Television's Future in America

By DR. LEE de FOREST

Dr. de Forest, still an active student and experimenter.

MOST of my readers today can remember the strangely sudden upsurge of popular acceptance and eager enthusiasm which American radio broadcasting experienced 25 or 27 years ago.

To all such elder observers, and especially to those who played a part in the earlier phenomenon, the recurrence today of a closely similar revolution is at once amazing and most gratifying.

In some respects the present popular demand for television broadcasting and TV receivers is even more remarkable than was that which radio enjoyed a quarter of a century ago. Today almost every household has one or more radio receivers and is therefore already aware of the world outside its threshold and the varied types of audio entertainment available, but in 1922 few indeed were the homes wherein such miracles of science could be observed. Radio reception then was far more amazing than is now the sudden apparition of a distant scene upon the kinescope screen. There was then no precedent for that unparalleled miracle—the erecting of a simple wire and listening to distant voices and remote music.

Today radio, and its ambient atmosphere of electronics, has annihilated wonder and atrophied the sense of almost reverent amazement with which we of old donned our headphones, tickled our cat's whisker, and twirled our multi-dials, in those ancient 'twenties. So television comes forth today, upon a stage already well prepared for her somewhat bold and blatant debut, to confront an expectant, yet somewhat blasé audience. The greater wonder therefore is this unleashed enthusiasm for our latest miracle—this crowning achievement of the electronics engineer —an eagerness which today strips the television receiver from retailers' shelves, unpacked and untested, and which compels set and tube manufacturers to work hard around the clock in futile effort to satisfy the demand.

In other ways also video is following paths long since blazed by the pioneers of radio! Program quality serves as one analogue, one scale for comparison. Television programs today are in an experimental stage very far behind in merit the high standards of excellence established by television's engineers.

Here, as in radio broadcasting, the engineer is far in advance of the man in the studio. The former's is an exact science, and his requirements demand nigh perfection. The engineer must know his media, his electrons, his cathode beam, his sweep circuits, the exactitude of his sync signals, his math formulae, his specified decibels of gain or noise suppression.

The program director, in contrast, works wholly with nebulosities; likes, dislikes, and prejudices of human nature, and that unpredictable quality politely styled "temperament." Further, he is strictly limited by a budget (the only fixed quantity in his entire equation). Also, too frequently, his sponsor sadly smears his calculated concoction, upsets his omelette, to mix a metaphor.

And so it comes to pass today that television, playing a variation of radio's insistent theme, has taken the "cheese"—the same corny lines, the same reiterative commercials—out of the ears and put it into the eyes of the populace; albeit with this saving grace: its commercials are sometimes intriguing, often interesting to behold, and generally far less painful to see and hear than only to hear.

And definitely our TV programs are improving. Since television's postwar start, a considerable sum of experience and knowledge has been acquired. To an outsider much of this might appear negative, but to learn what *not* to do is a step toward learning what to do. Lacking adequate production budgets, television programming has had to develop as best it could; and, although it has developed, it is still brashly amateurish in the main.

There has been lack of understanding of television audiences as well as failure to take proper advantage of the unique potentialities of the screen.

Directors from the radio studio, the-

Television is Booming—Cash in on it!

ater stage, and film lot have applied their various techniques and styles. Some of the least successful video producers have been successful radio directors, who, however, merely transferred radio techniques to television. When one merely adds sight to sound, the result is usually as inartistic as a view from a radio studio control booth.

The stage director, on the other hand, is prone to forget the limitations of the video screen and to spread his action too wide. Surely the one best equipped by previous experience to produce satisfactory tele-drama is the motion picture director, trained in skillful variation of medium and close-up shots that will blend these and varied backgrounds into a smoothly running continuity. Resenting the necessarily cramped restrictions imposed by the technical limitations of a "live show," he will keenly realize the common sense of *filming* his picture, cutting his retakes, and assembling the components finally into a flawless television presentation. Better to waste large film footage in the cutting room than needless costly hours in attaing 100% perfect rehearsals.

