What About Postwar

It Can—and Should—Go Places, but in the Meantime There Are a Lot of Troublesome "Ifs." Sound Broadcast Reception, on the Other Hand, Is Due for Immediate and Vast Improvement

PART II OF A SERIES ON ELECTRONICS AFTER THE WAR

YOU probably think, as does almost every one else, that you will have a television set in your home soon after the end of the war which will be a combination theater, baseball field, football gridiron, movie screen, animated newspaper, concert stage, and all entertainment rolled into one. You may be wrong.

The cold fact is that television, much as it has been publicized, has actually been a commercial failure. And it may well be a disappointment for years to come if we don't use our new war-born knowledge of electronics to provide a projection-type receiver selling for not more than $200, a larger image, better definition and greater brilliance, and possibly color, too.

Carl Dreher throws light on these problems in this authoritative forecast, and discusses as well the future of FM (frequency modulation) in sound broadcasting. He was one of the early radio amateurs, subsequently a radiotelegraph operator and engineer, then engineer-in-charge of WJZ and the first RCA broadcast network, chief engineer of RCA Photophone, and director of recording for RKO Studios. He has been a frequent contributor to POPULAR SCIENCE MONTHLY.

By CARL DREHER

"ENTERTAINMENT is a serious thing," Dr. Alfred N. Goldsmith observed in the early days of broadcasting. He was right: entertainment has remained the most important function of the mass communication services. It is important to instruct people, but in a nervous and complex civilization like ours it is even more important to amuse and thrill them. Of course the one by no means excludes the other; actually a medium like radio teaches best when it interests and intrigues the audience. What, then, is the future role of electronics in providing entertainment in this broad sense?

Television has been called a casualty of the war. The truth is that it was a casualty of peacetime. It had no job. It was a commercial failure.

It was the war that gave television, or the people employed in ingenious but unsuccessful efforts to make it into an industry, something important to do. Television provided skilled personnel as a nucleus for the development, manufacture, and operation of vital electronic equipment for the Army and Navy. It was no small contribution—and it may turn out to be bread cast upon the waters. There is every reason to expect that after the war the armed services and the war industries will repay their debt in the form of improved, simplified, less expensive equipment, and that in consequence television will achieve the mass acceptance and economic success which previously eluded it.

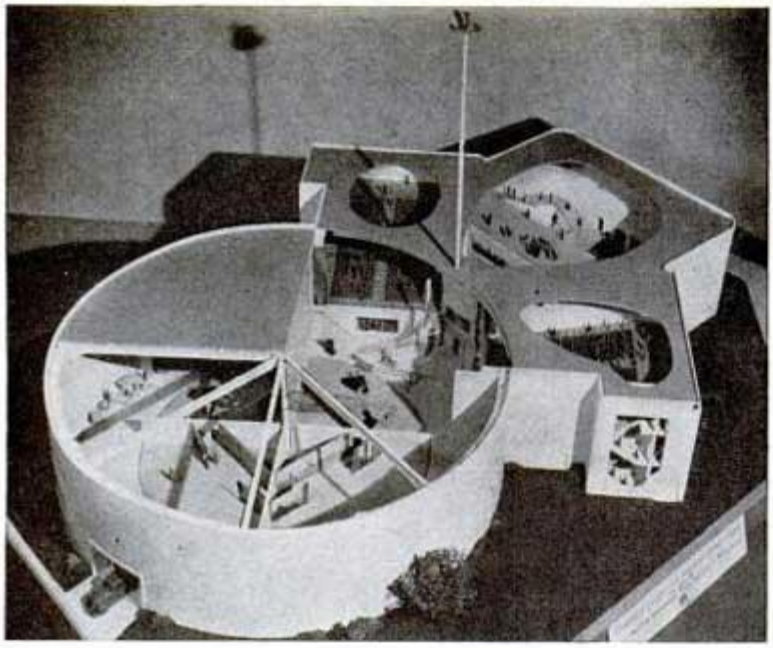
Prewar television was a commercial flop primarily because it was not good enough technically, and in consequence did not offer enough for what it cost. The image was too small. It was not clear enough. Those who were actually trying to make television into a medium of entertainment, as distinguished from those who were writing the ballyhoo for it, know that it was virtually limited to close-ups even in the studio, and that the actors were not recognizable in the average two or three-shot, with the camera cutting them off at the waistline.

