BROADCASTING
ITS NEW DAY

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To THE

CAPITOL "GANG"

AS THE AUTHORS' APPRECIATION OF
ASSISTANCE CHEERFULLY GIVEN AND
OF PUBLIC SERVICE WELL DONE

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FOREWORD

IN this work the authors have tried to present the bigger and more vital issues of broadcasting and commercial radio in as practical a manner as possible. No attempt has been made to embellish the treatment with fanciful prognostications or dreamy outlines of the future. Where the future has been mentioned, the forecast has been based on the trend of engineering developments of the present time. Nothing that does not stand in the shadow of technical achievement or scientific possibility has been included.

The critical matter pertaining to studio operation and to the problem of program arrangement and presentation quite naturally lacks the dignity of authority, for broadcasting, as an art, is so nebulous that it would be folly even to attempt to set up a standard technique at this time. Only time, experience, and thoughtful application to details will bring broadcasting to a point of artistic development where it can take its place beside the motion-picture and the drama. If the present treatment will hasten the evolution, no greater reward for the time and thought spent in its preparation can be asked.

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BROADCASTING: ITS NEW DAY

CHAPTER I

BROADCASTING: ART OR EPIDEMIC?

THE harsh title of this chapter may send an annoying chill surging down the spinal column of the devotee of broadcasting whose enthusiasm has been manufactured by the thrills born of the pure novelty of the thing rather than by a mature consideration of its more substantial aspects. The title is, in a way, a challenge that will bear defense; any attempt to affix the term "art" to the new science would be rash and unjustified unless its weaknesses, its tendencies, its limitations, its trials, vicissitudes, and ramifications are laid on the vivisection-table for impartial examination and analysis.

In the development of any art, a point is reached where a ruling consciousness of progress and aim must sway the minds of the pioneers who struggle under the burden of their oftentimes uncertain re-

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sponsibilities. A tedious and blind process of groping experimentation, unguided and highly speculative, must be passed through before this consciousness can be focused on an object that will bear clear definition. To the sincere student of broadcasting it would seem that a point has been reached where it is now logical to assemble the results of past experience, in as systematic a fashion as the records will allow, for the purpose of presenting them for serious study. Provided the task is well done and the many confusing angles of the case sufficiently treated, the opportunity for the nebulous formation of this new consciousness should emerge as natural fruition. This consciousness may be but a puny embryo, but even so it is important in that it marks the beginning of an intelligently guided evolution.

The appalling outburst of intellectual energy and creative thought that marked the inception of the Italian Renaissance was in no sense a psychological phenomenon; it was a burning new consciousness of beauty accompanied by a passion for the fulfilment of intense ambitions in the arts. It was an emancipation of genius that endowed its fervid leaders with an instinct for the beautiful, and upon the remnants of the earlier devices of art they fastened their inquiring minds for guidance and inspiration. New life blossomed and spread over Europe.

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The antithesis of this noble and uplifting thrust of human effort, this bolt from convention, is found in the average broadcast studio director of to-day. He is stranded high and hopelessly dry in the mire of similitude. More than this, he is confused, and in his bewilderment his vision is limited by the sordid and bleak walls of the deep rut in which broadcasting aimlessly rolls. He has no compelling thought or passion to guide him. As the words of this book are laid down, broadcasting has left behind it four years of rather sterile history. The programs of 1920 could be placed beside the programs of 1925, and the most superficial observer would at once notice the striking similarity. In fact there is not even a tiny mark of difference, nothing to the later productions to give them even modest distinction. It would seem that the present genius of broadcasting is utterly exhausted and stands panting like a chased animal ready and willing to admit defeat.

The most inspired critic has no license rashly to chastise those who occupy the studio saddles of the country without carefully considering the apparently insurmountable objects that confront their imaginative powers and the fact that they are, in the majority of cases, operating without funds. The unleashing of streams of sharp criticism does not in itself require any bold stroke of genius unless it is

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tempered with a sympathetic understanding of conditions and a reasonable amount of constructive and practical thought. Consequently, the authors of this volume have made a sincere effort to avoid unnecessarily harsh or vitriolic comment, however ridiculous the efforts of studio managers may appear. If the criticism seems smarting or less than decently tolerant, the reader is urged to exercise patience, for the case may be one where enthusiasm to bring out a significant point has for the moment overcome the restraints of diplomatic expression, an entirely venial sin.

The studio manager is the victim of a peculiar set of circumstances. Snatched from one of the ordinary walks of life, he has been placed in a position where he has but few precedents to guide him and where he encounters new though solidly set traditions to entice him to take the easily trod path of custom. Because of meager appropriations and the necessity of arranging expenses to conform with the non-profit-producing features of ethereal entertainment peddling, he does not receive sufficient recompense to make him either overly ambitious or alert to the fullest possibilities of broadcasting. This is not a universal situation, but it is generally true. Economy prevents the station owner from attracting men with the advantage of breadth of training, refinement,

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genius, and experience in matters relating to public entertainment on generous scales. Then, too, the ideal director of broadcast activities will find himself confronted with the tremendously complex problem of appealing to the tastes of a gigantic audience, a fickle, impatient audience that needs only to exert its willing wrist to render his best efforts futile.

The severe requirements dictated by sheer necessity have placed the majority of our broadcast studios under the guidance of mere novices serenely unconscious of the niceties demanded by an artistic temperament. It would be unreasonable to expect broadcasting to thrive under these conditions, for art must always be mothered by minds sensitive to esthetic impulses. Talent of this nature is not available to broadcasters at the current figures.

One of radio's greatest advantages, the superficial connoisseurs hold, is its universality. Agreement with this contention is fair only if universality is taken to mean the mere spreading of the entertainment offered and the impossibility of escaping it. If it means the wide range of the matter offered, objection is in order, for, with serious-minded listeners, it is part of the evening's work to become completely disgusted with the mediocre or entirely preposterous program of one source and to seek solace at the ethereal portals of another. Solace is an elusive thing

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to chase through the ether of space. One is often excited to mild desperation in the task.

As each fleeting week is added to the history of broadcasting, hebdomadal reviewers are seldom afforded the opportunity of looking back and saying, "Well, tangible progress was made last week, and the new week will see radio on a higher rung of its evolutionary ladder." Of course, the interested observers of radio must become reconciled to the fact that progress in any art is a slow and annoyingly tedious process, with advances emerging so slowly that they are not always perceptible.

If our list of more than five hundred ambitious disturbers of the ether is considered, and it must be considered in any serious attempt to analyze the weaknesses of broadcasting, this much-alluded-to universality presents itself with a vengeance. Herein lies one of the most aggravating problems with which the embryo art is confronted. We have too many broadcasters. The situation is one of those phenomena of progress where too many adherents weaken the forces that tend to build strength and virility. Yet, in the face of this evident evil, licenses continue to be granted in substantial numbers, and avaricious seekers of publicity continue to be attracted by the mirage of ether notoriety.

Those who recognize the folly of overdoing any-

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thing cannot give themselves over to enthusiasm or demonstration when a new radio station, wherever it may be placed, is opened, for it is the large number already operating that justifies the use of the word "epidemic." A new equipment can add only confusion to an already confused scene. To think that mere additions of quantity will offset the demands of quality, will improve the art, is like thinking that a few million more automobiles will alleviate our traffic problems. This is aside from the serious matter of wave-length conservation and the growing problem of chronic interference.

New York will serve as an admirable example in illuminating the fatal dangers that attend the confusion created by extreme broadcasting activity. Nothing could be more convincing as proof that subtractions from the list of studios should be hailed as progress rather than additions. New York alone has no less than eighteen broadcasters, and if twelve of this number would permanently close their antenna switches, a service would be done to radio. This would directly affect the quality of broadcasting, as will be seen.

Questions relating to talent are the bane of the studio manager. His audience measures the quality of his program by the talent he uses in entertaining them; aside from modulation, this is the one thing

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that marks a studio as good, bad, or mediocre. The number of broadcasters affects the availability of talent; here is the crux of the whole problem. One who has exposed himself to the offerings of the average radio broadcaster cannot help but believe that the interests of the science would be served if 75 per cent of the talent used to-day would remain at a safe distance from the microphone, for this percentage of the talent that is used is lured from the parlor, the cheap vaudeville theater, and the dingy studios of third-rate impresarios. It makes up the greater part of the vast army of entertainers necessary to serve the needs of so great a number of wave manufacturers. While new broadcasters seek the air and enter the highly competitive market for entertainers, a market already overrun with sharp-eared consumers, real and pseudo impresarios, more thirsty straws are placed in the musical mug. The tragedy of it is that the contents of the mug are not overly effervescent, and the energetic draft taken by every user of straws usually results in a somewhat flat swallow. Only a definite and limited number of suitable artists is available, and another competitor for air honors only makes the scramble madder and the programs less appetizing.

The absolute independence of those who broadcast without compensation is the natural result of

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the condition outlined above. While analysis of the motives that lead mediocre barytones, sopranos, and strummers of various stringed instruments to broadcast proves that they are attracted largely by the lure of publicity and the possibility of receiving engagements from easily pleased admirers of their offerings, the many opportunities afforded them to air their work tend to sharpen the realization of the broadcaster's obligation to them. Consequently they are independent and easily offended, and the studio manager has long since learned that he cannot risk a suggestion as to the type or title of the numbers they broadcast without being reminded of his utter unimportance.

The obliging parlor barytones and sopranos who need little coaxing to appear before the unprotesting and easily punished microphone are wont to exercise their real or imagined talent (more often the latter) upon selections that have long since become the common property of the musical world. Barely a night passes that does not bring forth the plaintive strains of "At Dawning," "I Hear You Calling Me," "Give a Man a Horse He Can Ride," "Tommy Lad," et cetera. The unmitigated use of these well-worn numbers by no means plays in broadcasting the part of an interest-building influence. Even the musical bourgeoisie, to say nothing

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of the intelligentsia, are annoyed by the growing monotony brought about by the tattered numbers of the ambitious novices. They certainly add nothing to the artistic side of radio and less to its popularity. Yet this is an evil that will not yield to mere thought alone. Nor will it be solved by the few thinking studio directors who well understand the dangers involved in attempting to reform the tastes of the homemade seekers after musical fame. If "At Dawning" is not appreciated at one studio, there are plenty of studios that will be glad to add it to their banal programs.

A studio director who was daring enough consistently to protect a censorship would invite disaster of the most appalling variety. His list of "possibilities" would dwindle to a shadow of the strength necessary for continued operation, and he would eventually be confronted with the unpleasant and highly ruinous task of filling a substitute program with material of a still lower musical type. The director must be partially exonerated, for it is evident that he cannot be held up to ridicule for something that lies far beyond his most strenuous efforts at correction.

Sticking to the example of New York City, where, it will be remembered, no less than eighteen broadcasters make daily use of the ether, a cautious

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observer cannot help but see that the resources of music are not sufficiently large to stand up under the incessant drain that is made upon them. Under these conditions, repetition must constantly intrude upon even a modest diversity. Here again the evil of too many broadcasters looms up in all of its grotesqueness. Suggestions for a remedy will remain fruitless unless they involve cropping the long list of licenses.

Fewer studios would mean fewer opportunities to broadcast for those who contribute their services. This would make them more amenable to reason and less desirous of imposing their will upon the directors. A point might be reached where they would actually agree to sing certain numbers with the feeling that they were aiming their efforts at the destruction of monotony, radio's greatest enemy. Such an acquiescence on the part of the lesser of the musical nobles can be safely anticipated, for those who have been long associated with broadcasting understand the motives that bring them into the studios. They are rarely moved by philanthropic impulses; it is usually a matter of ambition and a desire to expose their wares to the supposedly breathless world for approval—surely never for condemnation. Of course, there is a thrill to the first or second "appearance," though this is soon forgotten;

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but a few letters from untutored admirers make the fulfilment of many other engagements appear very much worth while. So, in the long run, people broadcast with a selfish motive, or else from the line of the new. From the latter motive, however, habitual broadcasters are seldom developed.

The fact that not a few of the singers and instrumental soloists receive engagements as a result of their work in the studios, greatly encourages those who have the high ambition of receiving similar recognition. So, after all, the fair-minded critic of radio programs cannot be accused of "looking a gift-horse in the mouth" without being accorded the privilege of reaching for arguments of defense. Even the broadcast equipment owners have a motive, for it is plainly evident that a sane business organization is not going to spend as much as fifty or seventy-five thousand dollars a year to supply entertainment for the dear public without feeling that some benefit comes as a result.

Our large number of broadcasters will always defeat any serious attempt to raise broadcasting above the level of a dreary and common form of entertainment; and it would seem that it will long suffer from extravagant use. Cool-minded authorities agree that as few as forty good studios located in strategic positions would be able to serve the entire

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country with the assurance of better programs, less confusion, less interference, and less monotony. Yet our Yankee enthusiasm and rash pioneering will have to run their course before this ideal condition can be reached. Perhaps new technical developments (these will be treated in a later chapter) will disturb or destroy the ruinous rampage, but these cannot be expected immediately.

We have all manner of broadcasters, from the billion-dollar communication company to the proud though ignoble owner of a wheezy twenty-watt contraption who enjoys the same rights and privileges as the more able dispensers. There is no altruism in broadcasting. It is a cold, commercial thing squirming under the unmerciful heel of exploitation. Yet this cannot be taken to mean that broadcasting will be unable to lift itself to a higher artistic plane through the operation of the motives supplied by commercialism; it simply means that broadcasting is temporarily overwhelmed as a helpless victim of ungoverned selfish desires. Moving-picture production and presentation have been carried into the higher esthetic sphere of art with exploitation as the only motive, and there is no reason why broadcasting, sanely controlled and conscientiously administered, cannot enjoy a similar growth. Before this can be done, however, broadcasting must throw off

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the embarrassing yoke of universality and common ownership.

Newspapers, electric shops, religious sects, department-stores, railroads, telephone companies, banks, hotels, theatres, cities, and colleges are among the varied list of broadcasters. A few of them—a very few—are doing a creditable piece of work, considering the opposing influences and the natural obstacles that they are forced to overcome, but the majority are simply cluttering up the ether with that which can only prevent the growth and expansion of the more artistic side of radio.

Our present legislation also militates against the best interests of broadcasting. Any one who can meet certain simple requirements and has sufficient capital can erect and operate a broadcasting station. What practically amounts to absolute freedom is permitted in regard to program material.

While the best of American traditions would not be honored by any legislation that would make the freedom of the air insecure, the evil of permitting it to become cluttered up with all manner of disturbances cannot be looked upon as the happy course of justice lying between the two extremes. It would seem eminently fair to enact legislation that would limit the use of too low a power. This would automatically set a better standard of broadcasting

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by discouraging those who do not have sufficient funds to establish and maintain a transmitter of the electrical dimensions to be demanded by law. Those who are now able to "get into the swim" with two or three hundred dollars would be deterred, and broadcasting would be saved from further embarrassment.

There are few broadcast listeners who have not had the amusing experience of tuning to a small station where the modulation (the result of impressing sound waves upon electrical waves) was so poorly adjusted, through want of expert attention and better equipment, that even the melody of the music was buried in an avalanche of galling cacophonies. A broadcasting station so small and mean that it cannot keep its machinery oiled, so to speak, is a menace to artistic growth. Not only that, but it is an injustice to the few broadcasters who are trying to bring broadcasting to a point of development where public approval will be more generous and universal.

But the law has nothing to say about modulation. It does not even demand that speech transmitted over a radiophone be understandable. In ignoring this, it leaves broadcasting struggling in the absence of much-needed support, for modulation is the first thing that militates against popularity in the mind

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of the average listener. The release of music or speech thick with the mold of distortion will, until the law is changed, be one of the crushing weights under which the art must stagger.

The solution of the problem of modulation is so simple that it seems nothing less than preposterous that it was not considered in the recently proposed legislation that took form under the none-too-wise eyes of Congress. A committee on modulation, empowered to order corrections in cases of transmission bordering on the impossible, would hasten the development of broadcasting to a very desirable extent. Of course, such a committee would have to be technical and unmoved by political affiliations. This is not a large order, however; the Bureau of Standards could be brought to function in a most efficient manner.

No one can seriously treat the artistic side of broadcasting without attention to that both maligned and loved person, the announcer. While some might not be inclined to give the announcer any more consideration than a mere train caller, his importance must be admitted by any but the superficial and easily pleased listener. Announcing is in itself an art, although it has but few advocates or passionate practitioners. The announcer must always take a conspicuous part in every program, and his

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interpolations are usually so frequent that unless he is interesting he robs the program of a deserved garnish. If he takes the part of a listless informant, he brings a depressing influence to bear upon the entertainment in general.

The ideal announcer should be characterized by all of the qualities of the successful toast-master, who always has it safely within his power to pull a lame dinner to its feet and give it the stamina necessary for entertainment. This calls for a peculiar kind of genius, a genius that has not as yet been recognized by our amateur studio managers. Witticism, breadth of experience, choice of language, and the ability to comment intelligently upon widely divergent matters mark the toast-master, who should be the inspiration of radio announcers. This man is not obtrusive nor is he objectionably arrogant; he is funny but not awkwardly facetious. Above all, he does not make the mistake of attempting to view everything through humorous eyes. If he is confronted with the opportunity of making humorous comment without running the risk of being ridiculous, he takes it; but if the subject he wishes to introduce is too serious to bear light announcement, he is wise enough to see that he gives it a deserving introduction.

It must be confessed that the job of the radio

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announcer is far more severe than that of the toastmaster. Night after night he must approach the microphone to herald the coming to the air of various events. It may be a lecture on the care of the teeth, or the first movement of Schubert's "Unfinished Symphony."

Our announcers are badly overworked; here again the matter of economy lays its imposing bulk across the path of progress. No man can be expected to meet the requirements of the perfect announcer if he is held to the necessity of exercising his talents nightly. Like a good pitcher, he should be worked sparingly and with due consideration of his importance. Three nights a week would give a man time to reflect on his work and the opportunity of carefully examining future programs so that he might determine his procedure.

Although the salaries received by announcers do not permit managers to employ the type of men who can best meet the requirements of intelligent and interesting announcing, poor choice is made in the average case. Men woefully lacking in musical knowledge, who stumble over the names of European composers with amusing awkwardness, find their way into the studios in the capacity of announcers. Furthermore, they exercise little control over the English language in general, and not

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one in fifty has the happy touch of imagination that permits departure from the ordinary and the banal.

Reason dictates the necessity of having two classes of announcers at each studio, the one class to serve the general lecture material and the other class to give more gracious administration to the musical announcements. Those of the latter class do not need to be professors of the art. They should simply have had musical experience and a rather firm foundation in musical terminology and analysis. The practicability of this procedure has been beautifully demonstrated by one New York studio, which happily employed a man with some musical vision and the rhetorical power to make the subject of absorbing interest to the lay mind. His interest-provoking sketches of opera stories and the motives that brought the various musical themes into existence have made him an important figure with the musical bourgeoisie. He has made himself a valuable acquisition to the studio where he is employed, and the success of his work proves that announcing is more than a mere matter of telling the radio audience what is going to happen next.

"You have just listened to," and, "The next number on our program will be," practically sum up the stock of phrases used in the majority of studios today. Dreary reiteration lies over the best programs

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like a soggy blanket. It has a murderous influence on the imagination of the listener, reminding one of the monotonous introductions used on the old-fashioned cylinder records of the phonographs. The veteran listener can anticipate every word. Announcing, to be interesting, must carry with it the power to illuminate, to amuse, to visualize, to give sympathetic understanding and insight. It should have the power to make the invisible listener more of a part of the performance, to create an illusion of intimacy. A good announcer, an announcer with personality and the ability to express himself in pleasing fashion, adds strength to the bonds between the listener and the studio. It comes within the scope of his activities to lift an otherwise meritless program so that it will command the interest and respect of the most critical listener. In short, the announcer is far more important than he is thought to be; broadcasting will never reach the higher levels of artistic presentation until this fact is recognized and digested by those who are responsible.

Not a few of the present brood of announcers strain themselves to be funny, and as a result they pun awkwardly if not pitifully. The man who cannot tap his humorous vein without giving evidence of the painful process of extraction will do well to remain at a safe distance from the microphone. The

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microphone, it must be recalled, is a sensitive betrayer of sham and insincerity. It reveals truth with unmerciful accuracy. A lame humorist is given no more opportunity of fooling his audience than when he is on the stage of the legitimate theater. The consistent practice of attempted humor in announcing is tiresome and boring; not one man in a thousand can remain fresh and interesting. Of course, an announcer may at times be adroitly facetious or plainly humorous with beneficial results, but if he is imposing any great strain upon his wit he sacrifices his naturalness, and this is usually fatal.

Affectation is another fatal mistake made by overly ambitious announcers who labor under delusions. Some of them seem bent on conveying the impression that they are of the higher intelligentsia, and they adjust their voices and pronunciations to meet their ideas of the élite. This procedure is totally disastrous, for the announcer eventually becomes an object of ridicule, and his moral defeat is reflected upon the studio to which he is attached.

All but a surprisingly small number of studio announcements at present are unromantic preludes, with no warmth or life, and just as mechanical as the machines that bring them to the offended ears of the listeners.

Otium cum dignitate is the three-word rule that

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announcers will do well to follow. Of course, it is possible to carry dignity far beyond the limits of ordinary conduct. This reduces announcing to the plight of a mere sham, and it creates at the same time a cold atmosphere about the microphone, which makes the listeners feel that the whole performance is foreign and unfriendly.

There is nothing quite so lamentable as the recited announcement; that is, the announcement that is carefully penned and rehearsed before the performance. When such announcements are being read one can almost see the author biting the end of his pencil and running his hand through his hair in the throes of composition. Such a recitation is instantly detected by alert listeners.

The necessity for incessant announcing from a radio studio makes this part of the program one of the most difficult to handle if it is to be kept within the limits set by an intelligent consideration of the requirements. Repetition is a positive and dangerous enemy of entertainment; if announcing is not prevented from becoming a singsong heralding of program numbers, obstacles are bound to be placed in the path of an otherwise smooth-running course of events. The damage is subtle in that people find themselves becoming dissatisfied with broadcasting without knowing the real cause. Monotony is poi-

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son to many; whether they are aware of it or not, they seek to avoid it.

The annoying appeals for mail at the termination of each radio feature are a mark of immaturity that makes the struggle for artistic presentation more difficult and progress less perceptible. The sin would be forgiven were it not for the fact that the practice is virtually unavailing. An obstinate audience cannot be made to applaud under protest. If it likes a program and feels like expressing itself, correspondence of appreciation will be forthcoming in abundant quantities. It is not pleased with the presentation, it will be found quite immune to the most impassioned appeals. This very fact has been proved by the broadcast audience of the Capitol Theater, New York. This audience has never been asked to express its opinion, and yet it floods the offices with as many as twenty thousand letters a week. This is normal expression; coming without solicitation, it proves that a program stands or falls on its merits just as other types of entertainment.

Appeals for correspondence cheapen broadcasting. Anything that cheapens broadcasting without helping it in any way is a heavy liability indeed; it is a liability that broadcasting cannot afford to carry. The request for mail made by the flattering announcer may console and please a conceited per-

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former, but it cannot help broadcasting. The mailing of words of appreciation will always remain voluntary regardless of the efforts of obliging announcers.

A practice more obnoxious than this is that of asking for telephone calls and telegrams with the promise that names and addresses will be announced. It affords the vain listener the pleasure of hearing his name exposed, and although this airing of the cognomen means nothing to the thousands who hear it, it appears to afford the willing sender of the missive a thrill. Yet it is disgusting to listen to the roll-call of a long list of John Joneses and Mary Smiths who consistently maintain that the "program is coming over fine," and to "please play so-and-so." Not a few broadcasters are guilty of this misdemeanor that so effectively crushes artistic values.

The reading of these personal communications should be construed as point-to-point communication, which is strictly beyond the legal boundaries set down for broadcasting stations. Such practice could be easily prohibited by the proper procedure on the part of the Department of Commerce. Its elimination would be an important step in giving broadcasting as a whole the final polishing and leveling that it so badly needs.

There is still another highly objectionable prac-

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tice, which, like the appeal for communications, comes only from the less desirable sources. Those who are sticklers for dignity, for the establishment of a polite atmosphere in the appalling void from which the waves come, cannot help but feel that every studio radiates a sort of personality, be it good or be it bad. The esthetic soul is invariably annoyed to hear the insipid clatter of applause made by stragglers in the studio at the end of a rendition. Here, too, is a mark of imperfection that is certainly fatal to dignity and poise. A discriminating observer cannot help but think that it puts the "dollar ninety-eight" placard on the whole performance, so successfully does it shatter regulation and smooth operation. It is usually followed by chatter and laughing, which effectively lend their aid in the destruction of all that is essential to the best interests of propriety.

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CHAPTER II

PROGRAMS AND THE IMPRESARIO

THE architecture of program construction is perhaps the most sadly neglected phase of broadcasting today. In fact, broadcasting will never emerge from its swaddling raiment until program building is rescued from the innocent though destructive hands of the studio stenographer who works with no guidance but the empty spaces in her always-ready date-book. Programs, strange as it may seem to the uninitiated follower of radio, are constructed solely by chance, not design. There are no science, no system, and little judgment used in the assembly of a list of events that may reach the ears of hundreds of thousands of people. It seems that the proper balancing of program cards is something our studio managers have failed to recognize as important. One cannot help but wonder when broadcasting will be able to claim a genius who will fabricate a program with the deft deliberation of a seasoned impresario. Such a man must be able to distinguish between head and

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tail, climax and anticlimax, for the diligent listener has yet to expose his ears to a flow of entertainment wherein the first could not perform the function of the last safe from detection. The rankest kind of a ten-twenty-thirty melodrama always manages to dispose of its villain in the last act, and the slapstick movie invariably ends with the pretty city girl sitting on the lap of her fervid country lover, but radio programs can boast of no set construction. They are aimless and wandering.

Day after day, night after night, one can search the voids of space, hoping to find something that could be taken as an indication that radio has discovered a new genius who will do for this naked art what other men have done for the moving-picture art. There was a time when the art of moving-picture photography had outgrown the art of presentation, and true gems glistened on the screen only to have their beauty smothered by their grotesque surroundings. In the same way the purely technical advances of radio appear to be feeding the dust of the highway of progress to the more backward and totally unorganized method of presentation. This, it seems, merely amounts to rounding up available material and listing it in the most thoughtless manner. In fairness to a few broadcasters who are more than dimly conscious of their obligation to the lis-

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tening public, the authors do not wish this to be taken as an all-inclusive indictment; but it is safe to say that it includes at least 98 per cent of our studios.

If there is anything that guides our studio managers at all in the choice of program material, it is correspondence from listeners. Now, true public opinion has never been reflected by correspondence. Where is the successful newspaper that has permitted its readers to dictate its policy? Where is the successful magazine with an editor so dense that he finds it necessary to call upon his readers to help him out of his dilemma? Most important of all, where is the theater that has left the choice of the material it offers to those it seeks to amuse? The vital problem of selection is always left to a man who, through experience (and oftentimes without), is able to understand the peculiar tastes of a certain class of people and who straightway builds an editorial policy or a program which will interest that class. He does not set out to interest the entire country. There are few things in this world that can bear the stamp of universal interest; no task is more impossible than that of finding a universal anodyne in the way of entertainment. Class tastes and class peculiarities reign supreme. The successful impresario must first select a class and analyze

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its tastes if he is to sip the sweetness of lasting achievement.

It is plainly evident that our broadcasters will never perfect their art by listening to the whines and whims of their listeners. The following of such a policy is a sure destroyer of initiative, which is something that correspondence cannot supply. Readers are not going to suggest new program stunts and experiments; these things must be left to the studio manager. However, if the managers are victims of a false sense of duty well performed, we cannot expect them to rally to new impressions and suggestions. Perhaps five thousand of their listeners express satisfaction with their programs. This is invariably taken to mean that something very near perfection has been achieved. Nothing is thought about the other ninety-five thousand listeners who did not write.

Our broadcasters still permit post-cards to guide their actions, and the folly of their unplanned procedure is reflected in their programs. Even a superficial examination of the daily offerings is sufficient to convince one of the truth of this statement. Not one distinguishing mark of character will be found, so completely are the cards tarred with the same stick. Anything that might be recognized as individuality is totally absent, a fact that proves that very

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few of our studio managers have either the courage or the knowledge necessary to forsake the hard-beaten path of broadcast ritualism. Indeed, the mirage of correspondence is so completely deceiving that it is one of the worst evils with which broadcasting has to deal.

A few words about the experience that one of the authors has had with broadcasting a varied musical program from the Capitol Theater, New York, through Station WEAF, may serve to illustrate the point in question. There is no intention to intimate that his series of Sunday night performances meets even in a small way the requirements of the perfect program. In fact, this is quite beside the question. The studio program of the Capitol Theater was designed to meet the approval of a somewhat definite class of people in the middle walks of life who loved good music. Little attempt was made to appeal to the less serious music listeners with more unstable and fickle tastes leaning toward the newer creations and offsprings of the musical art. This visualization of the class to be reached was maturely considered, and the program was constructed along lines designed to satisfy the largest possible number of people in this class.

An incessant flow of mail in appalling measure,

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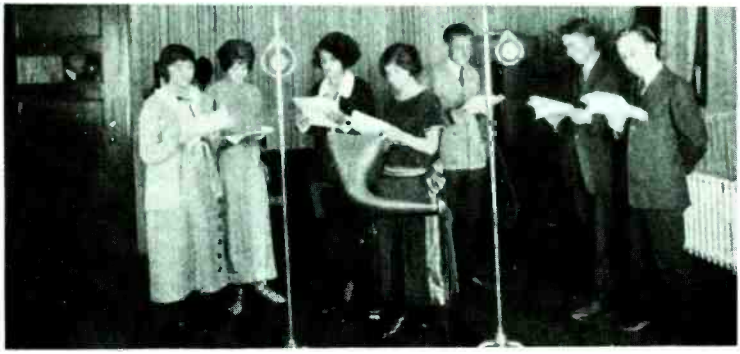
A tragic moment in an invisible drama ("Pierre of the Plains"). Pierre has been fired upon and falls in what are supposed to be dried leaves. The ear-illusion for the crushing of the dried leaves is supplied by the crumpled paper. As the story goes, Pierre has been feigning, and he grapples with his assailant. The noise produced by the paper is picked up by a special microphone on the floor.



A rehearsal of the radio drama by the WGY Student Players conducted before the microphone. The voice is carried to an adjoining room where the director, Edward H. Smith, with head-phones on head, listens to the lines. The loud speaker in the foreground enables him to direct the players from the room, making suggestions as to increasing the volume of the voice, standing closer or farther from the microphone.

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Part of the properties of an invisible theater. This shows the various bells and alarms as well as the dummy door used in WGY dramas.

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mail so vast that the bare problem of opening it is a troublesome expense, has come as a result of this attempt to please a definite portion of the listeners of the East. Although the mail is appreciated, read, and filed, its tenor does not exert an influence upon the general scheme of program assembly. Persistent appeals that express the desire to hear certain favorite numbers are sometimes honored providing the number in question has not been heard too many times from the source under discussion. If every one of these desires were fulfilled, there would be no occasion for the constructor of the program to use his own judgment, and his program would be the muddle that might be expected as the product of a number of minds working independently. A single individual must always be the generalissimo of any radio class. His authority must be complete, his choice unquestioned. An audience should never be trusted with the problem of pleasing itself; this first element of showmanship, which, summed up, is nothing more or less than a sympathetic understanding of the likes and dislikes of a certain class of people, should be the guide of our impresarios who believe that every evidence of both their crimes and their successes are to be found in the mail.

The growing banality of broadcasting cannot help

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but wound the appreciation of intelligent listeners. The monotonous repertoire of the hurdy-gurdy is not such a far cry from the singsong course of events offered by our very best microphones. Those who crave the bizarre, the exotic, or just the consistent flow of good entertainment, unhampered by the repetition of too many "favorite numbers," often find broadcasting a barren source of inspiration. No apparent attempt is made to appeal to the human emotions, and the problem of arrangement is dismissed without thought for what might be called the emotional polarity of the material offered. So Mary Smith, soprano, follows Bill Jones, parlor-made barytone; lecture follows lecture; and orchestra follows orchestra. No effort is made to shock the listener mentally.

Like a number of other evils that feast on the body of broadcasting, program building is also subject to the bad influence of too many studios and too many empty date-books. Yet it is not fair to place full blame for the inequalities of programs upon this single bad feature.

One cannot believe that broadcasting has spent its final effort at perfection and that we are now looking upon the finished product. That is a revolting thought when the stupendous possibilities are maturely considered. If our studio managers would

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but wake up to a number of points that are still left for exploitation, an inestimable amount of solid good might be done. Take science, for example. No honest effort has been made to dwell upon its human side. The poetry of the masters has been left practically untouched, and a spasmodic book review by a capable critic is an occasion for celebration. Lectures by explorers and adventurers are things to marvel at. A program is seldom put forward that is not lopsided with music.

At the present time there are two changes that would rescue broadcasting from the shadow of disaster and place it on the substantial footing that it deserves. If half of our better studios would cut down their broadcasting time and concentrate more upon quality than upon quantity, a very pleasing result would be the outcome; for nothing will so effectively purge broadcasting of pestiferous features and solidly intrenched monotony. The second change, and one almost as important, would be that of converting some of the studios to a class basis; that is changing the nature and arrangement of the material so that a definite class of people could be catered to. This is not an untried experiment, and the Capitol Theatre audience is not the only example that may be cited. There is a studio in New York that specializes in light music, and the younger ele-

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ment, with the less serious of the older element, naturally find themselves in accord with the programs. The writers know of no other audience that would fall so completely into the channel of close classification.

A school-boy can see that it is impossible to make up a universally interesting program, but that is the very thing that practically all of our studio managers are trying to do. They want to please the world at large, and the ambition is slowly stifling broadcasting with similitude.

Specialization on the part of a large number of our broadcasters is a needed departure that would snatch broadcasting from the humdrum path and place it on an equal footing with the theater and the magazine in range of appeal and breadth of entertainment.

The opportunities for specialization are not only numerous but positively alluring. Take the matter of sport, for instance. Here is a field that lays claim to the interest of millions of Americans, and a station devoted whole-heartedly to the subject would find itself vastly more popular than it could ever hope to be in competition with hundreds of other broadcasters jogging along the same highway. Nor would it need to broadcast every night in the

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week to maintain its dignity and influence. Perhaps it could give a brief résumé of the events of each day, with three full nights each week given over to a discussion of the most important happenings in sportdom. Such a station would soon establish authority and hold a unique position in a field of the art.

Stations devoted to the interests of women, jazz, chamber music, or science would soon build up a clientele of listeners who would find the things that they were most interested in. The purely cultural side of broadcasting would also be advanced from a position of uncertain value to one capable of definite measurement. Instead of all our broadcasters trying to do precisely the same thing in precisely the same way, half of them could be releasing special material that would not only bring them lasting honor but also serve the needs of civilization to a greater extent. Individuality in broadcasting, now crushed to earth, would rise for the first time, and the Colossus of radio would at last have the opportunity of demonstrating its strength. Instead of every broadcaster trying to do the impossible by trying to please everybody in the United States, classes would be recognized and appealed to in such a way that the stations following the special lines of broadcasting

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would have a far greater list of listeners than they now boast of. This plan is so sane, so logical, and so necessary to the requirements of intelligent broadcasting that it is little short of tragic that it has not been carried out.

Not a few of our broadcasters injure the esthetic and practical value of their programs by burdening them with too many "regular features" of doubtful value and small range of appeal. This is usually the result of mitigated effort if not of actual listlessness in the manner of assembling the material. The juvenile follower of the bedtime story has dozens and dozens of ambitious narrators to choose from where one good one would serve the purpose and release the remaining stations to exercise their waves in disseminating other material. There is a similar evil in broadcasting baseball scores; countless studios enter into unavailing competition in making known results that are identical, regardless of the individual engaged in giving the information.

For some unknown reason, the great majority of our studios are unduly conscious of their neighbors' success and well-being. So keen is the feeling of rivalry that it has baffled the efforts of the more broad-minded managers who have attempted to bring about coöperation. It seems that the plight of broadcasting as a whole must always remain a

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consideration secondary to the interests of the individual unit. A national association of broadcasters was formed, but the little energy it had was spent to offset the legal demands of certain song publishing houses who held that broadcasting must pay for the right to use protected ditties.

In the larger communities like New York and Chicago, there is not only the opportunity but the actual need for the studio managers to enter into some sort of a pact for the intelligent control and regulation of program construction. A few thoughtful conferences between those in authority biweekly or monthly would oil the machinery of radio with sympathetic understanding and concerted action. But selfish desires now rule with discouraging tenacity, while broadcasting struggles to hold what little prestige it has managed to develop in the minds of the listeners.

In the early history of broadcasting, a few of the managers located in greater New York used to meet in conference, but the outstanding purpose was that of seeing how much time each one could obtain for his own use, while the vital issues that affected the general standing of the art were left untouched and undignified by even the most superficial reference.

During the summer of 1924, WJY, the broadcasting studio of the Radio Corporation of America and

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the sister studio to that pristine broadcaster WJZ, thoughtfully put forth a new form of entertainment suggested in the "Last Night on the Radio" column conducted by one of the authors of this treatment in the "New York Herald-Tribune." The article that was responsible for this experiment follows:

Two years ago there was a strange fascination to the adventure of radio; it held one under a pleasant spell. It brought to every idle pilot of the knob, the thrill that comes to the voyager or explorer seeing for the first time an enchanting vista in a strange land.

There were flowery valleys and mountains blue,
And pastures and herds galore,
And fruits that were luscious to bite into,
Though bitter at the core.

Broadcasting to-day is stark and forlorn of thrill except for those who have been total or partial abstainers. The shell of the veteran listener grows harder and more impenetrable. Broadcasting appears unable to escape the similitude that threatens to lead it into a ghastly, agonizing quagmire.

Something daring must be done to avoid disaster. A number of simple expedients suggest themselves. One of our local stations could well try the experiment of using programs that run two or possibly three nights. Of course, such a program would have to be assembled with care, and it would call for all of the genius available in the broadcasting art. Conventionalism would have to be routed, and there would have to be some sort of continuity and schematic arrangement. Let us, by way of argument, assume that WJY has

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taken upon itself to broadcast for three nights a "Shakespeare Radio Revue"—something aimed at the middle-brows.

Appropriate musical introductions are plentiful; excerpts from the operas "Romeo and Juliet" or the "Merry Wives of Windsor" for instance. This might be followed with a brief controversial lecture, "Francis Bacon or William Shakespeare?" More music followed by a eulogy to Edwin Booth (which would be gladly arranged by the Players' Club) would tend further to cement the thing. Then a bit from "Macbeth" or "Hamlet" by a capable amateur or a condescending and benevolent professional would bring the full spirit of Shakespeare into bloom. The more beautiful musical passages from "Othello" could be drawn upon to supply the inspirational material. A burlesque on the "Comedy of Errors" would not be entirely out of place nor would it be bad taste to treat other of Shakespeare's tragedies in a light, popular manner. More music and a grand finale by a man of Hackett's calibre would end an evening of genuine enjoyment.

"How silly to think of broadcasting the same thing for three consecutive nights from the same station," the more thoughtless observer might argue. This suggestion is not nearly as rash as it might appear. There is certainly no visible object standing in the way of its success. Who, for instance, would be silly enough to believe that every listener is stationed at his receiver every night? It would be safe to say that even a three nights' performance would not bring into the fold more than 80 per cent of the listeners within the range of the station.

The idea suggests an endless chain of performances each with the power to create atmosphere. "A Night on the Montmartre" or "The Life of Schubert" are random suggestions along the same line of thought. All of the great tragedies of history and the personal lives of great men can

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be dramatized for radio in a most agreeable fashion. Of course, these things cannot be done by sitting in an office waiting for applicants to fill a date book.

The officials of WJY announced their plan with a letter sent to the various newspapers, over the signature of Stuart Hyde Hawkins, Broadcast Central Representative, Information Bureau. A copy of this is presented herewith:

Station WJY will present a new and heretofore untried form of broadcast entertainment during the week of June 16-22. The week will include four evening performances which, for lack of better term, have been styled "Omni-Oral Production." Each performance will be of two hours duration, the invisible curtain rising at 8:30 o'clock on Tuesday, June 17th; Thursday, June 19th; Friday, June 20th; and Sunday, June 22nd.

The basic principle of the "Omni-Oral Productions" is to give a radio performance which is a unified whole, in which each act, although complete in itself, is an integral and coherent part of the entire performance. While the "Omni-Oral Production" is primarily designed to please the listener who tunes to WJY at 8:30 and remains so tuned until the conclusion of the program at 10:30, each act is in itself as fully attractive and entertaining as any features of similar nature on present-day programs.