In my writings some six years ago I sought to emphasize the economic common sense of this procedure and urged that the directors of policy of the motion-picture industry, for self-interest even, look frankly in the face of this "baby that will *start* with the step of a giant." For nothing is today more apparent than the fact that television will hold millions of potential cinema viewers home of nights.

And today's video studio practice already depends largely on motion picture film, either between the projector and iconoscope, or in the camera before the monitor kinescope. When one of the best known veteran motion picture producers, Hal Roach, wholly abandons cinema film work to put all of his trained energies into making good short comedy films solely for television transmission we behold a highly significant augury.

It is of vital importance that both television and the motion picture producing interests cooperate in mutual understanding and harmony. The latter will not long hold back from the inevitable, as most of them did when I was demonstrating to them that film could speak. They will not long repeat the same stubborn blunder, else the film industry will be merely postponing a new prosperity which the new medium is openly offering it.

It is the opinion of an ever-increasing number of television men that film programs will constitute the bulk of television broadcasting, for such basic reasons, economic and mechanic, as the following: duplicates with sound on film can be made cheaply; such duplicates provide an inexpensive "chain system," saving charges paid to the telephone company; programs can be altered, edited, after completion; letter-perfect live productions requiring enormous rehearsal time and expense can be eliminated; talent need not be forced to rigid schedule; the production can be made at the most suitable or convenient location and time; program libraries are created; optimum lighting conditions for the various scenes can be had far more readily. A good film-renting business is already established. Soon this is certain to include classical plays and other timeless items, despite today's stubborn denials.

And, after all, where so much expensive and painstaking effort has been expended in the staging of a worthwhile drama or comedy, it is mere economic sinfulness to "waste its sweetness only once upon the empty air." Even granting nation-wide networks, co-axial or radio, by stratospheric airplane (or by the moon!) such worth-repeating spectacles must not be merely flashed and then forgotten—a lovely tapestry, artfully woven to be burned to ashes and lost.

Furthermore the time differential alone calls for program repetition by film, for example, East-West athletic events, though they are viewed hours after the uncertainties of fortune are resolved. For the evening hours moreover will necessarily continue to claim the far larger audiences everywhere.

So regardless of the spread of networks, whenever the factor of simultaneity is not paramount, what I long since dubbed the "tin-can network" will become more and more essential in profitable television transmissions.

The absolutely unrivaled possibilities of television for popular education are already evident to all observers. In the urban schoolroom (and soon in the rural areas) but emphatically in the home, television can be made a most potent agency for instruction for adults and young alike. The groundwork already accomplished by the FM network of the State of Wisconsin, under the auspices of their progressive State University, where countless homes are recipients of daily lectures by competent authorities on varied historical, agricultural, and cultural themes, is extremely gratifying to any informed educator. Witnessing the results attained by audio alone, one is stunned by the prospects which television offers along similar lines, where one picture is more impressive and longer retained "than ten thousand words."

America's greatest, most crying need today is mass education. Here then the Gods of Science have given to our nation a mighty weapon for its salvation.

Will the directors into whose hands fate has given this mighty potentiality for national uplift thus employ it? Or will they, as have many of their AM broadcasting predecessors, miserly, miserably fail?

Certain it is that within five years television programs will be in the homes of 50 million Americans. What *limitless good* can television then bestow for the salvation of America?

SIRAGUSA ON TELEVISION PROSPECTS

PROSPECTS are unlikely for a material increase in the number of video set manufacturers. To be competitive in price in the television industry a manufacturer must have mass production. He also must have an adequate source of vital component parts and raw materials, which in most cases are only available on a quota basis to companies that have been in the electronics industry since before the war.

Many of us in the industry believe that the coming year will find an ever-increasing demand for television sets even with the industry's doubling of production. That segment of the American populace that has viewed television likes it. They have decided they need television, and want it enough to adjust their budget to make it a permanent part of their living. And that segment is expanding rapidly.

