eddy

Preface

ANY person who deliberately takes it upon himself to write a book on television asks for the criticism of both qualified critics and lay readers. In a subject as complex as television, the temptation is always presented to an author to cover one phase in detail and disregard the others as purely contributory arts. This book, however, was originally designed to summarize the problems and potentialities of *all* the functions that go into a television production. Experts in each field will necessarily point out wide discrepancies between my coverage of their specialty and the practical application of their trade on the studio floor. Others will, no doubt, object to the too-detailed coverage given a field foreign to their profession. To all readers, then, may I offer my advance apologies for the liberties thus taken in reviewing the diversified arts that together comprise television.

No field of endeavor ever proposed by man offers more or demands more from its patrons than does the creation and transmission of electronic pictures. No person in television can disregard the functioning or precepts of an associated profession; if he does, he might overlook or perhaps nullify its possible contribution to his work. No one can feel that his knowledge of a specialty is in itself sufficient or that knowledge of the potentialities and problems of his colleagues are not required. Television is, in truth, a melting pot of the sciences, the arts, and the populace. This book is sent to the presses in the hope that this superficial résumé of the components that enter into a television broadcast may aid in a better understanding of the work being done by the other fellow.

A compilation such as this could never have been prepared without the fullest co-operation of the broadcasting fraternity. Although I have drawn many of my illustrations from my personal experiences while with Farnsworth, NBC, and Balaban & Katz, the work of every operator in the field has contributed to the telling of the story.

For illustrative material used in amplifying my descriptions, I wish to thank the National Broadcasting Company; Columbia Broadcasting System; General Electric Company; Balaban & Katz Corporation; The Austin Company; Philco Corporation; Allben B. DuMont Laboratories, Inc.; Television Productions, Inc.; Zenith Radio Corporation; Don Lee Broadcasting System; Farnsworth Television & Radio Corporation; Mole-Richardson Company; The Rauland Corporation; The Scophony Corporation of America; Television Associates, Inc.; the publishers of *Mademoiselle;* and many others.

For patient hours of reading, typing, revising, and counsel, I especially express my appreciation to my former colleagues at WBKB, in Chicago, where this book was written.

W. C. Eddy

Contents

1

The History of Television

CONTRARY to general opinion, television is not a concept of the twentieth century. Even in Biblical times theorists predicted the day when it would be possible to expand man's ability to see events occurring beyond his optical horizon.

In 1877 we find one of the first contributions to our present art in Senlecq's proposal of a crude system of mosaic television. Shortly thereafter other scientists of the period, such as Hertz and Nipkow in Germany and Sutton in England, advanced suggestions that further contributed to the art and formed a groundwork for the construction of our present video industry.

Few, if any, of these early discoveries are now directly employed in modern television. However, the original work of these and many other inventors gave impetus to experimentation by proving that light could be converted into electrical impulses. Later developments in electronics produced methods of transmitting those impulses and reconverting them to their original optical form. Fortunately for television, the development of the radio and electrical arts coincided with the advanced phase of research in the visual field.

While such names as Hertz, Hallwachs, Nipkow, Einstein, Edison, Elster, Geitel, DeForest, and Kerr will be given due credit for the basic discoveries, it is to the inventors and research men of the past twenty years that we give acknowledgment for the art as we have it today.

In 1923 J. L. Baird, in England, and C. F. Jenkins, in the United States, working independently, produced and demonstrated systems of mechanical television. The process advocated by these men described a disc perforated with a helical arrangement of tiny holes, rotating synchronously before a light-sensitive tube as the means of collecting the light energy of the subject in proper sequence. This method of scanning, while capable of producing a low-definition picture, is not in use today, nor is the receiving system that recreated the picture by reversing the scanning process now used in any commercial receiver. Although the 30–60 line images created during these pioneer days may seem to have little bearing on the techniques that produce the present-day high-fidelity, half-tone pictures available in a 525-line system, much of the theory that made our present equipment possible was proved during this mechanical era.

From 1923 on, we find a marked development in the use of vacuum tubes, with an attendant improvement in the processes of amplification that were necessary to any clarification of the image. With these new and increasingly efficient tools at their disposal, the scientists of the world gradually drew away from electromechanical methods and threw their combined efforts into the creation of an all-electronic system. In 1930 Von Ardenne, of Germany, published important discoveries in the field of cathode-ray tubes—discoveries that were both verified and, in some cases, improved upon by the engineering fraternity of this country. The development of the cathode-ray tube made it possible to design a receiver that would not be hampered by the problems of friction and rotating mass that had limited the use of the mechanical system.

In the same year, 1930, London saw its first demonstration of large-screen television, when Baird succeeded in broadcasting low-definition images from his studios in Longacre to the Coliseum in downtown London. This picture, being reproduced on a multi-lamp screen, was important only because it foreshadowed one of the potentially important fields of modern commercial television. Because the reproductive process used in this pioneer experiment is extremely limited in scope, it has aroused little enthusiasm among present-day investigators.

The year 1931 saw another projected, large-screen image which produced low-definition pictures through the use of a Kerr cell and mirror drum. Some variation of this system may yet be commercially feasible in the large-screen field.

In this country Philo Farnsworth and Vladimir Zworykin, heading parallel investigations, emerged in 1933 with proposed equipment and methods to make "all-electronic" television possible. Ives of American Telephone and Telegraph Company, Alexanderson of General Electric, Goldmark of CBS, as well as Engstrom and A. N. Goldsmith of RCA and DuMont, were all contemporaneously engaged in researching both the creation and the transmission of pictures, and, as a result of well-planned and well-executed programs, they were able to steer the course of investigations along lines that made possible public participation, beginning in 1934. Prior to this time, many of the larger organizations became interested not only in the possibilities of the art, but in some cases took active participation in both studio and equipment research. Among the outstanding early competitors in the industry were the National Broadcasting Company, the Columbia Broadcasting System, the General Electric Company, the Farnsworth Laboratory, Ltd., Zenith Radio & Television Corporation, and the Don Lee Broadcasting Company, while many others were carrying on more-than-cursory private investigations preparatory to their later entrance into the active field.

In these early days the definition of the picture was not standardized, inasmuch as the major part of experimentation was limited to camera and receiver development. The public avidly followed the reports of progress carried in the newspapers, and from 1934 on their reactions became an increasingly important function in the design of television.

In 1937 two systems of television pickup were developed to the point where they could be considered both practical and competitive. They were the storage-type iconoscope of RCA and the non-storage image dissector of Farnsworth, resulting in extensive efforts on the part of each company to prove the superiority of its own particular device. These companies were later engaged in litigations over several basic patents pertaining to the transmission of television images—a legal tangle that at times bid well to obscure the forward movement of television itself. The uncertainty brought about by a series of rulings by the Patent Office was later clarified by a patent-pooling pact between these two contenders, and the forward movement of the art once again built up momentum.

The original and variable number of lines of the early days was never considered satisfactory from the viewpoint of the non-technical observer, who even then was quick to compare television with motion pictures. Because of this, and in keeping with the steady advances in the equipment available, the definition was increased and standardized at 343 lines in 1935, and shortly thereafter it was raised to 441 lines. This standard was subsequently increased to 525 lines in 1940, where it now remains the standard definition of today's television pictures. The increase in lineage from 343 to 441 lines brought about a general redesign of both pickup tubes and cameras and left the storage-type iconoscope as the more acceptable version for studio use. This served to standardize the quality of the resulting direct-pickup picture and left the merit of the program material itself to be the comparable function between the various organizations.

In 1938 the NBC field test of television was presented as a cumulation of all past endeavors of this company and as a bid to interest the public in the possibility of a dependable television service. Although the sustained service offered in New York was duplicated in a less grandiose manner by contenders in other localities, it may be interesting to consider the scope of the New York experiment as a gauge of the advances that the industry had made at this stage.

Beginning with two studio cameras and two chains of film reproducers, the facilities at NBC were shortly increased to include a mobile unit carrying two field-type cameras. A varied program of interesting experimentation was then planned and executed by the newly formed production staff, headed by Tom Hutchinson. A series of television adaptations of popular Broadway shows were presented from NBC's Studio 3H in Radio City. Among the more popular offerings, as measured by audience reaction, were *Jane Eyre, Charlotte Corday, Susan and*

God, Brother Rat, and *June Moon.* Other plays, such as *Rome Haul, Waiting for Lefty, The Valiant, The Gorilla,* and *Treasure Island,* were also received with definite satisfaction by the growing audience, which now numbered better than 20,000. The studio offerings were not limited to drama or to adaptations of popular stories, but included a large proportion

NBC Photo

THE INCOMPARABLE HILDEGARDE BEFORE NBC CAMERAS

of the variety and night-club routines that played New York during that period. Many original plays were also written and produced in order to test the television taste of the New York City audience.

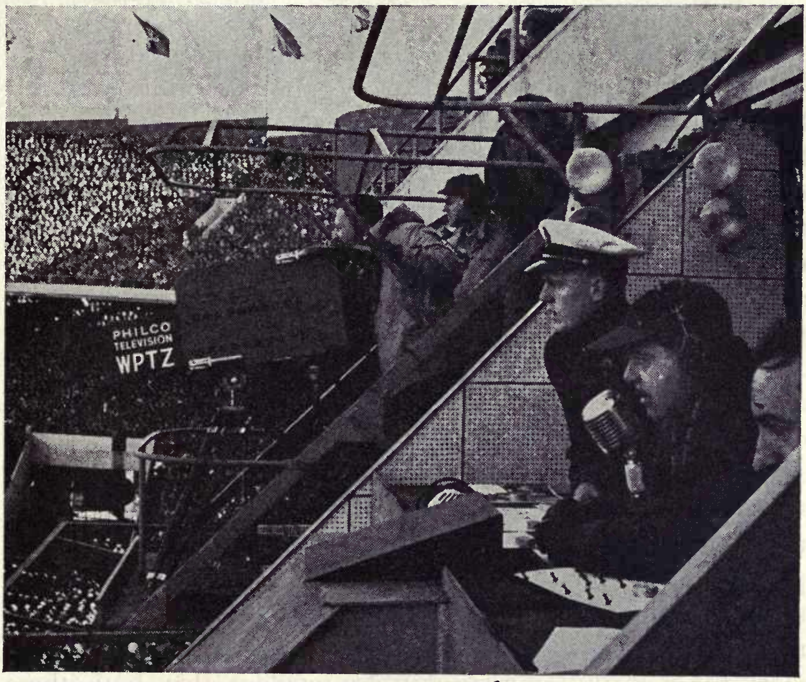
Realizing that a purely sustaining program service would be limited in both scope and originality, air time was made available to the advertising agencies for experimentation. The possibility of selling through television was subsequently tested by many different merchandisers in original programs of their own design. Outstanding musical events, such as *Il Pagliacci,* were presented by a cast from the Metropolitan Opera House; ballet, magic, name bands, jugglers, and even animal acts soon became expected items on the weekly television programs. In the early part of the test period, some of the latest Disney cartoons, as well as the most recent *March of Time* releases, were placed at the disposal of the broadcasters. However, upon the establishment of scheduled broadcasts, the privilege of using these films was summarily withdrawn.

The lack of availability of good film was a severe limitation to the popularity of telecasts originating from the film-scanning studios. Being unable to obtain late releases of features, the average telefilm program was made up of travelogues and commercial subjects. These were satisfactory test material from the technical viewpoint, but held little entertainment appeal for the audience.

The combined use of silent film with commentation by the explorers and adventurers who had made the photography did, however, constitute acceptable program fare, as did many of the commercial instruction films used as fillers. The filming of the Democratic Convention in Chicago in 1940 and the subsequent broadcast of this material to the metropolitan audience was a historical highlight in the use of film subjects. Earlier coverage of the Republican Convention in Philadelphia, where the signals were relayed to New York over the new coaxial cable, was another first in television's history book. Experimentation in the use of slides, kaleidoscope, and film inserts for dramatic shows established the necessity of having film facilities available in any successful broadcasting system. This reduced and simplified the problems of presenting complete programs from the live-talent studio alone.

The mobile unit equipped to pick up remote programs and relay them back to the main transmitter for inclusion in the regular program did yeoman service during the New York World's Fair in 1939. In addition, boxing, wrestling, hockey, basketball, football, track, and major-league baseball were covered by the portable television cameras. Backstage life at the circus, a *première* of a motion picture, a dress ball at the Waldorf, as well as countless other public events and parades, fell under the lenses of these roving cameras. Horse racing at Belmont Park, a fire at Randall Island, and an aerial trip over

Manhattan's skyscrapers gave some idea of the future potentialities of similar pickup units that were free to roam in search of material. To demonstrate the future possibilities of special broadcasts, a complete camera and transmitter equipment was



Philco Photo

A PHILCO TELEVISION CAMERA PICKS UP A TENSE MOMENT AT FRANKLIN FIELD, PHILADELPHIA

installed in a commercial air liner, and a program was broadcast as the plane flew over metropolitan New York. The frequent pickups from Madison Square Garden, covered by cameras manned by the mobile-unit crew, were extremely interesting inasmuch as they were for the greater part transmitted to the Radio City program center over telephone wires that had been adapted for this service by engineers of the Bell Telephone Laboratories.

Although substitution of telephone wires for the coaxial cables or relay networks discussed in the chapter "Television Transmission" may appear to solve the problems of intracity pickup, this usage of the telephone lines and the accompanying complex amplifier and compressor installations is still classed as an experimental project. A reduction in the present high experimental cost of such a system and a radical simplification of its electrical components may bring some such system into more general use in the future.

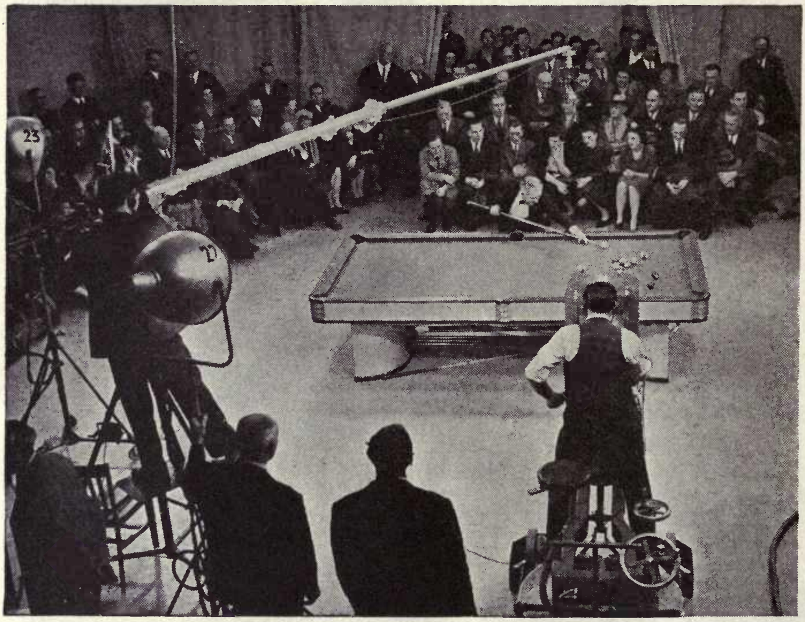
NBC's demonstration of big-screen pictures at the New Yorker Theater in 1940 and the Baird and Scophony exhibit of equivalent king-size pictures in Manhattan about the same time are highlights in the history of metropolitan television. These demonstrations, which were shown to movie executives rather than to the general public, were not received with great enthusiasm. This somewhat cool reception on the part of the film and stage magnates stemmed from two causes. First, the material chosen for the program was of a type that allowed the audience to make direct comparison with the superior product available on the movie screen in the same setting. The second objection voiced by many in the audience was based on the apparent unreliability of the picture material as received over the air or link system. Outside of the prize fight, the entertainment offered at the demonstration suffered badly by this comparison. Being showmen, they were particularly concerned with the problems which might attend using material in their theaters that could not be assured and that could not be previewed for quality. Because it was evident that both these faults could probably be corrected in time, the cold reaction was somewhat tempered by the realization of the wonderful box-office attraction offered by such a system of instantaneous coverage. It is evident, however, that aside from such features as Presidential nominations, coronations, or outstanding news and sporting events, the necessity for and general acceptance of big-screen-theater television will have to await the improvement of equipment.

The development and eventual program experimentation by CBS from their studios in Grand Central Terminal was simultaneous with NBC's growth. Although their original offerings suffered the usual growing pains of an experimental project, CBS, under the tutelage of Worthington Miner and Gilbert

International News Photos, Inc.

A TELEVISION PRODUCTION OF 1934 AT FARNSWORTH, EMPLOYING ONE OF THE FIRST TYPES OF IMAGE-DISSECTOR CAMERAS

Seldes, made a bid for recognition by presenting television programs based on original, if not radical, concepts of camera techniques. CBS's color work, however, was the frequently exploded bombshell that kept television awake and apprehensive. Sponsoring the use of full color, this company kept the press and the public aware of the advantages of full-color pictures, as compared with the limitations of the black-and-white ver-



G. E. Photo

WRGB TELEVISES A DEMONSTRATION OF EXPERT POOL SHOTS

sions then on the air. Frequent demonstrations of the system, coupled with over a hundred broadcast hours, did much to spread the gospel of additive color. This involved everyone connected with the industry in an argument over the merits of the two processes. Such a "washing of linens in public" marked the period that followed the cessation of active field testing in 1941. It was then that the various operators, aided and abetted by a press that used such controversial copy, discussed at length the most intimate problems of the infant industry. With little or no television on the air, and with column after column of one-sided criticism of television constantly before them, the potential buyers of receivers, as well as the ad-

G. E. Photo

A PUPPET SHOW BECOMES LIFE-SIZE VIA WRGB TELECAST

vertisers, used this confused situation as an ideal reason for delaying their more active participation in television.

In 1943 DuMont, having completed the installation of transmitter and antenna at his studios on Madison Avenue, once again took up the cudgel and began furnishing a program ser-

WBKB Photo

THE "VOO DOO MOON," A DANCE PRODUCTION, ON STATION WBKB, CHICAGO

vice. The early quality of these transmissions was the subject of considerable criticism in the light of previous offerings by the other companies. This operation, however, under the uninhibited guidance of Sam Cuff, soon became the center of all television activity in the New York area. By 1944, DuMont had succeeded in attracting a representative group of advertisers to assist in staging the programs giving WABD the first full program of commercial offerings. In the summer of 1944, Columbia and NBC again took the slip covers off their television investment and re-entered the broadcasting picture. This sudden spasm of activity may or may not mark the beginning of the long-awaited commercial period in New York. It may be that this stir of activity is merely part of the dream, rather than a real awakening of the commercial phase of television, because there are no new receivers available and many of the existing sets are already in need of repair.

Nine active television stations are in operation throughout the country in 1945. These are: NBC, CBS, and DuMont, in New York; General Electric, in Schenectady; Philco, in Philadelphia; Zenith and Balaban and Katz, in Chicago; and Don Lee and Television Productions, in Los Angeles. A large number of applications for licenses to construct tele stations are on file in the Federal Communications Commission Offices today, while orders pile high in the offices of the manufacturers for equipment, the cost of which will range into many millions of dollars. The press has once again taken up the word "television," and many new magazines are devoted to a discussion of the art.

In the meantime, however, much can and will be done in perfecting the techniques of using our present tools and in sustaining the interest of the public in television. If the present resurgence of television can do this, it will, in no small measure, contribute to the eventual success of the industry. If, on the other hand, the present enthusiasm subsides into the doldrums of inactivity, it may be "the straw that broke the camel's back," putting television back into the laboratories for many years to come. History alone will measure the importance of the 1941–1944 period.

2

The Development of Television

THIS account of the growth of a modern and dynamic industry that bids fair to revolutionize our present routine of entertainment and advertising is not a minute and painstaking review of detail, but rather is designed to be a comprehensive and panoramic glimpse of the highlights of television's development.

Seven short years cover the transition of television from the laboratory to its prominent position in the entertainment industry where we find it today, bidding for recognition as a public service.

The year 1934 marks the earliest concerted effort of the several television broadcasting stations to make public tests of high-fidelity television. Previous to this time, there were sporadic demonstrations of mechanical systems that, because of engineering limitations, contributed little to the formation of a public-service formula. This early experimentation with mechanical systems did, however, accomplish two important objectives: it tended to force the adoption of cathode-ray television by demonstrating the limitations of the mechanical systems, and it built and maintained a public interest that made possible the program-development era that followed.

The evolution of our present television programs was brought about through the contributions of many operators, rather than through the efforts of a single company.

The conscientious and noteworthy efforts of the National Broadcasting Company, General Electric, the Columbia Broadcasting System, DuMont, Farnsworth, Philco, Zenith, Don Lee, and the Paramount affiliates merit a top billing on television's honor roll. The sound groundwork, now established, might have been materially retarded by patent holdings and by company policies without the incentive of widespread and persistent competition. As the industry developed, the constant striving for audience popularity by the various operators made it expedient for each to keep constant check on new techniques and immediately to develop all proved formulas. Because of the scarcity of receiving sets, in all but the New York area, the permanency and enthusiasm of the audience for these video broadcasts was determined by the popularity of the programs that were offered. The expenditure of thousands of dollars was therefore required by each contestant to gain and extend this public acclaim, and at the same time to carry forward a development program that would meet competition.

The earliest public programs were hit-and-miss experiments, designed to determine the actual limitations of the equipment. Anything and everything that could be televised was placed before the camera as the pulse of the embryo audience was checked.

In many localities where no outside receivers were available, observers were invited into studio viewing rooms and plied with questions as to their reactions. Studio and technical program equipment, as we know them today, were non-existent, the broadcast originating from some section of a laboratory set aside for the purpose.

Prior to 1934, the novelty surrounding the production of a television picture, independent of its quality or pictorial interest, was considered sufficient entertainment to leave the audience "in the aisles." Once this novelty had worn off, the need for a tangible pattern of entertainment was evident. Early experimentation had proved that there were few subjects which could not be covered successfully by the cameras, and the primary problem resolved itself into one of showmanship, rather than pure technical development. This trend in television experimentation became evident in 1937, when the emphasis shifted from demonstrations of pickup to the production of organized programs.

One of the first obstacles encountered was the scarcity of home receiving sets, few of these machines other than experimental homemade units or imported commercial models being available outside the development laboratories. In a speculative attempt to correct this deficiency, as well as to field-test their receiver design, several of the larger manufacturers placed small numbers of their earlier models in the homes of their employees, thus creating the nucleus of the first American television audience.

While the first recipients of these original field-test models were, no doubt, biased in favor of television, this distribution of equipment did serve to increase the coverage and to stimulate general interest in television. RCA, CBS, General Electric, DuMont, Philco, and Zenith Radio Corporation were among those who distributed test receivers among their employees, but it was not until 1938 that a commercialized version of these sets appeared on the market and the first non-technical television audience came into existence.

Although our present perspective may point to New York as the focal point of pre-war development, we can more truthfully picture the growth of the art as being the result of a series of local endeavors. These suburban projects may have lacked the glamour and publicity of the more elaborate metropolitan field tests, but they did contribute to the formation of a pattern of television that is national in character. This pioneering became increasingly important in the light of network operation.

Typical of such endeavors were the experimental programs set up in Schenectady, Chicago, Los Angeles, and Philadelphia. These operations, while somewhat less extensive than those of New York, were not duplications of work done there, but were logically developed around the local situations. The local markets served by these stations could not in any sense be compared with the millions of listeners within television range of Manhattan's skyscrapers. Although the nation's largest city did offer more reasonable returns on the investor's dollar, it was the prospectors in the hinterlands, just as much as the companies working the New York bonanza, who produced the nuggets that have been fused into today's television.

Philco Radio and Television Corporation (W3XE–WPTZ)

Without extensive studio facilities, Philco, for instance, placed emphasis on the broadcasting of outdoor events in con-

Philco Photo

PHILCO COVERS A PENN–CORNELL GAME AT FRANKLIN FIELD

nection with its receiver field test. This effort was based primarily on the high-frequency relay link between the factory and Franklin Field over which the various sporting events were sent for retransmission to the local Philadelphia audience. Since the available studio properties were limited, such material was tied together with simple variety acts and short film subjects. From the engineering, rather than from the entertainment, viewpoint, Philco's contribution has been sound and constructive, adding to our knowledge of remote pickup technique by point-to-point relay. In addition to this, many other well-founded and stable advancements in the field of receivers and antenna can be attributed to these field tests.

The Don Lee Company (W6XAO)

Don Lee, on the West Coast, also without sufficient studio space or professional equipment, carried through the early days of pioneering with a program of wide experimentation based on discovering an "open sesame" to acceptable program fare. All possibilities of coverage were investigated. In today's experience, some of these attempts might well be considered as purely attention-getting projects. Considering the equipment at hand and the rather blasé audience of motion-picture moguls who were quick to scorn anything less than *Gone with the Wind* in four colors, the Don Lee unit under Lubcke deserves much credit for keeping television alive on the West Coast during its formative years. The effort was so persistent that the passive disinterest of Hollywood was finally overcome to the point where the ultimate acceptance of television is assured.

In 1939, the Don Lee Company, recognizing this new interest, appropriated a healthy budget to build modern studio facilities atop Mount Lee overlooking Los Angeles and the San Fernando Valley. This activity cannot as yet be directly credited with any basic contributions to the art of programming or engineering, but its continued work with television in all its phases has materially assisted the natural growth of the art, and has given impetus to the work of other operators.

General Electric Company (WRGB)

Since the birth of interest in television, General Electric has been a constant contributor to its development in both engineering and program design. This company could not afford to be challenged by any manufacturer or broadcast interest, if it hoped to maintain its position as one of the big three in electronics. It therefore made sufficient funds available for experimentation and drew on the full facilities of its research and manufacturing organization. Considering these potentialities, it is not surprising that a flood of equipment and technique improvements have originated in Schenectady.

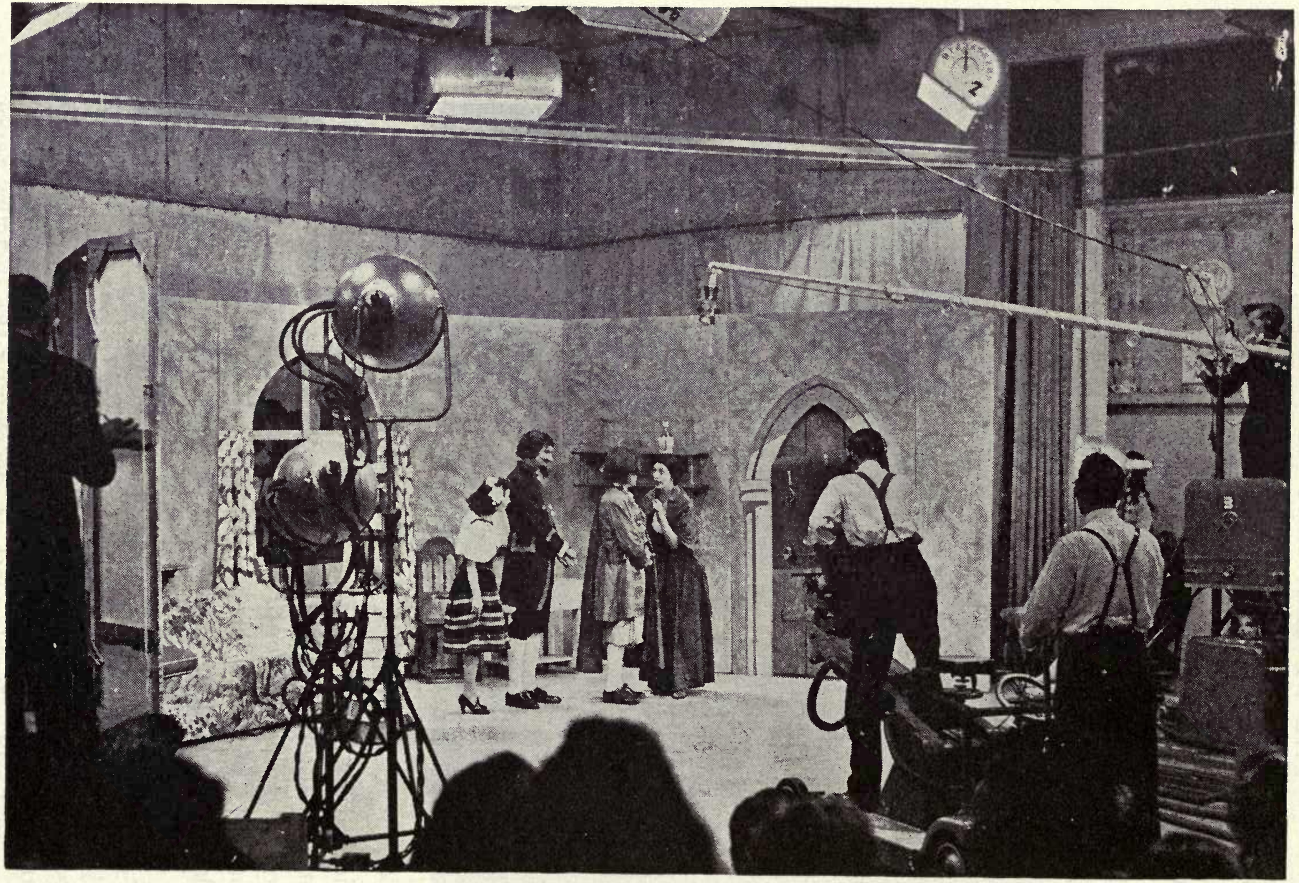
Under Dr. W. R. G. Baker's tutelage, General Electric took and maintained a front-line position in all phases of television. Its studio work has been consistently logical, although con-

G. E. Photo

A FASHION SHOW IN WRGB'S STUDIOS

sidered by some operators as somewhat unimaginative. Like other stations, General Electric's efforts were at first directed toward public demonstrations of the possibilities of television, but, like others in the major league, this practice gave way to development along commercial program lines.

If we were to make an approximate selection of General Electric's major contributions to television, we would choose its development of the high-frequency relay link between Schenectady and the Helderbergs, with its associated antenna and circuit research. In a similar category, we might place its original and valuable work in developing the mercury vapor lighting system for studio illumination which, as outlined in



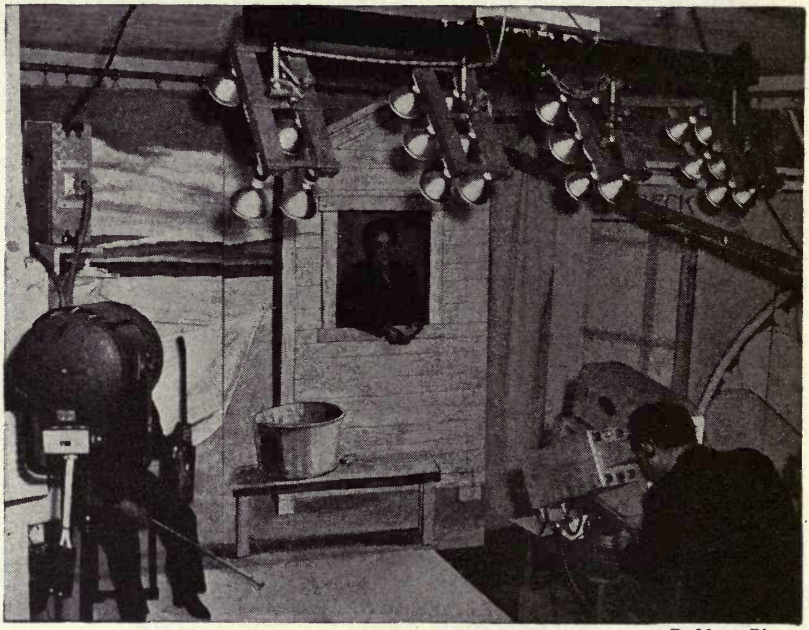
G. E. Photo

WRGB STUDIO IN SCHENECTADY WITH OLD ENGLISH SET BEFORE THE LENSES. NOTE PADDING ON WALLS FOR ACOUSTICAL TREATMENT a later chapter, has its enthusiastic adherents as well as its critics.

The multifaceted efforts of the parent company have produced an excellent receiver, considerable transmitting tube and circuit development, in addition to several novel contributions in studio and control-room technique. Its program work, while consistently good, has yet to reach the classification of phenomenal, and has, therefore, failed to leave its mark on the more imaginative pattern created by the New York broadcasters. While it can be stated with fairness that General Electric has never, with malice aforethought, overstretched the limitations of the equipment at hand, this same reserve has prevented it from discovering some of the less obvious studio techniques in use today. All in all, when the record is examined, General Electric and its WRGB Schenectady outlet will prove one of the leaders among the pioneers in television.

DuMont Laboratories *(WABD)*

The Paramount-DuMont interest can best be considered as two units, rather than as a single venture by the motion-picture people. The DuMont station, WABD, in New York, is in reality the outlet of the DuMont Laboratories. DuMont itself has only recently received full recognition as a real contender for national pioneering honors. Starting as one of the early manufacturers of cathode-ray tubes, this company, composed for the greater part of young and highly imaginative engineers, branched out in every direction. Confronted with the severe budget limitations of a small company, as well as a lack of big business affiliations, this group took advantage of its free-lance position and, unhampered by big company policies, entered the field of television research and design with unrestrained enthusiasm. Even though the stoical administration of the big operators brushed aside many of DuMont's proposals, the industry was eventually forced to take cognizance of DuMont's efforts. Admittedly, many of these early suggestions were made without sufficient engineering research and therefore died a natural death in the light of more thorough investigation. These new thoughts proposed by this group of young investigators did bear fruit, however, in forcing the bigger corporations on to ever-increasing effort in an attempt to submerge or discredit this so-called less professional competition. Many applications



DuMont Photo

"TELEVISION CANTEEN," A VARIETY SHOW TELECAST BY WABD, NEW YORK

of the basic ideas submitted earlier by DuMont were later developed into extremely important functions of wartime electronics.

The DuMont Company has been responsible for keeping the early stages of television out of the doldrums of technical complacency. DuMont has, through its growing manufacturing facilities, produced electronic equipment of all types, many of which are designed to compete on a cost basis with that made available by RCA and General Electric. Although many of these units are engineering counterparts of equipment obtainable from the larger manufacturers, certain circuit designs and techniques are indicative of extremely clever engineering. The

DuMont studios in New York parallel the practices of their engineering organization. Rather than be limited to a foolproof theorem of broadcasting technique, this activity forced its way into the air picture over New York by the persistence of its efforts rather than by the original quality of its product. Once established, however, it has turned to a digestive process that in the last year has brought the company status up to a par with that of other metropolitan operators.

In 1939, the economics of DuMont were considerably strengthened by Paramount Pictures' purchase of an interest, thus making available to them the prestige and facilities of a major film company. It is increasingly apparent that Paramount's present affiliation is purely an economic one and has not as yet taken the form of actual participation in program efforts. Whether the film company will eventually take more than the present cursory interest in DuMont's studio work is a matter for conjecture.

Paramount Affiliates
(WBKB—W6XYZ)

Paramount directly controls two stations that came into being in 1940, namely, WBKB in Chicago and W6XYZ in Hollywood. The contributions of these units can hardly be evaluated in the same light as those of the older companies, inasmuch as wartime restrictions were enforced too early in their history to permit a satisfactory establishment of their ultimate position in the field. These two stations are more concerned with the production of entertainment than with the development of equipment, and in this field they can be expected to use many practical television adaptations of the motion-picture technique. A quick survey of the premises on which these two outlets are being operated will disclose a trend toward simplicity of production and a new appreciation of the elements of showmanship.

Columbia Broadcasting System, New York
(WCBW)

The Columbia Broadcasting System has been interested in television since the art emerged from the laboratories. Not being a manufacturing concern, its participation has been limited to the utilization of the medium rather than the development of a patent history or the disposal of salable equipment. It has not had access to the constant source of new developments and new equipment which its Radio City competitor found so useful. This chain cannot be accused of being miserly in its television ventures, however. The establishment of a transmitter location in the Empire State Building by NBC was shortly matched by CBS's lease of the Chrysler location; the acquisition of Radio City studios by NBC was countered by lease of extensive facilities in Grand Central Terminal by Columbia. With all the competitive trumping, it must be conceded that CBS in the light of popular broadcasting failed to maintain a leading position in the metropolitan program field, although it did, under Goldmark and Murphy, carry out elaborate program and equipment experiments in the confines of the studio. Whether this reticence in broadcasting these efforts in black and white was due to the success of the color investigations then being conducted under the supervision of Dr. Peter Goldmark is not generally known. In 1940, however, Columbia did nullify its apparent attitude of disinterest in television as a future industry by demonstrating a full-color system based on an additive method of reception. Since this time, CBS's efforts have been characterized by the dual study and utilization of color as well as black and white in its broadcasts, although its equipment and facilities for airing the monochromatic version still rank with the best in the country. It remains for history to decide if Columbia's proposal of color television can be considered as contributing to the advancement of the art, coming as it did during the period when the whole industry was in a state of flux. Without a doubt, the proposition that we could have "all this and color too" placed a serious element of doubt in the minds of advertisers and laymen alike, who were then relatively well satisfied with mere black and white.

Demonstrations of full-color pictures, as compared to equivalent definition in black-and-white reproduction, further amplified this indecision of whether or not television should be black and white or in color, even though competitive black-and-white interests were quick to point out and isolate the weak points of the color methods. Whatever can be said for or against Columbia and its sponsorship of color, the controversy attendant upon their propositions will remain outstanding in the story of television history. Whether this proposition of color television will develop from its category in 1944 of an interesting and demonstrable possibility into an important function of the industry will determine the extent of the contribution that CBS has made.

Zenith
(W9XZV–WTZR)

For a long time, Zenith in Chicago enjoyed the enviable distinction of being the only frog in a big pond. Gene McDonald, its leader, while quick to point out the economic pitfalls that lay before the industry, directed his organization to continue a small-scale, but intensive, development of equipment and field testing. The studio efforts of this company can be considered more of a by-product of receiver research than an actual bid for programming honors. Inasmuch as a greater part of the Chicago audience watching this station have been Zenith employees viewing Zenith receivers, no great effort has as yet been expended in a development of the program department. A consistent history of shows has been maintained that does, in a sense, refute their published statements as to the futility of television.

Farnsworth
(W2XPF)

Farnsworth Radio and Television Corporation, another of the pioneers, originated on the West Coast as a development organization. After a short time it entered into a license arrangement with Philco and moved its operations to Philadelphia, where it later came to be considered as a separate unit engaged in research. During the period from 1934 to 1937, this company brought out several basic contributions, including such fundamental concepts as saw-tooth scanning, the image dissector tube, and expansion of the multipactor method of cold cathode multiplication.

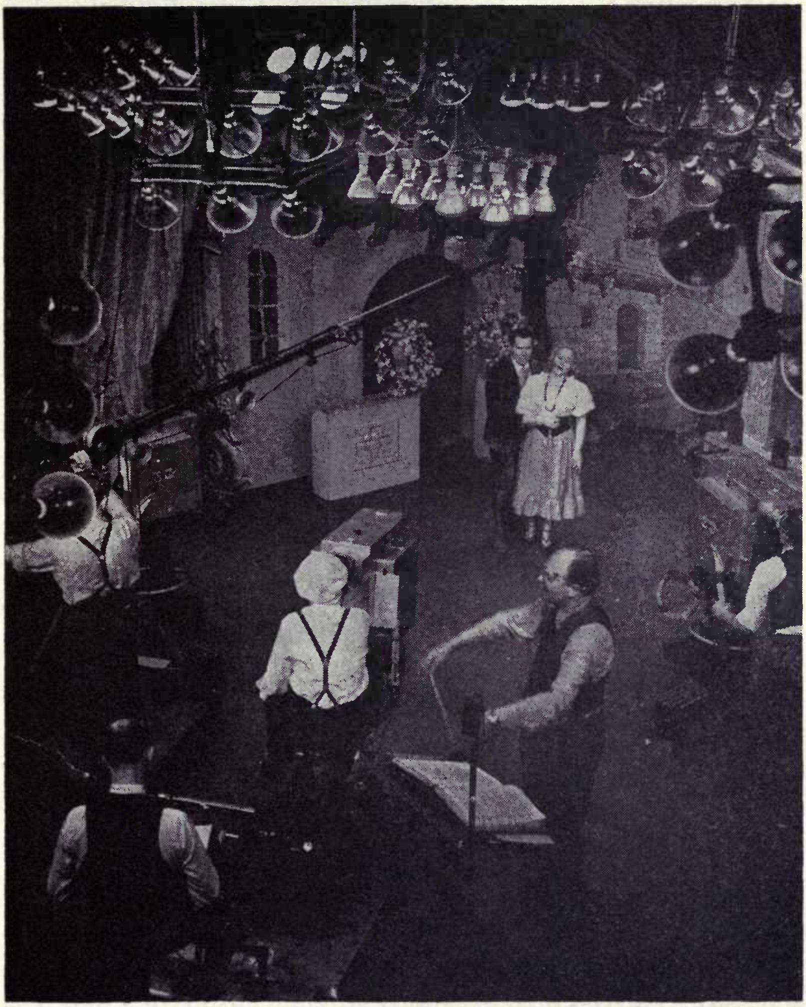
Farnsworth attempted to build an equivalent broadcasting unit, but at the time of its conception neither the equipment nor the public were capable of supporting the endeavor. In 1938, the original organization in Philadelphia was absorbed by interests controlling the Capehart patents, and the entire operation was moved to the Indiana headquarters. While much of their original patent material is now undergoing development and clarification, actual broadcasting and studio research has not been undertaken. Farnsworth merits recognition and honor for his original concepts of electronic television, as well as for his image dissector system, his proposition of saw-tooth scanning, and his work in electron multiplication tubes. With the present advantages of manufacturing and development facilities, Farnsworth Television Corporation will, no doubt, maintain an equally prominent position in postwar endeavor.

The Telephone Companies

Unsung and generally unknown to the layman, but as important to the engineering fraternity as food itself, are the countless discoveries accredited to Bell Telephone Company and to the American Telephone and Telegraph Company. The circuits and transmission equipment originating in the telephone laboratories are less spectacular in both concept and usage than those of the broadcasting units, but they make possible the more elaborate studio work. To detail these contributions would conflict with the non-technical viewpoint from which this subject is being presented, but the history of television will not be complete without reference to the outstanding work of these engineering groups. Coaxial networks, relay systems, amplifiers, and even tube development are but a few of the activities which should be credited to the telephone companies.

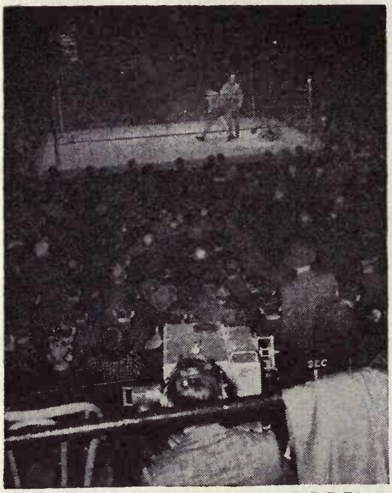
RCA, RCAM, AS, NBC

Probably the most outstanding single factor in the history of television to date is the work of RCA, which is an organization composed of many separate units. Whether it would be fairer



NBC Photo

THE METROPOLITAN OPERA CO. PRESENTS *PAGLIACCI* OVER WNBT, NEW YORK to subdivide this contribution into those of NBC, RCA Manufacturing Company, RCA Tube Company, Artists Service, as well as NBC Television, is a matter of choice. Each unit has carved its own niche, but not without the assistance of one or more of its affiliates. We might assume that NBC Television should be given credit for the introduction of the iconoscope and the development of its technique. The facts of the case show that the tube is a product of Dr. V. Zworkyin's laboratory, manufactured by the RCA Tube Company at Harrison, used in NBC cameras developed by RCAM in Camden, and picking up pictures of actors supplied by Artists Service in New York.

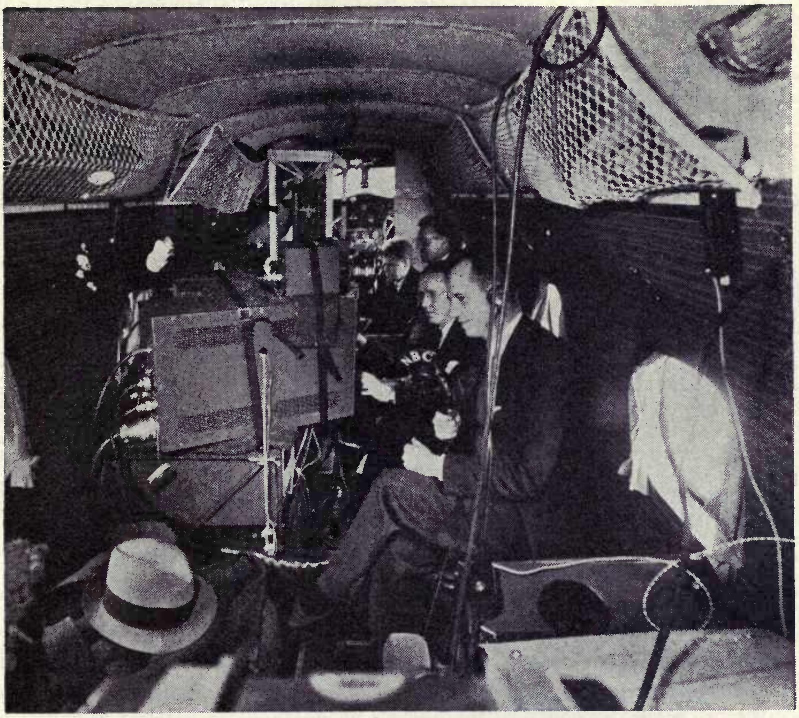


NBC Photo

NBC TELEVISION GOES TO THE PRIZE FIGHTS IN MADISON SQUARE GARDEN

In the studio phase of television broadcasting, RCA has been one of the major artisans in fashioning the pattern of the future, even though the economics of the 1937–1941 operation will probably remain an all-time and disproportionate high. RCA staffed the television program department with a group of outstanding young producers and provided them with ample budgets, stories, and adequate equipment. The result of this was the establishment of a continued program service through which the first consistent television audience was attracted. During this period, new ideas, as well as new equipment, were introduced in an effort to test the full potentialities of the art. As a result of this activity, the industry was able to gauge and predict the reaction of the public for the first time.

It can be justifiably stated that the extensive programming efforts of NBC created the pattern for at least the opening phase of postwar television. The major developmental work of RCA can be measured by the general acceptance of the iconoscope and



Courtesy NBC

TELEVISION BROADCASTING FROM AN AIRPLANE, AN IMPORTANT "FIRST" IN TELEVISION HISTORY. The telecast made by NBC showed New York City from the air.

orthicon tubes, as well as the many electronic circuits and technical units that have stemmed from their laboratories.

In this discussion there has been an attempt to accomplish an impossible task—that of assigning individual credit for creative development that rightfully could be assigned to many. Even though the offerings of other competitors in this market were far less conspicuous by comparison, television could not have hoped to become a public utility through the efforts of any one operator.

3

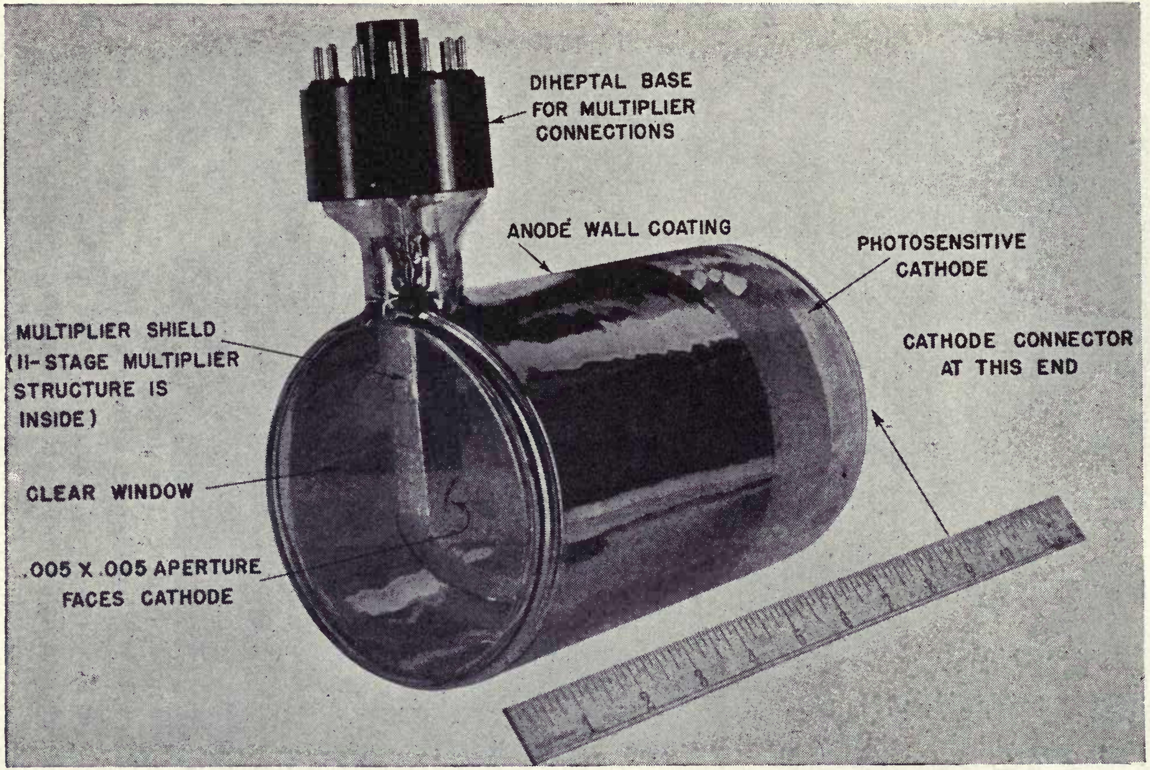
The Television Camera and Associated Circuits

THE picture that we see on our home television receiver is the result of a split-second integration between many pieces of electrical apparatus. For purposes of discussion, this complete evolution can be separated into four parts, namely, the camera, the amplifying and synchronizing system, the radio transmitter, and the home receiver itself, the last two subjects being covered in individual chapters. Each one of these functions is accomplished through the use of advanced electronic engineering practices so complicated that it is outside the scope of this work to present a detailed explanation of the processes involved. In lieu of a technical discussion that might tend to confuse rather than to clarify, an attempt will be made to describe these operations in general terms. In so doing, it may be necessary to use analogies that are not entirely satisfactory from a strict technical viewpoint, but that are nevertheless required in presenting an understandable picture of the individual steps involved in putting a picture on the screen of a television receiver.

The Camera

We shall begin our discussion of television techniques with a description of the camera, since it probably includes more features meriting explanation than any other single instrument of electronic television.

Although a large majority of the studio equipment now in



Courtesy Farnsworth

THE FARNSWORTH IMAGE DISSECTOR

use employs the iconoscope tube in converting light into electrical energy, we have in this country two other systems that are also used. These are the Orthicon and the Farnsworth Dissector.

Figure 1 shows the three basic parts of a typical electronic camera equipped with a storage-type or iconoscope pickup tube. The parts of the iconoscope camera include the lens, the pickup

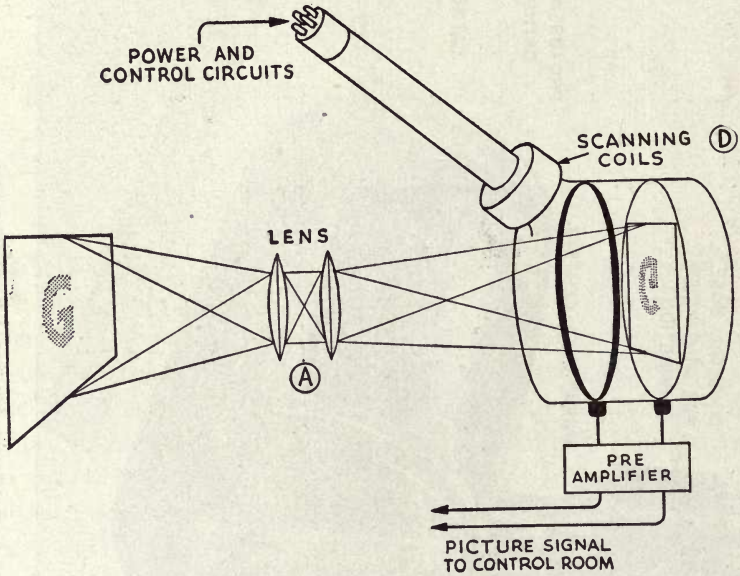


FIG. 1

tube, and the amplifiers, all of which are contained within the camera. For the purpose of illustration, this more advanced type of camera is chosen, for though the mechanical systems of television may appear to be more easily understood by the layman they are now obsolete. The storage-type pickup tube illustrated, in this case the iconoscope, will be found in general use today, and the theories of its operation, once understood, are easily applicable to other more advanced types of pickup devices.

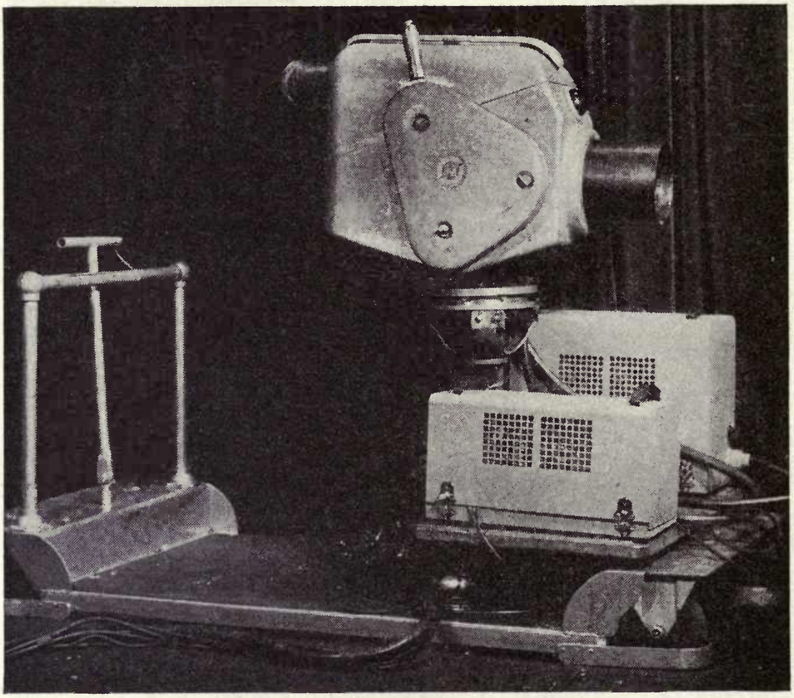
The operation of this camera is made possible through the reaction of certain chemical substances to light. In television we are concerned with the creation of an electrical coefficient of light through the processes of photoelectricity. To understand these processes, we must first consider the basic functions of

RCA Photo

DR. V. K. ZWORYKIN, ASSOCIATE RESEARCH DIRECTOR, RCA LABORATORIES, PRINCETON, N. J., HOLDING AN ICONOSCOPE, THE ELECTRONIC "EYE" OF TELEVISION, WHICH HE INVENTED

light as applied to a camera. Any object, illuminated to a point above the threshold of visibility, will present to the eye or to a lens a series of graduated areas of light and shadow. The brightness of each area is the amount of light that is being reflected back from the object or objects in view. Our ability to comprehend what we see lies in our ability to evaluate and interpret these shades of light and dark into terms of composition, dimension, color, and movement.

In order to make this explanation of a camera as fundamental as possible, we shall limit our considerations to the light and



Courtesy B&K

B&K TELEVISION CAMERA

shadow reflected from a stationary, three-dimensional, black-and-white scene, leaving the subject of color and movement for later development.

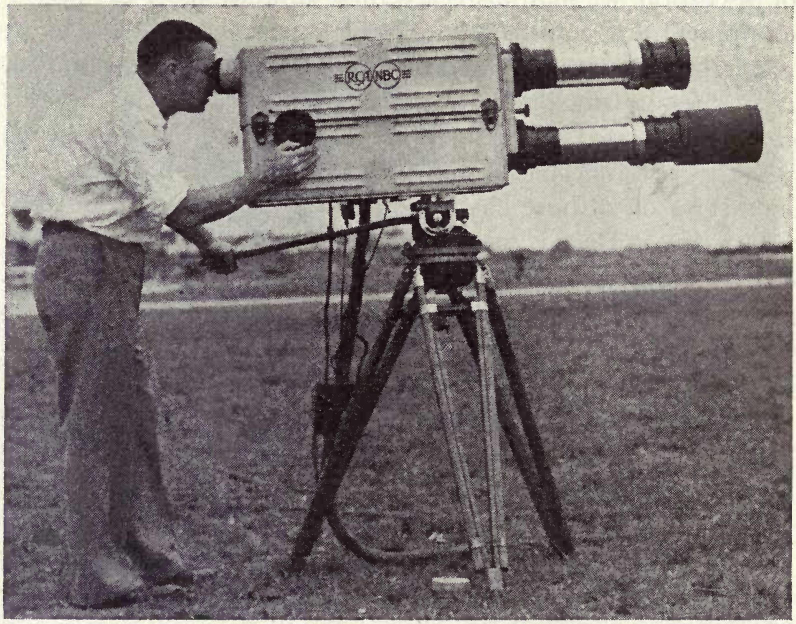
The lens system of a camera (Figure 1, A) collects the light energy reflected back from the scene in front of the camera and directs it into the camera, where it is focused on the light-sensitive surface of the pickup tube or iconoscope (B in Figure 1). This lens is able to differentiate distant objects from those near-by and to interpret faithfully the arrangement of light and shade in any one plane.

Unlike the eye, a single lens cannot adjust itself to reproduce both distant as well as close objects with perfect fidelity at the same time, and therefore in television we make use of many types of lenses in televising a studio production. For purposes of discussion, we shall disregard these limitations of the optical equipment and consider the lens only as a means of collecting the light energy of a two-dimensional scene displayed before it and registering it on the light-sensitive surface within the camera. This surface, or screen (Figure 1), has been so treated that it is photoelectric and as such will, under the influence of light, give off minute charges of electricity. In the iconoscope tube such a surface is called the mosaic and can be described as a silvery-white plate mounted vertically within the transparent glass bulb, at right angles to the axis of the lens. In the process of manufacturing, all traces of air have been removed from the transparent glass bulb.

This mosaic, approximately three inches high by four inches wide, undergoes an electrical reaction when light is played on its surface, creating the pulsations from which we obtain the electronic equivalent of the picture before the lens.

The mosaic is constructed of three layers of material, the rigid or visible plate being made up of a sheet of mica, which is an excellent electrical insulator. On the front surface of this mica sheet, millions of tiny globules of silver are deposited, which under a microscope would appear as tiny isolated islands of silver separated from each other by mica channels. These silver particles are eventually treated in the process of manufacture to change their composition from silver to globules of caesium silver oxide, a process that increases their photoelectric reaction to changes of light. Each of these tiny islands, measuring less than one thousandth of an inch in diameter, thus becomes a photoelectric picture element capable of reacting individually to any light focused on it. There are so many millions of these microscopic light cells on the surface of each mosaic plate that we can consider them to be arranged in rows. If we were to assume that there were 525 such rows across the plate and that there were 600 light elements to the row, it would total over three hundred thousand picture elements which could be used to interpret the optical picture focused on this plate.

The third or back surface of the mosaic is made by coating the reverse side of the mica sheet with a mixture of colloidal



Courtesy NBC

NBC OUTDOOR ORTHICON CAMERA WITH TELEPHOTO LENS

graphite, a conducting material, which is directly connected to the external signal terminal of the iconoscope.

A photoelectric element, such as the caesium silver globule we have just described, is composed of an electrically positive nucleus surrounded by a cloud of negative electrons. Each photosensitive globule, when exposed to light, gives up some of the electrons that comprise its structure and is thus temporarily thrown out of electrical balance. If each globule under the effect of light then becomes deficient in negative electricity, it has, conversely, become more positive with respect to a normal cell and can be said to be positive or "charged."

As an analogy, to explain this we might use a glass of water, which is allowed to evaporate under the sun's rays. If the water were to be considered as the negative electricity of a single globule and the air, the positive charge which replaces any loss in volume, the changing level of water, and its replacement by air would be similar to the loss of negative charges and the gain in positive potential of a caesium silver molecule under exposure to light.

It will be sufficient, however, to consider that under the influence of light each tiny unit of the mosaic will take on an electrical charge proportionate to the amount of light to which it is exposed. The released electrons, whose absence causes the charge, are collected by the positively charged annular ring (B in Figure 2), and disposed of and do not again directly affect our consideration. The result of this photoelectric reaction of the

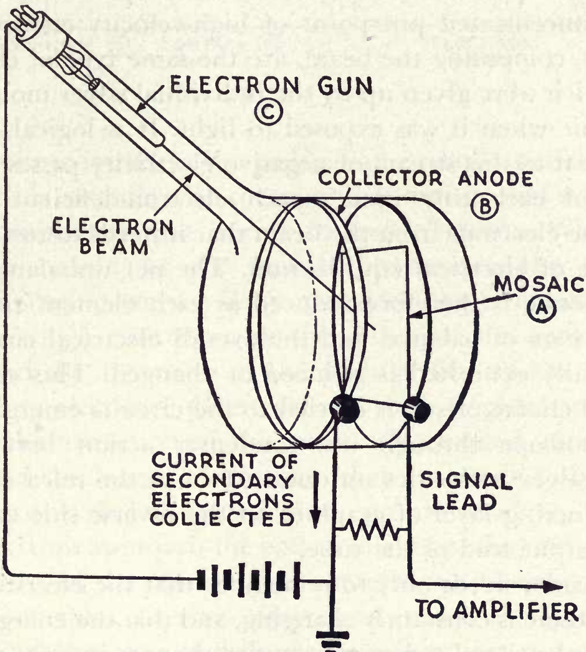


FIG. 2

mosaic produces a series of individual electrical charges which duplicate in quantity and arrangement the lights and shadows of the scene before the lens of the camera. Light energy is thus transformed into electrical energy, but it remains for us to collect these charges in a sequential manner that will later permit their reassembly in their original relation to one another. This process of collection is called "scanning" and is, as the term indicates, similar to the process of reading a page of print. In reading we scan the words from left to right and downward from line to line. The scanning process in television is accomplished similarly by sweeping a beam of electrons back and forth across the mosaic. Each element, like each word on the printed page, when touched by this beam of negative electricity, contributes its measured charge of electricity to our analyzation of the entire mosaic.

This electron beam, which is used to collect this information in the iconoscope tube, is made up of a stream of high-velocity electrons or particles of negative electricity that are focused into a concentrated pin point of high-velocity energy. These electrons, composing the beam, are the same type of charges as those which were given up by the individual silver molecules of the mosaic when it was exposed to light. It is logical, then, to expect that as this stream of negative electricity passes over the surface of each tiny island, each electron-deficient element claims the electrons from the beam that it needs to restore itself to a state of electrical equilibrium. The net unbalance of the entire mosaic is therefore reduced as each element regains its original state of balance, and the overall electrical charge that it originally exhibited is reduced or changed. This change in electrical characteristic is carried to the circuits emerging from the iconoscope through the condenser action between the isolated silver molecules on one surface of the mica sheet and the conducting layer of graphite on the reverse side connected to the output lead of the tube.

The reader needs only to remember that the electrical value of this mosaic is constantly changing, and that the energy emerging from the signal connection under changes in light measures and faithfully records these changes. To satisfy those readers who may question how this single connection may constitute a closed circuit, it is pointed out that the function of the annular ring (B in Figure 2) is to collect the secondary electrons freed by the force of impact of the beam and to act as a return electrical path between the photosensitive globules and the graphite coating that carries the signal.

A device called the electron gun provides the electron beam which sweeps across the signal elements in the scanning process. This gun can be best described by reference to Figure 3, which shows in cross section the arrangement of parts. The source of

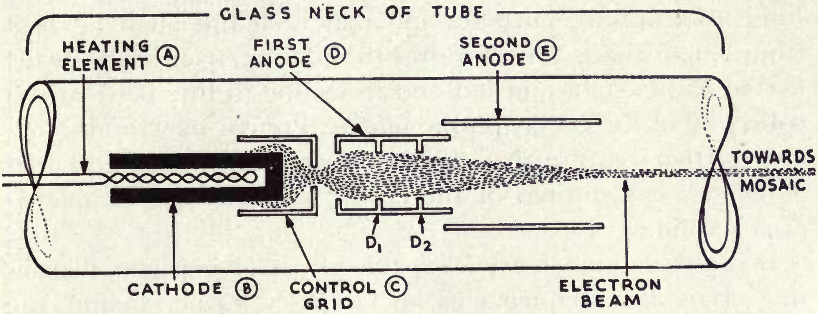


FIG. 3

the electrons is found in the tiny pillar, or hollow nickel tube (B), which is coated with a compound of barium and strontium oxides, a substance that is rich in free electrons. When this cathode is heated by the resistance element, the barium-strontium coating emits a dense cloud of negative particles of electricity which rush through the orifice of the control grid (C) toward the attraction of the positive first anode (D). As the speeding electrons, diverted from their original rotational paths by the attraction of this positively charged anode, continue down the length of the gun, they are made to converge further by the several apertures shown above as D_1 and D_2. As the electrons approach the end of this tube, they come under the influence of the more highly charged second anode, which further accelerates the now compressed stream of negative particles. An analogy that might serve to explain this gun structure can be found in the nozzle of a hose, except that the electrons, instead of being forced through a nozzle like the water in a hose, are drawn through the annular rings by an attractive force.

This gun structure, capable of producing a concentrated and accelerated beam of electrons, is located in the neck of the iconoscope in a position where it can be played or directed on any part of the mosaic (C in Figure 2).

As previously pointed out, we can consider that there are enough individual photoelectric elements on the mosaic to allow arrangement in a series of lines across the plate. Present-day television standards, set by the Federal Communications System, specify that the mosaic be divided into 525 possible lines for scanning purposes and that each line shall be read from left to right. This requires that the electron beam be deflected to the right and left and from line to line if we are to collect all of the energy on the mosaic. Present television standards further require that this beam shall be deflected so that 30 complete scannings of the entire 525 lines are completed each second.

Because the human eye is capable of perceiving light changes that occur at a frequency as low as 30 cycles per second, the observer would be aware of a bothersome flicker if these standards were maintained. This led to the adoption of an alternate system of scanning which effectively produces the equivalent of 60 apparent pictures per second, instead of 30. This process, known as "interlacing," is accomplished by scanning every odd-numbered line of the 525 possible subdivisions during one scanning sequence and filling in the picture by scanning the even-numbered lines during the second coverage. Because these two partial pictures are presented to the eye at approximately the same instant, they create the optical impression of one complete picture appearing sixty times each second. To achieve these standards, it is necessary that we insure that the scanning beam be accurately placed on alternate lines for each successive picture and that the collecting beam be controlled, in its split-second sweep across the mosaic, with an accuracy not easily obtainable by any mechanical means.

The speed with which this beam must move back and forth to produce the required number of frames per second precludes the use of any mechanical arrangement, with its inherent mass and friction. It is apparent that if the mosaic is four inches across, and thirty complete pictures of 525 lines each are to be collected each second, the beam will need to move 4 inches

Courtesy Farnsworth

A FARNSWORTH DIRECT PICKUP CAMERA

$\times$ 30 $\times$ 525 $\times$ 2 (back and forth) or 126,000 inches per second (more than 7200 miles per hour) to fulfill the standards satisfactorily.