Each performance will open with an instrumental overture, allowing the invisible audience a "tuning period" of five minutes. Next will come a prologue, appropriate to the general nature of the evening's production and explaining the locale of the acts which are to follow. Then come the various episodes which comprise the evening's performance, each of

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from fifteen minutes to a half-hour duration, each one varying from its predecessor in type but dovetailing in atmosphere and color with all the others. To the announcer will be assigned the responsibility of creating the mental picture scenery which will aid the listener in "attending" the new type performance.

For the week of June 16-22 the following productions will be presented: Tuesday, June 17th, "A Night with the Conquistadores"; Thursday, June 19th, "A Night Out of the Past"; Friday, June 20th, "Sport"; Sunday, June 22, "A Night at the Opera."

This was perhaps the most daring and at the same time the most commendable move ever made by a broadcaster. It was a bold thrust at that arch-enemy of entertainment, similitude, since it had for its objective the creation of a form of amusement distinctly individual and pleasantly edifying. A further letter signed by the same member of the staff of this station is also interesting, since it outlines in a brief way the results obtained by the initial efforts:

In much belated answer to your letter of June 30th requesting information concerning the special programs WJY had a few weeks ago, I am enclosing copies of the detailed programs for each of the four productions and will herewith augment aforementioned programs with a few personal ideas and observations.

As explained in the letter which I sent you in advance of the first one, "A Night with the Conquistadores," the fundamental idea of the innovation was to present the radio listener with something containing a greater percentage of

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imagination and consequently enjoyment than radio programs have heretofore offered. The first four try-outs were quite successful, particularly the latter two.

In the first production, "A Night with the Conquistadores," the attempt was made to create in the minds of the listener enough imaginative scenery to give a Latin American atmosphere. As you know, the music was all of Spanish characteristic, the one talk on the program was a Latin American travelogue, and the announcements were, in so far as possible, suited to the furtherance of whatever illusion the production was able to carry to the poor blind audience.

The second night, "A Night Out of the Past," was purposely designed to satisfy the great American love for sheer sobbing sentimentality and puerile pathos. Every moment of the evening was reminiscent in the most touching sense of the word, and no effort was made to bring back memories of the happier moments of bygone years. Quite to our amazement, the program received full-hearted and overwhelming approbation from that sentimental public which so applauded "East Lynne" and "Where Are My Children" a few years ago.

The third one, "Sport," was turned over, as you know, to Major White and resulted in being a very successful evening of the type which Major White first made famous in radio. The program was very well applauded by the radio fans.

The fourth one, "A Night at the Opera," like the first one, "A Night with the Conquistadores," was designed to please the better class of modern listener and from what we can gather succeeded very well. It was without exception a classical program, well adapted to the Sunday night standards of Broadcast Central, and did in our opinion, present the Omni-Oral Production in its best bib and tucker.

So successful were the four attempts that we have lined up a fifth Omni-Oral Broadcast which will be given on the

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17th of the month under the title "A Night in India," more of that to be announced later.

The reaction of the public seems to be that the Omni-Oral idea should not be presented every night, for there is still and, for all we can tell, always will be a great percentage of radio's charm in the ability to jump from station to station even though the jumps only be from one local broadcaster to another. However, once a week does not seem to be too often to force the new idea down the throats of the public, and their digestion seems to be perfectly capable of handling so limited a ration.

The details of the five programs, which showed a reasonable amount of taste and creative thought, are exposed below for laboratory purposes, since the serious reader may desire to have the full quota of information available:

PROGRAM FOR TUESDAY, JUNE 17TH, 1924

Station WJY—New York City, 405 Meters

A Night with the Conquistadores

8:30 P. M.—Overture—Thomas Clive's Fraternity Tango Orchestra.
8:35 P. M.—Prologue—by the announcer.
8:40 P. M.—Episode I—Tangos—Clive's Orchestra.
9:00 P. M.—Episode II—Spanish Folk Songs—Mildred Delma, soprano. Spanish Piano Selections—Vincent De Sola.
9:30 P. M.—Episode III—A Sunday in Caracas—Harry Chapin Plummer.

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9:45 P. M.—Episode IV—Mexican Compositions by Piedmont Trio.
10:15 P. M.—Episode V—Music of the Incas—Carlos Valle Riestra, pianist.
10:30 P. M.—Episode VI—"Bits from Carmen," sung by Glukerja Campanieskaja, soprano; Eumenio Blanco, tenor; Paul Morenzo, tenor; Francesca Catalina, soprano.

PROGRAM FOR THURSDAY, JUNE 19TH, 1924

Station WJY—New York City, 405 Meters

A Night Out of the Past

8:30 P. M.—Overture—N. J. String Quartet.
8:35 P. M.—Prologue.
8:40 P. M.—Episode I—"Songs You Know"—N. J. String Quartet.
9:00 P. M.—Episode II—"Songs of the 60's"—Royal Trio.
9:30 P. M.—Episode III—"Songs of the 90's"—Max Kalfus, tenor.
10:00 P. M.—Episode IV—"Reminiscences"—Geo. Laval Chesterton.
10:15 P. M.—Episode V—"Songs of 1900"—Temple Male Quartet.

PROGRAM FOR FRIDAY, JUNE 20TH, 1924

Station WJY—New York City, 405 Meters

Sport Night

8:30 P. M.—Overture—Café Madrid Orchestra.
8:35 P. M.—Prologue.
8:40 P. M.—Episode I—"Popular Jazz"—Café Madrid Orchestra.

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9:00 P. M.—Episode II—"A Sing-Song"—Dixie Stars (Bernard & Robinson).
9:15 P. M.—Episode III—"Three Miles Up," by Andree Peyree, holder of the World's Altitude Record for Women Flyers.
9:30 P. M.—Episode IV—"Popular Melodies"—Koty and Abrams (piano and banjo).
9:45 P. M.—Episode V—"At Home with J. Andrew White."

PROGRAM FOR SUNDAY, JUNE 22ND, 1924

Station WJY—New York City, 405 Meters

A Night at the Opera

8:30 P. M.—Overture.
8:35 P. M.—Prologue.
8:40 P. M.—Episode I—Incidental Operatic Airs.
9:00 P. M.—Episode II—"Operatic Bits"—Thomas Dunn, barytone; Elizabeth Gibbs, contralto; Pearl Miller, coloratura soprano.
9:30 P. M.—Episode III—"The Evening's Opera"—Thomas H. Cowan.
9:45 P. M.—Episode IV—"Il Trovatore"—
Leonora—Lilla Shepard.
Manrico—Franco de Gregorio.
Asucena—Jean Shanley.
Di Luna—Pasquale Romano.
Ferrando—Saverio Manghisi.

The possibilities of this departure are so enticing that the consistent application of the new formula would be a worth-while ambition for a number of even the best broadcasters. The experimental

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impulse has been so badly ignored in this great and new science that an original effort on the part of any studio is always a signal for the renewal of hope. Tremendous things, things that will do much to perfect and polish our civilization, lie within the power of the microphone; but they will remain undiscovered forever unless broadcasting attracts the genius necessary to exploit it.

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CHAPTER III

THE BROADCAST DRAMA: A NEW ART

IF there is one innovation in broadcasting that demands special treatment, it is dramatic expression. To look upon radio drama as even a mild contender for a position beside legitimate drama is quite useless, but this phase of broadcasting has so many interesting angles that one cannot ignore them without feeling that the general subject has been incompletely treated.

So successful have been the attempts to amuse the public by the broadcasting of invisible dramas that a special department has taken definite form, and studio managers have been forced to recognize public interest in something that at first received little serious thought. Startling as it may seem, we have in this country to-day several hundred thousand people who regard radio drama as a very definite part of their weekly amusement and who register their approval with its dispensers in great volume.

Waldemar Kaempffert wrote such an interesting bit about radio drama in the "Providence Journal"

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that the authors cannot resist the temptation of again putting it into print:

Every dramatist strives to make his audience part of the play if he can. Max Reinhardt does it by ignoring the stage as a stage and its special limitations. He has made [in "The Miracle"] a thousand "supers" bearing flaming torches rush through the audience and fling themselves upon the stage in a tragedy of Sophocles. Those who saw and heard "The Miracle" in New York were made to feel at one with the actors, for they were as much a part of the performance as if it had been a mass sung in a Gothic cathedral.

Richard Hughes, a British dramatist, has applied the same principle to the broadcasting of a radio drama which he wrote especially for the British audience. He felt that it was not enough to depend on yells, the crash of falling bodies, the insistent beat of rain on an imaginary roof to attain the realism he sought. The audience must feel what is going on, must be a part of the action.

Hughes wrote a special play the scene of which was laid in a coal mine. There had been a cave-in followed by an inundation of water. The play turned upon the situation in which a young woman and two men, who had been entombed and apparently condemned to a living death, found themselves. There was, of course, a rescuing party.

"The play to which you are about to listen," the announcer explained, "is enacted in the dark. Even if it were presented on a London stage you would see nothing. Therefore turn out all of the lights in your rooms. Listen in the dark. Imagine that you are in a coal mine."

So it happened that tens of thousands heard Richard Hughes' thriller in just the right gloom. From a battery of weird devices came every imaginable sound.

"The roof has fallen," shrieked the woman, and the audience

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not only heard her shriek but the fall of what seemed to be tons and tons of material. There was a steady drip, drip, drip.

"What 's that?" asked a voice.

"Good God! It 's water!" screamed one of the men. "We will be drowned like rats."

And the audience heard the dripping of the water; heard it swell in volume until it assumed the proportions of a cataract to their ears. There could be no doubt that more and more water was pouring in.

There were other realistic noises that must have curdled the blood of the listeners—explosions in distant chambers of the mine, the stumbling of the woman over blocks of fallen coal and the groans and moans of the men.

Here is a remarkably vivid record that at once impresses the reader with the unexpected realism that may be constructed with homely sound-making devices and an ingeniously fabricated plot. Hughes, to whom Kaempffert refers, has taken the position of a pioneer radio dramatist, and he demonstrates a remarkable aptitude for the work if we are to judge from the description of his effort. First, he recognizes radio's greatest weakness, the total blindness of the audience. The simple expedient of asking the audience to imagine itself in a coal-mine must have been acutely effective when aided by the dark rooms. "The audience has no eyes," reasoned Hughes "and I shall therefore seek its brain through the ears only." This is a fundamental rule of broadcasting.

WGY, Schenectady, has devoted itself whole-

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heartedly to the perfection of technique in radio drama, and as a result of this effort it has established itself firmly with great numbers of rural listeners who do not have the opportunity of viewing dramas in material form. A special company of amateur and professional talent has been assembled, and the various plays broadcasted are rehearsed faithfully before they are considered sufficiently polished for microphone presentation.

The writers have attentively followed a number of plays broadcasted from WGY, and they feel free to admit that the professional atmosphere created through the mere agency of voices and other sounds adds a miraculous chapter to the history of dramatic expression. Still greater things may be reasonably expected, for the new art is too young to have afforded much time for the development of the little niceties and the finer details of presentation that will only come with time and experience.

The plays used have been taken largely from the legitimate stage and adapted to the requirements of radio transmission. Not a few of them have been among the Broadway successes of a few years back, while several have been prepared especially to meet radio conditions. These, however, have demonstrated the lack of the professional touch and of the

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knowledge on the part of the authors of that which makes up dramatic situations of intense character. Of course, this is to be expected, for the remuneration involved has not been sufficiently large to attract the playwrights who have struggled through the long course of preparation necessary to meet the requirements of the legitimate art.

Since sound alone must be made responsible for the mental picture formed in the minds of the listeners, and since sounds other than those produced by the performers must be counted upon to carry continuity and action, a number of ingeniously simple contraptions for the production of ear illusions have been developed as part of the properties of the invisible stage. These devices lend color and realism; a performance unaccompanied by noises that indicate actions on the part of the actors and actresses or the behavior of the elements would result in a bare and somewhat unreal presentation. The roar and crackle of a great forest-fire, for example, has been duplicated by the simple expedient of a blow-torch aided by the breaking of match-sticks near the microphone. The psychology of the trick rests on such a firm foundation that one can all but sense the intense heat of a devouring conflagration. The lonesome patter of rain on a roof is reproduced

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by rolling dried peas down a paper tube. All manner of door-bells, alarms, and telephone-bells are assembled ready for use, and doors mounted in frames with locks are used to indicate the entrance of characters. The crushing of an egg-crate is a highly successful forced entrance, and a piece of card-board arranged to strike the blades of an electric fan causes airplanes to swoop down before the microphone.

The entertainment possibilities of radio drama are alluring, to say the least; there is reason to believe that the development of a very special phase of broadcasting is being witnessed in the efforts of WGY to bring this angle of the science to a higher plane of perfection. The following letter from W. T. Meenam, an official of Station WGY, gives a first-hand impression:

We have found that the radio drama is our most popular broadcasting feature. We base this conclusion on the volume of letters received from the listeners. This popularity is particularly marked in those parts of the country where the staged drama is not offered. It may interest you to know that one or two of the producers and some of the authors are coöperating with our station to the extent of permitting the production during the coming season of one or two plays prior to their casting for stage performances. They hope, by means of air production, to gauge the entertainment value of the play presented.

So far as we know our station was the first to attempt the broadcasting of drama; we know positively that we were

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the first to organize a company and to present the play as a regular weekly feature.

The first production was "The Wolf" by Eugene Walter. A day or two after the production we received a letter from a Pittsfield, Mass., resident informing us that he had received the play on a loud speaker and that the screams of the heroine in the climax of performance brought a policeman to the door to demand the cause of the family row.

This play, with its small cast, was so successful that Edward H. Smith was engaged to produce a weekly play with the assistance of a company which became known as the WGY players. This was in October, 1922.

Eighty-five plays have been presented in two seasons and the repertoire has included practically every type of drama from "Merchant of Venice" to a bedroom farce. The farce is sometimes weak, as the action is too fast and the situations too complex. Another type of play that fails via radio is the dual rôle play where the interest is dependent upon the audience knowing what the characters in the play do not suspect. Still another weak type is that in which a situation or climax hinges on—well, you might call it visual presentation. An example might be the scene in "The Thirteenth Chair" where the knife used in the first act to dispatch one of the characters drops from the ceiling and sinks into the table.

Our experience has shown that the best type of play is the melodrama and the comedy drama and these with small casts. It is difficult to put over a cast of more than six people, as you are almost sure to have two voices that reproduce very nearly alike, in which case confusion is sure to arise at the receiver end. By the exercise of a little ingenuity and the assistance of the engineering staff, WGY has been able to put over atmosphere by means of sound devices of many kinds. The obvious sound is not always best suited for

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radio. For example, a pistol fired near the microphone does not reproduce like a pistol shot. It has been found that a paper bag blown up and exploded by striking with the hand is better. The pistol shot causes blasting of the microphone. Other noises may cause distortion by overloading the tubes.

Care must be exercised in the proper placing of members of the cast before the microphone or one voice will unnaturally dominate the others. The women stand closer to the microphone than the men.

One of the most frequent criticisms of the plays is the interruption or intermission. The plays are broken up into acts as they are in the theater. Several have suggested that a play should run continuously until the end, that the experience is like having some one or several read a book. The continuous play might be desirable, but it must be a short play if it is not going to work an undue hardship on the members of the cast.

Among the plays presented have been: "Icebound," "The Passing of the Third Floor Back," "The Fool," "The Littlest Rebel," "Rollo's Wild Oat," "Here Comes the Bride," "Grumpy," "Shavings," "The Intimate Strangers," "The Traveling Salesman," "Pierre of the Plains," "Cappy Ricks," "The Green Goddess," "The Country Fair," "Daddy Longlegs," "The Man of the Hour," "The Hottentot," "Three Live Ghosts," "The Romantic Age," "Strongheart," "The Fortune Hunter," "John Ferguson," etc.

We foresee the time when plays written expressly for the radio production will be presented. WGY by means of a $500 prize contest endeavored to encourage the writing of the radio drama and had some small success.

On several occasions dramas have been broadcasted from the legitimate stage while being enacted before a regular audience. In cases of this nature, a

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drama must first be studied very carefully to see that it comes well within the limitations of what might be called absent treatment. Long periods of silence that cover action (the intrusion of a burglar, for instance) would be fatal to the illusion built up in the mind of the listener unless a very close and detailed description of the performance was broadcasted before it took place. This, however, is a haphazard way of overcoming weaknesses, since it almost completely destroys anticipation and suspense, the two forces that are largely responsible for interest. If a radio drama cannot stand on its own feet, so to speak, and convey to the listener a fairly tangible outline of its structure and continuity, its success on the air will be a matter of speculation. Experience has shown that a successful drama on the stage is not always a successful drama on the air. Of course, the shortcomings of any drama may be overcome for air presentation if certain changes and alterations are made.

The musical comedy is the very antithesis of the heavy drama, and its loose construction, unimportant continuity, music, and humorous dialogues and monologues give it a powerful status on the air. It all but lives a normal life, and but for the funny-faced comedians and pretty chorus-girls, the radio listener would enjoy the same privileges as the

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actual audience. The broadcasting of musical comedies and reviews from the stages of New York's best theaters has been a highly productive experiment in the interests of fuller radio entertainment, and the only thing that appears to militate against its continued use is the uncertain and oftentimes hostile attitude of unconvinced theatrical managers. Yet there is not a case on record where a broadcast placed any obstacles in the path of the box-office. On the contrary, noticeable increases in attendance have been traceable to the powerful interest-creating forces of radio; on at least one occasion a dismal financial failure was illuminated by the comforting light of more than mediocre success.

The success of a musical comedy broadcast depends in no small measure upon the alertness and personality of the person making the introductory announcement, for a vivid picture of the stage and the characters adds much to the pleasure of the optically helpless listener. Miss Bertha Brainard of the staff of WJY and WJZ has, through her sympathetic understanding of the requirements of this important function, earned for herself an enviable recognition as announcer for these occasions. Believing that the reader might be interested in knowing something about the elaborate preparations necessary for the

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successful broadcasting of a musical comedy, the authors prevailed upon Miss Brainard to write the following description, which clearly details the pertinent phases of the work:

WJZ of the Radio Corporation of America was the first radio station to broadcast a theatrical production directly from the stage. As long ago as 1922 a Broadway play was given to all parts of the country via the air, and as I arranged and introduced the first play and have been doing it ever since, I may be able to contribute a few facts on how we go about it, which you would be interested in knowing.

When a new play opens, the producer will telephone asking us if we are interested in broadcasting his play, which, he hastens to assure us, is the best and most musical put on this season. Our answer invariably is, "We will see the play and decide whether it has broadcasting possibilities." Then the publicity director of the play calls on us and gives us passes to the theater, and I see the performance. If there is no dialogue longer than four minutes between musical numbers; if the score is tuneful; if there is conversation between only a few characters on the stage at one time; if the action occurs down stage, that is, close to the footlights; if the lines are good clean comedy and the plot one which this station feels can be introduced into any home in the radio audience, we decide to broadcast. A year or so ago we broadcasted dramatic productions, but the wishes of our listeners-in and the advice of our technical department have convinced us that musical plays only are what we should broadcast.

After seeing the play I call on the producer, explaining how a wire will be installed in the theater leading directly to our station in Æolian Hall Building. Invariably he asks,

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"Will it damage my house?" When I assure him it won't, that we are permanently wired for all the big auditoriums, halls, and churches in the city, with never a casualty, he is pleased.

Next, the publicity pictures and notices for our radio announcements of the play are secured and released. The production's press representative arranges a meeting for me with the stage manager and the company manager and sometimes with the star. Without this important personage's sanction I may run into trouble, such as I met with when broadcasting a famous Shaksperian actor in one of his productions. The back-stage atmosphere of this particular company is a hushed one. Not a whisper is permitted between the actors, even before the curtain is up. Well, in this rare atmosphere, I "opened the station," as we say, beginning to tell where we were and what we were doing, when in deep rolling tones from across the stage the famous voice boomed: "Stop that talking. You can be heard out front." We proceeded that night, but it taught me that the star must always be consulted.

The play that is to be broadcasted I see six or eight times. By then I know the situations, the cues, the lines, the time of the scenes, and the curtains almost as well as the actors—sometimes better than the stage manager. I once asked a certain director who had been with the play about four months, "Is that song in the first or second act?" and his answer was, "Hanged if I know."

Our next step is with the Western Union crew of about five men who run a wire to the theater from which we are broadcasting, securing permits from the city officials for certain installations when necessary. The operators who are assigned to this work also see the play and plan the placing of their microphones according to the action. One microphone is usually placed in the orchestra pit facing the leader, with another just above it resting on the footlight protection,

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facing the stage. Sometimes the transmitters are placed in the theater itself, on either balcony box. And I have known the men to take Mike out of his case entirely, suspend the remains on a piano-wire stretched across the balcony, and expect him to work from there. Transmitters are seldom placed on the stage proper, for a change of scene is sometimes made in thirty seconds, too quickly, of course, to remove any apparatus. The location of the microphones is carefully studied, and even then the arrangements may be criticized. Not so long ago we did place a microphone on a mantel in front of which a long scene was played, and on which a real clock was busily ticking. This ticking could be heard throughout the broadcasting of this scene. The next morning our mail brought a complaint from an irate listener that our carrier wave was noisy. He could hear it clicking regularly during most of the play.

The next step in the broadcasting is the radio rehearsal. All the apparatus is installed just as though the play were being broadcast, but instead of going "to the antenna" the entire production is put "over the line," which means picking it from the stage and sending it to the station only. Here the engineer in charge is listening carefully, noting his suggestions for more voice here, less drum there, cutting out reverberation, so that he may discuss it with the operators between acts. They carry out his orders and make the necessary changes. Sometimes the chief engineer is not satisfied until the play has been radio rehearsed three or four times.

The night of the actual broadcasting two operators arrive with their portable amplifier, which looks like a glorified, illuminated suit-case when it is opened. This is installed on a table on the prompt side of the stage, or as near to the stage manager and his signal-board as is possible. A microphone is placed there for me, an electrician sees that I have

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my individual stage-light, and Props finds me a chair. Occasionally the engineers have sprung a surprise on me, changing our prearranged location. One evening I arrived at the theater to find we were installed way up in the flies, necessitating my climbing iron ladders and crawling over scenery to reach my microphone. Sometimes the crowded condition of the stage necessitates our setting up in the basement just underneath the orchestra pit. Occasionally we have been given a "greenroom" where only the star and important stage officials were permitted to enter.

If the play has an 8:30 curtain I usually get to the theater about 7:30 and make a final check with the stage manager on the time he is sending in the orchestra, ringing up on the first act, ringing down, beginning the overture for the second act, and many other things.

Around us the stage crew are sweeping the stage, scenery is being lowered from the flies, flats are being pushed into place and bolted down; the electrician tests his switches; it is all movement yet no confusion. The actors are in their dressing-rooms making up, but they will all be down a little early to hear what I have to say about them, and usually some late-comer asks, not once, but at regular intervals, all through the evening when he is off stage: "Did you mention my name? Some friends of mine out in—" etc. If she is cute, or he is good-looking, I tell them to wait and hear me sign off. Then I repeat their names, and they are all smiles. Their friends out in Oshkosh will know they are on Broadway.

And so, surrounded by the principals and a bevy of pretty little chorus-girls, we hear the control operator at the studio say, "You 're on the air." My microphone is opened and I "take the air." If the overture is sent in at 8:25 I time my introduction so that I will finish just at that moment. My last "Station WJZ" is a prearranged signal for the stage manager, who is at his board, hand on the switches. My

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microphone is closed; the stage transmitter is open; the music begins; the play is on.

As the play proceeds, many funny events take place. Sometimes the manager requests us not to let the girls listen with the head-phones, for they become so engrossed that they miss their cues. At one production the entire stage crew went across the street from the theater to hear their own play on a receiving-set located there; they were having such a good time listening in that they failed to reappear in time to strike the set for the next act. At one theater the crew had their receiving-set up in the flies. Here they all gathered to hear the play by radio and to watch it taking place on the stage below. One chorus-girl of this same production insisted on shouting, "Hello, Mama," into the microphone as she danced across in front of it, when that transmitter was closed and only the orchestra, playing full blast, was being broadcasted. Another young lady almost wrecked our entire performance; hearing her cue through the head-phones she was wearing and forgetting to remove them, she endeavored to dance on with the phones tied to the amplifier.

Broadcasting a production apparently revives the interest of the entire cast in their own play. At one production which had been running for about six months, I saw the actors rehearsing their opening scene to make sure they had the lines down pat.

I, too, had some exciting experiences back stage, not the least being when I was called upon to go out front myself and tell the audience just how we were broadcasting. Grasping a microphone in one hand and the star in the other, I endeavored to tell them what we were doing, and in the telling shook before that few hundred people as I never have before the many-thousand-times larger audience which we reach through the microphone.

At the conclusion of the play, as the final curtain rings

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down and the audience straggle out or rush for their Jersey trains, I again "take the air." At my closing "WJZ" the operators have half the equipment packed. Microphones come out with surprising speed, considering the time and labor it took to install them properly. By the time the stage cloth is laid, the operators are ready to leave.

And we are all rather loath to go. The odor of the grease-paint, the color, the lights, the excitement, all have their fascination. Engineers, operators, announcers all love the theater broadcasting. Some day we shall undoubtedly lose a brilliant engineer when he joins the ranks of the actors; or some dazzling musical comedy star will be dragged from the stage before she has reached her zenith, to be the bride of some member of our technical staff.

But I shall, I hope, continue to broadcast plays directly from the stage as long as those who listen in enjoy having them on the Radio Corporation of America's program.

A rather amusing though abortive experiment was recently carried out in England when George Bernard Shaw read one of his plays, "O'Flaherty, V. C.," into the microphone. Mr. Shaw obligingly changed his voice for each character, but the effect was droll and uninteresting. Thus, no less a person than George Bernard Shaw has proved the inadvisability of presenting a one-man play with ventriloquist effect.

There are many other considerations that must be put down in the rules of technique for the broadcasting of dramatic material. Impersonation, dual personalities, and other little tricks of the drama-

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WGY's dramatic director, Mr. Smith, at the telephone. At the left are two stages of amplification, one stage to amplify the voices from the studio for reception on the 'phones and the second stage to amplify the voice of the director which reaches the players through the loud-speaker.

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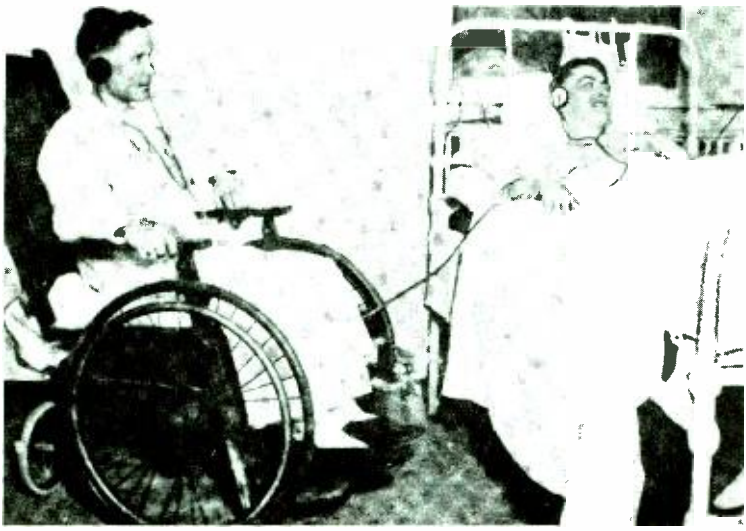
Two photographs after they had been transmitted a distance of eighteen miles by the Jenkins television apparatus.



The human side of radio in a hospital where the inmates call their radios their "Roxys."

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tist are practically ruled out; when these are introduced, the plots become so intricate and difficult to follow that the listeners are soon engulfed in a maze of misunderstanding. For instance, a play like "Charlie's Aunt" would be hopelessly impossible to broadcast, as would plays having to do with a great lapse of time when the characters grow old. No one, for instance, can visualize a character getting old without a change in voice if realism is to be preserved. Yet if the voices of the characters were changed trouble would develop in distinguishing them in the latter part of the play.

It is regrettable that some one with a fair knowledge of Shakspere has not undertaken the task of producing some of the best known of Shakspere's dramatic works in a manner suited to the needs of the average listener. If properly handled, such material would be fitted to the needs of broadcasting, not only on account of the beautiful simplicity of the plot but of the small number of characters required. Shylock, Othello, Macbeth, King Lear, and many others could be brought to meet the most exacting requirements of radio drama as we know it to-day.

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CHAPTER IV

THE HUMAN SIDE OF BROADCASTING

THERE is a deeply human side to broadcasting that cannot help but reach far down into the conscience of an impresario fortunate enough to win public acclaim. The searching nature of radio makes this so; radio is a magic fluid that finds its way into every crevice of human life. At the same instant it is seeking out the little family group in the cabin of a snow-covered sand-barge wintering in the dreary North River at Hoboken as well as those who are lounging in the luxury of a Fifth Avenue mansion. The lonely souls in an ice-covered, wind-lashed lighthouse on the North Atlantic coast are fellow-listeners with the humble folk in the murky tenants of New York's lower East Side. The little farm-house nestled in the snow-clad hills of Maine, the lonely trapper of the silent Yukon, the patient sufferers on hospital cots, the meek inmates of alms-houses, all are reached by radio. To some, radio is but a small part of a racy life of varied sensations, but to hundreds of thousands it is a great part of a

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life of spirit-crushing monotony. How apt the words of Byron:

> In the desert a fountain is springing,
> In the wide wastes there is still a tree,
> And a bird in the solitude singing
> Which speaks to my spirit of thee.

Radio is the great spiritual anodyne of the time. None but the hungry hearts that need it most can appreciate, even dimly, what it means. It is a new sunshine, a new hope in life, bringing with it immeasurable joy. It is all hopelessly beyond the understanding of the blasé who are bored by even the most sensational amusements that modern life has to offer.

One of the authors of this work will never forget the scene created by a deaf old man who found that he could hear broadcasting through the medium of ear-phones. At first he was mentally stunned; he could not speak, so appalling was the realization. Sound, music, voices, were penetrating a mind that had been accustomed to acoustic darkness and dead silence for years. As one looked at him one could almost see Nature providing him with a new countenance, the countenance that belongs to those who see and hear! His eyes filled, and great tears streaked down his wrinkled cheeks. It was too much for him, and the poor old soul sank into a chair quivering

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with emotion. "Good God!" he whispered, "I can hear it; I can hear it." There was not one in the party who was not moved to shed tears with him. Here was the human side of radio.

Radio has been no less than a godsend to the blind. It is one of a few precious pleasures that those deprived of their sight may share with their more fortunate fellow-beings. As a matter of fact, a blind person is able to take just as much from broadcasting as a person with full sight. Naturally, radio has quickly entered the life of the blind, and the comfort it brings cannot be appreciated except by those who live in eternal darkness.

Some hint of the depth of the human side of broadcasting—too worldly creatures can never hope fully to fathom it—can be found in the mail received at the Capitol Theater studio. Here as many as twenty thousand letters are received weekly, and what stories they tell! Here is one from a little mother on a barge in the North River!

We live on a barge, and I have to children. Well the little girl name is Margie and some time ago you said Hello Margie well my daughter said hello she says mamma he said hello. We enjoy your programs every Sunday night. And we all wish you luck on your trip and all have a nice time.

While it outlines a little incident dear to the heart of the one who wrote it, it carries no message of

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importance except when it is compared with the following note written on the gold-embossed stationery of a private yacht, with the insignia of a famous and exclusive club:

I want to express to you the pleasure and satisfaction I experienced last Sunday evening while aboard my yacht at Newport Harbor, listening to the excellent concert you broadcasted.

All the numbers rendered were good, and the tenor's singing I enjoyed very much. The entire program was a credit to you, and I know your host of listeners considered it an exceptional musical treat.

In the course of your announcements I noticed you seemed anxious to know whether the people were becoming tired of your concert on Sunday. I think I voice the sentiments of many thousand radio fans all over the country when I say it would be a great hardship to be deprived of this splendid concert which everyone eagerly anticipates each week. Therefore, I hope you will continue to broadcast your high class program which is so delightfully entertaining.

This is a mere study in contrasts, but what a convincing one it is! Could the universal appeal of radio be illustrated more effectively?

No letter of appreciation has caused more profound feeling and sympathy at the studio than the following one received from a bedridden soul waiting for the portals of eternity to open and swallow him:

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Dear Roxy:

If you can read this letter I will be glad. That you will understand it, I already know, for any man who gives of his time and talent to those whom the world has forgotten is raising a monument more enduring than granite.

I happen to be one of the victims of our late war with Germany, and as I lie in my bed with the ear-phones clamped securely in place, drinking in the remarks of the speakers and listening to the melody of the "Gang," I feel that although for me the war will never end until I am called before the bar, yet the road is made easy and pleasant, while I wait the summons to march. And so I thank you and your gang for the happy moments you give me, and I only wish that my thanks could take a more enduring form.

I have not long to stay. In the natural course of events I will take my place with those who have gone before and who have "flung the sword to those who can bear it." But while I am here I can smile and say with you, "God bless you."

ONE OF THE WALTER REED HOSPITAL BOYS,
Washington, D. C.

There is a haunting simplicity to this note. Who would not be thrilled at forming an invisible fellowship with a tortured soul like this? It is this sort of compensation that makes broadcasting worth the tiresome labors that go with it. It is response like this that makes every moment spent before the microphone precious and inspiring.

There is little difference after all between the visible radiations of the sunshine and the invisible though audible radiations of the broadcast transmit-

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ter. Each brings its message into the hearts of men, and each makes the burdens and vicissitudes of life, however arduous, easier to bear.

The uneventful and even tragic life of the lightkeepers is not beyond the power of broadcasting to offset, as this letter from the Cape Poge Light Station shows:

Dear Mr. Roxy:

If you could only see us here at the lighthouse, listening in to you and your artists, you would fully realize the pleasure and enjoyment we receive from your efforts in entertaining us. The cheer it brings us cannot be expressed. The radio has certainly been a God send to us here; otherwise it would indeed be a gloomy life. So please express our heartfelt thanks to the artists. We look forward to Sunday evening, knowing full well that we will have a treat. "Hail, Hail the Gang's all here." Keep up the good work.

From one of the radio fans.

LIGHTKEEPER,
Cape Poge Light Station,
Edgartown, Mass.

The following letter expresses beautifully one of the more significant services that radio is able to perform:

Of course, you appreciate to some extent what it may be for the small towner to listen in on the good things broadcast from New York, but you live within the immediate influences of Broadway and you cannot fully sense what it would be to be cut off entirely from them or to have never known them.

In a deep valley of the Blue Ridge Mountains of Southern

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Pennsylvania, between Gettysburg and the Maryland line, a young mother died and left a family of little ones in the care of the oldest of the lot, a daughter. She rose beautifully to the occasion, caring for her father, brothers, and sisters as her mother would, until at thirty years of age she had never been away from home, had never been out of the valley of ten miles in length by six or seven broad. And then one day her father prevailed upon her to ride with him to the top of a mountain that bounded one side of her valley, from which she could see other mountains, and yet other mountains, stretching away until lost in the blue haze of distance.

"Oh!" she exclaimed, "the world is bigger than I thought."

Her limit for the world was the top edge of the mountains that surrounded her little valley. There are thousands of others who are just as surely living within a Chinese Wall of limitations, although they may not be living within the confines of a remote valley in the mountains. They are living in such a way that the truly good things of the great world centers cannot filter through to them, pictures, books, songs, and music. To many such people the thing that you do for an hour or so occasionally comes like a revelation, and at the first awakening they are ready to exclaim, "I did not know there were such things." That is why I say you are doing more than you really know, than you ever can know.

Your program last night was fine and left nothing to be desired except some more of the same. Every one was just as good as if I could call them by name, and I hope they will, each one that took part, consider this a personal letter. As for you, keep it up, for you are certainly a blessing to your fellow men.

Little can be said about the influence of broadcasting in the lives of children until a generation or two has been raised under its régime. That it will

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affect destinies and build ambitions there can be no doubt. It is surprising to see the juvenile response in the mail. The following note is included to complete the series:

Dear Roxy:

We are two little girls age 9 and 11. We are cousins and we never fail to miss [?] your entertainment every Sunday night. We are writing you a letter to congratulate you on your most beautiful music. We never get tired listing. We both send congradulations to all the people you have in your studio. There is one man, we like much to hear, but we can't think of his name, but will explain as much as we can of him and then if you know who it is, you can tell him how we love to hear him sing. One Sunday he sang "Father's Whiskers," and last Sunday he sang a song but we forgot what it was, but we can remember him singing, "I came home so late I could n't find the gate." So hoping you will have a nice entertainment next Sunday, we remain,

Your two little friends,

ANNIE AND ANNA.

P. S. We live close to those poor boys in Walter Reid Hospital.

It is strange what warm friendships may be established with a means of communication no more tangible than ether. Yet hardly a day passes that missives delightfully interesting and intimate are not received. Here is one from the mother of a blind boy:

Myron has asked me to request you to have the studio orchestra play "Sleep" next Sunday evening if it is possible.

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He has been very ill again but has recovered and now has a boy friend from the Maryland School for the Blind visiting him and they are counting the days until Sunday to get your entertainment. No matter how ill the child may be, I have to get him near enough to the radio that he can hear the Sunday night concerts.

If the boys will play his request he, as well as all of us, will be very grateful.

It is interesting, too, to laugh with the more humorous members of your audience, for your mail takes in a wide range of motives and passions. The two letters printed below are delightfully entertaining:

Park Ave.,
New York City.

Samuel Pepys 260 Years Later

3rd. (Lord's Day.) Lay late but awake, thinking of all the disquiet in the world and that it do be strange that minorities do everywhere be in control. Up and to the Sunday papers all day but find in them but little to my content except the Herald Tribune cross word puzzle which I did pitch upon and do to my great content.

In the early evening did make adjustment of my radio machine, which methinks is the most wonderful invention I ever did see in all my life, and did again hear Roxy say, "Hello, everybody," and tell what was about to be broadcast, and my conscience do vex me that I never did write to let him and his gang know how keenly I do enjoy his concerts, though when I did dwell at an inn in Newark I once did write to Miss Mulholland in appreciation of her marvelous voice which do move me deeply, and I did have such an itch

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to see her from a near distance that I did go to a theater last Lenten time, to a midday service, for no other purpose—for which God forgive me—and did glut both eyes and ears.

This night I do enjoy hearing Miss Herbert, Miss Mulholland, and "Gambie" and all others in the gang and do find myself marvelling that Roxy has so greatly improved, not the character of his programmes—for that was always above criticism—but his method of announcing. So perfect was it all that I did almost think the voices did come from an adjoining room rather than sixty miles away for that I did listen in from Woodlawn Farm at Schooley's Mountain in New Jersey and my wife, poor wretch, was pleased too, though God knows she cares little for the radio.

After the concert we did fall to brave discourse about Scott and Yascha and Florence and Evelyn and Gambie and Daddy Jim and others of the long list of artists and of Roxy's noble work in behalf of our crippled soldiers and of the great hold which I do find he everywhere has upon the people and of his softly spoken, "Good night; pleasant dreams; God bless you," all very finely done and to our great content. So, to bed, where soon the yowling of cats did furnish a frightful contrast.

6th. Up very betimes and straightway to the obtaining of supply of White Rock, ginger beer, and Five Fruits against needs during the present hot spell and did carry it all home in my hand-bag of walrus hide, very hot.

Did lunch at home with my wife on club sandwiches and flagons of milk. Then abroad in a coach bearing the legend "20¢ a mile" to the Capitol Theater, being of a mind to hear again the music we did hear last Lord's Day by the radio machine and to see what we then could not. All very fine but the cinema play, a poor thing and poorly done, methought, but we did remain through it for that we were minded to again hear the music and were thrilled to see Miss

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Mulholland emerge from back stage and take a seat in the pit immediately in front of us, for which I did thank God, but she did not long remain. And again we did enjoy Miss Herbert's "My Hero" and Miss Mulholland's "Marcheta."

Then away home, stopping only to buy a news-sheet, which do say that cooling showers do be expected this night, for which we are thankful but skeptical.

Fell to discourse about the afternoon's entertainment and did both cry up the scene setting for "Song of India" and the singing of it by Douglas Stanbury as being very fine indeed and were of a mind that Roxy do provide a wealth of entertainment for but a few shillings. So to bed.

Deer Roxie:

i herd you apeel for lisners to rite you wheather they liked the sunday progrum an i gotta say that i done so as i better have my flours hear than hearafter i rite as soon as i can do so as i aint as mutch time as i had when i aint so got mutch.