The year 1948 was for the television industry its "Age of Adolescence." Television was a toddling infant at the end of the war and did not become a commercial reality until a little over a year ago when the Federal Communications Commission established definite performance standards. Television is an industry that is opening up a new frontier in the business life of the nation, and its effect upon the economic, social and political life of this country is bound to be enormous. Television brings with it new methods of merchandising and marketing.

Ross D. Siragusa, President, Admiral Corp.

But, all in all, more collective nonsense has been written and spoken about television than any other youthful industry. Fantastic results from the use of video, in all sorts of fields, have been predicted by visionaries, and have somewhat obscured the fact that television is a normal, healthy, young business with excellent future prospects . . . and during 1949 television will be seen as "coming of age."

Tele Network Problems

Dr. Allen B. Du Mont

Networking, so important to television, presents its own technical difficulties

By DR. ALLEN B. DU MONT

THE engineering problems involved in network operation by television broadcasters may be divided into three general categories:

1. Distribution of programs,
2. Standardization and maintenance of station equipment,
3. Adequate master-control and other station facilities.

The reader may feel that the latter two do not have to do with network operation, but, in fact, they are extremely vital to a successful net. A television network is made up of many affiliated stations. Its purpose is to give greater public service at lower cost per member of the audience. Failure to stay on the air is only one of many equally serious problems. Staying on the air during the long telecasting day which will become the standard for all network operations requires uniform test standards, adequate stand-by equipment, and continual preventive maintenance, as any AM network broadcaster can testify. Network operation imposes on the originating station the full burden of program quality, not only from the point of view of the excellence of its artists, scripts, and sets, but also from the viewpoint of smooth master-control operation, special effects, such as lap dissolves, superimposition of commercials, and uniform high quality of picture on the program bus. In fact, all the technical aspects of video and audio transmission become the prime responsibility of the originating station.

Program distribution

Let us consider the most obvious problem first, the distribution of programs from the station of origin to its affiliates. Three means are available for this. Two use facilities leased from A.T.&T.; these are co-axial wire lines and microwave relay-station chains. The third type of channel is the privately owned microwave relay chain, usually the property of the network.

Two engineering limitations exist in the operation of land lines. The first is restriction to a 2.7-mc video signal, and the second is compression of synchronizing-pulse amplitude. Microwave relays provide 4.5-mc video and less sync compression. The percentage sync specified by the FCC is 25. It has been common practice to generate 35% sync at the program bus of the local television transmitter, which results in 25% in the composite signal as finally transmitted.

Sync stretchers

The use of *sync stretchers* at each affiliate has become common practice to help overcome the sync deficiency caused by co-axial cable. A.T.&T. is said to be studying the advisability of including these units in their repeater stations.

A unit which will emphasize the synchronizing portion of the composite video signal is frequently needed in TV stations. This stretching of the sync may be necessary to compensate for the sync compression which may take place on a cable or in a relay transmitter or to pre-emphasize the sync to overcome compression in a succeeding part of the station equipment. In addition, it is often necessary to remove hum from the signal, restore its low-frequency response, or to remove transients which may arise from switching.

A standard sync stretcher is shown in one of the accompanying photographs. The input signal to the sync stretcher is composite video, black negative, 0.2 to 2.5 volts peak-to-peak, with a sync amplitude of at least 15% of the total signal. The input impedance is 75 ohms. The line output is a black-negative composite signal designed to feed a standard load impedance (75 ohms ±10%, resistive). A monitor output similar to the line output signal is also provided.

The degree of sync expansion is sufficient to provide RMA standard output, even though the input-sync-to-picture ratio (percentage sync of the peak-to-peak composite signal) may be below RMA standards. The amount of sync content in the output signal is adjustable.