Outdoors it could pick up objects only under the most favorable light conditions, and here again the smallness of the picture made full shots little more than a challenge to the spectator's imagination and an appeal to his forbearance. Too frequently, also, there were transmission troubles and

Television?

TELECASTING a scene from a modern studio calls for the closest co-ordination between performers, technicians, and directors. On the set, cameramen and director get orders by earphones from the program director, who watches pictures picked up by the cameras and switches close-ups, long shots, or filmed scenes onto the air. Unlike a movie, which can be patched together from shots taken at different times, the television program has to be assembled from several cameras scanning long and short shots, filmed material, and titles while the action is going on

Photo from CBS



The postwar television studio will look something like this, according to engineers of the Austin Company. Heart of the design is the large turntable stage, with an auditorium for visitors attending the shows

interference, much more irritating to the eye than equivalent defects in sound broadcasting are to the ear.

What the prewar era did accomplish was to establish television on a firm electronic basis, with the iconoscope and other all-electronic devices used for pickup, and the kinescope for reception. What postwar television will need is a projection-type receiver based on these or more advanced electronic principles, in which the picture will be thrown on a screen at least 12 by 16 inches and preferably 18 by 24 or larger, with definition, brilliance, and contrast equal to the best 16-mm. movies or better, free from interference 95 percent of the time, and selling in the $200 range.

If electronic technique can provide such a receiver, together with pickup improvements which will allow full utilization of its performance characteristics, then television will be going places. Then, indeed, it will have a mass market capable of putting a dent in an incipient depression, or helping proportionately to maintain a high general level of economic activity.

Conversely, until we are in a position to give the customers their money's worth, we had better not venture out on the limb again.

Is equipment of this quality going to be available at around $200? I have no inside dope, but I do have confidence in electronic research. Before the war we were pretty niggardly in spending money for research. Of course we talked as if we were turning our pockets inside out, but our actual annual outlay for industrial research was about $200,000,000 a year, or between 10 and 15 percent of what we spend for cigarettes. The war raised this figure substantially, and, by reason of the importance of radio in military and naval operations, much of the money was channeled into electronic investigation. With civilian outlets tightly closed, the resulting developments are piling up behind a dam of military necessity and secrecy, and are largely segregated even from one another. With the end of the war the dam will be breached. First a trickle, then a flood, of civilian applications will pour forth.

Capable of "Telecasting" Anything That Can Be Seen and Heard,

Photographs below, courtesy of General Electric

DRAMA . . .

SPORTS . . .

Television will hardly remain unaffected; thus war developments may help to solve the correlated problems of brilliance, definition, and size of image. Perhaps they are already well on the way to solution. In May of this year, RCA engineers announced that they had a model of a $200 postwar television receiver capable of producing an 18 by 24-inch picture through a highly efficient optical system of molded plastic lenses. With a de luxe attachment a six by six-foot picture could be projected in the home. In both cases brilliance and definition were said to be greatly improved over prewar standards. Another reported advance was a more sensitive television camera, capable of picking up outdoor events under adverse light conditions, and materially reducing lighting requirements for studio pickup. The General Electric Company was working along similar lines. Thomas Joyce, manager of RCA's television sales department, predicted the marketing of some 750,000 home receivers within 18 months after the war.

Clear, large-screen reception is a "must." In this RCA developmental job, the kinescope image is projected onto a mirror that reflects it onto the back of the translucent 13½ by 18-inch screen. The screen is retractable

A basic requirement for the economic health of television is syndication or network distribution of programs. Television outlet stations, like all radio transmitters using quasi-optical waves, have a range limited approximately to the optical horizon. That means you can transmit reliably only about as far as you can see under the best conditions from the transmitting aerial, or at most, 60 miles. The outlet stations must therefore be interconnected to reduce the total cost of programs, which is going to be extremely high, to a low cost per unit of audience. A $50,000 program, distributed to 5,000,000 spectators, costs only one cent per spectator. This is mass distribution applied to entertainment.

When sound broadcasting came into being, network interconnection facilities were already in existence, since the telephone had been invented over 40 years earlier. For picture broadcasting, equivalent facilities must be created. The coaxial cable and waveguide transmission lines are, as we saw in the preceding article, already in an advanced state of development. An alternative

Television Promises to Bring the World into Our Living Rooms

NEWS . . .