Roxy i think i am going to pass out unsatisfied and wrestless if I aint herd you sing as i think you ote to have a fine voice that mite be hard to distinguish from stattix but like all things that are diffrunt and noval alwais give pleshure and if they are them as dont kare for it they can go eat there supper wile you are singin anyway i feel as if you ote to do it and if you want to make it reel good you an gambie could sing a choras

they was only one thing the mater with the sunday nite program and that was my company which i had just as i wanted to lisen and i culd hardly be ladylike til they went home and i didnt get to here mutch.

my doter and neece has just came back from new york and they visited your place twist and they ses that the

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orchestra is too loud for the singers as they could here the singers better at home then they could in the theeter.

the only thing i dont like about your progrums is the lack of lenth. the durn time is over before you get started. i like your selections which show taste and artistry and with good performes as you has they aint anything more any one could ask except more time. i thank you.

DEMOCRAT.

Washington, D. C.,
United States of America.

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CHAPTER V

THE NEW FORCE IN POLITICS

IT is natural that a universal thought-carrying medium like broadcasting should have a political significance and that the present and future body politic should be subject to its influence. Some insist that a new day in politics has dawned and that we are on the threshold of political regeneration. That may or may not be true, but even the avowed skeptic must admit that broadcasting holds within its fiber a new sort of political T N T with a composition so complex and mysterious, and with possibilities reaching down into such great depths, that changes of a serious nature are to be expected. No accurate forecast of the changes that broadcasting will effect in our political machine can be made now, but a few mild speculations may be permissible.

The effect of broadcasting on politics cannot by the wildest stretch of the imagination be anything but beneficial. Broadcasting has brought together the ears of the nation; any agency that can do this

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has become so important that even the press must take second place. The political stuff that resides in radio can be sensed by wondering what changes would have taken place in the course of the French Revolution had Robespierre or Danton been able to hold the ears of France with a radiophone. A more modern example may be found in the case of Russia. What might have happened there had the subtle agents of Czar Nicholas found themselves in possession of a thought channel leading to the simple minds of every Russian peasant? The importance of mass communication has not yet been measured in terms of politics. The least our sane politicians can do is to stand in awe of it until its full possibilities, dangers, and benefits can be revealed by time and experience.

Broadcasting was experimented with politically for the first time during the campaign of 1924. The experiment was a cautious one, but its magnitude was much greater than had been suspected by the political generalissimos, who are usually incapable of sensing the more subtle forces at work in the political structure. No less than nineteen powerful broadcasters focused upon the Cleveland Republican convention, and there was not a nook or corner of the United States that was beyond reach of the convention waves. It was estimated that no less

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than fifteen million people listened to parts or all of the proceedings.

A feeling of utter impotence in the choosing of a Presidential candidate must have come over a large percentage of the more serious listeners. A personal investigation conducted by the present writers disclosed some important information in this respect, although it must be confessed that the small extent of the investigation was regrettable. About thirty people who had listened to the convention proceedings, either in part or completely, were asked to give their impressions. Twenty-two of them expressed regret that they had not felt more interested and fourteen berated the political bosses who so often override the desires of the people. If this miniature investigation was at all indicative of the mental attitude of the millions who listened to the convention proceedings, broadcasting of the event planted a germ that may sometime burst out into a political epidemic of a new sort, in the form of a more equitable system of choosing candidates. It will be the natural demand of a people who have come to realize their political insignificance through constant exposure to events completely beyond their choice or authority.

It may be reasonably contended that broadcasting helped to defeat plans for a boss-operated con-

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vention at Cleveland. Partially invisible powers, led by the pragmatic Mr. Butler of the Coolidge forces, had decided upon Governor Lowden of Illinois as the nominee for Vice-President; the failure of Lowden to accept forced them to go to a second choice, wherein they failed ungracefully; on their third attempt to pick a candidate, the delegates bolted and nominated a man on their own initiative.

Was this sudden assertion of power due to the sad spectacle that every delegate must have known he was making of himself before the voters of the country and the people of his own territory? Could he feel the millions of ears that were listening to the proceedings in the great hall? The question cannot be answered with any degree of certainty, but it at least comes within the bounds of a reasonable curiosity.

The Democratic convention broadcasted from Madison Square Garden a few weeks after the Cleveland Republican convention could have done nothing more than emphasize the need for political reformation in the selection of national candidates. A long period of wrangling and a lamentable show of indecision made the affair a rather grotesque joke. The entire radio audience came to look upon it as a sad spectacle of politics; and towards the end little respect was left for the best of the followers of the

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Donkey. It was generally conceded in political circles that no little damage had been done to the Democratic party because of the virtual presence of the radio audience. Even the most forgiving Democrat would have had to admit that the demonstration in connection with several of the candidates could have had nothing but a harmful effect.

Much has been said about broadcasting the daily proceedings of Congress, but for some reason no steps have been taken to provide the necessary facilities, and a stimulating piece of broadcasting is going to waste. There is at least one delicate political aspect of the matter, and it is barely possible that it has been responsible for the indifference that has been shown. A Congress completely exposed to the country, a Congress that could not utter a single whisper, make a foolish remark or mistake in grammar, without being heard by millions, might be a trifle uncomfortable. Congress might also balk at the thought of having the constituents back home so thoroughly and minutely informed concerning the fulfilment of the promises made during the stress of a campaign. The dangers of great embarrassment that lie here might easily defeat attempts to make a national broadcast of the daily business of our chief law-making body.

The political significance of broadcasting the pro-

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ceedings of Congress is not easy to analyze, but it is not difficult to see that the result would be to foster more intelligent political action by educating millions of listeners to a fuller understanding of subjects that are now outside their range. As regrettable as it is, it must be confessed that we have several million voters in this country who have but a hazy notion of the functions of the congressman or representative they vote for. The intelligent exercise of political rights is a problem. The need of an educational influence to meet the situation is fully met by broadcasting. Of course, such an airing of official action may also encourage subterfuge and grand-stand demonstrations, but such action cannot go long without detection, and congressmen who would care to risk their futures by overlooking the dangers residing in the faithful microphone would be welcome to the chance.

Broadcasting the important actions of municipal assemblies would not only encourage cleaner politics but would arouse lethargic voters by making them feel that they had a part in the proceeding. There is a world of difference between a newspaper report, however faithful, and the living voice of radio. A delinquent citizen might glance througth a newspaper account of what would be a momentous proceeding of the local assembly, but he would dismiss

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the subject with little thought and certainly with no plan for action at the polls. Let that same man listen to the proceedings by radio and he might take an altogether different attitude. A sense of importance might come over him, for he could not help but feel that he was part of the political drama that was being enacted. Even the personalities of the office-holders would be sensed, and he might take a perfectly natural dislike to one or more of them. He might disagree with their arguments, or he might even object to the manner in which certain individuals would speak. Any one of these experiences would have more influence in bringing this man to the voting-booth in November than the reactions he would have as a result of newspaper reading.

Lack of interest in the vote has stimulated public-spirited persons and organizations to institute various movements designed to prick the conscience of the political slacker. Whether it is due to lack of concerted effort or to the callousness of the offenders is not known, but the time and money expended so far have been practically unavailing. An intensive campaign waged through coöperation of the national broadcasters might do what less potent agencies have failed to do in bringing negligent citizens to appreciate the seriousness of their offense and its

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incompatibility with the best interests of popular government.

Although many public officials have voiced their opinions concerning the possible influence of radio upon politics, no public character has given more constructive comment than the secretary of the interior, Hubert Work. Mr. Work spoke through the medium of "Wireless Age," a contemporary publication devoted to the wider aspects of radio.

It is safe to assume that the experiences encountered in the conventions of 1924, because of the radio, will revolutionize the next national conventions four years hence, just as they are already changing the character of political campaigns. The cause is fundamental.

The orator who depends upon gesture and facial expressions to drive home his arguments when he faces an audience, must depend on his facts and logic when he speaks through a microphone.

He approaches an unresponsive mechanical device that is apt to embarrass the most seasoned public speaker. He misses the stimulus of being *en rapport* with his audience, and while the microphone and receiving set reproduces his voice with fidelity, it does little more. If he has a good radio voice he is fortunate, since many speakers who have won fame on the rostrum find that when shorn of the graces of public speaking, such as gesture, physical appearance and all of the other characteristics that go to make up the speaker's personality, they are unable to hold their audience.

The result is that radio speakers are giving more attention to content rather than embellishment in preparing and de-

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livering their political talks. There is no place in radio for the verbose, illogical and defamatory type of political oratory. Brevity, always one of the elements of good writing and speaking, becomes paramount over the radio; and denunciations of an opponent that may be greeted with applause when delivered from the platform, directly to an audience of the same political faith, fall flat when heard in the quiet of the home.

Since political speeches are purely argumentative in character, theoretically at least their primary purpose is to persuade the hearer to the speaker's viewpoint politically. One way of persuading the audience is used by the stump speaker, who attempts to arouse them to such a pitch of enthusiasm by his personality that they forget to use their reason or question his facts. America has had some famous "spellbinders" in its political history—men of genius who cannot be replaced by the present generation and whose passing denotes the close of a definite epoch in political speech-making.

The radio marks the beginning of a new era. Those who are destined to make a name for themselves in this difficult field must rewrite their speeches and recultivate their voices. With brevity, logic and a firm adherence to facts as their guide posts, they will fail to appeal to the passions of their audience perhaps, as did the spellbinders of old, but their influence on the reason and judgment of the "listeners-in" will be immeasurably greater and the consequent improvement in our political standards will raise America to even a higher place among the nations of the world.

The late secretary of agriculture, Henry C. Wallace, was an alert student of the radio situation as it affected the farmer, and his study brought him to the conclusion that radio would be a potent factor

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in the politics of rural districts as they affected the national situation. Mr. Wallace outlined his beliefs in the following words:

To-day practically every farmer, without appreciable expense, can receive almost immediately it is available the latest information on market and weather conditions. I do not mean to say that all farmers have receiving outfits, but there is efficient local distribution of information that is sent over the entire country by numerous sending stations. Daily weather forecasts are sent out by 117 stations in practically every state; crop and market reports and comments are put upon the air by seven high-powered radio-telegraph stations of the Navy Department and 75 radio telephone stations owned by colleges, newspapers and commercial concerns.

No one knows how many farmers have their own radio receiving sets, but the Department of Agriculture made a preliminary survey about a year ago, which gives some indication of the number. It was found that in a large number of counties investigated there were about fifty outfits on farms in each county. If that average held true for the entire country it would mean about 150,000 receiving sets on farms in the United States. Since the time of the survey the number undoubtedly must have increased greatly. The use the farmer makes of this convenience cannot be measured by the number of sets. Many banks in small towns and in some cases county agricultural agents have a practice of relaying information received by radio to the neighboring farmers by telephone. By such a method the number of people benefited by up-to-the-minute information is multiplied enormously. It is safe enough to forecast that radio will be a permanent factor in entertainment, education, business and politics. Many predictions have been made regarding specific changes. We hear that it promises to do away with the

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old-time political mass-meeting, citizens staying at home and learning the issues of the day without stirring from their easy chairs. Perhaps some such change may come about, but whether it does or not we can be sure that more voters are going to learn about the real issues than ever before. Neither weather nor stress of work, which might keep people at home, will prevent them from hearing the messages from candidates for office.

It is probable that more attention will be given to the contents of political speeches which will be heard in the calm of the fireside. The radio audience consists of persons of different political beliefs. Therefore, the effective talk will be one that is brief and limited to the real issues of the day. The speaker does not have his audience at his mercy and can lose them with the same ease with which he secured them.

Since no party can ever obtain a monopoly of radio facilities, its use should result in a far larger number of voters becoming informed on the issues under discussion, and it may be instrumental in stimulating a larger vote at the polls. Obviously those candidates who can make the most persuasive arguments in their own behalf will reap the greatest benefit from the radio.

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CHAPTER VI

THE INTERNATIONAL ASPECTS OF BROADCASTING

THE purely technical side of broadcast transmission and reception is receiving so much attention from some of the best engineering minds of the world that progress is a continuous process and the hazy dreams of to-day are the blazing realities of to-morrow. The best receiving distances of a few years ago are duplicated by the most modest apparatus of the present, which cost but a fraction of the sum that was necessary to assemble devices of the older type. Annihilation of time and space is being so effectively carried out that we no longer marvel at the report of a radio fan in Hawaii listening to a concert from Schenectady or one in Japan attuning his apparatus to the wave of a Pittsburgh broadcaster. There was a time, and not long ago, when such a feat would have surprised the world.

It was but thirty years ago that Marconi marked time by covering the modest distance of three miles, using power that would now effectively reach halfway across the American continent. It is not at all

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uncommon to-day for the people of South America to listen to the programs of our best entertainers, and the more capable English listener has long since ceased to be thrilled by the reception of a broadcast over the three thousand miles that separate the British Isles from America. Our own land, huge as it is, is effectively blanketed by the broadcasts of even one station. A youngster operating a three-tube set in rural Niagara County in northern New York is not even thrilled at hearing the far-flung wave of KPO in San Francisco. Rural blood is not so much moved by the wonders of to-day as it was by the wonders of twenty-five years ago.

The gradual extension of radio broadcasting will soon make it international. The first intentional international broadcasting was inspired by the Westinghouse Electric and Manufacturing Company, which, during 1923, made arrangements with British broadcasters to rebroadcast the programs of the pioneer station KDKA, East Pittsburgh. It was a daring plan, and its fulfilment may some day occupy a significant position in the history books of the world. The program originating in Pittsburgh was received in England on a highly sensitive set, where it was amplified and fed into the modulator tubes of a British transmitter. In this way it was rebroadcasted throughout the British Isles. British listeners

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tuned their knobs and caught entertainment from the midst of Pittsburgh's smoke four thousand miles away.

During the early part of 1924, English broadcasters coöperated in an effort to send their respective waves to America, and at the appointed hour of the evening thousands of American listeners were straining their ears to catch the sounds. At the conclusion of the tests, numerous cases of success were reported, and a second important chapter had been added to the history of international broadcasting.

Radio engineering is reaching such unexpected heights that one cannot help but wonder how international politics and relations will be affected by it. Will it be a great binder of nations, or will it, held in abeyance by diplomacy, never be permitted to dispel the conditions that make for war and turmoil? The ether of space is becoming a great international amphitheater where the voices, music, and culture of the entire world may mix. In a few years we may be listening to a broadcasting station in Holland, Greece, or Norway as easily as we now reach out for a local studio. No one who has watched the development of radio during the last five years would dismiss that statement as the fancy of an imaginative mind; it is close to being a reality.

International radio on a large scale will make this

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tiny speck of cosmic dust, that we call home, seem insignificant in size, and the concert-halls of Europe will be transplanted to every living-room of America. The folk-music of the nations will for the first time find a common heritage in the ether. Announcements in foreign tongues will inspire language study, and the younger generations will have more incentive to extend their means of expression.

The smallness of Switzerland, and the fact that she is surrounded by nations of different tongues, have forced its populace to master more than one language. This was a matter of convenience in some cases and of necessity in others. From the standpoint of language, Switzerland is an international republic. Broadcasting may cause the world to follow Switzerland, and the foundation for that dream of the impractical utopians, an international language, may be laid. To say that such a thing will actually come about is unsafe, but the facts of the case at least warrant the speculation. The authors feel comfortably sure (and in this they are supported by some of the better-known radio engineers) that international broadcasting is an imminent development, and it is natural to assume that it would arouse an increased interest in the languages which would emphasize the need of an international or world tongue more than anything else possibly could.

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Will the ether be the birthplace of a new world spirit? Will it make war improbable by building up invisible bonds of friendship? Will it expose the moods, intelligence, and general character of peoples in such a frank way as to defeat propaganda to destroy the faith that one people feel in another? Here is a matter that may remain speculative for many years to come. It cannot be considered rash, however, to hold that international broadcasting can do nothing to increase the prospects of war and that it will always be a force for good working quietly on the more cultivated side of human nature.

These statements have been made on the assumption that the evil influences that incite the killing mood are not to be permitted to prostitute broadcasting. Nothing would be a more potent creator of war than broadcasting if it were used to send slurs and insults upon the ether. Broadcasting must be kept out of the reach of the international schemers and dealers in the materials of war, for, like dynamite, its benefits are reversible, and it could be a peacemaker one minute and a war-inciter the next.

Although it is merely interesting to canvass the possibilities of international broadcasting at this time, one who weighs details and thinks more than superficially cannot help but wonder where broad-

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casting is leading us. The question is serious enough to interest thoughtful minds.

James J. Davis, secretary of labor, has this to say about the international aspects of broadcasting:

Two thirds of China live in one third of its area; that 's what I have been told, and since I have never been there I have to take another's word for it. But whether this proportion be too small or too large we all can reason that the first element of civilization in the modern sense of its transportation, its progress, depends upon commerce in some form—of beings, of goods, of thought. In the unpenetrated regions of Mongolia, where it is reported that even the wheel is unknown, and water transportation is extremely limited, civilization cannot exist. For man is a social creature that takes most from life when greatest is his contribution in intercourse and commerce. He lives most who serves most.

The romance of ships is inspiring. I never see the incoming or outgoing of an ocean liner but that my mind wanders to the ports which it has touched or will touch in the future, and as my mind wanders to unknown lands, I marvel at the progress of transportation facilities. Nothing is more thrilling in history than the development of navigation, first by drifting, then by paddle, by sail, by steam, by electricity, and even by radio. Nothing is more brilliant in the story of American achievement than the difficulties surrounded by the ever increasing efficiency of our means of commerce. The courier was displaced by the stage, and stage by steam, steam by wire, and wire by radio. But what has been true in America has been true in other civilized portions of the globe. And with each progression the world has grown smaller, the drudgery of labor has been lessened, and the comforts of mankind increased.

We need no one to suggest to us that the remarkably rapid

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advance in the invention of labor-saving machinery during the past generation is due to improved means of communication. Minds of men work so differently that without the communication of an idea, as in the case of a simple wheel turning upon an axle, it may remain unknown in another part of the world for countless centuries, yet once transmitted a different mind may develop that original product far beyond what an enthusiastic inventor ever dreamed was possible. We know that this has been true in radio.

The world has grown smaller by better transportation; nations understand each other better by commerce; and new mutual benefits and responsibilities have been created by the interchange of commodities and mingling of international society. Yet withal, this development has been of a material nature. The thought of an individual may be guarded; words and acts of individuals may not reflect public sentiment because of the circumstances which surround that individual in a given situation. Men are often biased by physical contact and do not give expression to their innermost thoughts. But if a nation and the family of nations has gained so much through physical transportation—that of peoples, of commodities, and of the written word—what may we expect with the broadcast dissemination and exchange of ideas by word of mouth intended primarily for a class but open to all? We have encouraged open diplomacy, but how can that compare with the openness of communication upon which the whole nation and the world may tune in?

With other nations listening in to the expressions of our public men, can we not hope to come to a more satisfactory understanding of each other's difficulties and aspirations? The thought expressed for the purpose of influencing our own people is more likely to be in sympathy with public feeling than the words of the individual emissary to a foreign land whether diplomatic or commercial. And so it seems to

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me we are binding ourselves not only more closely commercially to the other nations of the world, but more firmly in thought as well as in deed. While the ultimate effect of the use of radio facilities in expressing public thought can only be determined after we have given it a fair test, I predict that it will be no less a factor in promoting international understanding than has been the rapid growth of our physical transportation facilities.

The advocates of the so-called International tongues like Esperanto and Ilo are united in the belief that radio broadcasting and the possibilities of international communication with sound-modulated waves offer a great opportunity to test their theories.

It is interesting to note the reflections of Upton Sinclair. In a recent article in the "New York American," he has this to say about the joint possibilities of radio and Esperanto working together in the interests of a universal language:

I read in the paper just recently that the development of radio in Europe has reached a point where it is possible to broadcast to the whole continent; and the peoples of a score of nations suddenly discover that it is very inconvenient not to understand what the radio is saying. This is giving an immediate impulse to the movement for a common, auxiliary language. Once more there is talk of calling an international congress of scientists to bring about the adoption of such a language.

How many tens of thousands of years do you think we should have had to advocate that every one should learn to read and write if it had not been for the invention of printing

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and its cheapening by the power press. Printing has been used less than three centuries, but already in the country where it was discovered, Germany, there is but .05 per cent of illiteracy; that is to say, out of ten thousand persons 9995 know how to read.

And now comes the same kind of pressure applied to the problem of an international language. The air has suddenly become full of all kinds of wonderful things—songs and stories and lectures—an endless variety of entertainment, free for the taking.

I venture the prophecy that it won't take three centuries, but only three decades, for 9995 persons out of every ten thousand to be listening to the radio in Esperanto, or some other language of that sort. If you think that I am unduly optimistic as to time, let me mention that it takes years to learn to read English or French or German or Russian; but an average person can learn to understand Esperanto in three or four weeks.

I know that, because I have done it myself, and seen a great many others do it. Thirteen or fourteen years ago I attended a convention of the Esperantists, held in the little single-tax colony of Arden, Delaware, and I there listened to and chatted with men and women from considerably over a score of nations, who were able to communicate with one another freely, some having had only a few weeks' practice.

I have forgotten most of my Esperanto because I have n't had occasion to use it; but I know that I could get it back in a week or two, and I am ready to do it, any time I can listen to Chaliapin singing in Moscow, or to Tagore explaining love and human brotherhood to the pupils of his school in India.

The great number of enthusiasts who advocate an international language are careful to explain that they are recommending merely an auxiliary language; that is to say, we are

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all to use our native tongue, but when we want to communicate with foreigners who do not understand that native tongue, we shall have a means of reaching them.

For my part, I say: "So far, so good. We have to make a start, and that will do for the start."

But I add the prophecy that, after we have used an auxiliary language for a generation, we shall become tired of our mother-tongue or forget it, and in two generations it will be as obsolete as ancient Anglo-Saxon is to-day.

I know what a storm of protest this statement will raise; I know because I have tried it! I have tried it on poets and men of letters especially. They look at me with the pity they would apportion to a bushman from Australia; either that or they begin to rave and become dangerous. To throw away our precious mother-tongue, with its infinite treasures of beauty and charm, its heritage of exquisite poetry and noble prose.

I will say this at the very start: there is an awful lot of bunk believed and talked about the beauty of language. Ninety-nine per cent of it is memory association, and nothing else. We attach certain emotions to certain sounds, and if from infancy we had had those emotions attached to other sounds, it would be all the same to us.

Take that first and most beautiful of words, "mother." We all know what "mother" means to us—a precious word—and we hug the very thought of it and love the language which has such a word.

But now try the experiment of putting an "s" before it. Ugh, a hideous word! And will anybody pretend that there is difference enough in mere sound between "mother" and "smother" to account for the difference in the emotion it brings to us?

If you think that, let me show words that are made beautiful instead of ugly by the adding of that very same

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"s." The word "lender" is not a very pleasant word, because it makes us think of a pawnbroker; but add an "s" and behold, it is a word which every poet hastens to apply to his lady-love.

Some one was praising German to Mark Twain; such a vigorous language, full of expressiveness! Take the word "*Ausbruch*," which means outbreak, explosion; a fine, forceful word! "Oh, I don't know," said Twain. "It seems to me that toothbrush is far more expressive."

Of course there are a few words that are what students of language call "onomatopoetic"; that is to say, they are made to imitate real sounds. Such a word is "murmur," and such a word is "buzz"; and out of such words the poets have got pretty effects, such as Tennyson's "murmuring of innumerable bees." But that, after all, is child's play compared with saving the human race from war and enabling the discoveries of science to be made known to all mankind by the wireless telegraph in a few minutes after they are made.

You say, "Why not take English for the universal language?" That would be fine for you, of course; and it is easy for you to suggest. You can take the position of some character in English fiction—I forget who it was—who ridiculed the French for being so silly as to think that "pain" means "bread." You have never had to "learn" English as a foreign student learns it, and so you are unaware of the infinitude of traps it sets for the stranger.

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CHAPTER VII

WHAT RADIO CAN DO FOR EDUCATION

UNIVERSAL communication as typified by broadcasting must have an educational force, for, reduced to its fundamentals, the process of imparting knowledge, by book or spoken word, is a mere matter of thought transmission. A mathematics professor lecturing before a class functions in the manner of a broadcasting station, although the comparison may appear ridiculous. A medium that has it within its power to transfer thoughts to a great number of people at the same instant can be regarded as an important force working for the good of civilization.

It is natural that broadcasting should work in the interests of mass education as part of its daily routine, but the substance of this chapter will be devoted to the purely academic field and to the possible assistance of broadcasting in building up the educational system of the country. The experiments carried on in the interests of this phase of radio have not been numerous, nor have they been

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patiently prepared or followed out, but they have been convincing, nevertheless.

A significant experiment was conducted by the Board of Education of New York City during 1923 when an instructor in accounting left the class-room of the Harron High School and took up his customary duties from the studio of a local broadcasting station. The class received its instruction through the loud speaker, and the work proceeded with the same despatch as though the instructor had been on his platform.

The most glaring defect of absent instruction is the total lack of visual illustration which is a necessary adjunct to successful learning. Broadcasting cannot take into consideration the blackboard, and consequently its function must stop short of what is necessary to meet the requirements of the curriculum. This shortcoming, however, is not sufficient entirely to rob radio of a prospect of legitimate academic use, for there is still left the opportunity for service of a nature that has long since been needed in our national system.

The alert college professor in the arts and sciences does not fail to recognize the helpful inspiration that his students receive from outside lecturers. For instance, one can appreciate the value of a lecture by Cass Gilbert to the architectural classes of Colum-

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bia. John Hays Hammond would stir the imagination of every student of mining engineering in the United States. There is not a school of journalism that would not relish a message from such a journalist as Brisbane or Ochs. There are cases where special lectures by professors who have specialized in certain phases of electricity or chemistry are in demand, and it is not uncommon for our colleges and universities to coöperate in exchanging such men. An expert on the highly specialized subject of thermo-electricity or electronic bombardment may be borrowed for a few days with great benefit resulting to the classes of both institutions. In the average case, these lectures are unaccompanied by illustration, for the text-book usually performs this function.

It is difficult for the lay mind to see why an inter-collegiate or inter-university system of broadcasting stations would not push academic learning ahead by facilitating the supply of outside lecture material. While it is desirable that classes should be addressed by such men as Gilbert, Hammond and Ochs, we cannot expect these men to leave their daily work to perform a service that may take two or three days of their time. Yet with a properly established system of inter-university broadcasting, involving two or three strategically located studios,

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a man, without leaving his own office, could address an audience in every university and college in the United States. By taking advantage of the remote control system that is made possible by our many telegraph and telephone lines, no point would be beyond the reach of the broadcasting stations. The smaller institutions in the outlying districts of the country might enjoy more of the advantages now available to the larger schools, and the whole system of higher education would be drawn into closer relationship.

There is another important educational function that broadcasting may perform if full use is to be made of its diversified possibilities. There is an alluring opportunity to use radio in teaching the English language and the requirements of better citizenship to the thousands of foreign-born in our large centers of population. Small municipally owned and operated radiocasters given over to management by a non-subsidized board of education, free from political influence, would help to overcome one of the most stubborn obstacles to better city life and to the more intelligent use of the full advantages of citizenship. A municipality might even go so far as to lend simple crystal receivers to working-men with families who could not afford the necessary investment.

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In this simple way, naturalization would often be facilitated by several years. The evening classes in language now conducted by alert cities through their school systems are not so successful as they might be if tired workmen who have already put in from eight to ten hours were not expected to fill the seats. If this service could be brought to the home of the foreign-born worker and he could be taught the English language and the niceties of our citizenship by a member of his own race, a powerful instrument for combating ignorance could be developed.

Certain subjects can be taught directly to great masses of people by radiocasting. A case in point is the work of Dr. Fleck of Hunter College, New York City, who during the winter of 1924, lectured weekly on the subject of musical appreciation. An adroit and keenly interesting lecturer as well as a polished and sensitive student of music, Dr. Fleck was able to dissect music before the microphone and lay its intricacies bare before the members of his audience. His illustrations were given on the piano and by the aid of a capable ensemble of stringed instruments. The work and methods of the great composers and the secrets of harmony, rhythm, and melody were exploited to the amusement and edification of a large audience. It was a subject that could easily be taught by this method, and an audience in the

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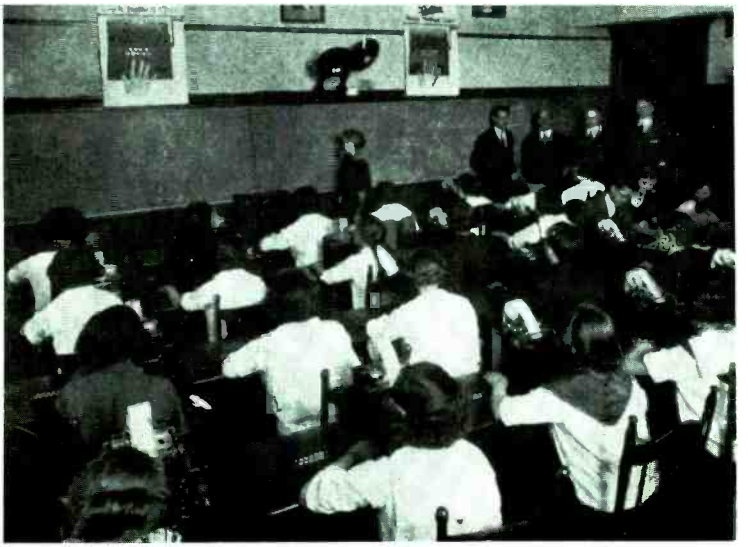
An instructor in adding-machine manipulation addressing pupils in the public schools of New York through a broadcasting station.



A scholar in a New York public school receiving instruction in the manipulation of an adding-machine by radio. The loud-speakers will be noticed over the blackboard.

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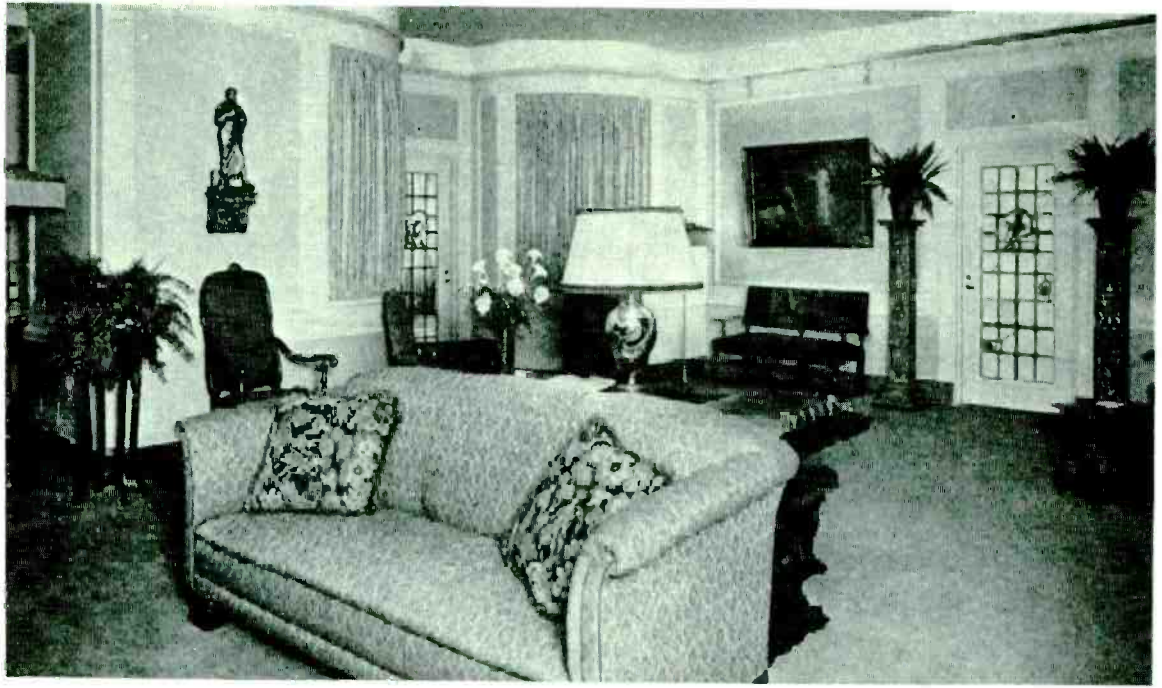

The luxurious reception room of a well-known New York studio. A great deal of money has been put into the decoration of broadcasting studios, while the finer details of artistic program presentation have been permitted to go unnoticed.

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physical presence of the lecturer could not possibly have had a better understanding of the proceedings than those who made up the radio audience.

While a number of colleges of very good standing have sought to ascertain some of the possibilities of radio as an adjunct to the dissemination of knowledge, no experiments stand out more prominently than those conducted by Columbia University during 1924. Two courses, one in politics and the other in psychology, were given over the air under the auspices of the home study division of the university. Close coöperation for the more serious was established by a small enrolment fee which brought forth certain helpful literature. The success of the experiment was based entirely upon the response to this offer of coöperation. Hundreds of people took advantage of the privilege of guidance under the tutelage of capable and recognized teachers. Of course, the great majority are not interested in such things, but enough followers can be found who wish to enlighten themselves on subjects of this nature to make such efforts worth the time and energy put into them.

Encouraged by these preliminary efforts, New York University made a move in the same direction, putting several of its best professors on the air in teaching such widely diversified subjects as geology,

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home economics, and English. Here again the response was encouraging, and it proved that there is an actual demand on the part of the more serious for instruction in such subjects.

It does not seem unreasonable to offer the speculation that our colleges may one day begin a really serious effort to establish an actual air college in connection with the home study services and extension bureaus.

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CHAPTER VIII

RADIO AND NATIONAL SPORT

THOSE who know the technical, economic, and commercial limitations of radio have always objected to the speculation in which unseasoned radio editors are inclined to indulge. Some of our more daring and imaginative newspaper scribes have had it doing everything from curing cancer to felling airplanes. It is a jack of all trades, capable of turning the world topsyturvy.

Radio is a tremendous thing, and it is easy to underestimate its importance and the far-reaching effect that it will have.

If there is one thing upon which radio has made an unmistakable impression, it is sport. Indeed, the average listener will agree that radio has proved itself a needed stimulant, for a new wave of enthusiasm is passing over the entire country. This is not a phenomenon but the natural and inevitable outcome of the broadcasting of sport events.

Before the writers proceed with their argument, they would first like to satisfy the reader that

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national interest in any sport is simply a matter of communication. Offhand this may sound like an overstatement, but let us go back to the time of ancient Greece with her marathoners and discus-throwers. Practically all of the sporting events of that time were entirely local. Athens had its meets as well as other cities. But there was no national enthusiasm or keen interest in any particular match. How could there be when news traveled so slowly? What enthusiasm could a man in northern Greece have for an event in Athens when it required two weeks for the news of the outcome to reach his ears? Each community to which news could with fair speed travel by word of mouth could, of course, raise itself to a considerable pitch of interest. But in any case there was not that great national fever that can be worked up to-day. Take our World's Series, for instance, the broadcasting of which is still fairly fresh in our minds. The baseball enthusiasts of Buffalo, Chicago, or Philadelphia were just as keen about the outcome as a man in the Bronx whose apartment window overlooked the Yankee Stadium. The reason is simple enough to understand. The men in Buffalo, Chicago, and Philadelphia have kept themselves informed regarding the vying teams throughout the entire year. They know the batting average, the errors, and the gen-

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eral record of each player. They read of them in the newspapers every night, or they get the news over the radio.

When Benjamin Franklin was postmaster-general of the United States, it took more than two weeks for a communication to reach Buffalo. Compare two weeks with two minutes and you can easily account for the enthusiasm of the Buffalo man. It keeps his imagination fresh and alive because he knows that the event has just happened. It is n't stale; it is n't a thing of yesterday or last week; it is fresh and stimulating. Would the enthusiasm of any follower of sport continue to thrill him if he had to wait two or three weeks to hear the outcome of a sporting event? It is the rapid spread of news that has given to America the love of sport that has placed her in the front rank in this respect.

We do not have to go back very far in history to reach the period when our sporting fever began to grow and thrive. Before the telegraph came there were no Bob Fitzsimmonses, Babe Ruths, or Bill Tildens. If there was a big event in Buffalo, the man in San Francisco had no interest in it, for it was history by the time he got word of it. Each event was isolated to the community in which it took place.

When clicking telegraph instruments began to

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feed hungry newspaper columns with fresh news, there was born in the national heart an undying love for the thrill that comes through the contest of human skill and power, whether it be fighting, sculling, or automobile racing. Before Morse's telegraph system came into wide use, sports were practically dead in this country. Ask any really old man to name a few of the champions of his early youth. Sport, indeed, was dead until 1850. John L. Sullivan owes his fame to the noisy little telegraph instruments that brought the news of his prowess to every city and hamlet of the United States.

Before the Atlantic cables were laid, what did we care about English horse-races or boxing matches? If we can have the details the day the event happens, the event assumes an altogether different aspect, especially if preceding news items have kept us keyed up. If we had to wait for the *Leviathan* to bring the news, what a drop the barometer of sports would take!

Is it not natural therefore that radio should bring about a great increase in the love for sport? Here is an instrumentality that so effectively annihilates space and time that it permits us to move our easy-chairs to the noisy grand stand of the football and baseball fields, the race-tracks, or the spectator's

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boats of regattas. No event, whether in the clouds or in the English Channel, is out of the reach of radio. The extent of the usefulness of radio could be appreciated by realizing what would happen if we had to stretch wires to all the points that are now connected by it.

If the growth of sport has been brought about through communication, we may expect that radio will bring with it a revival that will end one knows not where. It has already created a stir. People who never before took an interest in sports have found them to be exhilarating. They did not go over to the baseball field to get their enthusiasm; it was brought into their homes through the loud-speaker or the telephone. They tasted a little of it, liked it, and had more. It was radio that first actually brought them into contact with clean sport. Many of them never knew what they had been missing until the voice in the loud-speaker brought to them a mind picture of a great contest, brought to them the living voices and actions of the players as well as the spectators. Thousands awoke to find that they had a new form of recreation. Women who had thought they never could be interested in a prize-fight found themselves standing on chairs during the excitement of the Dempsey-Firpo battle. Business men who never liked baseball listened to

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the report of one game over the radio and next day found themselves for the first time lured to the grand stand. The conversion was wholesale, for radio is now installed in probably three million homes. If only 5 per cent of the listeners were made better sport lovers the calculation gives us a figure of two hundred thousand. The writer knows of a dozen and one people who have had aroused in them a desire to see either a prize-fight, a baseball game, or a football game; before radio they were indifferent and uninterested.

A few years ago there was plenty of room left in the grand stand at the World's Series, although the stadium at the Polo Grounds was not so large as it is to-day by a seating capacity of several thousand.

In 1922 the World's Series was broadcasted by radio. In 1923 both the Polo Grounds and the Yankee Stadium—which, by the way, is one of the largest in the world, with a seating capacity of sixty-two thousand—were filled to overflowing at every game, piling the gate-receipts up to a point well over a million dollars, and only six games were played. Never before had so much money been taken in at a World's Series. Never before was there such a nation-wide interest in the game. Is it not

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reasonable to conclude that radio has been responsible for this new support?

The American Baseball Writers Association objected to the broadcasting of the World's Series on the ground that it would interfere with the sale of the evening newspapers that carried a story of the games. Fortunately Judge Landis overruled their objection. Did it interfere with the sale of papers? It did not. It helped the sale by tens of thousands, for the listeners who heard the announcers, White and McNamee, describe the action play by play in vivid fashion, turned off their loud-speakers and went out to buy papers to see how accurately the broadcasters had described the games and also to get details of the games that could not be reported over the radio. Practically every one who listened and felt the excitement had this desire to buy a newspaper and to read over again the story of what had taken place. Every newspaper circulation man in New York will admit that radio has a good influence upon the distribution of newspapers carrying sporting pages.

What holds true of baseball holds true of fighting; half again as many seats could have been sold for the Dempsey-Firpo fight. What holds true here also holds true of football.

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There is another angle to the radio sport situation. It has to do with the health and well-being of the country at large. Now that every one with a radio receiver is exposed to the thrill that sport brings, is it not reasonable to believe that we shall have more actual participants in sport? For instance, a man listens to the account of an exciting tennis match. He may decide at the time that tennis is just the game he would like, and the next week may find him on a tennis court trying to learn the game. If he is young, he may succumb to the lure of baseball, running, boating, or any of a dozen other sports. This is happening every day and will continue to happen. Women, too, will be led to the tennis court, golf links, or swimming pool.

The wholesale conversion of people to outdoor sports is bound to have a beneficial effect on the national health and consequently on morality statistics. It is another instance of the way in which radio is bringing with it undreamed-of benefits. The radio horn is a potent spreader of good.

Every important sporting event that is now broadcasted is carried to an amphitheater large enough to throw the Roman Colosseum into insignificance. Its seating capacity is limited only to the United States; out of the millions who are seated in it we can expect to win many thousands over to be

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not only lovers of sport but participants as well.