The present standard input to the network distribution system is 2 volts peak-to-peak for the entire composite signal, including the synchronizing impulses, across 75 ohms. The land lines have repeater stations spaced approximately 8 miles apart. These house compensated amplifiers which correct for the frequency discrimination on the co-axial line and any nonuniform phase shift which may have occurred. The resulting video signal delivered to the network stations does not appear to degenerate or become degraded in proportion to the distance it has been transmitted, and arrives in very usable condition.

As was pointed out above, the limit of video frequency is 2.7 mc, and there is some compression of the sync below the 25% FCC standard; there is in addition, some "smear" due to uncompensated phase distortion. It is felt that these problems are on their way to solution. There is very little "shot" noise evident on either the land line or the microwave relay system, and few problems arise from this cause.

The usual spacing between repeater stations on the microwave relay is 30 miles, but the spacing varies considerably with local topography, the relays operating on line-of-right only. The present A.T.&T. microwave relay stations operate on the 4000-mc band with a transmitter power of approximately 1 watt. Metal lens antennas having a gain of 10,000 are commonly used.

Present American Telephone & Telegraph Co. rates (there is no distinction made between rates for cable and radio distribution) are set at $35 a mile per month, plus $500 a month per station connection. These rates are for exclusive service for eight hours every day.

At the moment, due to restricted distribution facilities, the charges are $25 a mile per month, plus $350 a month per station for 4 hours a day, 7 days a week, on a shared basis. Private microwave relay facilities have been shown to cost, assuming amortization of equipment in 4 years, approximately 20% less than the A.T.&T. rates and would have the added advantage of providing full-time,

24-hour-per-day, exclusive service for their owner.

Standardization

Any broadcast engineer knows that standardization of test procedures among all members of a network is imperative. Take the simple matter of checking audio levels; VU metering has been specified down to an eyelash so that the audio signal throughout a network will be uniform—no peaks which show on one VU indicator are missed by another.

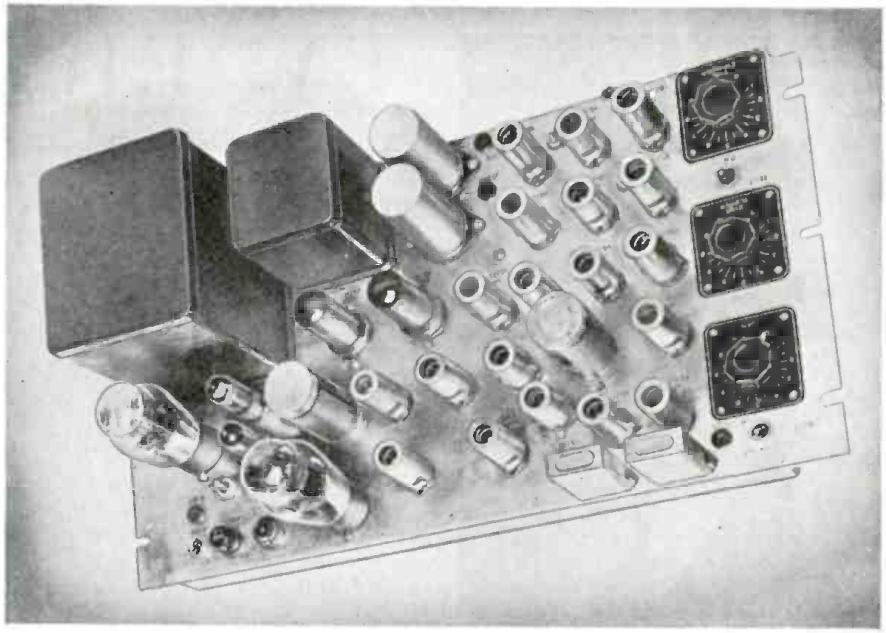
No corresponding standardization of the means for measurement of the composite video signal has been arrived at. The 'scope is, of course, universally used, but this in itself does not constitute standardization. When we consider *aspect ratio, linearity, transfer characteristic, dynamic range, gamma, film-print characteristics,* and so on, we realize that much work remains to be done regarding standardization of test between affiliates. Not the least of the problems listed above is the setting up of test standards and controls for density and gamma of processed films used for making *Teletranscriptions.*