Such accuracy and speed demands a synchronizing and amplifying system of moving the electron beam that will offer no frictional resistance and that can be easily controlled by electronic methods.

Such controlling influences are provided for in the scanning coil assembly shown in D of Figure 1. This scanning coil is made up of a series of four separate coils arranged in pairs around the neck of the tube.

Knowing that the motion of a beam of electrons is affected by the presence of a magnetic field, changing its direction toward a field of one polarity and away from a field of the opposite polarity, it becomes possible to control the vertical and horizontal motion of the beam electronically. If the currents passing through the top and bottom sections of the scanning coils are such as to set up opposing magnetic fields, it is apparent that the beam will be attracted toward one of the coils at the same time it is repelled from the other. When the currents in these two coils are reversed, the magnetic fields change polarity, and the vertical deflection of the beam is likewise reversed. Similarly, the two side units of the scanning coil assembly will control the horizontal motion of the beam. The necessary voltages and currents for energizing these coils or fields at the frequency and in the amount required must be provided for if the entire system is to function in synchronization. This is accomplished in a series of electrical circuits that will be discussed more fully in later paragraphs dealing with control circuits.

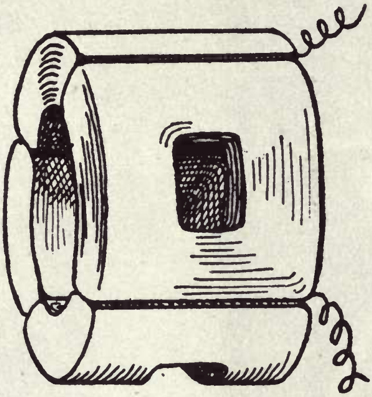


FIG. 4. DETAIL OF SCANNING COIL

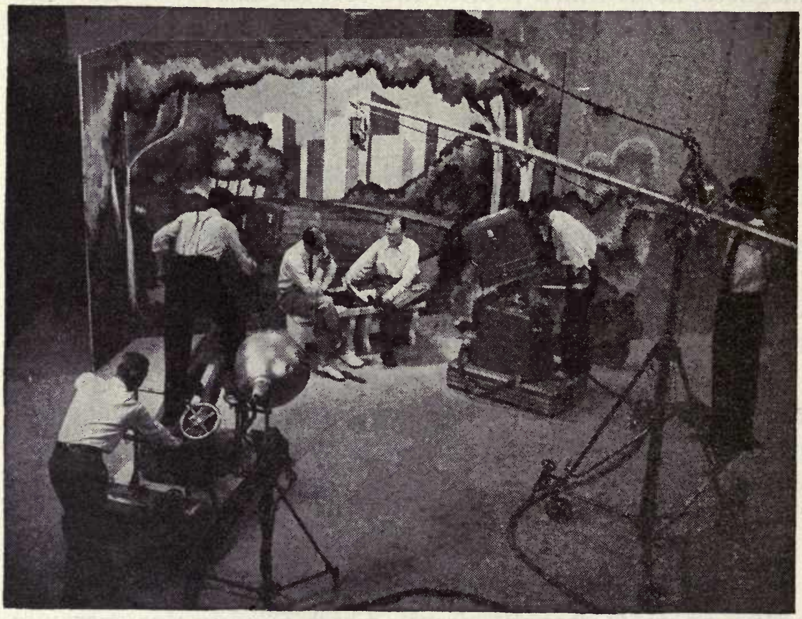
At this point let us recapitulate the electrical actions which produce the sequential analysis of the light image falling onto the mosaic of the iconoscope, and at the same time convert light into electrical energy. To begin with, we find a highly accelerated beam of electrons sweeping across the mosaic from left to right, discharging the light-sensitive elements in one row. The horizontal scanning coils are so energized that they cause the beam to return to the beginning of the third line instead of the second. Thereafter, the beam will continue to scan the 5th, 7th, 9th, etc., that is, the odd-numbered lines, until the beam reaches the bottom of the light-sensitive plate. Then the magnetic fields which control the vertical motion of the beam cause the latter to jump back to the upper left-hand corner of the mosaic. The magnetic fields responsible for the horizontal movement of the beam now cause the even-numbered lines to be scanned, that is, the 2nd, 4th, 6th, 8th, etc. By the time the beam reaches the bottom of the mosaic, its entire area will have been explored. Each element traversed in these exploratory sweeps of the electron beam gives up electrical energy in proportion to the light that has fallen upon it, creating in the exterior circuit a series of electrical pulsations representing the light values found during the sequential scanning process.

The voltage developed by the iconoscope tube will range from zero to five hundred millionths of a volt with the voltage and current varying as often as six million times per second. This electrical pulse is called the signal voltage or, more commonly, "the signal."

Camera Amplifiers

It is apparent that the circuits which amplify this energy to usable levels and still maintain the wide band of frequencies required for fidelity will be masterpieces of electronic design. Such amplifiers are not common to radio, but they are very necessary to television. The first, and possibly the most critical, amplifier is located within the camera itself. This unit, known as the head amplifier, or camera pre-amplifier, is positioned so that the exposed lead between it and the iconoscope is as short as possible in order to minimize the possibility of stray electrical noises affecting the extremely weak signal voltage obtained from the iconoscope. These amplifiers are designed to preserve the characteristics of the signal or pulse of electrical energy, while the amplitude or strength is being increased in each stage. In the B & K camera, which may be used as an example, we find six stages of this type of amplifier being used before the signal is considered sufficiently strong to be sent to the control room.

After the signal enters the control room, it is again put through a series of amplifiers in order to bring it to a level where more radical corrective changes can be made before it is sent on to the transmitter for broadcasting. In this position, the



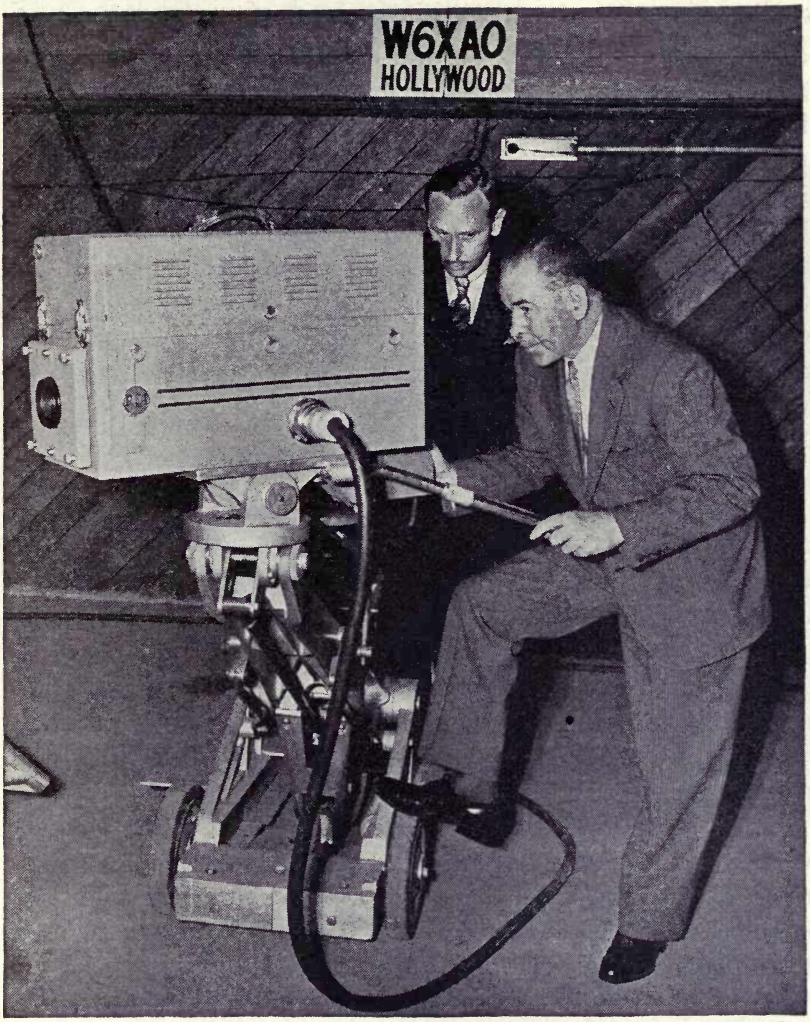
Courtesy G. E.

THE G. E. TELEVISION CAMERAS AT WORK

engineers adjust the relationship between the black and white and introduce additional wave forms into the picture signal in order to counteract spurious images (shading) brought about by parasitic secondary electronic action within the iconoscope.

Synchronizing Pulses

Here the reader may reasonably inquire as to what factor insures the micro-second accuracy of all these integrated electronic operations that have brought the picture signal thus far. The master controlling impulse for the entire system, an impulse that appears with the signal in all phases of its production and adjustment, is commonly known as the "synchronizing pulse." It is originally generated from the sixty-cycle alternating



Courtesy Don Lee

DON LEE TELEVISION CAMERA

current (house current), which supplies power to the system. The frequency of these alternations can be increased to any multiple of sixty by electronic multiplying circuits, and its original sinusoidal wave form changed to meet any special requirements. This standardization, multiplication, and conversion of form is done in a separate unit usually found in the control room and referred to as the "sync generator."

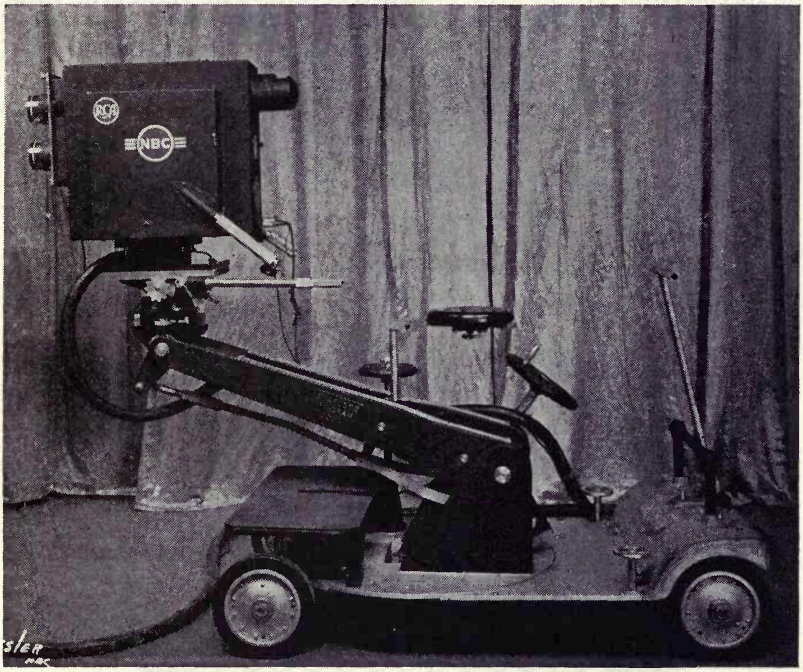
The outputs from this generating circuit are amplified and fed throughout the system. Certain frequencies are sent to the camera to control the back-and-forth sweep of the iconoscope beam which determines the line frequency. Other duplicate pulses are sent to the transmitter with the picture for synchronizing the receiver. This sync pulse has been aptly described as the key of the television system, fitting, as it does, both the camera and the receiver, and hence capable of controlling both. The combination of the synchronizing impulses with the picture signal produced by the camera is then superimposed on a carrier frequency at the transmitter to produce the resultant wave shape we so glibly refer to as "the broadcast."

Coaxial Interconnections

The electrical connection between the camera and the control room is made through a series of coaxial cables, generally bound together in a bundle and resembling a heavy section of rubber-covered hose. These coaxial cables are, as their name indicates, a two-conductor assembly with one conductor coaxially separated and insulated from the other. Inasmuch as television relies on this type of conductor for transmission purposes, camera cables, interstage couplings, and video patch cords, it may be well to describe a coaxial in some detail.

The reader will ask why television does not use telephone wires as radio does. While the complete answer to these questions will normally be the subject of many volumes for the engineer, it is possible that the general concepts can be explained to the layman's satisfaction in a few paragraphs.

A straight wire carrying alternating current (in this case a television signal) will offer resistance to such flow in the form of inductance, a characteristic of an electrical circuit which tends to resist any change in the value of the current. This inductive quality, together with the resistance, tends to impede the flow of varying electric currents by dissipating the energy in the circuit. Counteracting this is an opposing characteristic of alternating current circuits, called capacity. When the capacitance of a circuit is of such order that it counteracts the inductance of the circuit, we have a condition of minimum opposition to flow of current, and the television signal can be moved from point to point without appreciable loss. This condition of balance is commonly known as "resonance." Unfortunately, a single wire does not normally possess these opposing character-



Courtesy NBC

THE NBC PANORAM DOLLY

istics in proper relationship. If we arrange two wires parallel to and insulated from each other, we can, however, introduce the electrical currents in such a manner as to bring about this condition of resonance. Since the spacing between two wires and the length of the wires determine the inductance and capacity, it is logical to fold or wrap one of the conductors about the other, leaving constant spacing to produce the equivalent of the coaxial cable.

The coaxial cable, then, is a low-loss method of transmitting the broad band of frequencies which go to make up a television signal. Figure 5 represents a standard type of "co-ax" of the rigid or metallic variety. The inner conductor is rigidly supported in the center of the outer tube by the button-like insulators. The dielectric or insulating medium in this case is air. This rigid type will generally be found in antenna systems where long, straight runs allow us to take advantage of the high efficiency of this type of construction. The rigid-type cable

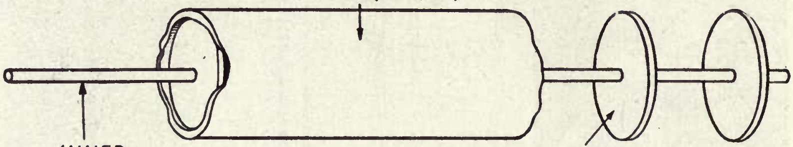


FIG. 5

does not lend itself to bending or to use under conditions where the inner conductor does not remain in the exact electrical center of the outer tube. Flexible co-ax, which we use for interstage connections and non-rigid transmission work, such as the camera cable, is shown in Figure 6. This type, while less

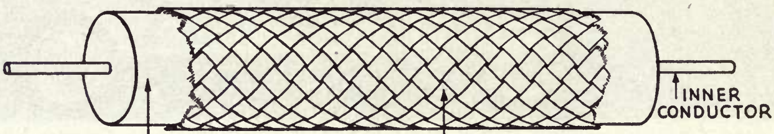


FIG. 6

efficient because of the electrical leakage of the insulating medium, is still satisfactory for the short runs where its use is essential.

When we consider the split-second integration of hundreds of circuits, the interfunctioning of optics, photoelectricity, and mechanics required in a television system, it becomes one of the wonders of modern science that this complex wave shape can be recreated into living pictures and sound in our homes by the mere pushing of the right button.

4

Television Transmission

The Transmitter

A TELEVISION transmitter is normally composed of two separate units, one being used for sound broadcasting and the other for picture transmission. In both instances, the electronic circuits closely resemble a modern high-frequency radio installation.

The functions of a television transmitter consist of amplifying the picture and sound impulses fed to it from the control room, creating a carrier wave, and impressing the amplified sound and picture impulses on this carrier wave for delivery to the receiver.

The amplification function of a television transmitter will be given little explanation here, inasmuch as it is merely a process of producing a magnified version of the electronic wave shapes generated by a television camera and the microphone.

Even after amplification these impulses which comprise the program of a television show have neither the properties nor the power to travel alone to the receiving antenna and, therefore, some kind of electronic delivery system is required to carry them to their destination. This delivery system is aptly named the carrier wave, and can best be described as a manifold multiplication of the frequency and power obtained from the 60-cycle power mains. Throughout this entire multiplication process, the original sine wave shape is retained, appearing in its final stage as a greatly magnified version of the original impulse, with many thousand times the original number of alternations.

The 60-cycle sine wave source referred to is an electrical current that is not a fixed and constant electrical function but one that continually varies from a plus to a minus quantity at the rate of 60 complete cycles per second. This type of electrical current is used to power both the transmitters and receivers and thus becomes the time basis for the entire broadcasting system. Electrical energy at these low frequencies is normally carried over wires, but if the frequency of reversals per second is increased from 60 to 60,000,000 cycles per second, and a suitable antenna provided, this energy can be transmitted or radiated through the ether without wires.

The original voltage and current as it comes in from the power lines must be amplified if the dissipation of energy from the antenna is to result in any more than a local disturbance around the antenna. This power amplification is also accomplished during the frequency multiplication process. While we have taken a radio frequency of 60,000,000 cycles per second as an example, it must be understood that radiation can take place at frequencies far below this figure. Radio broadcast stations, for instance, operate from 500,000 cycles per second to 1,500,000 cycles per second, or, as we normally describe it, 500 kilocycles to 1,500 kilocycles.

In addition to the function of amplifying the impulses developed in the cameras and microphones and creating the required carrier wave, the transmitter must also be capable of impressing these program signals onto the carrier wave. This process is called modulation, and it is accomplished in one of the many circuits of the transmitter.

The number of times the carrier current reverses direction in each second is the frequency of the transmitter channel over which the television program energy is received. Each one of these channels has been designed to a certain width, like a road, to permit the complete picture and sound passage without crossing over into the path of the adjoining program traffic from other stations. To protect further against such an eventuality, a guard band of 250,000 cycles is normally provided between assigned television channels.

Even though this radiated energy is capable of traveling without wires, it cannot be resolved into understandable picture or sound without further transformation at the receiving position. It will be apparent that a positive swing of electrical current followed by an equal and opposite negative swing of the current less than 1/120,000,000 of a second later will be effectively counteracted, producing a net result of zero in any but the most sensitive measuring device. Loud speakers and picture tubes are not capable of reacting at this speed. The carrier wave, therefore, can be considered to be an unintelligible feature of the broadcast, functioning solely as a transportation medium for the picture and sound energy that it carries.

Television Channels

The width of the broadcast "roads" varies according to the material that must be carried on them. The human ear can distinguish only a relatively low number of current reversals per second. A channel for sound, therefore, need be only wide enough to carry the maximum frequency band of the human ear, which in broadcast work is approximately 10,000 cycles per second. Since a television program is far more complex, it requires more channel width; in fact, it requires 600 times as much as sound alone. If the channel is not wide enough or if the available width is not fully utilized, a satisfactory picture cannot be produced. Television, because of its extensive requirements of band width or air space, has been assigned frequencies much higher than those used in the common broadcast band.

This allocation of television to the ultra-high frequency spectrum has many advantages, and in turn has also created many engineering problems.

It has often been proposed that the frequency assignment of the video services be raised to the uncharted spectrums above 100 megacycles and thus leave the lower reaches clear for commercial electronics and aural broadcasts. Each successive channel reassignment for television has tended to relinquish the lower bands and forced redevelopment of television transmitters and receivers for the new wave lengths. Recent recommendations of the Federal Communications System have proposed that television be assigned six channels in the 44–84 megacycle band, as well as a high-frequency channel from 180–216 megacycles. For experimental and investigatory work, the frequencies above 480 megacycles have been set aside as a result of the desire on the part of many broadcasters to develop this spectrum for future utilization.

It is no laboratory secret that commercial operation of transmitter equipment in the ultra-high spectrum presents difficulties in engineering at present. Many of the tubes and circuits that will operate satisfactorily at 40 megacycles either cease to function or function poorly in the ultra-high frequencies.

Although this proposed occupancy of the upper frequencies will give television the "leg room" necessary to growth and development, it again has its disadvantages. Any high-frequency signal has a tendency to bounce or reflect in much the same way as sound will echo from a wall or light will reflect off a mirror. As the wave length of the transmitted signal gets shorter, the objects that will reflect the signal become smaller, resulting in an increase in the number of "multipath" re-radiations, although the reflected energy will, in many such cases, be too slight to affect a receiver. In the lower channels now assigned to television, this "radar effect," although it does not present the problems that would be experienced in operation in the ultra-high frequencies, is still of considerable consequence in metropolitan areas.

These secondary radiation points may cause considerable trouble at the receiver, where an untuned antenna array will sometimes collect and register this reflected signal with the same efficiency that it will receive the master signal from the transmitter.

The secondary, or multipath, radiation must travel considerably further (from the transmitter to the point of reflection, thence to the receiver) and is, therefore, received a fraction of a second after the master or direct impulse. Even though this separation between the two signals may be only a matter of micro-seconds, the trace of the first picture has already moved across the face of the picture tube. The reflected signal, therefore, starts its duplicate trace with a slight right-to-left displacement, resulting in the creation of a "ghost image," or two identical pictures horizontally displaced. This objectionable complication can, in most situations, be reduced by focusing the antenna array so that it will not accept transmission from any but the direction of the master transmitter. The addition of the tuned director and reflector elements are most effective in this regard.

Another common method of "ghost suppression" is to direct the receiving antenna so that the signal from the reflective source will be received in the blank or unresponsive sides of the array and the more powerful direct transmission will be picked up with maximum efficiency. In order completely to eliminate secondary pictures by this method, it is often necessary to accept less than full signal from the station by positioning the dead side of the antenna so that it will completely blanket the unwanted reflection.

This may result in an arrangement of an array in which the sensitive side of the antenna is directed away from the direction of the actual transmitter. In some cases, especially where the unwanted reflection comes from the same general direction as does the actual transmission, little can be done outside of pointing the antenna in the opposite direction and accepting a true reflection from a less congested area.

Although considerable exploration of ultra-high frequency phenomenon has already been made, little is known as yet of the commercial characteristics of this newly assigned space. The armed forces have by necessity based a large part of their investigations and military use of electronics in this region. Around the results of their work, available after the war, much will be decided as to the future utilization of these frequencies.

Antennae

The electrical circuits of a television transmitter are simple and compact, even though the design characteristics entering into these units may be more complex and intricate than an equivalent radio broadcast transmitter. This reduction in the physical size of the components within the television transmitter is made possible by the short-wave lengths used and is one of the advantages of having television channels in the upper reaches of the radio spectrum. It is particularly true of the antenna systems where a proportionate reduction in length is found.

Long-wave broadcasting stations require long antenna systems to radiate the signal efficiently. The length of these antennae makes it impossible to arrange or mount them with the ease and efficiency that can be accomplished with the much shorter units of television. An antenna of five feet or less, which is typical of a high-frequency broadcasting system, can be arranged and installed in a manner that will produce maximum efficiency.

The antenna system of a radio transmitter can be compared to the headlight of a car with the actual signal radiator representing the source of light. It is true that in a headlight the filament of the lamp approaches the mathematical limits of a single point source, while, in considering the comparable television antenna, such a point source is approximated in only one dimension.

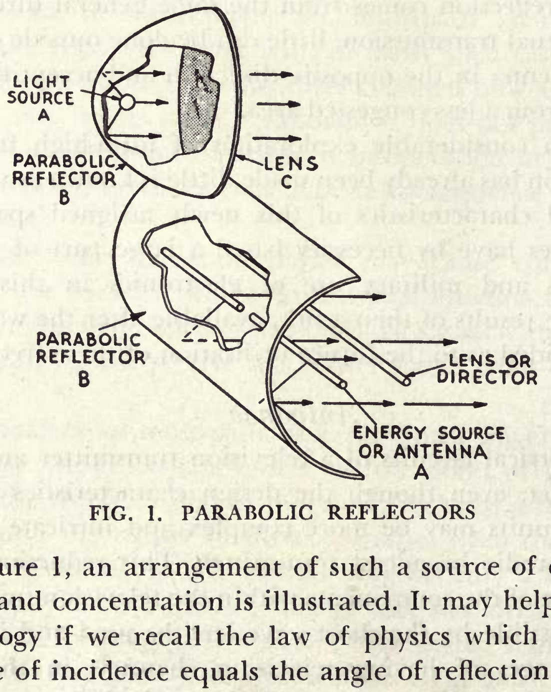
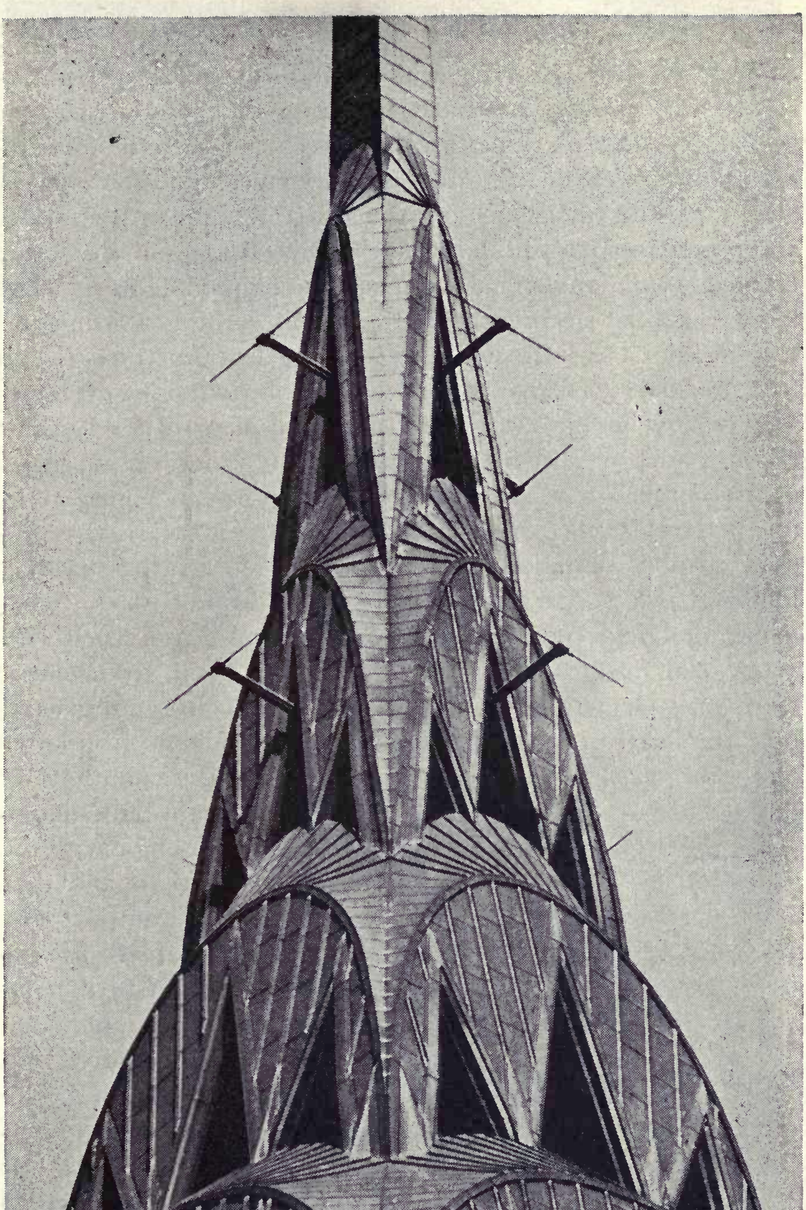


FIG. 1. PARABOLIC REFLECTORS

In Figure 1, an arrangement of such a source of energy, reflection, and concentration is illustrated. It may help to clarify this analogy if we recall the law of physics which states that the angle of incidence equals the angle of reflection.

The parabolic reflector (B) is a mathematically designed



Courtesy CBS

CBS TELEVISION ANTENNA ATOP CHRYSLER BUILDING, NEW YORK

concave reflector so arranged as to produce a series of parallel reflections from the reflected radiation of the source. The lens (C) will act as a collector and director of both the forward radiation as well as the previously described reflected energy. Such an arrangement takes all the available light in the source and projects it in a parallel beam. If a television antenna could be made to radiate from a point source comparable in size to a lamp, a similar arrangement of parabolic reflectors would be feasible, but the normal television wave length, which is five feet, precludes such an easy and efficient solution to the problem.

It is possible, however, to consider one plane of a television radiator as an equivalent point source, and around it construct a curved reflector in one dimension, as shown in Figure 1. In one plane this reflector will then function parabolically to produce parallel radiation. Such a reflector, measuring five feet long and at least five feet in diameter, would be both unwieldy and impractical. Inasmuch as we are now more concerned with a practical installation, the equivalent electrical arrangement of parallel elements shown in Figure 2 has come into general use. The single rod reflector is spaced approximately one quarter of a wave length behind the antenna, causing the radiations off the back of the antenna to be reflected in phase with the original radiations and thus fortifying the output that would be obtained by the antenna alone. A further increase in efficiency is obtained by placing a measured rod or director antenna at a computed distance ahead of the actual antenna. This element acts in much the same way as the lens of an optical system. The entire assembly is a satisfactory approximation of the results that might be obtained from a single plane parabolic arrangement.

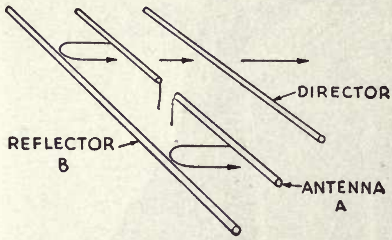
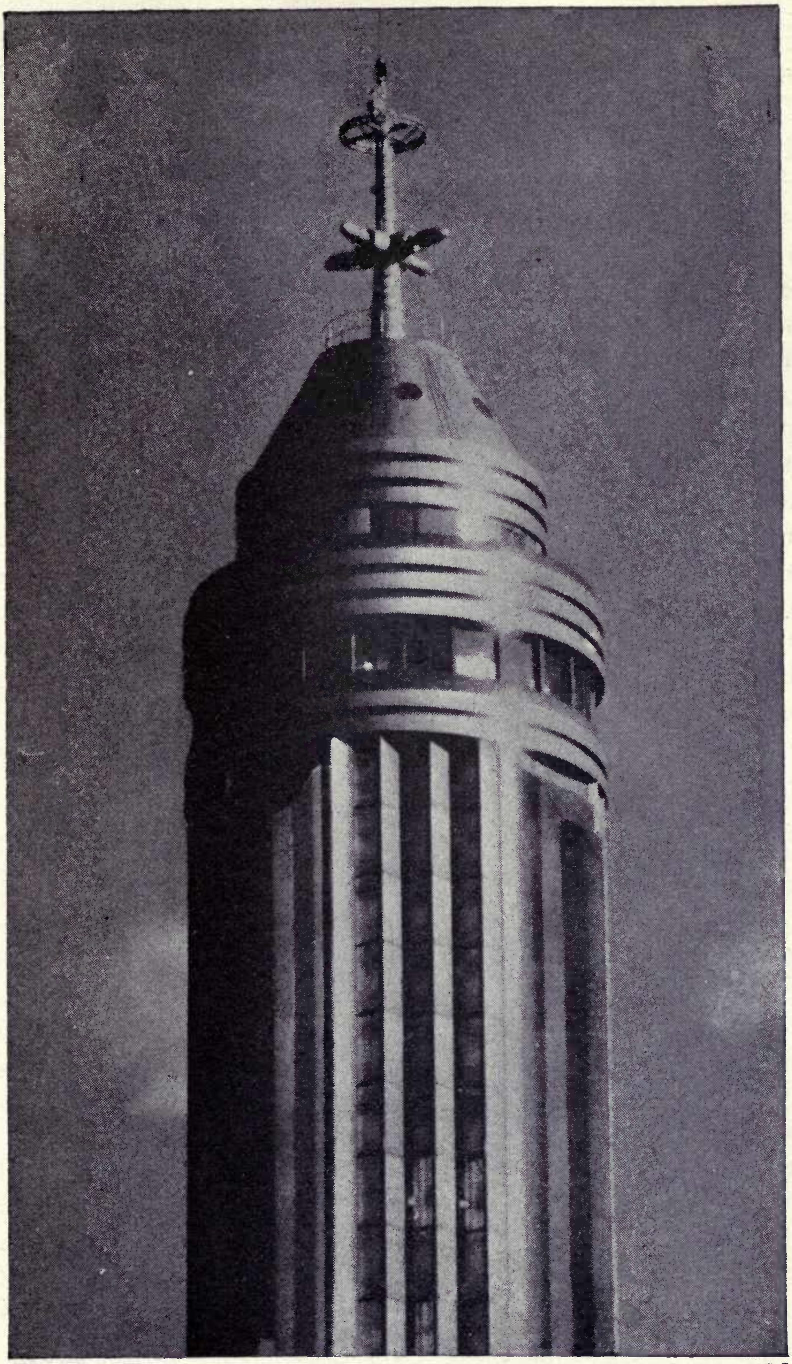


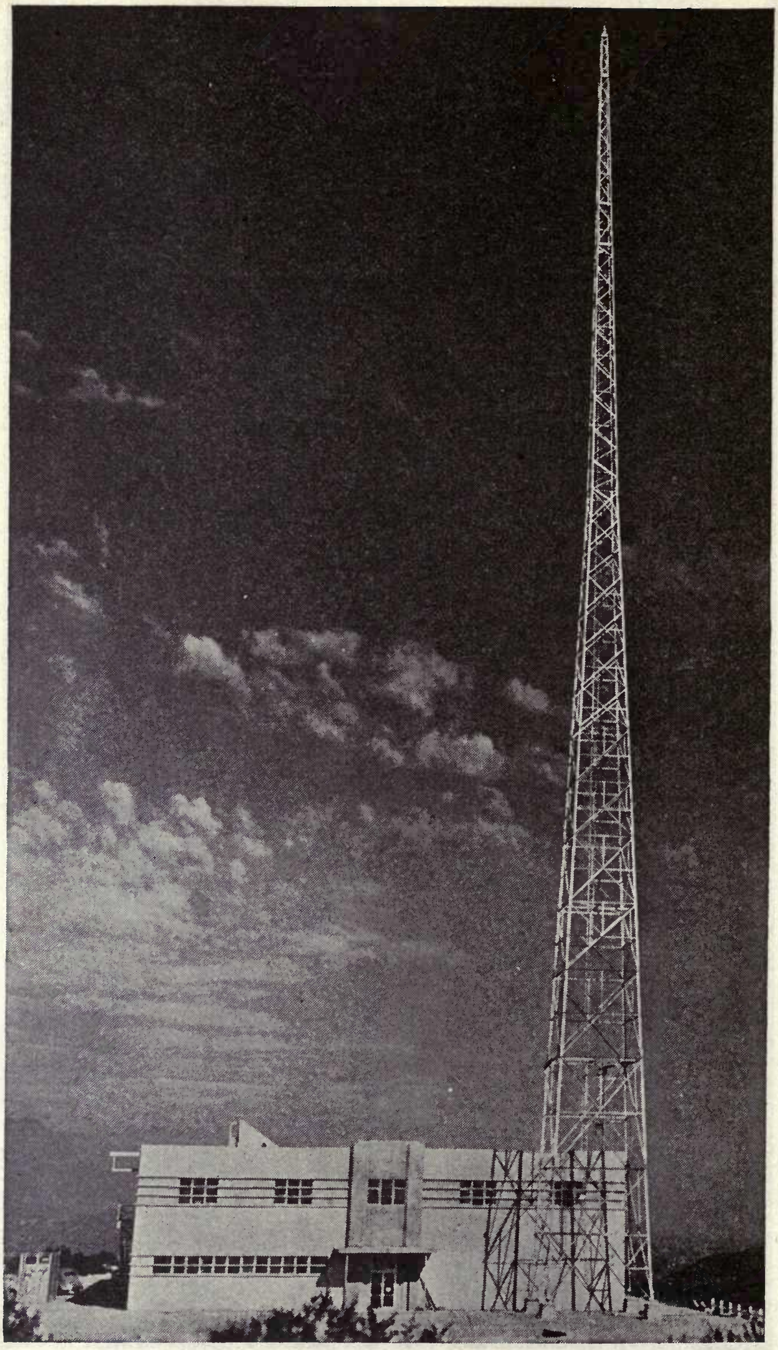
FIG. 2

By being able thus to focus the radiations of the output of a high-frequency broadcasting system we can concentrate and direct radio energy in the direction of the receiver. Conversely,



Courtesy NBC

WNBT'S TELEVISION TRANSMITTING ANTENNAE ATOP THE EMPIRE STATE BUILDING IN NEW YORK



Courtesy W6XAO

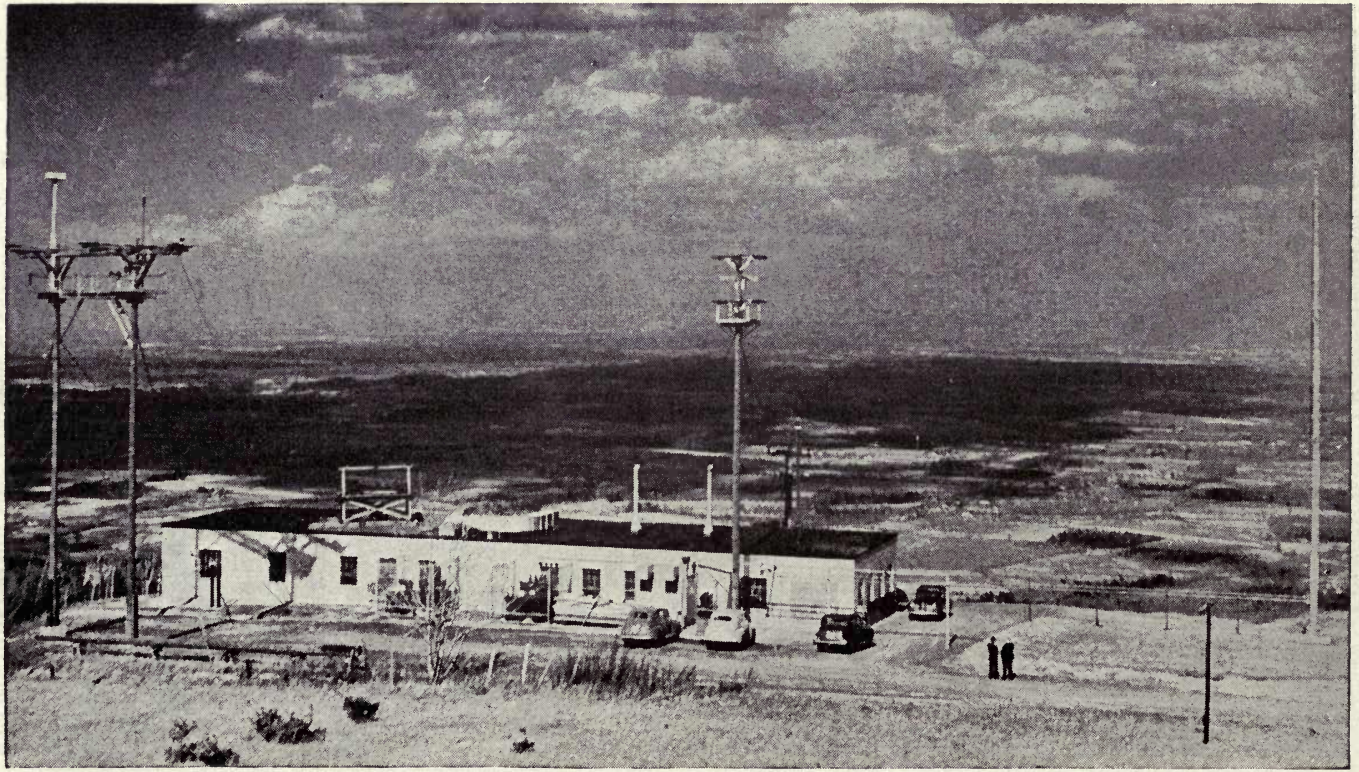
W6XAO, THE DON LEE TELEVISION STUDIO AND TRANSMITTER ATOP MOUNT LEE, HOLLYWOOD in the case of a receiving antenna we can, by the same method, pick up the maximum amount of energy from a transmitter. Normally, the antenna system of a transmitter will be designed to radiate with equal intensity in all directions in order effectively to cover the listening market and will employ non-directional antennae, commonly known as "turnstiles." The receiving antenna, on the other hand, will generally be designed to cover one or more stations with a reflector-director arrangement similar to the system just described. Although the antennae of the television broadcasting station will radiate its signal north, south, east, and west of its transmitter, the owner of a television home receiver will have to choose between north and south or east and west reception and direct his antenna accordingly. He will thus be able to receive programs from only those television stations located in the sector toward which his antenna array is directed. Those stations lying outside this sector of coverage will either be so weak that reception will be extremely poor or will not be received at all. Duplicate antenna systems or a method of rotation of the single tuned array is the only alternative possible at the present time.

Coverage

The wave length of the signal radiated by a station is computed in meters or feet from the frequency of its assigned carrier wave. The higher the frequency, the shorter the wave length, or, in other words, the greater the number of alternations per second, the shorter these radio waves become. This decrease in wave length has a direct bearing on the range of reception, resulting in a general rule that all transmissions above forty megacycles can be normally considered as limited to horizon distance.

Although the engineering difficulty associated with developing high power and wide coverage on the short wave lengths has been a consistent problem, possibly the greatest disadvantage in using these high-frequency channels is this horizon limitation, which precludes the coverage of many thousands of square miles by any one station.

Television, frequency modulation, and other high-frequency services all suffer from this limitation of coverage. The path of



Courtesy G. E.

EXTERIOR OF G. E. TELEVISION AND FM TRANSMITTER IN HELDERBERG MOUNTAINS, NEAR SCHENECTADY, N. Y.

the signal from a transmitter to a receiver can be considered to be a straight line. The normal range of such high-frequency services is consequently determined by the respective heights of the transmitting and receiving antennae above the ground, with the curvature of the earth considered a constant. The effective coverage of a high-frequency transmitter limited to the horizon will thus be visible from the top of the transmitter tower. Standard broadcast frequencies are not limited by such restrictions. These long-range broadcasts at the lower frequencies are the result of a series of reflections from a stratospheric, ionized surface surrounding the earth, called the *Kennealy-Heaviside Layer.* Low and intermediate frequency signals striking against the various strata of this ionized surface are reflected back to earth at considerable distances from the originating point. The height of this reflective surface and the degree of penetration of the original signal determine the distance from the station at which the signal will return to earth. As the frequency increases, this penetration of the signal into the Heaviside Layer becomes deeper and the angle of reflection more acute until at frequencies appreciably about 40 megacycles little or no reflection phenomena are observed. If frequency thus limits the range of a television broadcast, it is logical to ask, "Why not lower the channel assignments and thus obtain the long-distance coverage common to radio broadcasting?" If space to transmit the required six megacycle channel were available in the lower frequency bands, television could, no doubt, enjoy the same long-distance coverage of radio. The assignment of this 60,000,000-cycle width in the region now given over to radio broadcasting is, however, impossible because the total space available in this band would not provide room for more than one or two television stations to operate without doing away with all the other radio services now occupying the lower part of the spectrum.

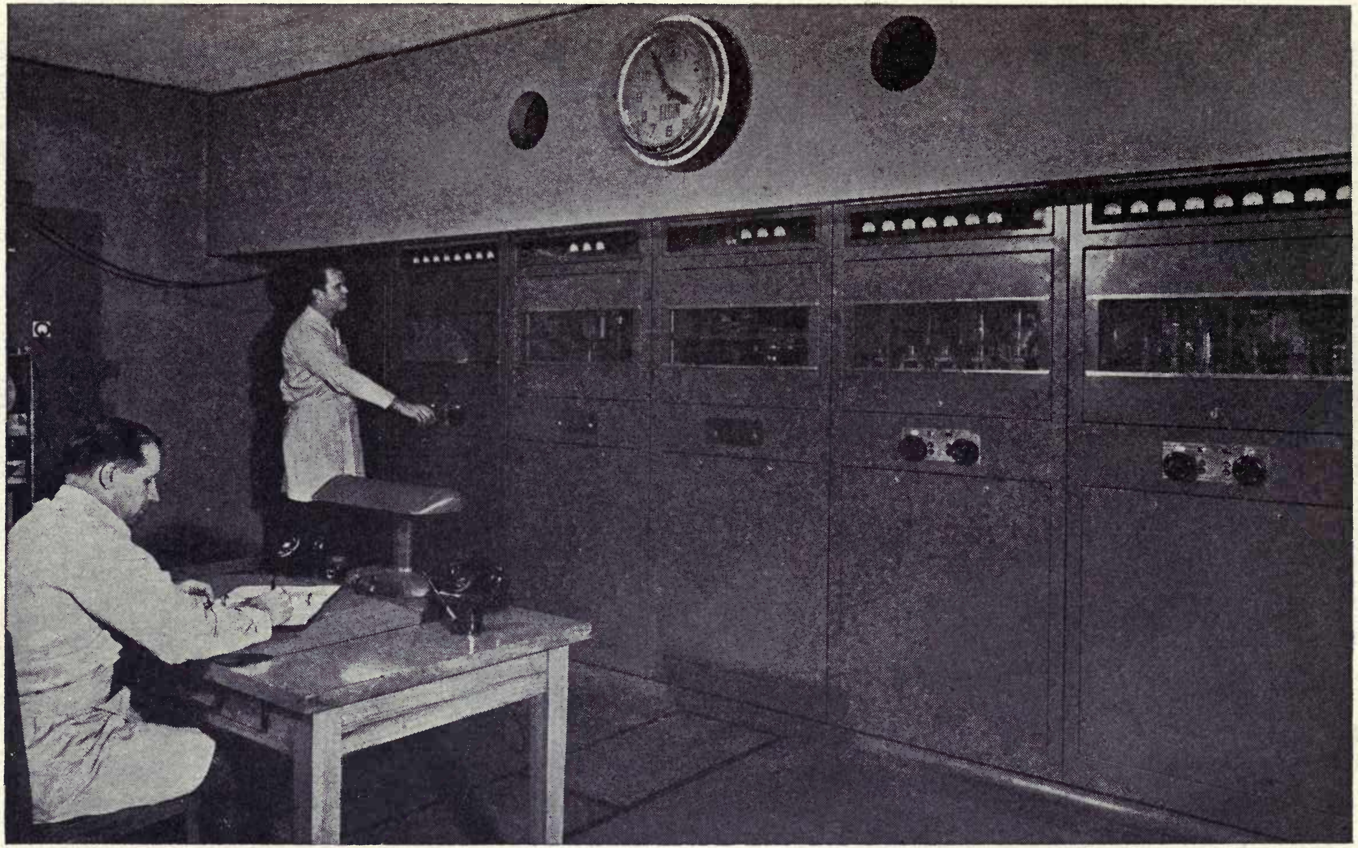
This quasi-optical range of television is a definite deterrent to the quick development of a national television system, requiring that the industry originate about local transmitters as a locus rather than encompass larger sections of the country by use of the powerful clear-channel stations common to radio.

This limitation of market has so far prevented television from duplicating the phenomenal growth of radio which marked the early '20's. In radio, shortly after the establishment of program service, nearly every home could listen in on the transmissions of such key stations as WGY, KYW, KDKA, and WJZ. The enthusiasm necessary to the development and progress was, in this case, more national in character and therefore more conducive to quick maturity.

Economically, the local coverage of television has restricted the quick development of the art by substituting small, local investments for the much larger sums that would have been available for prospecting a national market.

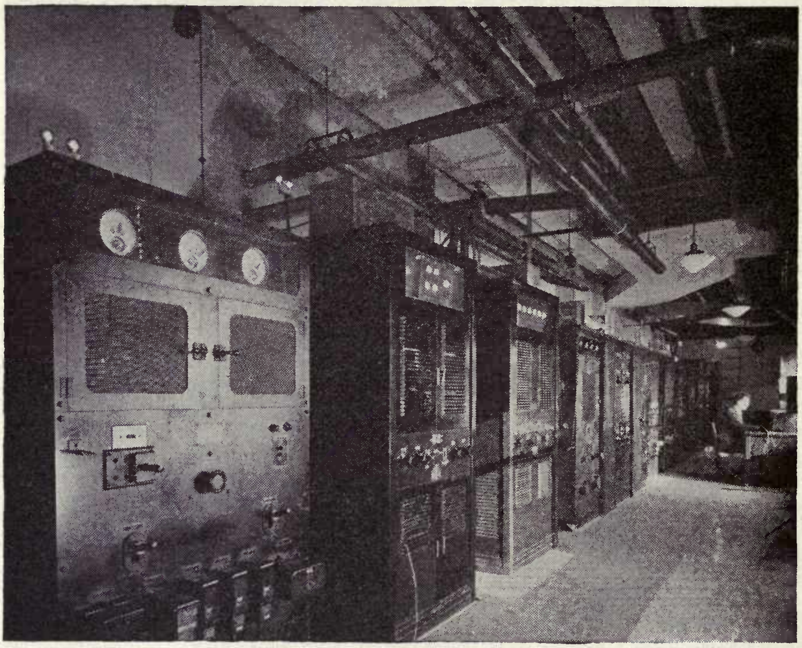
The problem presented is threefold in character. The general public, living beyond the range of the metropolitan stations, has for the greater part never seen television, nor is the availability of such service an imminent possibility. It is conceivable, then, that people will not, for the present at least, purchase receivers in a price range commensurate with broadcast equipment; the manufacturer, if he hopes to reduce the price of receiving equipment to a level that will foster general sales, must rely on mass production in his factory. The few local customers that are available do not constitute such a market. The price of television participation for the chosen few of the larger cities is, therefore, high and out of proportion to the value of the program presently received. The local broadcaster, in infrequent speculative attempts to create interest, must sustain a program service for his limited local audience without the financial assistance of the advertisers, who today look with disinterest on any audience that cannot be totalled in millions.

Without the financial help of the agencies, the average broadcaster cannot afford to underwrite all the engineering development and program costs. The program, therefore, is automatically curtailed in both quality and air time to the minimum dictated by license regulations and minimum public acceptance. Programs of such an inferior quality, while interesting from the novelty standpoint, are not sufficiently good to create a heavy demand for receivers. The manufacturer cannot introduce mass-production methods to reduce costs without seeing a general



Courtesy WBKB

TRANSMITTER ROOM AT THE BALABAN & KATZ STATION WBKB, CHICAGO demand for the merchandise, and the advertiser again voices disinterest in buying advertising aimed at such a limited and localized outlet. This vicious circle repeats itself again and again as long as television is considered in the light of a purely local service incapable of network operation. Luckily, this



Courtesy NBC

NBC'S TELEVISION TRANSMITTER ROOM

situation appears to be one that will eventually give way to engineering development resulting in equivalent networks being formed which will link the efforts and circulation of the local television stations into a national network boasting an advertising market acceptable to the monied clients. By thus expanding the audience, the program cost per listener will drop sharply, allowing greater expenditures for better entertainment material as the market thus reached makes additional investment by the advertiser worth-while. With better entertainment, the popularity of television will grow, and more people will want sets. Seeing a good market, the manufacturer will be able to make sets in large quantities and in this way will be able to sell them more cheaply and thus encourage further sales, and so the circle goes. If this is to be the bonus hinging on network operation, let us consider the various methods in which we can surmount the horizon limitations of television reception.

Networks

As is explained in the section on studio equipment, it is electronically impossible to transmit a television program from one station to another over ordinary telephone lines such as those used in radio broadcasting. The attenuation or loss of power resulting from transmitting high-frequency signals over routine wire circuits is of such order that, for all practical purposes, it can today be considered an impossibility.

The characteristic television signal can, however, be sent over coaxial conductors with little or no loss. Furthermore, the expansion of this method to provide for intercity communications does not increase the power loss to an appreciable extent. This coaxial method of station-to-station interconnection is entirely practicable, and experimental work in this direction increases its popularity daily.

A proposed coaxial network plan based on research conducted by American Telephone and Telegraph will give evidence of the wide possibilities of this system. The high cost of the original installation is the primary objection to coaxial networks—a consideration that may be partially eliminated by using these wide-frequency conductors for long-distance transmission of other communication services, such as telephone and facsimile pictures. A 3-megacycle coaxial line between two cities, designed to handle one television program efficiently, could be used to carry about 480 simultaneous phone conversations. If this coaxial line could thus be utilized during the non-program hours for carrying a pay load of other services, the cost of usage by television could be reduced. Even considering such an eventuality, the cost of creating coaxial networks such as are now proposed will be initially great, resulting in heavy utilization rates to the broadcasters. Coaxial ties do, however, have the advantage over other proposed systems of linkage in that they are unaffected by local or outside disturbances that might possibly disrupt radio relay networks.

Notwithstanding this ever-present problem of outside inter-

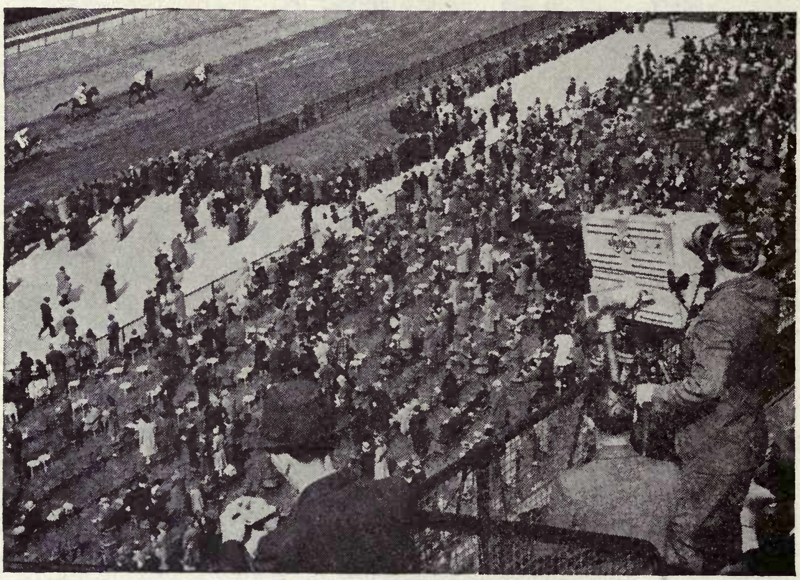
Courtesy American Telephone & Telegraph

SPLICING A SECTION OF THE COAXIAL CABLE NOW BEING LAID BETWEEN ATLANTA, GEORGIA, AND JACKSONVILLE, FLORIDA

ference, the development of radio relay stations for network linkage is steadily increasing. This relay frequency is normally far above the limits of man-made static and generally outside of most natural interference phenomena. The use of very high frequency channels, with their attendant reduction in wave

Courtesy American Telephone & Telegraph

A FANNED-OUT VIEW OF THE SIX-COAXIAL CABLE, SHOWING CONSTRUCTION OF ITS VARIOUS CONDUCTORS. This cable contains one layer of 21 quads outside the coaxials themselves, plus service pairs next to the coaxials length, permits high efficiency in the design and arrangement of radiation and collection antennae. With both relay receiver and booster transmitter capable of being operated as a remote-controlled unit, these equipments can be placed at horizon distances from each other and over this true line of sight interconnect one city with another. The economics of both construc-



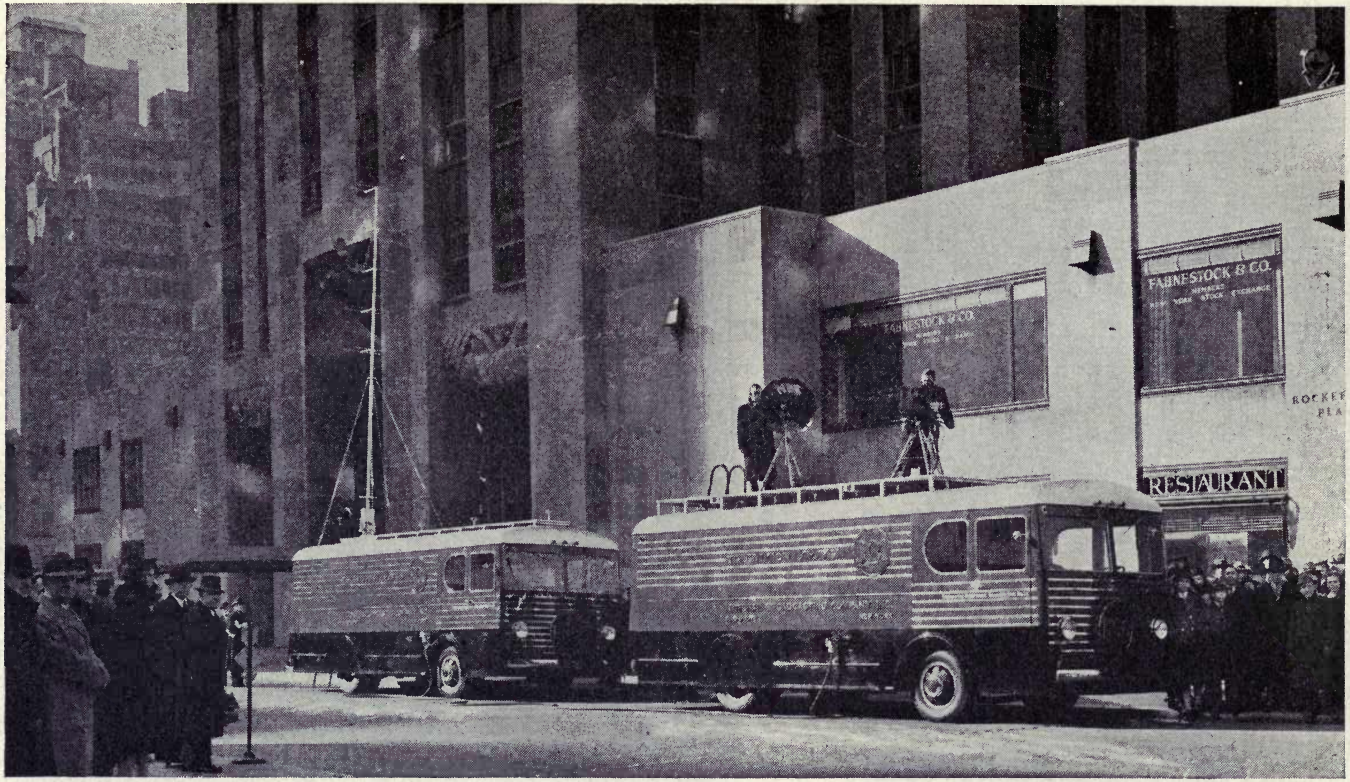
Courtesy NBC

NBC CAMERA ATTENDS A HORSE RACE ON LONG ISLAND

tion and operation of a network created from relay transmitters is apparently more favored by the broadcaster than the coaxial system, but, as pointed out, the radio link is exposed to outside interference that does not affect the coaxial setup.

Network television will undoubtedly develop around both systems of intercity linkage, with geographical as well as economic considerations determining the method adopted.

Although either or both of these two methods of linkage can be used to connect studios, transmitters, and program sources, we find a third system being employed for short-run local hookups. By using a system of line termination, it has been proved possible to transmit television signals over broadcast



Courtesy NBC

NBC MOBILE UNIT

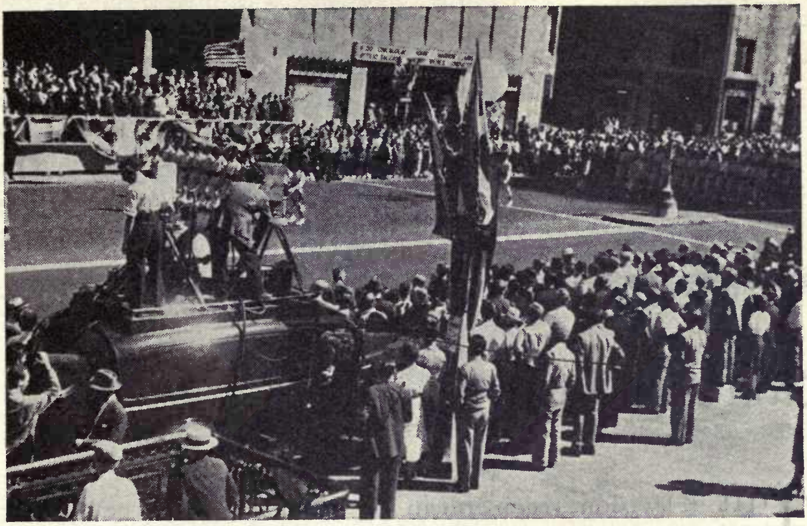
telephone wires for short distances within the immediate service area of the station. One of the best examples of such a usage of phone wires was demonstrated by NBC in co-operation with Bell Telephone Laboratories, Inc., when they picked up the Madison Square Garden pictures and fed them to Radio City over properly terminated telephone circuits. Apparently this method countenances some loss of signal even over the short runs, but it is sometimes easier to compensate for this depreciation in signal by amplification than it is to set up other facilities. Whether or not this line termination can be improved to the point where it can be substituted for radio or coaxial links remains a question to be answered in the light of further development.

The Mobile Unit

Somewhat similar to relay linkage is the function of the mobile units, which have been designed to cover programs originating in the field. Although it is conceivable that the larger cities may sometimes be wired with a web of coaxial lines feeding the centralized transmitter, today the practice in mobile-unit work is to use radio linkage.

The NBC trucks represent the "gold-plated" ultimate in this department, although at times their extreme bulk and superior equipment has been a serious handicap. The NBC mobile unit consists of two large trucks—one completely equipped with picture and sound-control apparatus, the second containing the radio transmitter as well as the power equipment necessary to relaying the program material back to the broadcast transmitter.

The trend in design of equipment of this classification has been, and will probably continue to be, toward light-weight, high-speed, and simplified units that will be able to complete the program link. Typical of this new departure would be the ton-and-a-half trucks used by WBKB in Chicago, W6XAO and W6XYZ in Los Angeles. In these smaller vehicles a great many of the facilities available in the large vans are missing, but nevertheless successful relay transmission work has been carried on with good results.



Courtesy WBKB

WBKB MOBILE TELEVISION EQUIPMENT PICKING UP SHRINERS' PARADE ON MICHIGAN AVENUE, CHICAGO

Courtesy Television Productions, Inc.

TELEVISION PRODUCTIONS, INC., MOBILE UNIT AT STUDIO GATE FOR PROGRAM "INTERVIEW OF THE STARS"

5

Television Receivers

THE television receiver can be divided into three fundamental sections—the radio-frequency circuits, the sound-production unit, and the picture tube. The radio-frequency section is similar in construction and general appearance to any well-designed, high-frequency radio and plays a similar part in converting the broadcast into intelligible audio and video material.

As in all other types of radio receivers, an antenna is used to collect the radio energy from the ether. This reception antenna is similar to the systems described in the chapter "Television Transmission," and is tuned or resonated to the particular band of frequencies used by the local television broadcasting stations. If this antenna is not resonated to a single wave length (a method by which the signal picked up from that particular station will be materially increased), it will probably be tuned to the middle frequency of a group of stations having closely associated frequencies. Irrespective of the characteristics and relative sensitivity, the function of the antenna is to collect the radio energy broadcast by a transmitter and through a coaxial cable, or its equivalent, deliver this energy to the receiver.

The television signal that the antenna collects from the air contains all the elements required for the reproduction of sight and sound. These components are the sound broadcast, the picture signal, and the synchronizing pulses, the latter being required for control purposes. The radio-frequency section of the receiver separates these various elements and directs them through a series of radio-tube circuits to their destination.

The amount of energy that an antenna will pick up from the ether is unbelievably small, so small, in fact, that it is

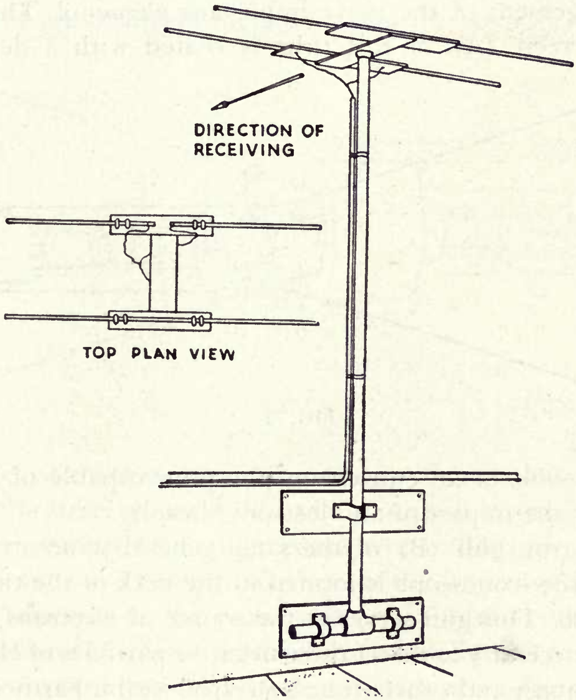


FIG. 1. DIPOLE RECEIVING ANTENNA WITH REFLECTOR

normally measured in millionths of a volt. Through the use of tuned radio circuits and successive stages of amplification, it is possible to build this original energy up to many thousand times its initial power and still retain, in this amplified version, all the minute characteristics of the original wave. During this process, the synchronizing pulses and the sound are isolated and sent through other circuits to the designated parts of the receiver. After the carrier wave has been removed and discarded, the remainder of the radio energy is called "the picture signal," and when sufficiently amplified is ready to be impressed on the grid of the picture tube.

The Cathode-Ray Tube

Probably the most interesting part of the television receiver is the video reproduction unit. Figure 2 shows a cross section of an electrostatic focusing type cathode-ray picture tube, with the arrangement of the more important elements. The inside face or screen (A) of this tube is coated with a deposit of

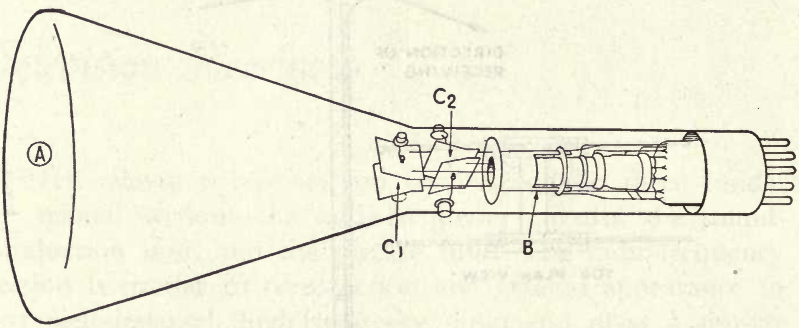


FIG. 2

willemite salts, or an equivalent phosphor capable of fluorescing under the impact of an electronic beam.

An electron gun (B) of the same general structure as that found in the iconoscope is located in the neck of the tube close to the base. This gun serves as the source of electrons and the elements necessary to direct these negative particles of electricity into a compact and concentrated electron beam. Farther up the neck of the tube will be found deflecting plates (C_1 and C_2). When properly energized by the synchronizing pulses, these deflecting plates are capable of controlling the movement of the electron beam back and forth across the inner surface of the screen.

There are two standard types of cathode-ray tubes used in the television receivers manufactured in this country, one using electrostatic force to deflect the beam, the other employing a magnetic system for the same purpose. Both systems are in use today, and the selection of the type used is a matter of choice on the part of the receiver manufacturer. In the electrostatic system, the two sets of plates described above and illustrated in Figure 2 are needed to guide and deflect the beam; in tubes of the magnetic type, no deflecting plates are used, the control being effected by a system of external coils (A) placed about the neck of the tube, as illustrated in Figure 3.