OPERA . . .

method is automatic, low-power radio relaying, which is also past the early experimental stages. The relay stations, using extremely short waves, will be individually limited in range, the same as the outlet stations, but a chain of 120 or so, equipped with highly directive receiving and transmitting antennas, would carry a television program across the continent.

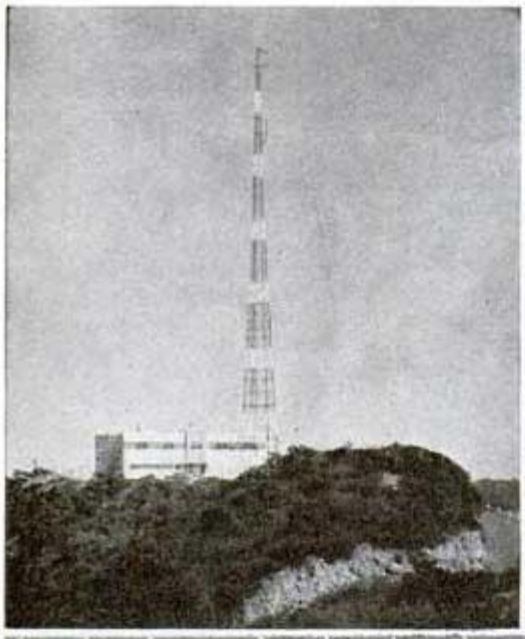
Television network connections are going to be expensive. Just to make a guess at the cost, let us assume that special cables for television will cost $10,000 mile, which happens to be the actual cost per mile of the first coaxial cable installed for regular commercial service, between Minneapolis, Minn., and Stevens Point, Wis., in 1941. At that rate, a transcontinental cable would entail an expenditure of $30,000,000, not all of which would be legitimately chargeable to television, since it could carry other services as well. However, to be conservative, we will load the whole capitalization onto television. Ten such lines, interconnecting the principal outlet stations all over the United States, would then represent an investment of $300,000,000. Or assume 10 lines of 120 radio relay stations apiece, each line spanning 3,000 miles and each of the 1,200 stations costing $60,000: that would add up to $72,000,000.

These guesses may be too low. Very well; let's shoot the works and assume that television interconnection will call for an initial investme t of a round billion dollars. That is real money, but it is still only one percent of what we are spending every year on the war, without the slightest hope of getting much of it back. A billion dollars, spread over twenty million receivers, comes down to an investment of $50 per receiver. Say $100 dollars per receiver for the whole works—studios, outlet stations, everything. That debt can certainly be serviced and amortized by an industry which can easily do a billion dollars' worth of business a year.

Television is going to be big or it isn't going to be at all. The decision as to whether we are going to have it will not rest with electronic engineers; they can only provide the means. Electronics can serve us fully only if we are a bold and energetic people. By nineteenth-century standards, even by prewar twentieth-century standards, the economics of television are on a staggering scale. But not by postwar standards, provided we are prepared really to take advantage of our technological skills and productive capacity to pay the bills for mass distribution of what used to be regarded as luxury products. Television is one of these.

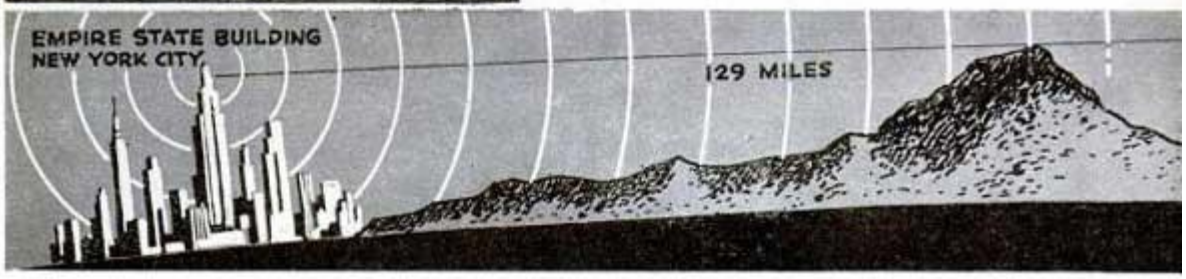
The benefits it promises are on the same scale as the costs. Take education. The little red schoolhouse, with its one classroom, has great romantic appeal, but it was really a very bad plant for teaching. Most of our rural schools, and many of the urban ones, still are. And as often as not the teacher is no better than the plant. The efforts of the average teacher might well be supplemented with television lectures on special subjects