At the time this book is published there seems to be a growing resentment on the part of large fight promoters against the use of radio at the ring-side. Tex Rickard, perhaps the world's foremost match-maker, has definitely decided that radio has injured the sale of seats at some of his large matches. This has caused him to forbid the use of broadcasting in connection with future fights. Students of the subject are not inclined to believe that radio has injured the attendance at the majority of sporting events. It is true that a few people might be influenced to stay at home because of the facility of the radio, but at the same time it is reasonable to suppose that thousands of people never before interested in such things have been aroused by the radio and have acquired a desire to see the events themselves at close range. It is a known fact that many people sought the prize-ring who had been won over to the sport by broadcasting. Radio builds interest and does not destroy it. If the attendance has fallen off at prize-fights, it is not fair to blame the radio; more likely it is an economic situation of a temporary nature that is the cause.

Another radio feature that will have a tendency to increase interest in sport is the gymnasium classes

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of the Newark station, WOR. Through the coöperation of the local Y.M.C.A. and its physical director, Mr. A. E. Bagley, an early morning class, which has probably half a million followers, has been established. By means of published charts which are available for the asking, and through directions given over the microphone together with the necessary music from a piano, a really effective and highly commendable set of exercises have been developed for use on the air. Here we have a practical application of radio which not only means a great deal to the five hundred thousand persons involved but will be a tremendous factor in interesting these people in body-building sports. It will eventually bring them to the canoe, the tennis court, the baseball diamond, the golf course, the track, and the gridiron.

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CHAPTER IX

RADIO, THE INVISIBLE CRUSADER

RADIO has affected so many departments of human activity that it is not surprising to find it taking a part in the affairs of the church. The history of radio and the church begins with the history of broadcasting itself, for it was but a few weeks after the first broadcasting station (KDKA) was established for general public service in Pittsburgh that the progressive pastor of a large Episcopal congregation there agreed to spread the gospel through the new and, up to that time, little known channel of communication. It was the move of a pioneer and was open to criticism from the blindly conservative element who take every advance as a signal for long lectures on the decline of civilization. The services were broadcasted each Sunday morning, however, and but a few weeks had passed before even doubters were constrained to admit that broadcasting might some day prove itself a weapon against the slow dissolution which some observers say is threatening the church.

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There is no serious division in the ranks of religionists concerning the godliness of radio and its right to take part in the dissemination of religious doctrines. There are a few ultraconservatives who are anti-modern and unreconciled, but they mutter their objections in the privacy of their studies, for they can obtain nothing but the impatient ear of the public in view of the admirable record broadcasting has made as an ally of the recognized religious faiths. Broadcasting is not the desecrating, unholy, material tool of modern science that religious bigots would have us believe, but a powerful, uplifting force that may eventually bring more changes in the meaning and application of faiths than could be effected by devoted and learned scholars in hundreds of years of crusading.

For the first time in the history of the orthodox church, services can be made universal, entering not only the home of the pagan and the agnostic but that of every professor of religious beliefs. A broadcast religious service, be it Episcopalian, Baptist, Hebrew, Congregationalist, or Roman Catholic, is available for any one. The most intolerant believer in another faith, regardless of denomination, would hardly listen to it if the service to which he was accustomed was not available.

Viewed from this standpoint, the ether may be-

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come a great and invisible melting pot for the faiths of the day. Certainly it can do nothing to injure the reconciliation that many far-seeing churchmen are trying to bring about in the interest of united worship. Had broadcasting been instituted five or ten years before the Interchurch Movement, which resulted in so dismal a failure, the movement might have had much more fertile soil to work. Broadcasting may help to fuse together the mere fringes of difference that now distinguish the various denominations. If it does this, the natural fruition of its influence will be a new and more vigorous effort at the bringing together of all creeds. It may take years of broadcasting to effect this result, but no one can deny that radio, with its far-reaching voice and its availability for the members of every faith, is the strongest present force working to this end.

Will broadcasting diminish personal church attendance? Will it make worshipers so lazy and indolent that the services will be conducted before empty pews? While no indication of anything of the sort can be seen at present, the importance of the question entitles it to consideration. As a general answer, it might be said that radio so far has not reduced attendance at other public functions that have been broadcasted. Theaters have been actually helped by broadcasting, and the same holds true of musical

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concerts. There is no reason to believe that the church will be an exception. The ears alone will never take the place of the eyes; since much of the impressiveness of a church service comes through the eyes, and since much of the feeling of comfort it affords is attained only through attendance in the flesh, there is little danger that radio will keep people away from church.

In considering church attendance and the radio, the non-church-goer presents an interesting angle of the problem. It is a matter of record that ministers who have been broadcasting their services through the various available agencies have received large quantities of mail from indifferent people confessing lack of attention to the spiritual side of life and promising greater devotion in the future. In not a few cases letters have been accompanied with monetary contributions in appreciation of the spiritual benefit derived from the services. The majority of these communications have also contained promises to attend church; and while no figures are available to show how many of these promises were anything more than the temporary effect of the inspiration of the service, it must be granted that a certain percentage of them were carried out and that radio has brought people back to church.

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There is also the case of the irregular churchgoer and the chronic invalid who cannot attend under any circumstances. The occasional churchgoer has found in radio a most valuable substitute for actual participation in the services, while the therapeutic value of spiritual comfort derived from broadcast services to bedridden invalids and others suffering from temporary ailments cannot be overestimated. If services were broadcasted for no other purpose than offering solace to hundreds of thousands of hospital occupants and invalids in the country, all of the trouble and expense involved in this sort of work would be justified.

The broadcasting of religious services and its effect upon communicants of rural churches is a field for lengthy discussion, since church attendance in the more sparsely settled portions of the country has always been a problem to the rural preacher. Of course, the automobile has helped to reduce delinquency among the farmers, but even the automobile loses much of its effectiveness during the winter months when the roads are made all but impassable by heavy snowfalls. Under these conditions, radio offers a service that cannot be performed by any other agency. While the farmer may not be able to tune in the church to which he belongs or even, perhaps, to a broadcast from a large city church

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representing his denomination, he is usually satisfied to listen to the gospel as preached by any of the orthodox churches.

A writer in the "Universalist Leader," a religious organ, predicts that radio will bring about many important changes in the facilities offered for rural worship. On one occasion he remained at home and tuned in the Sunday morning services of a splendidly equipped edifice where the choir, the prayers, the reading of the Psalm, and the sermon itself were all very beautiful and wholesome from the spiritual viewpoint. A short time later he visited a village meeting-house. Here is a record of his impressions and comparisons as made by himself:

> The music was monstrous. The organ was out of tune, and a choir composed of the neighborhood cats would have rendered, or rended, the anthems more effectively. The Psalm and Scripture were read in a way that showed that the reader had no comprehension of what he was doing. The prayer was an insult to the Creator and a slander to the congregation. The sermon was noisy, silly, unpractical, weak and worthless. When the benediction had been pronounced the writer grabbed his hat and fled to the deep woods where he could adequately express himself without being overheard.
>
> The congregation that listened in to the first service probably numbered thousands. The congregation that attended the second service numbered fifty-one, which was forty-five too many, because the minister, the organist, and the quartet deserved to torture each other, but had no right to torture the forty-five innocent women and children who sat in pews.

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With rhetorical indignation the writer for the "Universalist Leader" asks how long people in the remote rural communities are going to endure such services when they can get something really worth while for very much less trouble and expense. He prophesies a speedy revolution in the conduct of the country church which will perhaps save it from the "utter dissolution toward which it is hastening." He foresees that:

> Instead of ordinary barn-like meeting-house there will be a chapel good to look at and with an interior suggestive of worship, meditation and prayer. Instead of an organ, there will be a well-equipped radio. Instead of a choir making day hideous, songs will be caught out of the air, in which the congregation may join, led by some one who knows enough to beat time. Instead of a preacher who cannot preach but makes up for his defect by noise and bluster, the people will listen to some one who has something to say and knows how to say it. The radio, when a little further perfected, as Marconi assures us it soon will be, must certainly supplant the pitiful and painful service of the ordinary country church.
>
> And what is to become of the country parson? He will give himself to the work which he can do, that of organizing the social life of the rural community, and superintending the Sunday radio services. To that end he will have to be trained. He will have to know what to do with the boys and girls who now run wild in the village streets; he will have to know what to do with the young men who now loaf about the station and pool-room and tell smutty stories. He will have to know what to do for the women whose chief recreation is gossip, and the men who work, work, work and have no idea of

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adequate recreation. We are on the verge of a tremendous revolution in the conduct of the rural church. Let 's get ready for it.

The same problem is discussed by another writer who tells us in the "New York Times" that there has been a tendency toward a dwindling of congregations, and that in the absence of any other outstanding cause during the past twelve months this has been laid by some to the radio. The Rev. Wilbur Caswell, associate to the rector of St. Thomas's Episcopal Church, in New York, which broadcasts its services every Sunday, told the "Times" writer that clergymen complain that radio is stealing some of their hearers; that their congregations are more inclined to remain at home and listen to one of the leading pulpit orators in New York than to make the physical exertion of going to church in their own districts, where, at best, they could hear a service of inferior quality compared with that of the metropolitan church. One country church has met this dilemma in unique form, says the writer.

According to Dr. Caswell, a little Episcopal chapel in Maryland actually rigged up a radio horn in its pulpit one Sunday morning, got in tune with the cathedral in Washington, and the congregation sat in silence while the services of the great church came to them through the instrument. When the preacher in Washington announced a hymn, the congregation got out its hymn books and sang too.

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The incident suggests the question, Is this a forecast of the rural church of to-morrow? Will the devotional feature of religious activities become centralized in a large metropolitan center, with the country parishes becoming only provinces of "ministration" presided over by pastors whose sole duty will be that of making pastoral calls and officiating at marriages?

Precisely to what extent the radio has already reacted upon the country churches is impossible, of course, to measure thus early. But it is possible to say that if the present drift continues the smaller chapels are likely to be confronted with a situation which may cause them some embarrassment. Either they must devise some method of effectively competing with the metropolitan institutions or they may have to yield to them in this one department of religious activities.

There is one religious development going on by the aid of broadcasting that cannot be looked upon with so much favor. Reference is made to some of the lesser conspicuous devotees to recently developed creeds who have seized upon radio as a means of spreading adroit propaganda rather than aiding a broad-minded understanding between the factions; in the majority of instances services are placed upon the air by those who broadcast them with no intention of making a direct appeal for a change of faith.

Various religious sects have made such a determined effort to enlist the services of broadcasting for purposes of propaganda that some students of the radio situation are inclined to regard the situa-

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tion with some concern, believing that activities of this sort will eventually do harm to the art. Armstrong Perry, who has long been a devoted student of radio, voiced his fears in the January, 1925, issue of "Popular Radio" under the title "Religion's Raid on Radio." Even though Mr. Perry is an ardent adherent to the doctrines of Christianity, he objects vigorously to the growing invasion of the church, saying in part:

We used to expect the churches to be at least fifty years behind the times—but times have changed. They are speeding up.

It was only ten or fifteen years after motion pictures had taken their place with the foremost amusements that the churches began using them with religious motive. Sometimes a censor stood in front of the machine and held a newspaper over the lens when the film became too interesting from a worldly point of view, but there is less to-day that the religious leaders expurgate.

Everything that attracts people to the vaudeville show is being tried in church—even dancing girls at the regular services. So it is not altogether a surprise that the churches, at the beginning of the radio era, are among the first to try to grab the air.

A prominent divine in New York City has announced plans for opening a station that will blanket the metropolitan district and a good deal of other territory. "Listen to me or to nothing!" seems to be his slogan. Voliva, leader of the Dowieites, puts on a show at his station—WCBD—as good as any, and slips in his religious theories at psychological moments. One of his big ideas is that the world is flat, and

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that, of course, eliminates from radio the need for discussing the Heaviside theory and others advanced to explain why ether waves follow the curve of the earth.

In the latest list of broadcasting stations, about seven per cent are owned and operated by churches. A number of others, connected with colleges and other institutions are also under the control of religious leaders. Among the sects represented are Presbyterian, Catholic, Baptist, Methodist, Latter Day Saints, Christian, Christian Scientist, Zionist, Congregational Methodist Church (South), Lutheran and Seventh Day Adventist. Some have low power sets and transmit only their Sunday services. Others are using all the power the law will allow and operating all day long and into the night.

Complaints from listeners on Staten Island have been published in the newspapers and are to the effect that WBBR, operated by the People's Pulpit Association, transmits daily and blankets the whole island. The Association is composed of the followers of the late Pastor Russel, who, during his lifetime, was content to hire the largest auditoriums available and lecture free of charge to those who came to hear him. Los Angeles fans complain of religious propaganda that crowds out programs they would rather hear. Around Zion City, Illinois, there have been complaints that are but feeble forerunners of the storm that may arise when Voliva opens up his new five-kilowatt transmitter, one of the most powerful in the world used for broadcasting.

The air is filling up with propaganders. This is viewed by radio folks with other interests. Those who have been putting on Plug Tobacco Quartettes, Safety Razor Minstrels, and entertainers who have joked and jazzed all manner of trade names into the subconsciousness of ultimate consumers, are beginning to demand what right religion has to interfere with the business of advertising. Will the increase of

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propaganders scare away the propageese who swallow their offerings?

The answer to the complex situation, if there is one, goes down to the root of things. Religious leaders claim—and no one will deny it—that religion has as good a right to the ether as education or business. Educational broadcasts are not objected to because educators usually are modest and unobtrusive. Seekers after truth find it, and it makes them humble. Business is business. It does not hesitate to spread its propaganda by any and all methods available. But usually it has the common sense to avoid trying to force itself upon an unwilling public. It is more often adroit in its methods and it appreciates the value of good-will. The religious leader, viewed in the light of history, is sometimes the least wise, the least tolerant, the most bigoted of all. There are those who follow closely the teachings and practice of Jesus and try to win men by serving them; but too often the religionist stands on the platform that one man and God constitute a majority, and the majority rules. The Word of God is interpreted in as many ways as there are bigots, and each knows he is right.

Some people who have the best interests of radio at heart see in the present situation a menace. It is an open secret that the larger corporations concerned with radio development are looking forward definitely to a sweeping reduction in the number of broadcasting stations. It is predicted that in a few years there will be but six or eight super-stations, whose programs will be relayed, perhaps, to stations having only a local range. What if this happens and the religious interests come to control the big stations? Will we have to listen to religious propaganda or nothing?

Probably no such fear is justified. Those who look forward to a system in which less than a dozen stations will provide programs for the whole country are kidding themselves,

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unless they have the power to kill an interest in local programs by local people, which exceeds the interest in big programs and big stars by a ratio of three and one-half to one, according to a recent investigation. The fact remains, however, that religious prejudice, religious zeal, religious jealousy, grow faster and die harder than any other sentiment of the human race. It will be easier to start right than to readjust after serious mistakes will have been made.

It is bad enough to have different religious denominations preaching against each other and working against each other, all in the name of the same God, within the walls of their own meeting houses. In that case we do not have to listen to them unless we choose to. But if they get to competing in the air, we broadcast listeners will be out of luck. Already the Fundamentalists and their opponents have had their fling in the ether and a large part of listening America had a bad attack of spiritual nausea. So long as power is limited so that a propagandizing station can be tuned out, the situation is tolerable. The radio manufacturer and dealer especially are not averse to a condition that requires a high degree of selectivity in receiving sets. But when a broadcaster acquires a right to radiate an amount of power that will force oscillations in all receivers within five, ten or fifty miles, for any number of hours he may choose to monopolize the ether, he will have reached the ideal of the religious fanatic and the point where the average listener will junk his receiving equipment.

The desire to limit religious broadcasters so that they cannot disturb the peace of an entire community is not an evidence of antagonism toward religion. Religion is a fundamental instinct. No man can escape it, even if he wants to. Few attack the churches which represent the beliefs of their respective members. The rank and file of Americans are willing to let the other fellow express his religious views and

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feelings as he pleases, so long as he does not interfere with the rights of others.

But ministers there are who are not satisfied to let folks choose for themselves. They consider themselves divinely called to impose on others their own ideas and call them the Mind of God.

SOME OF THE SPECIAL STATIONS OWNED BY INSTITUTIONS UNDER CHURCH INFLUENCES

Call Signal	*Location of Station*	*Denomination*
IXK	Newton, Mass.	Catholic
IXN	Middletown, Conn.	Methodist
2XZ	New York, N. Y.	Catholic
2YA	Camp Dix, N. J.	Catholic
3XI	Washington, D. C.	Catholic
3XJ	Philadelphia, Pa.	Catholic
3XM	Princeton, N. J.	Presbyterian
3YO	Easton, Pa.	Presbyterian
3YI	Washington, D. C.	Catholic
5XBG	Waco, Tex.	Baptist
5XZ	Grand Coteau, La.	Catholic
5YR	New Orleans, La.	Catholic
5YV	Fort Worth, Tex.	Catholic
7YC	Seattle, Wash.	Evangelical
7YD	Seattle, Wash.	Catholic
7YG	Portland, Ore.	Evangelical
7YS	Lacy, Wash.	Catholic
8XAK	Springfield, Ohio	Lutheran
8YAC	Cincinnati, Ohio	Catholic
8YAJ	Cleveland, Ohio	Evangelical
8YM	Granville, Ohio	Baptist
8YU	Dayton, Ohio	Evangelical
8YYK	Delaware, Ohio	Methodist
9XT	Collegeville, Minn.	Catholic
9YAP	Davenport, Iowa	Catholic
KFBG	Tacoma, Wash.	Presbyterian
KFBU	Laramie, Wyo.	Catholic
KFDD	Boise, Idaho	Catholic
KFDX	Shreveport, La.	Baptist

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SOME OF THE SPECIAL STATIONS OWNED BY INSTITUTIONS UNDER CHURCH INFLUENCES—*Continued*

Call Signal	*Location of Station*	*Denomination*
KFGX	Orange, Tex.	Presbyterian
KFGZ	Berrien Springs, Mich.	Seventh Day Adventists
KFHF	Shreveport, La.	(*Not Stated*)
KFIX	Independence, Mo.	Christian Catholic Apostolic Church
KFMB	Little Rock, Ark.	(*Not Stated*)
KFOC	Whittier, Cal.	(*Not Stated*)
KFRP	Redlands, Cal.	Episcopal
KFSG	Los Angeles, Cal.	Evangelical
KJS	Los Angeles, Cal.	Interdenominational
KTW	Seattle, Wash.	Presbyterian
WABE	Washington, D. C.	Evangelical
WABK	Worcester, Mass.	Baptist
WABO	Rochester, N. Y.	Baptist
WABZ	New Orleans, La.	Baptist
WBBL	Richmond, Va.	(*Not Stated*)
WBBR	Rossville, N. Y.	(*Not Stated*)
WBBS	New Orleans, La.	Baptist
WCAJ	University Pl. Neb.	Methodist
WCAL	Northfield, Minn.	Norwegian Lutheran
WCAM	Villanova, Pa.	Catholic
WCBD	Zion, Ill.	Christian Catholic Apostolic Church of Zion
WDAH	El Paso, Tex.	Methodist
WDM	Washington, D. C.	Presbyterian
WEW	St. Louis, Mo.	Catholic
WFAQ	Cameron, Mo.	Methodist
WJD	Granville, Ohio	Baptist
WMAN	Columbus, Ohio	Baptist
WMAY	St. Louis, Mo.	Presbyterian
WOQ	Kansas City, Mo.	(*Not Stated*)
WPAT	El Paso, Tex.	Catholic
WPAU	Moorhead, Minn.	Norwegian Lutheran
WQAO	New York, N. Y.	Baptist
WQAW	Washington, D. C.	Catholic
WWL	New Orleans, La.	Catholic

Courtesy "Popular Radio."

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Mr. Perry's objections seem to be permissible when supported by the simple statistics available in the records of the Department of Commerce. Here we find a list of religious bodies of all shades making use of the air in an effort to broaden the scope of their activities and to enlarge the number of subscribers to their creeds. This list of churches is herewith presented through the courtesy of "Popular Radio."

It is regrettable that so scientifically beautiful a thing as a radio transmitter and receiver, a thing representing such tremendous strides in human intelligence, should be used to broadcast a revival of the pre-Columbian idea that the earth is flat. The evil becomes the greater when we realize that we still have many minds susceptible to such incredible ideas when they are issued by a religious clan. Out in Zion City, Illinois, the Christian Catholic Apostolic Church, fostered by William Glenn Voliva, not only preaches the doctrine of a flat earth but maintains that the earth is stationary in space, a direct contradiction of known scientific facts. How regrettable it is that such claptrap should find its way out into a medium that may carry it into hundreds of thousands of homes where the young and the susceptible may fall victim to it!

In contrast to these narrow activities it is in-

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teresting to observe the case of the Rev. S. Parks Cadman, who delivers a sermon each week through WEAF in coöperation with the Brooklyn Y.M.C.A. Perhaps nothing will so thoroughly demonstrate Dr. Cadman's broad-mindedness as his own words which are quoted from the "New York Times":

We are coming to understand more fully the possibilities and limitations of broadcasting. It is a fascinating problem which well repays study and analysis. If one uses the radio merely to preach special doctrinal views, he will fail. On the other hand, if he uses radio to broadcast the great basic principles of religion and of the welfare of the world, he finds in it an agency of unprecedented value.

In addressing an audience so large and heterogeneous as that reached by radio the speaker must be judicial in his attitude. If he preaches narrow doctrines, he antagonizes, his audience tunes him out. Against this, if he will expound sincerely personal opinions intelligently held, he seizes an opportunity which has no parallel throughout the ages. He must not attempt to destroy the faith of any of his listeners.

Now, the American public is the most tolerant and sympathetic to be found anywhere in the world. It is the American spirit to sympathize with any one who preaches for the universal good. If the message broadcast expresses a sympathetic and broad view of life, it will be widely received. The radio audience is an interesting cross-section of the American public. If the radio audience feels that the speaker has the interests of public welfare at heart, they will stand an immense amount of criticism.

The American people are emphatically religious. Here is an explanation in part of the unprecedented size of the audiences which listen regularly to sermons every Sunday

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throughout the country. Even the controversies in religious matters merely prove that religion is very much alive. These controversies are not always to be deplored. It is merely religious energy misapplied. Beyond question our people are at heart deeply religious. Radio proves it.

One of the most important features of the radio service is the influence of the questionnaire. Thousands of letters come regularly by mail from the unseen audiences throughout the country. Only those that are signed are considered. These are boiled down to some sixty, which I attempt to answer each Sunday. I think I express the general opinion of my great radio audience when I say that the answers to these questions are the most fascinating part of the weekly program.

I preach every week directly to an audience of about 1,200 men. My sermon lasts for twenty-five minutes and the answering of the questions some thirty minutes. I confess that the questions are hard work. They make it possible, however, for the entire audience, scattered over many thousands of square miles, to take a personal part, so to speak, in the service.

It is interesting to note that fully 60 per cent of all the questions submitted from the great diversified radio audience have to do with religion. On the whole the questions are very commendable. They show intelligence and sympathy. The question most often repeated concerns the future life. There is everywhere an insatiable curiosity to know what will happen after death. The question comes from all classes.

We fail to appreciate, I think, the social side of radio. It is serving to unify this great heterogeneous nation of ours. Good people think more or less alike. A great radio audience after all has a common sympathy. I know of a case where every Sunday afternoon a curious company consisting of two Hebrews, two K.K.K.'s, two Knights of Columbus, two Masons and several Christians meet by common consent to listen to

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my sermon, broadcast from the Y.M.C.A. It would be hard to beat that.

The radio sermon, as well as broadcasting in general, will have a general appeal as long as it preserves its dignity and independence of mind on great public questions. It must avoid sensationalism as it would the plague. There is ample evidence to prove this. The great danger threatening radio is that it should seek to be popular in the worst sense.

We must recognize the limitations of the radio. There is the loss of gesture. Much of the personality of the speaker cannot be broadcast, which is unfortunate. On the other hand, it has been proven over and over again that if the speaker who transmits is in dead earnest, the spirit of the man in some mysterious manner is actually broadcast. A strong personality gets over.

The preparation of a radio program in broadcasting sermons calls for considerable art. In the great audience will be found those who enjoy a formal service, others who prefer quite the reverse. All these factors should be kept in mind. The program should be popular. There should be music, and good music. I find that a sermon delivered before a congregation broadcasts better than when delivered from the seclusion of a study.

There is a danger in the broadcast sermon, of course, that those who listen in should be merely hearers not doers of the Word. It is easy for the man who has listened in to tell himself that he has done his duty by merely hearing a sermon. But, after all is said, there is abundant evidence that the radio has been a great stimulus to the development of life and character.

The influence of the radio sermon might be illustrated by innumerable stories. One of the most impressive pictures, I think, is that of the radio service held from time to time aboard our battleships at sea. A large congregation gathered on

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decks hundreds of miles from land have thus followed every word of the sermon, and at the close bowed their heads and repeated the Lord's Prayer at the bidding of an invisible message.

Some time ago I chanced to be motoring alone on a remote mountainside in Pennsylvania when my car suddenly stopped. It was past midnight, and the darkness was unrelieved by a single light. Eventually a car approached, halted near me, and a voice from out of the darkness asked if I had broken down. I answered briefly that such unfortunately seemed to be the case. The reply coming out of the darkness on this mountainside was remarkable. "Oh, I know you," said the voice. "You are Dr. Cadman. I know your voice well. I hear you preach every Sunday afternoon by radio."

Here we have Christianity in its broadest meaning minus all the annoying prejudices that creep into the words of the least charitable and tolerant members of the priesthood. To the best of the writers' knowledge, Dr. Cadman has never uttered a single word that would tend to mold sectarian opinion or cause his listeners to feel that they were being subtly directed into a new channel of religious thought. Dr. Cadman's Sunday afternoon sermons have breathed the very essence of universality. How proper it is that they should, and what better place is there to do this than in the great amphitheater of the ether. Dr. Cadman's tremendous following, a following made up of Jews, Gentiles, Protestants, and Catholics, seems to indicate that in radio we may find the one instrument that may some day reconcile our religious faiths.

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CHAPTER X

WHAT CAN BE DONE ABOUT INTERFERENCE

IF the liberal-minded are wont to call broadcasting an art, they must admit that its stage is cluttered up with many grotesque objects that do not belong among the properties necessary for performance. Natural interference in the form of static, and artificial interference from ambitious amateurs and badly adjusted commercial transmitters, are defects that thwart the artistic growth of broadcasting. Yet the cautious reader who is not the owner of a receiver must not take this to mean that reception is always marred by a shower of annoying cacophonies. Static, for instance, is altogether irregular, and little trouble is had with it during the cold months, while interference from amateurs and commercial stations, if it is experienced at all, is either due to a receiver so poorly designed that it cannot differentiate between the waves, or to the inexpert adjustment of the transmitters.

It cannot be denied that considerable interference is caused by the more unruly members of the

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amateur ranks, who, since the early days of broadcasting, have felt resentful that their privileges have been in the least mitigated. This is by no means a sweeping indictment that calls upon the entire amateur movement for a defense. It is but a small percentage of the less serious licensees who do not honor the self-imposed periods of silence which the amateurs, in fear of more serious consequences, established under the title of the Rochester Plan. This plan calls for silence of transmitters from 7 P. M. until the late evening, and the complete observance of the ruling would entirely eliminate the amateur as a factor of the broadcast situation; but a voluntary arrangement of this nature is not sufficient to check the desire of many novices to be heard on the air during the quiet hours. Complaints lodged by broadcast listeners at the interfering stations either bring forth an insolent and wholly inadequate answer or else an accusation that the complainant owns equipment incapable of selective tuning.

While it cannot be denied that many receiving sets would be more immune from foreign disturbances if they were designed by engineers of standing, this does not absolve the outlaw amateur who insists on carrying on unimportant, and at times perfectly ridiculous, conversations with a badly or inac-

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curately tuned transmitting device. Of course, this class of trouble-maker is invariably quite assured in regard to his knowledge of radio and always insists that he is operating on a legitimate wave-length. If he is using small power and is located a few miles from a radio inspector, no attempt will be made to subject his outfit to the tests required by the present radio legislation. As a result these individuals have what practically amounts to free rein. They endanger the whole amateur movement. Their knowledge of radio is little, and they make no contributions to the art of communication.

The membership of this branch of the amateur movement is in general made up of boys in their teens who regard a transmitter as a toy befitting their age and social importance. Unlike the older and more serious students of the art, they are satisfied with blindly following the magazines devoted to it. Of course, a rather superficial examination is necessary to obtain a license, but this is not sufficiently severe to be beyond the capacities of the average boy. The desire for conversation between themselves appears to be the compelling motive behind amateurs of this stamp, and as long as this is so, the broadcast listeners and the amateur movement as a whole will remain estranged.

It is regrettable that such a small percentage of

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the amateur forces should jeopardize the activities of their movement, for amateur investigation has brought forth a number of distinct improvements, and the ranks of the serious experimenters have functioned in no small measure as a feeder to the radio industry and in times of war to the signal corps and navy. None but the most intolerant broadcast listener would like to see the amateur harmed in any way, but some practical movement should be instituted to eliminate the bothersome tinker who disregards all privileges but his own. It is known that the studious experimenters who form the backbone of the movement would welcome any practical plan for the checking of this obnoxious class, but the entire problem is in the hands of the Department of Commerce. If a more rigid examination were instituted and the lower grades of licenses eliminated, the greater preparation necessary would dampen the ardor of all but sincere students.

There is little that the unorganized public can do to prevent the activities of the bothersome and unimportant amateurs and at the same time insure the unmolested existence of conscientious and serious investigators. Proper regulation, it would seem, can be brought about only by carefully prepared examinations designed to bring about an automatic process of classification. As long as the

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requirements are easily met, we shall always have an idle and superficial class of youngsters who do nothing but clutter up the already overburdened ether with senseless prattle.

The amateur is by no means the sole offender in interference, for there is at least one other prolific source of disturbance that is perhaps more chronic. This results from the continued use of antiquated spark transmitters that are still employed by ship and shore stations on wave-lengths that are dangerously close to those employed by many broadcasters of the better class. From the engineering standpoint it is practically impossible to tune such transmitters so that they will fail to register on receivers adjusted to within from 25 to 200 meters of the wave-length employed.

A perfect example of such diabolic interference is afforded by the sound steamers plying between New York and New England points. In the early evening they make their way up the sound from New York sprinkling dots and dashes over the music in thousands of loud-speakers and telephone receivers. The result is wholesale slaughter of any entertainment that may be on the air from the broadcasters using the higher wave-lengths. The most selective receiver that can now be assembled will meet with defeat in an effort to eliminate the intruding wave. Often-

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times the wholly unnecessary chattering of the various operators may spoil the enjoyment of hundreds of thousands of people. It is a gross injustice, to say the least.

The shortcomings of lame and antiquated transmitters could be immediately rectified by the installation of a modern vacuum tube radiator of approved design. Such equipment can be made to emit a pure wave unaffected by the stubborn properties that outlaw the product of spark transmitters. Under the present Radio Act, however, the Department of Commerce has no jurisdiction in the matter, although the act specifically states that certain wave-lengths shall be used for certain services. By no stretch of the imagination can one visualize the waves of such a transmitter as on single wave-length or as anything but a deformed and highly unsatisfactory product of an obsolete equipment. Yet, in the face of these conditions, our radio inspectors board such steamers at predetermined intervals and place their seal of approval upon the apparatus, knowing that it is hopelessly beyond present requirements. It is unfair, however, to blame them, for the law has been met from a purely legal standpoint, and there is nothing left to do but to permit operation.

Inadequate separation of wave-lengths, of course,

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aggravates a condition like this one, and our large number of necessary and unnecessary broadcasters have taxed the wave-length resources to a point close to exhaustion. This has forced the Department of Commerce to allocate wave-lengths uncomfortably close to the ragged outpourings of the type of transmitters just discussed. An example of this is furnished by WNYC, the municipal station of New York City. Here 526 meters is the wave-length used, while the sound steamers and the ships in general in and about New York employ wave-lengths in the neighborhood of six hundred meters. As a result of this, a great deal of preventable interference is caused. Even WEAF, a station on a 492-meter wave, is part of the interference complex through no fault of its own. It is natural that the less important stations located farther down on the wave-length scale are not bothered a great deal by the ships, but on the other hand they have their troubles with the amateur pirates. Between the two no equipment is immune from interference.

An interference conference held in Washington during the early part of 1923 resulted in bringing about some understanding between the interests involved (amateur, broadcast receiver manufacturer, and commercial companies), and the wave-length range of broadcasters was rearranged and extended

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in such a way as to make possible the operation of the large number of broadcasters now serving the public. This conference, however, while it did a large amount of good by preventing serious interference between the broadcasters themselves, aggravated the matter of interference between the amateurs and the commercial communication companies by extending broadcast wave-lengths. The conference probably took the less evil of two courses in trying to make the best of an apparently hopeless job, and it would be far from fair to say that it did not do the best thing. Pushing broadcast waves up closer to the bands used by the commercial companies, in an effort to accommodate new broadcasters, and pushing them down to within a few meters of the amateurs, brought about fresh sources of interference.

The problem of interference would not be fully treated if some mention were not made of the static nuisance. Of course, static is a natural phenomenon that has not submitted to the efforts of our engineers in attempts to overcome it. Some day the stage of the broadcast theater will be swept clean of this form of rubbish; even to-day the condition may be mitigated by the use of sensitive receivers employing indoor aërials as does the newer superheterodyne.

Other disturbances caused by power lines, trolley-

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cars, X-ray machines, and ultra-violet devices are often confused with static by the novice. Static produces a crackling noise, while other forms of interference cause a rumbling sound of low frequency. This is usually from leaks in near-by power lines, and prompt notification to the power company owning the lines usually results in alleviation or total elimination.

The most aggravating form of interference experienced by those who reside in congested neighborhoods is produced by unbridled receivers of the regenerative or oscillating type. It is the more aggravating because it springs from a wholly preventable source. When a receiver of this type is tuned, it is a prolific producer of electric waves of no particular wave-length. Such waves are picked up by other receivers in the neighborhood, and audio-frequency howls of great intensity work havoc with broadcasting in general. Oftentimes these receivers are left in such a condition of adjustment that they produce a continuous disturbance that may make the reception in the entire neighborhood poor, giving the reproduction a harsh, raspy sound. So subtle is this particular form of interference that all but a few people who experience it find it difficult to believe that it is anything but trouble in their own receivers.

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The weakness of our radio legislation is brought home rather forcibly when this phase of the broadcast situation is commented upon. The squealing receiver is a real menace to the growth of broadcasting and a constant annoyance to those who own and operate receivers. Yet this public nuisance could be checked by very simple legislation. Since the elimination of public nuisances comes within the province and jurisdiction of municipal authorities, city ordinances aimed at protecting the rights of listeners could be enacted. This would not work any unnecessary hardship on those who own and operate such devices, since it is a simple matter to change the design slightly or to purchase or make an attachment to prevent this destructive radiation. Had our manufacturers not been in such great haste to make money during the early part of the growth of radio, and had they taken into consideration even the immediate future of the business, it would have been decided that the wide-spread use of such receivers was going to militate not only against the best interests of broadcasting but against the manufacturers' own interests as well.

English radio legislation has entirely outlawed the squealing receiver, and a fine is imposed for their unauthorized use. As a result, English broadcasting is unmarred by the blood-curdling shrieks and

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cacophonies that do so much to destroy the musical value of our own air entertainment.

By pure accident alone, there is a clause in the present radio law that might be effectively used by the Department of Commerce in combating the squealing receiver evil. The clause provides that no person may operate a transmitting station without a license from the Department of Commerce. Every receiver that radiates is technically a transmitter operating on the same principle as the broadcasting stations. There is another view to take. No attempt has been made by the authorities in power to place this perfectly legitimate interpretation upon the law in an effort to restore peace and harmony in the sorely tried ether of space. Even a mild warning would have done much toward stirring up the conscience of the thoughtless.

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CHAPTER XI

THE WAYWARD CHILD OF COMMERCE

BROADCASTING is a wayward child of business and commerce in that it stubbornly refuses to submit plans that will insure for the station the inflow of revenue necessary to operate and maintain a respectable source of entertainment. Conceived in haste and executed without thought for the future, it grew in less than a year from an experiment of uncertain value into a national institution of considerable importance. If its sponsors did have any definite notion of the financial side of broadcasting, they were overwhelmed by the swift progress and unparalleled competition that developed almost overnight.

It is estimated that a well-regulated, carefully managed broadcasting studio of medium power cannot be operated in a way that reflects either good taste or mature judgment on the part of the director for much less than one hundred thousand dollars a year. This is a modest calculation, too, for it is based on the usual method of procedure with no

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funds made available for special features or for the employment of land wires for out-of-studio events which are necessary to meet the requirements of a fully developed and well-rounded program.

After it was finally realized that broadcasting was an illegitimate offspring of modern business and that it formed a grotesque growth on the economic structure of the country, the question of "Who is going to pay?" was on every lip. Of course, the owners of radio receivers were logically selected as the persons most indebted to the broadcasters, but the best business brains of the country could not invent a scheme that would insure a definite income based on anything more secure than moral obligation.

Completely baffled by the apparent insolubility of the problem, it was natural that a few of our broadcasters would risk an appeal to the public for funds. WEAF was first to institute a move of this nature, giving to it the name of the Radio Music Fund. It was an ambitious plan to interest the public in bringing before the microphone musical stars who were hopelessly beyond the appeal of gratuitous performances. Those who took a serious interest in broadcasting, however, could not but view this appeal with alarm, for it threatened to set up a dangerous precedent and stamp a great industry as a

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beggar. So real were the dangers that one could not believe that the sponsors of the scheme gave it the mature consideration it needed before they put it before the public.

Such a scheme would always find a number of philanthropic souls to offer support, but the placing of their contributions at the disposal of a single broadcaster would have brought about a rather distressing situation. If the plan had been successful and the other broadcasters had not found a way of supplying themselves with like revenue, they would have faced such serious competition that they might in the end have broadcasted to all but empty ether. On the other hand, had they been driven to solicit funds in a similar fashion, their tin cups would have glistened before our eyes at every street-corner; they would have stood panting at our back doors like hungry dogs.

There was another possibility that made the plan hazardous to broadcasting in general. Had high-salaried stars been obtained, the better class of amateur entertainers, who have formed the substance of the programs for the past three years, might have retired hurt and jealous, feeling that they, too, deserved compensation of some sort for their efforts.

The Radio Music Fund was not a financial success,

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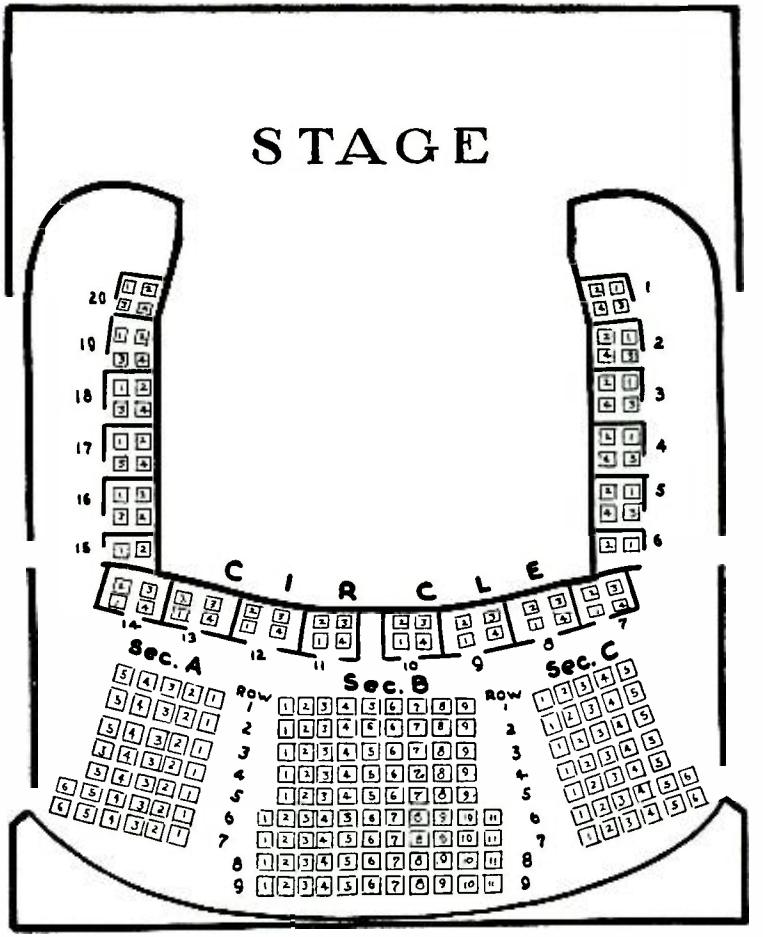
and it seems that it proved conclusively that voluntary contributions from the public for the support



How WHB, the broadcasting station of Kansas City, arranged the seats in its invisible theater as part of a plan for financial support from its invisible audience

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of broadcasting will not be sufficiently general to insure success.