The cathode of the electron gun, when subjected to the heat of the filament, provides a rich source of electrons. By providing a range of progressively increasing positive voltages, impressed

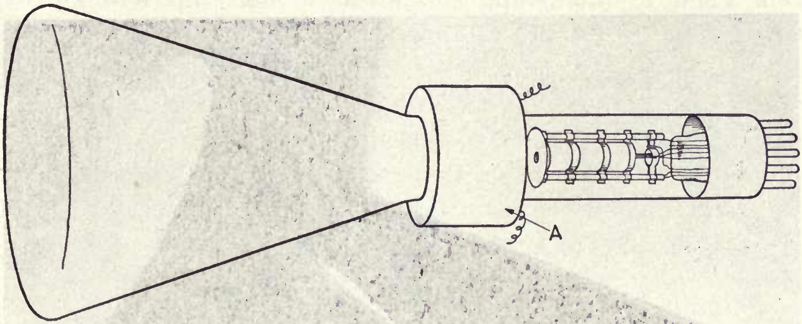
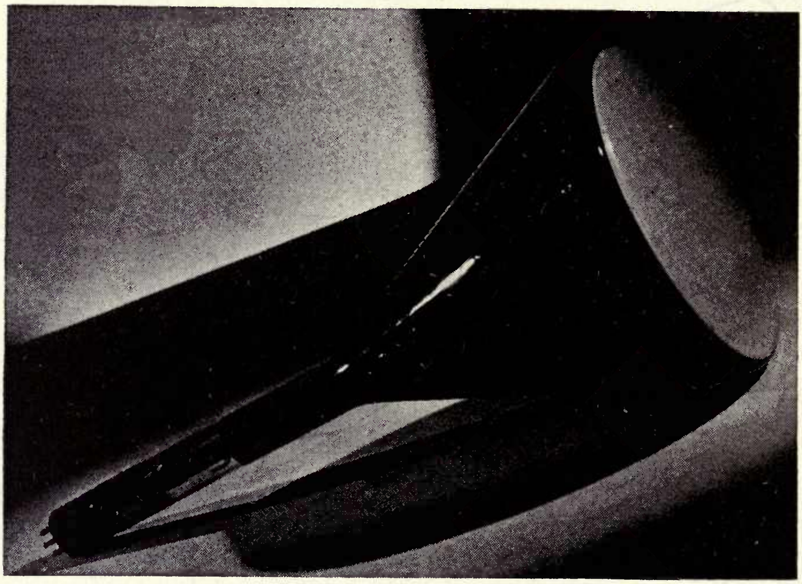


FIG. 3

on a series of anodes, a beam is formed which is directed up the neck of the tube, where it eventually impacts against the sensitized inner surface of the fluorescent screen. This impact causes the phosphors or chemical coating on the inner surface of the bulb to fluoresce at the point and at the instant it is struck. This produces the light with which we delineate the picture. As the beam rapidly sweeps back and forth across the inner face of the tube, this single spot, owing to our persistence of vision, becomes a line of light, and, by further moving the position of successive lines sequentially downward, it is possible to cover the screen with better than 500 individual lines. If the brightness of each individual spot that goes to make up these lines is considered to be a measure of the number of electrons contained in the impacting electron stream, it is evident that the brightness of this spot as it races back and forth could be varied by controlling the flow of electrons through the grid. Inasmuch as the television picture signal is made up of electrical pulsations originally created by variations of the light and dark areas registered by the camera, it is apparent that when this electrical equivalent of the light is used to control the opening and closing of the grid structure in the receiving tube, the lines created by this moving and variable intensity spot will reproduce these variations in lighting on the face of the tube. It is further evident that the sweep of the electron scanning beam that collects the picture energy in the camera must be accurately duplicated by the sweep of the electron beam that re-creates the



Courtesy RCA

RCA KINESCOPE

picture on the receiving tube. Such synchronization is assured by transmitting a series of electrical pulses as an integral part of the broadcast. Although these pulses are invisible and inaudible, they are capable of "triggering" the specially designed control circuits, which in turn activate the proper scanning coils about the neck of the tube. The use of the same pulses in the receiver as those that trigger similar circuits in the camera assures accurate duplication of the controlling forces acting on the electron beams in both camera and the picture tube. A separately operated adjustment on most receivers further controls the average brightness of the picture. This is obtained by restricting the overall flow of electrons through the gun structure in the picture tube by impressing a fixed voltage of the proper polarity on the grid. The average brightness now obtainable on the surface of such a tube is considered satisfactory for normal enjoyment and the successful reproduction of pictures. The present system of controlling the electron flow through an electronically actuated grid is sensitive enough to produce satisfactory half-tones and a reasonable equivalent of black and white. The human eye is capable of interpolating these variations to form a satisfactory picture, even though this reproductive system admittedly falls short of optical perfection. It will be apparent that any successful reproducer tube of the type described requires a fluorescent screen capable of glowing and then instantaneously extinguishing itself. Otherwise, the persistence in luminosity of the phosphors will seriously affect the reproduction of moving subject matter. The time that this process requires is a function of the chemical composition of the phosphors which have a reasonably fast "decay" of brilliance after fluorescence. Even with these relatively perfect salts, an object moving rapidly across the face of the picture tube will sometimes develop a comet tail of light, indicating that the energized picture elements have retained brilliance after the exciting force had moved on.

Under average conditions, this type of tube can be considered to have about 1,000 hours of useful life. Continuous impact of the electrons will eventually reduce the efficiency of the chemical salts on the screen, and the elements of the tube will wear out. Even then the cost of television entertainment made possible with this type of electronic receiver tube is but a matter of a few cents for every hour of enjoyment—a figure that will compare favorably with the price of any other bi-sensual entertainment medium.

Cathode-ray tubes for television are made in sizes ranging from the three-inch model used for control instruments in the laboratories to the twenty-inch picture globe produced by DuMont, which is capable of producing an image that measures 11×15 inches. The most popular size is the twelve-inch tube, which resolves an 8×10-inch picture.

Cathode-ray tubes are produced commercially with screens that fluoresce in various colors, depending on the chemical composition of the phosphors used in the fluorescent screen. For laboratory measurement work, where high brightness and extreme detail is required, the brilliant willemite green is

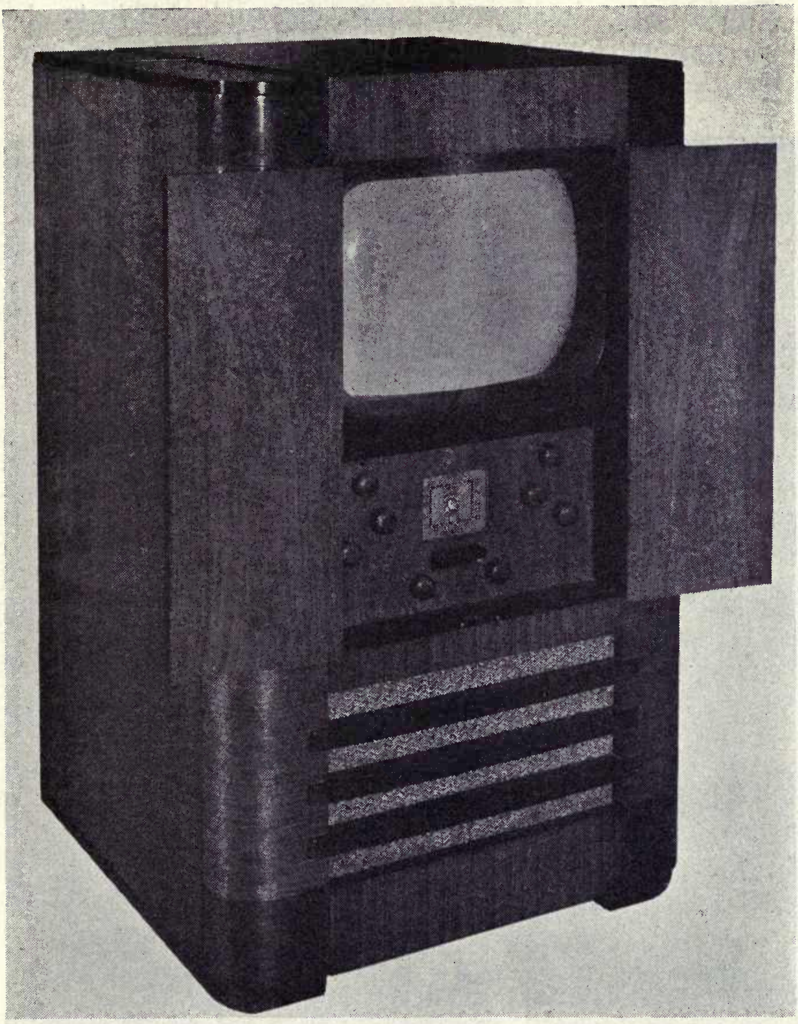
Courtesy DuMont

TELETRONS USED IN DUMONT RECEIVERS

used. Most home receivers use the black-and-white version of this basic salt. Even these so-called black-and-white pictures will generally have a light blue to a pinkish-brown tint, depending on the salts used in manufacture, but here again the eye is not too exacting, and willingly interprets the tones in black and white.

The Television Screen

As previously mentioned, the face end of the cathode-ray tube is called the screen, on the inner surface of which the television

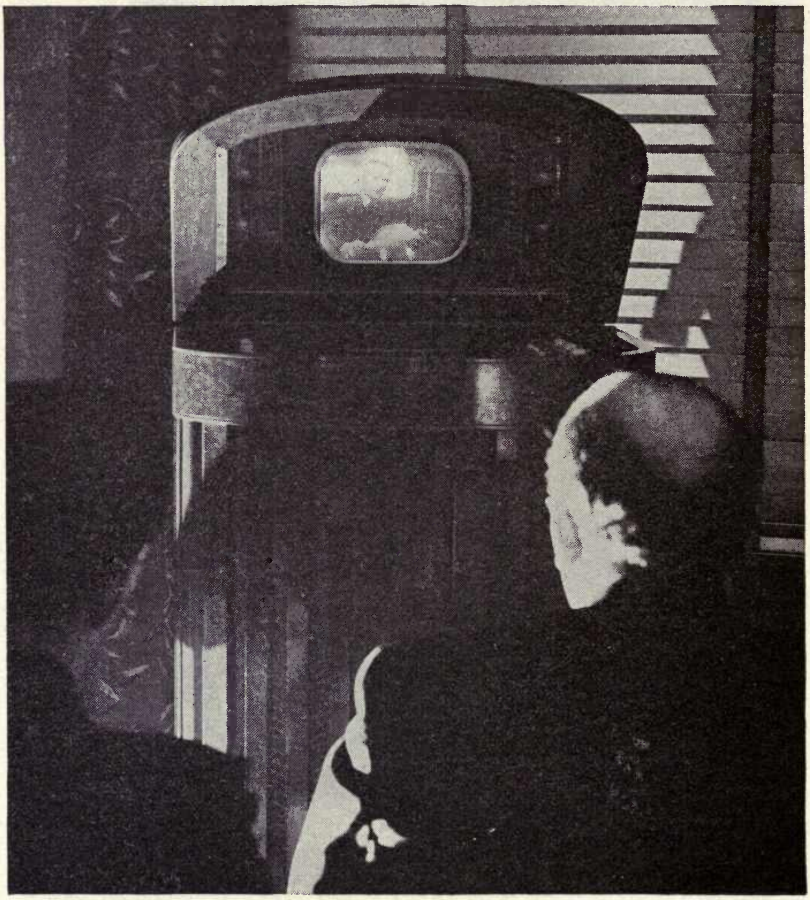


Courtesy DuMont

DUMONT DIRECT-VIEWING RECEIVER, 20-INCH TUBE

picture appears. On the direct-view type of receiver, the picture is viewed directly from the face of the tube, while in the reflecting-type receiver the image is traced on the end of the tube in reverse and then reflected in a mirror, where it is viewed from the raised lid of the receiver. Except for appearance, there is little difference between the efficiency of the two types.

The image produced on the screen of a standard 12-inch tube measures approximately 8 $\times$ 10 inches, which, when seen from a distance of 6 to 8 feet, is optically equivalent in size to a



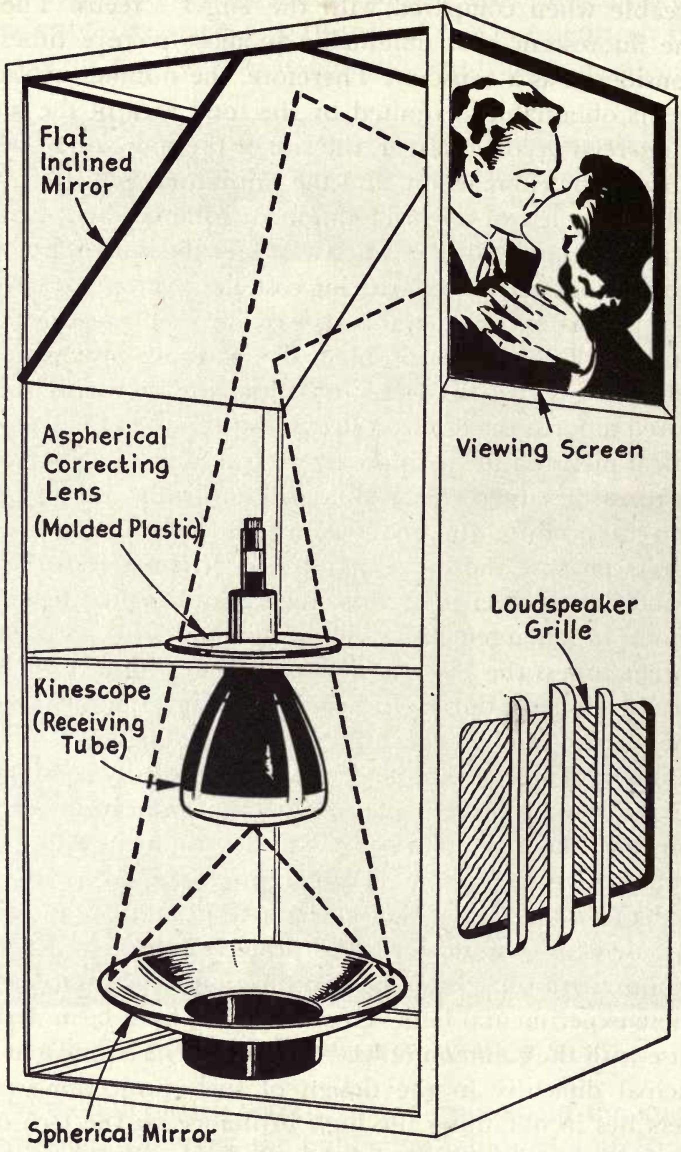
Courtesy Zenith

ZENITH REFLECTING RECEIVER, 12-INCH TUBE

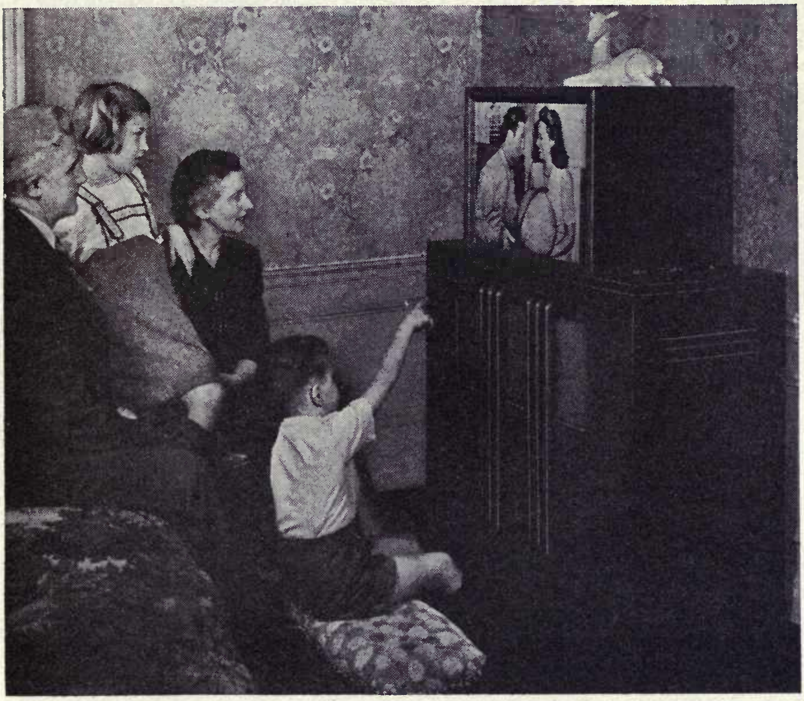
standard motion-picture screen viewed from about the middle of the theater. However, the public has indicated a preference for equipment capable of producing larger pictures for home use.

In the extremely small tubes, those which are three and five inches in size, a marked infidelity of picture reproduction is noticeable when compared with the larger screens. The size of the fluorescent spot obtainable in most picture tubes can be considered as a constant. Therefore, the number of picture elements obtainable is limited by the total area of the screen. As the screen becomes larger, the size of the spot will appear to get smaller by comparison, and the minimum spot size obtainable becomes less of a consideration. It follows, then, that better picture detail is possible when a larger tube is used. Engineering limitations and manufacturing cost, however, place an upper limit on the sizes in which this type of vacuum tube can be successfully produced. The problem of obtaining proper evacuation of the gases in the larger tube and the increased voltages required to focus the electron stream have limited the size of the practical picture tube to approximately a fifteen-inch screen.

Pictures of larger screen area will probably use an optical system to produce the required magnification. Some manufacturers propose the introduction of a lens between the tube face and the observer to increase the size of the picture. In such methods of enlargement, some distortion will normally be apparent unless the picture is viewed from a line through the center of the lens, but even then slight aberration at the edges of the picture can be expected. A properly designed lens plus a high-intensity screen can, however, be successfully combined to make possible a projected picture with a magnification of several diameters. The principles behind such equipment are not new or complex. A television picture reproduced on a tube with considerably higher brilliance characteristics than those generally used for optical viewing is projected through a lens system onto a translucent or back projection screen. Other types of these experimental large-screen receivers have been designed for use with the common reflective screen or its equivalent. The principal difficulty in the design of such projection-type receivers lies in obtaining the high brilliance on the face of the reproduction tube required for optical magnification. As the brightness of the fluorescent screen is increased by stepping up the impact velocities of the electrons, it will be seen that limits of efficiency will eventually be reached. Beyond this limit, the rapid destruction of surface material will seriously curtail the



LARGE-SCREEN TELEVISION FOR THE HOME, DEVELOPED BY THE RCA LABORATORIES. Broken lines indicate the path of light beams from a single picture element on the face of the cathode-ray receiving tube to a corresponding point on the screen. A plastic lens is used to bring these light beams to a sharp focus on the screen life of the tube. Furthermore, it will be remembered that the acceleration of the electrons in the scanning beam is accomplished by subjecting the electrons to successively higher voltages. Here too we have a limitation in voltage, dictated by equip-



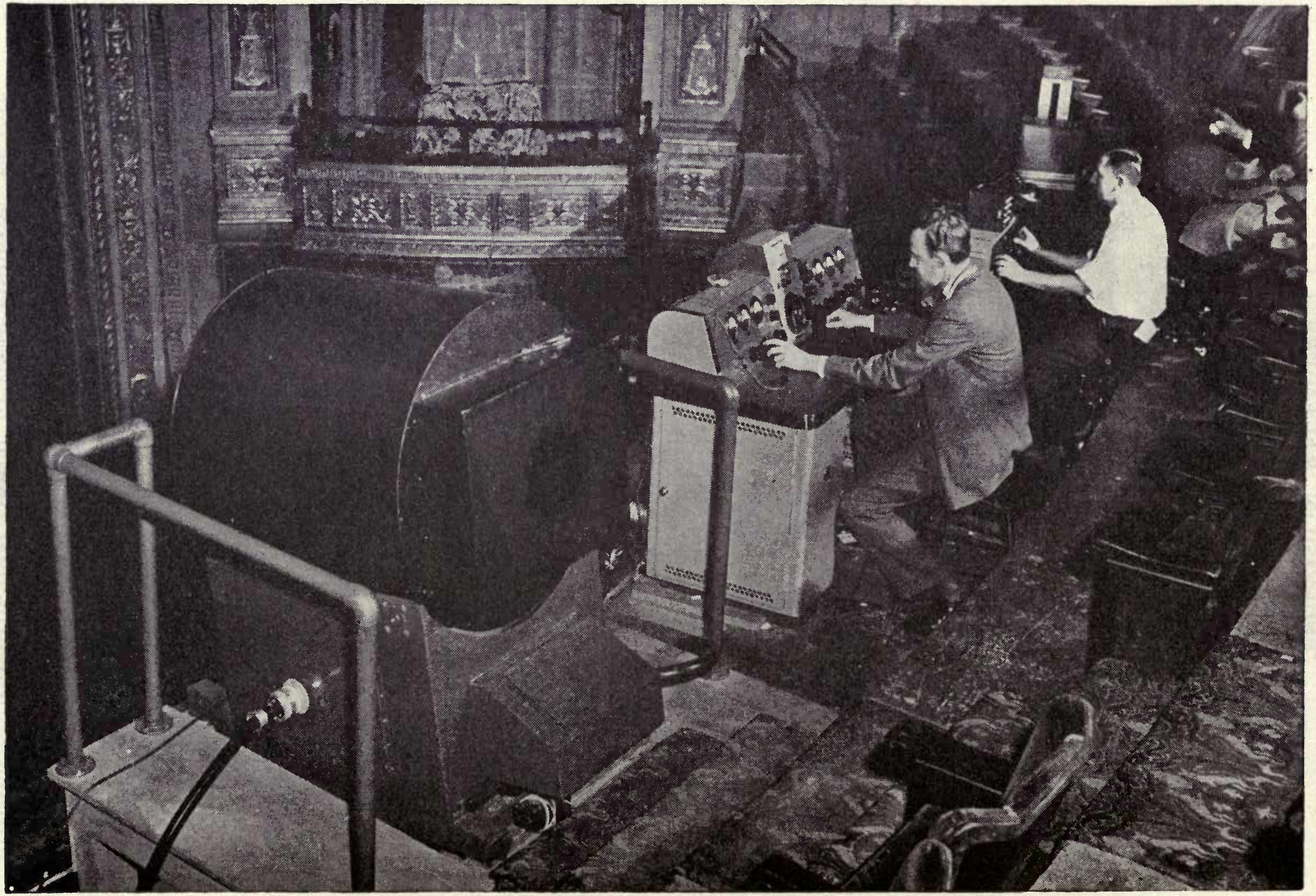
Courtesy RCA

EDDY IMPROVED LARGE-SCREEN RCA TELEVISION HOME RECEIVER

ment design and the stipulation of reasonable safety factors in producing a receiver for home use. Despite these ever-present limitations, the projection receiver of tomorrow has passed its preliminary tests and will, in all probability, supplant the picture tube of today. The use of optical projection methods enables us to produce picture sizes of 18×24 inches, with sufficient brilliance to satisfy even the most critical observer.

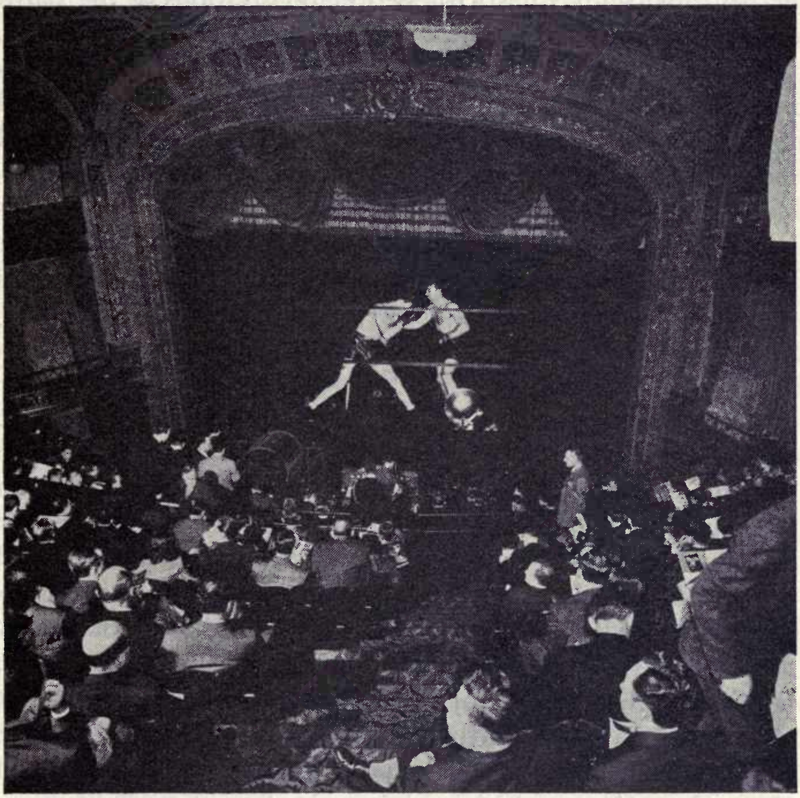
Theater Projection Receivers

Projection receivers of the larger or theater size are today utilizing optical principles similar to those employed in pro-



Courtesy NBC

LARGE-SCREEN TELEVISION EQUIPMENT AS INSTALLED IN THE NEW YORKER THEATER jection-type receivers for the home. The basic components of such equipment consist of the radio-frequency receiver, capable of stripping the picture energy from the carrier, a high-intensity picture tube of reduced cross section, and the necessary lens



Courtesy NBC

THEATER–SIZE TELEVISION, NEW YORKER THEATER, NEW YORK

and parabolic mirrors needed to project the picture on the screen. By using extremely high voltages in accelerating the electron stream of the picture tube, light intensities have been obtained on the theater screen that satisfy the minimum requirements for comfortable observation. Satisfactory demonstrations of these large-screen pictures have already been presented to the public. These pictures vary from 8 × 10 feet to 15 × 20 feet and may have a length of throw between projector and screen exceeding sixty feet.

Several types of these projection systems have been successfully demonstrated in this country and have been received with reasonable enthusiasm on the part of the public. In addition to the RCA theater projection system, which uses a parabolic reflector, this country has witnessed demonstrations of the Baird system in which projection is accomplished through lenses. The English-born Scophony system, which utilizes a semi-mechanical light-valve type of projection, has also been used in this country. While public demonstrations of the mechanical method (Scophony) has not been as well received as the all-electronic methods, this system has already found favor in England. A complete description of such equipment would be far too detailed and complex for this type of review and for this reason only the basic principles will be outlined.

The Scophony System

This projection system is based on the mechanical electronic equipment covered by the Scophony patents. It is designed to use a fixed external light source of high intensity, rather than the relatively low-level brilliance obtained from a fluorescent surface. The radio signal from the transmitter is received and translated in equipment similar to that common in other types of receivers, but the isolated picture signal in the Scophony method controls the operation of a super-sonic light valve, rather than the grid of a picture tube. By a clever arrangement of optical units, this vibrating light valve admits varying amounts of the external high-intensity light to a double system of rotating mirrors which project and reflect these light variations on the viewing screen. Use of a separate light source and the ability to modulate the amount of light admitted to the mirror wheels overcomes the principal objection found in the low intensities obtained by the electronic picture tube method. On the other hand, any mechanical operation has the disadvantage of friction and mass, which do not exist in the all-electronic systems.

Intermediate Film

Work is now under way to perfect a system that will be a happy medium between newsreels and straight television. The television broadcast as received over the air is photographed by a motion-picture camera, especially adapted to this purpose. To circumvent the problem of printing a positive film from this negative, the television receiver is adjusted to produce a negative picture on the face of the tube. When this negative picture is registered on the positive film of the camera, the result will, of course, be a positive print. This film is then fed directly from the camera magazine into a continuous high-speed development tank, where it is processed and dried in a matter of minutes. Then, as a film record of the picture that has previously been reproduced on the receiver, it is fed directly to the projection booth of the theater, or in some instances to a cutting room for review and editing. Although not original in this country, the intermediate film process may have good possibilities in our big-screen market. The advantages of this process are that the brightness levels and contrast of the projected picture can be controlled in both the photography and development. The resulting film can then be projected in the theaters at normal light levels.

The Color Receiver

Our final consideration is that of the color receiver. The advantages of full color will, no doubt, bring about increasing interest in this field. To date, only experimental models of these semi-mechanical reproducers have been shown.

All the color receivers that have been shown to the public are based on the rotating color disc system—a process that again is more fully described in other chapters of this book. This color disc, made up of a series of alternate red, blue, and green pie-shaped segments of transparent material, is rotated at high speed before the face of the receiver tube. This rotation is so synchronized by means of transmitted pulses that it will conform in speed and radial position to a similarly colored wheel which rotates before the camera in the studio. The filter action of these three primary colors will screen out and reproduce these pictures in the three primary colors of red, blue, and green. By viewing a rapidly repeating series of these monochromatic versions of the full-color scenes before the camera, the eye receives the optical resultant in natural color reproduction. The wheel that brings the color screens into successive position must have a diameter that is several times greater than the actual picture produced, which results in apparatus that has a tendency to become rather bulky. Dr. Peter Goldmark, in his development of this type of receiver, uses a filter section that reduces this required diameter to a mathematical minimum. Even so, the result has tended toward a reduction in size of the picture, and has generally dictated the use of a magnifying lens system to magnify the image size for direct viewing. Although such a method of magnification produces some optical aberration, the result, although not perfect, is good. The television industry is for the greater part not in favor of any mechanical reproduction system although practically no trouble with the mechanized section of these color receivers has been experienced to date. Most observers in the fields of color predict the eventual introduction of an all-electronic system that will supersede the experimental equipment of today. Positive data on the experiments in this field are not available for public release, although it is rumored that definite findings already imply an early solution to the color problem.

Conclusion

We can expect that the developments in electronic tubes and circuits, brought about by wartime exigencies and developed by the armed forces, will be directly applicable to new and improved receiver design. Such developments will not only improve the quality of reproduction and add to the life of the component parts, but they should materially reduce the cost of the set.

6

The Control Room

THE control room is the nerve center of the entire television broadcasting system. Here the raw materials that go to make up a program are assembled and welded into a form that can be sent on to the transmitter and from there broadcast into the homes.

Control-room equipment and location, like the studio spaces they monitor, vary so widely in facilities and placement that it is impossible to select any individual installation as a standard for descriptive purposes.

Most of these control centers have, however, developed around basic requirements that are common to all, with each operation attacking the problem in a manner dictated by local conditions. For this reason, it will be best that we choose for description a non-existent, yet average installation, which will be typical of those found in most television stations.

Control-Room Location

The control room itself is normally placed in an elevated location overlooking the studio space that it will operate. Although ample interphone communications could conceivably be installed between the studio and any other available remote space, there is no control mechanism that will supplant or equal the advantages of direct visual observation. Because stage settings will many times block the operator's view from a floor-level control window, it is considered necessary that the location of this space be chosen well above the top of the stage settings and opposite the end of the studio which is normally considered up stage. In a rectangular studio, the control space would preferably be on the narrow end, close to the ceiling. Whatever the facilities that must be modified or sacrificed to gain this objective of height and unrestricted view of the set, the operational advantages thus gained will eventually pay for the change.

There are two important reasons for establishing the control

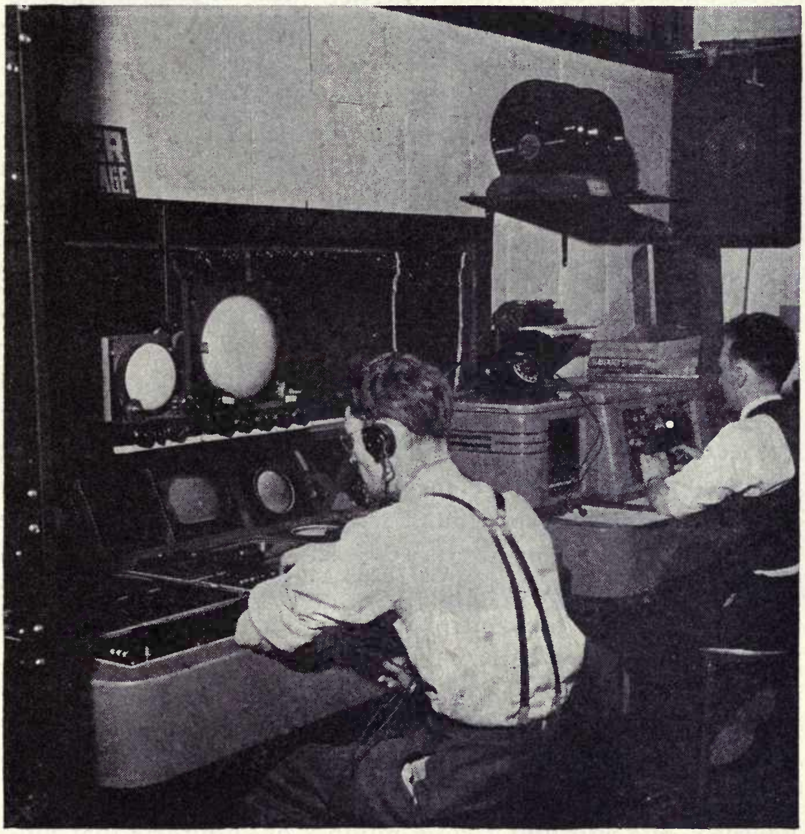
Courtesy G. E.

CONTROL DESK AT WRGB, SCHENECTADY

room on the down stage end of the studio. First, this is the area that will normally be used for operation of the cameras in registering the show. The length of cable required between camera and control room is thus appreciably shorter than that attainable in any other arrangement. Secondly, the operational crew in the control room will be able to view the major part of the show from the correct perspective (over the heads of the camera crew), and can visualize the control problem more clearly. Thirdly, the lighting system will generally be directed away from rather than toward the control-room windows, thus reducing the glare sometimes found to be highly objectionable.

Size of the Control Room

In setting aside floor area for control-room use, it is impossible to predict the eventual requirements that will be necessitated by reason of special production or expanded



Courtesy Zenith

ZENITH CONTROL ROOM AT W9XZV, CHICAGO

operations. For that reason many of the spaces now being used will have to be remodelled to accommodate the personnel and equipment required for full commercial operation. Foresight should indicate the normal expansion that might be expected, and sufficient space should be set aside for twice that amount. Only by overestimating the eventual needs can sufficient area be made available for any but the most fundamental operations. Independent of size, a control room apparently never has sufficient space to house all the equipment racks, turntables, consoles, engineers, directors, and producers that must be located there.

All operators concerned with the video and audio pickup equipment should be positioned so that each one will have an unrestricted view of the set. These technicians should also, by reason of their closely related functions, be placed close together for full efficiency. For this reason, a "side by side" setup, where the operating and directing personnel are each given a section before a long control window extending across the width of the studio, is not too practical. Possibly the most reasonable plan to date is the tiered arrangement wherein the shading and monitoring positions, as well as the audio panel, have been located directly before the window with the switching, supervision, and direction situated at a console above and in back of this primary control group. Such an arrangement gives everyone good observation facilities, the engineers having an excellent view of the floor and equipment, while the supervising and directing personnel see not only the floor but the control-room equipment as well. The proximity of station possible under this plan allows all direction and reports to be given by voice in the control room rather than by "intercom" telephone.

Equipment

The equipment to be found in a control room will vary widely with the needs of various stations. In all installations, however, one will find a large number of amplifiers that must be kept handy to the engineers. These amplifiers will normally be mounted in a bank of floor-to-ceiling racks and may or may not be accessible from the front or panel side. Operational practice dictates that such equipment should be located where ample space behind the racks can be made available for the engineering personnel to work safely. Such a space or subdivision of the control room is normally kept locked because the exposed high-voltage circuits on the racks constitute a definite menace to safety. Because television is constantly called upon to install new and supposedly better equipment, it is considered good practice to design the rack layout with ample spare panel space for mounting these experimental units. It is

Courtesy Philco

CONTROL ROOM AT STATION WPTZ, PHILADELPHIA

seldom that the engineering group finds fault with such a surplus or can find a sufficiency of rack space for normal operations.

Equipment racks can be placed in any part of the control room, but will normally be found on one side of the control console, close to the video engineer.

Video Control

The control desk is by far the most important single unit, both as to function and placement, and therefore this console above all others should be placed in an optimum position for viewing the studio. The engineer who operates this equipment not only has the control of contrast, level, and camera adjustments at his finger tips but the all-important "shading panel" as well. By proper manipulation of these knobs and switches, deficiencies in the picture produced by each camera can be corrected before being sent to the monitors and to the transmitter.

Although many of these adjustments will be made from the data registered on the oscillographs installed to interpret the electronic signals from and to the camera, it is often possible to predict required changes from watching the action in the studio. Visualization of camera placement, lighting, as well as action on the set, will generally be necessary to a completely satisfactory control operation.

One engineer can normally operate two banks of shading controls, although in emergencies it is possible that he could handle three units. If the studio accommodations are such that more than three cameras could eventually be used on the floor, the original design of the control room should provide for at least two video control positions.

Audio Control

The sound or audio control is an assignment that also requires unrestricted vision of the set, and this man will logically be found alongside the aforementioned video-control man. He is charged with the monitoring of levels and placement of the many microphones that are used in a television play, but in addition he will also have under his cognizance and control the turntables used to insert musical backgrounds and sound effects into the program. Through the use of "micrometer drops," which allow remote control of these turntables, this latter function may sometimes be moved to less crowded quarters, but in most control rooms one or more pieces of this type of equipment will normally be found at the audio-control position, operated by the audio engineer.

The audio levels will be monitored in three ways, with high-fidelity speakers, earphones, and VU meters which measure the intensity of the monitored sound. The high-fidelity speaker above the console is more for the benefit of the entire control group than for the control engineer, who will normally prefer to wear a headset to gauge sound quality. The actual audio level, however, is set and controlled by reference to a VU meter mounted in the console itself. The audio console for television is a counterpart of that used in sound broadcasting and will of necessity occupy equivalent space. As in the case of the video console, where the studio is capable of expansions well above the size of its immediate operation, the designer should allot sufficient room for a duplicate unit, to insure that the original arrangement will prove practical in the future.

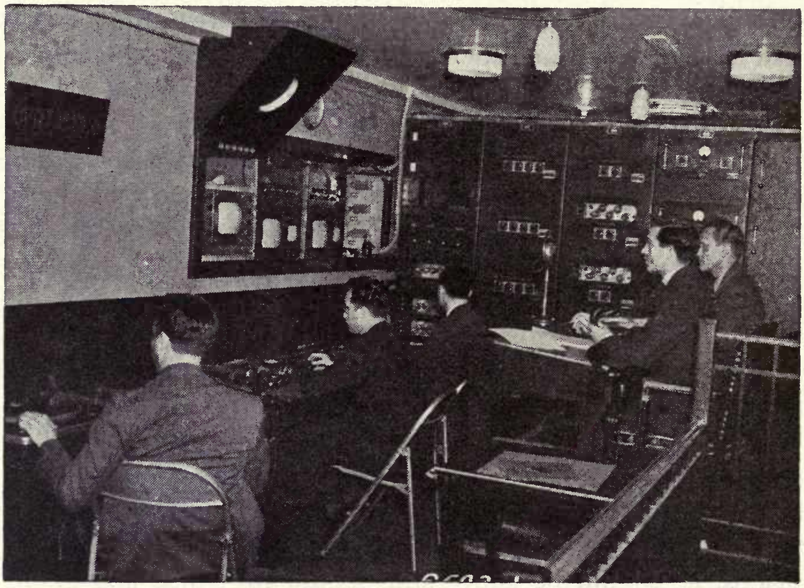
Master Control

The two master or supervisory positions will not be subject to any such duplication in the event of expansion and therefore the space originally selected should prove sufficient for the future. In order that the men occupying these two key assignments can do a satisfactory job, the facilities at their hand should be not only complete but conveniently placed as well.

The supervising or switching engineer is the senior position in the engineering phase of the program, for he is the one who interprets the technicalities of the non-technical orders of the director. Normally he will have before him the camera-selection switches and the fader controls, through which he will accomplish wipes and dissolves between cameras. Properly placed, he should be above and behind the video and audio positions where he can oversee the switching setup being used on the consoles as well as the panorama on the studio floor below. For efficiency, his desk should be at the elbow of the director, thereby permitting the maximum intercommunication of ideas and orders during the broadcast.

The director's console is normally devoid of any engineering equipment other than the studio microphone and, like that used by the supervisor, should be above and behind the desks of the operators at the window. The director, above all people, must have good visibility of the studio floor if he is properly to predict the camera shots required by the story. When the inevitable breakdown of equipment happens, the planned sequence of camera movements must be changed, requiring that the director coach every camera move as well as continue to select the pictures best suited to compose the sequence. In order that the necessary conversations between this man and the video supervisor can be carried on without disconcerting the others in the room, the director should be as close as possible to his colleague at the switching console.

Many studios, in an attempt to reduce the manpower re-



Courtesy NBC

CONTROL ROOM AT WNBT, NEW YORK

quired to operate a control room, have experimented with combining the functions of these two last-mentioned assignments by providing the director with the switching, fading, and dissolving controls he would normally require in "cutting" a program. Although WBKB at one time had this plan under consideration, it was evident that such a combination of responsibilities and equipment could produce nothing in the way of an improvement and might easily result in complete chaos.

In any but the most primary productions, the director will have to make constant reference to the shooting script as well as to the three to five monitors which indicate the various electronic versions of the scene before the several cameras in the studio. Charged with this dual and exacting chore, the director has little time to manipulate a complex control desk if he hopes properly to direct the action of both studio and control room.

Intercommunication Facilities

The extent that interphone communication should be carried in a television station has long been a controversial subject. Some operators believe that it is both necessary and advisable to have voice communication with every member of the studio crew, while others prefer a distinct limitation of the phone circuits used for such purposes. In that this maze of phone connections will generally terminate in the control room, it becomes a service that must be considered in the basic design of the facility.

It is the general impression that a happy medium between these two extremes will be both practicable and obtainable. Such a system can best be evolved around two separated circuits —one for engineering and one for production. The engineering circuit should have communication with, but not from, each of the cameras and two-way service with the lighting engineer, synchronizing generator room, and the transmitter. The ideal arrangement would filter out of the camera phones all incoming information that did not normally concern their operation. This circuit should originate at the supervising engineer's position with a "break in" switch from the video control console. The sound operator may or may not be in on this line, but he should at least have access to the main supervisory circuit between control and transmitter.

In many cases, the audio group will find it expedient to use a separate circuit entirely, relying on voice communication in the control room to give and receive orders over the main circuit.

The director should have a line isolated from any engineering control information but capable of communicating with all production terminals. The stage manager is normally assigned a two-way circuit as are most of the other positions in this department. It is highly necessary that the director be free both to give and receive information relative to the conduct of the play, in order that he may make the immediate changes that will be required to insure a smooth performance. The production staff does not have communication with the cameras directly—a rule that is designed to prevent conflicting orders being given by the two control chiefs. All orders affecting the movement of engineering equipment are relayed over the engineering line by the supervisor. A "push to talk" telephone with a chest-mounted microphone is considered the most practical two-way unit, while the single or double headset satisfactorily handles the one-way circuits. Where it is necessary, as it often is, for the operator to hear not only the message over the intercom but the general-studio or control-room conversation as well, a single earphone is indicated. Where the position requires that the information on two separated lines be received, a split headset is required.

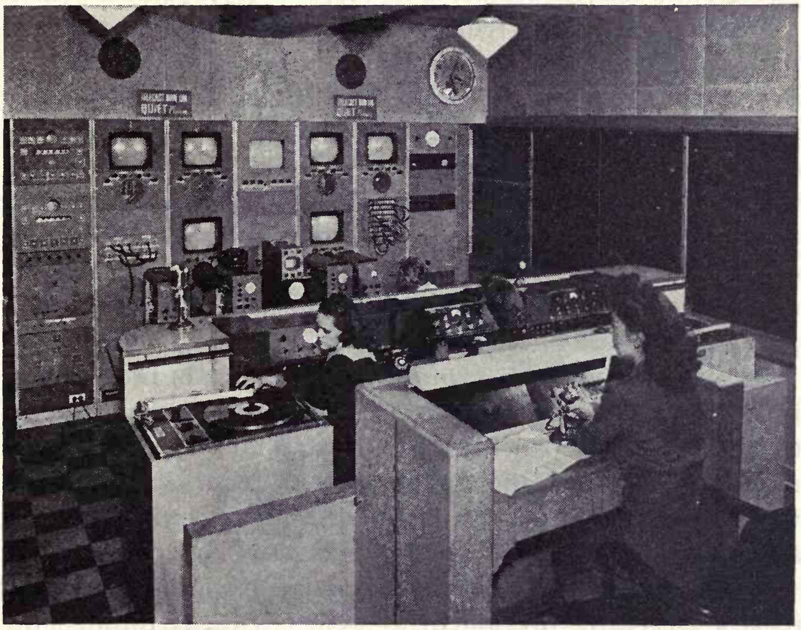
In many cases it is possible to use signal lights to advantage in cutting down the complexity of the communication system considered necessary. A single two-way phone available on the studio floor and using signal lights as a call can generally be used to take the place of many phone units and paralleled lines.

Monitoring Facilities

In order that the personnel in the control room can follow both the picture and sound that comprise the broadcast, a monitor speaker as well as a picture monitor of each camera are located on the wall above the control-room window. This position is chosen to allow quick comparison of the available electronic picture with the actual scene itself. It is common practice to use a separate monitor or picture tube for each camera in operation, and in addition to provide a larger or different color tube to indicate the picture that is selected for transmission. This master monitor may or may not have a series of black center lines embossed on the surface of the tube. Some operators feel that these indicating lines permit a more perfect camera alignment, while others prefer a visual and less critical method of "lining up" the shot.

Control-Room Illumination

Because of the need for constant reference to both the highly lighted studio and the low-intensity screens of the monitors, the level of the control-room illumination should be as low as possible. The observation window facing the studio must,



Courtesy WBKB

CONTROL ROOM AT WBKB, CHICAGO

therefore, be treated with some type of light filter to reduce the glare that would normally emanate from the staging area. Many systems have been tried with varying success, ranging from sheet plastic overlays to polaroid. One of the most satisfactory methods is that used at WBKB, where the windows are composed of two different types of colored glass, forming a practical one-way window in addition to reducing the light from the studio floor.

Air conditioning is considered a necessity in the control space as well as in the studio. The generated heat of the many amplifiers, as well as the radiated heat from the studio, will quickly decrease the efficiency of the staff if relief is not provided by forced ventilation and cooling.

One of the biggest problems that eventually faces the broadcaster, once he has designed, constructed, and staffed a control room, is, "Who shall be admitted to this sanctum?" Apparently the functioning of the control room carries an imaginative background that is considered a "must" by every studio visitor.

If every person who requested admission were to be allowed in this space, it would require an amphitheater to hold them all and would deplete the audience to a few ushers. Non-working personnel, independent of whether they be sponsors, vice presidents, or just interested passers-by, should not be allowed in the control room. Failure to insist on a definite restrictive policy in this regard is to ask for continued trouble. Independent of how important, how well mannered, or how interested these visitors may be, they distract the personnel engaged in putting the show on the air.

Because the general demand to see this phase of broadcasting is so insistent, it has many times been suggested that an additional observation panel be installed to allow visitors to watch the proceedings from outside the control room. Such a system was tried successfully in the Farnsworth studios in Philadelphia and should be relatively easy to arrange in new construction.

When we consider that the success of the program, which reflects the entire investment as well, is cleared through the control center, it is only reasonable that this space should be complete in every detail. Ample room, plenty of equipment, and logically placed positions can do much to fortify the broadcasters' investment when the plans of the control room are laid down.

7

Television Lighting

TELEVISION lighting has always been a controversial subject. It is a subject that can be argued by either director or engineer, for its problems lie in both the engineering and the dramatic fields.

Basically, light in television fulfills two functions. First, in illuminating the stage it provides the light energy necessary for the creation of an electronic picture; secondly, it reinforces this illumination by adding high light and shadow to increase the dramatic interest of the picture.

Before we consider the subject of television lighting, it might be well to review and compare the methods and equipment used by the legitimate theater and motion-picture studios. It is from these sources that television has borrowed some of its present-day technique.

In the theater the primary function of light is to illuminate the stage, and, since the people in the audience are not faced with the necessity of viewing the play through the limitations of an optical conversion system such as television, they are able to interpret the action with complete satisfaction if the illumination provided is sufficiently high to create a threshold of visibility.

The normal lighting equipment of the theater to accomplish these results generally consists of a series of small portable flood units reinforced by the spotlights necessary to the successful presentation of the play. The over-all illumination level required will generally run in the neighborhood of ten to thirty foot candles and may be in color. Unlike television, where light can be considered colorless, the stage has recognized and used this psychological effect of color on its audience and today employs this characteristic to the utmost.

A detailed study of the lighting technique and equipment of the theater would be most instructive in evaluating the use of light in television. Space, however, does not permit more than a cursory consideration of the equipment and practices that have been readapted from the theater for the television stage.

Television has found equivalent use for several of the lighting units commonly found on the stage, although the major part of this equipment was too specifically designed for the theater to make it practical on a television set. In addition, television required that light be considered in thousands of foot candles, where the stage requires a mere fraction of this amount.

The focusing spotlight is, in all probability, the most popular stage unit to be found in the television studio, although in effect work the high-intensity arc has been utilized with some success. Television requires that incandescent lights be lamped with considerable higher-wattage bulbs than would normally be required in theater work. Because of these requirements of high lighting levels, little use has been made of diffusing screens, gelatins, or other similar equipment so successfully employed in the theater.

The stage, in addition to being the source of some of the lighting equipment now used in television, has developed many of the techniques used in handling this and similar apparatus. For that reason we may expect to find a close similarity between the electronic art, the legitimate stage, and the motion-picture studio. It is not surprising, then, to find that in any application of light the engineer uses what may be termed a basic arrangement of equipment. The foundation, or key lighting, is created by a combination of sources that are designed to flood the acting area with shadowless illumination. On the stage, the overhead batten lights flood the set with diffused illumination, while from the wings vertical strips reinforce this general lighting. Cyclorama lighting, closely equivalent to television's method of fixed back-lighting, is accomplished from both a lighting trench and overhead border units. Inasmuch as most of the foundation light normally comes from above the stage, abnormal shadows on both the set and the actors are bound to be created. To counteract this effect, the footlights crossing the downstage apron are used to wash out these shadows and produce the required shadowless foundation on which the desired lighting effects can be built.

In the theater, spots from the wings, balcony, and in some cases from suspended battens are used to high light and delineate the action on the set. This specific light may or may not be controllable, depending on its usage, but general practice has specified that spotlighting from in front of the stage must be manned.

With the exception of the high-intensity arc spotlights, mounted in the balcony booths, stage lighting is generally obtained from incandescent sources. Heavy-duty dimmers, installed in each circuit and capable of reducing the power fed to each lamp, provide for adjustment of lighting levels from the backstage control board.

Faced with the necessity of creating a much higher level of illumination than was used on the stage, the motion-picture studios employed the focusing spots, kliegs, and "suns" for foundation lighting and the high-intensity arcs for modelling. This increase of levels was brought about by the low sensitivity of the film then available and in part by the increased height and depth of the acting area that had to be illuminated. The early movies did a large part of their shooting on outdoor sets, where the sun alone was the source of both foundation and specific light. This variable source, as evidenced by the uninteresting flatness of the early films, was unsatisfactory in addition to being uncontrollable. The camera crews were, therefore, forced to develop equipment and techniques that would make photography possible on indoor stages where light could be manually controlled. Today the producer uses location shots only under conditions approximating those of the studio, and generally requires, in addition to good sunlight, a battery of spots, reflectors, and diffusing screens to insure a satisfactory registry of high light and shadows.

When television came into being and the problem of using high-level illumination was again presented, it was natural to look to Hollywood for the answer. However, here, in addition to a wealth of equipment and established technique, was found a definite divergence in the two media. For instance, on a movie set it is possible to arrange lighting for a shooting sequence that will satisfy both the producer and the cameraman. This sequence may be of a minute's duration or longer, but as soon as the action progresses beyond the area that has been lighted, or the camera angles or position change, the action is stopped and the lighting rearranged. All these separate sequences, when spliced together in the cutting room, give a series of perfectly lighted "paragraphs." This can happen only in the movies, however, because in a television sequence, when the camera lights wink "on the air," the show continues for a complete act with no chance for the producer or cameraman to change the lighting until the final curtain.

In filming a motion picture, several cameras are generally used to photograph a single sequence. Only one of these shots will eventually find its way into the final version of the picture. On a television set, several cameras are also used to cover each scene, and, like motion pictures, only the shot best suited to portray a specific part of the story is selected to go on the air. But here again our similarity in situations parts company. On a movie set, the camera movement is closely integrated with the lighting; shooting stops when any or all the cameras outrun the specified lighting setup. The lighting is set and checked for each camera angle to insure maximum effects. In television, however, cameras must continue shooting from all angles and under all lighting conditions until the sequence is completed.

These two considerations both specified that a new lighting technique be developed for television stages, even though the level of illumination and equipment required in both media were in most respects similar.

In order to discuss the subject of television lighting properly, it is necessary to subdivide illumination on the set into two separate classifications—foundation lighting and specific lighting.

A stage properly illuminated with foundation lighting is theoretically shadowless. The backdrop on the set has the same intensity as do the objects downstage. The shadows that are normal to the eye are missing. No actor, none of the scenery or props stand out on this shadowless expanse of acting area. Shadows, normal in nature, from which we derive our sense of perspective and dimension, are missing or subdued. The entire set becomes an uninteresting box of light in which actors, scenery, and story move without dimension or substance. Since foundation lighting alone is insufficient to the creation of a satisfactory picture, optical or electronic, it is necessary that we reinforce this shadowless base with a type of light that will create interest and dimension. This light is best described as dynamic or specific light and normally includes light and shadow to create dramatic interest and destroy monotonous flatness.

Into these two brackets we can classify all types of theatrical illumination. Both are essential to the production of satisfactory lighting in any medium.

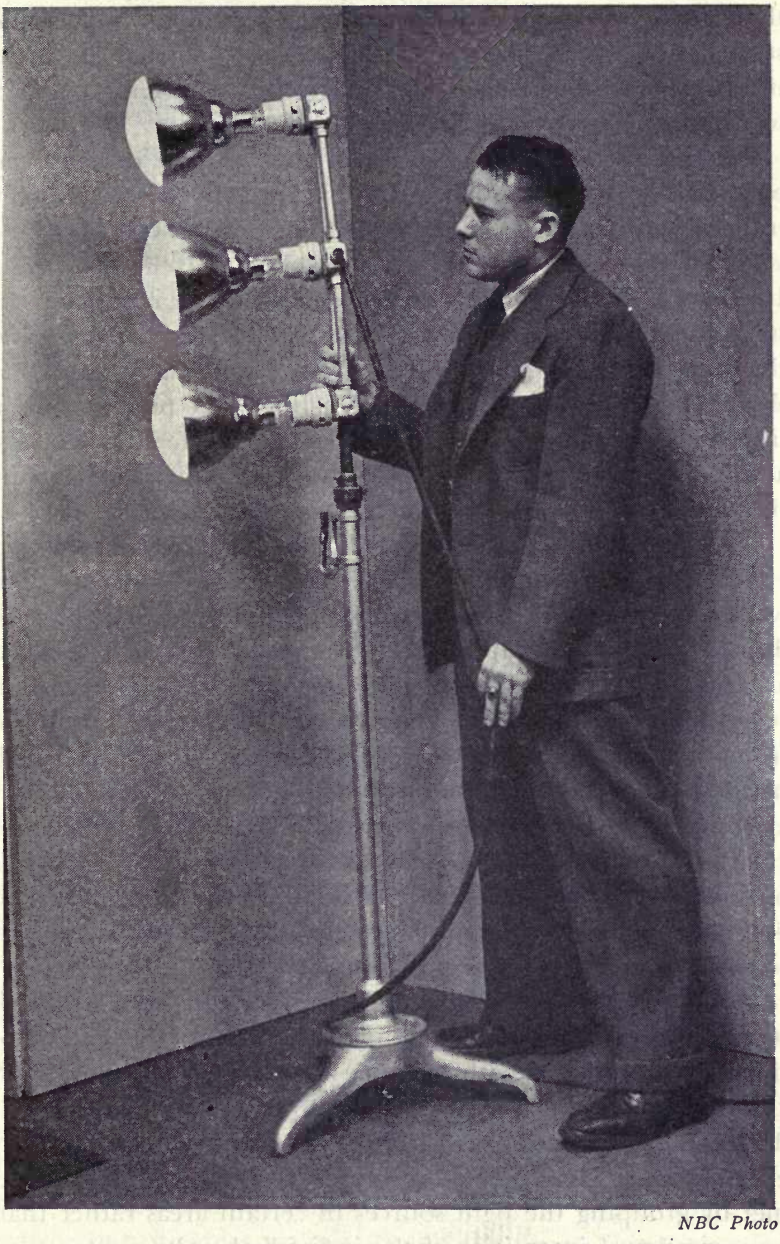
Foundation Lighting Practice

It is apparent that television, like the stage and motion pictures, will require a basic illumination of the acting area. Unlike the other two arts, it must be of a higher level and colorless. To obtain the quantity demanded by the relatively insensitive pickup devices of today's television camera on a stage of the cubic area necessary to our purposes requires the generation of tremendous quantities of light. The farther away from the acting area these lights are placed, the greater must be the original light source and resultant radiated heat. Economics and comfort, therefore, demand that these high-level lighting units required in foundation lighting be as close to the set as possible and be distributed over and around the acting area rather than bunched in the downstage or camera region.

Other arrangements have often been tested and disproved and are characteristic of lighting practices in the early days of television. In 1934 and 1935, during the first direct pickup experiments from a Farnsworth television stage, four 5,000-watt "suns," focusing incandescent spotlights, were used. By arranging these lamps behind the cameras, it was possible to flood the miniature stage with better than 2,000 foot candles of light. Only the more rugged of our pioneer talent could stand this test of intense heat and glare, but it did produce an electronic picture of a sort. This head-on illumination had no other characteristic, implied or created, than light and lots of it. Multiple shadows on the backdrop were of no moment at that period of the art, nor was the lack of halftones or dimension considered important to the all-electronic picture that was created on the face of the receiving tube. As the sensitivity of the camera tube increased, however, lack of high light and shadow became evident, and corrective steps were taken to bring about a more satisfactory lighting system. It was evident that illumination from downstage (in back of the cameras) was unsatisfactory, both from the standpoint of the effects obtained and the great amount of equipment required for lighting from that distance.

Lighting from the wings (side lighting) would, of course, have corrected the problem of head-on glare and the backdrop shadows, but it also created its own group of unreal shadows, which varied directly with the camera angles used. Side lighting also restricted the actor in movement from left to right on the stage because of the resultant wide variations in light intensities that were thus brought about.

These considerations led the industry to look to the ceiling as the logical place for the main source of foundation lighting, and that is where it is usually found today. In this respect television has borrowed directly from the stage, since overhead units in television are the stage's equivalent of batten and tormentor lighting. It is not to be implied that the possibilities of lighting from the wings or down front are not also taken into consideration in pouring light on the television set. Any place big enough to accommodate a lighting unit is generally usurped by the lighting crew as a logical place for a lamp unit. Although the equipment used may be similar to



NBC Photo

INCANDESCENT STRIP-LIGHTING UNIT AS DEVELOPED BY NBC that employed in foundation lighting (i.e., floor broads and strip lights), it has been a practice to class such lighting from the front and sides as specific lighting because of its tendency to create shadows and high-light areas.

There have been many stages in the creation of the overhead battery of lights that led to the present systems of controllable ceiling units. In 1936 experimentation was conducted at the Farnsworth studios with a series of reflector-backed 1,000-watt bulbs, mounted on battens swung in rows over the stage. Because of the inefficiency of both the light source and the open reflectors, it was necessary to use so many units that the radiated heat load made the acting area practically unlivable. This arrangement did, however, create a shadowless acting area, which was the basic objective of lighting during the era of television experimentation.

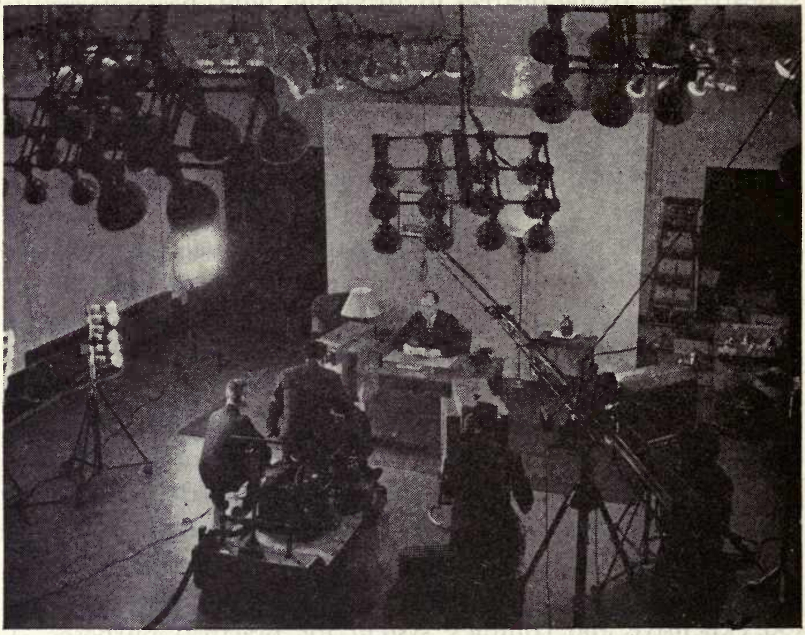
At NBC another variation of this principle was under experimentation. On the premise that true shadowless light would be the result of an artificial overhead hemisphere of diffused light, the Hollophane Company designed a fixed arrangement of lens-diffused reflector lamps for the television stage. Here again, television overcorrected the early faults of front lighting and as a result achieved shadowless stages which in themselves produced more problems. It was possible, however, with the judicial use of portable floor-mounted spots to create the high lights necessary to dimension and perspective on such a shadowless area, but each lamp placed on the studio floor further restricted the movement of the cameras and personnel necessary to the production of a telecast.

It soon became apparent that there were situations in which it was both unnecessary and unwise to have every portion of the stage illuminated with the same amount of shadowless light. In other words, even foundation lighting, non-specific as it was designed to be, must be variable in quantity if satisfactory effects were to be obtained on the receiver. This condition was met by grouping the light sources in certain areas rather than by variation of intensities of the individual units.

The technical limitations of our present pickup systems prohibit the use of dimmers (resistance units used on the stage to reduce the current and resultant brilliance of lighting banks) in controlling the brilliance of a lighting unit. As we reduce the current through the incandescent filament by introducing external resistance into the circuit (movement of the dimmer controls), the color characteristics of the light will change appreciably toward the red or lower end of the light spectrum. The normal television pickup tube, which is responsive in varying degrees to all visible light, becomes erratic as the proportion of infra-red radiation on the set increases. Changing the quantity of light by dimmers, and consequently changing the actinic value of the light, will upset the entire response curve of the camera, thus creating erratic results in place of the smooth reduction of light quantity actually desired.

It is necessary, however, to vary the quantity of foundation lighting on the average set while that set is in action. Without recourse to dimmers, the lighting engineer can only switch groups of units on and off, and if such a method of varying quantity is to be made smoothly and without interruption to the picture, it is necessary for the lighting equipment to be subdivided into many small controllable units. Adding and subtracting small units can be done in a way that approximates the effect of using dimmers, but in this case all the light added or subtracted will be of the same color characteristic or actinic value for which the camera controls have been set.

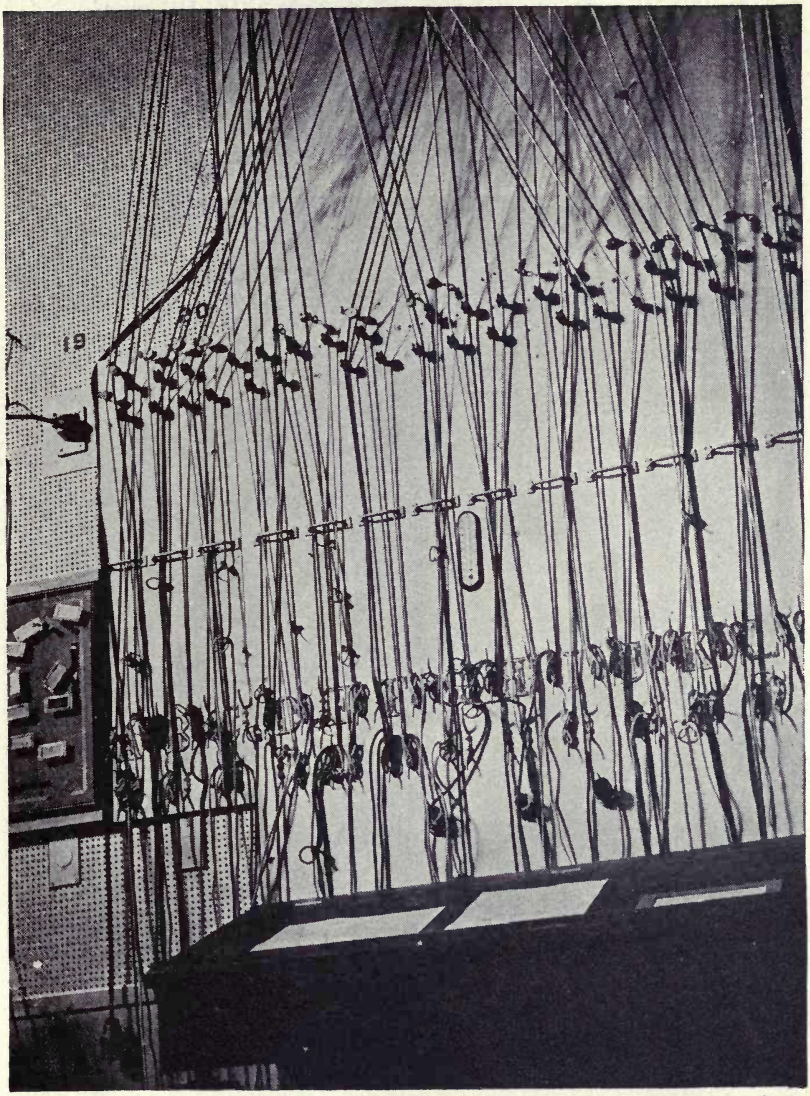
This proposition carried to extremes would result in a far too expensive and complex system for practical purposes. A reasonable variation would be found in limiting our control to groups of lights and designing these groups so that they could be focused or withdrawn from any part of the acting area. This is possible with most of the remote-controlled systems that are used in television studios today. The NBC Unit is typical of this arrangement and might well be described in detail. A movable framework, secured to the gridiron over the set, allows the lamp framework to be rotated through 360° about the point of suspension. This rotation is accomplished by two control cables wound around the drum. Further variation in angular radiation can be obtained by tilting the lamp framework about its lower support pin, and transverse movement about its center can be accomplished by raising the long supporting arm. The lamp framework mounts six internal reflector lamps of 300 to 500 watts each. Each row of three bulbs is separately controlled by mercury switches at the control desk. This unit then approximates the ideal light for present-day television lighting in the following respects:



NBC Photo

THE REMOTE-CONTROLLED NBC INCANDESCENT CEILING UNITS

1. It is capable of being controlled remotely.
2. Its radiation can be focused on or withdrawn from any part of the set.
3. Its internal reflector-type incandescent lamp is both efficient and dependable for a television studio.
4. Its physical position can be varied about its support point in order to make it available to any acting area within its range.
5. It is composed of a series of light sources, groups of which are controllable by switches.
6. It is cheap, sturdy, and simple in construction.