Range of television transmitters is limited to the visible horizon. Hence they seek the high spots, like this station of California's Don Lee System



Pioneer Television Network

A preview of nationwide video hookups may be seen in the New York-Schenectady link established by General Electric and in operation for three years



Section of "Prewar" Picture Enlarged to 18 Inches

Section of "Postwar" Picture Enlarged to 18 Inches

Photographs courtesy of Columbia Broadcasting System

Enlarging the prewar television picture to 18 inches would give a coarse image approximated by the halftone at left, above. Improved definition, as at the right, is a requisite for successful postwar operation

by the few great teachers of each generation. That holds not only for the elementary and high-school grades, but for much university teaching as well. Think of the tremendous service television can render to advanced study in medicine and engineering, for example.

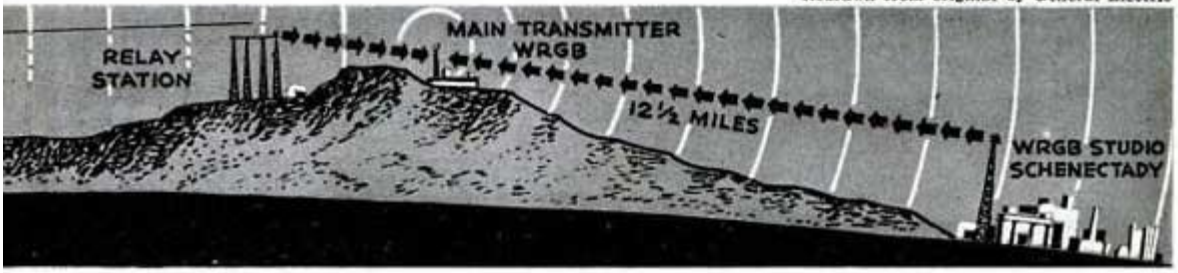
On the straight entertainment side radio needs television as the silent movie needed sound. Audio broadcasting is all right for background music and the like, when people want to do something with their hands and can lend the radio only their ears, but it is a feeble medium for plays and spectacles. The characters in a televisionless radio play have to describe everything that is happening. When somebody pulls a gun he has to say, "Do you see this gun?" or somebody else has to say, "Don't point that gun at me!" We will not have to put up with such clumsy devices once television is available for dramatic presentations.

Television will come: we need it, culturally and economically. But it will not come the day after the Nazis and Nips call it quits. It may be a year after approval of standards and authorization for full commercialization by the Federal Communications Commission before it really gets under way. War industry may furnish the techniques, but they will have to be adapted to new uses. The transition from military to civilian production alone may take six months or more. Remember how long it took in the other direction? Plants will have to tool up, *(Continued on page 228)*

Linking New York and Schenectady, N. Y., Uses a Relay Station

Programs transmitted from the Empire State Building, 129 miles away, are picked up by an antenna system mounted on four 128-foot towers at the relay station. A special receiver-transmitter relays them to the WRGB transmitter for broadcasts to the Schenectady audience. Programs of local origin are also telecast

Redrawn from original by General Electric



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hundreds of transmitters will have to be built, network facilities provided, program-production studios and organizations set up.

All this cannot be bitten off and swallowed in one gulp. It has to be done in stages. First we might install a relay system between Washington and Boston via New York; that will take a year or two. With the bugs ironed out, that pioneer network may be extended westward. At the same time a West Coast network may work its way from San Diego to Seattle in perhaps four years, with tentacles reaching eastward. Finally the east-west arms will join, like the railroads in the late 1860's. Transcontinental television is something on the order of a five or 10-year proposition.

One more word of caution. Television cannot stand much interference. The Federal Communications Commission will have to regulate industrial and medical radio devices such as diathermy equipment, which can raise hob with all the television receivers in their neighborhood. Electronic services must not be allowed to get into each other's hair. Secondly, the manufacturers of television receivers must do better than they have done with broadcast receivers, as far as reliability is concerned. If the telephone system used electronic equipment as undependable as many radio receivers of reputable makes, getting through a long-distance call would be a gamble. A 20 to 40-dollar radio will frequently incur from 50 to 100 percent of its initial cost in service charges during its normal amortization period. A television receiver is a far more complex instrument. Television receiving equipment will have to be much better than broadcast equipment, and television service men will have to be better trained, or progress of the industry will be retarded.