A visible ticket purchased for visible money for the invisible theater; this is part of a very cleverly worked out plan for the support, by contribution, of a broadcasting station in the Middle West

Another effort was made along the same line by Station WHB at Kansas City. The attempt, however, was adroitly ingenious, being so planned that it was a bit unfair to it to brand it as an out and out

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appeal to charity, although it was just that when bared of its cleverly constructed subterfuges. The listener was asked to visualize WHB as a great invisible theater, with all of the attributes of a tangible thing; with ushers, actors, seats, curtain, and, of course, a box-office for the usual purpose. Yearly tickets were to be sold, and a printed program was to be an extra service that went with contributions reaching a certain figure. The whole thing was a masterpiece of careful engineering, and although the writers have heard nothing of its success or failure, experience makes it safe to doubt the outcome. It has been pretty definitely proved that the public is not overly anxious to assume the burden of station maintenance in this way.

While the question, "Who is going to pay for broadcasting?" is demanding the attention of every serious-minded listener, Mr. David Sarnoff, vice-president of the Radio Corporation of America, holds that the institution is resting on a substantial foundation and that concern for its continued growth and perfection is wholly unnecessary. The following statements were made by Mr. Sarnoff before the Merchant Marine and Fisheries Radio Committee in connection with the White Radio bill:

I want to go on record very definitely in saying to you that it is my firm conviction that broadcasting can be made com-

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mercially practicable without any means being found for collecting from the consumer, that the greatest advantage of broadcasting lies in its universality, in its ability to reach everybody, everywhere, anywhere, in giving free entertainment, culture, instruction and all the items which constitute a program, in doing that which no other agency has yet been able to do, and it is up to us, of the radio art and industry with intelligence and technique and broadness of spirit and vision as to the future, to preserve that most delightful element in the whole situation—the freedom of radio.

Just as soon as we destroy that freedom and universality of radio and confine it to only those who pay for it—those who pay for the service, in other words—just so soon as we make broadcasting "narrowcasting," we destroy the fundamental of the whole situation. And, therefore, I believe very definitely that broadcasting as constituted to-day is commercially sound and that it will remain so in the future, although there may be selective methods and narrowcast methods which will do no harm. These may supplement the situation. There may be wired-wireless and the like. All of these will make their contributions. But fundamentally there will remain, and there must remain and be preserved, that element of the broadcast situation which makes it possible for grand opera to go to the slums and to the districts of the poor as well as the rich, everywhere in the world, without any charge. The real picture of a $15 or $25 set in the home of the slums, if you please, receiving the magnificent things in the air, is the picture we must preserve and, I think, can preserve without being altogether altruistic. Moreover, we can do it on a business basis and through a means I have already suggested publicly, namely, the super-power station.

The sterile promontory from which those unacquainted with the intimacies of radio must view

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its problems, naturally leads to the rôle of Doubting Thomas when a plan is projected to solve the difficulties of the present. The appalling magnitude and the great complexity of the broadcasting problem, as it faces us to-day, makes the prognostications of even radio's most learned and experienced disciples limp with uncertainty. Perhaps time will reveal the logic of Mr. Sarnoff's reasoning. Perhaps it will demonstrate the positive futility of continuing along present lines. At least, to say that radio will always remain independent of public support at this time is daring. It would seem that Mr. Sarnoff's views are inspired by the feeling of security that all large radio manufacturers now have when they examine the exchequer. But what ten years of intense effort to supply the demand for radio receivers will bring remains to be seen. Saturation has upset the most careful business calculations, and when radio reaches this condition a tonic of some sort will have to be applied in short order.

Advertising by radio as a means to collect the amount necessary to insure studio operation has been a consistently controversial subject since the day WEAF, New York, with all the daring and rashness of the intrepid explorer, placed a line rate on the most elusive electrical unit, the watt. With an apparently comprehensible understanding of the

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requirements of modern advertising, the experimentally inclined guardians of this station voted to publish a magazine in the ether of space. It was to have the features of many of its more tangible competitors—reading-matter, advertising, and free circulation.

The experiment has not as yet shown signs of hardening into a definite commercial proposition with a secure future. The alarming lack of agreement on the part of radio listeners makes this so. Some believe that it is a perfectly legitimate thing to exploit the ether, and others look upon it as an outright imposition.

In the opinion of the writers advertising by radio does not offer a solution to the problem of making broadcasting self-supporting on the scale that is necessary for national success. At best, it can only be a very special form of advertising to meet the very special needs of a small group of users. Its intangible aspects and the dangers to broadcasting that would attend its wide-spread application, place it in the position of a new phase of advertising with limited possibilities. Success beyond the present range of its activities is too highly speculative to warrant a lengthy comment.

Although broadcasting is not facing an immediate crisis, it is not safe to assume that it will

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always be free of the problem of financial support on the part of the public. The present lack of such support may not produce a crisis, but that the art is evidently making little or no progress under the present method of operation. Its development is static and will remain static until ways and means are found to bring outside money into the coffers of the broadcasters. The money needed for operation alone so severely taxes the resources of the average station owner that nothing can be spared to lift broadcasting to a higher plane from the cultural point of view. The last three years of broadcasting have demonstrated this amazingly, for progress in the method of presentation and in the material offered has been so small as to be almost imperceptible. Yet nothing more can be expected when the financial status is correctly considered. There is very little commercial incentive where direct financial reward is not forthcoming. Broadcasting is no exception.

It appears that our broadcasters will have to await engineering developments before they can hope to pull broadcasting to an independent self-supporting plane of operation. The developments referred to have to do with the perfection of equipment that will confine reception from certain studios to those who pay a monthly or yearly fee. This can be made

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possible by the use of a special receiver susceptible only to the product of a definite broadcaster. The incurious layman will not appreciate how imminent this new era of broadcasting is until he familiarizes himself with the research work that has been done during the last few years.

On numerous occasions Secretary Hoover of the Department of Commerce has voiced his opinions concerning the present commercial aspects of broadcasting and the business of collecting the necessary funds for the sustained maintenance of intelligent service. Below is an interview with Mr. Herbert Hoover published in the "New York World":

More specifically, Mr. Hoover is strenuously opposed to trying to levy a direct tax on the radio audience by any means yet suggested. The British license system is highly obnoxious and tends to limit growth.

"This country would never stand for licensing or taxing radio listeners," Mr. Hoover emphasized. "That idea only works when one company has a monopoly and all the revenue so derived goes into one pool, and we don't like monopoly. And then how are you going to keep the unlicensed folks from listening in? Are you going to have a police force snooping around for illicit aërials, and searching people's homes?"

Mr. Hoover has a way of chuckling that suggests more than words. He said something about dry law enforcement and then he chuckled. It seemed to be a natural inference that he thinks licensing listeners would hardly solve the problem of how to pay for the radio programs unless enforcement were

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better than anything yet seen around Prohibition headquarters.

"People go into the theaters and pay admission," Mr. Hoover remarked, "and that solves the problem right there for the stage or concert hall, but it is obvious that there is no such way of getting the radio audience to pay for what it gets. So you've got to approach that some other way—leaving out the license tax scheme. I've heard only one very feasible suggestion. That is to fix a certain tax—say two per cent for instance—on the sale of radio equipment. One company reports sales running over twenty-two millions in 1923, and that will be a good deal higher for this year. You could provide enough that way to pay for daily programs of the best skill and talent throughout the year.

"It would perhaps be possible to work it by setting up a general committee which would be charged with the duty of arranging these programs, paying for the services of artists and so on out of this fund. But, of course, as soon as you do that you are likely to get into conflict over what sort of programs to put out. One thing is certain—the radio industry cannot live on an endless diet of jazz."

"No, nor of political speeches," suggested the interviewer.

Mr. Hoover nodded and recalled a political speech he had made out West during the last campaign. "It was just an ordinary speech," he said, "and one that wouldn't have gotten any space in the newspapers, and didn't get much as a matter of fact. The point that I wanted to bring out was that material of this sort, ordinarily of little interest to the public, gets a tremendous reception when put out over the radio. Not merely that people listen in, but they get interested in things in which they never had any interest before. And they showed it in this case by writing in here for copies of that speech. There were something like 200,000 copies of it mailed out as a result.

"Now one important thing about it is that it increases

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newspaper interest. The psychology of it appears to be that people who listen to speeches over the radio want to read those speeches in print in their newspapers the next day.

"You see there 's no conflict with the newspaper business in radio, and that is especially true of advertising. The radio can be used for indirect advertising, but that is all. Just where the line is has yet to be shown, perhaps. But the radio audience will certainly never stand for direct advertising. People will gladly listen to some hotel's orchestra broadcasting music, which is indirect advertising for the hotel, but if you try to sell them some brand of shoes or anything else over the radio you 'll have no radio audience. People won't stand for that. It would kill the radio industry as quickly as anything you can think of.

"The newspaper remains the medium for specific advertising, and radio never will supplant it. That seems perfectly plain to me, but there appears to be a good deal of doubt in some minds about how far the radio is going to usurp other advertising media. You can indirectly advertise a name over the radio by having such-and-such an orchestra or performer, but it is as far as you can go, and to make that name mean anything, to identify it, you must turn to specific advertising."

Mr. Hoover remarked that it has been conclusively demonstrated to the satisfaction of many department stores, hotels, theaters and other advertisers that radio offers them a medium for indirectly reaching the public, and that this is so valuable as to be worth the expenditure of large sums in procuring talent and putting forth the best possible programs. One Washington hotel pays $500 for two hours in the evening, once or twice a week. Its only return is indirect advertising of the hotel name. And the radio audience is furnished a program of dance music for which the cabaret habitués are voluntarily shelling out high menu prices and a cover charge.

While it has not yet been shown which medium is best for

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broadcasting nationally, or internationally, various authorities think that either the super-power development or else the telephone hook-up will prove best in the end. In any case, the thing has been done, and will be done more. Indeed, Mr. Hoover would like to see daily programs offering a balanced combination of material—discussion of political problems; educational courses; classic music; jazz; whatever can be put on the air legitimately to interest some class of listeners. The time could be allotted so that those who like church music and hate jazz may have their hour, and vice versa.

As for how the radio industry is ultimately to be put on a solid financial basis, Mr. Hoover believes that it is far too early to foresee. Sale of equipment now more than compensates for great outlays in providing programs. That bids fair to be a continuing condition. At least no "saturation point" is in sight for consumption of radio outfits and outfitting.

"Obviously, since the existence of the industry is dependent upon the programs, it is a prime essential that programs be constant and the very best possible," said Mr. Hoover, "and the manufacturers of equipment will never kill their own goose by letting the program descend to low levels, to offensive advertising or to driving away trade."

In passing, it is interesting to note that the guardians of British broadcasting have long since come to the conclusion that advertising in any form whatsoever is fatal unless it is put on the air in an independent channel, where, like the advertising pages of a magazine, it may be turned on or left alone. As a result of this British opinion no private companies, newspapers or any other possible source of private

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propaganda is allowed to engage the ether. In a contract between the British Broadcasting Company and the Postal Department of the British Government specific references to advertising are made in the following way:

The Company shall not without the consent of the Post Master receive money or other valuable consideration from any person in respect of the transmission of messages by means of licensed apparatus or send messages or music constituting broadcast matter provided or paid for by any person other than the Company or the person actually sending the message. Provided that nothing in this clause shall be construed as preluding the company from using for broadcasting purposes without permit concerts, theatrical entertainments or other broadcast matter as herein defined given in public or in London or the Provinces.

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CHAPTER XII

THE FUTURE OF BROADCASTING

SCIENCE is responsible for many social changes. The telephone, the speeding express-train, and the ocean greyhound are all tremendous factors in the shaping of human destiny. Broadcasting, the newest and one of the greatest gifts of science, is an instrumentality so powerful as to make one stand in awe of its possibilities. To-day it is practically an unused and untried Colossus, although we have numerous experimenters making blind efforts to tap its resources. A few years hence, one single insignificant man, taxed by nothing more strenuous than the effort to speak, will be able to send his voice into ninety-five out of every one hundred American homes. In a small fraction of a second his thoughts will reach the ears of millions of listeners. This dynamic force, a force that can be used to sway the thoughts and opinions of nations, would be a very dangerous thing if left to the exploitation of untrusted guardians.

The average man in the street has no conception

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of the importance of broadcasting. To him it is simply a new form of entertainment, something that might perhaps wrest popularity from the phonograph. Its social, economic, and political significance is a closed book. As a matter of fact broadcasting is so recent and its possibilities are so amazing that we do not know how to use it. Quite unexpectedly Providence has placed a new force in the lap of civilization, and we awake, gaping, find it there, and wonder sleepily what we shall do with it. We are like a babe with its first rubber ball.

Our present broadcasting is at its best but a painful attempt to make use of a new discovery that has temporarily overwhelmed us. It took twenty years to learn how to use the wire telephone, and it will take us twenty years to derive from broadcasting the full benefits that are among its resources.

In any comment on the future of broadcasting, there is a grand opportunity for the play of the imagination, and fantastic thoughts may creep into the discussion, eluding the guard of the most realistic writer. Every effort has been made by the authors of this work to curb unsound reasoning and unbridled imagination in their treatment of the future of radio broadcasting. The principles of the weather man have been applied as far as possible. If the direction of the wind can be determined with fair

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accuracy, prognostications tempered with judgment can usually be made. The things that are happening and the things that have happened often make possible the construction of outlines of the future. No attempt will be made to bring into consideration the so-called "revolutionary changes" which we so often find in the pages of the daily press. There are very few revolutionary changes in any art, for real progress, sure progress, is a smooth-flowing course of events brought about as the result of great deliberation and forethought. Although broadcasting may move fast, it will not be changed overnight, as some of our acutely imaginative newspaper scribes would have the public believe.

It might be wise here to introduce into this discussion a brief outline of the pertinent happenings that have led up to the present status of the science. While broadcasting as we know it is but three years old, De Forest broadcasted opera as far back as 1909. This was regarded more as a purely scientific experiment than as an effort to launch a permanent new department of communication, and, aside from the newspaper comments, De Forest received little credit for this pioneering effort.

It was during 1920 that the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, decided to stimulate the sale of ama-

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teur radio equipment by broadcasting music from a small equipment placed in the garage of one of its engineers. This was the small end of the wedge, and many things happened that the officials of the Westinghouse Company had not dreamed of. The amateur operators received the music, and an endless chain of conversation was started that eventually brought rows of people six deep to the counters of the radio shops of Pittsburgh. Men closely associated with radio have little recollection of what happened directly afterward, so fast was the growth of broadcasting. Men of whom the public had never heard sprang into prominence overnight, and broadcasting stations, magic-like, began to dot the country. There was no plan to it; it was a pell-mell development in true Yankee style.

Yankee enthusiasm often runs away with Yankee judgment and our manufacturers of radio apparatus, who were footing the broadcasting bills, awoke suddenly and wondered how it was going to work out financially. Supplying the public with entertainment on so vast a scale was enough to force reflection. Yet, once the thing was started, the public liked broadcasting, and they would not listen to its abandonment.

When a phonograph is purchased, the manufacturer has opened possibilities for sales of records,

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and here is a constant source of revenue. In fact, if enough records were purchased manufacturers could afford to give the machines away. George Eastman once said that if people would buy enough of his films, he could afford to give cameras away. In radio, however, we have an altogether different situation. A broadcast receiver is purchased at a fairly reasonable price, and the manufacturer of the outfit is more or less obligated to supply the user with entertainment for an indefinite period. This is economically unsound. It is like asking an automobile manufacturer to guarantee free gas and oil with every car sold. This need of radio has been met by bringing to the broadcast studios a cheap class of talent upon which it is impossible to build a secure foundation.

The English broadcasting system is the economic antithesis of this rashly assembled American structure. Advantage was taken of our own experience in building up a coöperative plan along conservative lines by bringing together the various manufacturers of radio apparatus into a broadcast organization. This was done under the watchful eye of the British Government, and each producer of radio equipment was made shareholder and stockholder. The institution was mothered financially by a self-imposed tax levy, which was placed in a general

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broadcasting fund. Added to this there was a small tax received from each user of radio equipment.

Although the writers have not had occasion to compare the artistic quality of English broadcasting with that of our own broadcasters, the small number of stations used to blanket the British Isles places the odds in favor of the foreign studios. In place of a pell-mell race in which everybody was eligible, a rigid selection was made, and the number of stations needed conveniently to cover the territory of England, Wales, and Scotland was scientifically calculated. As a result the musical resources of the empire are not strained, nor is the interference problem so acutely serious as it is in this country with our large number of active broadcasters.

A development was brought to light during 1921 which attracted an unusual amount of attention and which was held by many to offer a complete solution for the whole broadcast situation. Reference is made to the system of "wirecasting" or "wired wireless" invented by Major General Squiers of the Signal Corps. The Squiers device makes it possible to lash wireless waves to wires; that is, a wireless wave could be made to follow a wire instead of radiating into space. These waves could be modulated and controlled in length in the same way as the wilder ones released from aërials. The reception

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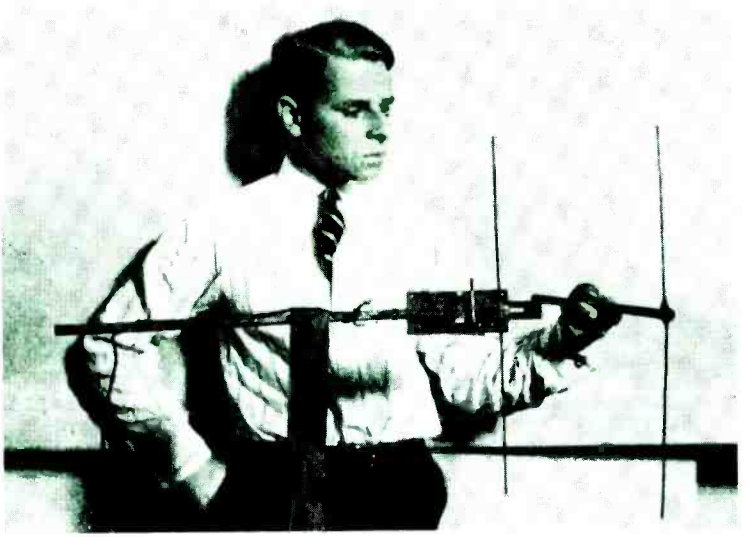
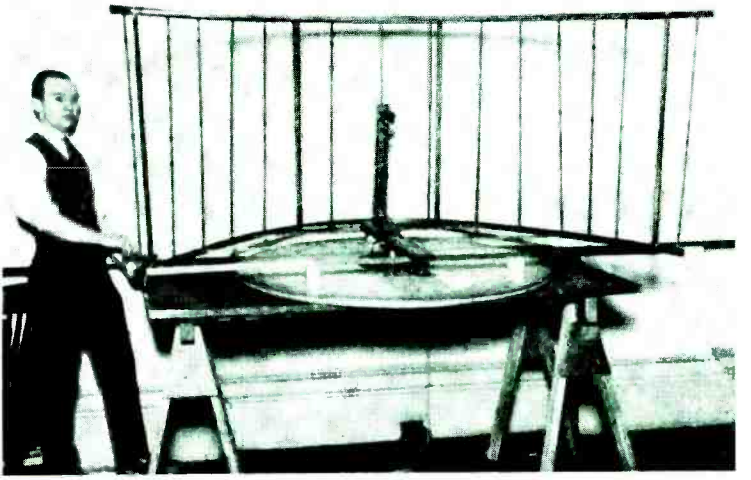


The transmitter of the Marconi short-wave device which has been used to demonstrate the practicability of communication on wave lengths a small fraction of the lengths now employed. The mechanism is being demonstrated by Mr. Bernard of the Radio Corporation of America.



A special reflector constructed by Mr. Marconi for the reflection and transmission of very short waves. The waves can be guided by this device so that practically straight lines may be followed.

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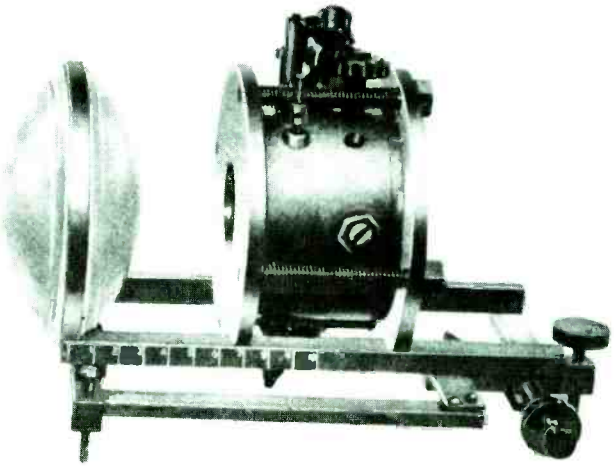
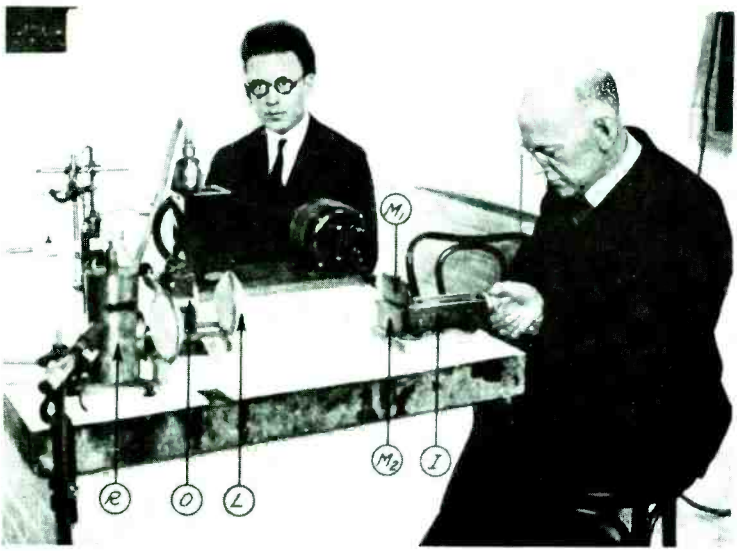


Courtesy "Popular Radio"

The oscillator and paraffin lens used in the Nichols-Tear short wave experiments.



Dr. Ernest Fox Nichols (right) with Dr. Tear, working with a device that generates radio waves 1/100 of an inch long. "O" is the oscillator or generator proper, while "L" is the paraffin lens. "R" is an instrument used for detection while Dr. Nichols is adjusting an interferometer "I."

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of the waves was made possible by the perfection of a special receiver attached directly to the wire holding the waves.

For a time this system seemed to be in a fair way to give space broadcasting a rather effective competition, for a wirecasting transmitter established in an electric power-house could supply music and entertainment over the regular electric light wires, and a service charge could be added to each monthly bill. There would be no laborious tuning or interference, and the class of talent would be better than that afforded by the best space 'casters, since a revenue would be available for the purpose of paying stars that the latter, with no reward to offer but publicity of doubtful value, could not attract.

The figures of the plan were especially alluring. What, for instance, would have happened had the system been installed by all of the New York City electric light companies and a list of about five hundred thousand subscribers built up? Let it be assumed that each subscriber to the service is charged fifteen dollars a year. This would build up an income of seven million five hundred thousand dollars, of which it is reasonable to suppose three and a half million might be set aside for the employment of the proper kind of talent. This would not be impossible considering the small cost of operat-

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ing equipment for wirecasting. This means that as much as ten thousand dollars an evening could be spent on entertainers, bringing within the range of the new studios artists like Tetrazzini, McCormack, Kreisler, etc. Surely such a tremendous scheme would put space broadcasting in a precarious position.

An experimental wirecasting service was established on Staten Island, and for a few months things looked bright for it. It had great possibilities, but as time went on it seemed to falter, and at the time of preparing this manuscript wirecasting presents anything but an encouraging example of growth and expansion. It is difficult to determine what may happen to it. It may quietly pass from the scene, and on the other hand it may be revived and applied so that it will at least give space broadcasting a hint of its existence. To say that it will be able to offer serious competition to space broadcasting would entail a great deal of risk. Its present tendencies are certainly not in the least alarming. If it does manage to lift itself to a more commanding position, it will find a few of our space broadcasters ready to receive its challenge by finally deciding to pay for artists. Such a development would be good for the art, inasmuch as it would discourage unimportant broadcasters and might reduce their num-

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ber. The ultimate outcome of such a step would be uncertain for those who decided to pay for talent, but they would surely not hesitate to make the move, should conditions warrant it. It is evident that wirecasting would find itself in a delicate predicament, should the space broadcasters match its efforts with a free service of high artistic merit. Yet it is safe to say that some of our larger manufacturers of radio equipment could afford to do this if wirecasting should in any way jeopardize the national sale of standard radio equipment.

A super-broadcast system composed of a few powerful stations, interlinked so as to work as a unit bringing every radio listener in the United States within the confines of a single audience, is one of the fond hopes of one of our leading producers of radio equipment. Mr. David Sarnoff, vice-president of the Radio Corporation of America, outlined this ambitious scheme before the Chicago Chamber of Commerce during April, 1924, and the portion of his address dealing with super-broadcasting is reproduced herewith:

Radio, like ancient Gaul, is divided into three parts. First, there is the marine branch of radio, by which is meant the sending and receiving of messages between ships at sea and stations on land. Marine radio is the beginning of wireless, as it was originally called, and though its history and develop-

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ment are romantic and interesting, it nevertheless remains a small part of the industry itself, although in a social sense it is perhaps the most important because it possesses the element of safety of life at sea. No other means exists for communicating between a fixed point on land and a moving vessel on the ocean.

I believe the time will come, and not in the very distant future, when it will be possible for a business man sitting in his office to ask for a connection with a ship at sea and talk by wire and radio telephony with the same ease and the same despatch as is now being done over ordinary wire circuits, and that will apply not only to the Atlantic Ocean, but to the Pacific and any other ocean of the world on which civilization may travel.

The second branch of radio development is that referred to as transoceanic, by which is merely meant the transmission and reception of messages across the ocean to foreign countries in competition with the cables of the world; and a very interesting development is there taking place, embracing, as it does, not alone the matter of commerce and the transmission of business messages, but embracing virtually the life of a nation, because communication is a very vital factor in times of peace as well as in times of war. That fact was simply demonstrated by the vision of Great Britain, which, prior to the advent of radio, had led in the means of international communications. The important cables of the world began and terminated in London, and London was the center of the world's communication; and where communication obtains, is easily had, and is flexible in nature, there commerce must locate, and that is why London, in the past, has been such a great center of commerce of the world.

To-day I am very glad to be able to say to you that America leads in modern means of communication, namely, radio. There are more circuits working out of New York

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City to-day by radio linking the rest of the world with the United States than there are in all of the rest of the world combined. We send messages daily to Great Britain, France, Germany, Norway, Italy, Poland, and are soon to inaugurate service to Sweden and Holland. We are also in direct touch with Buenos Ayres, in the Argentine, by radio, a very long distance covered with intervening or relaying stations, and we send and receive messages daily across the Pacific between California and Japan through the Hawaiian Islands.

The recent disaster in Japan amply demonstrated the great value of radio, because that agency was the only one available to notify the world of the great calamity which there occurred and the only agency which could possibly bring the news, help, and sympathy which were so promptly extended to our friends across the Pacific.

There is a great significance in international radio outside of the element of competition with cables, and that is the ability of radio to deposit its message directly in the country of destination. Not before the advent of radio was it possible for a man, say in New York, to send a message to Norway, or to Poland, without that message traveling through the intermediary of either Great Britain, France, or Germany, because the cables terminated there, and from those points it was necessary to relay the message by government land lines through various countries until the message reached the country of destination. And I need not elaborate too much on the opportunities afforded the friendly or hostile censors of these intervening countries to stop these messages in transit or to interfere with them if their purpose so dictated.

I do not regard any country as free unless and until this opportunity for free expression is given it through an agency which makes it possible for its voice to be heard in the rest of the world, and radio is that agency.

Our country, I am glad to say, especially the officers of the

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Navy Department in Washington, was quick to recognize the meaning of international communication, and the importance to the United States of having a position of preëminence in that field.

The Radio Corporation of America, which I have the honor to represent here to-day, was formed at the instigation of the American Government. It was formed as an outgrowth of the development of radio during the war, and it became evident then that the art had so developed and the various inventions and patents were so distributed among various contending parties that in order to develop an American owned and controlled system, capable of competition with the foreign owned cables of the world, it was necessary to mobilize and bring together these various inventions and improvements so that a strongly supported and financed American company might go forward with that development, and that, gentlemen, is the reason for the Radio Corporation of America.

It might also interest the business men present who have occasion to send messages to know that this development of radio has resulted in the reduction of the cost of sending messages across the oceans. Radio started with a rate one third or one quarter less than that charged by cables. After two and one half years of demonstration the cable companies reduced their rates to the level of the radio, and to-day a message can be sent to Europe at the same rate either by radio or cables, and the cable reduction in rates was the first made in thirty-eight years.

I would like, if the time permitted, to speculate with you on the great possibilities of the future in this field of transoceanic communication, but I have other topics in mind to briefly touch upon, and so I will leave this field of transoceanic communication with these two additional thoughts. First, I believe that every country of the world, large or small, will, in due time, have a radio station of its own capable of direct

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communication with the rest of the world. It will be so for political, commercial, and social reasons, and these reasons are adequate to justify a radio circuit in every country of the world.

Secondly, I believe that an additional development in trans-oceanic communication will be radio photography. To-day that may sound somewhat imaginative, but I might tell you, without violating the secrets of the laboratory, that we are experimenting with the development of radio photography and hope within a reasonable time to be able to demonstrate the practicability of sending photographic messages across the ocean by wireless, and when that is done you will be able to pick up your newspaper in the morning, or in the afternoon, and read of an important event that took place in another part of the world and have the news item flashed by radio supported by a photographic detail of the event itself, and that may be a matter of some interest to our newspaper friends.

The third branch of radio is that which deals with the matter of broadcasting, in which I assume you have the greatest interest. I find it difficult, my friends, to talk on that subject and still sound sane. The temptation to go up in the air, so to speak, and to sketch the unlimited possibilities of that development is so great and so alluring that one has to stop here and there, take inventory of what he has said, and put a little lead in his shoes so as to stay on the ground. Nevertheless, I am a great believer in broadcasting and all that that implies. I believe it is here to stay. I think it is no more going backward than the telephone or the telegraph or railroads or steamboats or any other public service utility. It is not a toy. It is not a mere instrument of amusement. It is not something that merely tells a bedtime story; there is a real philosophy back of it.

I believe that radio broadcasting represents the greatest

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development which has come to mankind, certainly in the last generation, because it represents the only means of one-way mass communication, by which I mean that for the first time in the history of the world it is possible for a single voice to reach countless thousands, or hundreds of thousands, or millions simultaneously. No other agency can accomplish that result, and in this particular fact lies the glory of radio.

There are other means of two-way communication. Important as they are, and important as they will continue to be—because I do not think that radio will supplant the older means of communication; it has never been the history of the new invention to destroy the old one—important as these agencies are, I think they will be eclipsed with this new instrumentality of communication, because of that very possibility.

The ability to reach everybody, everywhere, anywhere, at all times, is a great gift which has come to us and which requires and justifies sympathetic encouragement and development; and here, too, I am proud to say that the development which has taken place in radio broadcasting in this country is so far ahead of any development in that direction thus far existent in any country of the world that the comparison is almost impossible. But while we have been thinking in terms of national broadcasting, I believe that the day of international broadcasting is not far away. I believe it will be possible in the future to receive from across the ocean here, and for our friends across the ocean to receive us there, with the same clarity and the same ease as it is now possible to receive local stations, and I shall, if time permits, touch briefly on the instrumentalities which I believe will make that possible.

But first let me speak of this radio broadcasting in terms of an industry. It is now only two and one half years old and began in a very small way, and during this brief period, the figures which I shall briefly mention represent the answer as

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to whether or not there is anything in broadcasting. Some two hundred and fifty thousand persons are employed directly or indirectly in the radio industry throughout the United States at the present time. It is estimated that more than three million receivers are installed in the homes of this country. It is also estimated that the radio audience consists of more than ten million persons, which is perfectly understandable when we multiply three million by the size of the average American family.

There are over a thousand newspapers handling radio sections and radio columns in this country at the present time. There are more than thirty periodicals and magazines devoted exclusively to radio. There are more than five hundred broadcast stations sending in the air daily and nightly at the present time, and there are over a thousand wholesale distributors of radio, and more than twenty-five thousand dealers in radio throughout the country.

I know of no other industry in the history of commerce that can match that record of development in so brief a space of time, and it is but in its infancy.

It is natural, of course, that such rapid development and such great interest should bring in their trail a great many problems, and I do not pretend that the problems of radio and the radio industry are all solved, nor do I feel capable of outlining in detail at this time just how they should be solved, but I will make so bold as to sketch on a broad canvas some distinguishing lines of the fundamental principles which I think must underlie any attempt to properly and adequately solve this problem.

In some minds the question resolves itself into this simple problem: Who is going to pay for the cost of broadcasting? How will these broadcasting sending stations continue to give entertainment and programs without some means being found for collecting from the consumer for the service rendered to

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him? It is a question which properly may be asked, and one which deserves an answer. Personally, I do not believe that any answer is necessary which will require the consumer to pay directly for the service which he receives through the broadcast station in the form of toll-gate payments, so much a month, or so much a day, or whatever the case may be. There may be selective or so-called narrowcast systems instead of broadcast systems which will confine the wave to only those who are willing to pay for it. I have nothing to say about those systems except that they are not here yet, and if they come they may supplement and help the situation, but I do not regard any of them as necessary or desirable substitutes for the present system of broadcasting generally to all those who purchase or make receiving sets.

I believe that the present system can be made economical and sound without any means being found for collecting in toll-gate form, but before that can be done it is necessary to dissect the problem into its fundamental parts and to recognize that in advance of an economical solution to that question there must be a technical solution. How obviously hopeless it would be to hire talent, for example, and pay for it, and have that talent, either in the form of an operatic troupe, or instrumentalists, experts, or other artists of national and international fame to make the round of 563 broadcast stations throughout the United States, and to render their selections when paid for by these local stations. That is obviously and economically an impossible situation.

First, there must be provided an instrumentality which will be able to render a program of service so that it might reach every home in the United States and across the borders of the United States.

The answer to that problem, technically, in my judgment, is the super-power broadcast station, by which I simply mean raising the power of the present small stations from half a

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kilowatt to one hundred or two hundred kilowatts, if necessary, and to make their voices so powerful that they may be distinctly heard in every home in every city, town, village, and hamlet in this country. I do not mean necessarily one station. If half a dozen stations are required to cover the country, provide those stations, and then arrange to connect them together either by the radio wave itself or by wire when necessary, as was demonstrated with smaller stations yesterday, and have the main program at the central station relayed, or rebroadcast by the supplementary stations so that it may be heard very clearly in any part of the country, and with the same ease that we now hear a local station.

Let me say to you, ladies and gentlemen, that the problem of broadcasting is fundamentally at the transmitting end. I do not mean that the receiving sets have reached their ultimate state of perfection. There is bound to be improvement and development as the art grows, but fundamentally the improvement must come from the sending station.

The super-power broadcast station is not a dream. It is not merely a scientific term, because already we are sending messages by radio across the oceans, and if it is possible to daily send a signal by radio from New York to London, or Warsaw or Rome, why is n't it possible to send that same signal from New York to San Francisco, and especially by a super-power station located, say, in your own city, in Chicago, which we have designated as the center of the country. Its range need only be some fifteen hundred or two thousand miles, because radio waves travel in all directions; therefore it could be distinctly heard in all parts of the country.

Lest there may be fear on the part of those who are interested in the smaller stations, let me assure you that it is not in my mind that the super-power stations should necessarily destroy or interfere with the smaller stations. I think the smaller broadcasting stations have a distinct service

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to perform. I think they have a place so long as they do not interfere with each other or do not interfere with the public service. The matter of wave-length regulation, a subject which should be regulated by the Government, will provide utimately for the avoidance of this interference. The smaller station may furnish home talent, local news, may correspond to the local newspaper as compared with the larger newspaper or national magazine represented by the super-power station.

Furthermore, the smaller station can be arranged so that it can tap the bigger station, obtaining its program automatically and relay it on.

Now these developments, my friends, are in the course of very earnest study at the present time, and I believe that we may look forward to that kind of a station or set of stations in the future.

Assuming that the technical problem is solved in that way, then the economic problem becomes possible of solution because you will then be able to obtain the very best possible talent at these main stations, paying for it if necessary, and I believe ultimately it will not only be necessary but desirable to pay for talent at these stations.

Who is going to pay for it? Well, first and foremost let me explode, if I can, that fallacy that it is not being paid for at the present time. I do not believe in something for nothing. I do not pretend to violate any economic principles. The public is paying to-day for broadcasting in very great measure. Speaking for my company, and those associated with it, which operate a chain of broadcasting stations, the cost of maintaining and operating those stations comes from the returns of the sale of receiving apparatus. It is a cost of doing business. I do not believe, and I do not like to see the impression growing up, that the public is getting something for nothing. The public is not getting something for

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nothing. It may not be paying sufficiently at the present time, but fundamentally it is the public that pays. If the public stopped buying receiving instruments, there would be no broadcasting stations.

That being the case, I believe it is up to the industry to apply a portion of its sales returns to the cost of maintaining broadcast stations. It may be that at the present time the burden is unequally and inequitably distributed among the larger companies, but I have no fault to find or criticism to make of the industry as a whole, because no means have as yet been suggested in any definite or concrete form whereby all those in the radio business might contribute a portion of their selling price to the cost of broadcasting, but that will come about in the natural development of the industry, and a great many people, also competitors, with whom I have discussed the matter, have stated their willingness to help broadcasting.

Primarily, therefore, I believe that the industry itself has the responsibility of maintaining and supporting suitable broadcasting stations so that the sets which are sold to the public and bought by them may not represent a refrigerator without ice.

Radio does not function unless you send something from the broadcasting stations. There will be other means of support, but before I touch on those let me say that in so far as estimates have been made it appears that the American public will spend on radio devices during the present year in the United States alone in the neighborhood of three hundred million dollars. By that I mean not only radio sets but all of the elements which are part of the industry—tubes, batteries, material, parts, and a great many other things, telephones, loud-speakers, and so on.

Suppose, for the sake of illustration, the industry taxed itself say two per cent of the selling price of these receiving

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devices and applied that two per cent toward the cost of broadcasting and an agency were set up which would equitably distribute that two per cent among those stations which were rendering the necessary service to the public. Carry that a little further, and if you believe, as I do, that the radio industry will be worth half a billion dollars a year in consumer's prices during the next few years you will find that in that way alone there can be gathered somewhere between three and five million dollars a year for the cost of broadcasting.

I believe, in addition to the support of broadcasting which will come from the industry, and which, of course, is added in the price of the apparatus which the purchaser buys and therefore supported by the consumers, ultimately there will be other means for supporting broadcasting. Public-spirited citizens and benefactors may recognize the great opportunity offered by the broadcast station for perpetuating their names in the same way as Carnegie and Rockefeller and other people have endowed institutions; a radio musical foundation, a radio lecture foundation, a radio operatic foundation is not beyond the bounds of vision and possibility, but I do not rest the foundation of broadcasting on that. It may supplement, but fundamentally, as I say, the industry itself must support it.

Coming to our musical friends. There is one thought that escaped my notice as I was talking, and I would like to add it here. Those who think in terms of paying for broadcasting perhaps naturally think only in terms of music, and that is, Who is going to pay the artists? Now, music, delightful and important as it is, is but one element of the broadcast station. There are a great many other elements, such as national and international sporting events, lectures, and a variety of events which would take place in any event regardless of the broadcast station, which are now finding great favor with the listening public and which obviously need not be paid for.

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These represent a very substantial portion of the program of the broadcast station. I might say that more than fifty per cent of the material which passes from a first-class broadcast station is not musical. The President of the United States, who is always an interesting speaker, to whom the public wants to listen, need not be paid for his address, and so in considering this question I say there is this element of non-paid material which will always represent a very good portion of the broadcast program.

Let me say to my musical friends, if any there be here, or those who may be listening to me through the ether, that I do not believe that up to the present radio has hurt the musical industry. On the contrary, I believe that radio has helped the musical industry and especially helped the artists.

We must remember that there are a great many unknown artists as compared with the few known ones. It is not possible to-day for the most brilliant singer or instrumentalist to come before the public through the conventional method of the concert stage or public hall unless that artist is possessed of sufficient financial means to enable that kind of an introduction to the public. The microphone offers that opportunity gratis. More music-lovers have been created by radio broadcasting in the last three years of its existence than could have been created during several generations by other means, and anything which stimulates interest in music and in the arts stimulates the musical and artistic industries. There can be no denial of that fact.