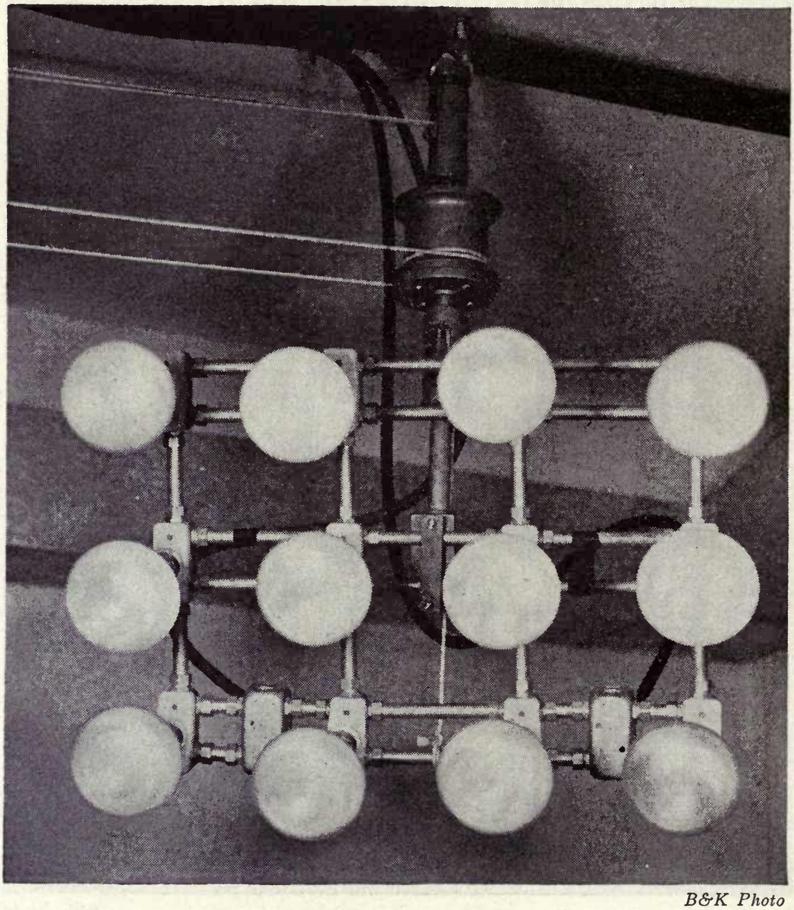


NBC Photo

LIGHTING CONTROL BOARD, STUDIO 3H. CABLES PERMIT ADJUSTMENT OF UNIT IN ELEVATION, AZIMUTH, AND HORIZONTAL POSITION

7. Being ceiling-mounted and remotely controlled, it does not utilize valuable floor space for itself or for the operator.

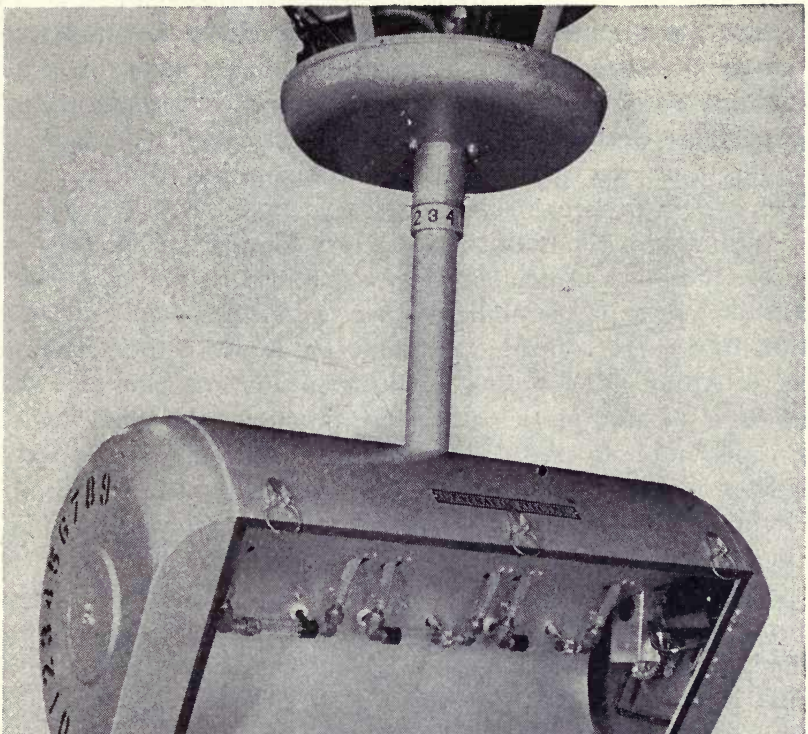
Another variation of this method of remotely controlled foundation lighting is the Balaban and Katz Unit. This system is a simplified version of the original NBC system, but it does not have the transverse movement of the supporting arm that the lights in Radio City boast. The lamps are also six 300-watt internal reflector lamps, arranged in two groups of three.



B&K Photo

THE B&K SIMPLIFIED REMOTE-CONTROL CEILING UNIT

The General Electric Hi-Pressure Mercury Vapor Lamp has many of the same general characteristics as the two types previously mentioned, with the added advantage of having full electronic control of movement, instead of manual control through a series of ropes. The source—water-cooled, high-



Courtesy G. E.

G. E. MERCURY VAPOR LAMP, OPEN TO SHOW MOUNTING OF "PILLS" AND ELEVATING GEAR

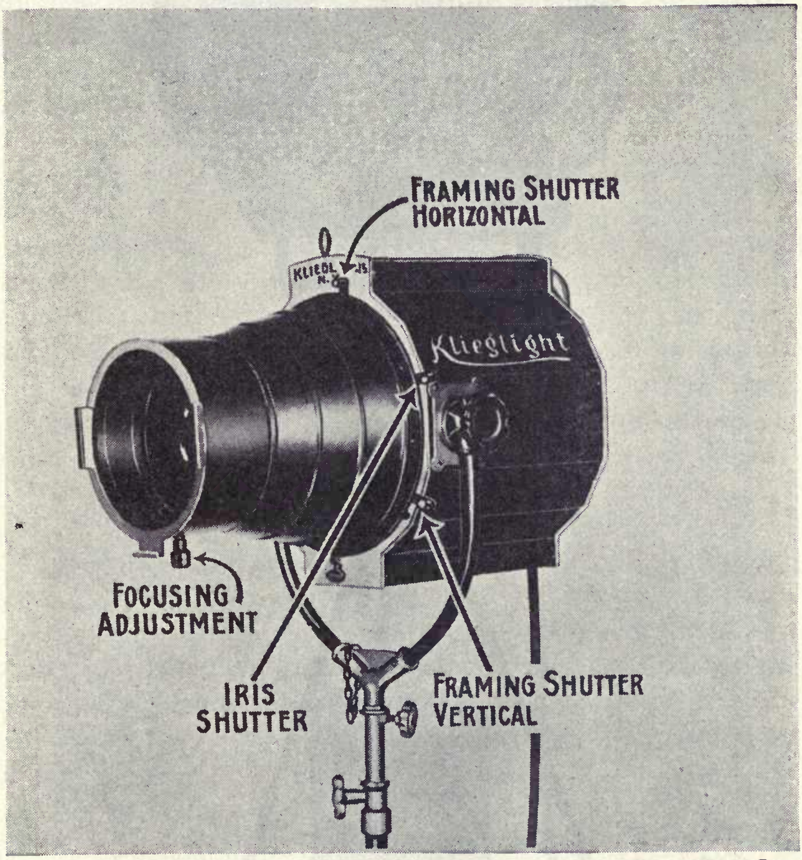
pressure, small mercury-vapor "pills"—produces a completely non-characteristic light that gives shadowless light of high intensity without the heat normally associated with incandescent lamps. Rather than divert to a discussion of light sources at this time, we will consider the comparative advantages of each system in later paragraphs.

With any of these units, satisfactory foundation lighting on a television set can be created by a qualified lighting engineer. He can create levels of light where and when required, and can, by remote control, vary these levels while the set is at work. Although "lumping" lighting in any one part of a set does, in a sense, participate of the functions of specific light, it is preferable to class this unbalance of illumination as purely a by-product of the basic purpose of these units. Under no circumstances can it be assumed that this overhead illumination is sufficient by itself, or that it can be substituted for specific light. Without a proper light foundation obtainable from a well-designed system of controllable overhead units, no engineer can complete his final lighting structure—an axiom that is more than true in the field of television lighting.

Specific Lighting Practice

Assuming that the judicious use of overhead lighting equipment has created a shadowless illumination over the entire set, the more intricate modelling process, by which the feeling of dimension is created, can be attempted. This phase of lighting, called specific lighting, treats of both light and shadow, so arranged as to imply the third dimension of depth.

Specific light is generally created by floor-mounted units using high-intensity sources. We have found it necessary to project this type of light from behind the cameras, or from the wings, and therefore lighting units that use a lens system to concentrate the beam are normally used. Most characteristic of this type of lighting, and conceded to be the all-purpose unit of the studio, is the focusing spot of one, two, or five kilowatts, equipped with filament-diffusing ring. This lamp, by movement of the reflector and light source in and out of focus, can vary its field of coverage from a narrow beam capable of carrying light into a set from a long distance, to covering the set with a non-spotty flood of high-intensity reinforcing light. These lamps will normally be mounted on either side of the set behind the cameras, and in the wings off stage. Whether

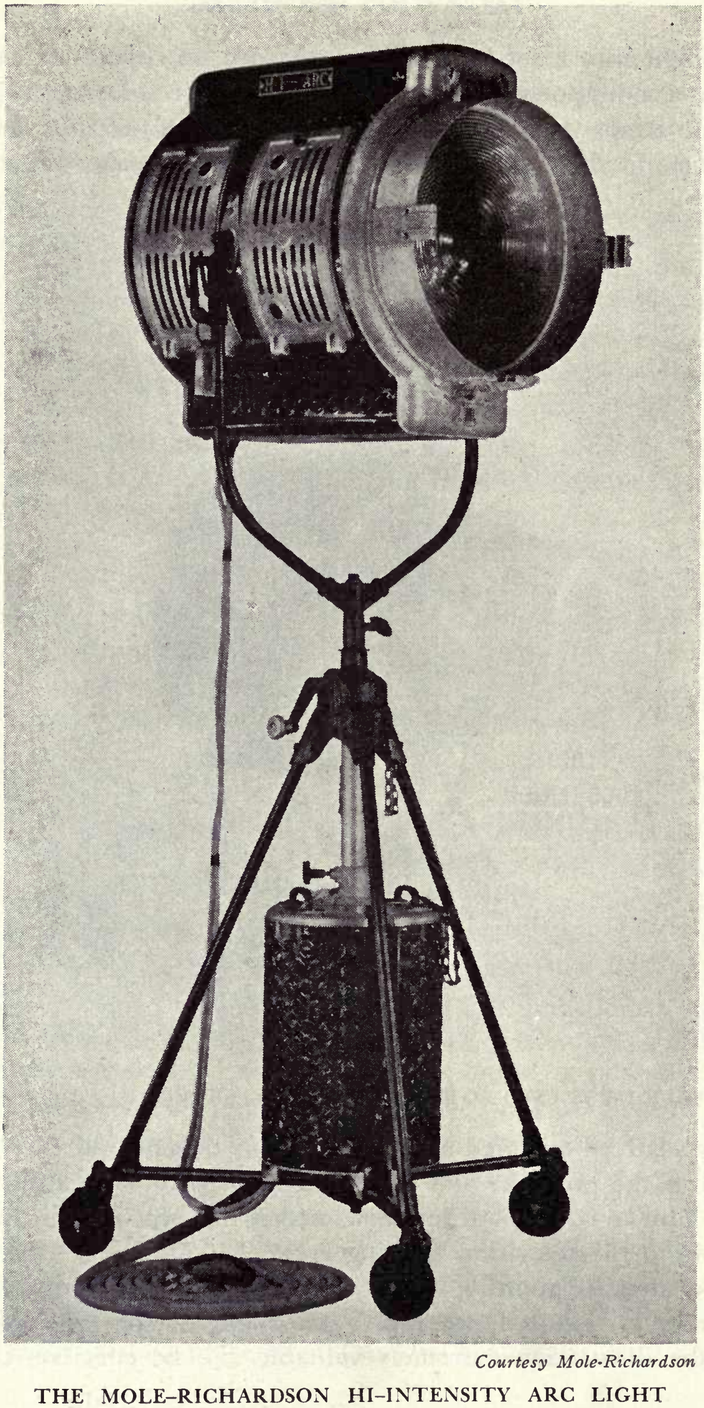


Courtesy Kliegl Bros.

KLIEGLIGHT IS USED BOTH IN THE THEATER AND IN TELEVISION

they shall be operated as floods or spots depends on the decision of the producer and lighting engineer, but the ability of one unit to cover both functions makes this type of unit invaluable to the television lighting crew.

For detailed spotting where a particular high light or a hard shadow is required, we find a klieglight of the type shown in the illustration extremely valuable. To be effective, these



Courtesy Mole-Richardson

THE MOLE–RICHARDSON HI–INTENSITY ARC LIGHT units are generally lamped for two kilowatts, and are equipped with iris and shutters.

A third source of specific lighting is the high-intensity carbon arc, which has made its appearance in the television studio as an effect lamp. The blue-white radiation of this unit, at the intensities available, makes it extremely valuable in producing both theatrical spot effects for variety routines and hard shadows. It is sometimes impractical to make full use of this instrument, because of its requirement of a direct-current power supply. With all its faults, it still remains a lamp that is necessary for perfect lighting.

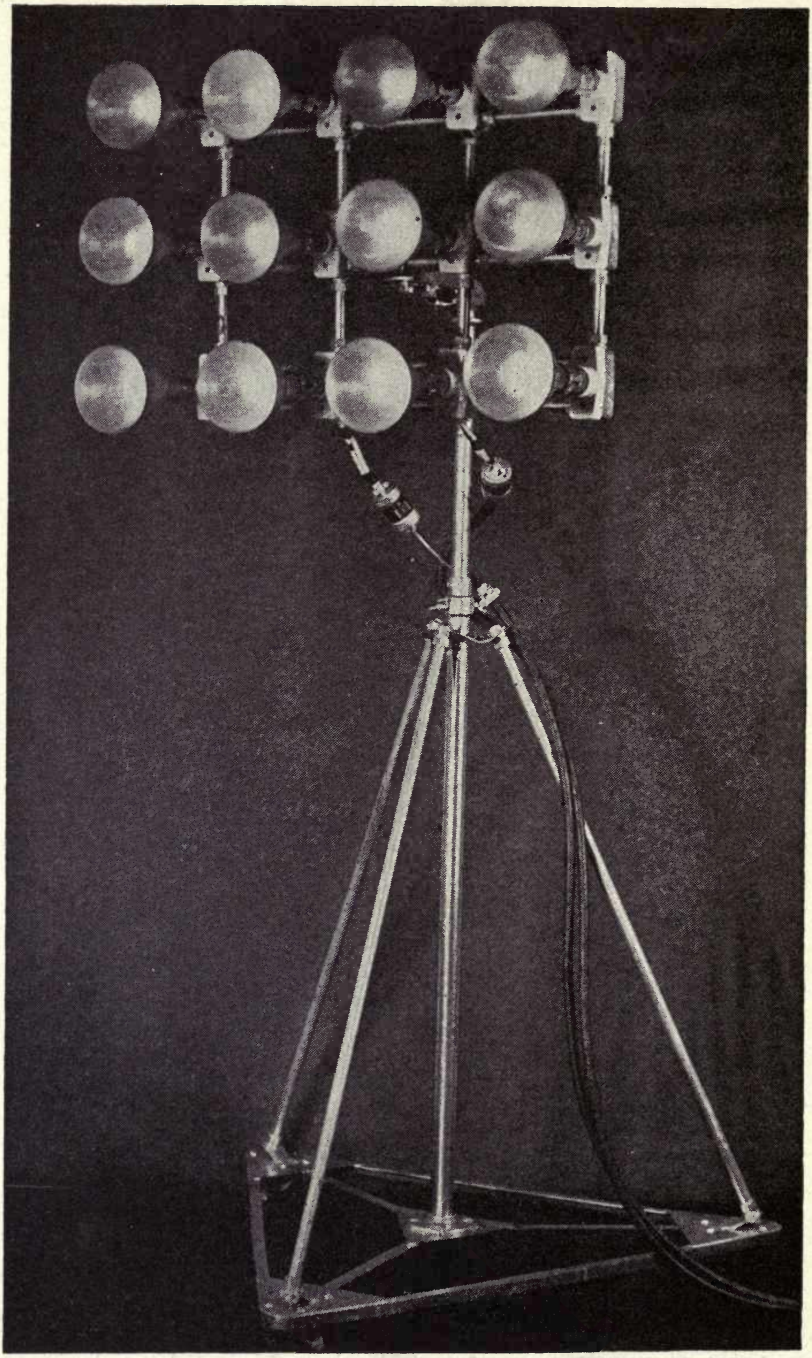
Between these three units designed for specific lighting and the controllable overhead foundation lighting, we have an intermediate classification of lighting equipment that partakes of the characteristics and usage of both. We call these floor broads, due to their normal position alongside the cameras. Their function is to reinforce the foundation light on the set and to assist in unbalancing the light to create a "lighting origin."

Lighting Origin and Camera Importance

"Lighting origin" is the basis for our perspective in lighting a set. It is the direction or object from which we will create our interpretation of the lighting script. In some cases, this source may be a floor lamp or a window that will indicate the preferred or logical origin of lighting. In other cases, this origin will be more obscure and must be chosen from the standpoint of operation.

By establishing a "lighting origin," we can, like a portrait painter, create natural shadows and high lights consistent with good composition and the practical considerations of televising the set. Without this premeditated planning on the part of the lighting engineer and the set designer, the cross shadows and high lights from many sources will tend to distract the audience.

With more than one camera covering an acting sequence, the maintenance of this origin of light is sometimes difficult. If the lighting remains fixed, each camera will register a different arrangement of light and shadow. Any attempt to duplicate the lighting equipment for each camera would result in a



Courtesy B&K

THE B&K FLOOR-MOUNTED INCANDESCENT "BROAD" WITH A PATENTED COLLAPSIBLE STAND conglomerate mass of cross-lighting, cancelling out any of the effects being sought. It is, therefore, necessary when using more than one camera that the cameras be classified as to importance, and the lighting arranged to favor the most important camera. Where more than one camera is used on a set, it will generally be found that a series of lenses are used, varying from close-up to long shot. Inasmuch as the close-up camera is capable of interpreting the more minute details in a picture, this shot will necessarily be better able to interpret the halftones and high lights of an artistically lighted subject. On the other hand, the long-shot cameras, and, in a sense, the intermediate lenses, are not capable of this degree of interpretation. It is therefore logical that the normal position and operation of the close-up camera be considered in establishing the lighting origin and that this camera be favored in setting up specific lighting.

Back Lighting

The subject of back lighting is one that, in spite of its apparent importance, is highly experimental and so far neglected in television. In portrait lighting, where the subject is fixed, it is possible to arrange lighting from the rear, a procedure that does much to improve the picture. This type of lighting creates subtle halo effects about the character and helps the camera to delineate the more obscure outlines of the subject. On a television stage, where the characters are in continual motion, normal back lighting cannot be accomplished by fixed spots. As an alternative system, we have found that reasonably good back lighting can be obtained by reversing the angle of throw of the upstage ceiling units. This method is satisfactory for most center-stage action, decreasing in effectiveness as the characters move upstage or downstage. Considerable experimentation in mobile back lighting, where the action is continually followed by controllable light, has so far proved it to be too complex for practical application.

Foot Lighting

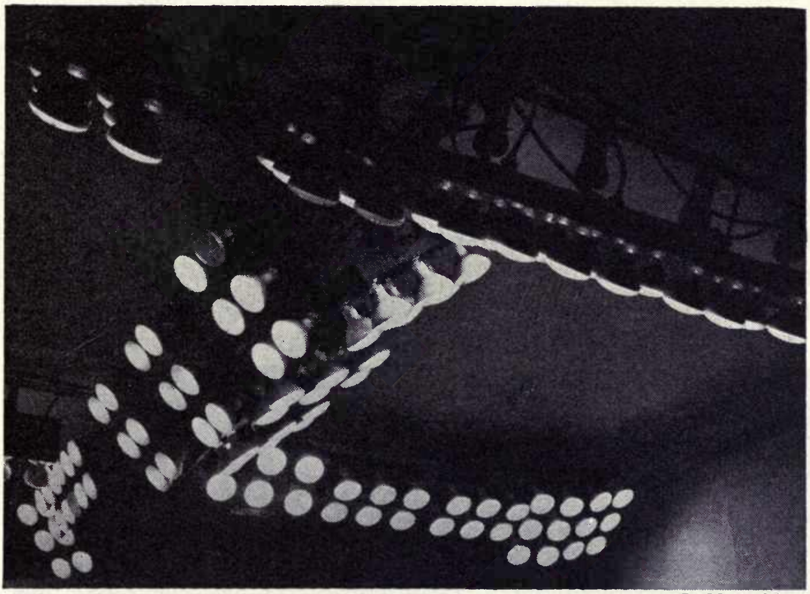
Foot lighting is a prime requisite, although a somewhat neglected phase of good television lighting. Due to the fact that a major portion of the light on the actors and setting will normally come from above, the unnatural shadows that will be created must be eliminated. Counter lighting from below will generally succeed in erasing these shadows, as it does on the legitimate stage. In television, where there is no proscenium arch to limit the downstage movement of players, fixed foot lighting comparable to that used on the stage would be impractical. The square law of lighting, wherein the quantity of light varies inversely as the square of the distance from the object, further rules against such a use of fixed foot lighting. Experimentation in this field has developed a satisfactory system of movable foot lighting operated from behind the cameras. Extreme care must be exercised in the use of this type of illumination in order to prevent overlighting and the resultant reversed shadows. On the other hand, the importance of this type of light should not be underestimated or its use curtailed by reason of the operational difficulties involved.

Television Light Sources

There are four sources of light energy that have been considered in television lighting, namely, incandescent lamps, mercury vapor, fluorescent sources, and arc lamps. Each has its peculiar advantages and disadvantages, as well as its proponents and critics.

Incandescents

Lighting equipment making use of incandescent filaments is by far the most common type in use today. If these lamps are operated at their designed voltage, they produce light energy that is well adapted to the energy-response curve of the camera pickup tube. The lamps themselves are generally inexpensive, easily available, and of comparable long-life characteristics. They do, however, have the disadvantage of producing radiant heat closely proportionate to the light obtained. Under the light levels that must be maintained in television, this heat load becomes a governing factor and complicates not only the technique on the set but the design of the television studios as well. Incandescent bulbs may be obtained in many forms and sizes, and many different types of reflectors may be employed to collect and direct the light energy in the path where it can be used. Silvered metallic mirrors or silvered glass reflectors are generally found in the larger lighting units, while polished or brushed aluminum and various white enamels nor-



DuMont Photo

SEMIFIXED OVERHEAD FOUNDATION LIGHTING, DUMONT STUDIO

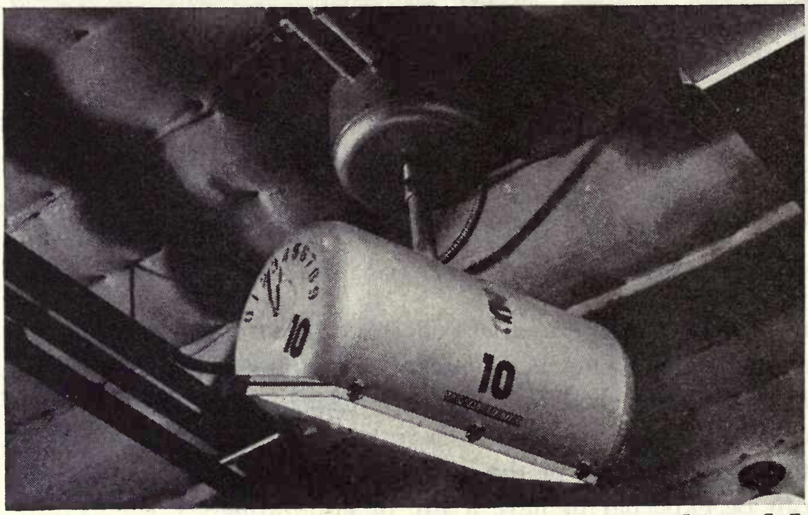
mally make up the smaller reflectors that are not protected by a lens system. The inefficiency of any reflective surface whose reflective coefficient is subject to reduction by dust and dirt deposit has brought about new interest in the internal-reflector-type lamp. Lamps of this type, burning at normal brilliance, can be expected to have a life of approximately 1000 hours, although the light output will decrease rapidly in the latter part of its cycle. This bulb, now relatively common, relies on the silvered inner surface of the lamp for its efficiency. Such a surface maintains its original coefficient of reflection throughout the life of the lamp and is not affected by dust or dirt, which reduce the efficiency of open-type reflectors.

Other incandescent units found in television are the focusing spotlights, the incandescent klieg lights, and the bunch lights or floor broads sometimes seen on the studio sets.

In the larger television studios the 36-inch sun lamp will sometimes be used as a reinforcing lamp for both specific and foundation lighting. These lamps, with a movable parabolic reflector, employ special high-intensity incandescent bulbs, which range from one to ten kilowatts. The life span of such lamps is necessarily short, ranging upward from 20 to 50 hours.

Mercury Vapor

Mercury vapor, or "cold light" as it is called, possesses the outstanding advantage of being able to generate high levels of illumination without the attendant high-heat output common to incandescent sources. It is necessary, however, to use circulating water to cool the tube, and many operators consider



Courtesy G. E.

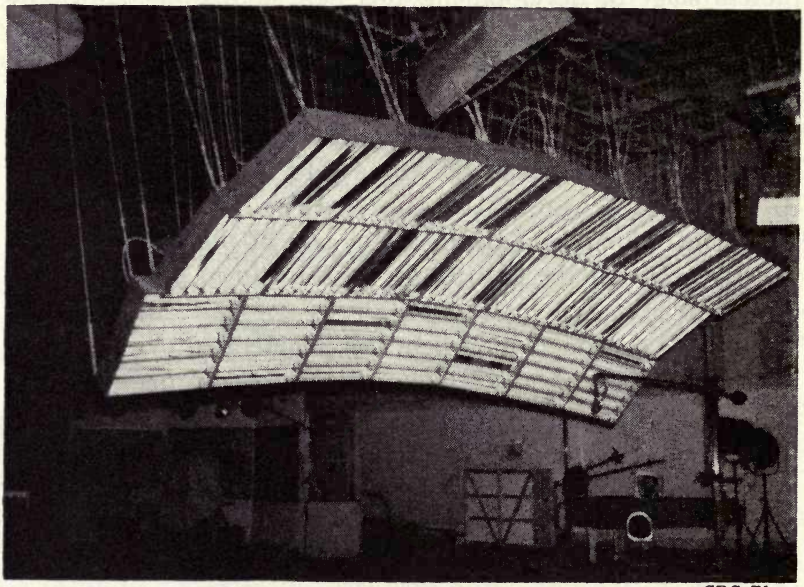
THE GENERAL ELECTRIC CEILING–MOUNTED HI–PRESSURE MERCURY VAPOR LIGHT, MOTOR–CONTROLLED

this a distinct disadvantage. This high-pressure mercury-vapor source, as now developed, is commonly known as "the pill," and is a small glass tube about the size of a cigarette. This tube contains mercury vapor under extremely high pressure, and when operated in the proper electrical circuits it will produce light levels far in excess of that obtainable by any type of incandescent filament. Mercury vapor has been adapted to both overhead remote-control units and floor equipment. At the present stage of development, this light source does not lend itself to specific lighting because of the diffused characteristics of its output. It does, however, produce satisfactory high levels of bluish-white light with little or no radiant heat. These lights cannot be operated at the present time without a water-cooling system. It is necessary to use three pills in each lighting unit energized by the three-phase source of power required for this type of illumination. Failure of any one of these light sources will require that the entire unit be shut down until all three pills are capable of lighting.

With the extremely high light levels generated by these units it is both unnecessary and inexpedient to use as many fixtures as would normally be required in equivalent incandescent installations. For this reason, each unit becomes a much more important individual source to the lighting engineer who is always cognizant of the number and location of the equipment at his command. Failure of one unit where only a few are installed can be far more serious than loss of a single lamp or even a group from the more extensive incandescent installations.

Fluorescents

The use of fluorescent tubes has been experimented with by several companies, but its use in television still remains in the developmental stage. The lumen output (measure of light radiating from the source) is low in comparison with other available equipment and on the basis of the physical size of the tube required is considered by many to be impractical for studio use. Estimates have been made by various operators that a maximum of 600 foot candles could be obtained by lining the entire studio with these tubes. It is sometimes difficult to group a sufficiently large number of fluorescent units on a set to provide satisfactory foundation lighting. Fluorescence has the advantage of producing a diffused non-glare radiation with little or no heat and in addition requires no water cooling of the source. Field measurements of load characteristics show a definite saving in power consumption, but with this type of light and all of these advantages it has found little use in present-day television.



CBS Photo

FLUORESCENT ILLUMINATION OF CBS STUDIO FOR COLOR AND BLACK-AND-WHITE PICKUP

Arc Lamps

Arc lamps are used in some studios to produce the hard, high-level spotlighting required in effect work. As has been pointed out, these units are D.C. equipment and even the best designs present problems in studio operation. Although today the cases covering the arc mechanism are sound-proofed, the electronic radiations from the arc and the fluttering of the light make this lamp one that will be used on a sound-television stage only in specific instances. Proper operation of this equipment generally demands individual supervision because of the constant adjustments required for satisfactory performance, prohibiting remote control.

These four categories of light will cover the average equipment used in our studios today. Combinations of all four types will be found in some operations, while other broadcasters limit their equipment to one type alone. There is no doubt that a combination of light sources will utilize the fullest possibilities of the art of illumination, but the variation of spectral coloration of the light, as seen by the pickup tube, requires integration of its net resultant by the lighting engineer. A studio, illuminated by one type of light, requires less interpretation of these values, and thus reduces the lighting problems to one of quantity and placement.

Lighting Control

Lighting control can best be accomplished from an elevated control platform, where the engineer can observe the set that is in operation and at the same time remain in close communication with the engineers operating on the control console. In television, the shading-control engineer has before him the necessary electronic equipment to effect adjustment of both the brightness and contrast of the picture after it has left the camera. Inasmuch as this control of lighting levels closely parallels the work of the lighting engineer, it becomes highly important that these two people work in close harmony. It has been wisely recommended that the lighting-control desk be equipped with a cathode-ray oscilloscope, giving the lighting engineer the apparatus to adjust the illumination from a purely electronic standpoint to the greater satisfaction of the control desk.

The lighting-control platform will vary in size and complexity with the equipment being used. At NBC, New York, the console or control desk was laid out in a pattern that duplicated the overhead lights in the studio, the mercury switches controlling the various units being easily identified by reference to the location of the unit on the ceiling.

Balaban and Katz, Chicago, has a similar although incomplete version of this panel, mounted on the studio wall.

If the overhead equipment is of the controllable type, the cables or electronic controls terminate at or near the platform. Remote control of the main lighting power should also be available to the operator.

General Electric has a much more complete lighting-control platform, from which vantage point the engineer can manipulate his lighting by means of electronic controls.

Most of the other studios in operation have variations of these basic patterns, all of which are designed to give one man continual control over both the quantity used and the placement of the lighting available to the set.

Other Lighting Considerations

The actual problems of lighting, omitting reference to equipment, are similar to the parallel problems in any other medium. There are, however, certain practices native to television that simplify the production of good illumination for electronic pictures.

In sets where low-level lighting is a necessity, such as a darkened room or mystery setting, the characteristic bottom flare in the television picture can be reduced by flooding the floor in front of the cameras with light. Most studios are now designed with light-colored floors to amplify this effect.

In reality, light being reflected off the foreground of a low key set fortifies the rim lighting of the iconoscope within the camera. It is generally more expedient to reduce the overall brightness of the picture by electronic means than to accept the problems of a low key set. If the foundation lighting on a television set is reduced below the optimum conditions required for successful operation of the camera, many erratic conditions will develop in the picture. In addition to abnormal bottom flare, resulting from such low-level lighting, the problems of shading in iconoscope systems increase materially.

Effective results can often be obtained by reducing the overall foundation lighting downstage and flooding the back drops or upstage wall with light. This will tend to create silhouetting, which can easily be overcome by judicial use of small quantities of light from down front.

Quick changes in lighting levels required by the script, such as a case in which the actor snaps on the lights in a darkened room, can be best accomplished by manipulation of the brightness control on the electric console. "Blooping," or a sudden shift in the transmitted picture, will generally characterize any attempt to do this by changing the amount of light on the set.

Coloration of the set itself has a direct bearing on the lighting problem. A dark-colored rug in the downstage area will generally soak up all the bottom lighting and again bring on bottom flare. Substitution of light-colored material will simplify the problem. This is particularly true when a news commentator is working at a desk. A white blotter or its equivalent on the table before him will reduce the quantity of lighting required and produce far more satisfactory results than the brute-force method of pouring on the additional light required to correct faulty settings.

Theatrical spots and the hard shadows sometimes demanded by the story can best be obtained with high-intensity arc equipment. Extreme care should be taken in the use of this type of lamp on a sound stage. It has been found more practical to strike and adjust the arc prior to going on the air, in order to insure against both noise and electronic interference. It must be remembered that an arc lamp will at times have a tendency to go into parasitic radio oscillations at a frequency that will modulate or otherwise seriously affect the cameras. At NBC, the arc equipment is moved into a sound lock for adjustment and when lighted is brought back on the set with the iris closed. Local conditions, however, will dictate the best methods of combatting the difficulties of getting this equipment into operation.

Hot spots, or small overlighted areas, can best be determined from watching the electronic picture at the control console, although it is possible to find the more glaring faults by scanning the set through smoked glass. The average eye cannot differentiate small variations in light at the high levels of illumination used in television.

The problem of unwanted reflections on a working stage is of major importance to the engineer because of the many sources and directions from which we obtain our light and the many angles we use in shooting the show. It is, therefore, good practice to remove the glass from all prop pictures, and wherever possible to reduce the reflectivity of metallic surfaces that may pick up these spurious reflections. In the case of mirrors, door knobs, and metallic fixtures that must remain as part of the setting, the unwanted reflection of these objects can be reduced without changing their characteristics by using putty as a stipling medium. This practice is particularly effective in reducing the glare of varnished surfaces and mirrors.

To light a television performance, the producer must have a knowledge of the operating principles of the electronic equipment, as well as a fine appreciation of the artistic considerations that should be achieved. Ingenuity based on a sound technique of good lighting practice will go far in solving the recurring problems that confront the personnel of this department. By using these three tools with intelligence and foresight, the quality of the resultant video picture will more than compensate for the efforts expended.

8

Color Television

ONE of the first proposals to follow the introduction of black-and-white television was that of producing these air pictures in full color. Since that time the subject of color has appeared in every discussion involving television, whether it was political, aesthetic, or engineering.

Although the findings of the Radio Technical Planning Board, late in 1944, later confirmed by the Federal Communications Commission proposals of January, 1945, have clarified to some extent the field of future development of color, it will be interesting to review some of the controversy that marked the pre-conference days of this art.

Color in television is today accomplished by a semi-mechanical system in both the recording camera and the home receiver. The method is commonly known as "additive color," and is based on patents that expired long before television came into being. It has long been known that the eye, seeing a series of three single color pictures, one representing the red component, one the green, and the last the blue, will add these monochromatic versions together to form a full-color resultant.

To create such a succession of three single-color versions of the scene in front of the camera, an adaptation of the familiar "color wheel" is used. This wheel or disc is made up of a series of pie-shaped segments in which are fitted alternative transparent filters of red, blue, and green gelatin. By rotating such a color disc before the lens of a camera, each filter section is in turn brought into position between the lens and the scene being photographed. The filtering action of each colored segment thus effectively reduces the image seen by the lens to a one-color version in which the other two filter colors do not appear. This process of subtraction can be made continuous by rotating the wheel containing the filters of the three primary colors before the lens at a synchronous speed.

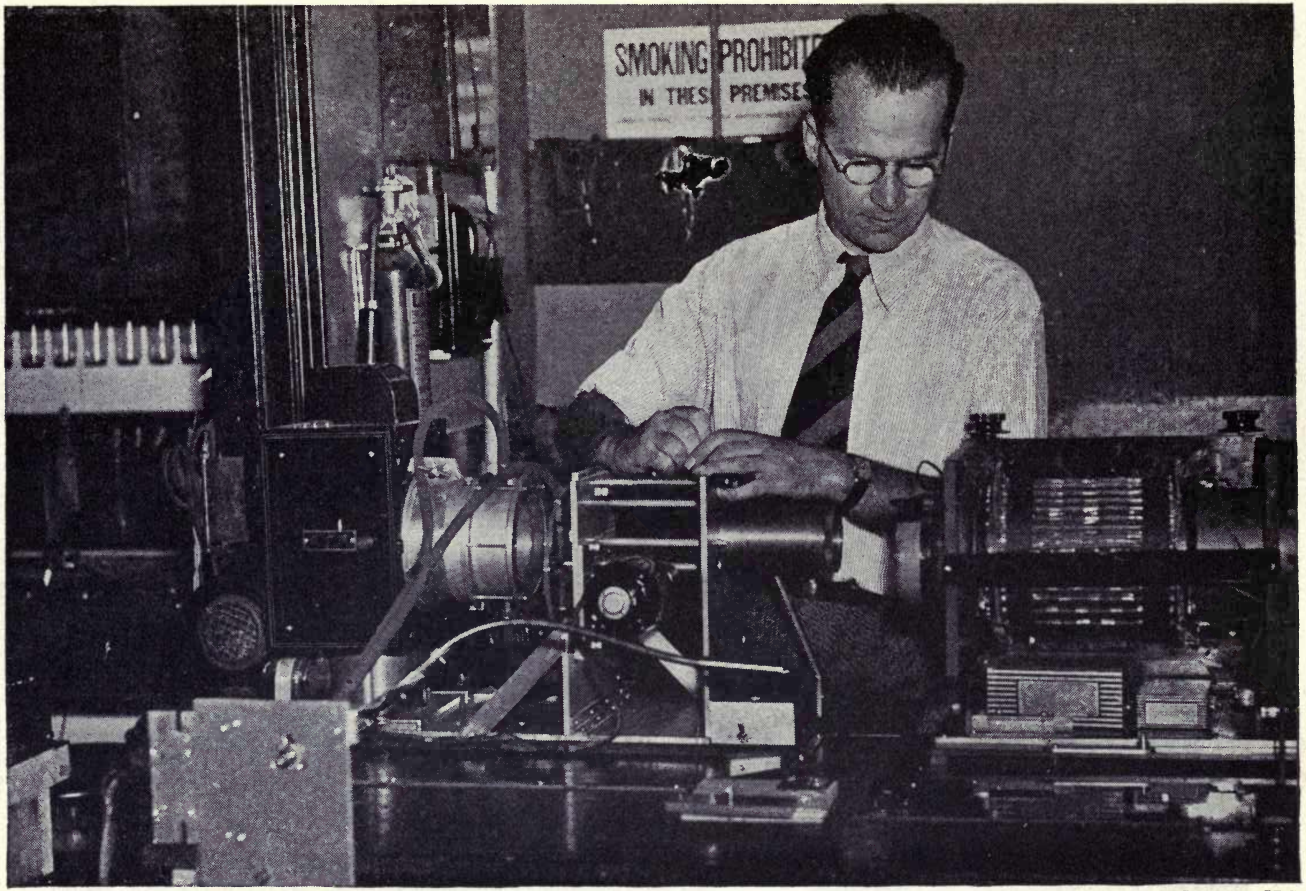
By transmitting this succession of tri-chromatic versions of the original three-color picture and viewing the reproduction on a receiver through the filters of another and duplicate color wheel, the observer sees the picture in its original full color. The eye adds up the three individual color pictures to create the full-color impression. Thus the term "additive color" is most descriptive of the process.

In actual practice, as demonstrated by Dr. Peter Goldmark, of the Columbia Broadcasting System, the color-filter disc is generally introduced within the color camera itself, resulting in a more efficient and mechanically feasible method of accomplishing this mechanical function.

The Columbia receiver, admittedly an experimental model, also boasts many similar improvements over the basic principle of a reproducer tube plus a rotating disc. A magnetic brake system, capable of holding the speed of the color wheel in exact synchronism, is one of the more advanced improvements, although the redesign of the shape and coloration of the filter section itself has resulted in higher efficiencies of reproduction. This mathematically computed filter shape not only increases the brightness of the picture but also has brought about a reduction in diameter of the rotating unit as well.

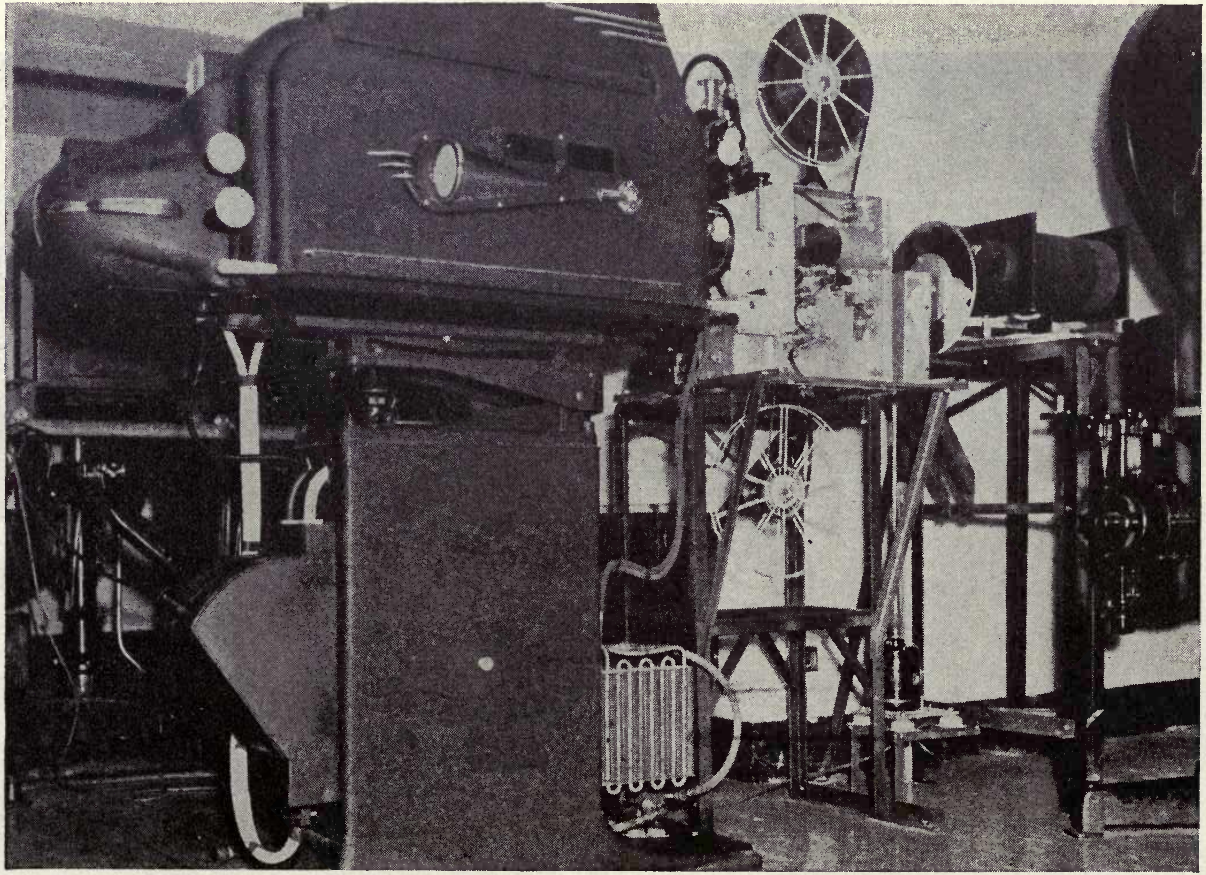
Goldmark, in his development program, has found the Farnsworth Image Dissector Tube to be well adapted for use in the color-film reproduction unit and has employed it exclusively in his tele-cine work. The illumination levels obtainable from the high-intensity arc that he uses as a light source provide sufficient light energy to override the loss experienced in the interposed filter sections.

In studio work, Goldmark uses a camera employing a modified version of the Orthicon tube with apparent success. In this



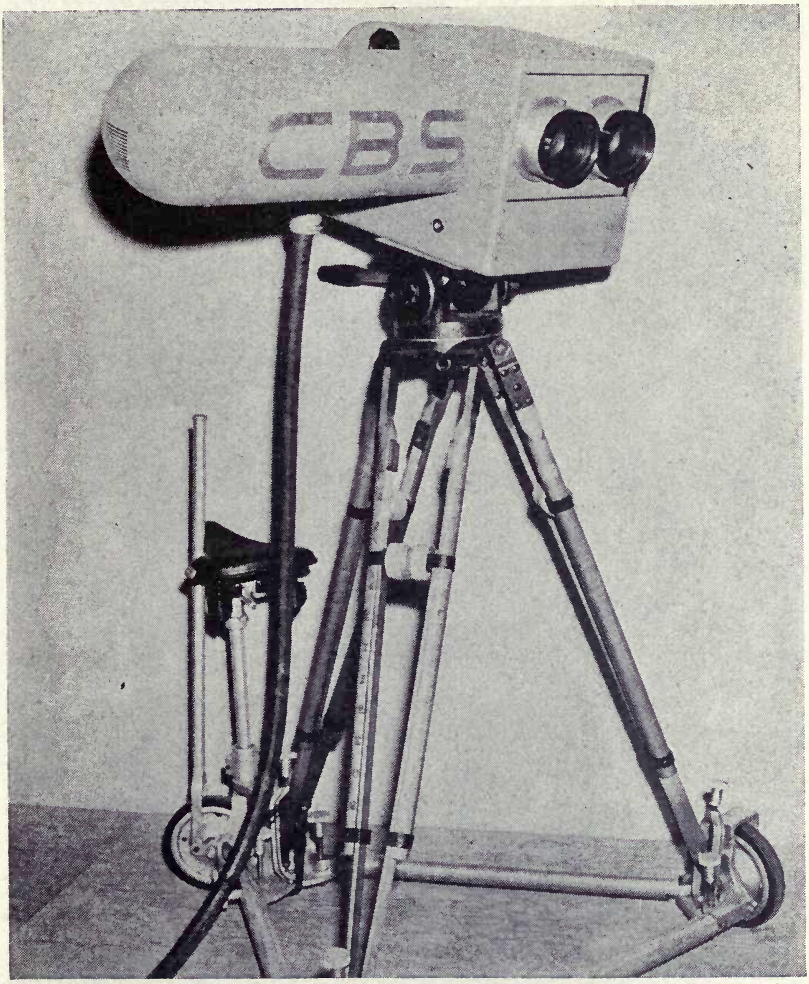
Courtesy CBS

DR. PETER GOLDMARK OF CBS WITH THE FIRST COLOR PICKUP EQUIPMENT



Courtesy CBS

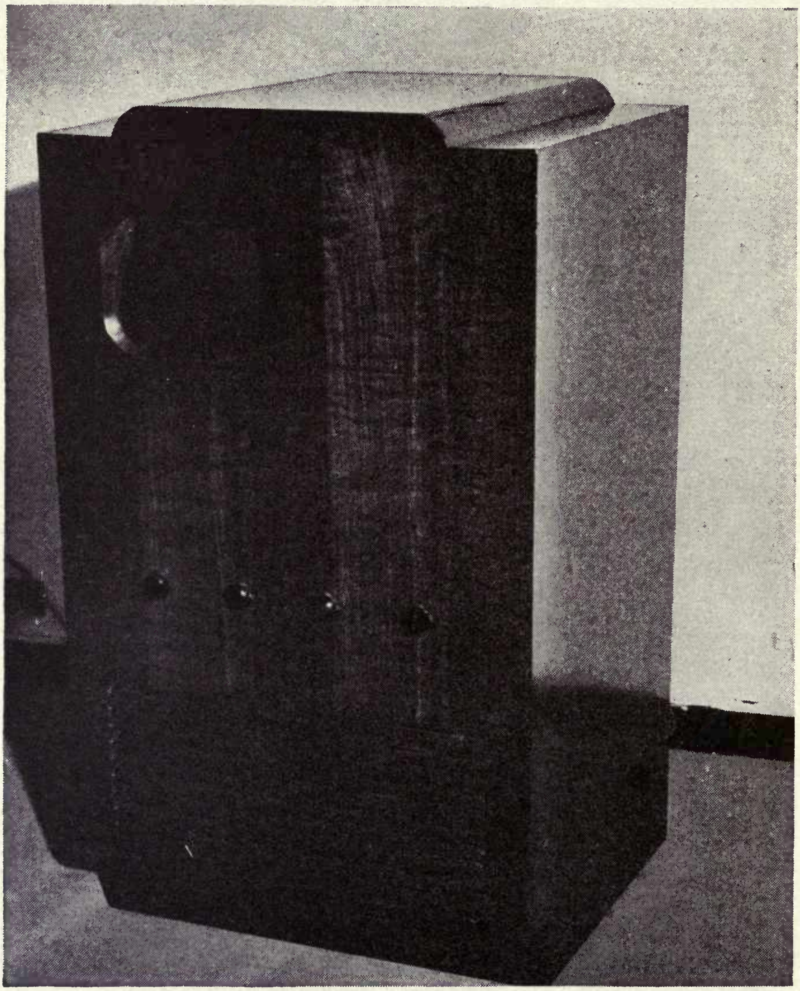
VIEW OF CBS TELE-CINE EQUIPMENT USED FOR THE TRANSMISSION OF COLOR SLIDES AND FILM camera, with its novel 90° lens system, a filter drum is placed at the focal point of the lens rather than exterior to the camera itself.



Courtesy CBS

CBS COLOR STUDIO CAMERA USING THE ORTHICON

Even though the theory behind any additive color system is not new, we must give full credit to the outstanding developmental engineering work carried on by Goldmark and his assistants at CBS in New York. The first full-color broadcast from this station took place in August, 1940, after years of careful experimentation. Although this first telecast was made up of Kodachrome slides and film, CBS went on the air in the spring



Courtesy CBS

COLUMBIA'S TELEVISION RECEIVER FOR COLOR

of the following year with a regularly scheduled color transmission, and maintained this experimental service for close to a hundred days.

During this period, Goldmark has produced a series of highly interesting disclosures that might well lead to the eventual adoption of this mechanical-electronic system of color broadcast and reception. His film pickup unit carried the brunt of the broadcast chore until the Orthicon studio camera was perfected. With the increased sensitivity made available by using this type of pickup tube and the constant improvement of both optical and mechanical equipment, Columbia now boasts a color-studio camera and home receiver that are comparable to the best of the existent black-and-white equipment.

The influence of a television system that can effectively broadcast full-color pictures will undoubtedly be far-reaching, affecting not only the economics of equipment and time sales but the future of standardized black-and-white transmissions as well.

It is not logical to assume that full color will be required for every subject that can be brought before a television camera. We make such an assumption after considering the parallel case of motion pictures, which today employ technicolor only with material that will be enhanced by using this more expensive process. Color in television, as in the motion pictures, will in all probability cost more than black and white and therefore the same economic reasoning as to its use should hold. Although few subjects will fail to increase in appeal when portrayed in natural color, there remains much material that will not benefit in proportion to the additional charges that must be levied. This element of cost is stressed because the set owner will indirectly help to pay for such services.

In every type of pictorial display that we use today, the advisability of using black-and-white reproduction is constantly weighed against the admittedly more effective and more expensive color process, yet a major part of our printed texts, most of our advertising, and the greater percentage of our motion-picture programs are eventually reproduced in black and white. Any of these media can be considered as being a much more permanent record than television, and still producers have not believed it necessary to go to the expense of exclusive color pictures. It is not reasonable that television should disregard the experience of its predecessors in the visual arts and design an all-color system to the exclusion of black-and-white pictures. On the other hand, color cannot be completely disregarded in setting up our standards for a future broadcasting system.

Originally, black-and-white television, as well as experimental color television, was assigned a succession of channels in the high-frequency spectrum. Both services developed to their present stature in these limited assignments, and both services now have reason to feel that they have outgrown the restricted fields that were at one time considered fully sufficient. The Federal Communications Commission, in January, 1945, reviewed the proposals of the various claimants and handed down a temporary decision that would permit monochrome television to continue its operation in the original frequency assignments and at the same time set aside high-frequency space for color experimentation.

To trace the development of color in its relation to black-and-white television, we must review the period of 1939 to 1944, when these video services both occupied the same band and restricted their experimentation to the assigned six-megacycle channel width.

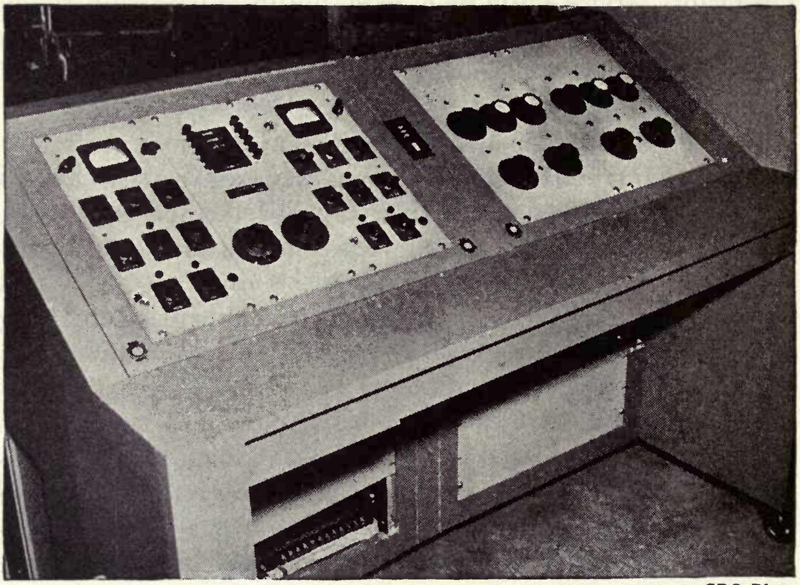
It has been generally conceded that the six-million-cycle channel allocated to each station was sufficiently wide to produce a satisfactory black-and-white picture and that the number of channels that could be operated between 50 and 100 megacycles would insure satisfactory local competition. If, however, instead of transmitting one complete black-and-white picture on each channel, television were to transmit three pictures, as was necessary in an additive color system, it would require approximately twice the band width that is now given over to each black-and-white broadcast to obtain equivalent resolution. The other alternative would be the transmission of color within the standardized channel, with each picture containing one half of the resolution considered necessary for a good black-and-white reproduction. The required double spread between wave lengths in the first case would allow only one half as many stations to operate in the spectrum now assigned to the television broadcasters.

If it is assumed that there would not be enough assignable space in the 50-to-100-megacycle band for the operation of sufficient of these wide-band stations to insure reasonable competition, it is natural to look to the frequencies above 100 megacycles, which today are relatively undeveloped. In this limitless space as many wide-band stations as might be required for a satisfactory service could be located, but in so doing other considerations, both economic and professional, would be encountered that would further complicate such an apparently logical conclusion.

In 1944, the investment of the nine station operators occupying the original channel assignments was estimated at close to \$20,000,000. Most of this was tied up in television equipment designed to produce black-and-white pictures in the 50-to-100-megacycle bands. A public investment of over \$2,000,000 had also been made in receiving equipment capable of reproducing black-and-white pictures in these band frequencies. Any shift in the allocation of frequencies would have made the major portion of this dual investment worthless. In some cases, it was argued, the value placed on existing equipment had been exaggerated, the true figure lying well below this estimate because of obsolescence in design. This assumption was no doubt partially correct, but the fact remains that this apparatus could then, and does today, produce television pictures and will probably continue to do so for many years to come. Furthermore, this investment by the pioneers, both operators and audience, could not be considered solely in the light of the dollars and cents involved, inasmuch as these dollars were expended by people who had faith in the industry to the extent that they were willing to back this confidence with money. If by a radical shift of frequency the \$22,000,000 investment were made obsolete, it would deliberately penalize the few whose foresight had made the industry possible.

At the best, it was only a consideration of an investment of some \$22,000,000, of which \$2,000,000 has been advanced by individual set owners. This is a paltry sum compared with the billions that will likely be spent on television in the next few years, but here again this apparently unbalanced ratio is affected by the knowledge that it was these smaller sums that blazed the trail to provide the service that tomorrow may be an industry.

To suggest that these amounts be considered solely as the unfortunate cost of an interesting experiment and to throw them away by making standards and equipment obsolete by the substitution of a completely new range of frequencies is not



CBS Photo

CBS COLOR TELEVISION CONTROL DESK

just a matter of financial loss. Such a revision would destroy a working machine before its replacement was built. Possibly such a philosophy could have been discounted as a research necessity, but it would hardly receive the same enthusiastic support from those who had made their investment and had seen proof that the equipment they purchased could produce satisfactory pictures. It is felt that this group of pioneers now enjoying black-and-white pictures in their home will join with the majority of black-and-white broadcasters in approving the FCC decisions that made possible the continuance of the present standards during the period of commercial experimentation that now lies before us in television.

By providing sufficient channels for color experimentation, the FCC has likewise seen fit to recognize the potentialities of a future full-color system. If, in the next few years, the companies that are now carrying out research in color can prove that color is inevitable and that it can at that time and in its new channel assignments be produced commercially, the public can then decide whether or not it prefers the additional investment for new equipment or whether it will remain content with the original receivers. As it now rests, it appears likely that color and black-and-white television will, for the time being, be forced to develop along parallel lines, independent of each other and gauged to different channel assignments. Although many operators felt at one time that both color and monochrome pictures could be broadcast over a series of extra-width channels in the present assignments, the new provisions for widely separated development allocations for these two services predict a dual system that may eventually resolve itself into a single service.

The six-megacycle channel now assigned the lower-frequency television bands is sufficient for the transmission of an understandable and acceptable black-and-white picture, plus the necessary sound and guard bands. If we were to broadcast full-colored pictures, each individual picture would have a definition only one half that now considered satisfactory. This resultant full-colored image would, however, have an apparent definition greater than that of any of its three components, leading to a frequent comment among laymen that satisfactory color too could be broadcast in the assigned narrow-band channels.

The eye, which is used to gauging detail in tonal variations of color rather than shades of gray, sees this low definition as a much higher apparent definition than actually exists. In many cases a colored picture having one half the computed definition of a black-and-white picture will appear to be its equal, if not its superior, in eye appeal. On close analysis this picture will have many imperfections, as will any picture created in less than 1,200 lines.

Columbia's proposals of 1943 and 1944 not only encompassed the expansion of the channel widths to accommodate color, but outlined in detail the benefits to be derived from increasing the lineage of black-and-white pictures to the optimum required for large-screen projection. Such high-fidelity black-and-white pictures would without doubt be a great improvement over the present standard transmission of 525 lines, but as previously outlined such an increase in fidelity of reproduction would require a similarly proportioned increase in the channel width, with a like number of channels available for assignment in the present television band. If all television channels are moved to the ultra-high-frequency band to provide for a greater number of stations, the existing investment in equipment and interest would have to be sacrified.

All past experience in television will not become obsolete, however, since most of it represents a substantial portion of the techniques for ultra-high-frequency color and black-and-white television.

Irrespective of its economic background and the fact that the decisions of 1945 have already outlined the policies of the Commission, it is only logical that the engineering considerations of this proposed change be reviewed if we are to complete our analysis of the color versus black-and-white controversy of the early '40's.

In the chapter "Television Transmission" it was pointed out that radio waves, especially the short waves of high-frequency transmitters, will reflect off objects in much the same way that sound is reflected from a wall or light is reflected off a mirror.

This phenomenon, commonly known as the "radar effect" or multi-path transmission, is the tendency of these short waves to reflect off surfaces and to re-radiate from the reflective object as a second source of power.

Since an increase in frequency causes a proportional decrease in wave length, the area of the reflective surface required to "bounce" the signal becomes smaller as the frequency rises. The total amount of energy reflected is, of course, also less when caused by a smaller surface. In the present television frequency allocation, the wave length is of such proportions that buildings and similar large objects will act as reflectors. As the wave length gets smaller, as it does in the new experimental frequency assignments, the reflections obtained off smaller objects become more pronounced until in the upper reaches of the spectrum practically any surface will cause reradiation. As already mentioned in previous chapters, the effects that this phenomenon cause in the receiver can be avoided in large degree by designing a highly focused antenna system capable of receiving only the radiation toward which the antenna is pointed. It will immediately be apparent that in any operation above 100 megacycles, specialized antenna design and construction for each channel would be a prerequisite for each station on the dial. Even then we would be constantly combatting interference from new and, in some cases, mobile reflections.

Recent research with ultra-high-frequency equipment has established the fact that the shadows or areas of non-reception behind large buildings and other objects restricting a true line of sight path between the transmitter and receiver increase or become erratic with an increase in frequency.

In addition to the acceptance of the known limitations of high-frequency broadcasting, it would mean, then, that the infant industry would also have to accept many new and unfathomed difficulties in launching a dual-color system in the very-high-frequency band proposed by the proponents of color.

Power transmission difficulties already evident in the 50-to-100-megacycle band will continue to require both experimentation and research, and all of this will take place in a band where no existing television equipment will operate.

It is little wonder, then, that the Commission saw fit to continue television in its present assignments and, for the time being at least, return color to the experimental status until it too can develop commercial aspects. The Commission in so ruling pointed out in its report that "the development of television in the proposed ultra-high-frequency band is extremely necessary to the establishment of a truly competitive system."

One cannot, however, overlook the potentialities of a system that may eventually bring full color into our homes. This color, if developed along the precepts already laid down by its sponsors, should bring about a near perfection in the art of broadcasting pictures.

Whatever the path and whatever the direction this striving toward perfection may take, it must not be allowed to destroy the existing art while contemplating the masterpiece.

9

The Use of Film in Television

IF PRESENT programming schedules are indicative of post-war operational policies, the screening of motion-picture film can be expected to comprise about one third of tomorrow's television fare. Although the continued measurement of the audience's reaction to televised film has pointed out a decided lack of enthusiasm for film, this coolness can be traced directly to the quality of film subjects that have so far been made available to the television stations. Some broadcasters feel that the present dissatisfaction with screened material may possibly reflect an antagonism comparable to that evidenced in the use of transcriptions for radio. Popular opinion, however, does not wholly agree with such an observation. To date, the television audience has been given little opportunity to see film that has any real entertainment value. The greater part of the film released to the broadcasters has been made up of short subjects and travelogues, a large majority of which has already outlived its usefulness on lecture tours and in film-rental libraries. Rather dull commercial shorts, obsolete cartoons, and civic information reels make up the balance of this much neglected item of television programming. Some full-length movie features have been tried, but they too were not particularly adapted to television screen viewing. A good many scenes in these standard theater releases were lost because too much detail was included in the long shots and the contrast was not suitable for television.

Several attempts have been made to exhume film "oldies" from the vaults of Hollywood and put them on the air. This practice is definitely a complete misfire unless aired with the object of showing the photographic technique of former days. In programs of this type, the audience views both the faults of television plus the obsolete photography and lighting techniques of the early days of motion pictures. The repeated experience of anticipating an advertised feature picture starring a big-name actor only to find that the film was one pre-dating his rise to stardom has made television audiences particularly unreceptive to the use of old film. Television can little afford to use anything but the best product.

The reasons behind the distributor's restriction of major releases to the broadcaster are manifest. First of all, the production and distribution of film is designed to be a paying business. Film studios cannot and will not release their product for the "pittance" that any individual broadcaster can pay for a single local exhibition. Furthermore, it would be a fallacy for the movie studios to release film to a local television station when such a rental would be in direct competition with the local motion-picture exhibitor, who, after all, is the studio's regular customer.

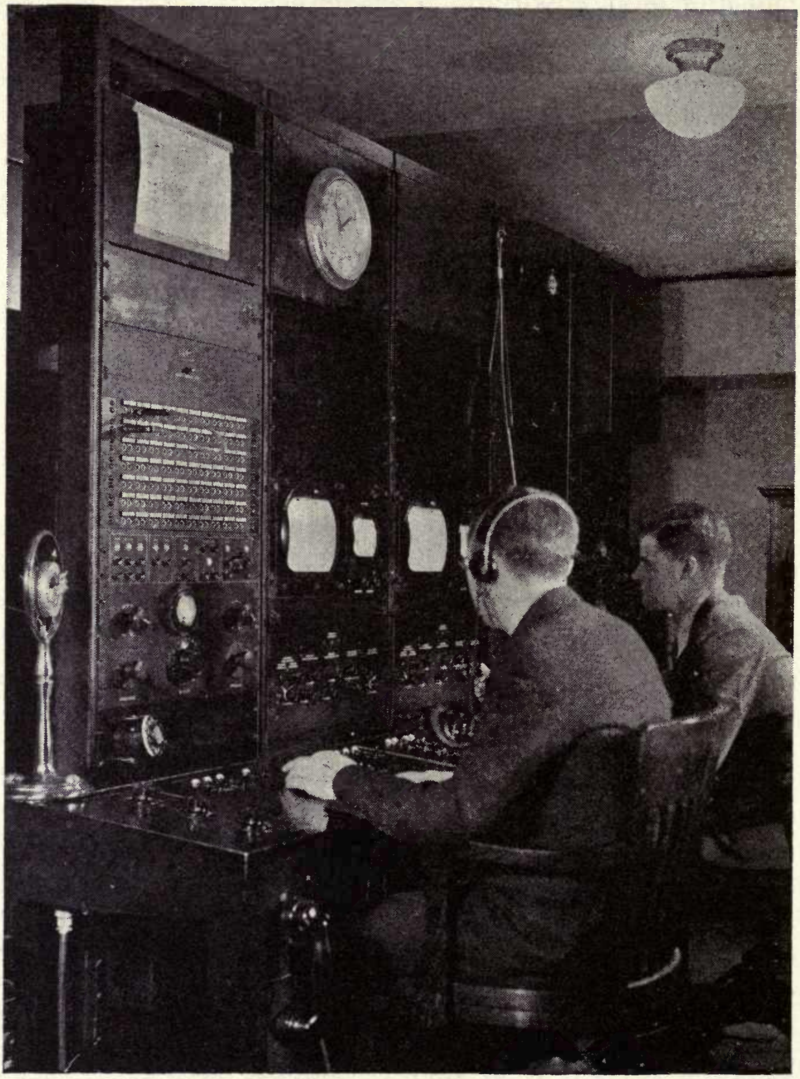
There is no doubt that usable and satisfactory film will eventually be made available to the visual broadcasters in some form or another. Already companies, such as RKO Television Corporation, are set up to make film exclusively for this market. Such a product will be designed for satisfactory reproduction on the small home receiver screens and will thus take into consideration the restricted detail of the reproduced picture, as well as the many problems of proper lighting, action, and length of the program. Whether such television film will stem from our present studios in Hollywood or whether it will have a less elaborate antecedent remains to be seen. Before the war, several other corporations proposed making short subjects for television, but the restrictions on materials and personnel soon curtailed their activities. Films have already been produced experimentally at a cost that might be underwritten by a group of television stations, but these pictures are usually devoid of the name stars and the lavish Hollywood aspects that the average audience has come to expect whenever film is projected. Taking all phases of the production and distribution problems into consideration, we still find it a matter of conjecture whether or not a minor independent company will be able to compete with the majors of filmdom in either price or quality in furnishing specialized film for television.

Short Subjects

Film shorts many times have a definite entertainment value and as such find ready use as program fillers while scenes are being changed in the live-talent studio in preparation for the next segment of the program. Among the more common sources of this type of picture release are the shorts made available by commercial libraries, and "Soundies," designed for a three-minute juke-box showing.