If television is not going to be borne in on the wings of the angel of peace, frequency modulation may well be. It has no missing links; its economic problems are on a much smaller scale than those of television; and the greater part of its pioneering has been done. Its full development is overdue and only wartime restrictions stand in the way.

Actually, one of the principal functions of medium-wave amplitude-modulated transmission was lost as long ago as the advent of network broadcasting. Once the novelty of distance reception had worn off, it became only a matter of time before a short-wave, short-range, interference-free link between the town radio audience and the local network outlets would supplant the

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longer-wave amplitude-modulated service.

Frequency modulation is *not* inherently high in tone fidelity. It *is* inherently high in freedom from interference, especially from natural static. In a sense, that is why it was invented. Around 1920, every radio engineer with any inventive pretensions was trying to eliminate static—the bugaboo of long-wave reception. Except for the amelioration afforded by sharply directional reception, which was not applicable to broadcast reception, all of their countermeasures failed. The proposed solution of E. H. Armstrong was one of the least successful; it was demolished in the discussion which followed the presentation of his paper on the subject, and nothing more was heard of it.

But that failure set one of the most powerful and lucid technological minds of the 20th century off on one of its exploring expeditions. The reason static could not be eliminated was that, once the impulses had got into a conventional receiver, they were, in effect, a signal on whatever wave length the receiver was tuned to. The signal was amplitude-modulated; so was the static. So when Armstrong got around to it, and developments in short-wave transmission had got around to him, he devised a method of modulation which did not exist in nature. Instead of varying the amplitude or power of the carrier for signaling, the frequency being held constant, he held the amplitude constant and varied the frequency. That eliminated static automatically. A normal FM receiver therefore has a quiet field under conditions which would produce intolerable interference with an AM signal. And since FM stations need a wide band and can operate only on high frequencies, the waves will not, presumably, travel beyond the optical horizon. Thus there will be no crosstalk among distant stations, no matter how many of them there are.

All FM has to do after the war is to pick up where it left off. It has continued to operate; the war merely stopped its expansion for the time being. The Federal Communications Commission has already set up complete standards covering its operation. An estimated 500,000 FM or combination FM-AM receivers have been sold. Now FM is being used extensively by the armed services. It looks as if it is in for a sustained boom as soon as the labor and materials are available. According to one survey, 144 AM stations plan to file applications for FM transmitters at the end of the war, and that is only a beginning. One authority expects

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2,000 FM stations within a 10-year period. Another speculates on an immediate postwar market for 12,500,000 home FM receivers, and believes FM automobile receivers will come into general use. The trend is toward frequency modulation right down the line.

This does not mean that amplitude modulation is through. For one thing, you can't throw out 900 AM broadcast transmitters and 60,000,000 receivers with a mere twist of the wrist. For another, FM is essentially an urban service, with transmitters in the centers of cities and its aerials perched on high buildings. The countryside will still have to be served largely by powerful AM stations on the medium waves.

The transition from AM to FM is likely to proceed through the addition of FM transmitters to existing standard-band AM transmitters, as well as the erection of independent FM transmitters. Most listeners will be equipped with combination AM-FM receivers. Once it is indicated that the great majority of the listeners in a particular service area are relying on FM transmission, the older method can be discarded.

Many other improvements in broadcast reception may be expected after the war. Portable receivers, already reduced to camera size, are likely to assume the proportions of a cigarette case or wallet. This may seem fanciful, but all that is required is a further reduction in size proportional to that which occurred between the two world wars, not only in portable radios, but in flashlights, hearing aids, and the like.

The postwar home radio receiver is likely to incorporate television, FM and AM sound reception, and a phonograph with a recording adjunct. A 16-mm. movie projector may also be incorporated but that likewise is no early prospect. All sorts of possibilities, such as recording of television programs on film in the home, can be envisioned for the more remote future, without much likelihood of attaining importance within the 10-year postwar period. But, even limited to the primary services of sound and picture reception and sound reproduction from records, the radio cabinet will be the electronic theater of the home, filling the major part of the average American family's entertainment needs, and exerting an immense influence on its mode of living and thinking.

In the third of this series of articles, to be published in the September issue, Carl Dreher will discuss the miracles to be wrought by electronics in industry.

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