But I would not have my musical friends believe that I could be so callous as to wish to sacrifice a whole profession on the altar of industry, I believe that the artist, like the laborer, is worthy of his hire, and when we come to the point that the great artists are required at the broadcast stations, and when the technical solution to the problem along the lines which I have sketched, or along similar lines, have

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been found, and when this great artist can play in New York, or in Chicago, or in San Francisco, and be heard throughout the country, why, this method of supporting broadcasting which I have referred to, will be more than adequate to compensate suitably those who are rendering service, and no one believes that in the ultimate development of radio broadcasting the broadcasting station will have any desire or any reason to deny payment for the services rendered, but we ask the support of these musical fraternities and their recognition of the contributions which radio has thus far made to their own business and to their own development.

I predict that the air will be the battle-ground for the Presidential election this year. The campaign issues will be fought in the air, and the convention details, instead of being known by the fortunate few who gain admission to the hall, will be known in every home of the United States. The public will be better informed and better instructed than ever in its life before, and the force which makes for better understanding, better feeling, better government, is a force deserving of the encouragement and the support and sympathy of the entire nation and the entire world.

Whatever the plans of the leading manufacturers may be, unless we have fewer broadcasters, less interference, and more intelligent arrangement of broadcast material, together with more capable performers, broadcasting will eventually lose much of its present power and standing. Yet when one considers the great importance of this new Colossus, it is difficult to see how it can suffer permanent injury because of rash business exploitation. It may receive temporary set-backs, but the whole thing, gaged by

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its usefulness to civilization, is so far beyond mere business considerations that it is easy to overestimate the harm that this business can do to it should present plans miscarry. Business is being intrusted with a sacred charge, and if it does not do justice to it, there is but one recourse left and that is unmitigated governmental control.

Super-broadcasting, if it is carried out, and at present the outlook is that it will be, will probably take advantage of a new department of broadcast research called relaying. While relaying is not altogether a new development, it is new in so far as it affects the relaying of the general entertainment. In the earlier days of the science, time signals from the bristling towers at Arlington were received at various broadcast studios, and after being sufficiently amplified they were fed to the microphone and rebroadcasted on a different wave-length. This was a perfect example of relay work, although little care was exercised in cautiously treating the amplification, since none of the delicate problems of modulation connected wth the transmission of the voice and music were involved; it was simply a matter of dots and dashes.

Relaying, as the engineers interpret the term today, refers to the rebroadcasting of the programs of the bigger studios by smaller broadcasters in out-

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lying districts. The powerful equipment is located in a center where talent is obtainable, and it is the function of the relay equipment to pick up this program on a receiver of high sensitivity, amplify it, and permit the output again to enter the microphone, where the music or voice will pass out into the ether of space for a second time.

This development has been an important step in the economic evolution of broadcasting, and it makes the idea of super-broadcasting very alluring from the commercial viewpoint. The protection of the original quality of the first broadcaster is the consuming problem of the engineers at the present time, but this will eventually yield to the untiring efforts of the more capable designers of receiving apparatus.

Numerous experiments in rebroadcasting or relaying have been carried on under carefully controlled and studied conditions, and the reports of operation have been so satisfactory that little seems to stand in the way of wide-spread application of the idea. The Westinghouse Electric and Manufacturing Company, pioneers in this work, erected a small relaying station in Hastings, Nebraska, and while this equipment could have picked up and rebroadcasted the program of any station that came within range of its receiving apparatus, it handled the output of its mother-station, KDKA (East Pittsburgh),

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exclusively. Save for minor details of operation and little technicalities that will readily yield to persistent investigation, the experiment was considered a success, and super-broadcasting, should it come into use, will have in the relay station an important adjunct. Then the long-distance telephone and telegraph lines, now largely controlled by a single corporation, need not be depended upon in reradiating certain events as was the case with the Democratic and Republican conventions of 1924, when about twenty broadcasters received the reports direct from the respective cities over telephone lines. The cost of this kind of relaying is all but prohibitive when long distances are concerned, while relaying stations, when it is recalled that they need no program directors, publicity men, or studio managers, are reasonably economical in operation and they are not affected by local storms that might interrupt wire service.

All of the experimental broadcasting for the purpose of relaying has been carried on with very short waves, one hundred and fifty meters or less. The purpose of this has been to take advantage of the engineering features of this type of transmission. While the general details are too complicated for discussion here, it might be mentioned that freedom from interference and sharp tuning are the out-

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standing possibilities. It is to be remembered that the lower we go in wave-length the more communication channels will be opened for employment. Perhaps the next move will be to broadcast on fifty or one hundred meters, and future developments may make it possible to go as low as ten meters, although the more conservative engineers may be shocked by the suggestion at this time. Recent experiments of Marconi have offered much evidence in favor of short wave communication. He has this to say about them:

> Radio waves only a few inches long have many advantages over the waves now used, which range in length up to twelve miles. Such short waves can be more easily molded to carry the human voice, and receiving sets tuned to them will be less disturbed by static and interference. Indeed, much of my time is now devoted to experiments with the short waves. So free from interference is the short wave field that I am reminded of my early experiments when the entire field was practically clear and the vast territory of radio was unexplored.

The experiments about to be described may not have any direct bearing on broadcasting for some time to come, but they form such a romantic chapter in the fringes of the science that it was thought the reader might be interested in them. Reference is made to the masterful piece of research work carried

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on by Mr. Ernest Fox Nichols, D.Sc., and Dr. Tear of the Nela Research Laboratories, Cleveland, Ohio. These experimenters have succeeded in generating diminutive waves one one-hundredth of an inch long, thereby adding a fascinating chapter to the history of radio. Let us compare a wave-length one one-hundredth of an inch long with the wave-lengths now employed in broadcasting, which average about 1,060 feet. The production of these short waves foreshadows many things and points to the possibilities of this type of research.

Previous to the work of these two scientists, the shortest radio waves were generated by Righi, a brilliant Italian savant. Righi succeeded in producing waves that had a length of only one-sixth of an inch. When wave-lengths of this size are produced, we are working in that part of the spectrum which is very close to the radiations that produce sensations of heat. Indeed, we might liken the spectrum, visible and invisible, to the scale on a piano. All of the radiations that make up the spectrum are electrical in nature. The waves that excite our optic nerves from a distant street-lamp are fundamentally electric, and they differ from the waves that we tune in on our radio receivers only in length. In the first case, we have many, many thousands of lit-

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tle waves crowded into the space of a single inch, and in the second case we have but a tiny fraction of one wave-length in the same space.

Wave-length is a function of frequency. When we strike the upper note on a piano, a high-pitched sound is produced, and, consequently a short wave-length. As we go down the scale, the wave-lengths produced are longer and longer and the sounds more and more coarse until the final bottom note is reached. So it is with the spectrum. At the one end we have invisible radiations that produce X-rays, radium rays, and ultra-violet rays. Going on up the frequency scale, we come to the visible portion of the spectrum. The fundamental colors are those which we are allowed to see when a beam of white light is allowed to pass through a glass prism. White light has no wave-length of its own because it is made up of a combination of the fundamental colors. The visible part of the spectrum takes a central position occupying a space that practically amounts to a dot, in comparison with the entire length of the spectrum. When we leave the radiations that produce visible red light we come into the invisible portion of the spectrum, at the end opposite the one just considered. Here we have infra-red and heat waves. After the heat waves come the longer waves, ranging in length from very small fractions of an

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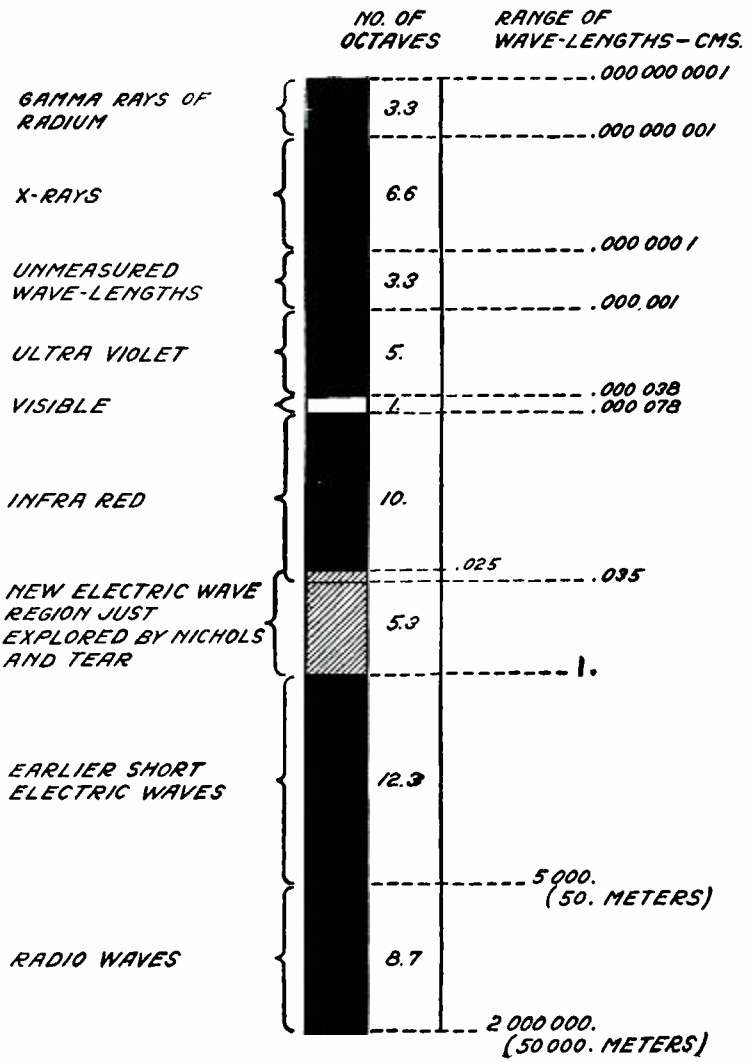

A chart showing the spaces occupied by all of the visible and invisible radiations of the spectrum, including the longer waves used in radio; the shaded region shows the part recently explored by the famous Nichols-Tear experiments

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inch to twenty-five and thirty miles long. These are the radio waves.

A glance at the accompanying sketch will allow us to visualize that which has just been explained. The shaded portion of the scale represents the region just explored by Nichols and Tear.

The problem of producing waves one one-hundredth of an inch long is one that would tax the ingenuity of the most patient physicist. A sketch of the sending apparatus is shown herewith. The sender, or oscillator, is extremely simple, being in a way a duplication of the device used by Righi. Mounted in the end of two glass tubes we have two tiny cylinders to tungsten. These are about one two-hundred-and-fiftieth of an inch in diameter and in length. Two of the electrodes are mounted in the tubes so that their ends come close to one of the ends of each of the two tungsten cylinders. The whole device is immersed in kerosene, and the two outer electrodes are connected to an ordinary spark coil. When these electrodes are energized with electric charges, part of the charges leak across the tiny air gaps until the two little tungsten cylinders become charged to such an extent that a spark passes between them. This tiny spark sets up electric waves in the surrounding ether, and the length of these electric waves will depend entirely upon the

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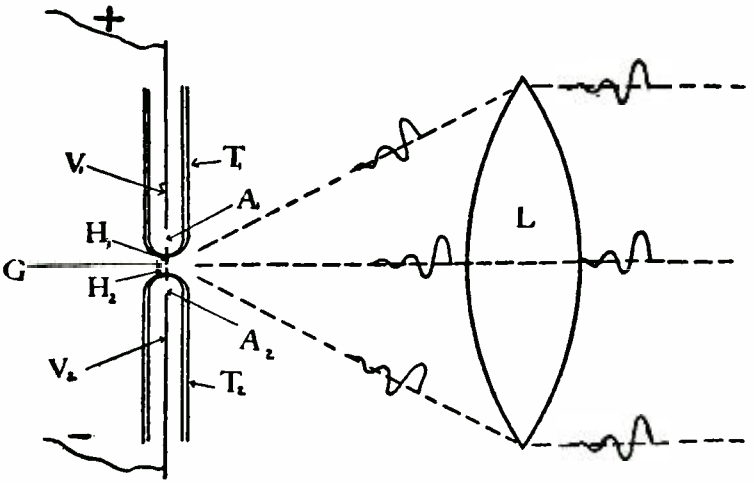
length of the tungsten cylinders and the length of the spark gap between them. We can look upon the two little pieces of tungsten as forming the parts of a complete radio transmitter so small that it is able to produce waves one one-hundredth of an inch long.



How the tiny waves generated by Nichols and Tear are focused through a paraffin lens; the lens is marked L, while the small gap is marked H and H_2

Since radio waves are the same in nature as light waves, it follows that they obey the same laws. The heat waves passing though a burning-glass are concentrated, and consequently their heating effect is multiplied. We can cause short radio waves to pass through a lens in much the same way. The lens, however, cannot be made of glass, since glass offers

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high resistance to the passage of waves of short length. A lens of paraffin is used, and this concentrates the waves into a beam. By using a receiver of special design, an interferometer, and an analyzer, Nichols and Tear were able to add a great deal of data to our knowledge of short waves.

Other notable work in actual voice transmission on waves of ten meters has been accomplished by Francis W. Dunsmore and Francis H. Engle, two radio engineers of the Bueau of Standards, Washington, D. C. They built a special parabolic reflector, and using a vacuum tube transmitter with only fifty watts capacity they were able to transmit a distance of several miles. Their report drew attention to the fact that static disturbance was conspicuous for its absence.

The writers are inclined to attach significance to a recent device developed in the laboratories of the General Electric Company by Mr. Charles A. Hoxie. Mr. Hoxie has produced an instrument which he calls the Pallophotophone. The Pallophotophone is a marvelous recorder and reproducer of sound, and as such it may one day become an important adjunct to broadcasting. In this respect it can give the very best phonographic apparatus cards and spades. The phonographic instrument as a recorder and reproducer of complex sound vibrations has many short-

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comings. Most of the trouble appears to lie in the reproducing part of the equipment. The phonograph disk contains a fairly faithful record of the sounds to which the master record was originally exposed, but our reproducing instruments are unable to bring forth all that the records contain. A surprising percentage of the sound is lost, and consequently the phonograph is by no means a perfect instrument. Its efficiency mark is unpleasantly low. For this reason the phonograph has never been successfully employed in broadcasting stations. Of course it has been used a great deal, but only as a makeshift and to fill in time. In fact, many critics of broadcasting have stood flatly against its use at all.

Any sound-reproducing apparatus causes a certain amount of distortion. A radio broadcast transmitter will distort certain sounds. When a phonograph is placed before it, the distortion caused by the phonograph is increased by the radio transmitter.

Mr. Hoxie does not place his sound record upon an impressionable disk, but rather on a sensitive photographic film. Before the possibility of the wide use of the Pallophotophone is discussed, a brief description of its modus operandi might be interesting. In the diagram a mouthpiece is shown which has a diaphragm connected to its small end. Attached to the diaphragm there is a tiny mirror

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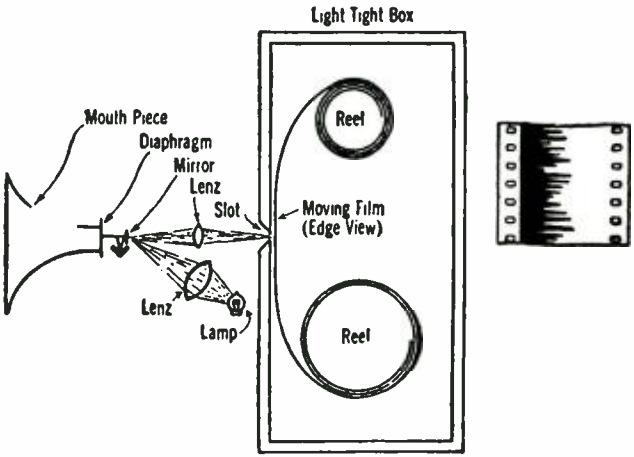
upon which an incident beam of light is allowed to fall. This beam is reflected from the mirror upon a rapidly moving motion-picture film. When the mouthpiece is spoken into, the tiny mirror is shocked



Courtesy of Journal American Institute of Electrical Engineers

A diagram showing the operation of the Hoxie sound recorder. At right will be seen a small section of the sound film after it has been developed

into vibrating in sympathy with the voice waves, and the path of the tiny beam of light in turn is constantly changed, by reason of the motion of the mirror. In this way the record that the light leaves upon the motion-picture film is in exact agreement with the movement of the mirror and consequently with the fluctuations of the voice. Here we have a record of the human voice, or of music,

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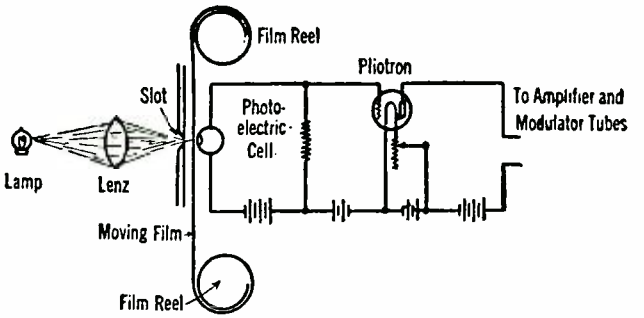
written upon the film, and it is a faithful record, since the tiny mirror of the reproducing element weighs only a few milligrams and therefore has very little inertia, a fact that enables it to keep step with the rapidly fluctuating sound waves.

After the record of the Pallophotophone is developed it is placed in a special projection apparatus.



Courtesy of Journal American Institute of Electrical Engineers

This diagram shows how the film carrying the sound impressions produced by the Hoxie sound recorder are reproduced for radio transmission

A light beam from a powerful source is allowed to pass through the film and strike upon what is known as a photo-electric cell. A photo-electric cell is a device which changes its electrical resistance under the action of light. As the film moves, fluctuation will be caused in the beam of light by the light record of the sound upon the film. It is evident that the amount of light striking the photo-electric cell will

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fluctuate in sympathy with the voice impressions upon the film. The current flowing in the circuit containing the photo-electric cell will also be changed, and these changes will also be in sympathy with the original record made upon the film. These small current changes are amplified with ordinary vacuum tubes, similar to those which we employ in the amplifiers of our vacuum tube receivers. If the output of these amplifiers is carried to the amplification and modulation tubes of the broadcasting outfit, the voice on the film may be reproduced and launched into the ether to be picked up by all who are listening.

Tests made during the past two years with Hoxie's device have been delightfully successful. On numerous occasions it has been used for broadcasting purposes at the WGY station of the General Electric Company at Schenectady. The listeners on the outside were absolutely ignorant of its use, and had they not been told that they were listening to the Pallophotophone they would never have known that the instrument was in use. This indeed speaks well for the faithful reproduction that it makes possible. So perfectly does it operate that even those with the most critical sense of hearing are unable to distinguish between the broadcasting of the Pallophotophone and the original human voice.

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The Pallophotophone may mean much for the future of broadcasting whether by wire or through space. With it it will be possible to gather program material from all parts of the world. The hunter diving into the wilds of Africa will not only bring back with him moving pictures of the wild life but will also bring to us the roar of the lion, the twittering of the fowl, and the chattering of the monkey. How novel it would be to have the Pallophotophone set up in the jungle and work through the night recording the sounds of the nocturnal prowlers and all the weird noises of the bush, to which we could afterward listen in our arm-chairs at home! Think of scientists studying the languages and habits of the savages of Borneo and Fiji. They could bring back to us records of the native tongue, songs, and ceremonials. The Pallophotophone can bring to us the roar of Niagara, the sound of the hissing steam of the geyser, or the rumblings of Vesuvius. It can "can" a program of any kind, and anywhere. The speeches and lectures of great men can be recorded and rebroadcasted later on. Already records have been made by Secretaries Denby and Weeks, General Pershing, and Dr. William Gates, a famous student of the history and writing of the Mayas.

Some day we may have Pallophotophone cameramen collecting material for use in broadcasting sta-

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tions, in the same way that we now have motion-picture camera-men alertly searching for the timely events of the day that are projected for us weekly on the screen. The Pallophotophone brings every event into the broadcast studio.

What will twenty-five years of broadcasting bring? That is much like asking what will happen when our receiving apparatus becomes so sensitive that relaying stations will be utterly useless and half of the civilized world will be laid open to reception under favorable conditions. Considering that the modern vacuum tube is several million times more sensitive to electrical disturbances than was Marconi's first crude coherer, and that this range of perfection was achieved in about twenty-five years of research, it is not unreasonable to anticipate the development mentioned above. The present broadcasting station or studio is a makeshift. It might be compared with our motion-picture theaters of fifteen years ago. This is to be expected, since broadcasting is young.

The first broadcasting station was rigged up in the private radio station of Frank Conrad, chief radio engineer of the Westinghouse Electric and Manufacturing Company. Our studios of to-day are far more luxurious and convenient, but it is evident that we shall some day have an enormous building given

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over to broadcasting. The broadcasting station of the near future will be a national, indeed, a world-wide temple of art and culture dedicated to the progress of mankind. In this great building there will be at least fifty broadcasting studios, each with its microphone. In another part of the building there will be at least twenty separate broadcasting outfits, all separated in wave-length by but a few meters or by a fraction of a meter. These wave-lengths will be so arranged that all of the stations can operate simultaneously.

But why all the studios and so many stations? Broadcasting is going to grow in importance and usefulness. The broadcasting of entertainment is only one of the things it can do. With our twenty-in-one station we shall be able to have wave-lengths devoted to virtually any subject that might hold the interest of the listener. One wave-length might be devoted to popular science, and the voices of our college professors in physics, chemistry, and electricity might modulate it. Politics, economics, household economy, finance, art, literature, history, news, radio plays, agriculture, and botany are a few of the subjects that present themselves as possibilities. There are other things that can be done. For instance, we might have expert readers reading fiction all the time; lots of people like to be read to. And then we

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must not forget juvenile subjects. Twenty wave-lengths would by no means be too many. But what would we do with the fifty studios? It would take fifty studios to serve twenty wave-lengths efficiently. The programs must be uninterrupted. The "Just a minute, please" and "Please stand by" are among the crudities of the present system. The motion-picture theater used to have the same habit because it had only one machine; after a reel had been run the old familiar "One minute, please" had to be shown. The public were greatly interested in movies, and they disliked these interruptions. Consequently motion-picture theaters moved out of the converted grocery stores, shoe stores, and hardware stores on Main Street and into buildings of their own, into motion-picture theaters. Here they had two machines, and the "One minute, please" was eliminated.

With twenty different studios there will be no need for annoying interruptions. As the artists, lecturers, humorists, sport writers, etc., enter the studio building they will probably go to a chief clerk's desk, where they will receive instructions to proceed to their proper studios. This they will do, and at the specified time they will be ready to broadcast. The announcer in the appropriate particular studio watches for a red light; when he gets this he knows

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that his microphone is on the air, and he at once begins to announce. Thus the broadcasting equipment can be rapidly switched from one studio to another without the least interruption.

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CHAPTER XIII

RADIO AND THE FUTURE OF AMERICA'S COMMERCE

THE annihilation of space and time in the transmission of intelligence is a basic thing in the progress of the world. Our entire industrial and commercial system is based upon rapid and reliable communication. When we rush into a telephone booth or telegraph office we seldom stop to realize that communication is a tremendously important thing. Little copper threads are nation builders.

The future of radio, as it concerns the United States and its position in the world of affairs, is interesting for the prosperity of the country is closely connected with its communication problems. The United States since the war has changed its position from that of a debtor to that of a creditor nation. We hold a dominating position in the finance of the world. Take our merchant marine, for instance, which was once in the hands of foreigners. We now have a merchant marine of fair size, and its success depends upon an independent system of communication.

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Long ago Carthage was the clearing-house for merchandise gathered by her argosies from every country within the known limits of the world. At that time shop-owners were obliged to commit their ventures to the hands of captains, and they had no knowledge of their losses or gains until their vessels touched the home port. The advent of the submarine cable changed this to some extent, but it was not until radio came that the modern owners of cargo ships were able to keep in constant touch with their captains, agents, and customers in every corner of the world.

Many persons are inclined to look upon radio simply as an aid to safety on the sea. Its value in this respect cannot be disputed, but, on the other hand, the part radio plays in commerce over the high seas is also of tremendous importance.

A man who carries on a business in this age without the use of a telephone does so at enormous disadvantage, and he is continually inconvenienced. So it is with a nation that cannot talk to other nations sufficiently, cheaply, and quickly.

The British Isles are the nerve-center of an elaborate world-wide network of submarine cables. When the cables of the world were laid, Great Britain realized the advantage of having them pass through London, and her success in bringing this about has

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been of a great deal more benefit to her than the control of the Suez Canal or the strait of Gibraltar. A glance at a cable map shows cable lines from every corner of the civilized world touching at the British Isles. This has given Great Britain a commercial advantage that is difficult to reckon in dollars and cents. It goes without saying that the commercial interests of England avail themselves of the many opportunities that come through control of world communication. It would be a blundering economist who would contend that Great Britain could have attained and held her position as a chief factor in international commerce, had she not made the British Isles the hub of the world's submarine communication system.

Before the Great War Great Britain was finding a dangerous competitor in Germany, who had realized too late what Great Britain had realized years before. The system that Germany had laboriously built up was almost completely smashed, and it has been eliminated for some time to come as an important factor in international communication.

The British have instantly available a vast amount of information relating to the export and import business of the United States. This fact was brought out in a statement made by Newcombe Carlton before a Senate subcommittee a few years

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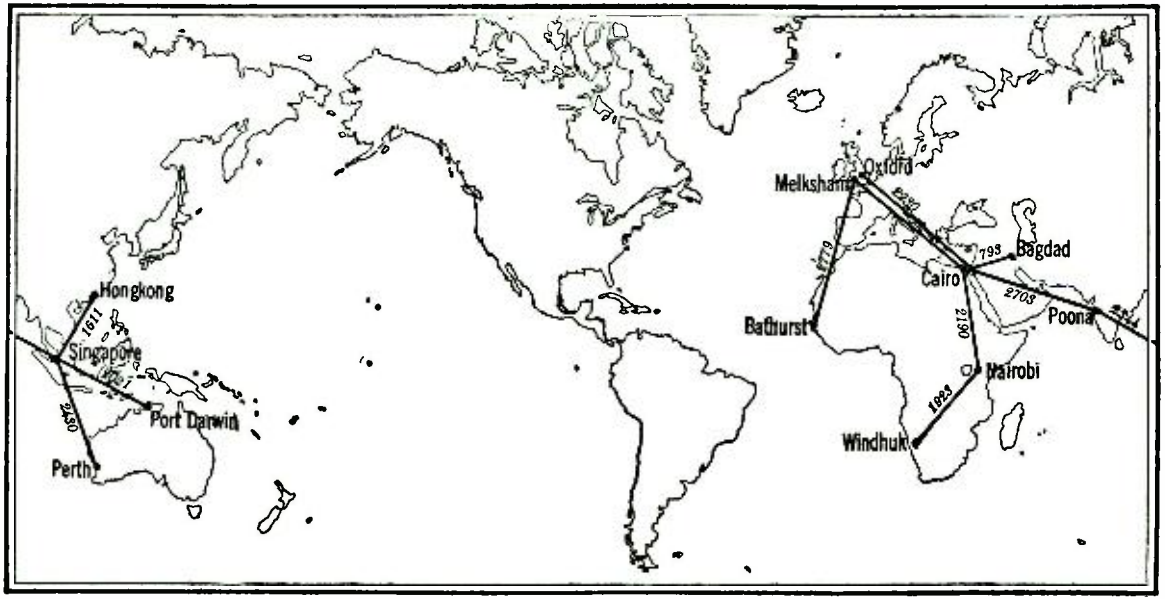

Courtesy of Journal American Institute of Electrical Engineers

The present English plan for a world-wide radio system

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ago. Documentary evidence exists which proves conclusively that Great Britain did take undue advantage of her position during the war to gain access to commercial secrets relating to the trade of her rivals. It was during 1917 that the War Trade Intelligence Department made a report to the British Foreign Office containing priceless information about the conditions of the American metal market. A copy of this document found its way into the hands of every British metal manufacturer; this report, insidious in its nature and far-reaching in its effects upon our own industry, is known to have had no bearing upon Germany's efforts to smuggle contraband past the blockade.

This report and others of a similiar nature emphasize the objectionable character of the British espionage system conducted in connection with the cables that touched the British Isles.

With the United States and Great Britain left out of the consideration, the cable systems of other nations of the world are relatively unimportant, and the messages that buzz through them sooner or later find themselves under British surveillance. If the cables do not pass through the British Isles they touch British territory in some other part of the world.

Belated activity on our part gave us a position

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second to Great Britain, who was wise enough to establish cable supremacy when that system of international communication was in its infancy. The octopus-like structure that comes under her control was due not only to shrewd, sagacious diplomacy, but also to a control of the world's output of gutta-percha, which was, and still is, used as the principal ingredient of cable insulation.

A diplomat cannot blame Great Britain for her policy. She took advantage of a circumstance and probably paid a great deal of money for the advantage, but nevertheless the situation as it exists to-day is a subtle danger to the extension of our foreign trade. It is true that we have stretched our cables to the shores of South America and other foreign lands, but we are still forced to do a large volume of our foreign business through channels of communication that are controlled by our most potent rival for foreign business.

In radio the United States will find salvation, and the advent of this new channel for international intercourse has found us awake and alert; it has helped us out of our dilemma. To-day we are confronted with an opportunity of not only strengthening our position in world-wide communication but of making our country the absolute center of this type of communication. Although the intensive

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application of radio telegraphy and telephony will not enable this country to offset the advantages held by Great Britain for a few years to come, it will nevertheless prevent our rival from dominating radio as she has dominated the cables.

Until a few years ago commercial radio was controlled by the British Marconi Company and the Marconi Wireless Company of America. Faithful to her traditions, Great Britain saw to it that the American Marconi Company should be a subsidiary of the British Company licensed to carry on its business in America. Our own government, after taking up the advisability of a government-owned system, gave its support to a financial group that was organized to give America the control over its radio communication which it so badly needed. This organization purchased the American holdings of the British Marconi Company, and, with the consent of the stockholders of the latter concern, absorbed the company, giving the United States control of one of its most vital commercial instrumentalities. This new organization, the Radio Corporation of America, at once entered into negotiations with the British interests concerning radio communication throughout the world; at last America was in a position to talk business.

Our present scheme for world-wide radio com-

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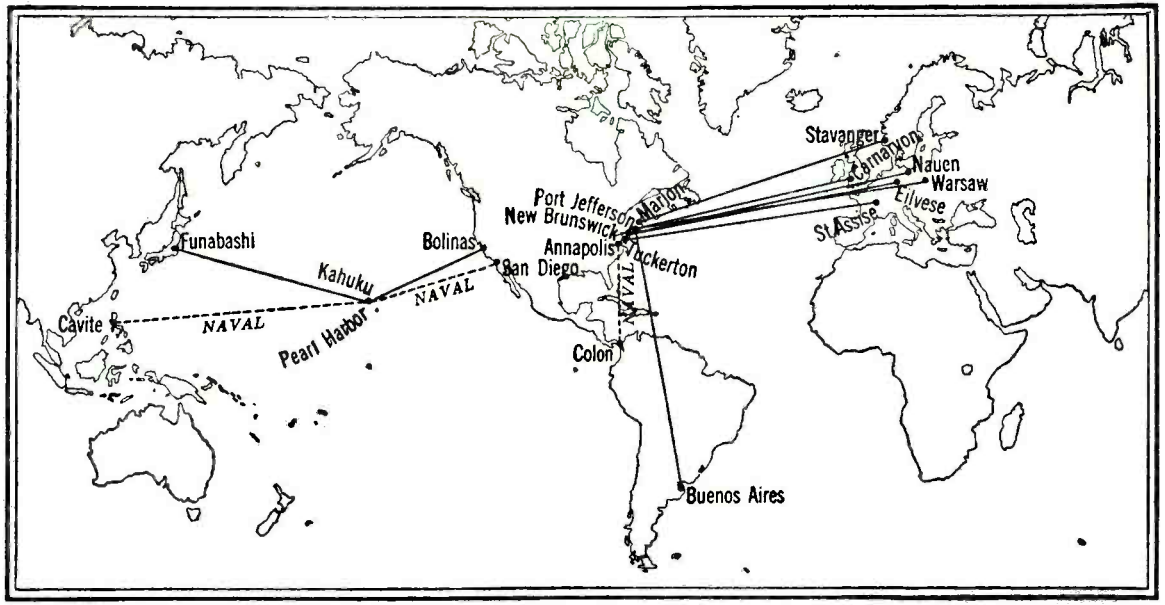

Courtesy of Journal American Institute of Electrical Engineers

The American radio plan for transoceanic communication

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munication is an ambitious one, and its completion will give the Uniter States a leading position in the affairs of the world. In order to make up for lost time and to gain strength where there is now weakness, we are planning our new radio system with shrewdness and with every intention of taking due advantage of our geographical position.

An adjunct to the new American venture is a group of engineers who are to be compared with the best in the world; through their unremitting labor in the perfection of the art, this country has been enabled to take the lead. Our engineers and technicians have not worked without coöperation, for commercial and governmental interests have applied the new developments as fast as they have been brought about, and, as a result of the concerted effort, this country has available to-day enormous facilities for international radio service. The swift progress of the art, since the first historic message was flung across the ocean by Marconi in 1902, has culminated in enabling this country to divert no less than 15 per cent of its total international communication traffic into radio channels. For one who has no idea of the volume of daily communication that takes place between this country and the rest of the world, it is difficult to comprehend this figure.

Because of technical difficulties that now present

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themselves, American radio engineers do not believe radio will ever scrap the cables of the world. Although the writers are not without technical knowledge regarding radio problems, they do not feel inclined to dispute the decisions of the technicians. Constant association, however, has led them to believe that engineers often lack imagination and foresight and that they often overlook possible future developments that may overcome present difficulties. The many engineers and scientists who passed the booth of Alexander Graham Bell at the Philadelphia Exposition smiled and pitied the man. They, too, failed to appreciate the fact that future development would bring the telephone to the important place it now holds. We need not be accused of idle speculation when we say that all the cables of the world will be scrapped within the next thirty years unless some genius increases their carrying capacity by further multiplexing. When the day of the cable has passed we shall find the United States holding an enviable position in the communication system of the world.

Radio offers many advantages over the cumbersome cables that lie under the water. It forms an invisible bond between the nations of the world, and it will some day become a powerful binder of the peoples of the earth. Cables run from one landing

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place to another in as straight a line as possible. They can be cut in times of war, and if they are not cut messages passing over them can be censored by those who happen to be in command at the ports where they terminate. Invisible radio waves pouring over the face of the earth can in no way be interfered with. When a radio message is sent it may reach all parts of the world. If in code, it is confidential, and if in plain language, it is available to the world at large. Ernest F. W. Alexanderson, inventor of the Alexanderson alternator, puts it this way: "It is not an exaggeration to say that the emancipation of the human spirit began with the invention of the printing press. It has found its fulfilment in radio communication."

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CHAPTER XIV

THE RADIO RECEIVER OF THE FUTURE

EVERY owner of a radio set is curious to know what form the radio receiver of the future will take. As to the immediate future we can guess with reasonable sureness, but as for the receiver of the far-distant future we shall, of course, have to speculate.

In certain respects, the purely physical development of the radio set will follow that of the phonograph. The first phonographs were nothing but ugly masses of uncovered machinery. They were as far from artistic as the daubs of the futurist artist. The tidy housewife who had a sense of artistic harmony strenuously objected to their presence. But in a few years the phonograph manufacturer had realized that he must incase his mechanism before the phonograph could take its place in the living-room. Thus the incentive for the artistic evolution of the phonograph was supplied and the phonograph became a thing of beauty. The morning-glory horn suffered and died, and its passing brought the phonograph into the furniture class.

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The early phonographs owe no apologies to the majority of the radio receiving sets of the present. The radio set of to-day is a makeshift, and the plain cabinet with its unsightly knobs, dials, and switches cannot take its place beside other articles of furniture. In the living-rooms of even the most modest American homes it is sadly out of joint with its surroundings. If the B batteries are outside the cabinet, unsightly wires have to be run around, and these by no means add to the artistic appearance of the cabinet.

The radio receiving set is bound to follow in the footsteps of the phonograph. And so for the immediate future we can look forward to rapid strides in the domestication of the radio receiver. The last five years of research have brought about a marvelous increase in the sensitivity of radio receivers. The super-heterodyne, the super-regenerative, and the radio-frequency circuit have ushered in a new era of reception. Few of us stop to think that the increase in sensitivity of radio receivers hastens the perfection of transmitting apparatus. If we had to use the radio receivers that were available ten years ago our broadcasting stations would have to be five times as powerful as they are to cover the same distances, and if they were five times as powerful, the technical problems involved would be corre-

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spondingly greater. Every improvement in receiving apparatus will contribute to the simplicity of the modern transmitter, until the day is reached when we shall have instruments so responsive to infinitesimal whiffs of radiated energy that a fifty- or one-hundred-watt broadcasting station will be heard throughout the country.

If the increase in the sensitivity of radio receiving sets proceeds with the same rapidity as has been displayed in the last two years, it will not be long before a two-tube set will bring the program of every station in the United States to our fireside. We must, of course, not overlook the great improvement that has been made in vacuum tubes. They have become more sensitive, and of course the modern receivers depend entirely upon them.

The receiving set of the future must be simplified, and it will be. The ultra-sensitive outfit of to-day is not an easy device to manipulate successfully, and many people have accordingly been prevented from buying outfits. The more sensitive outfits have entirely too many controls because of a multiplicity of tuning devices and needless accessories. Little or nothing has been done toward the perfection of the ultra-simple receiver. Indeed, the opposite has been true. We find many manufacturers producing more accessories to litter up the panel of the receiver. It is

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true that some of these devices make for greater efficiency, but that advantage is entirely offset by the additional complexity they introduce. A few years ago the automobile manufacturer had to draw the line on accessories, since inventors were putting every conceivable kind of device and instrument upon the dashboard, a point was being reached where the driver of the car would have had no time to watch the road if he wanted to take care of all his devices.

It is high time that our engineers began a series of investigations designed to give to us a receiver with one moving control that will enable us to exercise perfect regulation over the stations that we tune in. The only other thing on the outside of the receiver should be a small switch in the filament circuit of the vacuum tubes. With a single control outfit it will be necessary so to correlate the tuning instruments that they will function when placed on the one shaft. This is not impossible to-day, and we can look forward to very interesting developments in this direction. The coming of short wave transmission should facilitate the perfection of the single control receiver, since short waves allow much sharper tuning than is possible with the longer wave-lengths. Perhaps a new circuit will be discovered that will make it possible to eliminate one or two of the tun-

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ing devices that we now employ. Tuning is now accomplished by changing the values of inductance (amount of wire) and capacity (amount of electrical capacity).

The ideal radio set must be batteryless. Every radio user who has had anything to do with storage-batteries is thanking his stars for the dry cell vacuum tubes that were placed upon the market a short time ago. If there is such a thing as a radio heaven, surely these tubes are a gift from it. The heavy, ugly storage-battery, with its corrosive gases and odors, should never have been admitted to the household. It is a positive nuisance, always needing attention, and has no more place in the home than a cow or a goat.

We still have the B batteries to contend with, although it is now possible to replace them with devices costing less than fifty dollars. They, too, are trouble-makers, but fortunately they are not cursed with the defects that make the storage-battery so unpopular. They are, however, expensive, and they add considerable to the cost of maintaining our radio receivers. Even the dry cells that light the filament of our newer tubes must go.

We are closer to the realization of the batteryless radio receiver than we may think. In the laboratories of the General Electric Company there has

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been developed a vacuum tube which may make the dreams of many radio users come true. A vacuum tube is being developed which will take its plate current from our standard lighting circuits.

The present-day radio sets do not give us absolutely distortionless reproduction. The causes of the distortion are numerous; the ideal set of the future must be so constructed that it will eliminate the distortion. Distortion is caused in several different parts of our present receivers. It starts in the vacuum tube; the amplifying transformers add to it; and our telephone or loud speakers add still more. In fact at present it is undesirable to go beyond two stages of audio-frequency amplification, because distortion increases rapidly beyond the third tube. The first vacuum tubes were terribly noisy; remarkable work has been done towards the elimination of the noise during the last several years. Enough work has been done, indeed, to prove that radio engineers will eventually master the situation. The same is true in regard to transformers. The writers regret that they cannot say that the same holds true for our loud-speakers and telephones, the principal sources of distortion. It is not that we do not have conscientious telephone and loud-speaker manufacturers. Seventy-five per cent of the manufacturers are conscientious, but they have not found the se-

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cret of sound reproduction. Neither have the phonograph manufacturers discovered the secret, for that matter, and the ills of the phonograph in this respect are just as numerous as those of the radio receiver. The cause of the distortion in both the phonograph and the radio set can be laid at the same door. In each case we are trying to reproduce complex sound vibrations by causing vibrations in a thin piece of circular metal called a diaphragm. In the case of the phonograph, the vibration is communicated to the diaphragm of the tone-arm though the needle that makes contact with the impressions on the record. In the radio set the sound is reproduced by causing current fluctuations in the magnets of a telephone receiver. These current fluctuations cause sympathetic magnetic fluctuations, which act upon the diaphragm and cause it to vibrate in approximate unison with the sounds that are being produced in the distant broadcasting station.