Several commercial advertisers have also produced some excellent subjects extolling their produce in a subtle manner. To the average audience a good educational selling type of film is satisfactory entertainment, provided the material screened is of general interest and the advertising message is not overemphasized. Among the better films of this classification are some of the extremely clever reels put out before the war for automobile manufacturers by The Jam Handy Film Company and other independently owned film laboratories. In these reels the actual selling of the product is subjugated to the creation of entertainment. For instance, the Packard Motor Car Company sponsored a production of a series of "film tours through the country" that proved most acceptable as television fare. The only direct advertising used, outside of the title credits, was the familiar Packard radiator cap as seen through the windshield of the car. Subtle as this commercial message was, the Packard trademark remained in the lower foreground of the picture throughout the entire telecast. Such clever handling of combination commercial and entertainment shorts will in all probability find a ready market in television.

Civic films can generally be classified as an educational release rather than entertainment. They are generally designed to describe the life and customs of "San What's Its Name" in an



Courtesy NBC

FILM CONTROL DESK FOR NBC'S FILM STUDIO

informative manner. As a possible program for geography students, this type of picture may become a common listing in that it gives an excellent visual picture of the city or country being described. To the audience, however, these civic films are often little more than fillers that take up program time and as such attract few people to the television receiver by reason of their own program importance.

Travelogues, like civic films, are not likely to solve the problems of a ready and extensive source of film material for television. Such subject matter, with the possible exception of reels, which may contain timely coverage of a particularly newsworthy town or country, again remains just another program filler. It has been television's sad experience that these travel pictures generally consist of a series of long-shot panoramas that, while beautiful to the photographer, lose all their value when reproduced on the small television screen. Travelogues can, however, be used satisfactorily to punctuate the discussion of some noted explorer—a variation that holds considerable promise in the future. In 1939 NBC ran a series of this type of program featuring noted explorers and travelers. In these instances the film was secondary to the commentary and was tied in directly with the "name" explorer who was acting as narrator.

Sport reels, fashions, as well as the hundreds of other special releases, serve, just as they do in the motion-picture theater, merely as program fillers. They will be available in quantity and not "dated" and will probably continue to be economically satisfactory for filling broadcast hours, but here again little box-office value can be expected from their use alone.

Cartoons

Animated cartoons are considered one of the best types of short subjects available, the technique of cartooning being particularly well adapted to television reproduction. The predominating black-and-white lines that make up the subject matter are easily reproduced by nearly any television system. The humor of the cartoon comedy, while normally unsophisticated, will still bring a chuckle from the most hardened film critics. Inasmuch as the cartoon product of the major studios is still not available to the broadcasters, the program importance of this superior product has yet to be evaluated. If and when these feature cartoons make their appearance over television, it is believed that such programs will reach new highs in general popularity. Color cartoons such as are now being used for theater showings can be reproduced satisfactorily over the black-and-white television systems. Little depreciation in detail is noticeable in this conversion from color to monochrome through the pickup tube.

Training Films

Just before the war there was considerable activity among the independent film studios on the subject of educational shorts of the "how to do it" variety. (See the chapter, "Television in Education.") After Pearl Harbor, the armed forces took active interest in this type of motion picture. Thousands of these one- and two-reel subjects have already been produced by the Army and Navy in their training programs, and, while a great many of these will be of no use after the war, the groundwork has been laid for a major development in the educational field. The armed forces have proved that a good film properly written and produced can teach as well as, and in some cases better than, an actual instructor. With the wealth of monies at their command, the armed forces have been able to carry on the much-needed research into techniques of visual teaching, and these will be inherited by our educational systems after the war. While instruction film can hardly be construed as entertainment, there will, without doubt, be plenty of air time during less important morning and afternoon hours for material of this kind. Having seen at first hand the remarkable effectiveness of teaching by film and visual aids, the author cannot but anticipate that education by televised films will take an important place in our post-war programming.

Newsreels

Newreels are the enigma of the trade. Whether these bi-weekly releases are destined to be one of the answers to the tele-film problem or merely another type of filler depends on the timeliness of the release to the broadcaster. The active life of a newsreel film is considered to be three days in first-run theaters, with two or three weeks covering the entire life span of its showings in neighborhood houses. Just where television will have its innings in this time cycle of the newsreel has much to do with the value that can be expected from this type of program material. If television were allowed to broadcast newsreels within five days of their release in the first-run houses, there is no doubt that the program would have definite value, but if the

Courtesy NBC

A PHOTOGRAPH OF A TELEVISION PICTURE BROADCAST IN NEW YORK FROM FILM TAKEN IN CHICAGO DURING THE DEMOCRATIC CONVENTION IN 1940, SHOWING POSTMASTER FARLEY ADDRESSING THE CONCLAVE

release to the broadcasters were held until after playing the reels in the nickelodeons it would be useless for television. Here again, unless the material screened can offer quality and timeliness it will not draw large audiences to the receivers.

Several major television operators have considered developing their own newsreel organizations to guarantee this time element so necessary to this type of program. That would be an excellent solution if cost were of no consideration and if the broadcaster could conceivably support the network of cameramen and branch offices that a successful newsreel demands. Without an equivalent organization to that now used by the film-news companies, the product will be little more than a candid coverage of local news. In spots where no television station or network outlet exists to pick up the event directly on the electronic cameras, many broadcasters will probably turn to some such semi-newsreel arrangement. Such a plan would permit television coverage of scheduled events that occur at some distance from the station and would bring to the audience firsthand pictures of coronations, parades, national political conventions, ship launchings, and the like. Logically, if this service is not furnished by the newsreel companies at a price the broadcaster can afford to pay, television will then have to establish its own news-covering units. NBC made history in 1939 by covering the Chicago Democratic Convention with film cameras and later broadcasting this film each evening in New York after flying the celluloid East and developing it en route. In 1944 RKO Television Corporation took over the responsibility of filming the Democratic National Convention in Chicago with subsequent New York showing the same day. There is no doubt that some method of newsreel release will be used in television, inasmuch as such material with its timeliness and general interest fulfills the normal requirements of good video entertainment.

The Condensed Feature

The release of major pictures during their active box-office life in the theater is a problem that today has no answer. Hollywood at the present time turns a deaf ear to the repeated requests of the broadcasters for feature pictures at a price comparable to that paid by a motion-picture exhibitor. To grant such a request would only create additional competition for their regular customers, the movie exhibitors, who have supported and built the motion-picture industry. On the other hand, if the movie studios fail to consider this new and potentially large outlet, they may find to their great surprise that this market will someday outrank the demands of the theater trade.

It is the belief of many broadcasters that a condensed version of first-run features will eventually be made available to the air lanes during the time they are still popular in the box office. Such a condensation offers even more problems than the release of a story on an "as is" basis because condensation requires additional editing, cutting, and rewriting, all of which will perforce have to be done by experts. This procedure would, of course, add to the cost per foot of the release. A condensed version, furthermore, fails to answer the complaint of the movie exhibitor about being undersold in his local market.

Some students of the problem believe that the production of film for television could be simplified considerably, thereby bringing about the reduction in rentals that are so desired by the broadcasters. For instance, many of the costs of a feature picture are hidden in the subtle details that are so evident on a theater-size screen but that are completely lost on a television screen. There is no doubt that the technique of direction and photography now being used could be simplified, thereby reducing the overall cost of the production. Yet, no matter how radical the cuts that could be made in this department, the major costs of the story, studio, overhead expenses, and the name-star salaries still exist. It would, therefore, appear that any attempt to rebuild a major theater release for television's exclusive use would tend to increase rather than decrease the cost of film to the broadcaster. In addition, the cost of such a special version would fall entirely on the broadcaster, rather than be shared by the movie theater as well.

Without doubt the average motion picture of today would be benefited by judicious cutting for television use. Intelligent editing of these multi-reel stories would tend to speed up the pace as well as to discard sequences that could not be handled satisfactorily by the broadcast system. Such editing and cutting would again increase the net cost of the product—a cost that today is far above the intrinsic value of the material as a program.

Insert Work

The use of film for insert work in television apparently does not present so many problems. By "insert work," reference is made to the process of projecting film into the live-talent television broadcast to cover sequences that are not readily available to the studio cameras or the mobile-unit crew. Such an insert might be a "stock shot" of the fleet or the take-off of an airplane, which could serve as a "bridge" in resetting the locale of the story being televised in a studio. Many such shots are available today on a rental basis from film warehouses, or in some cases as material that has been previously photographed by the film crew of the broadcaster. The now famous television showings of *The Three Garridebs,* presented by NBC in 1939, used this type of film insert to cover the transition period where Doctor Watson and Sherlock Holmes left their quarters to investigate the crime. By filming several sequences of the cast in Central Park before the broadcast and introducing this material into the show at the proper time during the air show, it was possible to depict these two famous characters boarding a hansom cab and clattering down the street from the locale of the first act and arriving at the exterior of a house, which was the setting of the second act.

Other Uses of Film

Although not employing film in the strict program sense, there are two other applications of film in television that may be mentioned as affecting the industry. These systems use film in lieu of certain electronic components of the standard television equipment and are divided into two classifications—intermediate film in the pickup camera, and alternate film in big-screen television equipment.

In the intermediate film pickup system, used somewhat extensively in Europe before the war, the subject is photographed by a motion-picture camera rather than by the television camera. The film record is then fed directly from the camera through an accelerated-development system to a modified film projector, where it is projected on the iconoscope tube and converted into electronic impulses. This method makes use of the high-emulsion sensitivities available in film and the fast lenses of the motion-picture camera in recording the action, and is used to advantage in cases where light levels would be insufficient for electronic photography. It further allows high-light intensities to be used in projecting this film into the television camera. In this dual method there is a delay of minutes between pickup and projection, as well as an excessive film cost. Whether or not this time delay and extra cost are counterbalanced by the increased efficiency of pickup and projection and the permanent record thus produced is a subject for argument between the proponents of this and the all-electronic system of television.

Alternate Film—Big-Screen Television

The alternate film method now being perfected for large-screen theater projection work does have a promising future in the field of big-screen production because it furnishes the theater operator with a film record that can be fitted into his program without upsetting his advertised schedules. In this system, a motion-picture camera records the television program directly from the face of a television receiver on standard motion-picture film. The film then goes through quick-development tanks to a drier and in some cases a printer, thence into the regular projection booth to the theater, where it is either reviewed or thrown directly on the screen. This process also makes possible a more satisfactory level of illumination on the theater screen by utilizing the standard high-intensity arcs of the projection equipment.

It further provides a photographic record of the material received over the air that can be edited before showing, as well as one that can be used for more than one showing. These advantages, coupled with the aforementioned flexibility of fitting the television program into the exhibitors' schedule, may be a very important function of film in post-war television.

35mm vs. 16mm Film

There has been considerable discussion among station operators as to the advisability of using 16mm film in preference to the standard 35mm frame size. From the economic standpoint, quality being equal, it would appear logical that the less expensive 16mm film would be preferable. Without general assurance that feature subjects will eventually be rephotographed on the smaller film, there are many other considerations that affect the broadcasters' choice between 16mm and 35mm film equipment.

The present 16mm stock is usually produced on slow-burning stock and therefore requires the minimum investment in setting up the projection room. On the other hand, 35mm film is printed on nitrate stock, which requires completely fireproof booths and other safeguards against fire hazards specified by the underwriters.

Because of the reduced area that must be illuminated on a 16mm frame and the short optical path from lens to mosaic, small incandescent lamps are apparently satisfactory for light sources. On the other hand, in using 35mm film it is still necessary to use high-intensity arcs for proper illumination.

The actual picture definition available in the 35mm frame size is considerably higher than that found in 16mm. If present-day television systems were able completely to resolve all this detail, such a fact alone would make the larger film the more practical size, but unfortunately the electronic conversion processes now in use are not capable of such definitions. Those who have given the subject some study find that a 16mm frame contains about the same number of possible picture elements (650,000) as can be resolved by a perfect 525-line television picture. Such reasoning would indicate that 16mm stock would normally be satisfactory for present-day standards and there would be little need to go to more expensive 35mm equipment. We cannot, however, expect to find either perfect film or perfect television, and for that reason other factors must be taken into consideration. The present channel assignments for television have set aside frequencies that will allow experimentation with higher lineage pictures. It is, therefore, reasonable to believe that eventually the television camera will be able to scan many more available picture elements than can be contained in a 16mm frame.

The sound track on the 35mm film is of better quality than that found on 16mm—a factor of utmost importance to the sight and sound broadcaster. This improvement in fidelity is brought about both by the increased area available on the larger film for the sound track, and by the increased distance of the sound from the sprocket holes. While the proximity of sprocket holes to the sound track may appear to be a minor consideration, it is one of the principal causes of sound aberration in the smaller film. This defect, known as sprocket-hole modulation, is caused by the film's being distorted about the perforation by the repeated "pull downs" resulting in a low-frequency hum being superimposed on the audio output.

Film Pickup Systems

The television equipment for projecting 35mm film is an adaptation of equipment used in a regular motion-picture booth, while the projector for 16mm film resembles the commercial home-movie outfit. Both types of projectors require a redesign in the pull-down and shutter system to utilize standard film on television effectively.

Two types of pickup tubes will be found in television film projectors, each having its respective advantages. Because of the simplicity of the mechanics involved, and the adaptability of standard projection equipment, most studios use some variation of the iconoscope or storage-tube system. The Farnsworth Dissector Tube is also widely used, both in this country and abroad, because of its excellent reproduction of halftone values. This latter system demands some continuous method of scanning which is generally more intricate than the intermittent pull-down method used by the iconoscope.

Alternate Scanning

The system of alternate scanning was developed to compensate for the difference in frame frequency between the standards set for motion pictures and television. In viewing motion pictures in the theater, we see a series of still pictures, one appearing every twenty-fourth of a second. The eye retains the image seen on one frame as it views the next, thus creating the impression of continued motion. Television frames, because of the 60-cycle reference base of our synchronization system, must appear as a sub-multiple of 60, and not as a multiple of 24, as do standard motion pictures. To project 24 pictures per second into a system that reprojects at a rate of 30 frames per second results in a progressive error in reproduction as well as frequency distortion of the sound track. To overcome this discrepancy between the two standards, television has turned to a mathematical solution, wherein the 24-frame standard product is intermittently scanned to produce the equivalent of 30 frames per second on the receiver. Due to the fact that the sound track and the photography on standard film is gauged for reproduction at 24 frames per second, any attempt to speed up the number of frames shown per second would result in a marked increase in speed of animation and a perceptible rise in sound frequency. It was, therefore, a requirement that the film travel through the projector at the rate of 24 frames per second and that some mechanical or artificial conversion be accomplished external to the projection system, which would permit the iconoscope to see 30 pictures per second. This is accomplished by utilizing the storage principles of the iconoscope and redesigning the standard motion-picture projector pull-down mechanism so that the film remains stationary before the lens for 1/20th of a second for one frame and 1/30th of a second for the next. The mathematical average of 1/20th of a second and 1/30th of a second is equal to 1/24th of a second, the designed rate of the film. With such a mechanical arrangement of staggered exposure, it is then possible to create a scanning cycle on a 30-frame-per-second base. This is accomplished by having the frame which remains 1/20th of a second scanned by three 1/60ths of a second fields, and the next frame which remains only 1/30th of a second scanned with two 1/60ths of a second fields. By thus viewing one frame twice and the next frame three times, we artificially convert the 24-frame rate to one based on a 60-picture-field-per-second rate without changing the speed of the film. In order to accomplish this conversion without putting excessive strain on the film or pull-down mechanism, the shutter arrangement is designed to shut off light to the iconoscope during the scanning intervals and collect the picture from the storage tube during the retrace section of the scanning cycle.

Other methods of converting the 24-frame film to television standards have been used successfully. Notable among these propositions is the system proposed and used by Columbia Broadcasting, where conversion is accomplished without resort to moving optical units, and the equally ingenious arrangement of rotating lenses credited to Bamford, of the Farnsworth Laboratories, wherein the necessary integration is accomplished from a film moving continuously by the aperture at a rate of 24 frames per second.

Some of the film that is considered acceptable for projection use in theaters cannot be used in television. Excessively high contrast ratios in photography and rapid changes of lighting key present the same problems to the film-scanning cameras as would similar conditions in direct studio pickup work. For this reason, it is the practice of broadcasters to review all television film before exhibition in order that the required shading changes can be logged before the actual broadcast. If and when the economics of television permit the production of film expressly designed for this medium, these present excesses in contrast and lighting can be overcome in the original photography. On the other hand, it is reasonable to believe that the electronic system will continue to improve and that eventually the television film scanners will be capable of resolving all standard film with equally satisfactory results.

Conclusion

Whether or not film in television will increase in importance in future commercial programming remains an economic rather than an engineering problem. Based on the present development in this field, coupled with the possibilities that are known to exist in future improvements of the system, the popularity of film programs in the home is solely dependent on the entertainment value of the product. It is hoped that a satisfactory solution to the present economic impasse between broadcasters and film distributors will someday be effected and that eventually television will have a satisfactory film product available for programming.

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Color Response of the Television Camera

IF A person were to look at a rainbow in which all the colors from the red end to the blue end possessed the same measured intensity, the eye would see and the brain would interpret the yellow-green section as the most brilliant color. This is because the eye records the greatest sensation in the center of the visible spectrum of colors, with this sensation falling off to toward zero as the coloration approaches red or blue.

The range of frequencies that comprises light does not, however, end at the limit of our optical visibility, but exists as invisible light energy on either side of this visible band. Frequencies close to, but below, visibility comprise the infra-red or heat-energy spectrum, while frequencies close to, and above, the upper range of visibility are termed ultra-violet.

Even though the eye does not record any appreciable sensation at frequencies below deep red and above blue, the electronic equivalent of the eye, the photosensitive camera tube, is capable of recording and reacting to the energy contained in these invisible wave lengths.

At the center of the visible spectrum, the human optical system undergoes the greatest electrochemical reaction, creating the sensation that yellow is the brightest color. The iconoscope sensitivity is not as evenly distributed over the frequency range as is the normal eye and therefore its response to color will not be the same.

The sensitivity of the photoelectric substance that produces electronic energy from light is sometimes extremely sensitive to the infra-red frequencies of which the eye is never aware. For this reason, the television pickup tube will have an increased reaction to colors containing red. This color response variation between the normal human eye and the television eye creates a seeming discrepancy in the camera's interpretation of color. Because this difference in response is greatest at the lower or red end of the spectrum, we say that the average television camera is "red sensitive." This characteristic increase in response to red by a camera, where the eye would normally experience a decrease, gives rise to strange and bothersome problems in reproduction.

If the colors of the rainbow, as seen by the eye, were to be resolved into a black-and-white equivalent, we should expect a scale of halftones ranging from black through white to black. The normal eye will see and record a red object as a minimum sensation, or black. A television tube, on the other hand, with increased sensitivity in the red end of the spectrum will see red as an appreciable amount of light energy and will record it as a light gray or white. The interpretation of red by the camera, therefore, does not agree with what the eye is accustomed to expect from red, and we say that the reproduction is distorted. In order to correct for this evident discrepancy in reproduction, we artificially change the colors, which in reality are red, to some less sensitive color and thus produce in the receiver the halftone that we would ordinarily expect to see in black-and-white reproduction.

One of the most typical examples of this red discrimination of the pickup tube is brought out in televising a girl's face. The lips, as we resolve them through our human optical system, stand out sharply in contrast to the face. The addition of lip rouge intensifies this optical contrast. In the uncorrected television equivalent, these same red lips have lost their contrast and under certain conditions of lighting would probably not register at all. Such a picture would be both disappointing and unnatural. Now if this model used some color on her lips that the television camera would record as a deep halftone, the naturalness of the picture would return. It has been found that blue, or blue combined with other colors, registers in both the television eye and the human eye as a dark halftone. By using a mixture of red, yellow, and blue pigments in varying proportions, we can create a deep reddish-brown lip paste which, by reason of its greater blue content, will record in the camera as a satisfactory deep gray or near black. Although this color cannot be considered as essentially pleasing to the eye, it does not result in the grotesque effect that would attend the use of blue or black lipstick.

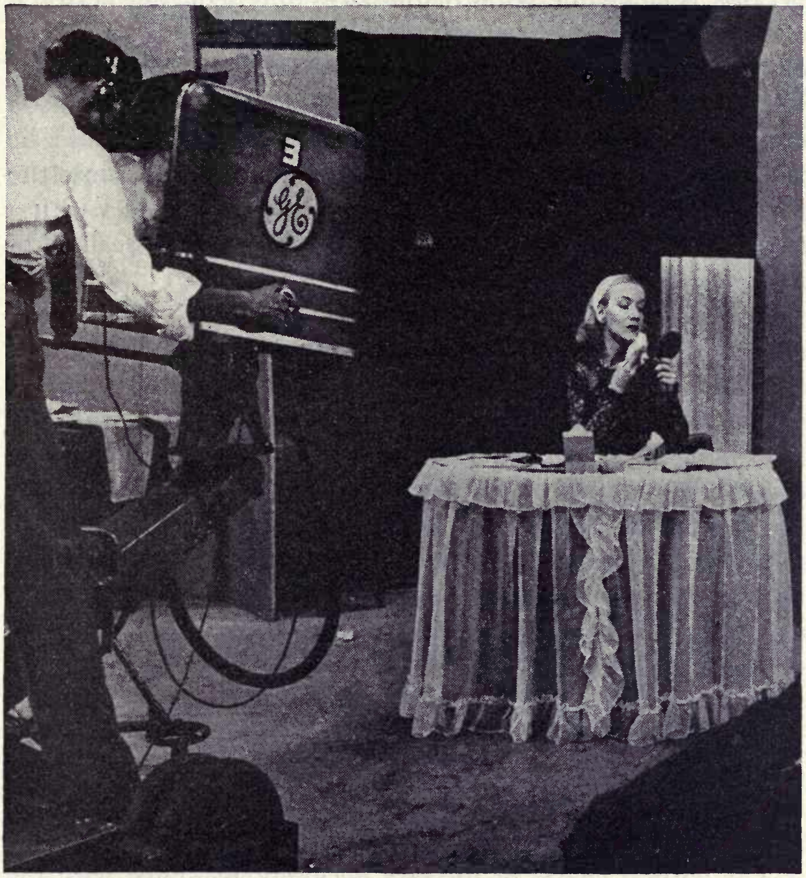
There have been many proposals of exotic and even weird make-up combinations for television, all of which accomplish the same result on the receiver. By appreciating the reason for make-up and the corrections that must be made, one can see that either black, blue, or purple lips will produce the required contrast to the face. Likewise, a gray, white, yellow, or orange base paint could be used to create the proper halftones on the face.

Such a practice does not find favor with either actress or actor, even though it might add to the novelty of a television production. At NBC the make-up department tried to come as close as possible to a natural sun-tan color in selecting the pigments that would bring out the required halftones. This logical approach to naturalness in make-up pays dividends in combatting the self-consciousness of the novice, so often evident before the camera.

In specifying make-up for television, the primary concern is to change the existing coloration to one that will appear natural-looking on the television screen. Just as the red lips will be lost in the reproduction process, other facial features normally delineated by a more subtle coloration may also be obscured. It is, therefore, generally necessary that the entire face be retouched if our television picture is to be satisfactory to the observer.

If the proper contrast between the face and its features is to be maintained, a base or standard to which we can refer this contrast must be established. The normal skin will vary over wide limits in its degree of reflectivity of light, and as a result the reproduced whiteness of the skin will vary greatly.

The first step in producing a satisfactory television make-up is to reduce the skin to a base color that experience has shown will register correctly in the camera. This coloring is commonly known as a panchromatic base and is produced in a cake or



G. E. Photo

MISS LYNN ENGLER, POWERS MODEL, DEMONSTRATES HOW TO APPLY ELIZABETH ARDEN COSMETICS FOR GENERAL ELECTRIC'S TELEVISION STATION AT SCHENECTADY

cream form by several leading cosmetic houses. Since the color of skin naturally varies in people, it is necessary that we provide a variety in the tonal qualities of this panchromatic base paint. Many shades of this tan paint are available and are designated by number. Television has used with success the range from Number 26 to 29 in Max Factor's product.

Before applying the base paint, it is usually wise to apply a good grade of cold cream to the entire face, rubbing it into the pores with the finger tips. This is done for two reasons—first, because it closes the pores of the face, thus reducing perspiration; second, because it allows the make-up to be removed more easily. When no more cold cream will be absorbed by the skin, the face should be wiped dry with tissue, and the chosen shade of panchromatic paint applied. This toning color should be rubbed in or stroked on thoroughly, extending it well into the hairline and the neck. Excess paint should be removed with a soft tissue and the eyebrows and lip line completely cleansed of any trace of it.

The face is now ready for the treatment of high light and shadow, which will accentuate any pleasing line and contour and suppress or nullify any negative quality. By using lighter shades or white base paint, known as "liner," it is possible to high light the features that must be emphasized, and by using deep blues and browns it is possible to put shadow and character lines on the face. *Where* the high lights and shadows on the face should be placed will be the subject of individual experimentation by the make-up artist in dealing with each subject. In all cases these lines should be smoothed into the base paint to insure proper blending.

As in photography, rouge is seldom used, because in television it would have to be either a deep and contrasting brown or some shade of blue in order to register. Rather than darken the cheeks by adding these colors, a light liner is sometimes used high on the cheekbones.

The natural charm of the face is closely associated with the eyes, so it is necessary that we accentuate these features if we are to insure a true television reproduction. Eye shadow in either blue or green has been found to be satisfactory if applied above the eyes. The use of mascara on eyelashes has given excellent results.

When the retouching process is complete, the entire face is dusted with a light, semi-transparent, panchromatic powder through which the accentuated detail will appear as extremely subtle tones of light and dark, but which are still capable of excellent registration in the camera. All excess powder should then be removed from the eyebrows and the hairline with a soft brush.

The application of lip rouge is the next step. The average actress is so adept in this department that little or no explanation will be attempted here. However, extreme care should be exercised in applying lip rouge in order to prevent overexaggeration of the natural lines of the mouth. There are several types of obtainable lip make-up that will conform to the coloration demanded by television. The majority of actresses use a paste, which they apply with a fine-pointed camel's-hair brush. An objection to this type of lip rouge is its tendency to cake under the drying influence of the lights. Some cosmeticians increase the oily base of the base paint by the addition of extra lanolin to the formula, but the recent introduction of a vegetable lip dye may prove an easy solution to the problem.

The hair is an important consideration in any portrait. To insure the proper values of light and shadow, the natural lights of the hair are accentuated by spraying brilliantine into the finished coiffure. In some cases, it has been found expedient to sprinkle a fine powder of "sparkle dust" in the hair to increase its reflectivity. The style of hair-do selected will be a matter of personal choice, but it should flatter the subject from all camera angles. Exaggerated styling will sometimes present a grotesque appearance to any but the full-face camera angle.

Making Up Male Talent

Contrary to general impression, this necessity for corrective make-up is as important for men as it is for women. If the beard of a man is dark, it will record in varying dark halftones, dependent on the length of time since shaving. Even the freshly shaved face will have a tendency to register in tones that are darker than normal because of this nearly invisible beard stubble. This overrecording of the beard is the antithesis of the underrecording experienced in the red lips of an actress and, therefore, is corrected by opposite methods.

Normally, unless playing a character part, a man does not like to wear grease paint. This is especially true of news commentators and speakers who have only a short appearance before the camera. In these cases, it has been found that the dark effect of the beard can be corrected and an even skin tone obtained by lightly dusting the face with panchromatic powder. Many male novices in television object to even this procedure until negative audience reaction forces their hand.

Coiffure problems in men are limited to the corrective treatment of bald heads. A well-oiled, perspiring, hairless skull can easily become the center of interest by reflecting each light in the studio directly into the camera. Unless this effect is required in the script, the make-up man has ample chance to practice corrective treatment. Experience has shown that the application of large amounts of panchromatic powder will reduce the reflectivity of a bald head.

Make-up in television has become an art of correction rather than an attempt to beautify the subject before the camera. When cosmetics are carefully selected and properly applied, the resultant television picture is both natural and pleasing. It is necessary that detailed care and sufficient time be given to preparation of make-up for a television appearance because of its important contribution to more attractive pictures.

Costuming

Costume reproduction is again a matter of color sensitivity, coupled with reflectivity of the fabric. A television picture is made up of the light that is reflected back from any object, which is, in fact, the actual color seen by the eye. For this reason, we may expect to find a jet-black satin dress appearing as a very light-colored costume to the television camera, while a deep-pile material of a much lighter shade will appear very dark. Typical of this peculiarity of reflected light is the normal television reproduction of a tuxedo coat. The black broadcloth of the coat will generally appear black, but the reflective satin or grosgrain lapels on the tuxedo reproduce as a very light gray, giving a novel but disconcerting variation to this costume! Too much contrast between parts of the costume and face will result in the loss of effects of one or the other, or an unsatisfactory reproduction of both. For practical purposes, NBC has stipulated a light yellow shirt and tie for dress for the actors on the video stage, as a means of reducing the black-to-white contrast to practical limits.

Soft materials are generally a safe choice in any setting, since they do not throw back the light in unpredictable amounts. Tweeds and sport clothing and off-white linen comprise a good television costume for announcers or commentators. Dresses with necklines or collars made of a material similar in color to the hair can always be counted on to produce satisfactory picture results. Floral prints and large patterned prints also televise well.

Stage Settings

In considering the color problems presented in the design of stage settings, we must again take cognizance of the television camera's tendency to react to red. Even though the actual color of the paint used on the scenery may be far removed from red, as seen by the eye, the existence of red pigmentation in the paint may cause the camera to record a completely different halftone from that desired or expected.

Most set designers in television have found it necessary to use grays, whites, and true blacks for this reason. It is comparatively easy to keep these basic tones free from the colors that are known to cause color aberration. Use of monochromatic tones in painting scenery gives the designer an opportunity properly to evaluate the halftone balance of his work before the telecast rather than trust to the sometimes erratic interpretation of the camera.

No make-up or costume can be effective if during the telecast the subject blends into the backdrop. For this reason, it is necessary that the studio be equipped to handle the various types of subject matter that will normally be brought before the cameras. A set of three velours backdrops in white, gold, and navy blue have been found to be very satisfactory for setting the stage for impromptu acts that do not require more than an abstract background for stage dressing.

By choosing the backdrop color that will provide the most natural contrast to the subject, you can maintain the proper balance between the featured act and the setting.

Here again it would be possible to employ tones of black, gray, and white to obtain equivalent results. Most studios prefer, however, to use predetermined colored drapes that will register in known halftones, rather than employ the more somber shades of black and white.

Some attempts have also been made to substitute similar tones of brown and white for black and white in painting the sets. Results to date have been quite satisfactory and may lead to the adoption of this practice in general studio work.

The problem of combatting erratic color registry has always been a topic of discussion among the program and engineering fraternity charged with producing "natural looking" pictures. All television systems normally require some corrective compensation in color, fabric, or material to insure that the reproduced picture will be a true portrayal of the scene before the camera. For that reason, the staff of any studio should be well versed in the reasoning that underlies the practice of color compensation in television.

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Studio Design

TELEVISION has not as yet progressed to a point where studio specifications can be considered standardized. Experimental installations now in use or under construction vary widely in proportions and in the type of equipment used.

Even though many of the television installations do not as yet resemble the motion-picture lots in anything but the complex assortment of stage settings, cameras, lights, and cables, the trend of design appears to lean toward the style of Hollywood sound stages rather than toward that of radio-broadcast studios. In attempting to satisfy the recommendations of the engineers and producers who are working in the present cramped bandbox settings, architects have brought out many new and ingenious innovations. Some of the ideas incorporated in these proposals are excellent and should bring about a general simplification of production problems. Other suggestions are considered too radical in concept to warrant large capital investment for the necessary physical experimentation. All the plans proposed to date are based on a larger floor area and a greater ceiling height than are found in the converted radio studios that are today serving as television stages.

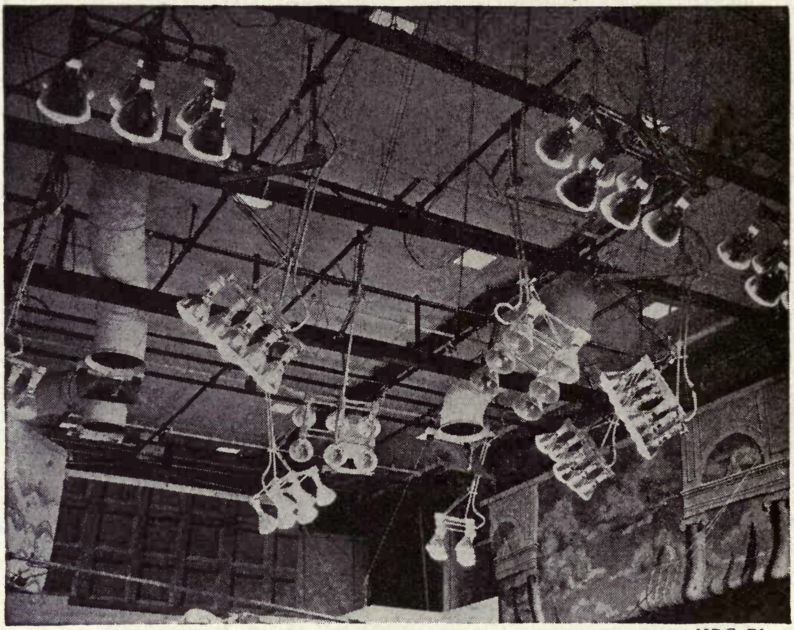
The pattern of the present-day television studio has developed logically from that used in radio broadcasting, since television was originally a by-product of this aural art. In television's infancy such space as could be spared by the radio broadcasters had been temporarily turned over to the video engineering group for experimentation. As this experimentation grew in

CBS Photo

CBS TELEVISION STUDIO SHOWING USE OF FLUORESCENT BANKS importance, as well as in magnitude, these temporary quarters became permanent because of the cost involved in moving equipment. In many cases it would have been utterly impossible to move these early television installations with any hope of salvaging the equipment or without going off the air for an extended length of time, since a major part of the apparatus was hand-built. For this reason, most stations grew up in the environment in which they were originally conceived and have since then suffered growing pains as they approach maturity. As these ex-radio studios were converted into television stages, much of the original audio and acoustical equipment was retained and put into use, establishing standards that in some respects were misleading. For instance, acoustical treatment of walls and ceilings was pointed more to the success of a radio show than to the staging of a telecast. Irrespective of how perfect the reverberation time of an empty studio may be, the introduction of resonant flats used in stage settings, carpets, and backdrops will reduce the significance of the work of the best acoustical designers.

Planning the Studio Area

The proportions of the average radio studio, strangely enough, come close to the ratio preferred by most television producers—approximately 1½ times as long as it is wide. Such a rectangular area, with the control room located on one of the narrow ends, allows the maximum use of the floor space for camera work. If television cameras were free to roam in any direction or for any distance, the square or round studio floor might be feasible, but with the cameras tied to the control room wall by coaxial cables, as they must always be, the rectangular space is considered most efficient. In an area of this shape, a series of secondary stages can be built along the side walls, thus reserving the end walls for the larger and more important sets. In this way the full length of the studio can be used for dolly shots on the big end stages, leaving the width of the studio available for the more intimate camera coverage normally staged on the secondary sets. Individual production problems will determine whether this optimum arrangement will prove adequate in all cases, but even in the many production situations already investigated, the $1\frac{1}{2}$ to 1 ratio is still considered satisfactory. In most cases where the television studio is an adaptation of the space originally occupied by some other activity, such as radio, the ceiling height will be found to be lower than desired. This low ceiling is further accentuated by



NBC Photo

OVERHEAD COMPLEXITIES OF A TELEVISION STUDIO, WNBT, NEW YORK

television's requirement that extensive use of the ceiling be made for lighting equipment, stage hangars, and a restricted equivalent of the theater's gridiron. The maximum height of stage sets will, therefore, be about four feet less than the ceiling height to allow for this overhead equipment. For this reason, also, a great deal of care is required in setting the cameras for long shots on the end stages, lest they pick up the unwanted complexities of the overhead installations along with the drama.

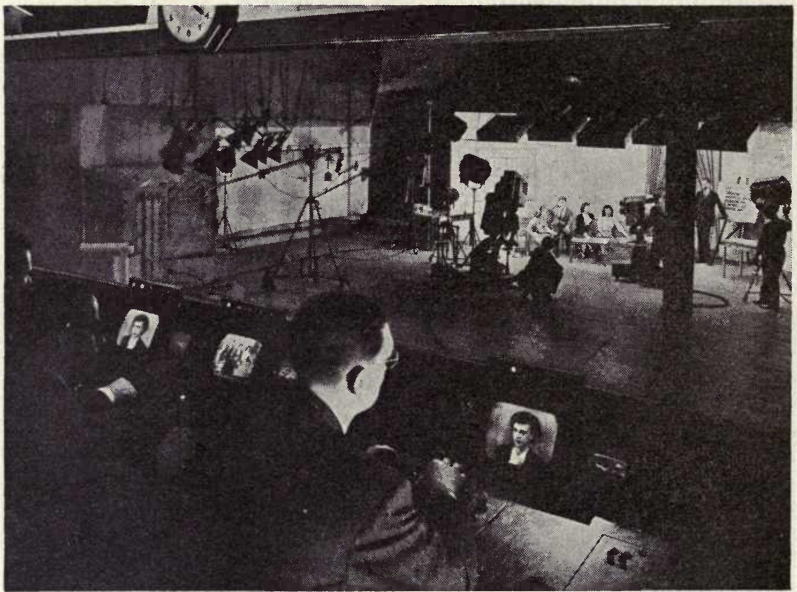
In Studio 3H at Radio City, NBC's 30 × 50-foot former radio studio, a ceiling height of eighteen feet was available. This low ceiling brought about considerable restriction in the use of long camera shots and limited the overhead suspension of stage and lighting properties. In this studio, a 14-foot flat was normally used in constructing the sets. In several instances, NBC has used a condensed, two-story set with reasonable success by shifting the overhead equipment and thus making practicable the use of 18-foot flats.

NBC Photo

SEMI TWO-STORY SET USED IN NBC'S TELEVISION STUDIO, NEW YORK

In ceiling height, as well as in floor space, the studio of WCBW, Columbia's television outlet in New York, is the envy of every operator. To all intents and purposes, the possible ceiling is unlimited. Practical usage, however, has dictated the suspension of a false framework from the rafters, to support lights and drops that are close to the working area. Columbia's main staging area measures 56×87 feet, with an available 34-foot ceiling height.

Station WRGB, General Electric's station in Schenectady, although not designed specifically for television, probably represents one of the more ideal arrangements now in use in this country. This studio area, with a floor measuring 42×70 feet, is considered well-balanced for television work. The 25-foot ceiling has made possible the ceiling-mounted, motor-controlled lighting system, as well as the 18-foot flats on the set. A studio of these proportions has proved particularly advantageous in staging the larger television productions scheduled by this station.

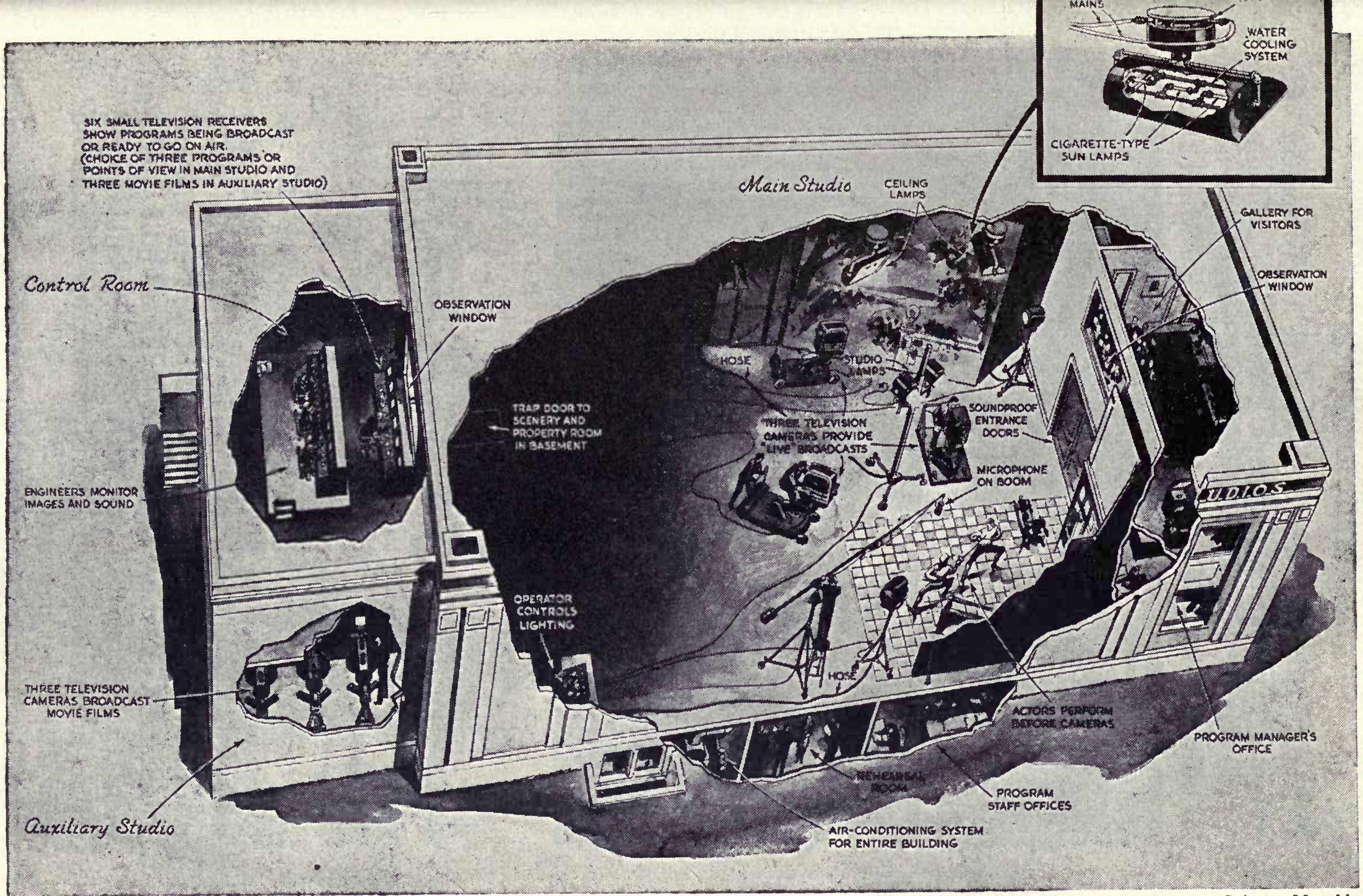


CBS Photo

STUDIO FLOOR AS SEEN THROUGH CONTROL-ROOM WINDOWS AT WCBW, NEW YORK

The new Don Lee Studios atop Mt. Lee in Hollywood represent one of the first designs created specifically for television. In this operation, the influence of the motion-picture studios is evidenced by provisions made for movie-type lighting to be mounted on and handled from catwalks along the studio walls. The ceiling height of the main staging area, typical of motion-picture practice, is thirty feet, with a floor measuring 60×100 feet. There is also a second stage which measures 26×46 feet, with a 16-foot ceiling.

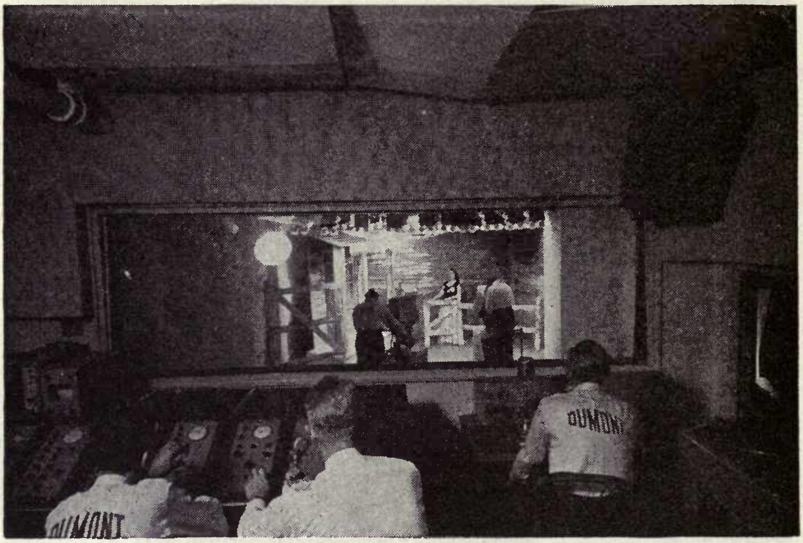
Philco, DuMont, Balaban and Katz, and Zenith all have adapted space designed for a different use and their staging areas are, in all cases, restricted as to cubic area and especially in ceiling height.



Courtesy Popular Science Monthly

CUTAWAY SECTION OF WRGB, SCHENECTADY

The WABD studios in New York are a development of the original experimental quarters assigned the DuMont transmitter group. A ceiling height of thirteen feet and a floor plan of only 15 $\times$ 20 feet constitutes the area from which DuMont originated its early programs. Later construction on a lower



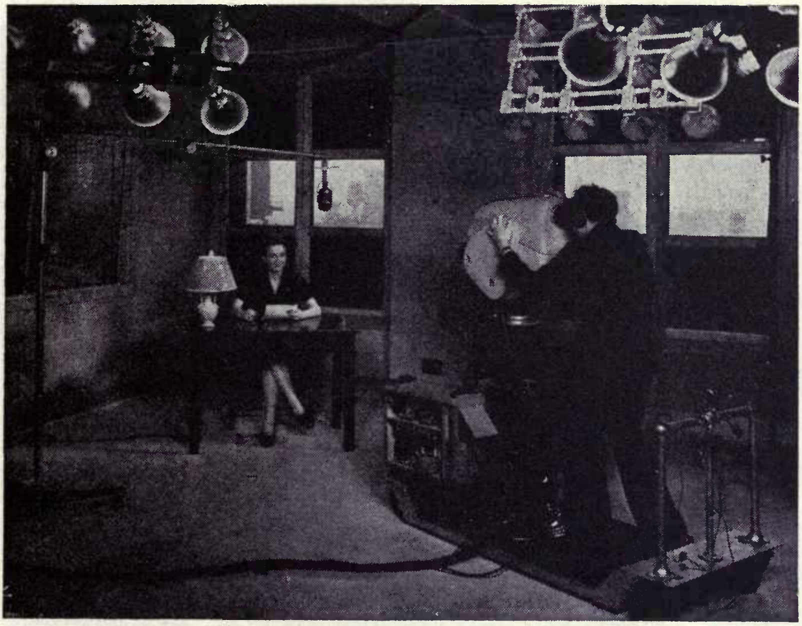
DuMont Photo

LOOKING INTO THE STUDIO FROM THE CONTROL ROOM, WABD, NEW YORK

floor amplified this space by providing a second and somewhat larger studio measuring 25 $\times$ 39 feet, but again limited to a single floor height of thirteen feet.

Balaban and Katz in Chicago had commenced construction of an extensive three-studio layout in their State Street television quarters when the war interrupted and brought about a conversion of most of this space into a Navy school. Although the two big adjoining studios would have exceeded the largest plant now in use, this station broadcasted during the war from a minor and somewhat inadequate audition studio. Here again there is a floor measuring about 16 $\times$ 24 feet, with a single-floor ceiling height restriction seriously interfering with any but the most simple productions.

Zenith, operating out of its original testing location at the factory on the west side of Chicago, is little better off as regards floor space. The present studio measurements are about 16×30 feet, with a ceiling height of eighteen feet. During the war this station limited its broadcasting to film and, therefore, the



B&K Photo

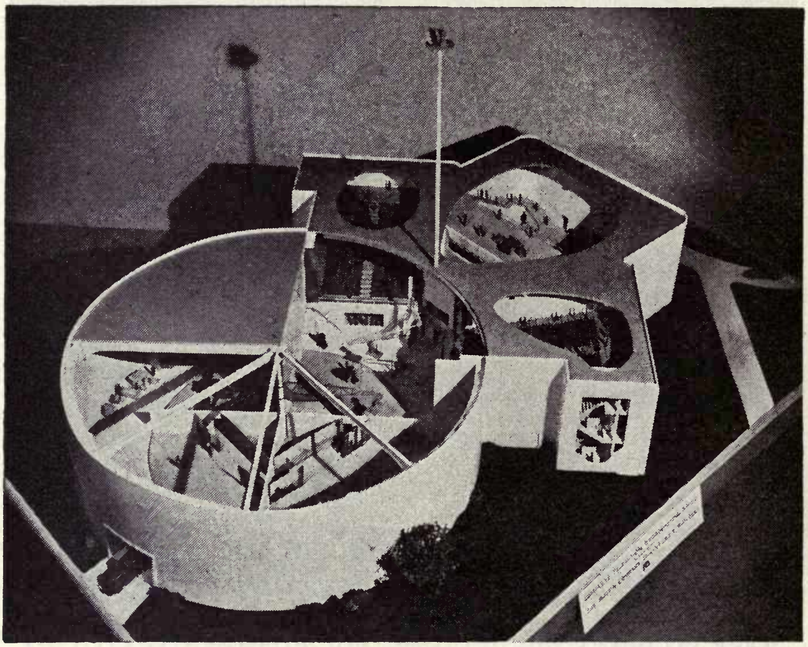
WBKB STUDIO IN CHICAGO. CONTROL ROOM IS SITUATED TO THE LEFT OF THIS ROOM. NOTE OBSERVATION WINDOW

evident space restrictions that would be placed on programming were not felt.

W6XYZ, the Television Productions Paramount outlet in Hollywood, has, like its West Coast competitor, Don Lee, come under the Hollywood influence in studio proportioning. This station, located on the Paramount lot, is using a stage area of 25×35 feet and a ceiling height of 49 feet. Good production within the limitations imposed by restricted camera movement can probably be accomplished in a unit of this size.

In most of the other experimental stations, studio construction has not progressed past the blueprint stage. The proposed plans, however, are most interesting, for they comprise some of the corrective measures advanced by veterans of the industry.

One of the more novel ideas of housing a complete television activity was introduced by General Electric in 1944. It is the creative work of The Austin Company, Engineers and Builders, in Cleveland. Their proposal recommends a rotating stage area

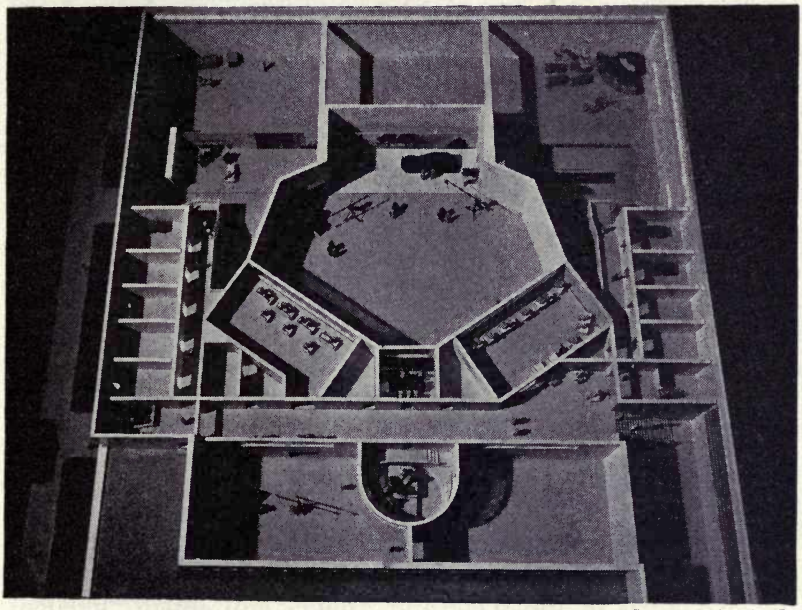


Courtesy Austin Co.

MODEL OF A COMPLETE TELEVISION BROADCASTING STUDIO DESIGNED BY THE AUSTIN COMPANY, ENGINEERS AND BUILDERS. UNUSUAL FEATURE OF THE STUDIO IS THE TURNTABLE STAGE

equipped with full-size sector compartments. Ample storage space is provided in the blueprint for props, offices, and laboratories, as well as excellent viewing auditoriums for the public. Although this plan is extremely radical and is a definite departure from our present technique, it would, no doubt, simplify the problem of using multiple stages.

The Austin Company has recently brought out a new and improved studio design which apparently answers many questions concerning the feasibility of their proposal outlined in the foregoing paragraph. In describing this later plan, the prospectus issued by Hill and Knowlton for The Austin Company points out that the design is suitable for construction in most American cities. It is *a combination one- and two-story structure of striking modern design. The station includes one large studio with 44-foot movable stages and two smaller studios that are served by a common set of controls on a pivoting control plat-*



Courtesy Austin Co.

DUAL-CONTROL, MULTI-PURPOSE TELEVISION STUDIO DESIGNED BY THE AUSTIN COMPANY

form. Offices, dressing rooms, work shops, and storage facilities are located on the ground floor surrounding the studios, while the second story is devoted to control rooms, broadcasting equipment, sponsors' lounges, and public observation areas.

The large studio stage moves to right or left on a track for speedy change of scenes. Its control and observation facilities have been arranged in a manner similar to that in the Austin-designed master television studio, where a turntable stage and independent seating areas on either side of a central control room make possible rapid changes of both scenes and audiences.

Activities in the two studios can be watched from a public observation corridor, which also commands a view of the con-

*trol room through the glazed walls of a sound chamber connecting the two studios and the control room. Sponsors' observation rooms are situated on a balcony above the public corridor.**

In today's studios the many sets required for televising a single program are generally arranged in sequence about the walls of the studio. If still more sets are needed, provision is made to "double bank" or stack the sets used in the story, and to "strike" these sets when the action shifts to another part of the studio. The new architectural proposal of The Austin Company simplifies this process by providing a series of pie-shaped cubicles, which can be swung into camera view as the entire stage area is revolved. Examination of the architects' sketch shows that a normal stage setting in these triangular partitions would leave considerable waste area backstage and that quick movement from set to set might be somewhat hampered by the necessity of revolving the basic stage area between acts.

Acoustics

The problem of ideal acoustical treatment for a video studio is as yet unsolved. NBC sound-treats the walls in the Radio City studios as if staging a radio show, even though such precautions are nullified to some extent by the introduction of the large flat areas of the stage and camera equipment. Balaban and Katz Corporation in Chicago has also experimented with a similar flat-wall acoustical treatment, in an attempt to reduce the reverberation time of the room to a point below normal, counting on the introduction of the stage settings to return the characteristics to normal. It is apparent from the data derived from experiments in these enclosures that there can be little harm in designing a studio that is dead, or sound-absorptive, since the flat, taut surfaces used in staging have a general tendency to raise the reverberation time. If these resonant flats are introduced in a studio whose sound characteristics are normal when empty, the resultant "live" studio will bring many unwanted reflections in the sound pickup.

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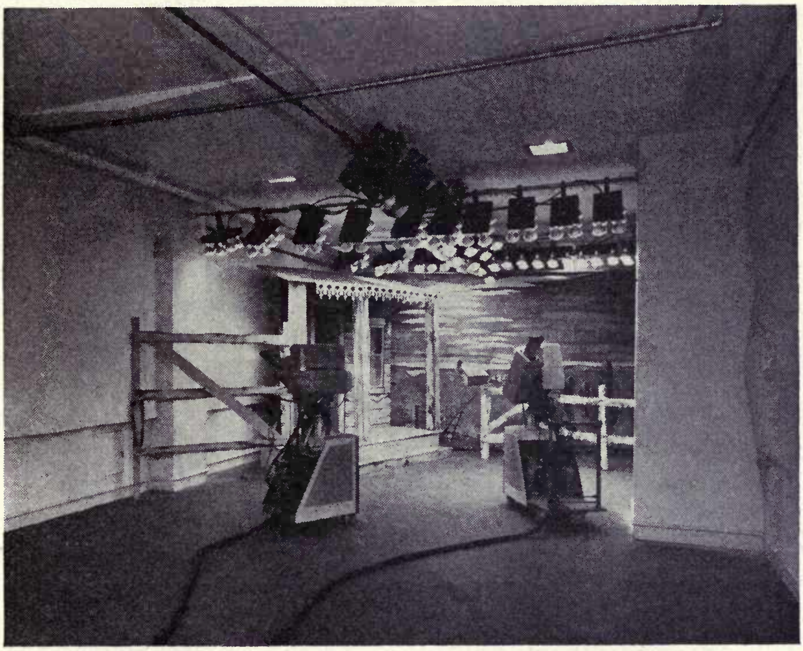
* *The italics are taken direct from the press release issued by Hill and Knowlton for The Austin Company, August 29, 1944.*

The practice followed by some of the studios taking cognizance of this sound problem consists of sound-treating the ceiling with absorptive padding and in some cases using alternate patches of sound-absorbing material on the walls. DuMont



DuMont Photo

TELEVISION STATION WABD, NEW YORK. NOTE THE ACOUSTICAL WALL TREATMENT AT RIGHT

in New York, for example, has developed a series of angular transite wall panels arranged to break up effectively the larger sound reflective paths.

It is believed that extremely interesting results can be obtained by concentrating the absorptive sound treatment on the ceiling, since this is one of the few places that will retain its original identity from program to program. Any treated wall section, independent of how effective it may prove to be in a sound-deadening capacity, is useless when covered by a reflective stage set. The unwanted pickup from these flats can be somewhat reduced by the introduction of curtains, backdrops, and draperies into the design of the stage settings, and such methods may be required where no other sound-deadening provisions have been made.

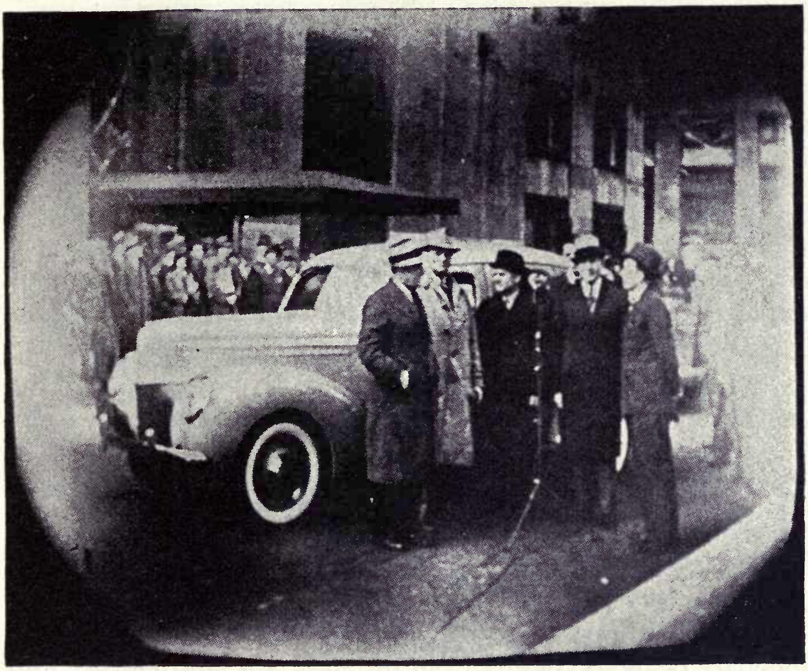
Air Conditioning

The supply of sufficient air to the studio may also be considered a sound problem. The heat load of any studio using incandescent lighting equipment is extremely high and demands that large quantities of refrigerated air be forced into it at a high rate of delivery. Even though the ducts that deliver this air are treated acoustically to mute the mechanical noises of generation, the movement of large quantities of air out of the orifice ducts creates a distinctive interference noise. Inasmuch as a specified cubic footage of low-temperature air must be delivered into the studio each minute, there has been a general trend, in order to keep down the interference noises, toward the use of large-volume, low-pressure ventilation systems, rather than the high-speed method.

Sound muting within the air-supply ducts can be accomplished in many ways, with some designers even going so far as to design the duct itself from non-resonant materials. In all cases, however, a simple wind screen should be used between the microphone and the source of air when it is necessary to operate the microphone in close proximity to any input duct. This screen may be a standard accessory permanently fixed to the microphone or, in emergencies, can be made from a properly designed cardboard sheet. In either case, it will serve to prevent the air from flowing directly into the microphone and thereby causing unwanted noises.

The Studio Floor

Most studio floors are highly sound-reflective, and, with the exception of an occasional rug, which may sometimes be added to the stage setting, the floor must be considered as a potential source of sound reflection. But of more importance from the standpoint of studio design is the color and texture of the floor. A linoleum surface is now conceded to be the best for all-around usage, although successful camera work has been carried on with hardwood floors. It should be remembered that the success of dolly shots (where the camera is required to move in and out of the set in a straight line) will depend on the smoothness of the floor path over which the camera dolly has to travel, inasmuch as it has been found impractical to use



NBC Photo

AN EXAMPLE OF BOTTOM AND SIDE FLARE IN A TELEVISION PICTURE

portable dolly tracks as is done in the production of motion pictures. The ideal covering of the studio floor should be light-reflective if the problem of "bottom flare" in the picture is to be circumvented. This "bottom flare" is very noticeable in pictures in which the lower part of the scene before the cameras is darker than the upper part. Spurious electron radiations within the iconoscope cause the electronic picture to "flare" or glow unevenly under these conditions. Normally, this situation can be partially corrected within the camera itself by varying the rim lighting level described in the chapter dealing with the television camera, but any method such as a reflective floor, which will aid in brightening the foreground area, will be of assistance in combatting this effect. A light, cream-colored floor has been found to be very satisfactory although it does present a constant cleaning problem. The importance of maintaining high-light reflectivity has become so necessary that it is now a common practice to wax the foreground area of the television set in order to increase the light reflection as well as to preserve the surface.

Studio Windows

All studios must of necessity be equipped with large windows that will permit observation of the set from the control room and from public observation booths. These windows, normally excellent sound reflectors, are now constructed of two glass surfaces instead of one. The outer or studio pane is inclined to reflect the sound up into the absorbent material in the ceiling, while dead-air space between the outer and inner panes results in complete blanketing of sound between the two rooms. Door panels, also the source of extremely bad echoes, can generally be corrected by using rubber insulation in the framework.

Since the control room must be kept dark because of the preview screens and monitor screens located there, the windows between the studio and control room must be treated to reduce the glare of lights coming from the stage sets and pouring into the control room. A thin sheet of tinted plastic will cut down this glare, although its makeshift appearance may not be entirely satisfactory. A control-room window treatment found to be very successful has been installed by WBKB in Chicago. It is composed of two pieces of specially colored German glass, each 1/8 inch thick and assembled in such a way that the glare of studio lights is shaded from the control room although at the same time a view of the action in the studio is visible from the control room.

Studio Observation Facilities

Whether or not the producer likes it, there will always be a demand on the part of the public for permission to see a television show in operation. If it is not the general public, it will be the sponsor who wants to see "his" show come before the cameras. It will, therefore, be necessary to provide suitable audience space when planning complete studio facilities. It is highly impractical to permit visitors to remain on the studio

B&K Photo

AUDIENCE VIEWING ROOM, WBKB, CHICAGO

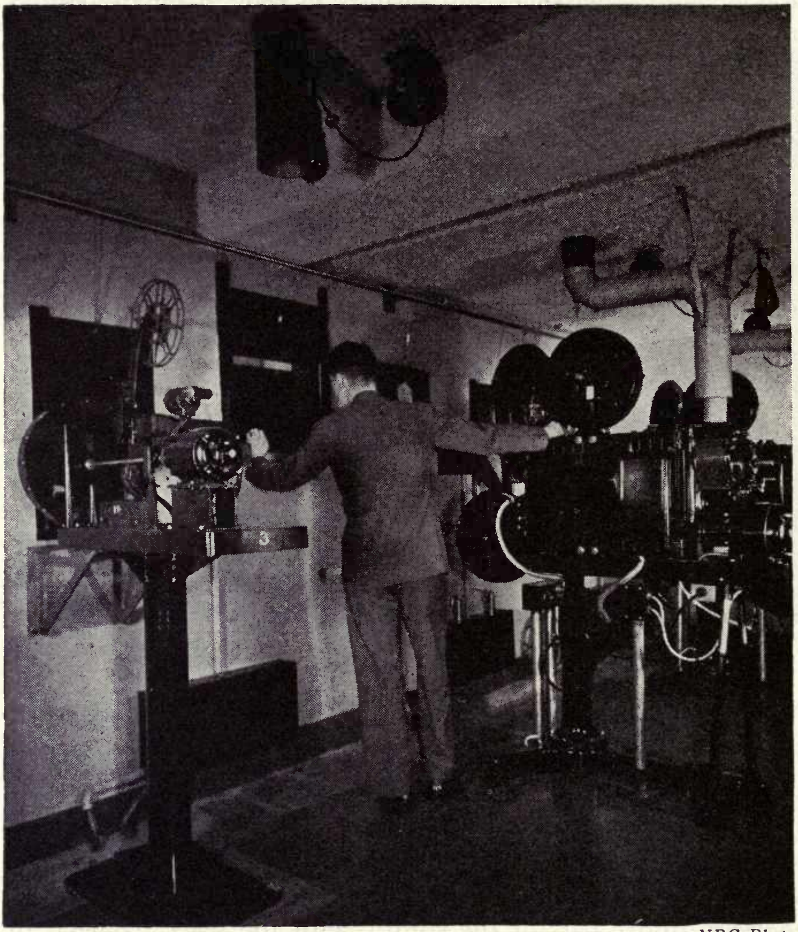
floor itself because a chance cough or an audible footstep may ruin the effect of a whole broadcast. Most designers have, therefore, located the public observation booths at the end of the studio, opposite the control room. To make it possible to see over the tops of the various sets that are arranged on the studio floor, it will be necessary that the audience space be in the very upper part of the studio, with the seats arranged in elevated tiers similar to theater practice.

The use of sound-proofed windows in this space will require the installation of repeater speakers so that the audience may follow the sound as well as the picture sequence from the set.

The Film Projection Room

It is highly desirable that the studio space containing the film-scanning equipment be adjacent to the main staging area.

Although much of the program derived from film will be sent directly to the transmitter from the film control board, there are occasions where split-second co-ordination between film



NBC Photo

FILM–PROJECTION ROOM ADJOINING CONTROL ROOM AT WNBT, NEW YORK

studio and the direct pickup cameras will be necessary. In this event, it is extremely helpful to have these two spaces adjoining each other.

A film-scanning studio is designed to include two separate rooms—one is a fireproof room in which the film projectors are mounted; the other is a control room containing the switches, panels, and monitor facilities. Fireproof vaults will be required for film storage, and they should be located close to the projection rooms. The regulations covering the construction of film-projection facilities will make it impossible to include the film department as part of the main studio. In such cases there is no alternative but to install this equipment in an approved location and to operate the unit as an outside program source.

The Control Room

The control room, like the public observation booth, should be as high off the floor as possible and situated in a location where the engineers can observe everything that takes place on the acting area. This room will vary in dimensions in accordance with the size of the studio being controlled and the amount of equipment required for operation. Each person working in the control room should be able to watch the studio phase of his operation. Because the standard engineering crew seldom consists of less than five people, and because a large amount of monitor and control equipment is normally necessary, this room is also tiered to give a satisfactory view from each technician's position.

The Prop Room

In considering any studio or group of studios, one should not overlook the space requirements for scene docks and property storerooms. The necessity for sufficient storage space adjacent to the acting area is of prime importance in the design of any television installation because of the large quantities of material required to equip a single program.