Station facilities

With the advent of networks, television broadcasting has become "big-time"—it can no longer hide behind the excuse of being experimental, but must deliver programs of technical excellence. The delivery of such a product requires complex facilities. An integrated master-control system is necessary to handle programs from many studios, remote pickups, and other stations. Equipment permitting maximum flexibility in dubbing, fading, lap-dissolving, superimposing pictures, and other tricks of photography is required. The use of electronic timing circuits to pace the picture dissolve is an example of a refined feature now available in some modern mixer equipment available to stations today.

With the development and refinement of television, these techniques will take more advantage of electronic instrumentalities, with a resulting increase in the complexity of the required equipment.

Master-control equipment must provide the following facilities: transmission of the on-the-air picture to the studio control room; supplying a program to the network, client rooms, and main transmitter; push-button selection of a program from any of at least four sources; patch (plug-in) preselection of four programs from as many as 10 sources; fade timing; continuous monitoring of the on-the-air picture at the operating console; sending an independent preview (cueing) picture to the studio control monitors and to the client room; a continuous preview picture at the operating console; phasing of remote and local sync generators before switching; emphasizing the sync component of an incoming remote or network video signal; and separate routing of remote and network programs.



Chassis view of a "sync stretcher" used to boost the sync signals in relayed programs.

POTENTIAL TELEVISION APPLICATIONS

By W. R. G. Baker, Vice-President, General Electric Co.

As the television art progresses the electronics industry will put the television camera "eye" and the picture tube to work in industry and business, in the school room for child and adult education, in our police stations for criminal detection and will apply them in our national defense systems.

One of the potentially great uses for television, of course, is in the field of teaching. The television picture tube may never replace the blackboard but its possibilities of reducing the training period are so intriguing that it surely will enlist the cooperation of the nation's educators in applying the television technique as an important supplementary teaching aid. Television demonstrated its ability to project a common classroom into hundreds of police precincts and other training spots during the war. Thousands of air-raid wardens were given basic training in defense work as they "studied" such subjects as the incendiary bomb and gas protection via the television screen.

Industry has numerous possible uses for television which will be studied as special equipments are devised for these applications. There are those where the engineer wants to watch an operation but does not want to be present—some mining operations, underwater exploration such as ship salvage, in explosive or chemical plants and other dangerous manufacturing operations.

These engineers lifted television out of the amusement field and gave it to the scientists recently at Azusa, California, to aid in getting close-up views of dangerous testing operations of high-thrust rocket motors at the Aerojet Proving Grounds. High ranking Naval officials, seated in a conference room 700 feet away from the test pits, saw the rockets being fired as clearly as if they were only a few feet away.

Television certainly has a place in law enforcement's future. The Federal Bureau of Investigation is studying its application for direct use in the Bureau's work. Criminal detection and apprehension can be aided not only by the direct telecast to the public in emergency, but also by televising the daily lineup of suspects at police headquarters for the benefit of precincts in outlying communities. Development of equipment for police cars which now use radio so effectively is another logical step in television's future applications.

Dr. W. R. G. Baker

TV, Electronics, and Radio in '49

By BRIG. GEN. DAVID SARNOFF*

TELEVISION set production, *for the industry as a whole*, in 1949, will total approximately 2,000,000 receivers. This, according to the best available studies, will be stepped up in succeeding years, and by 1953 the industry's annual television set production is expected to reach close to 5,000,000. By the end of that year, the total number of sets in operation would be nearly 18,000,000. Also, by 1953, it is believed that a coast-to-coast television network service will have been made possible by radio relays and coaxial cables.

At present, 124 television stations have been authorized by the Federal Communications Commission. Fifty-seven are on the air. Seventy-five other applicants have permits to construct stations, and 312 additional applications are pending. Television networks are expanding across the nation—opening new markets for receiving sets and constantly increasing television's "circulation" as an advertising medium of powerful sales appeal.