There is a law in the physics of sound that tells us that each body has a natural sound period of its own. For intance, if we set a tuning-fork in vibration by striking it, the rate or frequency of its vibrations will depend upon its physical dimensions. Tuning-forks of a certain size, therefore, always set up sound waves of a definite length. The same law holds for any body, even the telephone receiver

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diaphragm. There is one frequency at which the telephone receiver diaphragm is most responsive, and that frequency is the natural frequency of the diaphragm. But we call upon the diaphragms of our phonographs, loud-speakers, and telephone receivers to respond to a wide range of frequencies, and it is quite natural that they cannot do this effectively. It is a physical impossibility. In addition to this, there is the problem of inertia. A diaphragm does not respond to magnetic pulsations as quickly as it could be desired; this is also a cause of distortion.

To sum matters up, we must find a new way of creating sound waves from fluctuating electric currents, and this must apparently be done without resorting to the use of vibrating bodies. It is evident that we shall have to find some way of setting the air into direct vibration without depending upon any intermediate medium. The problem sounds like a hard one. It is a hard one, but it will eventually be solved, and when it is solved a delightful improvement will have been made in the reproduction of music and speech transmitted by radio. The future receiver must have such a device. What form it will take we do not know.

Some years ago, a Dutch physicist developed what he called a thermaphone. It was made up of a tiny

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platinum wire placed in an enclosed glass tube. The tube was small enough to fit into the ear. When voice-modulated electric currents were allowed to pass though the platinum wire it became heated, and as the current fluctuated the heat fluctuated with it. The surrounding air was therefore heated and cooled, and sound waves were thus set up. Here was a way of reproducing sound without depending upon the inefficient diaphragm. Is there not some way of modifying this principle and so applying it as to eliminate our radio troubles?

It goes without saying that the radio set of the very near future will be aërial-less. There was a time, and not long ago, when reception over long distances without the use of outside wires was impossible. To-day we have loop sets that will easily bring in programs over a distance of a thousand miles. The aërials of the future may take the form of a small coil of wire tucked away in a corner of the box.

Will the radio sets of the future amplify at radio- or audio-frequency? How many vacuum tubes will be used? These are two interesting questions, and a little sober reflection might enable us to answer them with assurance of reasonable accuracy. Experience has proved that we obtain purer and sweeter amplification through radio-frequency than we

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obtain by audio-frequency amplification unless it is resistance coupled. For those who are confused by these two terms, it might be well to mention that amplification at radio-frequency is that which takes place before detection. In other words, amplifying tubes would be placed before the detector. Radio-frequency is inaudible or supersonic. It is only after the radio-frequency currents pass though the detector that they become audible, and therefore any amplification added after the detector is audio-frequency amplification. As before stated, the advantages of radio-frequency amplification are numerous, and it seems logical that there will be a tendency toward greater use of this method of reception in the near future.

Let us return to the question of the number of tubes the future radio receivers will have. We might at first be inclined to say fifteen tubes, thinking that the more tubes we have the more sensitive our outfit would be. That is true at present, but the mere fact that we use fifteen tubes demonstrates inefficiency rather than efficiency. Progress will come through the reduction of the tubes necessary until the time is reached when we have but one remaining tube, which will be endowed with incomparable sensitivity and will at the same time possess marked amplification power. We shall some day have a tube

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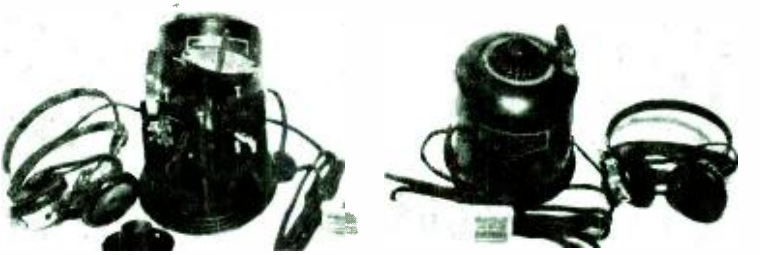

A wired-radio receiver of the amplifying type. The receiver is especially designed for this new service and cannot be employed for ordinary space reception.

Light, heat, motive power, "cold," and music all from the same electric light connection. Reception by wired-wireless in no way interferes with the electric service for the waves are made to follow the wires; they do not travel in them.

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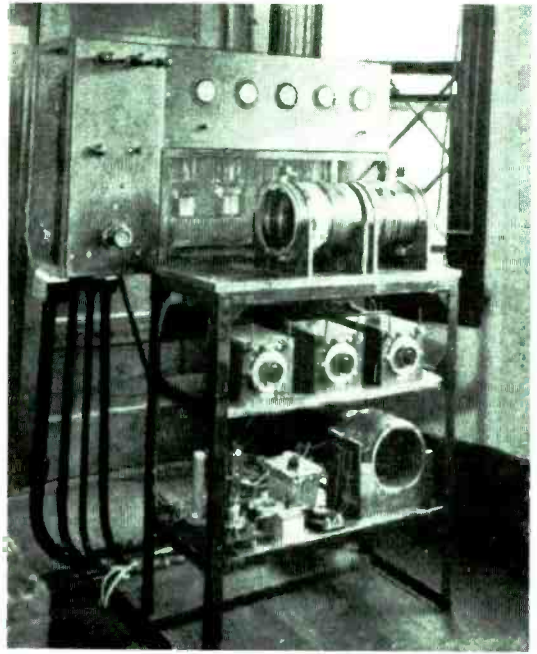
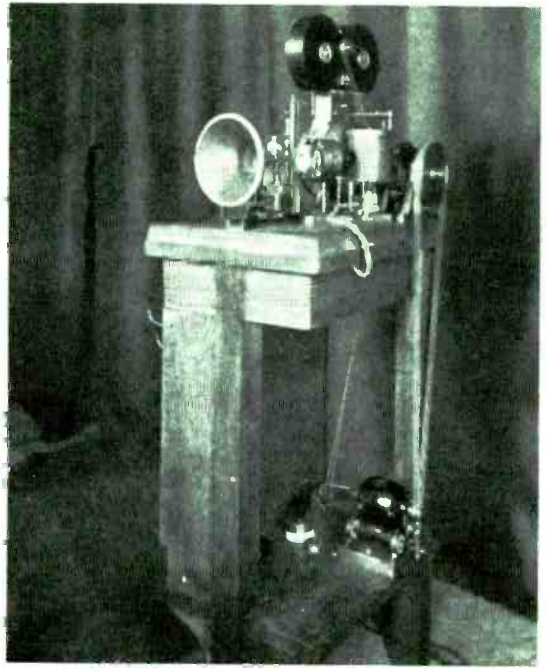


The wired-wireless transmitter. This equipment produces radio waves that are made to follow the light wires reaching out from an electric power plant. The entertainment is made available to electric power consumers by a simple receiver rented by the month.



The Pallophotophone developed in the laboratories of the General Electric. With it sound is faithfully recorded on standard moving picture film. When speech is reproduced before a broadcasting microphone, it is impossible to distinguish it from a human voice.

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that will amplify as it detects. Perhaps it will be a tube with one or more additional elements added and with a special circuit. But whatever its form or shape, it is on its way to us.

The total space occupied by the instruments contained in the radio set of the future will be very small, making possible a truly portable outfit. The portable radio receiver is not in wide use to-day, because it is too heavy and cumbersome. Radio, besides, is still a form of entertainment and not a necessity. As the importance of broadcasting grows, and as broadcasting acquires a more important position in our daily lives, every traveler, whether by land, sea, or air, will be able to have his private portable outfit in his pocket.

If we peer far enough into the future of radio we can visualize a combined radio sound and picture receiver. The combination will be a perfect one, for at any time of the day we may project upon the wall of our home distant scenes, and may hear the sounds that go with them. In the next chapter we shall have more to say about television apparatus and its possibilities.

There is at present a movement on foot in technical radio which means a great deal to progress. During the last three years the demand for radio receiving equipment has been so great that the main

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object of the manufacturer has been to meet the demand, and little attention has been paid to research and technical developments. This has been especially so with the smaller manufacturers. The bigger interests, of course, have continued the work of research, but most of the producers have done very little. With such a situation it was inevitable that our engineers would sometime begin to consider the most inefficient parts of radio receivers. This happened in the middle of 1924, and a new movement toward higher efficiency was begun. It made itself known in the tendency toward low loss apparatus. By this is meant radio apparatus designed not only to prevent the leakage of high frequency currents but also to prevent losses though hysteresis, dielectric absorption, and similar causes. As a result more suitable materials for insulation in condensers, sockets, and coils are coming into use. We are now using such desirable materials as pyrex, isolantite, and quartz. We are indeed at what might be called the checking-up period of radio; manufacturers are being moved by a new consciousness of the need of efficiency. The public, too, is a more educated one than it was years ago, when radio began its career. Radio has lost much of its mystery, and parts are bought with a better understanding of their functions.

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CHAPTER XV

RADIO VISION

THE FRENCH Government recently officially recognized the validity of a signature made by radio. A business man idling at Deauville or Monte Carlo can attach his name to an important document in Paris, and the courts of France will recognize his signature. This is a mark of progress. What France has done this year, America will do a few years hence.

The radio signature is not translated into dots and dashes. The actual facsimile is reproduced at the distant receiving station. Photographs, maps, and drawings can be sent in the same way.

"All of this is wonderful, very wonderful," says the man in the street, "but, for the life of me, I can't understand how such a thing is possible."

The system employed is simple. The devices used are delicate and intricate, but the basic principle of operation can be described without the use of any Greekish words.

Those of us who have waited for incoming trains at the Grand Central or Pennsylvania Station in

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New York have probably noticed the busy little telautograph upon which train-time appears as if by magic.

If we had looked closely at the device we should have seen a pencil held at the end of several metal rods. The pencil would dash rapidly across the paper, writing humanly on its way. It would seem that it was controlled by a spirit hand. Connected with the receiving telautograph there is a transmitting device, which also has a pencil. When the transmitter is manipulated, electrical currents carry the results of its motions over an electric circuit to the receiving pencil. These act upon the apparatus controlling the receiving pencil in such a way that every movement of the transmitting pencil is faithfully duplicated by the receiver. In this manner it is possible to reproduce writing at a distance.

Although the sysem used in radio is not the same as the system used in the telautograph, the general principle is the same. A transmitting device causes certain changes to be made in the radio circuit, and these changes are picked up by the distant receiver.

There are a number of different systems used in the transmission of photographs by radio, but the systems developed by C. Francis Jenkins, an American, and Edouard Belin, a Frenchman, are by far the most practical.

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When a photograph is to be transmitted by the Belin system, it has first to be treated by a special process. The subject to be shot through space is photographed or printed on a sheet of special photographic paper. The paper is wrapped around a brass cylinder, which is so treated that the image is transferred from the paper to the face of the cylinder. Further chemical treatment brings the photograph into relief on the cylinder. Some parts are raised more than others; an embossed effect is produced.

Every photograph may be said to be made up of certain amounts of lightness and darkness; it has shades varying between black and white. The photographs to be transmitted by the Belin system are prepared in a way that produces a relief effect depending upon the various shades in the picture

For instance, a dark spot in the picture would have a more pronounced relief effect when reproduced by the special process than a light spot would have. In other words, the finished picture, when ready to transmit, in place of dark and light variations, has high and low variations. All the dark spots are high, and the light spots are low; a gray spot on the picture would lie between the extremes.

The picture is now mounted on a brass cylinder that looks very much like the cylinders used in the

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old-style phonographs. A small, especially constructed needle makes contact with the relief picture as it revolves on the cylinder. The needle moves lengthwise slowly along the cylinder, so that it comes into contact with all parts of the picture.

It may take the needle or stylus five or ten minutes to make the trip from one end of the cylinder to the other. Moving along, it bumps over the relief photograph, trailing over hill and dale. As the point of the stylus rises or falls over the uneven surface of the cylinder, it increases or decreases the amount of current flowing through the circuit. When it strikes a particularly high spot of the revolving cylinder the current increases in value, and when it strikes one of the depressions the current decreases. Thus the current changes keep pace with the movement of the stylus. The stylus is connected directly to a wireless transmitter, and the changes of the current that are caused by the moving stylus affect the wireless waves that are sent forth by the transmitter.

Thus the photograph is translated into radio impulses. The radio waves faithfully obey the stylus as it moves over the surface of the relief photograph. In this way the picture is shot out into space. Not in physical form, to be sure, but it is there, and

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all that is needed now is an apparatus that will pick up the electrical disturbances and reproduce the photograph.

A wireless receiving station of the usual design is used to detect the picture-laden waves. Detectors, tuning coils, and all the other usual devices are employed. The message is tuned in. Instead of passing into a pair of phones, however, it is carried to a special recording instrument.

The photographic transmitter is simple when compared with the receiver. The receiving apparatus is one of the miracles of the age. It is indeed a rare treat to stand over it and see it pick the likeness of a human being out of the arms of space. Of all the modern inventions, not one is more interesting than this. There is nothing treacherously intricate about it, but a little explanation will be required before it can be made clear.

The currents, instead of passing into a telephone receiver as in ordinary reception, pass into an electromagnet. Although the impulses are extremely weak, the magnet is made in such a way that it makes the most of them. Suspended in the front of the magnet is a sensitive wire carrying a tiny mirror. As the currents surge through the magnet, the wire and the mirror vibrate in sympathy with them. The

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wire is now vibrating in sympathy with the stylus at the transmitter, which may be several thousand miles away.

A beam of light from an electric lamp passes through a lens and falls upon the dancing mirror. The beam in turn is reflected from the mirror through a specially graduated screen. From this point it passes through another lens to a revolving cylinder which carries sensitized film.

The trick of the whole thing lies in the graduated screen. When we once understand the purpose of the screen, the whole thing becomes clear. The screen is shaded; at the top it is light, and it gradually becomes darker until it is virtually black at the bottom. If the beam of light from the vibrating mirror struck on the top of the screen, it would pass through easily, and little of its intensity would be lost. If it struck the bottom of the screen, practically none of it would get through.

In the transmitter the light and dark spots of the photograph to be transmitted were represented by the high and low spots of the relief picture. The stylus causes the distant mirror to shoot the beam through either the dark or the light portion of the graduated screen, according to the low or high spots that pass under the stylus at the transmitter.

In this way the "darkness" and "lightness" of the

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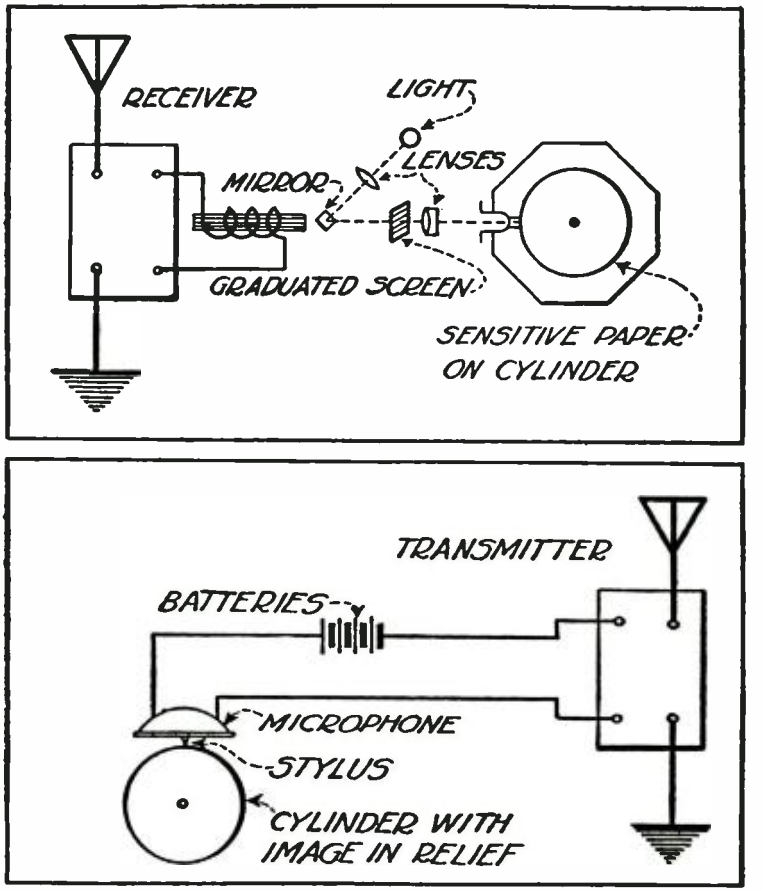

A diagram of the transmitting and receiving apparatus used in the Belin system

photograph are transcribed at the distant receiving station. The lens, which is placed between the sensitized paper and the screen, is used to steady

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the beam so that it will not always fall on the same spot. The little cylinder carrying the sensitized paper is synchronized with the distant transmitting cylinder. Every time the transmitting cylinder makes a revolution, the receiving cylinder makes a revolution also. The two are always in step.

That is all there is to the radio transmission of photographs. Signatures are transmitted in the same manner. After they are penned, a photograph is made of them, and they are placed upon the transmitting cylinder. A signature can be transmitted in two or three minutes..

A glance at the sketch will be helpful in visualizing the process involved in one of the more recent methods of radio vision. Here a revolving disk with staggered perforations about its periphery revolves before a source of light and allows a beam to play over a graduated screen. The light beam is also allowed to pass through a photographic negative, after which it impinges upon a photo-electric cell. The photo-electric cell is a very simple contrivance which will allow a certain amount of electricity to pass through it, *the quantity being determined by the amount of light falling upon the cell.* When an intense beam reaches the cell, maximum current is allowed to flow, and, as the beam becomes gradually weaker the current drops correspondingly. Now, it

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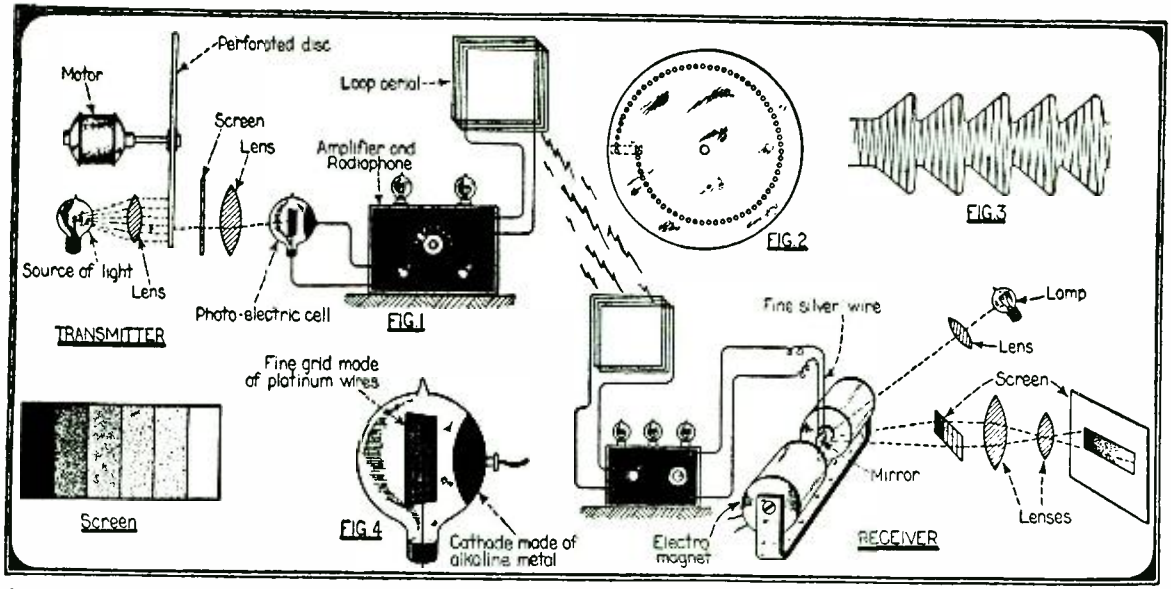

Courtesy Science and Invention

The diagram, Fig. 1, shows how the transmitter operates. Fig. 2 shows how the disc, rotated in front of the screen, is perforated so as to permit a beam of light to cover the whole length of the screen at every revolution. Fig. 3 illustrates modulation of the radio waves produced by the radiophone transmitted every time the ray of light passes through the screen from black to white. Fig. 4 is a detail of the construction of the photo-electric cell which modulates the oscillating current of the radiophone transmitter. The diagram of the receiver clearly shows how a beam of light produced by a lamp and concentrated upon the mirror of the oscillograph reproduces upon a white screen, the shaded screen which varies in colors from black to white, passing through all grades of gray interposed between

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is evident that the intensity of this light beam depends upon the part of the photograph through which the beam is passing. Thus, if the beam is allowed to play over the entire surface of the photographic negative, the amount of current passing through the photo-electric cell will vary between rather wide limits. The photo-electric cell in turn is connected to an ordinary radiophone transmitter in such a way that the wave emitted by this transmitter will be modulated by the light and dark spots of the photographic negative instead of by the sound impulses as is the case with voice transmission.

The receiver which grasps these impulses and translates them back into a light beam of varying intensity is simple. In the sketch we notice an ordinary radiophone receiver and amplifier, the output of which is connected to a tiny coil of wire suspended between two powerful electromagnets. Attached to this coil of wire there is a tiny mirror which is caused to swing to and fro, the degree of the swing being determined by the strength of the modulated impulse. A powerful beam of light is reflected from the surface of this mirror through a graduated screen, and after passing though the screen the beam strikes a sensitized photographic plate. As this plate is moved progressively before the beam of light,

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the light and dark spots of the negative in the distant transmitter are successfully duplicated.

There are many and varied methods of transmitting pictures by radio, but this description will serve to give an idea of the general process. As yet no particular system has been so perfected that it will stand up and give service under the strain of commercial application. The instruments so far developed have been too sensitive, and they are wanting in the dependability and simplicity that are demanded for day-in-and-day-out service. Regardless of their shortcomings, however, it is evident that we are not far from a device that will overcome the present objections.

Within the next five years we shall no doubt see established a news picture service for the larger publications. It will enable them to gather picture material from all parts of the country. The next two or three years may see such a service begun by wire; it is a service that is barely possible even at this moment. It was more than two years ago that one of the writers witnessed the successful transmission of a photograph from the offices of the "St. Louis Post-Dispatch" to the offices of the "New York World." Half an hour was required for the transmission.

When the radio transmission of picture negatives

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is begun the benefits to the newspapers and to the public at large will be great. At present it requires five days for a photograph of a happening in Los Angeles to reach a New York newspaper. With radio transmission of photographs, we could see in our afternoon papers the picture of an event that took place in San Francisco at noon.

The influence of such an invention upon other departments of our social system would also be marked. Facsimilies of legal documents might be transmitted. Such a device would render great service to police departments in broadcasting photographs of escaped criminals.

As this book is written a considerable time element is involved in the transmission of a photograph. From five minutes to an hour is required to effect the transmission of a photograph. This time must be reduced and will be until instantaneous transmission becomes possible. The idea of the instantaneous conveying of a photograph from one place to another leads to many interesting speculations. The successful transmission of motion-pictures is a development that rests entirely upon the amount of time involved. If we could transmit one picture instantaneously we could transmit moving pictures very easily, since only sixteen per second would be required to produce the optical illusion that we now

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witness in the moving picture theater. The writers do not believe that they are unduly enthusiastic when they assert that we shall have broadcasting of moving pictures within the next ten years. Science has placed at our disposal all the requisities, and we have but to find a way to use them. The less optimistic reader may not accept this prediction, but who ten years ago would have believed that five million American homes were going to have radiophone receivers? Much can happen in ten years, and one single discovery may place in the arms of civilization a picture-broadcasting device. We are living in an age of rapid discovery and rapid exploitation.

We shall, moreover, have broadcasted with the moving pictures the voices of the artists. The entire program that we see in a theater will come to us. In fact, the moving-picture theater as we now know it may cease to exist. Why should people leave the comfort and warmth of their home on a winter night to seek entertainment that can be brought to their fireside by radio? That does not mean that the producers of moving pictures will not continue to capitalize their artistic efforts. It simply means that there will be no more use for the moving-picture theater as an institution and that we shall pay a service fee for the privilege of enjoying the

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program. The ether will vibrate with the likenesses of our favorite stars, which we shall receive faithfully.

Beyond the transmission of still and moving pictures lies the possibility of direct radio vision, which will mean the direct transmission of the light variations that now affect our optic nerves. We see by means of reflection. A body is black because it does not reflect any appreciable amount of light, and a body is white that reflects all of the light that falls upon it. The color of a body and its brightness depend upon the light it absorbs and the light it reflects. It is not impossible that these various degrees of light intensities and colors could be successfully used to modulate a radio wave. When the problem is finally solved the world will indeed become a very small place to live in. The living spectacle of Niagara, with its rush and roar, or the vast abyss of the Colorado Cañon can be brought to us. We can travel through Africa, Asia, and Europe while seated in the easy-chair at home. Our baseball players, instead of performing before a group of spectators, will perform before a radio transmitter, and we shall hear the whack of the bat and the call of the umpire, and see the dust raised by the sliding player's feet.

Radio vision is not an idle dream; we can at

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least name it among the possibilities of radio. With radio vision we shall see the friends to whom we are telephoning. The Joneses or the Smiths may indeed pay us a call on a bad night without bringing their physical persons along at all. This may sound like fanciful speculation, but in the rapidly moving world of to-day there is very little that stands between speculation and reality.

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CHAPTER XVI

RADIO'S LONG ARM

A FEW years ago Nikola Tesla, to whom the world owes much for his daring experiments and practical development of electrical inventions, made the statement that within twenty-five years we would be sending crewless ships guided by radio to every port in Europe. The prophecy was not taken seriously by many, but before ten years had passed a ponderous mass of steel weighing many thousands of tons had been given a sense of direction by the impulses of radio. The writers refer to the old battle-ship *Iowa,* which was rigged up with the Hammond radio control system. Without a man on board, the proud old ship, once the navy's pride, was guided over the waters of Delaware Bay. The steam entering the engines was under the control of a radio-operated throttle. The propellers and even the liquid fuel flowing to the flames beneath the boilers were obedient to the will of distant operators.

Tesla has lived to see the world well on the way

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to the realization of his dream. The experiments with the *Iowa* were wonderfully successful, and, if many thousand tons of lifeless steel can be given a sense of direction, surely there must be many other things in the world that could be easily operated by radio. It almost seems that the world will soon be regulated and controlled by ethereal impulses.

It may be difficult for the layman to understand just how a great mass of steel can be placed under such perfect control. He will probably be surprised to know that the control is maintained by comparatively simple devices.

When the earlier attempts were made at controlling mechanisms over distances, radio engineers had little to work with in the way of reliable equipment. Transmitted impulses were weak, and there were no practical means of amplifying them. When the vacuum tube arrived the problem was greatly simplified. A received impulse could be amplified until it became strong enough to cause an appreciable effect when it passed into the proper kind of an instrument. When perfect amplification became possible, the rest was comparatively easy. Weak impulses could not be relied upon, but now that the engineer had been placed in possession of the vacuum tube, the science of radio-dynamics developed rapidly.

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For those who are seriously interested in radio, a brief description of the operation of a modern control system may not come amiss. Most readers are probably familiar with the electrical instrument called the relay. This is a device to enable a weak current of electricity to control a heavier one. A radio relay is like an automatic switch. A radio impulse is very weak even when heavily amplified, and of course it could not be expected to do much work. In the radio relay the current enters a pair of heavy magnets, and it produces just enough magnetism to move a delicately balanced arm or armature. The armature has a contact point arranged at its end, and when the armature is moved even slightly the contact point meets another contact point, and another independent electric circuit, which has a heavy current flowing through it, is closed. This, in turn, may close another heavier relay. Thus the big motors that move a ship may be eventually placed in operation. Of course, the impulses travel through these relays very rapidly. Thus a weak impulse which would not be able to annoy a fly may move even a battle-ship.

It is not difficult to foresee that reaching out into space with the long arm of radio must some day play an important part in our civilization. We have only begun to travel down the road that will eventu-

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ally lead to the radio era. The dreams of to-day are the realities of to-morrow.

Battle-ships are not the only machines that have been tamed to radio. The airplane as well has been controlled through the ether. During the war intensive research was done on radio-operated airplanes, and strenuous efforts were made to perfect a manless ship of the air that could be flown over German cities. Some success was attained, but it is evident that the airplane cannot be so readily subdued as the more passive battle-ship. Airplanes were made to fly, however, and they were steered and controlled by this means, but the control was not reliable, and a number of years are likely to pass before we have a perfectly controlled airship. But come it must, and doubtless we shall have crewless airplanes sent to every port in Europe just as we shall have ships in the sea.

Multitudinous devices lend themselves to long-distance operation by radio, and it is natural to assume that these devices will be the first to be brought under radio control. Light-ships, light-houses, and light-buoys could be very profitably brought into the radio realm, and there is also the possibility of radio train control, which many inventors have tinkered with. Extremely important development work in this direction has been done

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in Germany. Radio control is used successfully on the Berlin-Hamburg Railroad; it is not possible for the engineer to pass a stop signal, for a radio mechanism automatically applies the brakes.

Let us imagine a limited train with a string of passenger coaches rushing through the night at a seventy-mile gait. There is the sudden thunder of a terrific impact, a shower of splinters, and the hissing of escaping steam. The engineer has passed a signal. It is not a new story, to be sure, but it is one that has cost many thousands of lives and an appalling amount of property.

It is difficult to appreciate rear-end collision of railway trains. Imagine a hundred souls in a wooden coach, unsuspecting and unprepared, when a mass of steel, weighing several hundred tons and traveling at a rate of sixty miles an hour, plows through it. There is a deafening, terrific impact, and nothing remains but a mass of splinters, mangled bodies, and twisted iron.

Sober thought reveals the importance of reliable and positive train control. The old-fashioned signal system leaves too large a gap for the human element. A mere red light is called upon to stop a train. It is all that stands between a rapidly moving mass of steel and a passenger train following it in the next block. The engineer may be careless; he

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may be stricken with a sudden illness; he may drop dead. Such things have happened many times. In such a situation the warning light is useless.

Radio engineers for some time have thought that radio might be applied to the problem of train control. The subject has been under experimentation ever since the control of distant mechanisms by radio impulse was first undertaken. Now that battleships have been controlled at a distance, why not locomotives, engineers ask.

We may recall a disastrous wreck which overtook the Atlantic City Express not long ago, in which a score of people were killed. The signalman in the tower, though aware of what was going to happen, was powerless to prevent it. He knew that the trains would come together, yet he could do nothing. Had radio train control been perfected, he could have sent forth a signal which could have been picked up by a receiver at the roadside, amplified, and shot into a relay. The relay would have closed a motor circuit, and the motor would have lifted a small arm in the center of the track in front of the advancing train. As the locomotive rushed over the spot the arm would have tripped a device which automatically would have closed the throttle and applied the brakes.

This system is by no means impossible, although

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radio-dynamic probably has not yet been developed to a point where such a system could be installed and operated with entire reliability. But the system can be operated, and has been. A number of railroads have experimented with it, and a few of them have spent thousands of dollars upon it. That considerable work has been done is proved by the fact that in the patent office there have been filed a number of patents covering systems of this nature. Radio engineers know that the problem can be solved, but the systems they have developed thus far have not been able to meet the need. Any device of this nature would have to be absolutely reliable, since it would be depended on to save lives when called upon for that purpose.

Radio control systems now in operation are simple but not very reliable. Contrary to the general impression, however, the received radio energy does not actually operate the distant mechanisms but only controls them. Just as a detonator cap sets off a charge of dynamite, so do received radio impulses release the local energy which controls the motor that lifts up the train control arm in the center of the railroad track. Suppose that in place of our radio receivers we use a very sensitive relay. A relay is nothing more or less than an automatic switch. When a radio signal arrives, it passes

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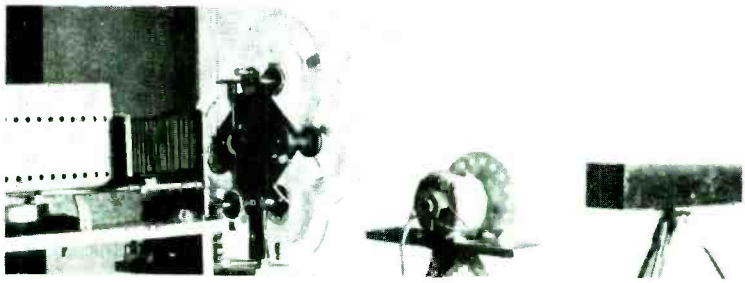
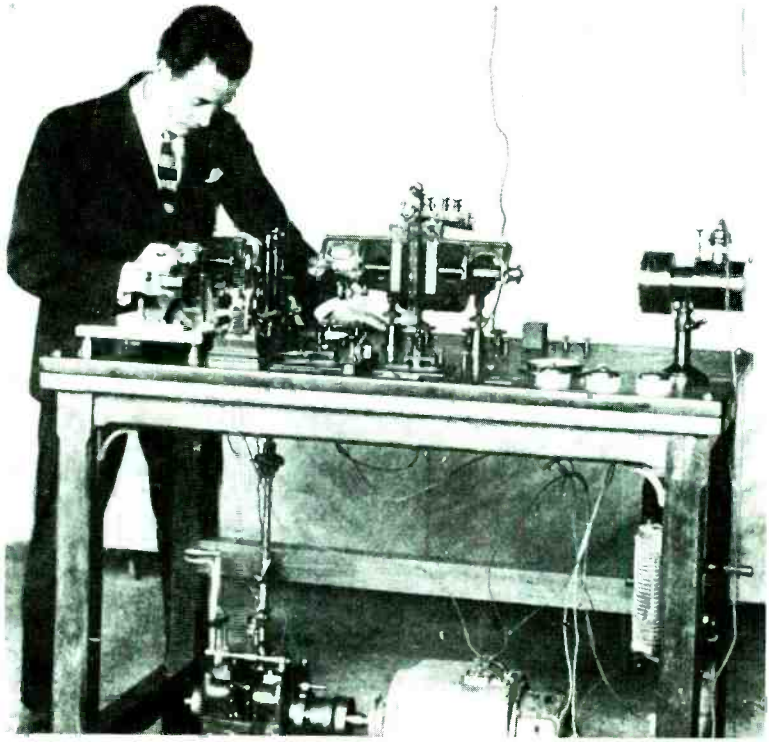


The Jenkins television apparatus which brings science within reach of radio moving picture transmission. This device functions by the aid of revolving prisms and is notable for its simplicity and speed of action.



The Belin television apparatus. Remarkable duplicates of photographs, maps, and documents have been transmitted by this device over distances that were not dreamed possible five years ago.

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A radio-controlled submarine of French design. It is being guided by the boat in its wake which carries the transmitter. This same kind of control has been used successfully on large battle-ships.

Mr. W. G. H. Finch demonstrating his radio-controlled typewriter designed for rapid news service to Mr. Laurence M. Cockaday, famous radio engineer. Mr. Finch is pointing to the highly sensitive relay, the heart of the mechanism.

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through vacuum tubes, where it is amplified, and thence into the relay. The relay closes, contact is made, and current from a local battery is allowed to flow into a motor. The motor can be so arranged as to do anything that is desired.

Some of the country's best minds are working on the train control problem. It must be realized that a radio control system for trains would have to be dependable under working conditions. If, for instance, the devices were placed alongside the tracks, they would have to be rugged enough to withstand the vibrations of passing trains; they woud also have to be insensitive to stray signals and inductive effects that might tend to operate the relays.

If a wireless system were employed it would have to be used in connection with an extensive wire system, since the natural limitations of radio would prevent its application to an entire signal system.

Radio train despatching deserves to be considered in the same connection. As early as 1910, Earl Hanson, who is a well-known radio inventor, was employed by the Sante Fé Railroad to perfect a system of this nature. He rigged up aërials on the cabs of a number of locomotives, and communication was held with the engineers while their trains were in motion. Although encouraging results were ob-

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tained, railroad officials are hard to please, and the experiments were abandoned. With present-day radiophone equipment there apparently should not be much of a problem involved in radio train despatching. The engineer could be kept within listening distance of the despatcher all the time.

Numerous attempts have been made to establish direct telephonic communication with locomotive engineers, but the systems used were ineffective. If there is one need to which radio is adapted, however, it is this one. Many an engineer, if he had been given a warning message in time, could have stopped his train and avoided a great disaster. Of course if he had fallen dead, as perhaps in some cases he did, a radio message would have been of no avail, and radio control would have been needed to save the day.

In New York's subways there is a wonderful system of automatic control by wire devices. No more than one train is allowed in a block at one time. If the motorman of a train passes a block signal, the emergency brakes are applied instantly and without his intervention. While this system works beautifully in the subway, where the more delicate parts are protected from contact with varying weather conditions, it could not be depended on to perform the service equally well on an outside

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track. The time is ripe for some genius to apply radio to the train control problem. A practical solution would mean a saving of many millions of dollars to this country annually.

Yankee ingenuity puzzled the Germans a number of times in the late war. Allied vessels were able to steal into port without a light and without the use of marking buoys or the radio compass. On the darkest nights and during intense fogs, they would find their way through the most dangerous stretches of water with apparently nothing to guide them. There is no record that an accident ever occurred. German submarine commanders were baffled. They could not understand how ships could steal by under their very noses and pass into harbors with nothing to guide them. The credit for this piece of work also belongs to Mr. Earl Hanson. During the war he came east and entered one of the laboratories of the Navy Department at Washington. Here he invented and perfected the invisible radio pilot, which saved the allied countries a great number of human lives as well as vessels.

The Hanson system is not strictly a radio one, but it is closely allied to it. When a current of electricity, even a weak one, passes through a metallic wire, there develops about the wire an electromagnetic field. This spreads out in all directions

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about the wire. The magnetic field is made up in the same way as electromagnetic waves or radio waves. Those who have experimented with electricity know that every coil of wire develops within it an electric current if the coil is allowed to move through a magnetic field. If we take a small coil and move it in the vicinity of a household electric lighting wire, there is generated in the coil an electric current, and if the coil is connected to an electric measuring instrument the presence of the current can readily be noted.

It was these facts that Hanson had in mind at the time he invented the radio guiding cable. First, he laid a cable on the bottom of the channel. Then he connected the cable to an electric generator, which produced an alternating or pulsating current. Next, he rigged up an old boat and placed a large coil of wire on each side of it. These coils of wire were connected to vacuum tube amplifiers. He set out on his first journey with the thought that this simple arrangement would allow him to keep his ship directly over the cable that was in the river-bed. Experiments proved that he was right.

The United States Navy at once became interested in the possibilities of this new arrangement, because of its adaptability as an adjunct for the prosecution of war. After further work on the perfecting of the

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system, a cable was laid through the Narrows into New York Harbor. A 1½ horse-power generator, producing a current which alternated at the rate of five hundred times a second, was installed at Fort Lafayette, which is a small naval magazine located near Fort Hamilton. The generator was connected to the cable, and it was interrupted by an automatic transmitter which constantly spelled out the word "navy" in the Continental Morse Code. This was done so that the signals received on board the ship should not be confused with other signals from the various stations about the harbor.

The United States destroyer *Semmes* was equipped with the necessary detecting equipment. Two large coils wound on huge wooden frames were hung over each side of the vessel's bow. These coils were connected to two vacuum tube amplifiers, so that their weak currents could be amplified sufficiently to be heard above the roar of the engines propelling the craft. The radio pilot operated a small switch, which allowed him to change over very quickly from one amplifier to the other. When the switch was moved to the right, he would hear in his head-phones the sound generated by the current in the coil on the right side of the ship. Shifting over to the other amplifier, he would hear the sound developed in the coil on the opposite side of the ship.

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By balancing these two sounds, the pilot could tell when he was directly over the cable. If the ship moved too far to the right, the sound in one of the amplifiers would weaken, and the vessel would immediately be brought back until the sound produced in both amplifiers became equal in volume. It was a very simple matter to keep the ship in the proper course with all lights out and with nothing to guide her save the invisible signals. The pilot was able to bring her into port safely without depending upon usual aids to navigation.

An effort is now being made to have Congress appropriate sufficient funds for the establishment of a similar system in every harbor and port in the United States. If this is done, vessels can find their way into port without depending upon the light-buoys now used for guiding purposes.