When programs are in constant production, the proximity of this storage space is an important factor in production costs and studio efficiency. Such space should be sufficiently large to store complete stage settings as well as to accomplish minor repair work. It is not generally considered necessary to provide for scenery and paint shops on the premises since this scenery will either be purchased from a regular dealer or will be built at some distance from the studio.

The property room, however, should be close, if not adjacent, to the acting area, for from its shelves come both the routine as well as the emergency props that find their way into a television program. A prop room at some distance from the studio may be able to provide better accommodations, but it will be of little benefit in providing the last-minute necessities of the program.

Studio Site

From the economical standpoint, it would be natural to look to the suburbs as a logical site for a television plant if it were not for the more important consideration of talent availability. When the studio is situated at some distance from the center of local activity, the time and expense consumed in moving talent to and from the outskirts will soon override the differences in urban construction and operation costs. In outlying locations it would often be impossible to utilize the impromptu program material that is normally available in the business area of a large city, and most of this material could not be readily transported to the outlying studios. For these, as well as many more reasons, it can be predicted that the television studio will be built close to its source of program supply although the costs of real estate and air rights may be high.

Conclusion

The potential broadcaster, after having solved all the pertinent details relating to the interior design of the studio, and after having allocated space to each activity that *must* be near the camera area, finally arrives at an area that will rival Madison Square Garden in dimensions. It then becomes necessary to analyze the scope of the operations contemplated, and to reassign space on this curtailed basis. The cubic capacity required for television will nevertheless be great, demanding areas that will be both difficult to obtain and expensive to lease in a downtown section.

To draw a set of plans that could hope to cover every individual problem in television studio design would be impractical. There are certain elements that will be common to all, and will of necessity have to be provided for in the blueprints. Beyond that, the ingenuity and foresight of the staff in coping with the individual problems presented by the local situation will determine the optimum size, shape, and location of the television studio for each station.

12

Visual Effects

REGARDLESS of the quality of the separate sequences that make up a complete television program, the necessity for logical "tie-ins" between acts is of the greatest importance in producing a television show. These connecting links, which weld a series of associated or dissociated performances into a program unit, are known as "bridges," and they take many forms.

Some of the more common bridges will be made up of inanimate or animated art work, film, miniature staging, or abstract interludes, such as kaleidoscopic pictures. Inasmuch as the choice of material is more or less dependent on the current circumstances and the character of the broadcast, we will discuss visual-effect work in general here, rather than make an attempt to isolate and apply any type of visual-effect work to specific situations.

We can divide visual-effect work into two separate classifications. Both are interlocked as to function and equipment because of the frequent use of effects to make titles more adequate and because of the many instances when titles are used as part of the effect work. Usually we designate a simple art poster portrayed in an exhibition device as a title, while the same copy included as part of a more extensive setting would be classified as an effect.

Titling

In all title work, we find two main considerations. First, we must present a certain amount of factual copy that cannot be written into the play but that is necessary to give a full understanding of the sequences that follow. Typical of such copy would be the title, cast, credits, and possibly some explanatory material containing information about the locale or period around which the play is written. We try to hold such material in television to the barest minimum.

The second consideration of titling, and probably the most important from the program standpoint, is the use of such effect work as an optical "bridge" or break that may be required by the producer to terminate a thought, to give an opportunity to reset a scene, or to create an intermission. In this usage we find our richest field for ingenuity on the part of the special-effects department, which strives to create new methods of presentation that are in character with the material being bridged. The opening title, if it is properly designed, can do an excellent job of setting the scene, while the proper sequence and nature of effects in succeeding acts can do much to maintain the proper mood for the audience.

The most commonly used of all visual effects is the title card. In television, as in motion pictures, it is necessary that a certain amount of wordage be used to explain or announce the picture material that is to follow. Judicious use of the printed word will often save many minutes of extraneous pictures and dialogue, and will add to the complete understanding of the program.

The Simple Title Card

The simplest type of title card is, of course, the static announcement of the act or play that is to follow. The visual-effects department at NBC carried out extensive experiments in determining the optimum treatment of this basic unit. Logically, the title card should be constructed in the aspect ratio of 4 to 3, which has been adopted as the frame proportions of all television pictures. For all practical purposes, a standard-size card of 11 $\times$ 14 inches is considered to be most satisfactory for normal usage; it is a standard subdivision of the larger sheets sold by jobbers.

It has been found that a neutral flat gray card is much more satisfactory than one with a white surface. A white card will

NBC Photo

SAMPLE OF SOME TITLE CARDS DONE AT NBC FOR TELEVISION USE have a tendency to reflect hot spots of light and, in addition, will provide a high contrast between the black lettering and the white background and cause undesirable streaking. By employing a neutral-gray background, we circumvent this fault and thus increase the range of monochromatic tones available to the artist. If a white card is used, the art work must be limited to tones of neutral gray so that the overall contrast will not be too marked. If a gray card is used, the artist can range from black to white through the various shades of gray, and he has a much wider latitude in creating his design. Therefore, the gray card is widely used by television artists. It might be added that another reason that the use of standard white on black for titles, as commonly found in motion-picture work, is to be avoided in television is because of the present inability of the medium to reproduce black satisfactorily.

The secret of all successful title work lies in its legibility. No matter how intricate the art work, if it cannot be resolved into legibility by the television receiver, it fails as a title. Although composition, copy, and arrangement are as important in television as in any other media, we may sometimes be forced to modify our usage of these principles for the sake of legibility.

Even though the standard title card is 11×14 inches, the vagaries of television demand that we use only a portion of this area for the copy, leaving at least a one-inch margin on all sides of the usable rectangle. This area is generally indicated by thin pen lines, called set or limit lines, which can be used in lining up the cameras. We include this border in case of any overshooting that may occur when the camera position is set up hurriedly. Even with allowance for camera discrepancies, we still should not use the total remaining area within the limit-lines for copy because there remains the possibility that some home receivers will be so adjusted that a condition of undershooting exists. In addition, it should be remembered that in many receivers there is some optical aberration, which reduces the clarity of the television picture at the extreme edges. On an 11×14-inch card we must, therefore, restrict our material to an area not larger than 7×10 inches if we are to insure against the ever-present problem of overshooting and undershooting.

Because of the heat generated by close-up incandescent lighting, the material used in the title cards should be of multiple cardboard, which will resist curling. Ordinary Bristol board is generally unsatisfactory, because it has a tendency to curl when used under the hot television lights. The most satisfactory title board is one having a non-reflecting pearl-gray coating and one that can be used for illustration with either pen and ink or brush.

Intelligent use of the airbrush with positive tints (light grays and white) has been found to be a desirable method of brightening the edges of the card to provide a better television reproduction. For reasons too technical to be discussed here, it has been found necessary to light artificially the edges of the iconoscope mosaic within the camera itself. Failure to provide this artificial or so-called "rim lighting" causes an unnatural flare at the bottom of the picture when dark areas are present along its bottom edge.

It is quite often possible to substitute a well-lighted foreground for this counteractive lighting within the camera. This can be accomplished by the proper use of footlights, a light-colored reflective floor, or the introduction of some light-colored material into the lower part of the title composition. It is natural that this corrective technique should be used in title cards, where the detailed and reduced areas emphasize the difficulties of "bottom flare." The artist will find that considerable experiment will be required for each camera system and lighting setup before he can satisfactorily tone the lower edges of the card to the shade of white required for correction of this "bottom flare" without overstepping and thus reversing the process. Inasmuch as we are interested only in providing enough white or positive tone at the lower edge of the picture to create some positive response on the mosaic in this area, the condition can sometimes be met by arranging the composition and design so that some lettering or border line satisfies this requirement and supplants the use of brushed tones.

Art work for television should always be evaluated for its effectiveness over the air rather than for its qualities as a visual-display card. We have often seen title cards that were outstand-

NBC Photo

AN ANIMATED BOOK USED AS OPENING TITLE IN *THE THREE GARRIDEBS* ing examples of intricate art work, but that failed miserably when seen through the eye of the television camera. Because of television's compressed black-to-white spectrum, a characteristic of our present reproductive devices, many of the fine gradations of halftones are lost in the reproduced picture because they are grouped into a closer spectrum subdivision that can be registered by the camera and the receiver. For this reason, it is wise to limit the halftones in title work to contrasting blacks or grays, rather than to leave the interpretation of these blended values to the vagaries of the equipment. The reproduction of intricate pen work is still not sufficiently satisfactory to make this technique worth the time required in preparation. The bold, heavy line is still considered the most reliable by all television effect artists.

The black-to-white interpretation of the chromatic scale of visual colors will provide satisfactory halftones. These tones can be obtained by using color of the proper tint and opacity. After some study, the artist will be able to evaluate greens, reds, and other spectral colors in their equivalent shades of gray, and can effectively use this knowledge in his rendition of halftone title work.

Type faces adaptable to television will vary in accordance with the character of the title. Caslon Bold has been found to be an excellent type font because of its readability. The more complex the letters, the less use we find for them in television. Where necessity requires the selection of Old English or Spencerian Script, the letters should be simplified so that ornateness does not tend to reduce overall legibility. All printed titles should provide a spacing between the lines equivalent to half the height of the letter used. Best results are obtained by grouping the copy into a series of parallel lines, rather than by presenting a curved or angular layout. This is to limit or counteract the streaking effects that are sometimes apparent in television. There is little that can be done by the artists to counterbalance this all-too-common electronic fault of the iconoscope system. It is an engineering problem of amplifier distortion which causes the black or white letters to carry over either a positive or negative trace in the direction of scanning. If the spacing of the letters is too close and the mass of contrasting letters too great, streaking can reduce legibility to zero. The only safeguard in this case is to reduce the "card to letter" contrast as far as possible and to be sure that sufficient spacing is used between letters and words so that the "streak" will not obliterate each successive letter.

The Drop Card

A variation of the simple title card is the drop card, which is used where more than one title must be displayed in sequence. Figure 1 will show the simplicity of this title board. Since the

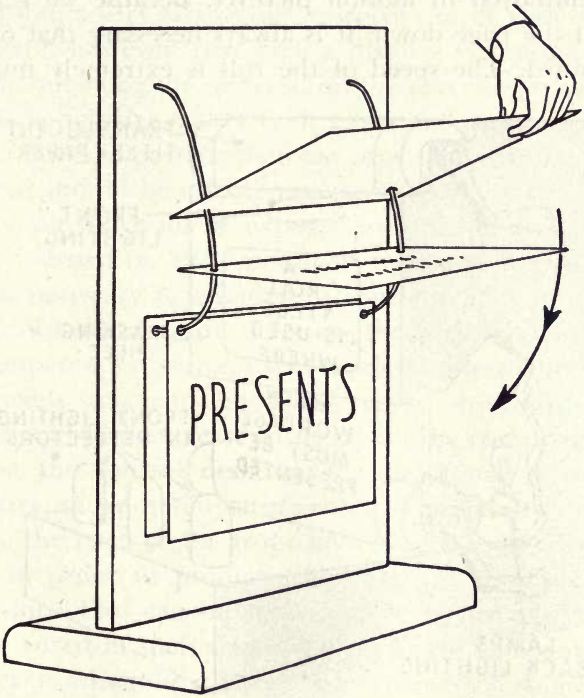


FIG. 1

punch holes must not appear in the picture, the width of the top margin must be increased by a sufficient amount to insure that the mounting holes do not appear in the televised picture. The arrangement of guide wires shown in this drawing has been designed to maintain accurate focus of the title pickup.

Due to the close-up shot required to cover the title card, the actual depth of focus with high-speed lenses remains a matter of inches. If these cards were allowed to build up, one on another, each title would be successively farther out of focus. With the illustrated equipment, the weight of the card is sufficient to move the preceding title back on the hanger as the new card falls into position.

Roll Titles

When extensive copy is required in a title—in a synopsis, for instance—we use some variation of the roll title. This method is often employed in motion pictures. Because we read from the top of the page down, it is always necessary that our copy move upward. The speed of the roll is extremely important.

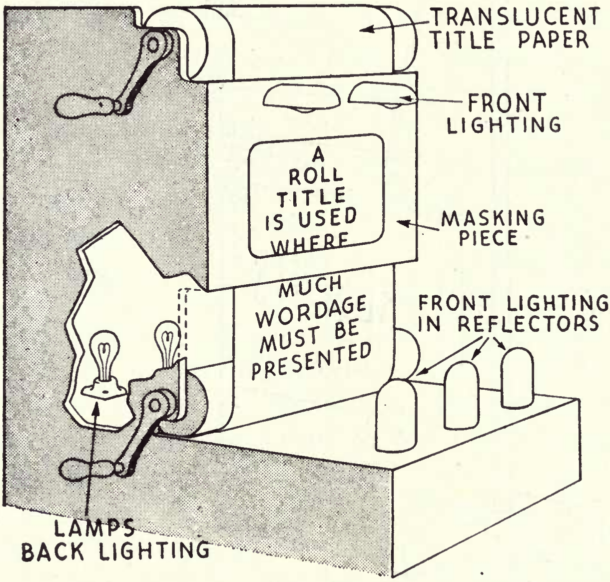


FIG. 2

We must insure that each observer, under varying conditions of reception and concentration, will have an opportunity to read the material.

It has been determined by field experiments that a speed of title movement based on a triple reading in the studio will produce the best legibility at the receiver. Roll titles, as a general rule, should not contain art work, such as background illustrations and halftone overlays, for such material tends to confuse and reduce the legibility of the copy. In roll-title work, parallel lines are advised in preference to curved lines or other possible layouts. Figure 2 is a typical basic roll-title machine. It will be noted that either front or back illumination can be used.

Optical Dissolves

Where dissolve effects are required, material can be drawn on both sides of the translucent paper and, by varying the back illumination, a very satisfactory dissolve can be created. It will be apparent, however, that such a dissolve is limited to introducing or removing the material on the reverse side of the roll, as the back lighting makes both front and back copy visible. It is, therefore, important that the copy that is to be dissolved in and out should be on the reverse side of the roll, with the fixed title on the front or exposed surface. Because television response is based on the amount of light striking the mosaic, it will be necessary to maintain a constant light level in such a dissolve. In other words, if we use the back lighting to bring out a transparency dissolve, we have added this quantity of light to the already sufficient light being played on the front surface title. Although this increase in signal can be compensated electrically at the control desk, such a procedure is considered unnecessary and not too satisfactory. A preferable method is to reduce the level of the front lighting while increasing back lighting in order to produce the required constant level of illumination. This can be accomplished by using two ganged rheostats, wired in such a way that one light goes down as the other goes up when the master knob is turned. A single potentiometer with the proper taper may be used in cases where less intricate dissolves are indicated.

A more complex system of optical dissolve can be created by combining a half-silvered mirror with a series of controllable light sources, as shown in Figure 3. Such a multiple dissolve would be employed in situations where a simple "in and out" effect was unsatisfactory or where the added latitudes provided by such an effect machine capable of handling a succession of titles could be used to strengthen the program material that followed. As light is thrown on the title or picture material

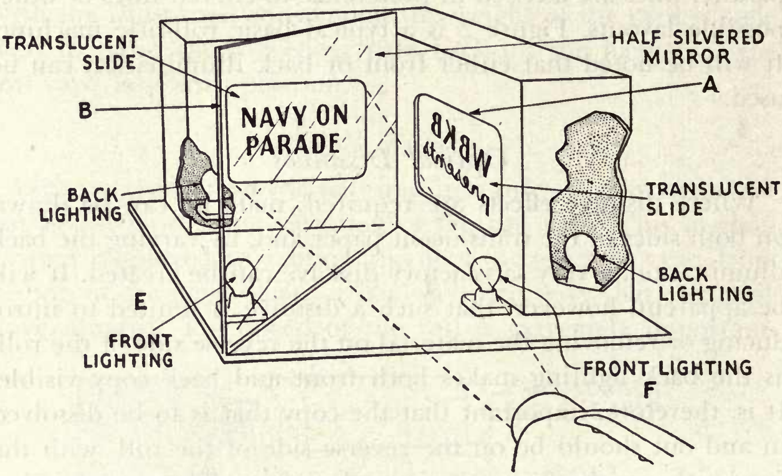


FIG. 3

at "A," the half-silvered mirror "B" reflects it into the camera. As the illumination is increased on the title at "B," the transparent qualities of the mirror increase, disclosing the combined or dissolved pictures. Further dissolves can be created by front and back illumination of each title position, as indicated by light sources "E" and "F," but the complexities of preparing these transparencies is generally not worth the effort required for such combination. It is evident that the material placed on side "A" will be reflected off the mirror "B" in reverse. It is, therefore, necessary to use subject matter in this side position that will not be affected by reversal and that will be usable when reflected. Although this system of closely grouped light sources lends itself to many interesting displays, it is not infallible, nor is it a complete solution to the problem of title exhibition. The mirror, which has equal reflective and transparent qualities, will sometimes permit light leakage between the two positions and under some conditions will restrict the unlimited use of the device.

NBC Photo

THE OPTICAL DISSOLVE TITLE MACHINE USED AT NBC

The "Wipe"

A novel variation in exhibiting two or more titles is to have the second title slowly obliterate the first title as the second display slides into play. This method of sequential exhibition is called a "wipe." The half-silvered mirror dissolve system can be used for wipes by the addition of opposed or complementary shutters in the plane of the title exhibition positions, as shown in Figure 4.

In order that one picture will not be visible through the other, the shutter system must be opaque. To produce true opacity in the wipe, independent of the material from which the slide is made, it is necessary to use back lighting entirely, which requires that each title be a transparency. The operation is fairly simple—the two opposed and complementary shutters are operated by one control, which obliterates one picture as the second is disclosed. This wipe can, of course, be reversed for the following title. If the material being wiped is reading

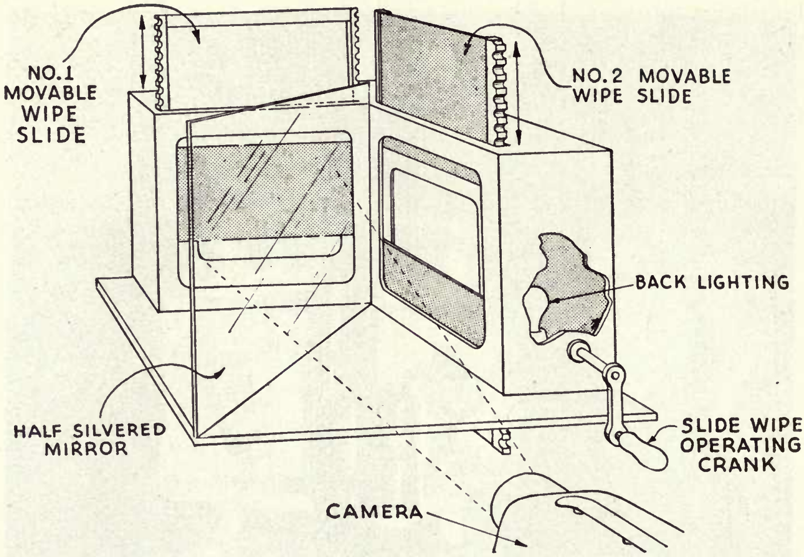


FIG. 4

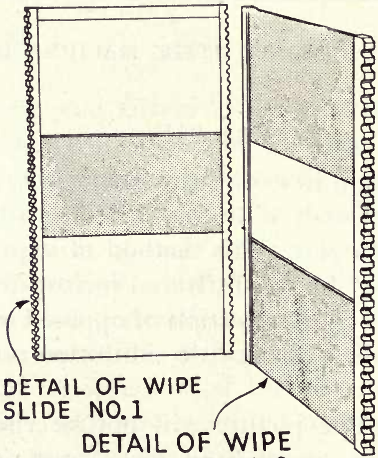


FIG. 4A

matter, it has been found preferable to have the wipe move downward. If both displays are copy, the title should be left in view for three readings and briskly wiped with the second title to prevent confusion. Special-shaped wipes can be developed around this basic type.

The Title Drum

The field of visual-effect work in television is so wide that it is impossible to describe any but the standard types of exhibiting machines that are in use in nearly every studio. The card drop and variations of the half-silvered mirror system fall into this

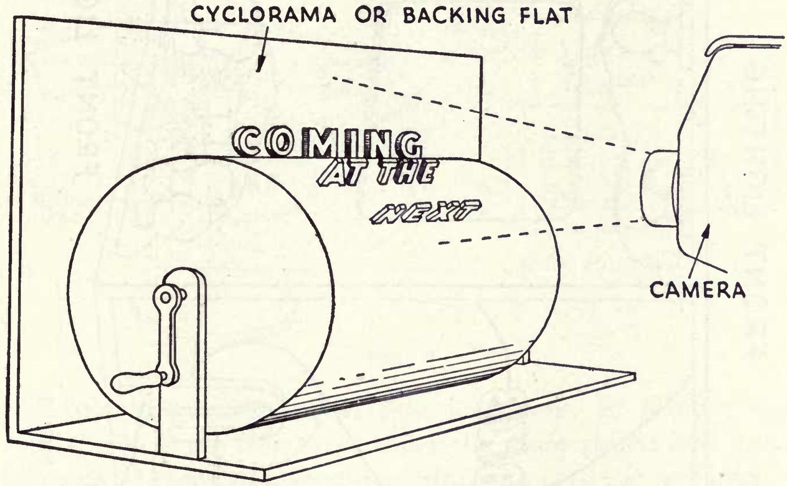


FIG. 5

category. A simple but efficient unit is the title drum shown in Figure 5. Such a unit is excellent for work where the cast is limited in number and the credits are not extensive. It does not lend itself to extended copy.

The Traveling Belt

A somewhat similar title effect can be built around the traveling belt, as illustrated in Figure 6. In this case the moving shadows of the lettering on the backdrop create an extremely interesting result. This sensation is accentuated by the letters apparently growing larger and more indistinct as they approach the camera from the position of sharp focus.

The Hexagonal

The hexagonal display device, shown in Figure 7, makes a handy all-purpose title machine. Either transparencies or front-

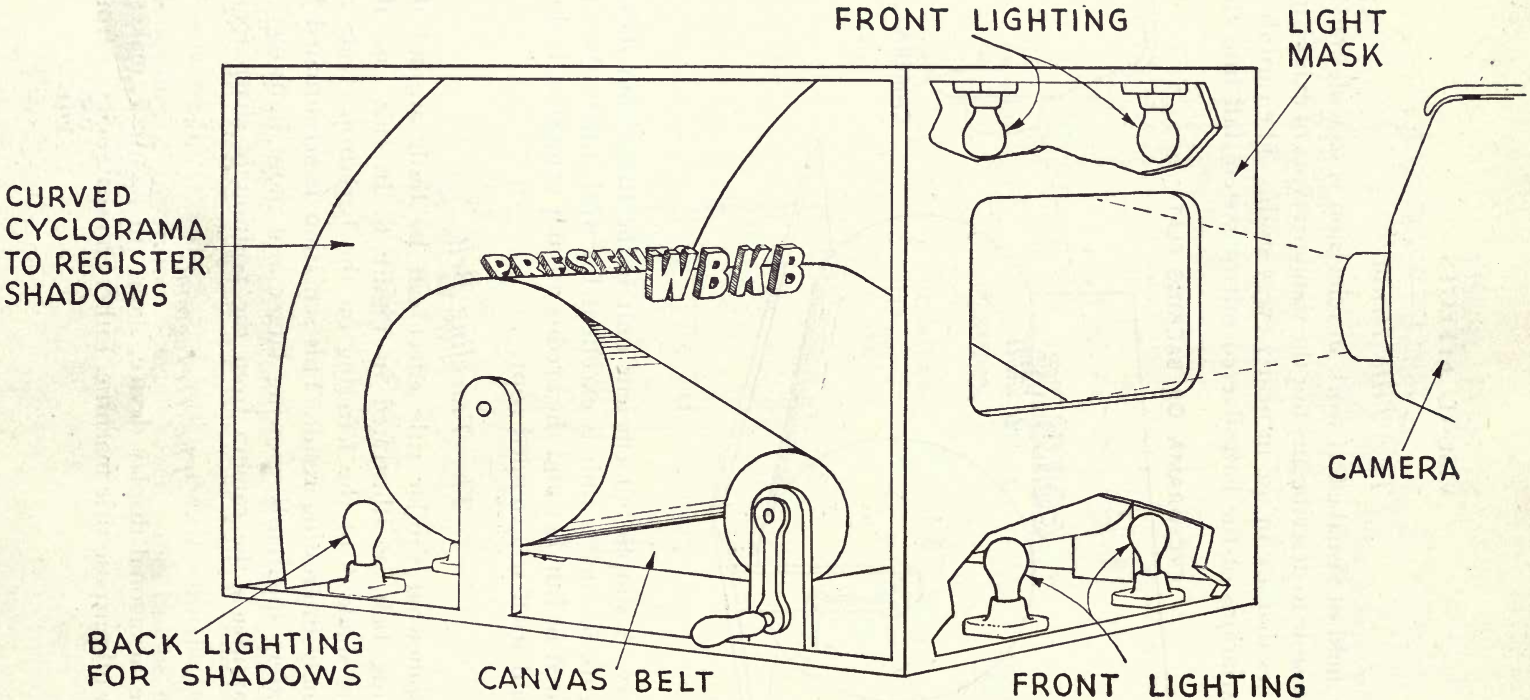

FRONT LIGHTING
LIGHT MASK
CURVED CYCLORAMA TO REGISTER SHADOWS
PRESENT WBKB
CAMERA
BACK LIGHTING FOR SHADOWS
CANVAS BELT
FRONT LIGHTING

FIG. 6

view titles can be used, although this unit again does not lend itself to complex displays.

As previously pointed out, the distinction between title work and pure special-effect work is not clearly defined, since the

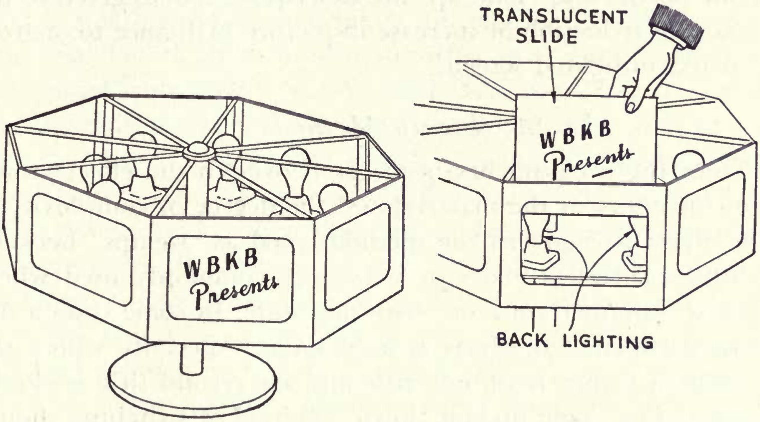


FIG. 7

two functions are mutually interdependent. In dealing with special effects, we usually consider the more varied and subtle methods of conveying essential information to the audience.

Control of Lighting Effects

It is apparent that intelligent use of a flexible lighting control will make it possible to insert effect work into the program in several different ways. This poses the problem as to whether the control room, with its electronic control over the picture brightness, should make the initial switch to effect work at full-picture brilliance or fade the picture down before shifting control to the effect engineers. The best co-ordination can be obtained by working out a plan of switching prior to the airing of the program. If the effect is to be faded into the program, the control room should accomplish the fade down prior to switching; conversely, if the effect is designed for full-screen brilliance, the control room should transfer the program at a corresponding level. From the technical standpoint, it has been deemed more practical for the control room to take over the initial switch from program to effect work, and to allow the effect group to carry on with successive titles up to the last exhibit. Any one of the normal methods of switching is considered satisfactory for bridging from the program into special effects. The direct switch and the "fade down-fade up" are most commonly used. "Fade down" and "fade up" are descriptive names given to the process of reduction or increase in picture brilliance to or from a blank, unlighted screen.

Tie-up Methods

Once the program has been given over to the effect group, the continuity of the material and the degree of complexity of the effects will govern the methods used as "tie-ups" between exhibits. Direct switches or wipes are commonly used where copy is contained on more than one slide. In some cases a dissolve between two effects is acceptable, especially where the message is complete on one title and the second title is closely related. The "fade up-fade down" method of switching should be employed in much the same way a paragraph would be used in writing to indicate the completion of one thought and the introduction of a new one. All these changes can normally be accomplished by variation of the lighting used on the effect, but it should be pointed out that wide, unexpected variations of lighting, which are brought about by improper use of the control facilities available to the effect technician, can upset the entire electrical balance of the system and the value of the effect itself. This fault is often encountered in switching the picture from the control room to the effect studio, or vice versa. Such a fault can be avoided if the control room is cognizant of the levels to be expected and knows when the shift will be made.

Effect Work

Effect work many times resolves itself into the problems of miniature staging. In this category, the limitations of a machine exhibition of copy are removed. In many cases it has been found more expedient to use such methods in preparing the title material for a show because of its close tie-in with the action that follows on the set.

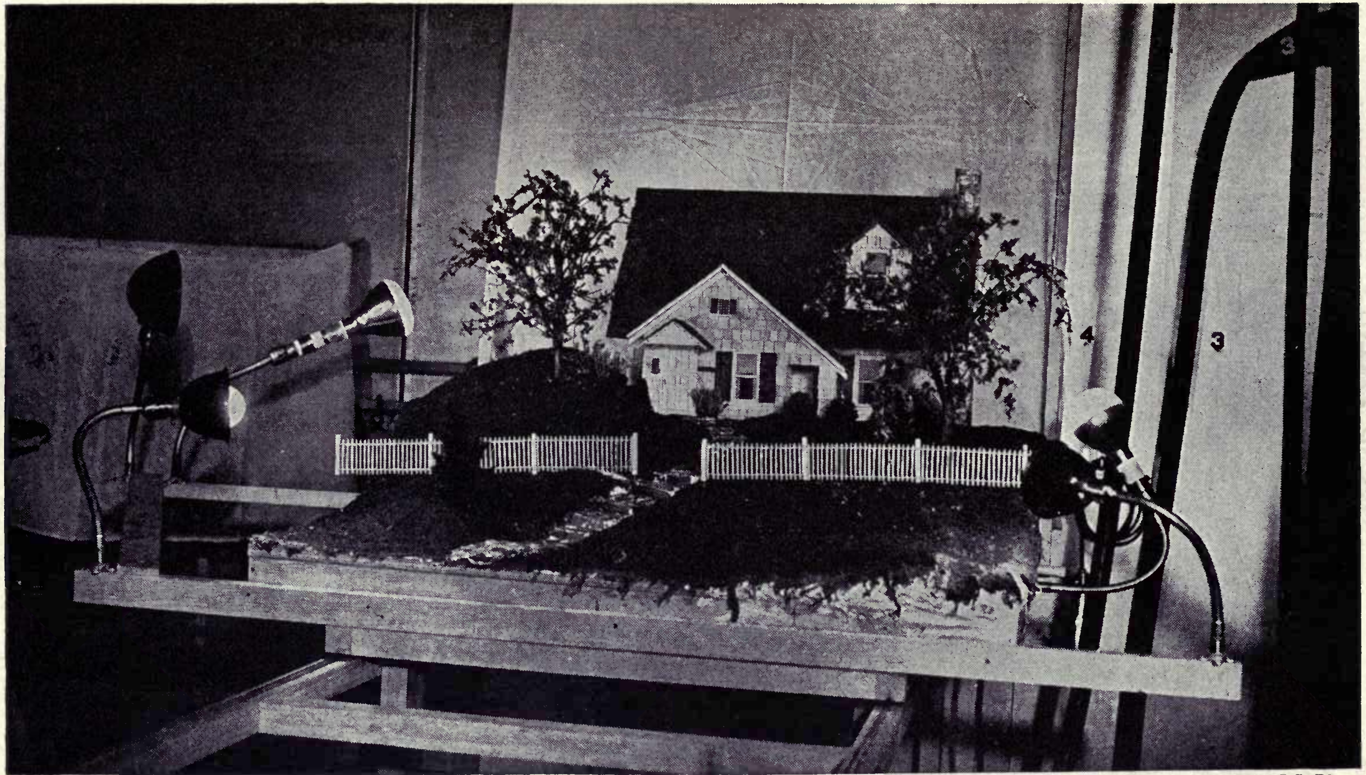
"The Doctor's Wife"

Illustrative of such usage would be the title-effect work in NBC's *The Doctor's Wife.* To set the scene of the story properly, it was necessary to acquaint the audience with the fact that this doctor lived in the suburbs, in a certain kind of cottage, set well back from the road. The continuity required that these details of the situation be explained, in addition to the usual listing of cast and credits. To put all this on a roll title would have made the introduction extremely long and far too wordy to hold audience attention. In the story conference that preceded the casting, it was decided that the use of a miniature to carry the material, in lieu of the more prosaic methods, would be suitable. A miniature street was designed and built, and a series of miniature billboards were placed along the street. These billboards carried the name of the play, the cast, and the other copy that could not be illustrated. The second miniature reproduction of the actual cottage was also constructed and, for the opening scene, the stage crew built a full-size replica of the entrance door of the cottage. The shooting sequence of these three sets was simple. The street scene was covered by a long, parallel dolly shot that took the audience down the street, past the billboards, and out into the open country. At the far end of this set was a miniature picket fence, which was again in the foreground of the cottage miniature. This practice of attracting attention to some striking detail in one set and showing the same detail in the succeeding shot of the second set, thus making it possible to tie the two sets together in the minds of the audience, is known as a "psychological tie-in." In this case, the white fence, first seen among the bushes at the end of the suburban street, is again shown in the right foreground of the second miniature; thus the relation of the cottage to the street, and of the street to the section, is explained to the satisfaction of the viewing audience.

The camera work on the cottage or second miniature consisted of a long dolly shot that opened at some distance from the fence and carried the audience up through the gate, to the door of the house, where we found two more "tie-ins" placed

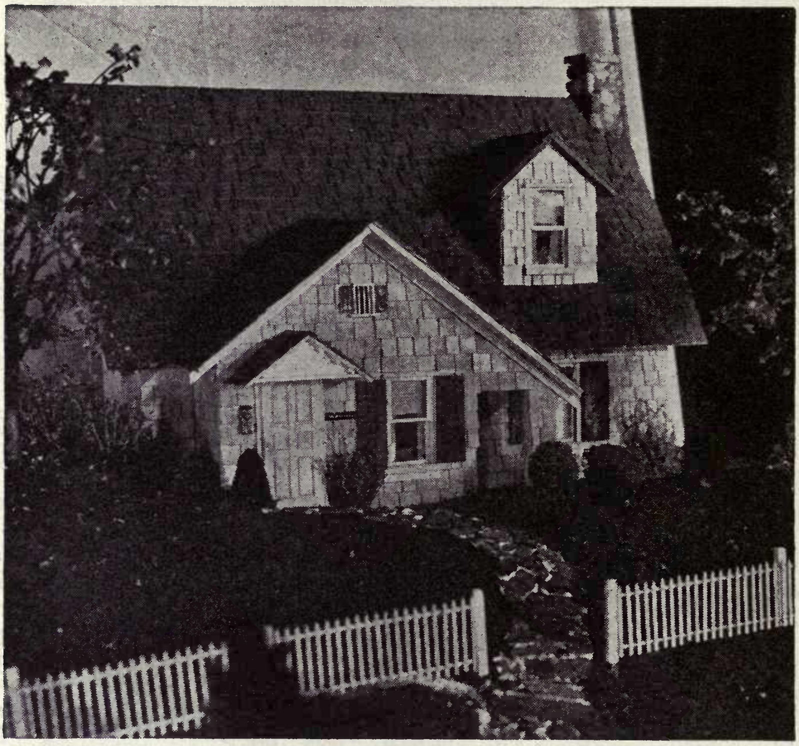
NBC Photo

MINIATURE BILLBOARDS CONTAINING TITLES AND CREDITS USED IN *DOCTOR'S WIFE*



NBC Photo

MINIATURE COTTAGE AND SURROUNDING GROUNDS IN *DOCTOR'S WIFE* AT NBC



NBC Photo

CLOSEUP OF MINIATURE COTTAGE IN *DOCTOR'S WIFE*

to connect with the next shot. In this case these "tie-ins" consisted of a mailbox on the left side of the English-type door and the doctor's shingle on the right side. These were duplicated in full scale on the third or life-size set. As soon as the picture size of the miniature door matched the picture size of the full-sized door on the monitor, the pickup was switched to the third set and the action on the set began with the doctor's lines. He introduced himself as he opened the door and collected his mail. The business of the play, which was shot in interior sets, followed. Such combined use of miniatures, full scale, and title work is not uncommon in television. The Ronson Lighting Company, in presenting the Ronson Light Opera House, used a miniature theater and ticket booths and full-sized sets with unusual effectiveness.

NBC Photo

RONSON LIGHT OPERA HOUSE TITLE MINIATURE

"The Pirates of Penzance"

In *The Pirates of Penzance,* staged in 1939 by NBC, it was necessary to indicate that the second act would take place inside a castle, at some distance from the first act. We could have said as much in words, but that would not have been television and it would not have been so effective as the method chosen. In this story we built a miniature castle on a miniature mountain, and placed the entire set on a rotating platform. As the first act closed, the cameras faded down and then faded in on a long shot of this slowly rotating castle and mountain. The covering camera started a slow dolly on this scene, gradually increasing speed as the image got larger. The castle, now whirling madly, filled the entire screen and became a blur. The second, or off camera, ready for the opening shot on Act II, was adjusted for an equivalent out-of-focus shot on the life-size interior of the castle. When both images matched in size, the switch was made. The effect was one of flying through space toward the castle and through the walls into the interior, where the second act of this popular Gilbert and Sullivan operetta begins.

"Treasure Island"

Another interesting title miniature was the beach scene used as an introduction and intermission break in Robert Louis Stevenson's *Treasure Island.* The waves washing up on the sand in this set disclosed the title and the author without departing from the mood of the production. Because of the complexity of the devices used, the cast of characters was not given until after the play. The names were then shown in Old English Type on a parchment background. In many cases it has been deemed advisable to get directly into the play and to hold the list of characters and credits until the final curtain. This practice provides an opportunity for introducing the actors in costume by dissolving over their billings.

Conclusion

Each story presents a new problem and a host of new possibilities to the effects department. It is wise to vary the title work and methods of exhibition from play to play, so that this part of the program will not become a commonplace item in the evening's entertainment, but will contribute to the success of the story itself. In its favored position of being first on the screen, effects work can do much to make or break the play that follows. Effects work can always be considered a highly important function of the production, and it should never be relegated to the position of a subsidiary art.

13

Special Effects and Miniatures

ALTHOUGH we have mentioned the subject of miniature staging in the preceding chapter, the importance of miniature technique in television programming is such that it merits further coverage.

In both television and motion pictures, the creation of realistic settings is of paramount importance to the dramatic impact of the story. In many cases, however, scenes are written that must be played against backgrounds too unwieldy and too complex in their original size to be usable. Confronted with such a situation, the motion-picture producer has the choice either of taking his cast out of the studio to film the scene on the proper location or of sending camera crews out to make the necessary film to be used in creating a process shot in the studio. By using such film or its equivalent obtained from the studio film library, the producer can project animated scenery on the back wall of the set through a battery of backstage motion-picture projectors. Many of our outstanding Hollywood epics have been staged against such scenery with excellent realism.

As yet, television does not employ either of these alternatives. Unlike motion pictures, the television story cannot be pieced together from a series of non-chronological scenes, nor can it countenance the delays associated with moving the cast and equipment to location.

The instantaneity of reproduction of this new art requires that the material going into a television story be ready before the cameras at the time of broadcast. Such conditions preclude the use of location shots in building the average video program.

At the present time there are no studios in this country designed to use background projection pictures in lieu of scenery. This process, to be effective, requires long projection

Courtesy NBC

SPECIAL–EFFECTS MEN AT NBC AT WORK ON A MINIATURE TOWN

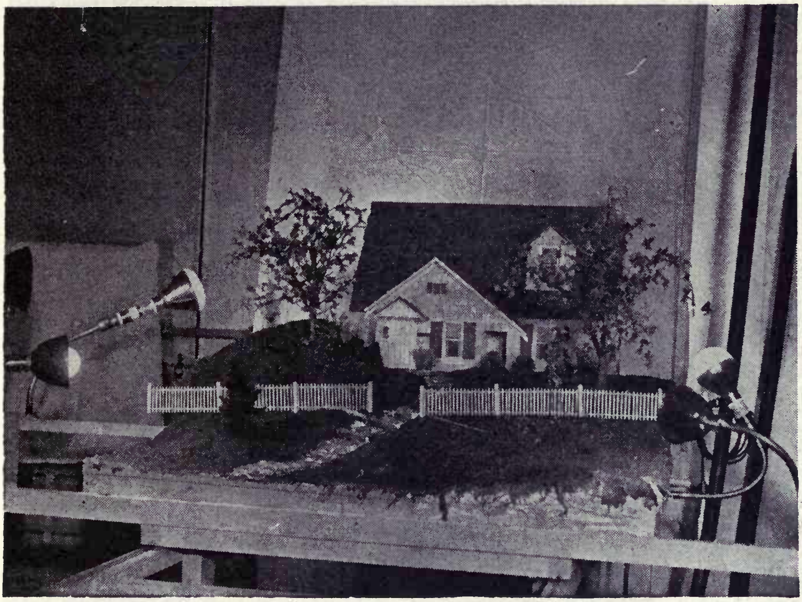
paths between the film machines and the screen—a stipulation further complicated by the high-light levels used on a television stage and the resultant extremely high intensities required to project a usable picture under these conditions.

Furthermore, the discrepancy in frame frequency between the twenty-four-frame-per-second speed used in motion pictures and the thirty-frame-per-second speed used in television prohibits experimentation with any existing equipment.

For these reasons, television has turned to miniature settings as a means of creating many scenes whose nature and size forbid reproduction in the studio.

Small-scale sets have already been used with excellent results both here and abroad. The potentialities inherent in this field presage a heightened interest in this type of shot that will, no doubt, increase the present usage beyond that which has already been accomplished in the pre-war period.

Miniatures, belying their name, can be of any size, but we try to limit the gross area of the set to a minimum cross section



Courtesy NBC

LIGHTING A MINIATURE SET AT NBC

commensurate with good photography and the creation of the detail required by the story. This contradictory consideration, which on one hand requires a large set to depict detail and on the other hand stipulates that the set be small in order to fit in the restricted floor spaces of the studio, may be further aggravated by the ever-present lens situation, which eventually dominates all other factors in television.

Unless a separate special-effects camera is provided for this work, such lenses as are scheduled for use in the studio production must be considered first. The shooting sequence should then be arranged with the producer so that the selected lens and camera will be free for miniature work in ample time for proper checking.

Normally, where we have a choice, the short-focal-length lenses are selected in spite of their limited depth of focus. The wide angle characteristics of such a unit may sometimes rule against this selection by requiring too wide a backing flat or background for use in the studio. Employment of the longer-focal-length lenses with their narrow angle of coverage will

Courtesy NBC

"LIL JOE," ANIMATED COWBOY PUPPET WHO COULD SMOKE A CIGARETTE FOR WNBT'S TELEVISION AUDIENCE

correct this tendency to overshoot the smaller set, but such a lens requires considerably more studio floor space in front of the miniature for the camera operation.

Because of the many contradictory problems that characterize each situation, it is futile to do more than caution the effects man as to the importance of choosing the proper lens for the job. Once an intelligent choice of lens has been made and the camera availability has been determined, the rough layout of set dimensions can be made. In charting the proposed camera movements and in all preliminary sketches, particular emphasis should be given to the limitations in depth of focus obtainable under the existent lens and lighting conditions that are to be used, so that important details on the set will not be brought in to destroy the desired effects.

The focal depths of most lenses used in miniature photography will not cover the entire set in sharp focus. It is, therefore, necessary that the miniature be so constructed that the natural foreshortening from front to back will be built in the design to bring out the desired effect of reality.

By computing the size of the field covered by the lens to be used, the effects man can determine the size and position of the backdrop or backing flat he needs to create either distance or dimension. Experience indicates that carelessness or lack of foresight in designing the backing flat has been a major factor in the lack of naturalness in most miniature photography. A stray shadow on what should represent limitless sky is seldom overlooked by the discerning audience, nor does the life-size image of a technician hovering off stage contribute to the realistic effect sought on the miniature stage. Even though an oversize backing flat may call for painstaking work and alertness on the part of the stage hands, it is sometimes essential to prevent overshooting and the inclusion of backstage life in the picture.

There are many instances where properly conceived and executed shadows can be used to great advantage to augment the realism of the setting. The same care is required in establishing such lighting effects for the miniature as for the larger area. For this reason it would probably be wise to use standard studio-lighting equipment to build up the foundation lighting, since the light levels should be equal to, if not greater than, the levels used on the set. These higher levels of illumination that are easily obtainable on a miniature stage permit the camera man to "stop down" the lens, and thus effectively increase the focal depth of the shot. Because of the short throw required, specific lighting can then be satisfactorily handled by much smaller units than would be required for such work on the television stages. For this purpose, a handy unit consisting of a 500-watt internal-reflector lamp, mounted on a flexible arm at least twenty-four inches long, is recommended. A selection of these lamps will suffice to create any required lighting effects without cluttering up the studio floor and obstructing effective photography of the set with the use of larger and more cumbersome light equipment.

Action of the Miniature Set

Unless some movement is introduced into the miniature set, the results will be only slightly more effective than those obtained from a two-dimensional drawing. If it were not for the realism brought about by motion and the opportunity of choosing from a variety of camera angles, a two-dimensional drawing could and should be substituted for the more complex miniature with far better results and infinitely less work. Motion, however, tends to eliminate the impression of artificiality in a miniature setting and is, therefore, worthy of considerable effort. A tree swaying in the wind or an artificial cloud shadow is all that is required to efface the two-dimensional inanimate feeling. On the larger miniatures, trains and cars moving across country are well worth the extra effort required in animation.

It must be remembered that the rate of movement in miniature must be carefully planned and executed, so that it is in proportion to the scale used. Although we visualize the explosion of a shell or the collapsing of a bridge as an instantaneous occurrence when it is seen in close-up, the same event will resemble slow-motion photography when seen from a distance. To achieve realism in miniature work, it is necessary to decelerate movement by artificial means. A shell explosion can be made to appear natural by using a heavy, finely ground powder, such as lycopodium, under low air pressure. The inertia of the material, plus the persistence of the dust in still air, will generally bring about the required results without recourse to slow-motion photography.

In many cases, however, extremely important insert shots of this nature may have to be first registered on slow-motion film for introduction into the story. Typical examples of where this film-miniature technique would be used effectively are the collapse of a bridge, the sinking of a ship, or similar superanimated incidents that cannot be readily encountered outside the studio

Courtesy NBC

NBC MINIATURE SET IN WHICH MOVING TRAIN WAS USED

or effectively photographed on the set. Under such conditions, the combined use of the scale miniature for locale shots, including a before-and-after coverage, together with a slow-motion photographic version of the actual event, can be worked out with satisfactory results. In brief, this would be the procedure: The miniature set would first be used for the series of panoramic or locale shots, with the film sequence of the animated incident previously photographed from the miniature inserted in its appropriate spot. During this insertion process, the miniature can be quickly reset to correspond with the after effects, which have previously been recorded and televised on the film.

Lengthy experimentation will determine the proper speed of

Courtesy NBC

THE AUTHOR TRIES OUT A MINIATURE TACTICAL PROBLEM FOR NBC SPECIAL EFFECTS

photography necessary to record the event in normal deceleration. Methods of controlling the actual sequence of events on the miniature during photography are so varied that it would be impossible to describe more than the suggested treatment of a single situation.

Reduced-scale stages should be set up in a section of the studio inaccessible to air currents from the ventilating system or other sources, and in a place where the movement of studio personnel during the shooting will not create unwanted drafts. To disregard this is to run the risk of erratic and unnatural reproduction of smoke, clouds, and other effects. Where such an isolated location is impractical, protective screens can be placed around the miniature so that still air conditions will prevail during the shooting.

In their efforts to approach realism, makers have found it preferable to use natural-color miniatures, rather than the monochromatic gray used on the full-scale sets. By blending the proper types of dye and paint pigments, we can reproduce the desired halftones with normal camera equipment.

Perspective Considerations

Realism cannot be obtained with the average lenses where the actual distance from foreground to background is a matter of a few feet.

In full-scale photography, the background has much less detail than the foreground. It is, therefore, incumbent on the designer to build in an artificially tapered detail to insure that both foreground and horizon will not register with equal distinctness.

Full-Size Detail Stages

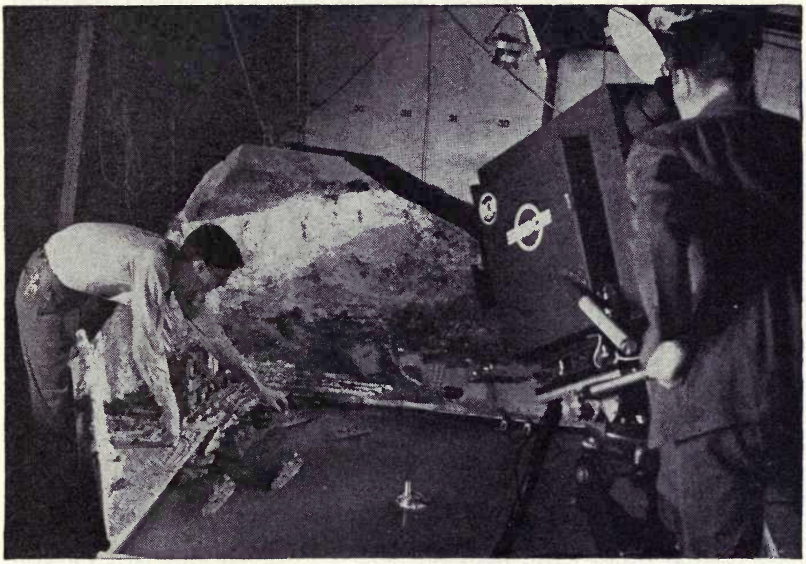
In discussing effects and miniature stage work, we must also consider the full-size detail stage, which is generally a duplication of some part of the main set being televised. As an example, we might suggest the effect shot of a hand opening a wall safe and extracting a gun. If the wall safe were located on the upstage wall of the main setting, it would be difficult to get a camera into shooting position without interrupting the action on the main stage. Such a sequence would dictate the use of a detail full-size stage. By this method, the required photographic definition, as well as special lighting, can be assured without crowding the acting area itself. Ordinarily such detail stages will be located in an off-stage position available to the effects camera, although in some cases it may be necessary to design this setting as a mobile stage capable of being moved before the designated camera at the proper time. Where important detail is necessary to complete the story, the producer will probably specify a detail stage to handle the sequence so that he can be assured of proper control as well as good photography.

Quite often it is preferable to use a detail setting rather than work out the sometimes intricate problems concerned on the main set. This is particularly true of close-up shots. While the average story will be photographed through lenses whose focal depth does not require extreme realism to be built into the backing sets, a close-up stage shot near a wall may disclose the artificial perspective of the scenic artist and thus disillusion the audience. Under such conditions, a detail set is employed to increase the naturalness of the sequence.

In creating scale miniatures for use on the Lilliputian stages, we are forced to design with an eye to both the photographic quality and the economics of the production. Often the materials that go into such a setting must be thrown away after the performance, and in practically every instance these sets must be designed and constructed in an extremely short time. It is, therefore, necessary that the methods and materials employed will be generally available for immediate use and that simplicity of construction rule the effects shop's technique.

Reproducing Nature

Trees, bushes, and undergrowth are the most difficult of all materials to produce in acceptable miniature. The construction of a single tree can consume considerable time and effort, but in television the overnight schedule of production after production precludes such painstaking methods. Necessity again has forced the development of ways and means to achieve equivalent results from materials that are immediately available and easily manipulated. Rather than laboriously building the intricate detail of a tree from twigs and plaster, we may find that many natural shrubs can be procured locally. The wild blueberry or barberry twig makes a satisfactory miniature tree, and furthermore can generally be obtained in one of its stages of growth to approximate the problem at hand. Where the leaves are out of proportion, the bush can be stripped. Should foliage be essential, however, one can bypass a seemingly tedious job simply by using wool fluff of the right color. Chop several skeins of yarn, preferably in a green-omber shade, into sections about one fourth of an inch long and mix together to form a powdery fluff. The miniature tree is then touched up with iron glue in the places where foliage is desired. It is then dipped into the bag or box containing the wool fluff. After some experiment-



Courtesy NBC

A SEACOAST TOWN IN MINIATURE AT NBC

ing, the results can be made to appear most realistic through the eyes of the television camera. Miniature flowers for hedges and lawns can be produced in much the same way by using glue-coated pin heads.

Underbrush and distant wooded areas are commonly constructed from steel wool that has been spotted with a dilute plaster paint tinted to the proper color. This paint will dry hard in an extremely short time and can be made by mixing plaster of Paris, water, and the necessary color. When this paint is used to touch up steel wool to represent underbrush, the contents of several cans of tobacco may be mixed with the color in order to produce the unevenness of surface that adds further realism to the effect. Evergreen trees can be satisfactorily reproduced by substituting scale models made of pampas grass;

palms may be constructed of the proper-size doweling, with pampas-grass fronds and acorns for fruit. Sponges make acceptable hedges when treated with plaster paint, while broom straws may be adapted for any canelike rush.

Grass is made from various types of mohair or other deep-pile fabrics. An uneven area of satisfactory grass can be simulated by coating the surface with shellac and dusting it with green lint. This lint could be obtained commercially as "velvet dust" before the war, and it can be produced today by scraping velvet or plush with the edge of a dull knife.

Although pebbles of practically any size can be found to answer the set builder's problems, he is sometimes faced with a need for more than he has at hand. In such cases a variety of puffed cereals washed with thick plaster paint will dry to a reasonable facsimile of miniature boulders. Corn meal spread over a shellacked surface makes a very satisfactory rough cement or stony field, as do certain grades of sand or sawdust. Cement sidewalks are easily built by painting plywood with shellac and dusting the sticky surface with sand.

Although it is extremely difficult to create acceptable cloud effects, excellent results have been obtained from glass-wool bats fluffed out to the proper proportions. Clouds can be constructed of cotton, but they are very apt to look like just that—cotton. To create the more ethereal wisps that may be required in close-up photography, it is possible to blow additional strands of the material into the cloud from the tips of the fingers. These wisps will cling to the other glass wool and produce the illusion of a cloud with no apparent dimensions. Glass wool, which is highly reflective, will further respond to good lighting, which is an extremely important function of this type of work.

Clouds can be made to move either by using guy wires run horizontally across the set or by creating a gentle puff of air off stage. In every case, however, we should remember that if proper deceleration is not feasible under the plan proposed, the cloud should be left stationary rather than risk spoiling the effect of the entire setting.

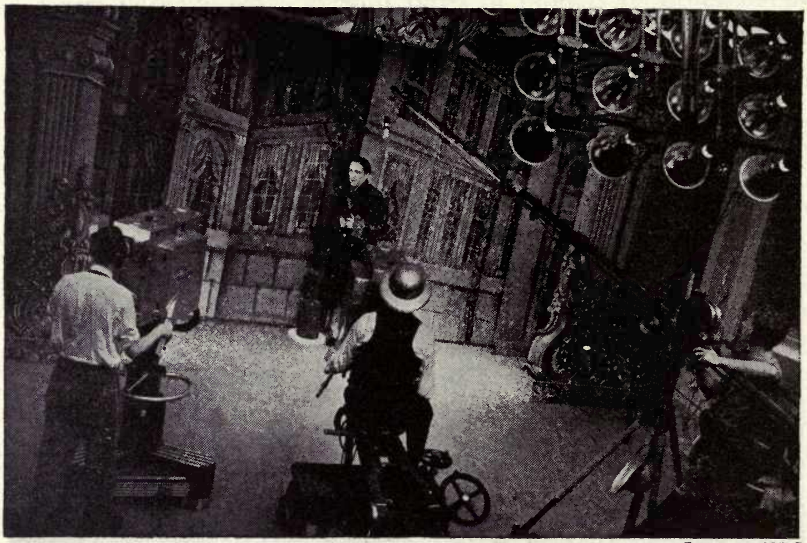
Supporting wires in television can be made invisible by running them across the stage parallel to the scanning lines rather than up and down. A one mil (1/1000 of an inch) steel wire whose reflective properties have been reduced by drawing it through putty is both strong and practically invisible.

Topographic bases for large miniatures can be built easily

Courtesy NBC

CREATING RAIN EFFECT BY SHAKING PULVERIZED MICA THROUGH WIRE SCREENING. AS THE LIGHT PLAYS ON THE FALLING MICA, IT GIVES THE EFFECT OF RAIN FALLING ON THE MINIATURE CASTLE BELOW

and economically from a rough-wood foundation of the right size, with the required mountains and hills shaped from piles of crumpled newspapers or chicken wire. A blanket of monk's cloth or burlap is placed and tacked down to form the proper valleys and ridges. After the contours have been shaped, the entire setting is given a coat of fairly thick plaster paint to harden the surface and preserve the landscape in its original form. The necessary details can then be glued to this surface or affixed to wooden backing blocks, which are built in during construction. Such a model is light in weight and easy to build. In ad-



Courtesy NBC

SNOW SCENE AT WNBT

dition, it can be altered at will by breaking the plaster surface and reshaping the padding.

A similar method is used in making life-sized stone walls for basement scenes. After the burlap has been tacked to form the backing material into stones, the surface is coated with sand mixed with gray plaster paint. When it hardens, the surface of some of the stones can be broken, while others should be spotted with shellac on which powdered glass or mica is dusted. The result is extremely satisfactory, and it can be stored for future use.

Miniature cut stones for fireplaces, chimneys, and curbstones can be made from cubes of sugar broken to size and painted with water colors. During wartime rationing, with no sugar ration points available for this type of work, it was generally necessary to redesign the set for stucco or cement block.

Antique work in wood can be reproduced with a blowtorch and a fine wire plus a hand drill. By searing the wood with the torch and creating artificial worm holes with a red-hot wire and the drills, we may many times beat Nature at her own game.

Spraying liquid latex, with the aid of an air stream set up by a small electric fan resembling a vacuum cleaner, will produce extremely natural cobwebs, while this effect can be further enhanced by sprinkling or dusting the entire set with talcum powder. In this way too, the dust of antiquity can be easily portrayed.

Snowfall for a full-scale set can be made by splitting two ordinary bed sheets into ribbons and suspending them, doubled, between two battens arranged in the flies over the set. The effects man can produce anything from a few flakes to a blizzard by filling this basketlike container with white confetti and oscillating the battens slowly with the guys. Similar devices can be rigged on a miniature, but the material simulating snow must be of finer consistency.

Rain effects can be created by sifting "flitter dust" (powdered tinsel) before the lens of the camera while the accompanying sound effect is created off stage by sprinkling salt on a crisp lettuce leaf close to the mike.

Artificial fire is best created by igniting lycopodium dust. Several types of lycopodium burners are available on the market or can be built to fit the specific problem. Figure 1 is an illustration of such a device. Even though this artificial fire is merely a controlled form of spontaneous combustion, care should be exercised in its use around inflammable sets or close to actors.

Flashes from guns are made by using small pills of magnesium powder in which a resistance fuse wire has been imbedded. If the control wires are energized from an off-stage switch, the flash can be electrically actuated at the proper time. Extreme care should be observed in the use of this highly explosive powder. It should be brought on the set in a fireproof metal box, and excess powder should be kept in this container at all times. Further precautions should be taken to see that the *flash never occurs close to or visible from the camera position. The brilliant light of a magnesium flash can easily paralyze the expensive iconoscope and put it out of use.* Flashes created by this method can be slightly slowed down by mixing sulphur and saltpeter with the magnesium. In a confined set, however, it is unwise to overdo the sulphur content unless the studio is shutting down directly after the shot, for sulphur in the air will cause discomfort to all in the studio.

Smoke production is a problem similar to that of cloud-making. Too much smoke will fog up the studio, too little will

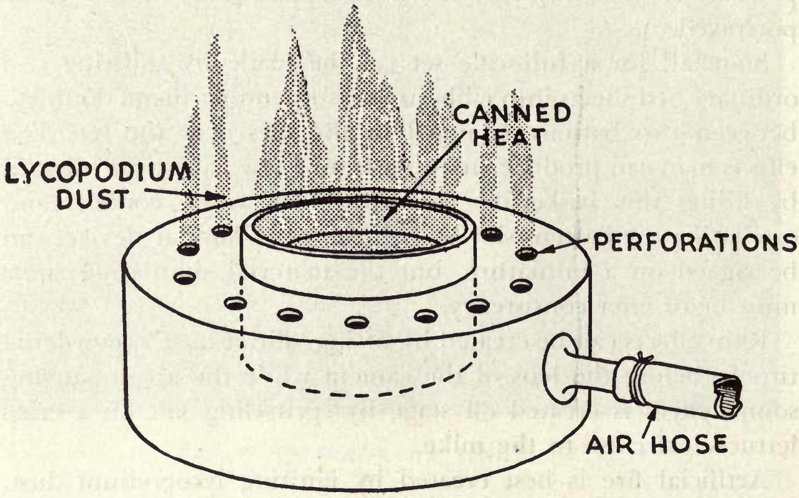
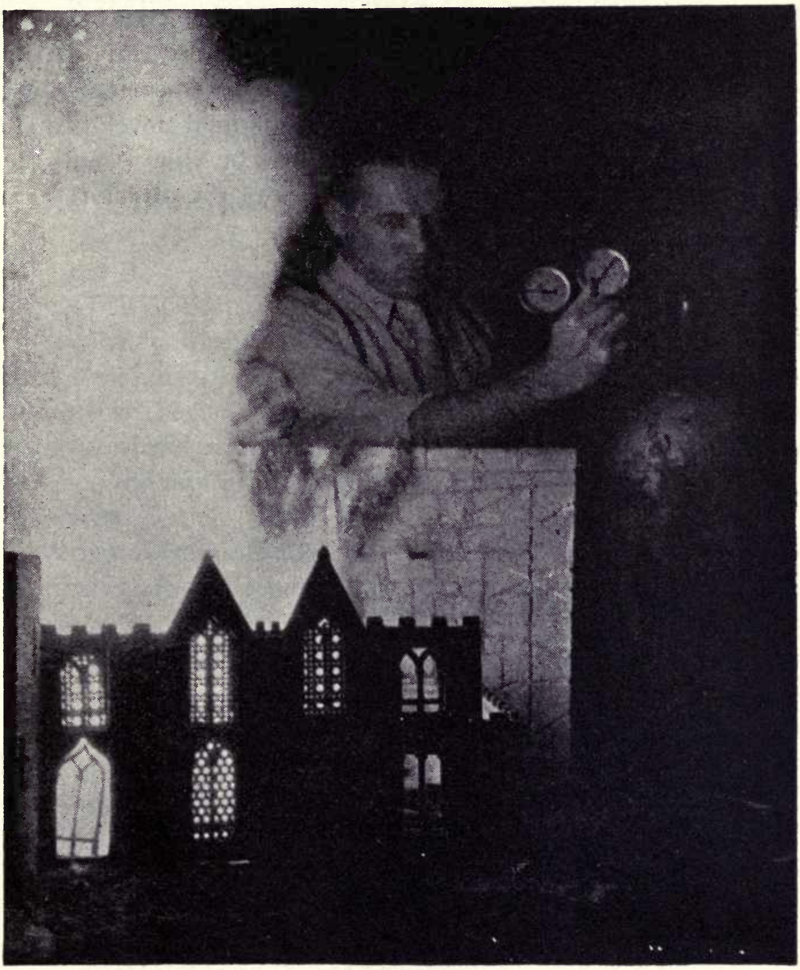


FIG. 1. SPECIAL EFFECTS

be invisible, and all types present difficulties. Asthma powder has been used with excellent results. This vegetable preparation emits a thick cloud of whitish-yellow smoke, and the cast receives a minimum amount of ill effects. Furthermore, the smoke can be controlled by making use of its tendency to cone up on the burner. Powdered charcoal, sprinkled on the burner after ignition, will produce black smoke with equally satisfactory results.

Flying dust or bullets are generally activated by the common mouse trap. If the effect requires that a bullet strike the wall above the hero's head, showering him with dust, the effects man may bury a mouse trap in the wall, and, after filling the hole with broken plaster and fine powder, seal it with paper. A long trip-wire off stage to release the spring mouse trap is all that is needed to activate the device. A window can likewise be shattered by hiding a mouse trap in the window sill. The mouse trap can be set to throw a lead pellet at the windowpane, previ-



NBC Photo

THE CASTLE IN *JANE EYRE* BURNS IN MINIATURE

ously cut to make it shatter easily. Lamps and jars on a shelf can be broken in a similar manner, without exposing the cast to actual gunfire or fear of injury.

A further variation of miniature work and special effects is found in title work. Illustrative of this usage would be the televised hands of the alchemist opening the cover of an ancient book, on the pages of which are displayed the title copy of the telecast. Other examples of this variation of "mini-stages" would be puppets and advertising displays.

The ingenuity displayed in this field is equalled only by the demands made upon it by the producers. It is, therefore, a requirement that the people working in this field develop their own bag of tricks, so that they may always be able to pull the proper rabbit out of the hat at the behest of the director.

14

The Economic Aspects of Television

ENTIRELY apart from the engineering and programming considerations, there are two major economic problems that the industry must face and eventually answer before television can become a reality. The first is, "Who will pay for television, and how?" The second is, "What effect will television have on the other industries with which it is more or less closely associated?"

We can assume that the advertiser will continue to pay the bill in much the same manner that he now underwrites radio broadcasting. Intent on employing the most effective media for selling his wares, the advertiser will certainly look with interest on the new possibilities that television will open up to his sales engineers. The success of the experimental merchandising programs that have already used both sight and sound attest to the fact that this interest is not misplaced. The fear that his business competitor may use television and find it effective as an advertising medium will further spur the advertiser on to be the first to discover new applications of the art to his particular problems. Whatever the reason for his experimental entrance into television, it is bound to affect the apportionment of his advertising dollar among the other media that he had previously employed in selling his wares.

Although it is logical to believe that the economic formulae developed and proved in radio broadcasting will be adopted for television, two other methods of underwriting the cost of this new service have been proposed as alternatives. One suggests that the government create the necessary agencies and provide the funds that would subsidize the developmental period. The other, and probably less influential group, suggests a toll method, wherein the subscriber pays directly for the broadcasts. Proponents of both of these plans view with alarm the present situation, where commercial accounts have use of the airways for unrestricted advertising, even though the American system of commercial radio broadcasting, made possible with the monies expended by these same advertisers, has been unique in its superiority over broadcasts from any other country.

Some economists criticize our present system of commercialized programming on the grounds that it relinquishes too much of the control and policy-setting prerogatives of the broadcast spectrum to the advertiser. They no doubt have lost sight of the very definite control that public opinion can exert. The advertiser invests in broadcast time to build favorable public opinion for his product, as well as to sell his merchandise. The prerequisite of such popularity lies in providing program fare satisfactory to the majority of listeners. If sales or audience-rating curves dip downward, the sponsors must redesign their program patterns to correct the indicated deficiencies as soon as the first sign of disfavor becomes apparent. Even though the public has assigned the stewardship of the air lanes to the highest bidder among the advertisers, the public still holds final and absolute power in determining how the facilities shall be used.