Recently, Chairman Wayne Coy of the FCC estimated that in another two years there will be 400 television stations on the air, and 1,000 stations in seven or eight years from now. He also pointed out that nine-tenths of everything we learn comes through our eyes, and added: "Television enables us to reach the mind via electronics at the speed of light. It is costly to build and to operate a television station. But the advertisers will find it the most powerful, most effective and most profitable medium for mass merchandising yet devised."

So swift has been the scientific and engineering development of television transmitters and receivers that those responsible for the artistry and showmanship of television have found it a real challenge to keep the pace. Nevertheless, the great improvement in programs at the beginning of 1949 reveals such progress that it guarantees continued advances in the development of this new art.

Ultrafax

Combining the great advances made by television with sensational achievements in radio relays and photography, the Radio Corporation of America in 1948 introduced Ultrafax, a new system of high-speed television communication, capable of transmitting and receiving handwritten or printed messages and documents, and even complete books, magazines and newspapers, at the rate of a million words a minute. It was demonstrated publicly for the first time on October 21, 1948, in the Library of Congress, Washington, D. C. This development which splits the second and utilizes each fraction for high-speed transmission of intelligence, promises to be as significant a milestone in communications as was the splitting of the atom in the world of energy.

While many uses for Ultrafax are foreseen, its scope will multiply with time and experience. We foresee the day when through television and Ultrafax, a radio newspaper may be delivered through the air into every home equipped with a television set. It will be possible to have the same transmitter that broadcasts a television program broadcast the radio newspaper simultaneously. In fact, the same home-receiver, with proper attachments, could print the newspaper without interrupting the television program.

As a radio mail system, Ultrafax could deliver the equivalent of forty tons of mail coast-to-coast in one day.

We can also envisage the day when Ultrafax will provide us with a new service of international television. First, however, a radio "air-lift" must be provided across the Atlantic. With 12 to 14 suitably equipped communication planes flying over the ocean and suitably spaced, an overseas airborne radio relay system could be established between the U. S. and Europe to provide not only an exchange of television programs, but also to handle the equivalent of tons of mail, news and other services. Ultrafax would make all this possible with lightning speed and mobility.

Broadcasting

Radio broadcasting provided the firm foundation of experience and public service upon which television is being built. Sound and sight combined are weaving a pattern that is more appealing to the mind than sound alone, so a gradual fusion of these two great services is to be expected. More than 1,700 standard broadcasting stations are operating in the United States and construction permits for approximately 300 more have been granted. There are 39,000,000 homes equipped with radio receivers in this country, which means that more than 90 per cent of American families have radio sets.

FM (frequency modulation) broadcasting continues to advance as indicated by the fact that the number of FM stations on the air increased from 300 at the beginning of 1948 to nearly 700 at the close. More than 300 construction permits for additional FM stations have been issued. The number of radio sets equipped for FM reception increased to more than 3,000,000 in 1948.

Science and research

Industrial electronics, with its widespread possibilities for useful application, continues to challenge our scientists and engineers. For instance, in 1948, RCA introduced a new electron tube, which acts as a "transducer," converting mechanical vibrations into electrical pulses that can be studied as audible or visual signals. The tube is smaller in diameter than a cigarette and only half as long. It weighs only 1/16 ounce. It is so sensitive that it can measure the vibrations made by a fly walking on a steel beam. Therefore, it is easy to see what great possibilities it has for use in such diverse fields as the detection of defects in airplane construction, the causes of dynamic unbalance in rotating machinery, the measurement of the effects of oil well blasts, recording blood pressure, studying under-water sound and numerous other applications.

But so wide is the scope of radio science today, and so great its possibilities for the future, that it is beyond human power to foresee all the new advances that will appear. It is safe to prophesy that some developments will overshadow in significance many of the achievements of the past. This much is certain—our scientists and engineers will continue to devote their energies and skills toward extending the usefulness of the electronic and communication arts.

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