In addition to receiving the best radio entertainment in the world today for the mere price of owning a receiver, the buying public benefits further by the increased sales and lowered costs that successful national advertising brings about. This economic phenomenon in a sense contradicts the theory that the cost of advertising is directly chargeable to the consumer. By creating a national rather than a local demand for his commodity, the manufacturer is able to use mass production and distribution methods with an attendant reduction in his selling prices.

The consumer, therefore, can purchase an advertised commodity at prices that are considerably lower than those which would prevail if the product were less widely known and less popular in the stores. Although a portion of the purchase price of the commodity can unquestionably be traced to advertising costs, this charge is negligible when compared to the benefits that the buyer eventually receives as a result of increased sales.

The adoption of some plan of government subsidy has often been proposed as a logical method of underwriting the expense of establishing a nationwide television system. Advocates of this plan point to the tremendous initial costs of such a project and to the large budgets that will subsequently be required to tide it over its early experimental days. If this is to be a national public service, they argue, why not let the government carry the cost of construction, in much the same manner as it would build a dam or lay a superhighway? This is the reasoning of many proponents of government assistance.

Such government subsidy of a broadcasting service or its equivalent, government ownership and control, is not new, for it was used in England prior to the present war. Ample opportunity has already been provided for judging the advantages and disadvantages of such a system of support. Each radio-set owner in England is called upon to contribute to the upkeep of the radio and television stations operated under government auspices. Commercialized broadcasting, with the attendant improvement in quality that competition brings, is unknown in the British system. In its stead, we find prosaic government-designed radio programs attempting to compete with the popularity of the dynamic commercial programs common to stations in this country.

Even if government ownership has proved entirely satisfactory in England, it would not follow that such a method of indirect taxation and government control of a public service would be found workable in the United States. The average American citizen would probably not be overly enthusiastic about turning over the control and regulation of free speech to the government. If our broadcasting system is to remain what it was designed to be—a public service—then its operation, its management, and its material must stem from the public. If by subsidy or full ownership, broadcasting facilities were to become the oracle of any power group, then the value and effectiveness to the service would dwindle in direct proportion to the degree to which it was used as the mouthpiece of the few holding control.

In comparing the English plan of direct taxation with the American system of competitive commercial sponsors, we also must consider the geographical differences that have a bearing on the two cases. In England, with its comparatively small area and densely populated suburban districts, the task of bringing both radio and television service to every home is not too difficult to accomplish. It is not unreasonable, then, to expect these present or potential subscribers to contribute willingly to the maintenance of a television broadcast network.

Outside of our metropolitan areas, such a concentration of population does not exist in the United States. This situation is further complicated by the tremendous expanse of sparsely populated territory stretching between the main market areas in the Western states. There is little likelihood that a nation-wide blanket of television over such an area can be provided in the immediate future. Even with a growth of American industry more rapid than might be normally expected under a national underwriting program, it is apparent that complete coverage of taxable territory could not be established for many years to come. If television were to be introduced under government subsidy in a limited number of states, millions of non-participating taxpayers would be obliged to contribute to a system that in its formative years would benefit only the small percentage of the population that would be the first to receive television service. Even if we were to overlook this obvious advantage of the metropolitan areas, it is doubtful if we as a people would subscribe to government ownership of broadcasting, any more readily than we would endorse similar jurisdiction over the press. In England, on the other hand, where government support and control of radio service has already established such a precedent, the people would be far less antagonistic to an extension of this system to the video service.

The toll method of financing television would require that the set owner pay directly for each program that he received. Such a method would not meet with the approval of the average set owner, who is accustomed to receiving excellent radio entertainment for the mere cost of listening. Such a plan would certainly be fraught with extensive engineering difficulties, and the variable income produced by this pay-as-you-go system would place severe limitations on the continuance of high-quality programs.

It is, therefore, logical to predict that the advertising agencies will continue to "pick up the check" and pay for the production budget of television in much the same way as they now do in radio. If the price of utilization of television is higher than that of other media, the value and return obtained must be correspondingly higher.

The advent of this new billboard of the ether, with its appeal to both eye and ear, will be certain to bring about a redistribution of advertising money among the other media now being used for promotion. Department stores, clothiers, and hundreds of other merchandising houses who have found it impractical to use words to describe their materials on the air will find in television a new and satisfactory sales window. Newspapers, radio, and in a sense the entire field of aural and visual selling will eventually feel the competitive effect of television. No greater field of advertising has ever been made available to the merchant, and it can be expected that he will naturally review and revise his advertising expenditures in the light of this new and dynamic outlet.

The Press

The daily newspaper can be put on the street for the cost of a few pennies only because of the substantial return from the advertising carried in its pages. What effect, then, will extensive television advertising have on the newspapers? For the sake of argument, we can consider any advertising budget as a fixed figure—a definite percentage of the profits set aside by the company to insure a continuance of profits in the future. Depending on the nature of the merchandise, this budget is expended in many different media, principal among which are the printed page and the radio. Both these channels reach millions.

One uses a permanent but inanimate display in print, and the other uses an instantaneous and virile appeal through the spoken word. If part of this advertising money is diverted to buy time on television, then one or all of these present allotments will be affected. Considered opinion would predict that both the newspaper and the radio will eventually feel a curtailment of their income from advertising when television broadcasting finally develops a satisfactory market.

Newspaper advertising is, without a doubt, one of our most effective methods of presenting a printed message to the general public. It is carried directly to the consumer along with the news items that make the newspaper a requisite in the lives of millions. Because of the frequency of its publication, the sales message carried in the daily papers can be as timely as the news itself.

Because of its more permanent nature, newspaper advertising enjoys a distinct advantage over television. This advantage must not be underestimated. An advertisement in print is effective until the paper is destroyed, while similar copy over the air is only an instantaneous bid for attention. The newspaper display may be seen by many in the course of its life, yet the television advertisement, to be of value, must be viewed at the instant it is presented. Even under these limitations, the development of television advertising will most surely cause the advertiser to weigh the ultimate value of each medium. The inherent possibilities of presenting timely advertising with moving dynamic pictures and words in lieu of static illustrations and printed text cannot fail to affect the present incomes now enjoyed by the press and radio and, with possible full-scale acceptance of television, may result in a forced redesigning of the economics of both.

Motion Pictures

If there is a possibility that this new entrant into the field of advertising will affect such basic industries as the press and radio, what will be its influence on motion pictures? On first thought, we might predict that television, with its ability to bring the Broadway stage or the thronged football stadium directly to the fireside, would completely supplant the motion-picture theater. However, the executives of the motion-picture industry are not of this opinion. They find many advantages in television that may economically counterbalance the expected reduction in box-office customers.

The average American citizen of today finds that the motion-picture house, the theater, and the night club serve to fulfill two persistent needs. First, they satisfy the craving for entertainment; second, they supply variation in outlook and relieve the monotony of the surroundings. The first function—that of entertainment—will be brought into the home by television, although not in the colossal style of the Hollywood studios. The audience will, no doubt, have drama, variety, news, sports, and education available at any hour of the day, but the natural desire to "go places and do things" is still not satisfied. It is a situation similar to the choice between dining at home or dining out. The food at home is just as good, if not better, than that served in public places, but the setting when dining out is different. By reasoning that this characteristic of the American people will continue, the motion-picture executives do not believe that they will have empty houses immediately upon the advent of television. Obviously, they will have to recognize this new competition, but such cognizance will likely take the form of a redesigning of their product, rather than a complete capitulation to this new field of entertainment.

The motion-picture houses today present a potpourri of features, fillers, news, and comedy designed to cater to a wide range of tastes as a return for the admission price paid at the ticket booth. Most of the material presented has been developed by the motion-picture industry and might be considered as belonging to it by right of discovery. Similarly, we can expect television to challenge the motion pictures as to their qualifications in certain fields of entertainment.

No student of television believes that the medium will ever compete with Hollywood in the production of feature pictures. The instantaneous nature of production and the costs and limitations of equipment all indicate that in this respect the West Coast celluloid factories will remain without peer. Television, with its ability to portray events as they happen, could conceivably challenge the popularity of news and sports reels in the theater, which are normally screened several days after the event. Also, assuming a reasonable improvement in equipment and in production technique, we can expect that in the field of pure entertainment television may offer a challenge to Class B and Class C pictures.

This will not destroy the motion-picture industry. The film theaters of tomorrow will remain paramount in presentation of the great dramas and comedies of the hour, while, in lieu of the filler pictures now on the program, we can further predict a renaissance of the stage shows so popular in the '20's. If the offerings of the motion-picture houses of the future are to consist of superfeature pictures with increased drawing power, these productions will call for increased admittance costs at the ticket window. By concentrating upon the production of outstanding entertainment at an increased "take" per customer, the motion-picture theater of tomorrow should continue to do a lucrative business.

We must not overlook the advantages that television will bring to the motion-picture theaters of today. Theaters must advertise their dynamic product largely through the media of the press and billboard. Printed words and pictures serve merely as announcements of the entertainment available, and fail as a medium for advertising the drama and suspense of a major film story. The subtleties, charm, and popular appeal of these superproductions can never adequately be described in printed advertising alone; they require the use of a dynamic medium equivalent to the art itself.

Today motion-picture houses rely to a great extent on the film trailer to develop interest in a coming attraction. By exhibiting key excerpts from the show, interspersed with good advertising copy, the film trailer gives the audience a preview of its high lights. The value of such advertising is, however, limited to the customer who has already bought his ticket, and it has little or no influence on the untold thousands outside the theater doors. Television, on the other hand, can take this trailer and broadcast it to the homes of millions and thus bring about an increase, rather than a decrease, in the number of theatergoers.

Many motion-picture executives point to further benefits that television may bring to the theater in acting as an agency for discovering, exploiting, and popularizing new names and faces for the entertainment world. Radio popularity has made many of our film stars of today, and radio popularity does much to maintain them in stellar billing. Although such personalities as Bob Hope, Bing Crosby, Fred Allen, Fibber McGee and Molly, and Jack Benny stemmed originally from the stage, it was their national appeal over the air that made them acceptable material for motion pictures. If radio can conceivably discover and build the headlines of our entertainment business, why can we not expect television to carry this process even further? If we assume that picture broadcasting will eventually reach the proportions where it will be capable of challenging other media using pictures, the benefits that will be forthcoming should more than compensate for its possible competitive effect on the picture business.

Possibly the smaller neighborhood motion-picture houses, which today have committed themselves to a policy of double-feature programs, may find an easy solution to this enigma of television by reconverting their theaters to use big-screen television. This would permit them to present current television broadcasts in much the same manner as they now show film, and it would offer a definite competition to the more extensive billings of the downtown theaters.

Radio

Last, but not least, we must consider the possible effect that television may have on radio broadcasting. To assume that the introduction of such a closely allied competitor as television will not materially affect the economics of radio is to avoid the issue. If both systems are to be dependent for financial return on their qualities as advertising media, then the one that can sell best will be the predominant art.

The eventual cost differential between the two media will probably not vary enough to justify bringing dollars and cents into the problem. The expanded future coverage of television and the avowed advantage of visible over audible salesmanship will bring the net cost of television broadcasting down to a figure comparable to that of radio. With the cost differential between use of radio time and television reduced to a minimum, these two industries will be competing for the lion's share of the fixed advertising budgets now allotted to air time. Radio, with no commercial opposition from television, has today built its elaborate structure on the 100-per-cent monopoly of these monies. Logic predicts that the entrance of a parallel, and in some respects possibly superior, art into this competitive field will bring about a marked reduction in the income now enjoyed by the aural broadcasters.

Whether or not this will force curtailment of the present elaborate programming and thus automatically lessen the popularity of radio, we do not know. Such a progressive economic decay occurred in the silent-picture industry during the early days of sound, and it resulted in the complete collapse of the silent-picture market within a few years. Television will probably never exert such a radical and conclusive effect on radio, but it is only reasonable to believe that a marked redistribution of influence will be in order. Unless radio continues to receive the royal income it now justly deserves for its programming efforts, it cannot maintain programs at their present high standard. Maintenance of quality, however, will be of prime importance in meeting the competition of television. If this quality has to be lowered because of reduced income, the dread cancer of a progressive decline will soon bring about the total collapse or the re-establishment of the audio arts on a new low level of importance.

Luckily, there will always be advertisers who do not or will not utilize pictures in selling their wares. These customers will find in radio an excellent outlet to millions of ears and will, therefore, be blind to the temptations of television coverage. We may further expect that the advertisers now using radio will not limit their coverage to one medium alone, but will employ all possible methods of displaying their products. Possibly these factors will result in a parallel, though somewhat restricted, continuance of radio as a sales medium.

In discussing the effect that television may have on the press, on radio, and on motion pictures, we have assumed a maximum development of television's coverage, usability, and importance. Such a stage of development will not be reached overnight. If this growth is impaired by reason of unforeseen difficulties, the possible repercussions on the associated arts will be minimized in direct proportion. In making this analysis, we deliberately enhanced the importance of television so that it might be viewed on a level with the matured arts that it may affect. To many students of the subject, a comparison based on such a premise is a deliberate cry of "Wolf!" and the reasoning that of an alarmist. For the benefit of those in radio who still insist that "it can't happen here," we point to the parallel situation in 1927, when motion-picture executives were quick to belittle the idea that "someday pictures would talk."

15

The Television Commercial

JUDICIAL use of the new dimensions in advertising that television will provide should be able to overcome many of the criticisms that are today leveled at the commercial spots on radio shows.

The much maligned radio commercial originated as a trademarking device in the early days of the industry, where it flourished unnoticed, protected by the novelty effect of the new art. By the time this novelty of radio had worn off and the set owners had turned to broadcasting for entertainment and information, the radio commercial had already started a growth that was to prove as phenomenal as radio itself. At first these advertisements were limited to a mere identification of the sponsorship, but it was not long before some of the agencies began to use more of the broadcast time for their sales message. One sponsor then vied with another in testing the limits of endurance of the audience, until public opinion finally forced a curtailment of this procedure by outspoken objection to both the type and the quantity of selling messages carried on many radio stanzas. Even then, a large percentage of the broadcast was left open for the client to use as he pleased.

Some of the more informed advertisers were quick to sense this growing public sentiment toward the "club and blackjack" type of commercial, and redesigned their program schedules to include a more subtle presentation of the selling stint.

Other advertisers, mainly those with comedy skits, found a solution in working their advertising into the body of the script.

Still others obtained coverage by lampooning the product itself. Today we still pay heavily in program minutes for the privilege of listening to radio entertainment, and we must likewise expect to pay for the privilege of seeing and hearing television. Many national advertisers have indicated that the price of observation measured in percentage of the program given over to selling will, however, be more reasonable than we find it in radio programs today.

We do not expect the advertiser to contribute thousands of dollars' worth of free entertainment without at least identifying his sponsorship and the product he has for sale, but we hope, on the other hand, that the methods used in radio broadcasting for presenting the sales message will give way to a far more subtle and equally satisfactory type of advertising when commercial television becomes a reality.

It is no trade secret that the constant repetition of a selling message, such as we often hear on the radio, will increase the sales of a product. Objectionable as this method may be to some listeners, it still proves highly efficient in getting the greater percentage of the audience to identify and buy a certain commodity.

In a way, we might compare the more objectionable overcommercialization of our air lanes to a series of duplicate billboards erected along a public right of way. They both accomplish the same purpose, but we still do not permit billboards to be erected at any and all vantage points that can be leased by the advertiser. If we did, many of our outstanding scenic vistas would quickly become lodestones for bigger and more elaborate sales displays.

In the case of billboard advertising, many communities have enforced limitations as to the location and extent of such displays, in order that the rights of the many may be protected over the benefits to the few.

The agency man and the advertiser will argue that drawing such a parallel is both untrue and unfair. They will be quick to point out that no one is forced to listen to a certain broadcast, be it radio or television, and they will further feel that the listener always retains the privilege of tuning to another and less objectionable station. A similar argument could be used to countenance the use of the rocky walls of the Pallisades for soap advertising, or the erection of a billboard on the edge of the Grand Canyon. The public could shut its eyes and go on its way or, better still, stay at home, but if by chance people wished to reap enjoyment from these natural sources, they would have to do it over, around, and through the advertising message.

Fortunately, the majority of men who make the policies of our advertising agencies are quick to recognize these so-called rights of the individual and are more than willing to adopt formulae that will protect these rights as well as insure maximum popularity of their program.

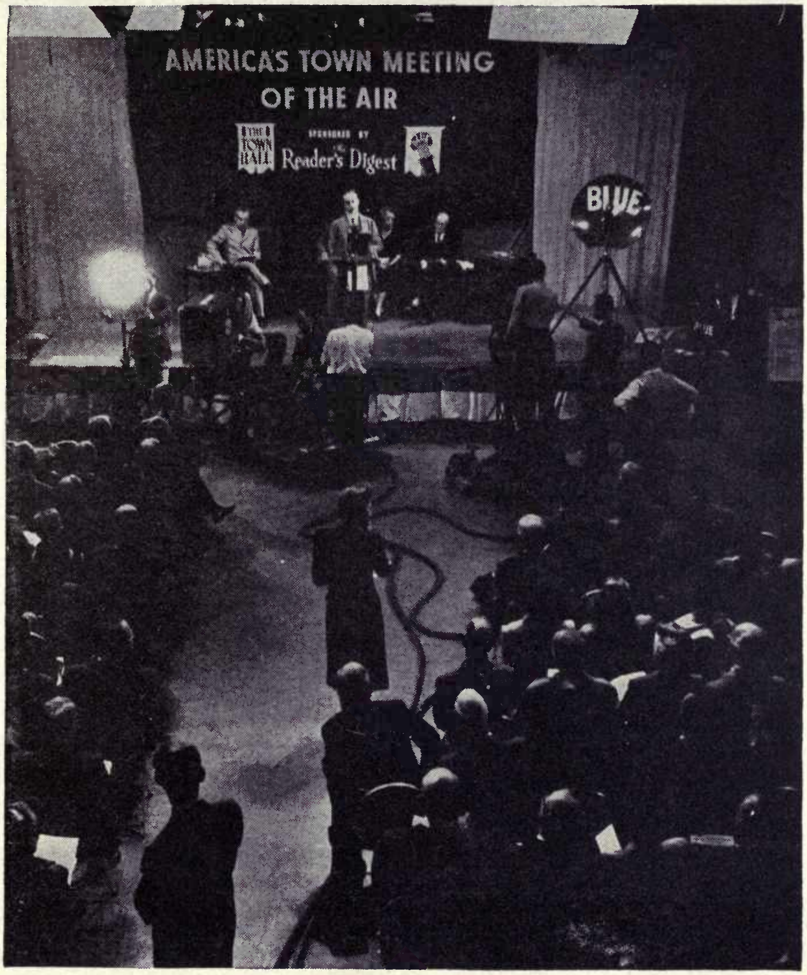
The air lanes used by broadcasting can definitely be classed as a natural resource in which the public has both basic ownership and control, even though the use of these pathways into our homes has been leased by certain advertisers for a given period of time. It is not unreasonable to expect that this lessor will respect the preferences of the listener when he lays his plans for advertising over television.

It is fully agreed that some sort of advertising is necessary to make it profitable for the agency to give us the varied and enjoyable programs that have so far marked the typical American broadcast pattern. The difficulty lies in how much and what type of advertising can be tolerated without releasing a publicly owned resource to the possible exploitation of private interests.

It is our contention in television that it is not too early to consider this problem. We feel that, rather than to adopt the present radio formulas per se, it will be necessary to analyse the possible changes in format that will be available through television, and to adopt formulas that will be mutually satisfactory to both the audience and the merchandiser. With that thought in mind, let us consider some specific problems in television broadcasting where intelligent use is made of the pictorial channels to carry the sponsored messages.

Exhibition of the company seal or its product at the opening of the show can be used to trademark the program. This mere designation of sponsorship may not be considered by the average time buyer as sufficient return on his money, although some of our larger concerns have already indicated a preference for this method over the more involved selling techniques.

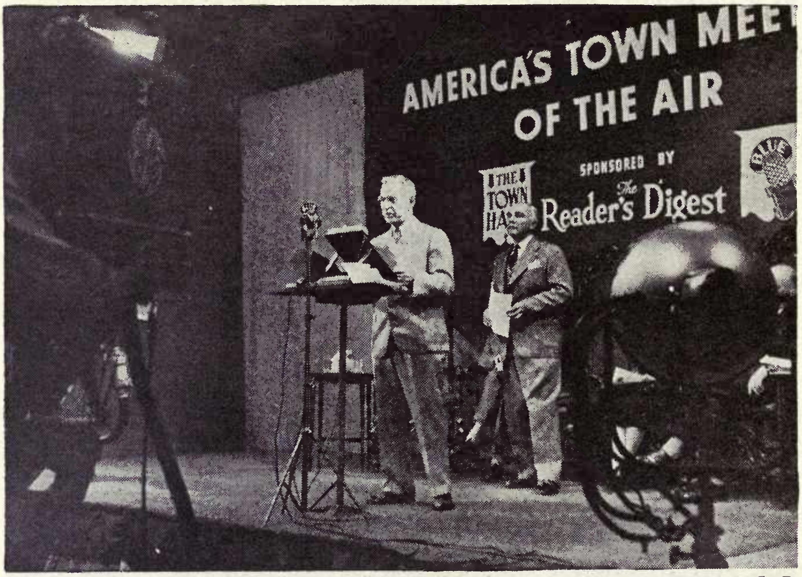
The simple program identification can range from a card title announcement of the sponsorship to an elaborate display of a nationally recognized package. The telegenic qualities of



G. E. Photo

TELEVISED "AMERICA'S TOWN MEETING OF THE AIR" FROM THE STUDIO OF WRGB, GENERAL ELECTRIC'S STATION IN SCHENECTADY the merchandise will indicate the type of presentation most preferable.

For example, a well-known and easily recognized package of soap could be considered good pictorial material, while a similarly shaped package of nuts and bolts would have little value as an identification of sponsorship.



Courtesy G. E.

A BACKDROP WHICH LEAVES LITTLE DOUBT AS TO SPONSORSHIP. A GENERAL ELECTRIC BROADCAST OVER BOTH TELEVISION AND RADIO

Where the product is known, as in the first case, display of the product constitutes the stronger selling message, but where the product is not as well known or where no single item of merchandise is to be stressed, the printed announcement or company trademark would be indicated. In both cases, the spoken word could be used to fortify the visual appeal of the introduction.

Where audio trademarks have been developed and perfected in radio, they should by all means be used as an aural background to the visual display. In many cases these radio trademarks have become standard colloquialisms, and should certainly be continued in television. Typical of this type of material is the Rinso White whistle, the Jello scale, the Texaco Fire Chief opening music, and Lucky Strike's Chant of the Tobacco Auctioneer.

As examples of television trademarking, such as have been discussed, we can cite several programs that have already experimented with this new medium.

Illustrative of the more reserved but still effective formal announcement is that recently seen over WBKB—"Marshall Field Presents Don McNeil and His Supper Club." Little more need be said to identify either the sponsor or the program. Marshall Field's and the quality of the varied merchandise that they carry has become a Chicago legend, while McNeil, in light of his radio work, is both well known and appreciated in the Windy City.

A Sunoco program, broadcast over WNBT, opened with a facsimile of the company's easily recognized seal. As an aural background to this trademark, Hugh James presented a short and concise advertising message before introducing Lowell Thomas and the news.

Rinso, over WABD, has used an animated display of its familiar package, backed by the radio-established whistle trademark to introduce its television program.

Visual trademarking of this type is probably destined to replace the direct radio type of commercial, in which the announcer is televised delivering his message. There are, of course, instances where a personality may be used in preference to an inanimate display, but in most cases the substitution of an announcer for a printed title throws away the definite advertising value of the visual trademark, which it has cost thousands of dollars to establish. If an announcer is used, the entertainment that follows should preferably be in the nature of a variety show in which the announcer appears as a master of ceremonies.

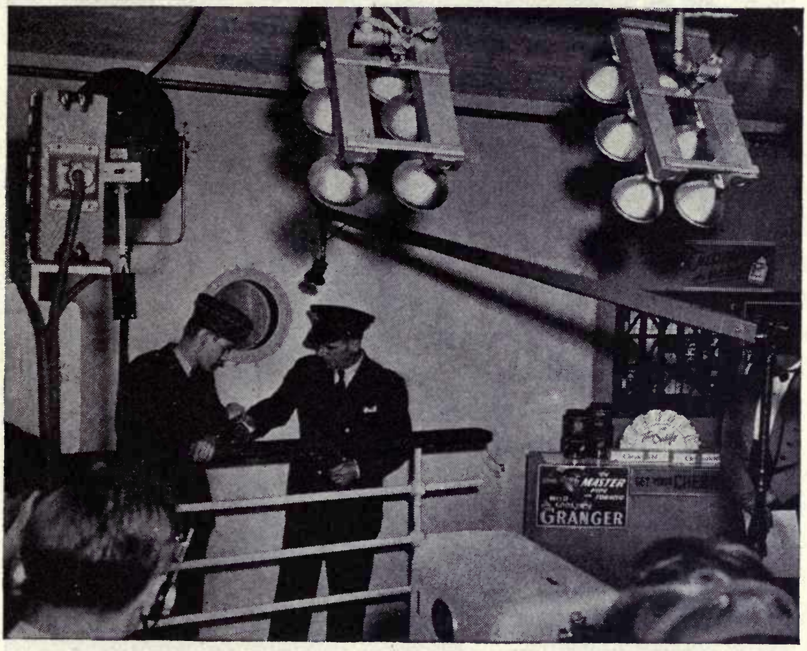
There are, however, many cases in radio today where the announcer, by reason of his name value and his long identification with the program, has become an important contribution to the success of the show. Though the announcer's primary job is one of selling, the public has put many of our top-flight radio announcers in star billing. Harlow Wilcox, of Johnson's Wax; Don Wilson, of Grapenuts Flakes, Jello, and Lucky Strike fame; or Bill Goodwin, of the Swan Soap family, are typical of such participating announcers, while many others are as be-

Courtesy DuMont

AN AMUSING RINSO COMMERCIAL USED OVER
WABD BY RUTHRAUFF AND RYAN AGENCY

loved by the listening public as the radio stars themselves and, like the stars, identify and recall the product they advertise.

These personalities should not be considered mere script-reading salesmen, but as artists of the first magnitude. If they can learn to talk without the ever-present radio advertising script before their faces, they should be billed to the advantage of the product. If it is deemed advisable to use an announcer to deliver the selling message rather than a visual or printed display, it is highly desirable that the announcer memorize and deliver the commercial with a forcefulness that assures confidence in the product. Where a television program has recourse to such personalities, new latitudes are opened in using both aural and pictorial material in framing the selling message. When this salesman is forced to divert his attention from the audience to the script, it belies his knowledge of the merchandise



Courtesy DuMont

TELEVISED CHESTERFIELD COMMERCIAL, FRED WARING SHOW ON STATION W2XWV, DUMONT'S OUTLET IN NEW YORK

he is selling. Because of the difficulty in finding telegenic announcers capable of delivering commercial copy without reference to the script and because of the general insistence of the client that his advertising be delivered as written, it is likely that many television shows of the future will start with inanimate trademarking commercials, leaving the average male announcer to carry on in radio.

Today we find more and more of the better radio programs leaning toward the reserved type of identification. Typical of such broadcasts are the musical hours sponsored by nationally known manufacturers, who would gain little by describing their product in detail. In fact, the good will created by the lack of insistent plugging has been found in some instances to more than counteract the possible loss encountered by not advertising the specific merchandise for sale. This system of merely identify-

Courtesy Commonwealth Edison

COMMONWEALTH EDISON EXPERIMENTS IN HOW TO PRESENT A GOOD COMMERCIAL TELEVISION SHOW OVER WBKB, CHICAGO

ing the sponsor has gained in popularity with both the client and the radio listener, and it has already been demonstrated in television with excellent results. However, it requires a product that is known by sight or a sponsor whose merchandise needs little authentication, as well as a client who believes that his audience will recognize and acclaim both the merit of the product and the anonymity of the contribution.

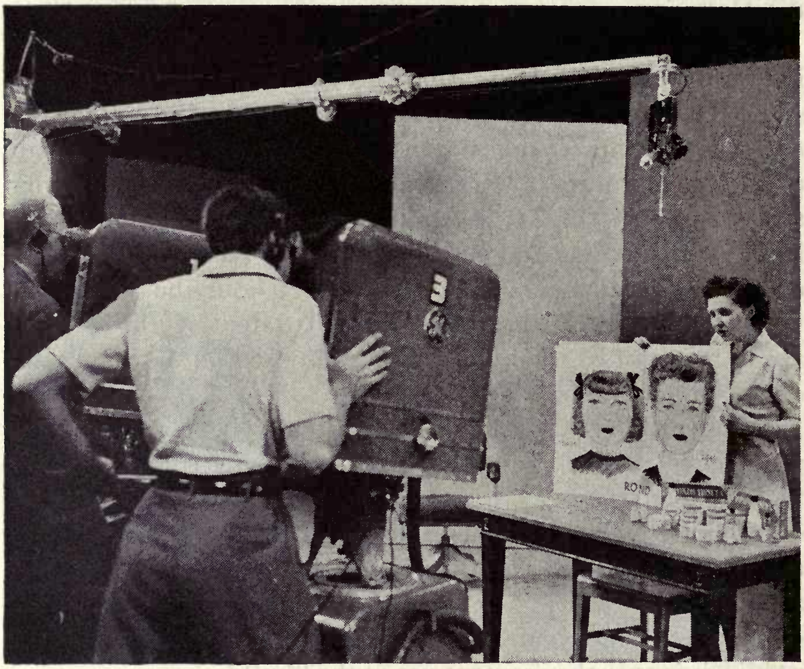
The Commonwealth Edison Company of Chicago is typical of such sponsorship over television. This company, in promoting the electric service and kitchen appliances that it had for sale, scheduled a series of cooking demonstrations staged in an all-electric kitchen. Rather than intersperse the instruction or the clever dialogue with cold, blunt advertising, the company relied on an actual demonstration of the equipment to make sales, identifying its sponsorship by an extremely clever title card arrangement that was disclosed upon opening the oven door of the Hotpoint range.

In many cases the problem of obtaining effective advertising is simply one of incorporating the trademark in the picture setting in an artistic manner. The number of minutes that the trademark is thus visible is considered far more effective than the result obtained by infrequent spot insertions of other types of commercials. If ingenuity and finesse are employed in incorporating visual trademarking into the backgrounds or set design, rather than in the foreground of both the audio and visual transmission, the audience is flattered by the evident appreciation of its intelligence and impressed by the good taste of the presentation.

It is true that television will eventually be playing to the multitudes, and this subtle type of advertising copy may have to give way to the more pointed and repetitious type of advertising typified by our standard radio commercial. Proponents of this school of thought are quick to point out that, even though a subdued and intelligent type of selling message may at first create excellent good will between the advertiser and the public, it is only the insistent use of the "bulldozer" commercial that makes customers put on their coats and rush en masse to the nearest grocery store to buy the soap or cereal advertised.

If we assume that the latter method has proved its ability to sell merchandise, even though it has created both criticism and resentment, would we not be wise, in setting up the format of a new advertising medium, to experiment rather than to adopt methods that admittedly are open to criticism? Television should no more be forced to accept the radio commercial of today than it should adopt the asbestos curtain of the theater.

In non-dramatic programs, advertising such as we have outlined is entirely feasible, but can such a commercial be used in the presentation of plays and operettas? It would be out of the question to have Jane Eyre discourse at length on the cut of Rochester's two-pants suit, or to have Pagliacci reach for a Lucky as he intoned the commercial. Such intrusion of concrete fact into the play would tend to destroy any dramatic illusion that might have been created and would also challenge



G. E. Photo

THE RIGHT AND WRONG METHODS OF APPLYING MAKE-UP ARE DEMONSTRATED BY MISS MARY STUYVESANT, POND'S BEAUTY EXPERT, BEFORE THE CAMERAS OF WRGB, GENERAL ELECTRIC'S STATION IN SCHENECTADY

the listener's patience. In such situations, where an opportunity for legitimate advertising is not available, it would be far better to forego this function and be content with the privilege of before-and-after identification.

In staging comedy or variety routines, the requirement for keeping "hands off" is not as important. In the first place, the average variety show will be made up of many separate sequences between which it may be possible to introduce material dealing with the product. Such commercials must, however, be in keeping with the tone of the program to avoid straining this ever-present sense of propriety on the part of the

G. E. Photo

FATHER LEARNS ALL ABOUT CARTER'S BABY GARMENTS DURING TELEVISED COMMERCIAL AT WRGB, G. E.'S TELEVISION STATION

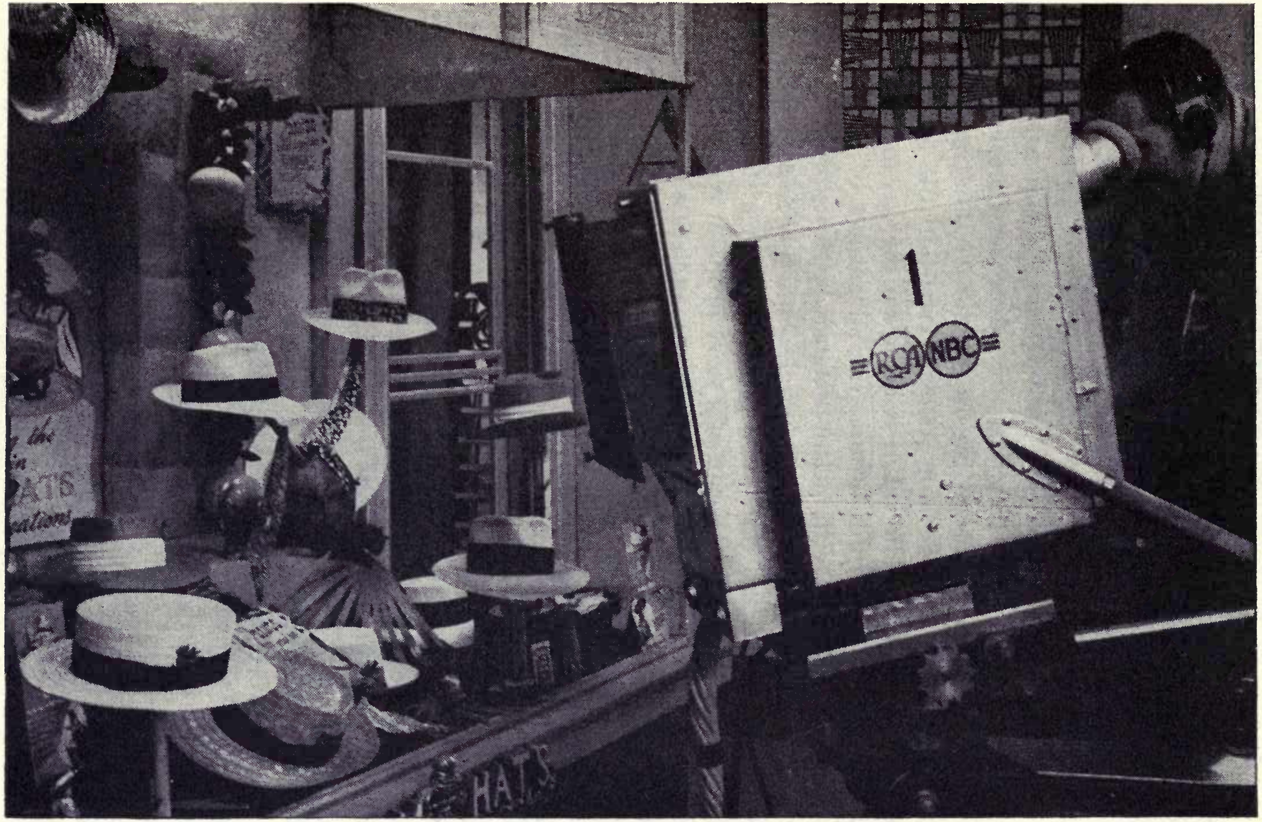
audience to the breaking point. If a reasonably small percentage of program time is thus used by the sponsor, the members of the audience will see the program with the feeling that they have benefitted from the show, rather than that they have been exploited by the advertiser.

In certain types of programs, it is entirely feasible to set aside a period when the product can be discussed or demonstrated. These may appear to be contradictory paragraphs, but in this case it is assumed that the presentation of the selling message will be "in character" with the program and that the time and place of the insertion will be logical and appropriate. Take, for instance, the problem of advertising some beauty preparation. Rather than televise a typical radio commentator, who will at intervals throughout the telecast rave about the display of bottles and flagons of this wonder-working lotion, the sponsor could well afford to minimize his talk, and redesign his show into a semi-dramatic interlude that carried an equivalent message. By thus using the advantage of sight over sound, the sponsor will receive satisfactory returns on his advertising dollar.

It is good television to build a skit around the effect of crankcase gum and actually to show it and how to use the oil that will prevent it. To say that this soap or that cheese will save you pennies on each purchase is not enough. Good television requires that we show the pennies that will be saved if the audience takes the sponsor's message to heart. A mere verbal recital of fact is good radio, and it is all that radio can broadcast, but it is decidedly poor television unless it is accompanied by visual material that makes full use of the effectiveness of the picture transmissions.

Properly used, television may well become the ideal advertising media, reaching people through eyes and ears simultaneously. It has been demonstrated many times that today a combination of pictures (in space advertising) and the persuasive quality of the human voice (radio) does a better job than when either one is used alone.

There are many products that in themselves become the nucleus of satisfactory entertainment, even though the entertainment is based entirely upon a selling message. Typical of such merchandise is clothing, around which the advertiser could build a fashion show, or automobiles, which could be advertised by sponsoring travelogues or other educational series. Such cases present little or no problems other than the development of the available material along the pattern of good showmanship and the selection of a proper method of identifying the merchandiser.



NBC Photo

ADAM HATS APPEAR IN THE NEW ELECTRONIC SHOW WINDOW OF THE AIR OVER WNBT'S TELEVISION SYSTEM

For every product that contains the precious, basic element of showmanship, there will be hundreds where the successful formula is not self-evident. In such instances, the agency must do its best to devise methods of presentation that will be acceptable as entertainment or education but that, at the same time, will do justice to the product.

The fate of the "soap opera" in television is a question that is always posed when two or more advertisers get together. Will this typical American feature of the daytime radio programs die, or will it develop its counterpart in the television of tomorrow? The radio serial is based on the day-to-day continuance of a story built around the adventures of a limited cast of characters. Without an extensive television network available to the user of such material, could any sponsor afford to underwrite such a continued production for a strictly local audience? Although the script and story problem remain about the same in television and radio, the video telecast will require stage settings and accomplished television actors to produce the show. Today it is possible to broadcast a radio serial after a quick reading of the lines, but a telecast of the same material will require hours of rehearsal before the camera. Even if it were expedient for the advertiser to discount the cost of script and talent for the limited local coverage of television, will it be possible for a company of actors to rehearse and produce original shows on a daily schedule? Our knowledge of the problems of television production indicate that it will not. The value of these serial plays is of such importance in radio that we cannot lightly dismiss the problem.

There are two alternative solutions if the methods used in radio today prove unworkable in television. One would be to record the episodes on film and distribute this program to all stations for local telecasting. The other, and probably the less practical method, would be to establish a group of traveling stock companies who would present a varied repertoire in lieu of the continuous story.

If it is necessary to perpetuate the continuous drama in television, it will probably be more expedient to resort to film. Only by this method could the cast be expected to learn and produce a series of connected playlets with the frequency in which they must be presented. By presenting the show before the film camera as a complete story, we reduce the problems of lengthy rehearsals, possible errors, and impermanence of cast to a minimum. By such methods, it would also be possible to present the same story to audiences across the country, rather than having to limit the broadcast to a single locality.

The second alternative—retaining a series of stock companies who could present repertoire plays on a daily schedule—is not a counterpart of the serial, but it might be an interesting substitute. By using several acting groups it would be entirely feasible to earmark a certain program period of each day for dramatic productions under the sponsorship of one advertiser.

Such plays will necessarily be nonserial in type, and, presented directly from the television stages, they would have to be simple in construction and excellent in workmanship. Such a combination must be obtained with the best of talent, so here too the budget price is of major consideration. If these individual productions have to be staged under the techniques and difficulties that now attend television broadcasting, it will probably be more economical to consider perpetuating the serial story in film. Even with the availability of complete networking facilities, such a program for daytime presentation would cost exorbitant sums and would in all probability return unsatisfactory results because of the limited free audiences during these morning hours.

If the serial program is to continue in the same form as we know it, there is little doubt that the distribution of the program as a series of filmed episodes is the only solution. The cost of such a production would be great if it were of the quality that might lead to popularity. Whether or not the proponent of this type of program feels that its advertising value is of such order that he can underwrite a major film production, such as indicated, must be left to the decision of the sponsor. If such serial shows will be available on television, they will become a must for many millions. On the other hand, the advertiser must also realize that a program made up of both picture and sound must be given the audience's full attention. Even if we assume that the television counterpart of the daytime radio serial will also be presented during the morning, will the audience of housewives be able to stop their work and watch the telecast, or will they merely listen to the story as they work? If the latter is the case, then the advertiser would be better off not to consider converting his program to television.

The ultimate value of daytime television broadcasting has always been considered problematical by the advertiser. It is impossible to select periods other than late afternoon and evening when the time buyer can be assured of an available leisure group. Because of this fact, we have many times proposed the possibility of using daytime television for education. Such a plan would provide a large and receptive audience of students for commercial broadcasts during the daytime periods. It is reasonable to believe that a tooth-paste manufacturer would see fit to sponsor an oral hygiene program that could be considered excellent educational material for the grammar schools. A cereal company might offer a program on dietary subjects, and a manufacturer might underwrite a course in manual arts that were exemplified, in the highest degree, by his merchandise.

If such material were available on the air and the subject matter were of a caliber that could be readily adopted into the school curriculum, could not the present objection of teachers to such commercialized educational broadcasts give way to at least an acceptance of sponsored education?

From the advertiser's point of view, such a proposal is not without merit. It has been proved again and again that one of the best methods of persuasive selling is to convince the children first and to rely upon them to persuade the adults to buy. Sponsored education by television would do just this, and it would carry with it a good-will factor that could conceivably be far more important to the sponsor than the program itself.

Whatever the solution of the daytime telecast problem, the final and satisfactory formula will evolve around a program that will return more real value to both the listener and the advertiser for the time and money expended.

It is conceded that eventually the advertiser will come to realize that a note of subtlety in the design of his merchandising may bring far more returns than the garish colorations so often employed in radio advertising. Television can be of inestimable value with its sight as well as sound, but the temper and receptivity of the audience for the advertised product can only be guaranteed when the client considers this audience as guests.

16

Staging a Television Production

THE process of preparing and producing a satisfactory television show should follow a logical plan, designed to bring the play before the cameras in the shortest possible time. The type of playlet selected will determine the length and detail of rehearsal. Very often a variety act can be staged with a single "run through" before the cameras to establish camera angles and at the same time to review the routine. On the other hand, the production of a full-length drama is a problem calling for many hours of planning and rehearsal. Inasmuch as the production of such shows will, no doubt, be the forte of television, this chapter will be based on problems associated with the staging of an original script designed to run more than an hour before the cameras.

The choice of story may be the province of the producer, but in all probability the story will be read, selected, and purchased by the script department and assigned to the director for production. If the director is allowed to select his own story, he not only has the great advantage of choosing a work that holds definite personal appeal, but in all likelihood he will have already formed a mental picture of its television possibilities. In either event, the first step consists of a careful reading of the synopsis prepared beforehand or a thorough reading of the book or story itself. From this review the director prepares his first rough plan of production in which the time allotted to the high-light sequences will be determined and a rough skeleton of the action developed.

With this television synopsis in hand, the director calls the first story conference, in which the script writer, set designer, costumer, special-effects engineer, and chief television control engineer assigned to this program will normally be present. Knowing the general details of what will be required in scenery and special effects and having a rough idea of the camera work involved, the director will review his plan with these representatives of the various contributory arts.

The set designer will suggest various stage arrangements, and these in turn will be discussed from the viewpoint of production and engineering limitations. He will submit sketches that will then be modified until a complete agreement is obtained in these two departments.

The subdivisions of the show are decided upon so that the special-effects department may propose the title material and "bridges" for consideration. In many cases, these intermissions are injected into a story to allow for resetting of the stage or for making major readjustments of a camera position, and they must, therefore, be determined before any details of the play are developed.

Once the general concept of the program has been agreed upon, the design theme selected, the sets and studio arrangements approved by all departments concerned, the director can give his attention to the job of cutting the story to fit the time allotted and the medium of presentation. After this editing, the story is turned over to the script department, to be written in the form of a preliminary script in accordance with the plans laid down at the conference.

In adapting any story material for television, the director retains as much of the original material as possible, with stress placed on action rather than on words. Situations and dialogue are composed in such a way as to produce the best pictorial material when played before the cameras.

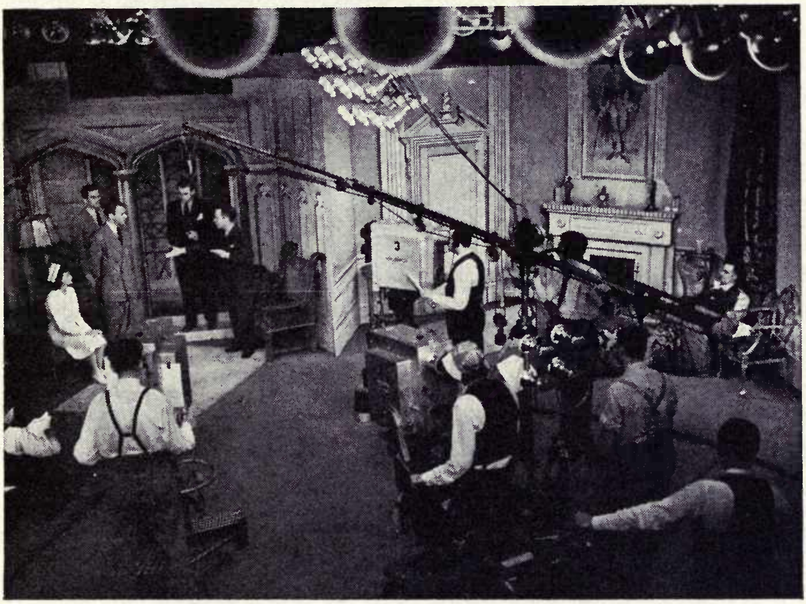
Upon completion of the script, there should be a second conference between the various department heads to decide upon a detailed plan of development to correct any discrepancies in the original plan. By this time the stage designer can, no doubt, produce finished sketches of the stage settings, with an outline of the costumes and properties required for the production. From these sketches or scale drawings and with reference to the shooting script, the engineering department can suggest the lenses that should be employed, the lighting possibilities and problems, as well as the availability of cameras and other equipment. The effects department can offer sketches of the title work, miniature settings, intermission "bridges," and other details that fall under its cognizance. During this conference, which will probably be the last in which all contributory departments will be present until the play is brought into the studio, all general details are ironed out.

If the play is to be a costume story, the wardrobe department will obtain the necessary measurements and will specify the clothing that will be furnished by each actor for his part. It is the general practice today for the actor to supply his own wardrobe, unless the story specifies some articles of clothing not generally available or unless it includes a sequence that might destroy or damage the clothing that is to be worn by the cast.

Just before the copies of the now perfected script are distributed, the director will call the cast he has chosen into a story conference to which the public-relations department will be invited if name stars are billed. At this meeting, the play is discussed in detail and the proposed action is illustrated with sketches and outlines of the major crosses, entrances, and exits. After the production has been covered in this manner and thoroughly understood by the actors, an appointment for the first rehearsal is set and the members of the cast leave the meeting to study their parts.

The director must now begin the preparation of his camera or shooting script. Knowing by now the arrangement of the sets, the number of cameras and lens equipment available, he can lay out a scale model of the studio in which the actual set lines, doorways, and stage properties are indicated. The various camera angles necessary to telling the visual story will be computed from this blueprint and entered on the margin of the script.

The latitudes of free camera movement and broken continuity of shooting used in motion-picture photography are not found in television staging, where each camera is tied to the control-room wall with a fifty-foot length of camera cable. Hence, the problem of camera movement becomes extremely complicated in cases where the field of operation of one camera



NBC Photo

A MULTIPLE-SET DRAMA BEFORE THE WNBT TELEVISION CAMERAS

crosses that of an adjacent one. To prevent the occurrence of such situations and to reduce the entangling of the coaxial cables with stage settings and other fixed properties, when planning the action of the play on the blueprint, it is a wise practice to use a model camera, which has a string connecting it to the proper connection block. In this way a crossed cable or a proposed sixty-foot dolly shot on a fifty-foot cable length can be kept out of the shooting plan and a workable solution found in its stead.

A further excellent variation of this pre-rehearsal planning is the system used at WBKB, in which a masking pattern outlining the coverage of the lens and the usable depth of focus predicted for each situation is used in conjunction with the scale camera models. From this combination the director can actually put down on paper a detailed sequence of camera positions, lens choice, and angles of coverage, and can predict what he will get when the play arrives in the studio for its first camera rehearsal. This advance information is extremely valuable. In staging the action during the early "walk-through" rehearsals, the director, by reference to his plan, can group his characters within the field of the lenses, and thus avoid having to make major revisions of action during the first camera rehearsal.

At the first line rehearsal, the members of the cast are expected to have their lines memorized. Necessarily, the entrances, crosses, and exits may be ragged and the interpretation of action by players may not coincide. The walk-through rehearsal follows and serves to smooth out these discrepancies and to weld the characters into a fluid group of performers.

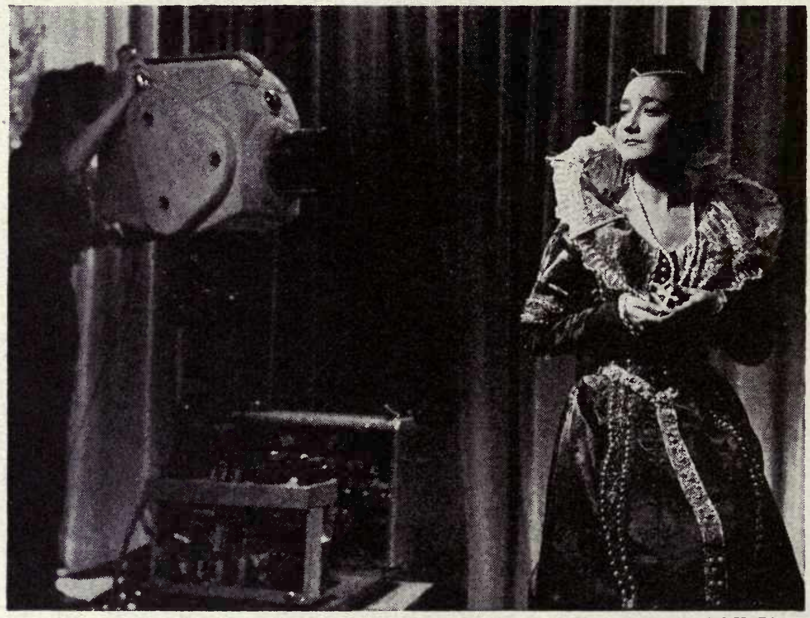
Because of the scarcity of television studio equipment, the excessive cost of operating this apparatus, and the need for many hours of rehearsal, the cast will normally work in a rehearsal room without the use of television equipment or sets. The position of the back walls, doors, windows, and stage properties should be marked on the floor of the room so that the action can be properly contained. This also eases the transition from one stage to another. In complex situations that may be included in the script, the actual set furniture should be used to facilitate a detailed breakdown of and familiarity with all the required moves. Director, stage manager, and chief cameraman should, of course, be present at these early rehearsals to check on the requirements and possible complications in the developing activity.

In the meantime, the scenery will be in preparation in the scene dock, and the exhibiting apparatus lined up for presentation of special effects. The camera studios will probably be in constant use during the days of preliminary rehearsal with the space unavailable for camera work until the morning of the scheduled date. Only then will the members of the cast see the actual stage settings and make their first use of the properties designed for the play. It is common practice to construct the

NBC Photo

TELEVISING *MAMBA'S DAUGHTERS* AT NBC, NEW YORK sets in the studio during the early morning hours, so that the actual camera rehearsals can begin as early as possible.

The cast is well drilled in both lines and actions, and little remains but to smooth out the performance and to set the camera work in its final form. In order that the camera positions



B&K Photo

SHAKESPEAREAN DRAMA BEFORE THE B&K CAMERAS IN CHICAGO

selected will be duplicated in the ensuing dress rehearsal, and in the program that goes on the air, each camera is provided with a simplified cue sheet on which the cameraman can record in his own hieroglyphics what move or position his camera takes. In order to establish these positions, the cameraman marks a series of numbers on the floor over which his camera is moved in sequence.

The lighting engineer now verifies his predicted arrangements of both foundations and specific lighting, and prepares the "light plot," which is, as the name implies, a schedule of lighting changes using lines of the play for cues.

The sound technician covers the first rehearsal with the boom microphone, noting any deficiencies that may appear in pickup, and then installs the additional microphones required for adequate coverage.

NBC Photo

A BROADWAY "HIT SHOW" BEING TELEVISED IN NBC'S RADIO CITY STUDIO

The wardrobe department makes last-minute checks on the fit or color of the costumes, while the stage manager organizes his assistants to meet all the eventualities of the production.

In well-rehearsed plays, two to three camera rehearsals will suffice before the actual dress rehearsal. This final rehearsal is generally scheduled several hours before curtain time so that last-minute changes can be made in both story and photography, and so that the cast may have an opportunity to relax before going on the air.

About thirty minutes before curtain time, the studio is lighted and the make-up on the players checked in front of the camera. Sound levels are tested, special effects and title operations are rehearsed, and when all is in apparent readiness the sets are cleared and the cameras are moved into position for the opening shot.

From this point on to the final curtain, anything can happen, and in television it usually does! The minor catastrophies that sometimes occur even on the best organized sets are then completely beyond the control of director, cameraman, or actor. In most cases, these untoward occurrences are quickly absorbed by the well-drilled cast and are not noticeable to the audience. Camera failures, however, require a departure from the prearranged plan and the substitution of impromptu direction. Where previously the cameras were moving to fixed positions, with little or no coaching from the control room, they must now be shifted with constant instructions as to where to go and when to move. The failure of a camera seriously hampers the production of any rehearsed and predetermined program, and it may even result in the complete fiasco of an otherwise excellent piece of staging.

Failure of the cast to follow pre-arranged plans will result in "ad lib" moments with cameras and story that bring lumps into the throats of every person in the studio. It is not to create the impression that these awkward incidents are a normal and expected part of every television show that they are pointed out here. In the entire course of NBC's field test, there was but one show that was seriously affected by occurrences of this nature, although in this case the "freezing" of an actor and his resultant failure to remember lines brought about some of the most interesting "ad lib" variations to a story that can be imagined. The director, and in fact the entire cast and studio crew, should realize that the unexpected can happen and should therefore be prepared to make a quick and reasonable substitution. This will require not only a quick-thinking director but also a well-trained cast and a competent studio organization.

The director of a television drama must be a writer, an artist, a drillmaster, and an excellent tactician. Even with a story of mediocre quality, the skilled director can many times transform the television version into an excellent and appealing program; conversely, a poor director can reduce a good story and an evening of capable acting into a production that does not merit air time.

A director in television should also be well versed in many of the associated arts if he or she expects to use the studio to its fullest advantage.

A full knowledge of lens practice is a prime requisite, both in producing the show and in laying out the original shooting sequences. The more complete this background is, the more efficiently the director will be able to use the camera equipment at his disposal. Experience in amateur photography, motion pictures, or even individual study in this field will be of definite benefit to the novice in the art.

Understanding the theory and practice of lighting the set is quite as important as being able to select the proper lenses for a video broadcast. Although much can be learned from observation of actual studio procedures, a conscientious review of the many excellent books written on this subject is recommended. Here again, however, actual studio experience will be required to apply theory to practice.

Once light is transformed into electronic energy, the control of levels, contrast, and shading becomes the responsibility of the control-room engineering group. Inasmuch as these adjustments can nullify or improve all the work that has gone before, the director should at least have a superficial understanding of the functions and limitations of the shading generator as well as the switching panel. All too often the neophyte director will demand settings that will not reproduce satisfactorily over an electronic system. In many cases these scenes can be saved by readjustment of lighting levels or slight changes in the desired effect. Although in most studios the program director is considered the senior member of the control-room staff once the show is on the air, it will behoove him, not only to accept counsel from the engineering staff, but in addition to recognize that some situations that may be easily photographed on a movie set will be unsatisfactory or impossible to reproduce over television. The engineering staff assigned to the production will normally have a far better understanding of the capabilities of the equipment under their charge than any man in the program group. They will generally be found to be most co-operative in experimenting with, and in most cases solving, the trick production problems proposed by the director, provided they are given the opportunity to become more than operators.

It may appear from the foregoing paragraphs that the television director should be a supercombination of artist, writer, lighting engineer, and electronic technician. If he were, he would have little trouble in producing acceptable television programs. If he is a specialist in one field and deficient in some of the contributory arts, as he no doubt will be, his willingness to take and use the counsel of his more qualified co-workers will compensate for his shortcomings.

The director, of all people in the studio, cannot have too detailed a knowledge of the equipment and arts that he wields in fashioning a television program, and he should at every opportunity add to the experience that has placed him in the directorial seat.

Even though he may possess many of these capabilities necessary to the actual production of the electronic pictures, it is generally agreed that a real director is born, not made. Although many men may be able to follow a series of rules and succeed in producing successful programs under ideal circumstances, it is the natural-born producer who, under adverse conditions, can "pull rabbits out of a hat" and save the show. This same director will also see in the simplest situations an opportunity for camera work that will make of a routine playlet a television show that will gain public acclaim.

Practice and experience are necessary in the development of any director, in addition to his grasp of the elements of showmanship and an appreciation of the equipment limitations with which he is working. The better producers in television today have originated in so many walks of life that it is impossible to delineate any common heritage. This gives proof that television will develop its own directors rather than borrow them ready-made from other fields.

The director's chair is not the easiest in the control room. If the show is a success, credit is given to the cast, the story, the lighting, or the lack of automobile ignition interference on the receiver. If the program is a failure, however, the producer may expect to see his name in print in every review of the fiasco.

17

The Actor in Television

OUR limited experience in commercial television programming has so far given no indication that the art of acting or producing in this medium will require a radical change in the accepted stage habits or techniques of either actor or director.

As in other vehicles of entertainment, however, a successful television production generally demands that the participants adopt certain proved "tricks of the trade" that have been found to insure a more satisfactory electronic picture on the home receiver.

The actor, for instance, must recognize a change in stage habits in much the same way that he must now vary his voice and actions according to the change in feeling of a script or the size of the theater.

In the theater, the lines and movement of the actors are keyed to the middle rows of the orchestra, even though these gestures and reactions, as seen by the front-row patron, may appear to be slightly exaggerated. It is, therefore, necessary for the stage artist to play to the entire audience spread before the footlights if he is to gauge his performance accordingly.

In television, the audience is brought into a new close-up intimacy with the actors in the play. From an optical point of view, the television audience can normally be considered as being seated only a few feet from the acting area. Under these circumstances, the actor would do well to play his part to the cameraman behind the lens, as representative of the unseen audience seated before the receivers in the home. Television has brought about this new intimacy between player and audience, not only because of the predominating technique of close-up photography used, but even more so because of the environment in which the average set owner will see the program. Exaggerated action, together with other types of overplaying, will appear doubly distasteful when observed from the fireside seat in the familiar atmosphere of the home. The lens of the camera can be looked upon as the proscenium arch stretching before an audience of thousands, and, although the performer must necessarily remain apparently unconscious of this engineering substitute for a living audience, he must at the same time continually sense its position on the set and play to it.

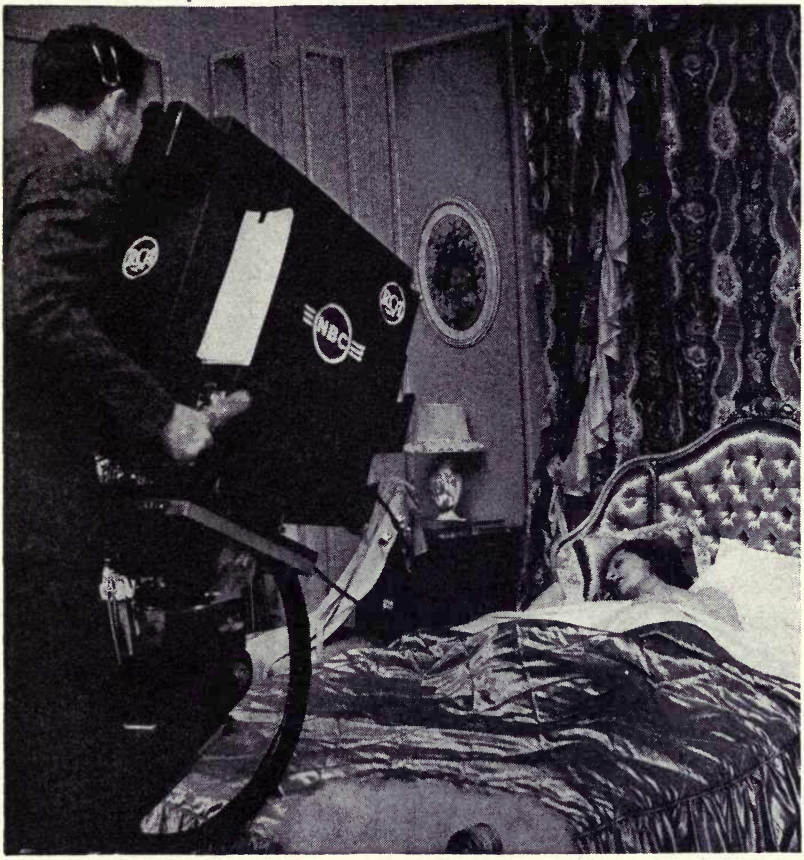
Probably the greatest difference between acting on the stage and in television is the total absence of audience reaction in the latter art. Those actors who are accustomed to playing to and for the response of a live audience at first find it extremely difficult to give force and realism to their lines in the indifferent and sometimes disconcerting atmosphere of the television studio. After the first few television performances, however, this total lack of "lift" from the remote audience is soon forgotten, and in its stead is developed a lens consciousness, which is very essential to a satisfactory television performance. Speech mannerisms are particularly undesirable in television, since they generally tend to distract attention from the visual performance. It is easy to spot a radio actor in his first television performance by his furtive searching for the microphone. Perhaps this is because of the moral support that this inanimate gadget offers to a broadcasting veteran, or else the actor may doubt the sound technician's ability to pick up the lines satisfactorily. Sound in television must be considered as merely an adjunct to the action of the play. It is the studio's responsibility to see that the lines are picked up at the proper level and in the proper perspective, no matter how subdued they may be or from what point they may be spoken on the set. To accomplish this pickup, television uses a series of microphones, some overhead on booms, some hidden on the set, and others placed about the set to record isolated sequences that would normally fall outside the range of normal pickup equipment.

It is the studio's further responsibility to see that the audience is never made conscious of the presence of these microphones. Like the motion-picture studios, television takes full advantage of the flexible microphone boom. The operator of this apparatus, equipped with high-fidelity earphones, will monitor the level and quality of the pickup as he moves the mike up and down the stage above the heads of the actors. In the control room, the audio supervisor will further check the quality, as well as the level, as he controls the switching, fading, and dissolving from one mike to another. These two men are responsible for the recording and transmission of the audio component of the play, and with the equipment available to them they are fully competent to relieve the actor of any worries that he may have on this score.

The ever-present problem of volume balance between the delivery of several actors should be the concern of the director as well as of the sound technician. Our normal audio equipment is incapable of adjusting wide variation in individual parts. Therefore, overplaying by one actor will generally result in an unsatisfactory audio accompaniment to an otherwise satisfactory picture.

The establishment of individual voice levels by proper placement or staging of the characters can be considered a primary responsibility of the director. It behooves the actors themselves to determine the correct level of delivery in order to benefit their individual portrayal, as well as to contribute to the quality of the piece in production.

It is extremely difficult to examine the various possible sources of television talent and to select the one that will provide the best background for television. The stage, motion pictures, radio, and the night clubs all create typical acting habits that can be used in building a topnotch television star, and, conversely, each art develops idiosyncrasies that are objectionable when they are seen through the discerning lens of a camera. Independent of their background in other media, the actor and actress on the television stage should be quick to respond to the advice of the control-room director, who is able to foresee the televersion of the play. Details that may seem extremely un-



NBC Photo

GERTRUDE LAWRENCE RE-ENACTS THE SECOND ACT OF *SUSAN AND GOD* FOR THE TELEVISION AUDIENCE OF NBC

important on the set may easily appear incongruous on the receiver. Remembering that "naturalness" is the goal of a successful television play may help to prevent many of the minor faults so common to newcomers in the art.

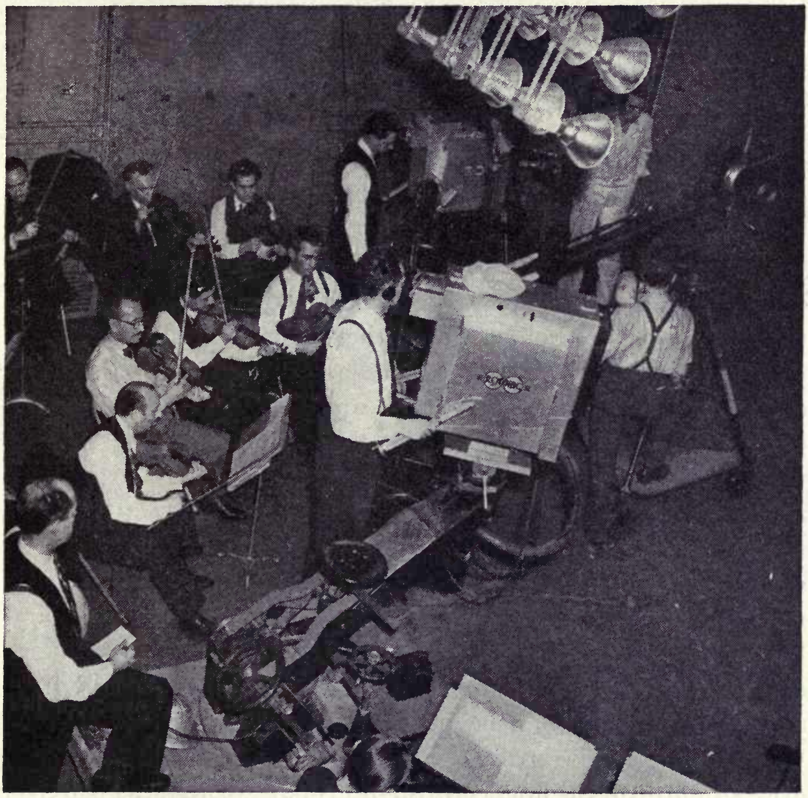
Most professional actors have cultivated many minor traits that will bear remodeling for television, but they at least have mastered the basic techniques of acting that will prove satisfactory for all media, including television. Once these actors and actresses develop the habit of automatically directing their efforts to the lens of the active camera, they can make full use of the fine subtleties that make them accomplished stage performers.

On the stage, a great many gestures must be exaggerated or else be lost to any but the front-row-center audience. These traits of overplaying may sometimes become second nature to the seasoned actor. While this ability to emphasize or, better still, to overemphasize, is admirable on the stage, it becomes a noticeable artificiality before the intimate lens of a television camera. The dramatic student and stage actor would do well to practice restraint in gesture if they wish to prove themselves telegenic.

On the other hand, unless radio stars have stemmed from the theater, they are prone to stress voice delivery at the expense of acting. Although this overemphasis will mark the newcomer from the radio studio, the fault is generally short-lived and can be quickly corrected by a diligent director. We have noted cases, however, where an ex-radio announcer has unconsciously cupped his hand over his ear in radio-studio fashion long after having made his debut before the television cameras.

Vaudeville and night-club acts will generally require less readjustment for television than the straight stage and radio productions. Their routines, designed for the intimate settings of the night club, are paced and staged to this restricted horizon, and will thus be admirably suited to television reproduction and the space limitation that is necessarily a characteristic of the television studios.

It is generally agreed that a minimum factor of eight to one can be assigned the effectiveness of sight and sound over that of sound alone. Applying this index to program production, we can conclude that the action or "stage business" becomes predominately important in television. Now that we are able to produce pictures over the air, it is not surprising to find that the audience prefers action pictures to samples of still life. This does not infer that in order to satisfy this requirement the cast should be continually on the jump, but it does require that normal movement and action should be written into the television story in order to avoid the immobility that is more appropriate to the other arts. To illustrate this, let us imagine a girl and a boy seated at a table on a country-club terrace.



NBC Photo

A "DOWNSTAGE" SCENE DURING AN NBC TELECAST

The script provides several pages of conversation that must be delivered. If the characters speak their lines with no consideration of the picture created, these close-ups will bore even the less critical audience. The producer, therefore, has little opportunity to do more than switch from close-up to intermediate lenses to break the monotony. On the other hand, in properly prepared television script the girl could be slowly stirring a drink, pausing for emphasis when she needed to accentuate one of the lines. The boy could light a pipe or cigarette and use these normal movements as a subtle foil for his words. Whatever video action that can be employed, provided it is not overdone, will transform a mediocre still picture into a dynamic picture story that goes far toward making a successful television performance. The director, given such additional picture material, can then add his touch to the portrayal by clever use of his cameras to cover the lines and action with interesting shots.

This visual interpretation of the script does not in any way call for gross artificialities of movement, but instead requires that the actors be natural on the set.

News broadcasters are prone to be the most flagrant violators of the rule of naturalness. Concerned solely with the importance of the copy before them, they run on, head down, for the assigned fifteen minutes, with scarcely a glance at the audience. If the television set owners are to expect nothing more than this bird's-eye view of the news analyst's bald spot, it would be far better to use radio. Even in the limited field of acting available to the commentator, the newsman can do much to benefit his presentation. First of all, whenever possible he should forget the script before him. If the subject matter is such as to require exact delivery, he should school himself to read ahead so as to be able to deliver his lines more or less directly to the camera. If he is permitted to "ad lib," all the better, for then he becomes more like a visitor in the home and less like a town crier. Let him be natural—smile, even stop to run his fingers through his hair, or light a cigarette. Let him feel, and make the audience feel, that he is conversing with each one individually, not reading the evening paper while he makes his scheduled visit.

Lowell Thomas is conceded to be outstanding in this field. Thomas is natural, and herein lies his charm. I have heard many members of the television audience remark that the wink that Lowell Thomas invariably gives as he closes his broadcast makes him a member of the audience group, rather than merely a picture traced in electrons.

In an attempt to relieve the monotony of telecasting individuals, WBKB, in Chicago, has experimented somewhat successfully with the use of more than one commentator and has thus developed a conversational setup with an interesting

NBC Photo

LOWELL THOMAS, NEWS COMMENTATOR, APPEARING SIMULTANEOUSLY OVER WNBT, A TELEVISION OUTLET, AND THE BLUE NETWORK

background. Cubberly and Campbell, for instance, have adopted a typical newsroom locale and normally play their bit in shirt sleeves, to the accompaniment of typewriters and telephones.

This double feature allows one actor to consider his lines as well as the picture. While his colleague is talking, there is an opportunity for him to develop well-thought-out questions and answers to sustain the interest of the audience. Ann Hunter, another extremely popular commentator of the Chicago air, prefers to play her bit solo, and does it so successfully that she bids fair to rank high in the lists of popular newspeople in the

B&K Photo

ANN HUNTER, CHICAGO'S ACE WOMAN COMMENTATOR

postwar period. Ann Hunter uses the direct "ad lib" technique, and by talking directly to the lens she becomes not only an interesting commentator but a particularly charming and acceptable picture as well.

This type of close-up delivery requires expert mastery of the face and eyes, since these are the only props available for emphasis and accentuation.

Jerry Walker, educational supervisor for WLS, Chicago, has also developed an extremely interesting method of news commentation for television, playing his words and action directly into the camera and employing a conversational attitude in covering current events in and around Chicago.

Whatever the style the commentator adopts or has forced on him by his material, let it be one that will emphasize the picture to the improvement of the script.

While it may seem that these subtle movements are being overstressed, experience indicates that they merit much attention. An old rule-of-thumb in television production states that a still or immobile picture will never hold the interest of an observer for a period of more than thirty seconds. This means that once the members of the audience have seen and digested the details of such a close-up or intermediate shot, their eyes will tend to wander, searching for other interests. Lacking movement, which is planned to concentrate and maintain attention on the speaker, they will notice successively the grain of the picture, shortcomings in shading, faults in lighting, and other discrepancies too numerous to mention. This diversion of thought from the play itself to the artificialities that go to recreate the picture on the receiver detract from the effectiveness of any story. If the lines to be spoken are such that their delivery will require immobility for any length of time, action of some sort needs to be created; otherwise, the situation is one of gaining and losing the attention of the audience with each camera shift. By designing actions to complement the lines, the producer will find that the appeal of the production is greatly increased.

When we speak of the "tricks of the trade," we do not infer that they are a list of television short cuts, the mastery of which will lead directly to star billing. Unluckily, there is no such compendium now available, but in its stead are a few axioms that may shorten the road to greater capability in the television studio.

First, play close together. The height of the recorded image is determined by the width of the field. If you insist on playing your part across the stage from other participants, you must be satisfied with the small area that you will fill on the receiver. If you play your lines and action close to the other members of the cast, your picture size and detail will increase proportionately. The director can do much in rehearsal to insure this proximity of delivery, but if the actors, in the course of the play, develop an "I-want-to-be-alone" attitude, the director can do little but use a long-shot lens and curse the day he cast such actors in his production.

Another point to bear in mind is the limited focal depth of the television lenses. By this we mean the very few feet existent between out-of-focus one way and out-of-focus the other. All action that is properly recorded must take place within these limits. This area will be represented by areas of varying width, horizontal to the center line of the lens. The closer the close-up, the shallower the depth of this in-focus area.

The second rule, then, is to make as little change as possible in your distance from the camera, even if it requires "cheating" on the part of one or more actors. Otherwise you can be assured of a succession of poor focus shots to mark your debut on the air. This "cheating" can be carried out so naturally by an accomplished actor that it is not discernible by the receiver audience. It may consist of leaning over a chair to place the actor in the focusable area or, possibly, a step up stage or down to attain the position that is needed. Circumstances will define the most advisable measures to be taken. The important point is for the actor always to be conscious of the fact that the lens will not cover the entire depth of the stage satisfactorily. Always strive to play your part in the field of the camera, rather than in the haze of the background.

Rule three has to do with movement about the set. Unless the action is planned and previously rehearsed, do not make quick movements. This is because the cameras cannot follow quick and unexpected moves without ample warning and careful rehearsal. Unless you prefer a headless reproduction, do not rise or seat yourself without giving some intimation of your intention and, furthermore, do not make quick movements across or up and down stage. It may be that the director has elected to use the close-up lens just at that particular sequence in which you decide to "get away from it all," with the result that you appear as a fleeting shadow exiting right—if you appear at all. This subject of movement is particularly important in close-up portraiture, where the depth of focus is a matter of inches. Swaying, bending, or any but the most studied and expected movement in these shots leaves both audience and cameraman at a loss to explain the significance of the picture.

Where close-up shots are required by the continuity, some directors prefer to write the script so as to plant the subject in a position where he will be sure of getting a still. Reminiscent of the photographer's head clamp of the 90's is the placing of the close-up subject in a chair from which it is impossible to move out of focus. Even though it may require some reworking of the stage, a fixed position for an important close-up is generally worth the trouble, and it brings about a more satisfactory picture.

Rule four has to do with comparable speed of speech. For some reason or other it is apparent from observation and experience that an audience, seeing as well as hearing an actor, prefers a delivery of lines slower than that normally used in radio. To decide whether or not this is a function of the coordination between the eye and ear is beyond the scope of this writing, but the fact remains that a somewhat slower pacing of wordage is found to be preferable in television. To overlook this fact may result in losing the designed effectiveness of an important line. It is hoped that this reference to the desirability of slower speech will not be construed as a recommendation of halting delivery, for this as well as too rapid speech is to be shunned. Temper your delivery to the part, and remember that your picture and lines must both get across to the audience to insure satisfactory reception.

As a converse to the rule regarding slower delivery of speech is the demand for faster pacing of action. Radical rewriting of some stories may be necessary to build the proper tempo, although it is sometimes possible to stage material written for other media by merely cutting out the nonessentials that cause the plot to drag. Care should be taken, in this cutting process, to insure that the continuity is not seriously affected. A good director is quick to recognize this "dead wood," once it is reproduced on the telescreen, and he can generally amputate or substitute without harming the sequence.

So that the actor may know which camera is in action, we use a system of indicator lights to call attention to the "on the air" camera. As the director switches from one camera to the next, these warning lights blink off and on. The neophyte actor on a television set will at first either ignore these camera lights altogether or, on every switch, give a four-star rendition of the "startled doe" routine. Of course, both these extremes are examples of poor television stage technique. These lights are used to call the actor's attention to the camera to which he must play his lines. The change in playing angle resulting from changing of camera should not be conspicuous, as it will be if the actor jerks his head first toward one camera and then toward the other as the lights change. It is preferred and anticipated that this change will be accomplished naturally, and not with the mechanical precision of a puppet. A good actor, always conscious of the camera, will note this light change out of the corner of his eye and will shift his position to favor the new camera angle at the first reasonable opportunity.

Prompting on a television set is an impossibility unless it originates among the cast. Nothing is more embarrassing to actor and producer alike than to have a character forget his lines or his cue and stand mute. Little help can be forthcoming from outside the set, as the glare of the lights will normally prevent such assistance. Even one spoken word from off stage is taboo, for the ever-present mikes will carry the "prompt" with the same kilowatts of power that are used to broadcast the legitimate lines. The only solution in cases like this is for members of the cast to throw leading cue lines, and possibly the line in question itself, at the frozen actor, in order that the play may go on. To insure the success of the play is the responsibility of the entire cast. It is, therefore, necessary that everyone work for the common good of the show.

Although the foregoing considerations are of prime importance, there are other minor characteristics of television acting that may help to assure the success of the performer's debut. Experience gained by a few appearances before the cameras will generally teach these points, and in many cases experience is the only practical way in which an actor can develop the fine points of the art. However, a few details peculiar to television acting may be worth mentioning here.

In television, actors normally take their bows at stage center rather than from the wings. This allows the director to fade down electrically on the picture as he cuts to the next act. If the bows were to be taken from the wings, the control room would either have to fade down on an empty stage or have the cameras execute a quick and difficult "pan" shot toward the fleeing performers. Most vaudeville routines will have to be remodeled in this respect when they are planned for a television appearance.

Because of the continual shifting of camera position, it is possible for an actor to block or cover other actors on the set. This might be permissible in order to claim precedence on his own lines, but is extremely bad television when an actor intentionally or unintentionally covers some other actor's lines. Each actor must keep a weather eye on the signal lights and give way to the other members of the cast, irrespective of how important he estimates his part to be.

The usual prohibition against "talking over" another actor remains in effect in television in much the same degree as we find it in radio. The mike can best record one conversation at a time, and duplicate sound tracks are generally unintelligible. In order that the desired results may be accomplished, each actor's lines must be played as written, and not at the same time as those of other members of the cast.

Beyond these few admonitions, there is little that can be placed in print that will take the place of actual experience before the cameras. Acting ability, personality, and good photographic qualities are faithfully recorded by the television cameras—there being no electrical substitutes for these basic requirements.

The actor must always remember that the main factor of all successful television productions is the element of naturalness, and he must work toward this end. The closer that the actor, by reason of his experience and knowledge of the system, can approach this goal, the higher will rise his star in the new firmament of the video arts.

18

Television in Education

IF TELEVISION is to take its proper place in the scheme of our postwar world, it will need to prove that it can satisfy a definite need in education. This can be done by providing a new and effective mode of learning through visual channels.

When education is mentioned in the same breath as television, many educators are quick to point out that education comprises, for the greater part, both retention of an idea and study, and that therefore it is definitely not a field that lends itself to broadcasting. It is quite true that knowledge is acquired only by work on the part of the student, and as an analogy it is equally true that strength and health of the body are best maintained by eating food. However, no dictates of man require that this food be taken in its basic forms of grain and uncooked meat in order that we may derive its fullest benefits. The culinary arts, which transform the cereals and grains into delectable and appetizing dishes, in no way reduce the benefits obtained from the basic foodstuff, even though some small portion of their original characteristics may have been lost in the process of a more appetizing presentation. Education presented over a television system can be considered in much the same way.

Admittedly, nothing will ever replace either the time-tested question-and-answer period between teacher and student in the classroom or the printed text, which contains the formulae and propositions relating to the subject under consideration. But what of the fields where visual representation has already been found to be effective—the manual arts, the geometries, the crafts? Are we not, for the greater part, still teaching this material in the manner best suited to abstract theory, with total disregard of the visual method of teaching practice? Furthermore, are we presenting education today in a manner that creates appetite and interest in learning? In short, can we not employ modern tools in this oldest of professions—education?

We in television believe that a fair analysis of the potentialities of this art will prove our contentions that broadcast sight and sound is a logical method of distributing knowledge.

Education can take many forms, and even though we consider subjects that have previously proved inherently uninteresting to the average student, we find upon analysis that it is many times possible to present them in a way that will be both efficient and attractive. The pre-eminent function of postwar television will be to introduce into the educational process those visual methods and techniques which will make education more entertaining and appealing to the pupils of the world.

The solution of wartime educational problems has greatly strengthened the belief that Confucius was correct in stating that "one picture is worth a thousand words."

The armed forces, in 1942, faced with the Gargantuan task of educating millions of young men almost overnight in the technical complexities of modern warfare, turned quickly to visual instruction as the most satisfactory solution of the problem. Since Pearl Harbor, the training divisions of both the Army and the Navy have produced hundreds of educational films dealing with the material that had to be taught quickly and effectively. The subject matter of these films ranges from personal hygiene to the operation of our most complex electronic equipment. In the course of minutes, this material, which would have taken hours to explain by less dynamic means, is presented to the student in a carefully prepared mixture of fact and entertainment. The results of such educational methods, as demonstrated on the decks of destroyers and in the jungles of New Guinea, prove that these lessons, taught for the greater part by pictures, have been absorbed and retained beyond all reasonable hope.

It has been definitely established during the war period that the retention of material previously taught these same boys in high school and college has been woefully incomplete. To be sure, a man is expected to retain more of a subject in which he is interested or which he knows may later save his life than he will of some abstract concept taught in peace time in which he has no personal interest. Yet, making all due allowance for the influence of motivation, we can still discern a sharp contrast between the effectiveness of the visual-auditory type of instruction and the conventional schoolroom practices. In the former, a picture, plus a carefully prepared commentary, combine to create in the student a logical impression through two senses (sight and hearing). In the latter situation, the eyes are left free to roam, while the ears find it necessary to absorb the material for the two senses. In the one case, we present or frame the mental picture to be impressed on the student; in the other, we permit this picture to be created (or diluted) by the imagination, which may at times be engaged in far less concrete considerations.

Hence it has come to pass that the old adage, "one picture is worth a thousand words," is now recognized by both servicemen and civilians as an established truth, and its acceptance portends a revolution in educational broadcasting after the war.

The extensive use of visual aids by the Army and Navy came about as a natural development. The sole interest of the armed services was in getting the job done, not in promoting a dogma that might yield interesting results and later establish new educational procedures.

The success of the educational program employed by the armed forces has already achieved general recognition based on verified results, so it is reasonable to the continued use of such visual instruction in postwar civilian education. Commercial educational film was just beginning to come into limited use in our school systems when war was declared. The advertiser, one of the first to see the possibilities of this new method of educating or persuading his customers, did much to hurry its growth and development. At the same time, several college foundations had set up equipment to produce pioneer educational film.

The production of film stories that might be used in teaching was not, however, enough to bring about their immediate acceptance by the school. Projection equipment, especially that adapted to sound or film, was scarce and seldom to be found outside the school auditorium. The film laboratories, faced with a limited demand for these educational subjects, were forced to offer the material at a price well above its supposed value as a teaching aid, thus further delaying the general, immediate acceptance that might have been possible had the projection equipment been available.

The armed forces, on the other hand, tested the use of film under ideal conditions. The cost of the project was a consideration secondary to the objective to be gained. Furthermore, there was no shortage of equipment, for the service classroom was normally equipped to show both still and motion pictures at any time. Since film and projectors were abundant, the requirement that visual teaching be made an integral part of each curriculum was easily met. This material, recorded for sight as well as for sound and representing the combined thoughts of both the educator and the film editor, was presented in a form so effective that even the mediocre student generally found a new interest in the subject.

It may be argued that this is a plea for the cause of educational films rather than for education by television. To some extent this is true, for it is the present successful use of film (sight and sound) that allows us to predict the advantages of the proposed broadcast method of sight-and-sound education. It is reasonable to forecast that, when and if it is possible to equip every classroom for sound-film projection, much will be done toward improving our present-day educational systems. This statement is not generally contested, because film education has proved itself in the past few years.

In arguing the use of classroom television receivers in conjunction with or in lieu of film projection equipment, we feel that television with its unlimited possibilities can do more than film alone. As a test of such a proposed visual-education method, we need no further proof that it is now feasible to produce film that will successfully teach a specific subject. (It also needs no further proof that a television receiver can reproduce this film material, which would be broadcast from some central source.) But here the parallel between films and television ends, for the television receiver can also be used to reproduce impromptu lectures, demonstrations, and travelogues, as well as other educational programs of a more spontaneous type. For an investment comparable to the cost of installing individual film equipment in a classroom, we can substitute television with its unlimited sources of material. Through this receiver the voice and personality of the best teachers available can be brought to every schoolroom so equipped. These specialists would normally be teaching before limited classes in the more advanced schools, their talents available to a few, whereas, through the medium of television, they could be teaching many. We who live in the metropolitan areas can point with pride to the high quality of the instruction made available by the city's educational system. But can this same high standard be assumed to apply in the rural districts surrounding those centers of population and lying within television range of the city schools? We can safely assume that such a standard does not prevail, owing to economic as well as to professional causes. These smaller district schools could, through television, derive direct benefits from participating in broadcasts with the larger educational associations.

Let us further consider the case of the large city school systems. We all know that between schools, and even between classes themselves, we shall find a wide variation in the teaching abilities of the various instructors. Through the close observation of the teachers operating throughout the Navy's educational program, we have found that the varying aptitudes of two teachers in presenting the same subject to a class have a marked bearing on the ultimate accomplishments of the students. If, by utilizing a centralized broadcasting point, it were possible to bring tested and outstanding instructors before the television cameras, we could make them available to every classroom in the system.

Courtesy B&K

A COOKING SCHOOL OF THE AIR AS PRESENTED
BY THE BISMARCK HOTEL OVER WBKB, CHICAGO

In presupposing such a centralized system of education by remote control, consider the great strides that radio has already made in the promulgation of education among the schools and the public alike. Radio education by itself will naturally fall short of perfection in attempting to present the manual arts or other technical subjects. Here the subject matter is generally too complex to be taught satisfactorily by oral means alone. Through its visual channel, television will bring into use the second sense necessary to a complete understanding of the subject and will make possible the fullest realization of the benefits now less completely available through radio education.

Let us consider an actual situation in which television was utilized to instruct an audience. The listening group was made up of boys and girls interested in building model airplanes. The necessary standardized kits of materials had been procured previously by each member of the audience. In this instance, work was done at home rather than in the schoolroom. Outstanding instructors then appeared before the cameras and outlined the necessary steps in construction. These instructions were enriched by demonstrations of each step and the proper, detailed use of each tool. The efficiency of such a method of technical education was verified by the excellent results obtained by the students participating in this pioneer experiment.

The manual arts will lend themselves, in a greater degree, to the mass presentation of visual instruction from a centralized source. We can also predict the use of such a system in teaching more abstract subjects. The fact that the practical applications of theoretical mathematics is being taught in part through visual means in the Navy's education program lends weight to this prediction.

It is not improbable that a system paralleling that used successfully by the Navy may be employed in our schools of tomorrow. In the early phases of fundamental electricity, the student is required to visualize rotational mathematical functions and apply this concept to the development of the sinusoidal curves of electrical current and voltage. This is one of the earliest instances where the student is required to apply theory to practice in this subject, and it has been one of the major stumbling blocks of our high-speed mathematics course. The Navy has proved that this problem can be simplified by the use of visual teaching methods. Could not the medium of television satisfactorily broadcast this material to the many in much the same manner as is now being done in teaching the few?

Television can similarly be utilized to present pictorially the more simple mathematical processes in a manner that will find ready acceptance by the average student because he can visualize the proposed concepts. Such bi-sensual learning will be retained far longer than that acquired through the spoken word.

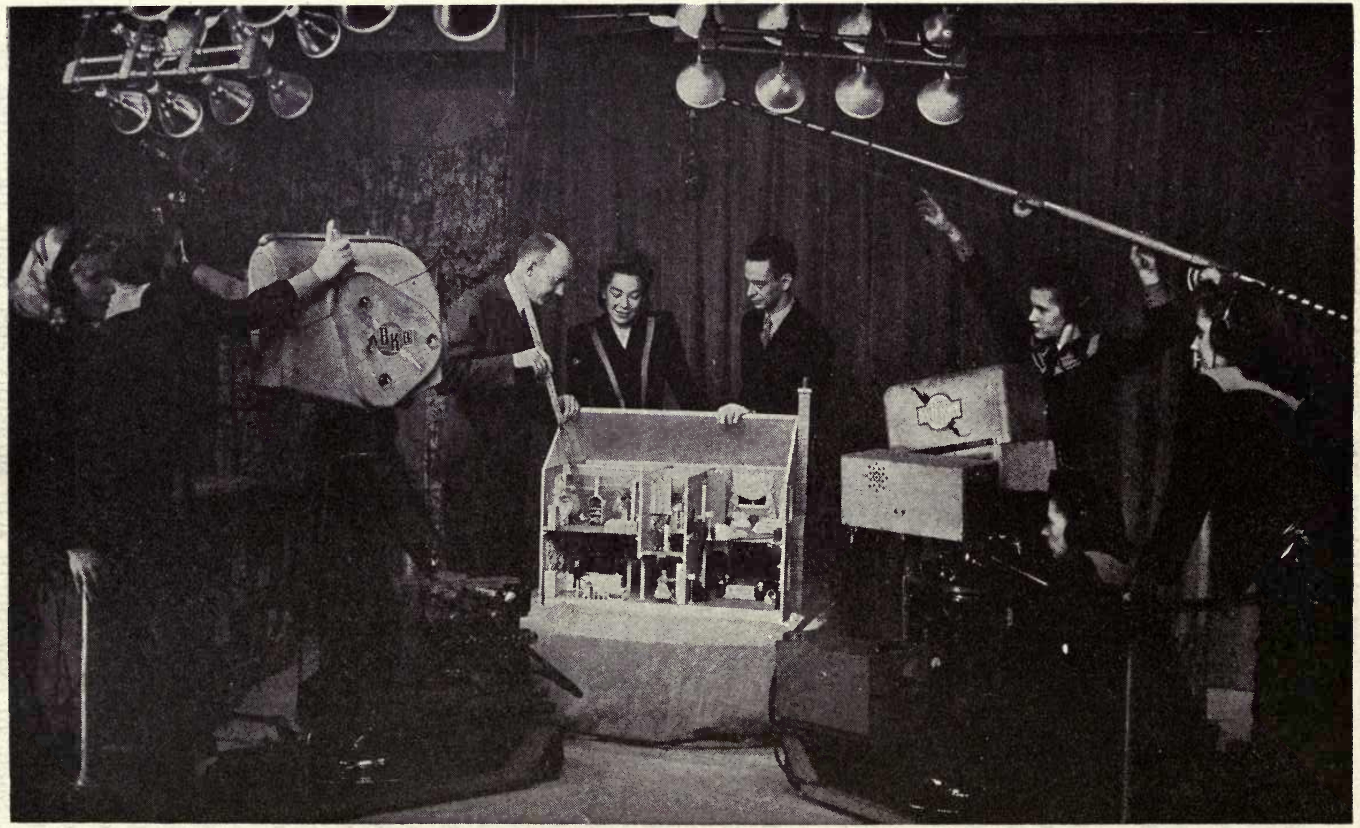
Cost has always been a prominent consideration in any discussion of proposed national television service. If education wishes to share in the benefits of sight-and-sound broadcast, it will, with the rest of the public, be required to shoulder part of the economic load in conjunction with the broadcasters. In comparison with the unlimited wealth of educational material that can and will be made available by the postwar television stations, the individual cost per student will be small.

Television receiving equipment is so designed that, with proper maintenance, it will be self-sustaining over a long period of time and will present little or no maintenance cost. While the possible adoption of large-screen receivers for auditorium use cannot be so cheaply brought about, even they will be relatively free from major weaknesses.

The coverage of a local school system with a television broadcast is well within the range of possibility today, and any school equipped with receivers can become a part of this new classroom of the air. The material, both film and direct pickup, has been tried, tested, and found to be applicable to the problem at hand.

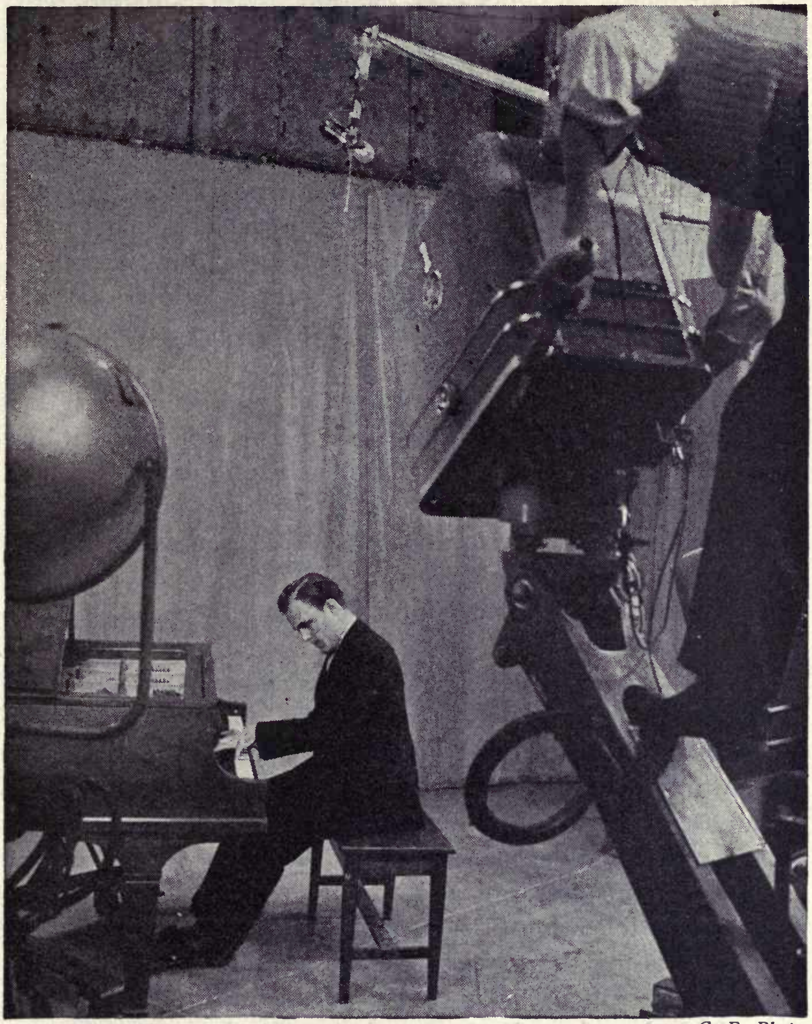
Our problem, then, is to break the original key log that holds back the establishment of our first test use of the medium of television in education. This problem can be solved by setting up sufficient receivers to permit a complete analysis of television's present potentialities and, from data thus obtained, to resolve an estimate of the possible future value that will stem from this beginning.

Such an experiment will probably cost many thousands of



Courtesy Safety Council

THE LESSONS OF NATIONAL SAFETY WEEK ARE PRESENTED IN A TELECAST OVER WBKB, CHICAGO



G. E. Photo

ADVANCED TECHNIQUES TOO CAN BE DEMONSTRATED OVER TELEVISION, AS SHOWN BY THIS WRGB STUDIO SHOT

dollars in both equipment and station time, but unless it is tried the exact value and potentialities of television in education can never be realized. Rather than wait until the industry has been built to the proportions of today's radio, would it not be better for education to make its test now, so that its eventual policy can be determined and the facilities for service be created?

Should present cost stand in the way of such a test, which may lead to new educational concepts which, when properly developed, may eventually save millions of dollars in our educational system?

Basing their reasoning on the cost of radio time today, a great many educators will argue that the television broadcaster will value his air time at a figure far above that which can be afforded by the individual school systems of our nation. In television, however, we must have a completely different concept of value, related directly to the time of day during which the broadcast is presented.

Radio broadcasting is a twenty-four-hour service, since it does not require complete attention from the listener. In fact, it now represents a melodious accompaniment to the daily work of a large percentage of the daytime audience. Little or no thought, and practically no interruption of work, is demanded of radio listeners. Housework, bridge games, driving, and a thousand other occupations continue uninterrupted with radio as an accompanying background.

Television, on the other hand, does demand complete attention from its audience if any but the oral phase is to be understood and appreciated. It would be very difficult for a housewife to continue her work and still see a television program that is broadcast in the morning hours. It would not be economically practicable for factory workers, clerks, and other groups to cease their work and give eye attention to a television broadcast. Observing a television broadcast while driving is impossible.

If we measure the daytime television audience by those few who can give full attention to the telecast, it would appear that the salable broadcast hours may be confined to a much more concentrated period than we find in radio. If an audience must be guaranteed to the advertiser, and such an audience is not available in the daytime, why not consider the morning and afternoon hours for education in the schools and, if necessary, have these programs sponsored, rather than play to the restricted few who may be available in the homes? The advertiser, as a general policy, will not wish to broadcast programs over a period when he cannot be assured of complete attention from a large audience. Might not the broadcaster of tomorrow, as a gesture of good will and as an expression of sound advertising philosophy, be willing to underwrite the educational program matter broadcast to the assured audience in the schools? The decision will have to wait for postwar developments, based on the attitude taken by both educators and broadcasters with respect to joint responsibility for education.

In brief, it is not difficult for us, who have seen the effectiveness of visual aids in education and who have had the opportunity to watch the latest strides in television broadcasting, to predict a new technique in education built up around this medium.

This is not a problem that can or should be postponed pending development of the industry. While the framework of the medium is still pliable, and while the new educational concepts of the war period are still fresh in our memory, we should attempt to avail ourselves of the magnificent opportunities that television appears to present. To fail to conduct the tests necessary to prove or disprove the value of television to our educational process is to ignore the concepts on which our economic and cultural standards are now based.

19

Tall Tales

TELEVISION is not always concerned with the serious phases of engineering and production. There are times when it generates its own levity to relieve the tenseness of many a situation in control rooms and studios. Many of the tall tales that have grown out of such incidents have, of course, been embroidered with the passage of time, although some are so complete in their original form that little exaggeration is possible in the telling. Each studio and each laboratory has its favorites, but unfortunately the author can vouch for only those which occurred in his own organization, and he must pass on as hearsay those not actually seen. In the interest of passable veracity—a trait not common among devotees of the art—the author will therefore limit most of this chapter to the events that occurred in the organizations with which he has been associated.

The playful propensity of "open mikes" is a recurrent headache in both radio and television and is frequently the cause of station embarrassment. An open mike is an active microphone left on by mistake in an otherwise apparently unoccupied studio. Being "alive," it will pick up any unguarded conversations with the same fidelity as it would a program. Probably the outstanding incident in this category is tagged to a popular children's program broadcast over an East Coast network, wherein Uncle Elmer or his equivalent was cajoling the kiddies into washing their teeth, eating the proper cereals, and generally qualifying as All-Americans. At the end of this half hour of sugary admonitions, Uncle Elmer swung into his closing theme, working up to that frenzied pitch that would guarantee thousands of adolescent ears at the same time the next evening. Then, with the program presumably over, he turned to the agency man sitting at his side and in a tired voice, which was dutifully carried to every listener by the open mike in front of him, remarked, "I hope that keeps the little —— quiet."

That incident supposedly happened in radio, but in Farnsworth's Philadelphia studio a similar event occurred in television at a time when the studio engineers were engaged in preparing a show for a group of church wardens, who were even then sitting in the viewing room. In the bustle of preparations, one of the engineers bumped his head on the overhead microphone and thereupon began a complete review of his rather extensive profane vocabulary. This would probably have passed unnoticed had not the engineer decided at the same instant to check the quality of the pickup from the studio, with the result that the worthy wardens were both mystified and chagrined at the verbal description of all television in general and this station in particular crackling from the loud speaker.

If an open microphone can cause trouble, an open or active camera can top this trouble by at least eight to one. During one of the early test periods at NBC, the staff was checking the fidelity of camera tubes by moving a white card back and forth across the studio and in and out of range of the camera. Such work was both uninteresting and monotonous. To pass away the hours and at the same time entertain the equally bored engineers in the control room, those engineers engaged on the studio floor began at intervals printing messages on the cards, such as expressions of condolence or gripes about such menial tasks. One of the last of these cards to be exhibited just before the supper hour read, "NBC unfair to television engineers." Of course, with the transmitter shut down and the cameras only registering on the monitors of the control room, no one was the wiser.

Fifteen minutes after the studio crew had left for dinner, one of the vice presidents of RCA called NBC and asked for a transmitter check, so that he might show several stockholders of the company a recent improvement in his reception. The assistant chief engineer was the only man present at that hour, so he went to the studio and put the equipment in operation, notifying the transmitter room to put the signal on the air. Then, as an added touch of realism, he walked out in front of the cameras, picked up the white cardboard sign, and held it unread before him. The exact telephone conversation that ensued hard upon this impromptu demonstration has never been ascertained, but rules were shortly posted defining the material that could be used to test camera fidelity. It was assumed from this that the reproduction had been perfect, that night at least.

Most television productions have little or no time written into the scripts for costume changes. For that reason, it is common practice to set up folding screens close to the sets, where the actors and actresses can disrobe or make quick changes in reasonable privacy. In one case, however, the large number of stages in the studio made it necessary to use a section behind one of the sets as an impromptu dressing room for an actress who required a quick change during one of the acts. Inasmuch as the lower control-room window formed one side of this enclosure, the curtains to this space had been drawn. During the staging of this play everything went as planned up to the sequence where our actress made this change of costume, or at any rate left the set for the dressing room.

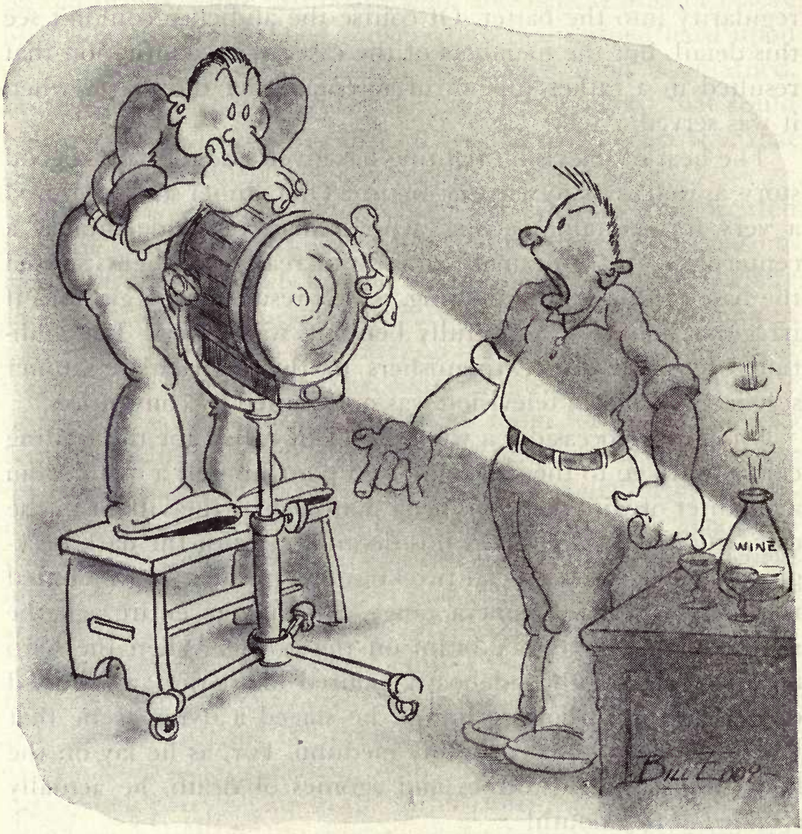
Meanwhile, in the upstairs control room, a group of station owners was being escorted through the intricacies of the business by the head of the production department. Taking this intermission as an excellent break, he suggested that the members of the party repair to the lower control booth, where they could get a more intimate picture of television. This they did. The guide, finding the curtains drawn, raised them—on the dressing-room scene. His excellent sense of timing proved beyond a doubt the new intimacy of the medium.

In one television show staged shortly before Christmas, a complete kitchen was set up in the studio and a leading dietician demonstrated the preparation and baking of some sort of cinnamon roll. To make the story interesting, a dinner party was staged at the same time to prove "the pudding by the eating thereof." In the first part of the telecast, the entire group was seen gathered in the kitchen, watching the cook prepare the dough. Because of the heat of the lights and the excitement of a first appearance before the cameras, large drops of perspiration began to form on the cook's face. Soon they plopped with regularity into the batter. Of course the audience couldn't see this detail, but the members of the cast could—a situation that resulted in a rather lukewarm acceptance of the pastry when it was served.

The heat of television lighting has given rise to many a good story, as well as many a queer picture. One dinner scene featured a very formal table setting, with a massive candelabra as a centerpiece. As the dramatic interest increased, the lights started the base of the candles melting, which resulted in a glorious if irregular bonfire of gracefully bending wax tapers. The addition of pyrene fire extinguishers to the immaculate dinner service proved that television was not limited by convention.

On another occasion, a whodunit plot called for the leading character to go to the sideboard and pour himself a drink from a decanter of wine that had been poisoned by the villain in the case. In order to high light this decanter against the dark background of the set, a special two-kilowatt spotlight was mounted near-by, just out of camera range. During the entire act, the spotlight poured its hot beam on the bottle. When the hero at last crossed to the sideboard, poured his potion, and tossed off the now near-boiling liquid, he staged a dying scene that has rarely been equaled in any medium. For, as he lay on the floor simulating the throes and agonies of death, he actually steamed at the mouth!

Heat, fire, and smoke are always hard to control, and their actions are generally impossible to predict. In substantiation, we cite the time our video-effects laboratory was given the problem of causing an old-fashioned fireplace to smoke. Not just any smoke would do. The trick lay in producing a smolder that would rise in lazy, comfortable curls. Furthermore, the smoke had to possess a harmless, non-nauseating odor. The boys began by testing all known types of smoke, but each one was either too thick or too thin or too lachrymose. Completely entranced with the problem, we moved the experiment to a bench directly under the exhaust to the air-conditioning system, where the work was pursued with fresh enthusiasm. Not content with having produced a relatively successful blend of smoke



from a combination of sulphur and asthma powder, we added wool grease and several other idle ingredients at hand in the shop.

Each addition brought us nearer our goal of the perfect smog until suddenly the door to our smoke-filled laboratory burst unceremoniously open, to admit several squads of New York City firemen and probably one of the most unappreciative air-conditioning engineers then in the employ of NBC.

It appears that the hour we chose to conduct our research was the same period that the air-conditioning engineer had elected to recirculate the exhaust air into the system as well as into all the other studios in the building. The excess air was then ejected into Sixth Avenue. Apparently we had overreached ourselves, for from firsthand accounts greenish-yellow clouds of smoke were seen pouring into the street from the exhaust vents to Radio City, while in the radio studios below soap operas were staged under conditions of extremely low visibility and with a strange increase in coughing by the cast. The upshot of the hasty conference that followed the exit of the fire marshals, air-conditioning men, vice presidents, and general public was a unanimous decision to postpone this particular phase of television research indefinitely.

In staging the play *The Gorilla,* Reggie Hamerstein, the producer, asked the staff to produce a non-toxic smoke to further the creditability of the scene where the gorilla is forced out of the cellar by a smoke grenade thrown down the steps. To accomplish this, a cellar door was constructed over a boxlike structure. "Stricture" would come closer to describing it, for the "gorilla" (a man tastefully dressed in a moth-eaten gorilla skin) and I could just barely squeeze in. Having already won an unenviable reputation as a smoke producer, I was chosen for the job. Armed with asthma powder, blowtorch, and breakers, the gorilla and I took our assigned position in the cellar, awaiting the cue for clouds of smoke and the exit of the actor. In order to produce enough smoke, it was necessary that I get my equipment working somewhat ahead of the cue line. Rehearsals had proved that the timing was satisfactory and that the proper consistency of smoke would be forthcoming when needed. Came the key word and I lighted the mixture, but the cast took this opportunity to diverge from the script and ad-libbed a page or two of lines into the closely timed story. The smoke, meanwhile, billowed about in fierce profusion. Suddenly the gorilla whispered hoarsely, "I'm getting the hell out of here," and made a somewhat premature entrance from the cellar door—an exit accompanied by a rasping series of non-gorilla-like coughs. If the scene had not been shifted directly to another set, the cameras would have also disclosed another, and this time unscheduled, actor in the smoke, for I too took the gorilla at his word and exited right at his heels.

Among the more troublesome problems to an effects man are the automatic gadgets that we sometimes concoct for props. In one case Tom Hutchinson asked for a simulated bullet shot that would smash a lamp on the table, this breaking of the lamp being the key to the entire sequence. For several days we experimented, finally demonstrating an electrical system that would bring about the desired effect and that would be actuated from off stage. In two rehearsals it worked perfectly and in the dress rehearsal it easily took star billing.

Came the evening show and the sequence in question. The heroine spoke the cue line, the contact button was pressed, but the lamp burned on unharmed. Again the fateful cue was given, and again the switch was closed with no effect. Once more the situation on stage was built up and cued, and once more the gadget failed. Happily, excellent extemporaneous acting saved the play, and it moved on minus this bit of important action. As the curtain rang down, the exhausted cast gathered about the table with the all-too-perfect lamp down center. Then, and only then, for no known reason, the lamp shade absolutely disintegrated, very definitely "too late but not too little."

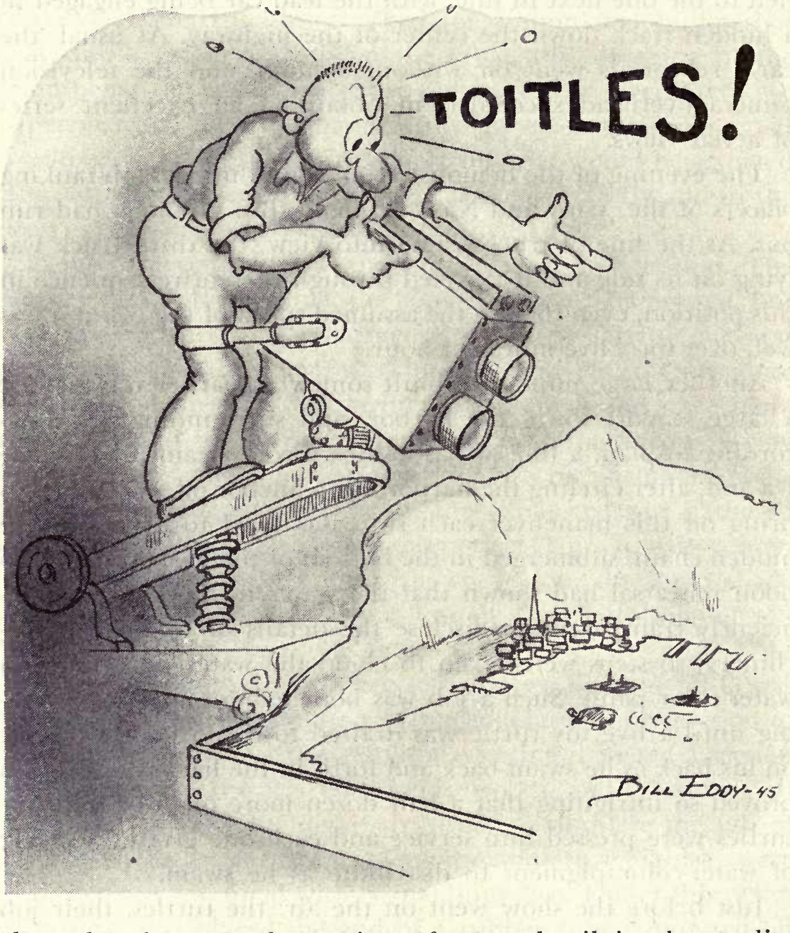
One of the largest miniature sets that we built at NBC was designed to demonstrate the possible adaptation of television to aerial reconnaissance. The miniature setting depicted a section of mountainous country with fields, woods, and crossroads all developed in excellent detail. In order to simulate the fall of artillery shells, certain points along the miniature highway were hollowed out and filled with lycopodium dust. Under this pellet of powder was placed the end of a rubber tube connected off stage to a pressure bulb. By squeezing any one of a dozen bulbs, we could blow the fine powder into the air, creating a realistic picture of a shell explosion. In order to build up a plausible plot or story, it was decided to send a line of miniature trucks down the highway toward the intersection. Along this route, explosions of shells would be simulated up to the point where the supply train reached the crossroads. Then, as if the artillery battery had found its range, the salvos would land in the center of the road, destroying the road as well as the equipment. In order to move this series of trucks, each one of the models was tied to the one next in line, with the lead car being engaged in a hidden track down the center of the highway. As usual, the early rehearsals went off without a hitch, and the television camera overhead succeeded in obtaining an excellent series of aerial views.

The evening of the demonstration found many high-ranking officers of the Army and Navy on hand. But our luck had run out. As the line of trucks came into view, the third truck was lying on its side and it traveled through the entire sequence in this position, even though the assumed speed of the column was well over forty-five miles per hour.

Another large miniature built somewhat earlier represented a large seaport town, the harbor, and surrounding hills. According to plan, a line of battleships was to steam in from the sea and, after circling the harbor, drop anchor off the town. To bring off this maneuver each ship was fixed to a link in the hidden chain, submerged in the bottom of the harbor. An afternoon rehearsal had shown that the water in the tank was sufficiently transparent to disclose the details of submerged machinery, so steps were taken to cloud the water by stirring in water-color paint. Such a job was both tedious and uninteresting until a live toy turtle was drafted to carry daubs of paint on his back as he swam back and forth in the harbor. This idea proved so intriguing that a half dozen more of these souvenir turtles were pressed into service and each one given a helping of water-color pigment to distribute as he swam.

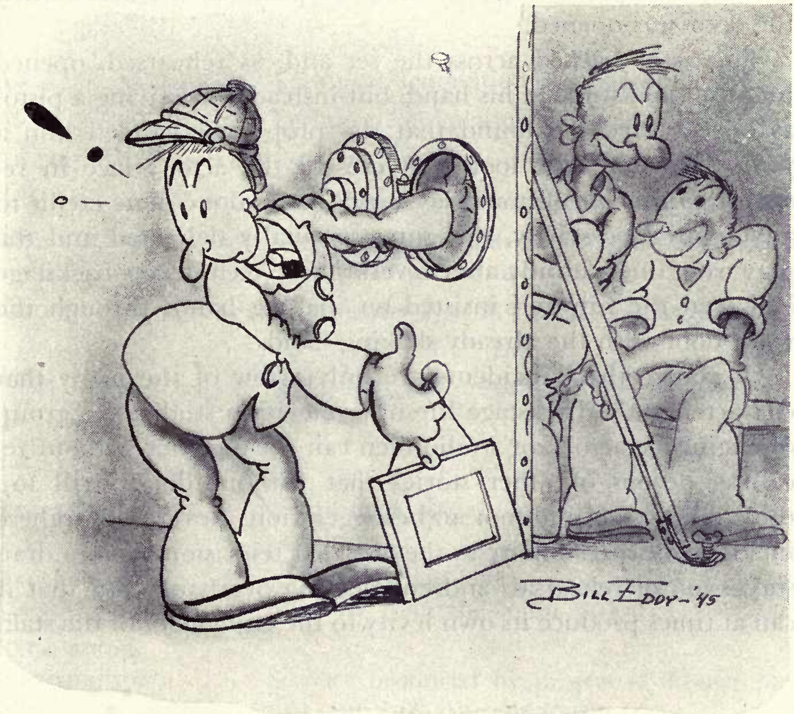
Just before the show went on the air, the turtles, their job now done, were captured and put back in the aquarium, and the miniature was reported ready for cameras. Everything clicked up to and including the majestic procession of the battleships down the channel. At this instant, alongside the leading dreadnaught a sea serpent that would have measured several hundred feet in beam surfaced and paddled very turtle-like ahead of the formation, creating waves that set the model fleet on its beam ends. Needless to say, whoever was responsible for the contribution of this extra turtle never appeared to claim his gift or to meet the video-effects staff in formal combat.

The major part of all humorous occurrences are brought



about by chance maloperation of some detail in the studio. There are, however, instances where the staff has deliberately brought about situations that have had their funny side. One that comes to mind concerned a doughty English actor of the old school, who from the time he reported for rehearsal had been the bane of our existence. Nothing was right in the studio or on the set; no other actor was qualified to play a supporting role; nor was the medium itself capable of properly projecting his histrionics.

After several hours of this routine, each individual on the staff took turns in an effort to deflate his ego. An unusual number of spotlights were brought out from the storeroom and



focused directly on our "primadonna" with little or no effect other than increasing the discomfort of the entire studio. In the last act, however, our friend had some lengthy business around the filling and smoking of a meerschaum pipe. The actor needed little else as a foil for a superb performance, and he used every minute of the sequence to demonstrate his ability. In the final show, however, his performance was definitely off. In fact his lines and action both tapered to a dismal dead end to the surprise of all except the technician, who had ground up a mixture of rubber bands, horsehair, and tobacco to fill the humidor on the set.

In a mystery story concerning a wall safe, an actor was called upon to reach into the safe as if to extract the jewels and instead bring out a pistol which he promptly used to bring justice to bear. Built in a studio flat, the safe was only deep enough to give an outward appearance of security; therefore, a prop man was stationed behind the set to hand the pistol to the actor when the door was opened.

The actor backed across the set and, as rehearsed, opened the vault and stuck in his hand, but instead of receiving a pistol as he expected, he found that the prop man handed him a peeled banana. The look that crossed the actor's face in response to this bit of horseplay would have alone done credit to any actor. Necessarily, the gun was finally delivered and the play went on, but only after several more technicians backstage had seen the fun and insisted on shaking hands through the vault door with the already shaking hand.

Of course these incidents are only a few of the many that characterize the backstage life of a television studio. No group of engineers, actors, or studio men can get together without recalling dozens of other stories that without doubt will top these tales in both humor and exaggeration. Nevertheless, these incidents bear testimony to the fact that television is not a drab succession of rehearsals and engineering overhauls, but that it can at times produce its own levity to the enjoyment of the staff.

Glossary

–A–

A3	Technical designation of an audio broadcast.
A5	Technical designation of a video broadcast.
Ad lib	To extemporize in playing a part.
AM	Amplitude modulation broadcasting.
Anode	A tube element that is normally positive in relation to the cathode.
Array	An antenna system, normally referring to a high-frequency design.
Audio	Pertaining to sound. Example: audio transmitter.

–B–

Backdrop	An upstage curtain used as a setting for a television act.
Background	As used in audio, to mean sound of lesser intensity than the main pickup.
Background projection	Scenery produced by projecting filmed pictures on a translucent screen.
Base	The panchromatic toning color used in television make-up.
Big screen	Theater-size television pictures.
Black out	A short act.
Blooming	The equivalent of overexposure in an electronic picture.
Boom	An extension support for equipment used in a television studio. Example: mike boom, camera boom.
Boom shot	A sequence televised by use of the extended camera boom, allowing greater radius of action by the camera.

BOTTOM FLARE	The washing out of the detail in the lower part of a television picture.
BOUNCE	The reflected radiation of a high-frequency signal.
BOX OFFICE	A slang term for popularity. Example: "He got a big box office on his show."
BRIDGE	A short video or audio sequence used to tie two parts of the program together, normally abstract in character.
BUSINESS	A rehearsed bit of action by a player. Example: "Go through that business again."

—C—

CAMERA SCRIPT	A cue sheet indicating sequential camera positions for a telecast.
CARRIER	The radio waves on which the video and audio impulses are impressed for transmission.
CATHODE	The tube element from which the major part of the electron stream is obtained. Also, the photosensitive plate of the Farnsworth image dissector.
CATWALKS	Elevated walkways alongside a stage set, normally used for mounting equipment.
CHANNEL	The assigned broadcasting or telecasting frequency.
CLOSE-UP CAMERA ..	The camera registering the least area of the stage.
COAXIAL	A rigid or flexible conductor used in television to carry high-frequency wide-band signals.
COMMERCIAL	The selling message, or the portion of the telecast given over to this function.
CONSOLE	A control desk.
COPY	The wordage used in titling.
CYCLORAMA	A term commonly applied to a backdrop of the upstage curtain.

—D—

DEPTH OF FOCUS ...	Limits of distances between which everything appears in sharp focus.
DI-POLE	A common type of television antenna.
DISSECTOR	A non-storage-type pickup tube developed by Farnsworth.
DISSOLVE	To combine two or more pictures to create an effect shot.
DOLLY	The movable platform on which equipment, such as a camera, may be mounted or transported.
DOLLY SHOT	The picture produced by moving the camera in or out while telecasting a scene. Example: "Give me a smooth dolly shot, ending with a big close-up of the face."
DOUBLE BANK	To erect one stage setting in front of a second and later setting.
DOWN STAGE	Toward the camera. Example: "Move down stage."
DRESS	To arrange the minor properties of a stage setting preparatory to telecasting.

—E—

EFFECT SHOT	A special camera shot that produces a desired effect.
ELECTRON GUN	The tube element assembly that produces and directs the electron stream used in both the iconoscope and reproducing tubes.

—F—

FADE DOWN	To reduce the brilliance of the television picture to zero. Normally used at the completion of a sequence.
FADER	The control used in reducing the audio or video output.
FADE UP	To build up the picture brilliance from zero to normal levels.
FLAT	The cloth-covered wall sections used to construct a stage setting.

FLY	To lift a stage setting above the stage.
FM	Frequency modulation broadcasting.
FOOT CANDLES	The unit of measurement in television lighting practice.
FOUNDATION LIGHTING	Non-characteristic light, producing sufficient illumination to register a satisfactory electronic picture on the camera tube.

—G—

GADGET	A term applied to any piece of apparatus that does not have an accepted descriptive title.
GELATIN	A gelatinous screen used to diffuse the beam of a light source.
GHOST	A multiple or secondary image on the receiver caused by reflections of the transmitted signal.
GOBO	A shield used to block unwanted light rays from the set or camera.
GREASE PAINT	The panchromatic toning color used in television make-up.

—H—

HAM	A slang expression for an actor.
HAND PROPS	Small stage properties used by the cast.
HARD SHADOW	A single definite shadow, as opposed to multiple shadows.
HOT CAMERA; HOT MIKE	A term meaning the apparatus is energized.

—I—

ICONOSCOPE	The storage-type pickup tube used in most studio cameras.
ICONOSCOPE MOSAIC	The photosensitive surface of the iconoscope.
IKE	Colloquialism for iconoscope.
INTERFERENCE	Spurious radiations that depreciate the quality of a television picture.

Interlace	The process of scanning alternate lines of a television picture to reduce flicker.
Iris	An adjustable opaque shutter having a circular opening that is used to regulate the light admittance of a lens.

–J–

Jeep	A wired television system, as opposed to broadcast. Example: a "jeep" camera or a "jeeped" receiver.

–K–

KC	Kilocycles, one thousand cycles per second.
Kennelly-heaviside	An ionized atmosphere surrounding the earth's surface, capable of reflecting radio signals.
Kine	Colloquialism for Kinescope, the RCA-type picture tube.

–L–

Light plot	A cue sheet for lighting arrangement.
Line	A circuit or series of circuits connecting two sections of a broadcasting unit. Example: "Put a signal on the studio line."
Liner	The lighter tones of grease paint normally used for high lights in character make-up.
Line rehearsal	A rehearsal of speaking parts.
Lock in	When the televised image is properly synchronized.

–M–

MCS	Megacycles–one million cycles per second.
Mike	Colloquialism for microphone.
Modulation	The process of impressing audio or video impulses on the carrier wave for transmission through the ether.
Monochromatic	Of one color.
Mosaic	The photosensitive surface of the RCA iconoscope.

MUFFS	A television colloquialism for earphones.
MUGGING	Overemphasis or exaggeration of either action or wordage.
MULTI-PATH TRANSMISSION	The various reflected signals that combine with the true signal to cause interference in high-frequency radio.

—N—

NETWORK	A system of associated stations capable of simultaneously broadcasting the same program; a series of electrical circuits.

—O—

OFF CAMERA	The camera not feeding the transmitter line.
OLEO	A painted backdrop.
ORTHICON	A variation of the storage-type pickup tube used for outdoor pickups and in cases of low-level lighting.
OSCILIGHT	The Farnsworth picture tube.

—P—

PADS	The electrical apparatus used to reduce the level of sound or picture.
PAN	Taken from panorama, signifying a sweep of the camera left or right. Example: "Camera One, pan right."
PHOTOELECTRIC	The property of certain substances of giving off electrons or creating an electric potential under the influence of light.
PHOTOMETER	The instrument used in measuring light intensities.
PIPE	A slang term referring to a coaxial cable. Example: "Put the picture on the pipe."
PROJECTION RECEIVER	A large-screen receiver where the picture is reproduced on a projection screen, rather than the face of a cathode-ray tube.
PUMP	A slang term meaning to create or generate. Example: "Pump me a picture on the transmitter line."

GLOSSARY

–Q–

QUASI-OPTICAL ..... Taken from the Latin word "quasi," meaning "as if it were" optical, referring to the horizon range characteristic of a television broadcast.

–R–

RAIN .... Finely divided vertical interference patterns in a television picture.

RELAY TRANSMITTER A transmitter used to relay pictures or sound signals between two stations.

RETRACE .... The return path of the electron beam in the iconoscope and television picture tubes.

RIM LIGHTING ..... Corrective lighting within the camera to reduce bottom flare in the picture.

ROUTINE .... A rehearsed act, a specialty number.

–S–

SCANNING COIL ..... An assembly of four coils used in controlling the path of the electron beam.

SCENE DOCK .... A storage room for stage flats.

SHADING .... The process of introducing externally generated wave shapes into a television picture to compensate for the discrepancies created by uncontrolled electron distribution in the camera tube.

SHADING GENERATOR The series of electrical circuits that create the wave shapes used in shading.

SHOOTING SCRIPT ... A final version of the television script, including all camera shots and cues.

SIGNAL .... The electrical impulses carrying video or audio information.

SIGN OFF .... The required technical announcement made by a broadcasting station when leaving the air.

SIGN ON .... The required technical announcement made by a broadcasting station when coming on the air.

SINE WAVE .... Referring to the sinusoidal trace descriptive of alternating electrical current.

Sixty-cycle current	An electrical current having sixty complete alternations from plus to minus each second (household current).
Slipping	Failure of one or both of the synchronizing circuits to hold, which causes the received picture to slip vertically or horizontally.
Soap opera	Slang for a radio daytime serial.
Sparkle dust	A term used to designate any iridescent powder, such as glass, mica, or tinsel.
Specific light	High light and shadows used to create the feeling of dimension in a television picture.
Spot announcement	A short sequence normally spotted between two acts.
Stack	A slang term for antenna. Example: Up the "stack."
Stage braces	Supports for stage flats used in erecting scenery.
Stage furniture ...	Special hardware used on scenery to allow speedy assembly.
Stage left	The actor's left. Example: "He exits stage left."
Stage right	The actor's right. Example: "Move stage right."
Streaking	A spurious image in a television picture normally of reversed color, which appears to the right of the real picture. Caused by poor low-frequency response in the camera circuits.
Strike	To dismantle a stage setting.
Suds scenario	Slang for radio daytime serial.
Switch	To change to a different camera shot in making up a telecast.

—T—

Take	To televise a sequence for transmission.
Tear out	Breaking up of a section of the televised image because of maloperation of the synchronizing system in the receiver.

TELECAST	A broadcast of both sight and sound.
TELE-CINE	A Farnsworth term for televised motion-picture film and equipment used in this type of televising.
TELEGENIC	Having good pictorial qualities when seen over television.
TELETRON	The DuMont picture tube.
TEST PATTERN	A design that is broadcast before a telecast to aid in alignment and adjustment of receivers. A standard used to check camera and system resolution.
TRANSCRIPTION	The high-fidelity recordings used for broadcasting purposes.

–U–

UHF	Ultra-high frequency, normally above 300 mcs.

–V–

VHF	Very high frequency, normally between 30 and 300 mcs.
VIEW FINDER	The optical or electronic equipment used in focusing a television camera.

–W–

WALK THROUGH ...	A rehearsal without cameras, normally conducted on the set.
WASH-TUB WEEPER .	Slang for radio daytime serial.
WINGS	The sides of a television set normally off stage.

TELECAST ... A broadcast of sight and sound.

TELECINE ... A Farnsworth term for televised motion picture film and equipment used in this type of televising.

TELEGENIC ... Having good pictorial qualities when seen over television.

TELETRON ... The DuMont picture tube.

TEST PATTERN ... A design used in television before a program to aid in alignment and adjustment of receivers. A standard used to check camera and system resolution.

TRANSCRIPTION ... The high fidelity recordings used for broadcasting purposes.

—U—

UHF ... Ultra-high frequency, normally above 300 mcs.

—V—

VHF ... Very high frequency, normally between 30 and 300 mcs.

VIEW FINDER ... The optical or electronic equipment used in focusing a television camera.

—W—

WALK THROUGH ... A rehearsal without cameras normally conducted on the set.

WASH-TUB WEEPER ... Slang for radio daytime serial.

WINGS ... The sides of a television set normally off stage.

Notes for Student Producers Using the Facilities of The Balaban & Katz Television Station, WBKB, Chicago

(*This is a reprint of a pamphlet given to guest producers at WBKB.*)

Producing a television show has a technique of its own. Although television employs the same general selection of lenses as are used in the motion pictures, and although the stage settings are similar to those used in the theater, the technique of production is a combination of that used in both fields. One of the outstanding problems in producing a good television show is the maintenance of continuous action—a problem that requires forethought by the producer as to his use of lighting, cameras, and microphones from the time the show first hits the air until the closing sequence. Remember, *there can be no pauses or blanks for the resetting of equipment or cuing of lines.* It is necessary, then, that the producer first establish in his mind a complete picture of what he wants to accomplish, and from this formulate a detailed plan as to exactly how he will use the equipment at hand to create the desired effect.

Cameras

It is considered good technique to play cameras as far down stage as possible, utilizing a proper choice of lenses for close-up and intermediate work rather than unnecessarily moving the camera into the set.

The producer should always attempt to end an act or sequence with his cameras, microphones, and floor lighting all the way down stage, so that the next act can start from this position.

Considerable thought should be given to the lenses selected to open a telecast and to the subsequent necessity for changing this selection during a sequence. Starting out with the cameras equipped with lenses having extreme focal lengths (16″–4″, for example) will generally lead to trouble or the partial use of the cameras later in the act. It is much safer to use a series of intermediate focal length lenses in the cameras, relying on proper camera placement to obtain desired results, than to change lenses during the act. Such a lens change will require one to two minutes of program time, during which period that camera is unusable.

The normal lenses used in television are from 9″–14″, with a 6″ high-speed lens, and a 16″ F 4.5 lens.

Slow pans and dolly shots are permissible and can be used to the benefit of the act, provided they are not overdone. The producer must remember that the camera movements are a severe test of camera personnel, and are not as satisfactory when reproduced as the track shots employed in Hollywood productions. Many times it is possible to move characters down stage to the camera for a desired shot rather than dolly the camera upstage toward the performers. This is particularly true in shooting single characters.

Lighting

The producer should always analyze the cross-lighting situation that develops when shooting from two different angles. In most cases, lighting preference is given to the close-up camera, although sufficient illumination must be provided for all shots.

Be extremely careful about reflections on the set, such as windows and mirrors that may kick back the front lighting from the floor-mounted units. At no time should the cameras be pointed into either direct or reflected lighting.

Stage Business

A producer should arrange the "stage business" so that characters play parallel to the focus plane of the camera. If one character is upstage, the other down, it is impossible to get them both in focus because of the speed of our lenses. This will require consideration in planning the set and action. You should endeavor to have your characters play as close together as possible, even though this action may appear to be "hoked." It is the only way that you can be sure of a satisfactory television picture.

Backgrounds

Background detail is not as important as it is in many of the associated fields, because of the limitation in depth of focus of the lenses used in television. Stress the dressing of the immediate foreground of the set. Have all characters on the set play toward the camera. This problem is particularly vital in cases where conversation is being shot around a table. Characters here must be placed so that the camera can get in for reasonably effective direct and relief shots without having out-of-focus heads and backs in the foreground.

Script

It is good practice to have all lines delivered ad lib, or from memory. The use of any type of script on the set is decidedly untelegenic. A line delivered ad lib is worth three pages of script read from the book. In writing your sequences, put in as much small-stage business as you can successfully work in, remembering that the picture is worth eight times that of the sound and that a still picture is only good for fifteen seconds of interest on a television receiver. Television will stand reasonable "mugging" on long and intermediate shots, but this overemphasis must be held back on close-up work.

Movie Inserts

Outdoor locale and other insert work is normally accomplished with film. It is, therefore, necessary that this material be made available for preview and timing several hours before rehearsal, in order that it can be checked and inserted in the sequences. The use of film does not tie up any stage cameras and can further be dissolved or switched into the program in the same manner as any of the stage cameras.

Switching

Switching technique is similar to that used in movies, comprising dissolves, switches, fades, and black outs. Superimposed shots—i.e., two pictures superimposed—can sometimes be used effectively in shooting a scene.

In order to simplify and standardize the orders that the director will normally use in producing a television show, a glossary of accepted terms has been adopted for use in this station:

To check mikes:
"Give me a mike check on number one—boom, et cetera."

To check cameras:
"Give me a camera check on three."

To switch between two cameras:
"Take one" or "Take two."

To double-fade two pictures:
"Fade down one—fade up two."

To get a picture ready for fading up, as in an opening shot:
"Punch up one and fade it down."

To dissolve between two cameras:
(1) "Set up dissolve, cameras one and two."
(2) "Dissolve one into two."

To mix studio mike with transcription:
"Fade music under—up voice."
or
"Fade voice under—up music."

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