Hanson's system holds out many other possibilities. If the currents passing through a submarine cable are modulated by the human voice, an operator on deck could hear the voice. A similar system might be used by the police. An energized cable could be buried under the street surface and connected with the police stations. Each policeman would carry a small coil, which would intercept the electromagnetic radiations from the underground cable. In this way he could receive his instructions

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without resort to the ordinary wire telephone. This would be a practical application of the Hanson system, and it would be far more reliable than the pure wireless system that has been tried in Chicago.

Two years ago the New York Stock Exchange experimented with a modification of the Hanson system. Communications to the chalkers were carried over a cable, and the chalkers moving in the vicinity of the cable carried the necessary receiving apparatus with which they picked up the messages.

Last year one of the writers conducted some experiments designed to guide touring automobiles. He developed an instrument for the dash which visibly registered the signals passing through a cable under the road. By assigning to each road a definite set of characters, an automobilist could be enabled to follow his road.

Some time ago the Navy Department made notable experiments in guiding seaplanes by the use of the Hanson cable. When the planes flew low they followed the cable with perfect ease even though a dense fog hung over the water. The system is more reliable than the compass, it is of course not so universal. The pilot will receive assistance only while he is following a course marked out by a cable. With the radio compass he can be guided anywhere.

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In the future it may be possible to use submarine signal cables in establishing permanent airplane routes over the high seas. Some time ago a passenger plane plying between Miami, Florida, and Bimini Island got off its course, and all of the passengers lost their lives. Had the plane been able to follow a radio cable the pilot would hardly have lost his way.

There are many places that radio can fill, and its commercial exploitation has only started. Although broadcasting is now occupying the center of the stage, the day will come when it will be but one of many commercial applications of radio. After the telephone came into use it was a number of years before its commercial possibilities were understood.

Some of the country's most capable inventors are applying themselves to the industrial problems of radio. Prominent among the workers in this field is William Dubilier.

Fully to appreciate Dubilier's work, it is necessary to devote a few words of description to a fire control system used in practically every large building throughout the country. This is commonly called the sprinkler system. Each building is piped so that an extension reaches every room and corner. At regular intervals automatic valves are attached to these

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pipes. At normal temperature the valves remain closed, but should the temperature rise beyond a certain point the valves open and water is sprinkled over the surroundings. A special alloy, which has a very low melting point, is used to keep the valves closed. In case of fire, the alloy melts and opens the valve, and the immediate surroundings are flooded. If a fire is burning it is likely to be immediately extinguished.

Although the sprinkler system is very effective, it has certain disadvantages, which it now appears can be overcome by the use of radio. After the water is released and the fire is extinguished, the water continues to flow, and if no attendant is present the water damage may run into many thousands of dollars. If a fire occurs on a Sunday, for instance, the water may run for a full day, and the merchandise and office equipment may suffer severely. For a number of years the sprinkler companies have tried to make arrangements for signal wires that would run from each sprinkler-equipped building to a central office where an alarm would be given whenever a sprinkler was released through fire or accident. Under the streets of New York is one of the richest copper-mines in the world; there are so many telephone wires, power wires, telegraph wires, fire alarm wires, and burglar systems that there is little space

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available, and the city would not give the sprinkler companies franchises.

And now Dubilier enters the scene. He has demonstrated that it is possible to employ radio in the solution of this problem. "What can be done with wires can be done with wireless," he says; and with this thought in mind he assembled an apparatus that will take the place of any two-wire system. His method is both simple and ingenious. While the valves of a sprinkler system are all closed, the water in the pipes remains stationary, although it is under high pressure. When one valve in the line is opened, the water moves, and Dubilier would have the moving water close an electric switch. The switch would in turn release an automatic sending key, and the key would control a small radio transmitting outfit that would be located on the roof of the building. As the automatic key operated it would send out signals which would be characteristic of the building. The transmitter employed would be connected to a loop aërial, which would be pointed in the direction of a central listening station, where a trained man would be constantly on the alert. If a valve in a building opened, a distress signal would be sent out after a few seconds. The central station operator would receive the call, refer to his list of registered buildings, and, after locating it, despatch an emer-

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gency wagon to the scene. This would not only prevent unnecessary water damage but would also help to forestall a conflagration in case the fire had got beyond control of the sprinkler system. Mr. Dubilier declares that his system would be reliable and that the installation would cost very little. In fact, the cost would be one tenth of the cost of the installation of a wire system. The transmitting apparatus could be operated at very low power by storage battery. Five watts of power would be sufficient, if a private wave-length could be employed.

Despite general belief to the contrary, there is little difference between electrical impulses that pass over wires and the wireless impulses that pass through the ether. The scientific research of the last few years has tended to prove that electric currents do not actually flow through wires but simply follow them, though it is by the use of electric conductors that we guide electrical energy from one point to another. Every wire carrying an electrical current has spread around it electro-magnetic waves, which cling closely to the conductor. If by suitable means we increase the frequency and provide the proper means for the waves to escape from their bondage, they jump off into the ether and dash over the face of the earth as ripples in the universal pool.

There is an analogy that may help us to under-

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stand this condition. Imagine water under pressure flowing through an iron pipe. Like an electric current guided by a wire, the water is unable to leave its path. Let us assume that a sprinkler is placed at the end of the pipe line. When the water reaches the sprinkler it rushes off into the air in all directions. In other words, it changes from wire to wireless.

When we examine radio in this light we see that it is not really a new thing. It is as old as the science of electricity itself. It was left to men like Hertz, Marconi, Tesla, and others to release the electromagnetic waves from their bondage and to find means of detecting them after they have been launched into the ether. We might apply the terms "guided" and "unguided" waves. In the case of telephony we find that the waves upon which the voice is impressed are simply taken in hand, so to speak, and guided through the maze of wires at the telephone exchange.

The facts that we have just considered should be interesting since they indicate the possibility that everything that can be done by wire can also be done by radio. In the first case we guide the electrical impulses that control the distant mechanism, and in the second we do not. This means that anything that can be done by wire can be done by wireless;

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in most cases the wireless system is by far the most convenient, but unfortunately it is not at present the most reliable. Its reliability is increasing from day to day, to be sure, but radio receivers are still very delicate instruments, and anything that is so delicate is not altogether reliable.

Years ago the Western Union Telegraph Company undertook to supply accurate time service to offices and public buildings. The company's engi-

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number of such devices have been produced, and a few of them have been patented. Of course they are made to function automatically, and they are designed to require only occasional attention. They are driven electrically, and the mechanism is so arranged that the hands of the clock may be automatically regulated. The incoming time signals are received on an ordinary radio outfit, where they are heavily amplified and carried to the mechanism of the clock itself. By the use of special relays and other instruments the hands at ten o'clock are brought to the proper position.

Such a system of radio clock adjustment is, in a way practical, but it is not entirely reliable. It has been successful enough, however, to foreshadow a day when we shall be able to depend upon our radio mantel clocks and to catch our morning trains by them.

Some of the experiments on radio clocks conducted by the Bureau of Standards some time ago may be of interest. An electric clock was constructed which was operated by

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Years ago the Western Union Telegraph Company undertook to supply accurate time service to offices and public buildings. The company's engineers worked out an elaborate wire system, which is in use to-day. For a few dollars a year, an accurate time service is provided. Each clock is connected by wire to a central station, and the station receives time signals from the United States observatories, where time is checked by the stars and then through a master clock placed on the wires and sent to all points of the country. At intervals through the day the electric time clocks are set, and if their minute hands have become too fast or too slow they are restored to the correct position.

Believing that the present wire system could be replaced by a wireless one and that radio clocks should be on the shelf of every home, a number of inventors and investigators have attempted to devise a reliable contrivance that will pick up the Arlington time signals twice a day and use them when amplified to control the hands of a clock. A

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the circuit the frequency of the circuits can be controlled within wide limits. The vacuum tube permits the production of currents with frequencies as high as ten million a second. By using the proper apparatus the Bureau of Standards was able to generate a current that changes its direction only once a second. The apparatus functioned so beautifully and the oscillations were so accurate that it was suggested that the device might be used as a clock. This would be entirely possible, and a clock could have been developed that would have been unerring so long as the batteries of the circuit delivered the right amount of current. If the clock were designed to operate on a lighting circuit it would run for weeks without any attention.

The distribution of press news is likely to be revolutionized by radio. To-day very little press service is sent through radio channels, and the old-fashioned telegraph wires are still holding their own. Those who are familiar with telegraphy know that it is possible to operate a typewriter by wire. Instead of having the operator receive and translate the message, translations are made directly on the typewriter, where the impulses representing each letter are faithfully registered. Telegraphic typewriters have been developed that will allow reception as high as two hundred words a minute, which is well

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beyond the capacity of even the most expert operator.

If whatever can be done by wire can eventually be done by wireless, typewriters operated by radio will be no exception. In fact they have already been devised by Mr. William G. H. Finch, working with one of the large news collecting agencies of New York. Using a special radio relay the well-known Kleinschmidt automatic typewriter has been used to register as many as one hundred words a minute. Radio will not only speed up but also effect a considerable saving in the cost of dissemination of news. To-day the newspapers in the smaller rural districts are denied the "red-hot stuff" because it is beyond the range of their pocketbooks. They cannot subscribe to the telegraphic services that the larger newspapers can afford, and consequently their subscribers must be satisfied with news that is two or three days old.

Before another five years roll by the editor of every country newspaper will probably go to his radio receiving set, switch on the vacuum tubes, and watch the news of the world peel off the typewriter. The service will be cheap, it will be faster than the wire, and it will make a city newspaper out of every old-fashioned country sheet. The service will cost less than the amount a telegraph operator

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could be hired for. The machine will not belong to the newspaper but will be rented to it together with the service for contracted periods.

Traffic congestion in the larger centers of population is growing to be not only a menace to public safety but a tremendous item in city expense. In New York a system of signals by means of lights has been established which partially but by no means completely overcomes the problem. It is a mere expedient for temporary relief. Laurence M. Cockaday, one of the outstanding radio geniuses of the country with innumerable radio inventions to his credit, has suggested the use of radio to overcome the traffic problem. It is logical, of course, that radio should be use for such a purpose, for it provides an instantaneous method of communication, and a single transmitting equipment could blanket a whole town with ease. Mr. Cockaday, however, does not propose the use of a transmitter of conventional design. He believes that a form of wired wireless or carrier wave radio should be used to overcome our traffic troubles in great cities, where the chief avenues of traffic are constantly choked to the straining point. Mr. Cockaday recommends the use of carrier waves either on the electric light wires above the street or along specially laid wires running parallel with the thoroughfare. A carrier wave sim-

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ilar to the one described in connection with wired wireless elsewhere in this book would be placed upon these wires, so that the signal transmitted would be brought within range of every automobile in the city if necessary. A small radio receiver of very simple design would be mounted in the car and used in connection with a relay, so that the signal would be communicated to the dash of the car in the form of a small red or green light. Thus a single man located at the heart of traffic could, by the mere pressing of a button, control the movement of traffic throughout the metropolis.

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CHAPTER XVII

POWER THROUGH THE SKY

SINCE the dawn of radio, inventors and scientists have dreamed of transmitting power from one point to another without the use of metallic mediums. The triumph of mind over matter and the successful conquest of electricity will not have been realized until a system of power transmission without wires has been discovered.

Power transportation is, perhaps, the most important development that is yet to come. The problem can best be understood by considering a high intercity motor truck pounding along the highway. It is the desire of the State that the road upon which the truck travels last as long as possible. So it is with the heavy current that passes silently through the conductors that parallel the highways. The wires and the poles are the highway upon which the current travels. The highway must last as long as possible, and the current must pass over it with minimum loss. It is obvious that a great deal of money could be saved to the country if highways

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could be eliminated. Some day airplanes may bring this elimination about. Similarly, the development of power transmission by radio may eventually take the current out of present-day electric highways and send it through the clouds.

It may surprise some to know that wireless power is being transmitted every day. In fact every radio receiver is a tiny power station which reaches into the ether and picks up an infinitesimal amount of electrical energy. Every broadcasting station is a wireless power transmitter which pumps current into the ether. Since the current is flung out to all points of the compass, the amount received at any one point is only an insignificant fraction of the total amount radiating from the broadcasting station.

The successful transportation of electrical power without the use of metallic connecting mediums between the point of generation and the point of utilization will never be brought about until a directional system is perfected. The energy must be made to flow in a narrow stream through the ether. It cannot be broadcasted.

When a ball rolls downhill or water flows through a pipe, a certain amount of resistance has to be overcome. The same thing applies to electric current passing through a metallic conductor. The current

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has to meet and counteract a certain amount of electrical resistance. It has to overcome the material opposition offered to its passage by the metallic conductor. For this reason only the very best conductors could be employed in transmitting power. When resistance is overcome, power is lost. The lower the resistance, therefore, the more efficiently the power will be transmitted.

So far no system has been developed that will enable us to transmit power wirelessly without enormous losses. Efficiency is the watchword of the engineer. Every development fit to find a place in the workaday world must be economically sound, and must have a certain degree of efficiency.

A number of attempts have been made by scientists to use ether paths as conducting mediums for the transmission of energy. Tesla was one of the early workers in this field. He spent tremendous sums of money in practical demonstrations. Tesla poured into space electrical currents with pressures that ran into the millions of volts. He was not only able to do this, but he also devised apparatus that could pick up and reconvert an appreciable amount of this radiated energy into useful power. At Shoreham, Long Island, Tesla erected a wireless power transmitting station which marked the beginning of the development that will some day place a new

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and powerful instrumentality at the disposal of civilization.

The ether wave as we understand it to-day is not an efficient carrier of power. This is probably due to a lack of understanding on our part. We do not know how to make it carry power. The time will come when we shall be able to make the waves form veritable streams of energy that will dash through the ether with the speed of light.

Dr. Samuel Cohen, one of the authorities on broadcasting, experimented at one time with an inductive system of power transmission. Although he was using wireless, waves of normal length were not used.

When a current of electricity passes through a wire it develops about the wire what is technically known as a magnetic field. If another wire forming an electric circuit is in the neighborhood of the first current-carrying wire, a current will be induced in the second wire. This is the principle of electro-magnetic induction, discovered by that prince of experimenters, Michael Faraday.

To employ this system of transmission in an experimental way, Dr. Cohen set up two large coils of wire, resembling the loops now used in radio telegraphy. To one of the loops he connected a large electrical generator, producing approximately seven

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horse-power of current. To the second loop he connected several electric lights and a small motor. By tuning the loops to a point of resonance, Dr. Cohen was able to run a motor connected to the second loop and at the same time to light the bulbs. This was done over a distance of twenty feet, and the power was actually transmitted through the ether.

Although this system was practical to a certain extent, any commercial application for it was out of the question, for it transmitted power with an efficiency of only 2.27 per cent. To-day we transmit power through conductors over distances of several hundred miles with only a small percentage of loss, and a system that will dissipate 97.73 per cent of its power over a distance of twenty feet is useless. Dr. Cohen, however, opened up a very interesting field of research which may some day be exploited more thoroughly.

An English experimenter, John Hettinger, sought to transmit power through the upper ionized layers of the atmosphere. He worked on the basis that ionized gas is a conductor of electrical current. It is generally known that certain rays of light passing through a gas will ionize it. The ultra-violet light, reaching the earth from the sun, plunges into the atmosphere and ionizes the upper stratum. Between this stratum and the earth there is interposed a great

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volume of air which has not been thoroughly ionized and which effectively cuts off a large part of the ultra-violet light. Under this dense air is the earth. Here we have two conducting mediums, the earth and the ionized air, separated by an insulator. It was Hettinger's idea to establish an electrical connection with the ionized air and with the earth, allowing these two mediums to form the parts of a gigantic electric circuit. He suggested the use of powerful beams of ultra-violet light to form the connection with the upper atmosphere. These beams of invisible rays would ionize the air they passed through and enable it to carry current.

Great things are undoubtedly going to happen in the next few years. We must keep it in mind that some of our most brilliant scientists are thinking and working on the problem and that once the ball starts rolling things will move rapidly. Some outstanding development may give this branch of electrical engineering the impetus it needs.

Peering into the future, we can see great radio power stations with gigantic towers and humming transformers. During the night their elevated structure wlll light the country-side with vivid blue rays as hundreds of thousands of electrical horse-power jump off into space, to be picked up and harnessed to the machines of the world. This step is not nearly

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so long as that which first gave us the means of receiving radio impulses. These prognostications are not based upon hearsay nor are they the idle musings of second-rate engineers. Experimental power transmission has been carried far enough to give results that warrant further intensive investigation. Nature yields her greatest secrets slowly, and it appears that the amount of human effort put forth is proportional to the degree of importance that a discovery holds for civilization. It is difficult to get something for nothing, at least from Nature; tyrant-like she makes us work hard for everything we obtain.

Experiments were recently made in which appreciable quantities of radio transmitted power were sent from one side of a laboratory to the other. About two kilowatts of power (approximately three horse-power) were used at the transmitting end. The receiver was able to pick up a small part of this to operate a small toy motor which probably required two or three watts for its operation. The inefficiency was appalling, but what is most important is the fact that power was transmitted at all. All great things have small beginnings. If it is possible to run small motors by radio transmitted power it will some day be possible to run large motors likewise.

In a recent issue of "Popular Mechanics," Otis S.

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Sawn outlined some very significant experiments with power transmission. He said:

Recent experiments in an eastern engineering institute on power transmission by radio have resulted in the discovery of some interesting phenomena. It is known that wireless waves may be more or less directed in one vertical plane. They have never been directed in a single line. That is, if a man were sending in a valley to a man on the top of a mountain, and his waves were directed, every one between the two stations could pick them up. Now it is possible to so direct the waves that no one not in a straight line between the two stations could receive them. This opens up possibilities of power transmission.

If the waves may be so controlled that they are in a straight line, there will be very little energy lost due to promiscuous radiation. Hence, if one kilowatt could be sent out, very nearly one kilowatt would be received. Why has no one ever done this before? The answer is simple. Wireless waves in use to-day are about 300 meters or longer. These long waves are many more times liable to radiation and diffraction than shorter ones. This is so because of the inability to control their direction.[1] The problem, therefore, is to make short waves. Previous experiments have been conducted with waves about 50 meters in length, and now waves of the unprecedented shortness of 45 centimeters have been produced. With an apparatus capable of producing waves of, say 59 centimeters, it would be comparatively simple to make them transmit power. Waves as short as this are of the nature of light waves, but are not seen by the eye. So, the rigging up of an aërial consisting of a foot or less of wire, in the focus of a parabolic

[1] Mr. Sawn refers to an exceptionally narrow beam of waves. Waves have been directed but not in sufficiently narrow beams for power purposes.

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reflector, and a receiving outfit of a similar aërial and with a similar reflector would constitute the complete outfit. The unsolved part of the problem, however, lies in getting a tube which will stand up under one kilowatt, or more, and such short waves. At present, tubes are being made to stand this strain and when they have been found satisfactory the question of practicable power transmission by radio will not remain long unsettled. It might be well to state that this problem is not to be confused with wireless control of motor apparatus.

The successful transmission of power by radio will eventually have just as great an influence upon civilization and the ultimate destiny of man as picture and sound broadcasting. If we should take away our telephone, telegraph, electric light, fire-alarms, street-cars, electric locomotives, and all power transmission lines we would begin to appreciate what power transmission means to civilization to-day. Who then dares to predict what power transmission without wires will do toward mitigating the labors of man?

Before closing this chapter, let us see what the late Charles P. Steinmetz had to say about power transmission through the ether.

In some respects, there is radio transmission of power to-day, for the message you receive has been carried to you by the electro-magnetic wave from the sending to the receiving station. But we really are able to utilize less than one-millionth part of the power sent out, for it scatters in all

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directions. Hence, the problem of radio power transmission is that of directing the radio waves so closely that a large part of their power remains together, to be picked up by the receiving station. Some success has been achieved in this. Most of our transatlantic stations send their power eastward to a large extent. But even so, it scatters all over the coasts of Europe from Norway to Spain.

The impossibility of concentrating a beam of radio waves may be illustrated by a beam of light. Light is an electro-magnetic wave many million times shorter than the radio wave-length. With the searchlight we can concentrate it to some extent, but there is an inevitable scattering of it, for at the light's face it may be three feet in diameter, and at ten miles it is half a mile except where distances are moderate and efficiency of transmission of secondary importance.

The second possibility of such power transmission is by resonant vibrations, or standing waves. Suppose we had a very large station sending out electro-magnetic waves, not of hundreds but of hundred thousands of millions of kilowatts, and suppose we could find a wave-length where the absorption in the passage of the wave through space is sufficiently small so as to be negligible compared with the amount of power. Assuming that there were no receiving stations, then the waves issuing from the sending station would encircle the earth, returning to the sending station. If the wave-length were adjusted so that the return wave coincided with the outgoing one, it would return its power, and the little power would be required by the sending station to maintain such a system of high-power standing waves. Only enough to supply the losses, just as little power is required in an electric wave transmission system to maintain the voltage wave, as long as no current is taken off.

Suppose we now erect a second station, tuned to the same wave-length as the sending station. It would resonate with

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the standing electro-magnetic wave issuing from the sending station, thereby stopping its passage by absorbing its energy. It would, as we may say, punch a hole in the standing wave sheet coming from the sending station. Power would then flow into this hole, the sending station would begin to send out additional power to maintain the wave sheet and this power would be received by the receiving station.

This would give a real radio power transmission. Any receiving station of suitable design would then be able to pick up power from the universal power supply carried by the standing wave sheet covering the earth. Also, several sending stations may send out power. These may then have different wave lengths, so as not to interfere, and the receiving station could be tuned to receive power from any of the generating stations. Or, what would be still more preferable, all the generating stations could be tuned to the same wave-length, that is the same frequency. They would have to be synchronized and operate in synchronism, just as different electric generating systems on the same transmission line are operated in synchronism.

Theoretically this is merely interesting speculation, but whether it could ever become a possibility would depend on the question whether a radio wave of such length could be found as to make the losses of power by absorption et cetera economically permissible. Furthermore it would have to be an international development. Therefore, if radio transmission of power by stationary electro-magnetic wave sheets were possible, its realization at present is rather distant. The present outlook for radio power transmission would seem in general to be rather remote. It is, however, of interest as a speculation of future possibilities.

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CHAPTER XVIII

NEW JOBS FOR RADIO

WE are rapidly finding new uses for radio, and almost every day the size of its job in the affairs of the world is being increased. Radio crops up from time to time in the most unexpected places, doing the most unexpected things, and if we are to learn something about its future application, much can be added to our knowledge by a consideration of its present uses.

The writers have mentioned wired wireless in another chapter. This is the system in which radio waves are caused to follow metallic paths. Some of the large power companies are employing this method over their power lines for telephone transmission and the success that has been attained suggests many other uses. Perhaps we may employ wired wireless to multiply the capacity of our transatlantic cables. We do not need to be told that a transatlantic cable is very expensive. Anything that would allow us to multiply the capacity of the cables would be welcomed by the cable companies, since it

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would advance the day when radio messages will be so much cheaper than cable messages as to make the further use of cables inadvisable. The writers referred the question of transoceanic wired wireless before Dr. Lewis Cohen, former assistant to Major-General Squires, who is the originator of the system. Dr. Cohen's answer follows:

> There is comparatively little data on the problem concerning the application of wired wireless methods to ocean cable telegraphy. The attenuation of cables increases very rapidly with the frequency and it is possible if very high frequencies could be used on very high cables. Still there is a possibility of employing line radio methods and utilizing comparatively low frequencies. As far as we know, this method is being employed on only one cable, i. e., the Key West-Havana cable, which is, of course, a very short cable. The circuit arrangements employed on this cable are precisely the same as those used by the American Telephone & Telegraph Company on their land lines, using high frequency currents and multiplexing.

According to this authority, the possibility of adapting wired wireless methods to the problems of the transoceanic cable, like many other applications of radio, seems to be largely a question of time.

Perhaps the average reader of this book is not aware that he may talk by radio when he uses the long-distance wire telephone. When we talk to New York from Chicago, our voice is really whisked along on radio waves that are bound to the telephone

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wires. Several other people may indeed be talking over the same wires on waves that differ in length from the one that is carrying our own voice. Waves employed for this purpose are called carrier waves, and when more than one carrier wave is following any particular wire, the process of multiplexing is used.

It is evident that a means of rapid communication across gaps that cannot be bridged by wires should make it an invaluable aid to the already long arm of the law. Radio aërials that cap the domes of many of the police stations in the larger cities stand as evidence that the police are using the assistance offered by radio. As long ago as 1902 radio began its career as an aid in the apprehension of criminals. Two negroes had stolen some property in Avalon on Catalina Island, which is a few miles off the coast of California. They had boarded the steamer and were on their way to San Pedro. Radio easily won the race, and the two colored men were arrested on the gang-plank.

The police are only beginning to find the uses of radio; they have had to educate themselves to it. In New York City the police boats and police airplanes are equipped with transmitters and receivers and are able to maintain communication with police headquarters on Center Street, where operators are

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always on duty. It would be impossible to establish reliable communication in any other way. If a telephone call for police assistance comes from any inaccessible part of the waterfront, the radio equipped police boat is soon sent speeding on its way.

The significance of radio communication in local matters is overshadowed by its broader national application. With three hundred broadcasting stations and five million listeners-in, the police can find in radio a powerful ally. A few months before this book was written, Verner Alexanderson, six-year old son of Dr. E. F. W. Alexanderson, famous for his radio inventions, was kidnapped from in front of his home in Schenectady. The alarm of his disappearance was immediately broadcasted from the General Electric station, WGY. A description of the boy was given to thousands of people, which could not have been accomplished in so short a time by any other means of communication that we have at our disposal. As a direct result of this broadcast the kidnappers were in the custody of the police two days later.

Criminologists have long agreed that our police system is local rather than national and that there is not sufficient coöperation between the police of different cities. This is not because of jealousy or

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indifference, but in the past they have not had facilities that would permit greater coöperation. We can see that radio broadcasting is going to do a great deal towards unifying the police system of the nation. Another five years will provide the police forces in the larger cities with more radio equipment, and the day will soon be reached when all of our police departments can be regarded as units of a single national system. With the improvements that are being made in the transmission of photographs, a local police force will soon be able to lay down in any city in the country the actual finger-prints and portrait of an escaped criminal. Then there need be no mistake about his identity.

The United States Forest Service was one of the first national agencies to seek the aid of radio, which it used for combating the disastrous fires that have robbed us of so many millions of acres of our wooded lands. The fire-fighters, aided by radiophones and airplanes, are now able to coöperate in a way that was never before possible. The value of radio in this connection was recently demonstrated in the installation that had been placed between Buffalo Hump and Warren, Idaho. Two days had been required to effect communication between the two places before the radio was installed. After the installation had

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been made fire calls were handled in about four minutes.

Far up north, inside the Arctic Circle, lies a desolate island called Jan Mayen. It is located in a section that has a peculiar meteorological importance. The north wind brushes constantly over its rocky surface. It is this wind that regulates and determines the weather of Europe. The Norwegian Government established a powerful radio transmitter on Jan Mayen with no other object than to supply meteorological data. The daily reports that are furnished keep all of Europe informed regarding the weather for several days ahead. The British Government looked upon the station as of such importance that it offered to contribute toward its cost and upkeep. Here again radio performs a service that cannot be supplied by any other means of communication.

The Government has been greatly aided by radio in the dissemination of meteorological data. Twenty years ago sea-captains were unaware of the weather that they were going to experience. Now they receive several reports a day, not only from the government station at Arlington but from other stations as well. A forecast is given for the different zones as well as the correct time, which is also available to every broadcast listener. The big timepiece located

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in the basement of the United States Naval observatory at Washington is connected directly with the radio transmitter at Arlington. At every tick the circuit is closed, and the radio responds faithfully.

The writers could not hope to outline all of the newer applications of radio in this chapter. They have touched upon enough of them, however, to give the reader a hint of the rapid way in which radio is establishing itself in every-day life.

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CHAPTER XIX

THE HIGH-FREQUENCY AGE

RADIO has brought to the fore a new science which will, no doubt, grow rapidly in importance and practical application. In radio what are known as high-frequency currents are used. From a dry cell we get a unidirectional or direct current, but from an alternating current generator we get a flow of current that dashes first in one direction, stops abruptly, and then dashes back in the opposite direction.

The number of times that it alternates in a second is called its frequency. For instance, in an ordinary house lighting circuit there is a frequency of sixty cycles per second, which means that the current makes one hundred and twenty reversals per second. Such a current is said to have a low frequency.

In radio we deal with currents that swamp our imaginations when we attempt to conceive of the rapidity with which they oscillate. It is not uncommon to have currents changing their direction of

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flow as many as a million times a second. These are the currents that set up ether waves; investigation has shown that there are many other possible applications for currents of this nature. It is only within the last few years that physicists have investigated the properties of such currents, which are often quite mysterious in their behavior. Take insulation, for instance. An insulator might be capable of holding back as much as one hundred thousand volts of low-frequency current, yet the same insulator would be unable to hold back fifteen thousand volts of high-frequency current. The nature and reason of the behavior of such currents has not been satisfactorily ascertained. The phenomena that they exhibit are profoundly interesting.

It has been found that high-frequency currents exert a marked influence upon certain chemical reactions. Thus the bonds between the chemist and the electrical engineer have been tightened and a new phase of the electrochemical industry seems to be well under way. German scientists have been the first to investigate this field. Reports have recently reached the United States of a process that has been worked out for the fixation of atmospheric nitrogen; it is stated on good authority that nitrogen can be bottled up in this way at a cost of about ten cents a pound. Already a German organization has been

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formed which plans to establish an enormous fixation plant in the arid valley of the Nile.

Calculations have shown that a thirty-thousand-cycle current has a chemical effect five hundred times greater than is produced by a sixty-cycle current. It has also been found possible to produce currents of this nature up to one hundred thousand kilowatts. With 746 watts making up each horsepower, it is easy to understand what a tremendous flood of energy is involved. An impetus has been given to the German development through the invention of a high-frequency alternator which has no windings and is able to produce efficiently an abundant supply of high-frequency currents.

To picture in the mind's eye the way in which these currents stimulate chemical action, let us remember that chemical action is brought about by an interchange of atoms and that every chemical reaction involves a rearrangement of these ultra-tiny particles. Atoms are in a constant state of agitation, and they vibrate periodically at enormous speeds. We may imagine high-frequency currents shocking the atom into greater activity and the atom absorbing part of the energy of the current, which gives it new chemical vigor and susceptibility. In the case of the insulator it is apparent that the high-frequency currents produce a molecular agita-

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tion, which eventually brings about physical disruption. This indeed is a convincing demonstration of the manner in which the high frequency currents affect organized matter. High-frequency currents, it should be noted, are an offspring of radio. They are another of the benefits that radio has brought to civilization.

The application of high-frequency currents to the production of gasolene by the cracking process has been investigated, and it is reported that there is a great deal of promise in a new process that will take advantage of the chemical acceleration offered by these heretofore little used currents.

It has been known for some time in the field of medicine that high-frequency currents have a distinct therapeutic value, and they have been used successfully in the treatment of numerous diseases. In fact, few physicians' offices are without them in some form or other. About two years ago Earl Hanson and his collaborator, Wendell L. Carlson, obtained patent protection for a high-frequency therapeutic outfit operated with what is practically a small radio transmitter. The currents, however, are used not to agitate the ether but instead to traverse whatever part of the body a physician may wish to treat. The passage of currents of proper frequency have a highly stimulating and invigorating

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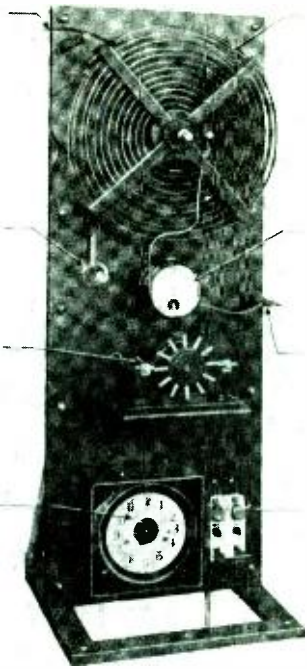
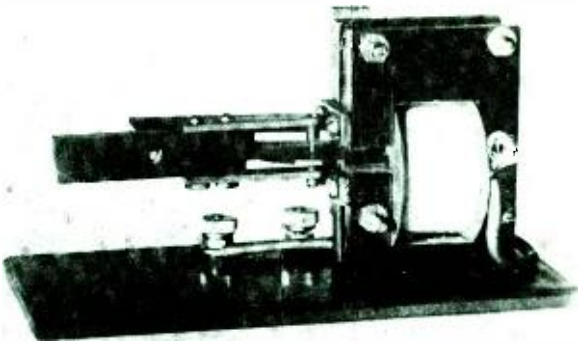


This apparatus makes possible the application of high-frequency radio currents to horticulture. It has been found that these currents have a marked influence on plant growth and that continued treatment results in more than normal development.



A forerunner of the age of radio power transmission. This is a tiny motor which operates with power transmitter by radio. It was invented by R. D. Duncan, Jr., of Wired Radio, Inc.

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In the accompanying photograph the generation of these currents and the manner in which they are caused to pass through the earth at the roots of the treated plants are illustrated. The device that is used to produce them is nothing but a radio transmitter, which with no alteration could be used to send messages. Radio is now being applied in this case, however; we are simply applying the currents that are responsible for the phenomenon of radio, electromagnetic waves.

Unfortunately no large-scale experiments have been conducted in electro-horticulture, and there are few data at present that would tend to establish the economic soundness of such an installation. That it holds alluring possibilities there is no doubt, and perhaps in another fifty years there might be found a small, high-frequency generator on some farms for increasing the productivity of the soil. With the cheapened and simple means that are being found for the abundant production of high-frequency currents the practicability of a small farm generating plant is apparent.

A further evidence of the growing practical industrial application of high-frequency currents is the newly developed Northrup high-frequency furnace. In this a blistering heat of three thousand degrees

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Centigrade is produced within a short time by the rushing currents. The apparatus that Dr. Northrup uses for the production of the currents is exactly the same as that which is employed in an old-fashioned wireless transmitter of the spark type; there are condensers, transformers, and spark gaps. The current produced by these devices, instead of being released into the ether, is passed through a heavy coil of copper ribbon, which is arranged about a refractory tube containing the metal that is to be melted. The metal acts as a short-circuited coil which has induced in it currents that cause it to become heated. A heavy current passing in a short-circuited circuit will of course cause intense heating. That is why fuses are blown when a screwdriver is used for tinkering around a broken socket.

The high-frequency furnace is not the dream of an impractical scientist but an actual industrial realization, which is in use day in and day out in many parts of the country. In Germany an experimental electric locomotive has been driven by the employment of high-frequency discharges jumping to a pantograph that is separated from the overhead wire by several inches, thereby reducing friction and allowing the locomotive to gather its current without material connection. The current, once in the loco-

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motive, is carried through special vacuum tube rectifiers, where it is rectified to direct current. It is then allowed to pass into the driving motors.

From the consideration that has been given to high-frequency currents, some idea can be gathered of the importance of this new branch of chemical and electrical science, which has developed through the labors of our radio pioneers. The effects of these currents are so amazing as to make it difficult to speculate regarding their future application. That they will build industries is evident.

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CHAPTER XX

RADIO AND THE WIRE TELEPHONE

A SHORT time ago one of the writers experienced the novelty of talking from a New York office to Captain Rind of the steamship *America,* then cutting the waters of the Atlantic ninety miles off Ambrose Light. The conversation from the standpoint of clarity and volume was exactly as if it had taken place over a telephone wire. This event marked the beginning of an important epoch in telephone communication. It foreshadowed the day when we shall from our telephones get toll connection with a party in Berlin, with a ship amidseas, or with a transcontinental airplane on its way to San Francisco. This development means so much to radio and its future that a fuller discussion of the work that has been done might be interesting.

In 1919 the American Telephone and Telegraph Company, coöperating with the engineers of its subsidiary, the Western Electric Company, initiated the first step in a program with the object of perfecting a radio telephone system that would extend the Bell

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telephone service to ships at sea. The program was by no means a modest one. It involved a vast amount of the experimental work which is always necessary when an invention passes from the laboratory into the workaday world. The aim was to make it possible for every subscriber of the Bell system, whether in San Francisco or in a small town on the plains of the Dakotas, to carry on conversation with a vessel on the Atlantic Ocean. So far as the subscriber was concerned the service was to be exactly as if he were talking to a neighbor on the other side of town, except for the time that would be necessary to establish connection in a toll call. Two-way conversation had to be established; when the person on the ship spoke, the man at the end of the land wire was to hear, and vice versa. Of course, no hand-manipulated switching arrangement could be used. Such an arrangement would be simple with wires alone, but with the wireless gap intervening the technical problems involved were of a discouraging nature.

The outstanding problems were recognized as:

(1) Much greater variability in transmission equipment to be expected in the radio link.

(2) Much greater and more variable interference, both natural and artificial.

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(3) Lack of secrecy such as is provided in a wire system.

(4) Greater possibilities of cross talk between channels because of the use of a single medium.

(5) More complication in signaling and in the setting up of the telephone circuit.

To be commercially sound, a system of this nature must allow more than one conversation to be carried on simultaneously between the same two points without undue interference in either one of the communication channels.

After much experimental work the American Telephone and Telegraph Company set up two complete stations, each with three communicating channels, so that three people located at three widely separated points in the United States should be able to carry on conversation with three ships or with a single ship on the Atlantic Ocean within range of the transmitter. This meant the establishment of three independent transmitters and receivers working on three different wave-lengths separated by only a few meters.

One of the stations was set up on a sixty-acre plot on the coast of New Jersey at Deal Beach. Here three sixty-five-foot steel towers were erected, and three independent aërials, arranged in the form of

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an equilateral triangle, were held aloft. The receiving station was located several miles away, and in it were placed three ultra-sensitive and ultra-selective receivers that collected their energy from the ether through the use of small loop antennæ. The transmitters were of about one kilowatt capacity, which is approximately the capacity of the average broadcast station.

Experiments proved only 3 per cent of difference in the wave-lengths of the three different transmitters was needed. Three per cent is very little, as every radio listener who has tried to tune out unwanted broadcast stations can testify, yet the available commercial wave-lengths are becoming so precious that they must be conserved wherever possible, and the development just referred to reflects great credit upon the men who carried it through. Loop antennæ were used on the receivers to help eliminate interference, since a loop is more responsive when turned to a position where it will be in exact line with an approaching wave.

In the experiments about to be described, which definitely established the practicability of tying the wire telephone system up with the wireless, a single transmitting and receiving equipment was placed on two different coast steamers which came almost daily within the range of the transmitters and receivers

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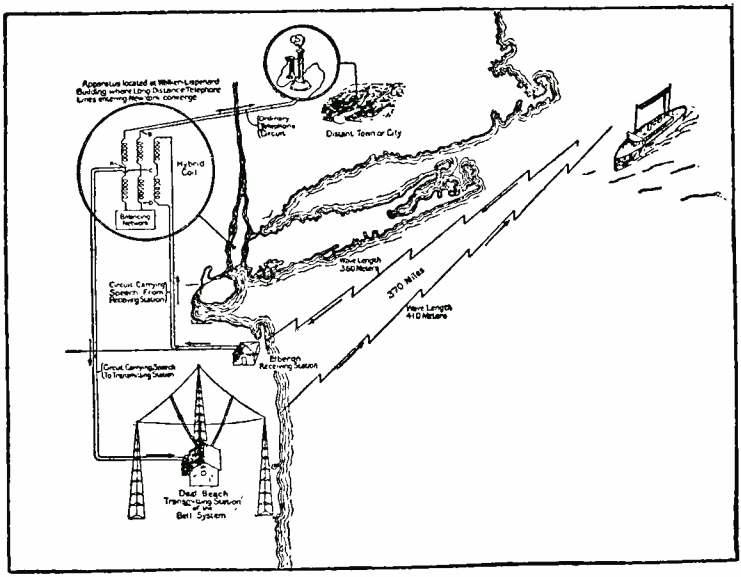
at Deal Beach. Lack of space made it necessary to use the same antenna for receiving and transmitting aboard the ships. Hence the antenna was called upon to transmit and receive at different wave-lengths in



A map diagram showing wire and wireless channels of communication involved in carrying on a telephone conversation between a telephone subscriber and a person aboard ship

two directions. Because of better receiving conditions on shore, the proper transmission balance was obtained by making the output of the ship transmitting set about three-quarters that of the land.

Now let us suppose that a telephone subscriber in Utica, New York, wished to talk to a passenger

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aboard a ship on the Atlantic Ocean. The local operator would be called in the usual way, and she would be told that a party on such and such a steamship of such and such a line was desired. The operator would then call the New York operator through the toll lines, and the New York operator would plug the connection through to Deal Beach, which is connected with New York by a number of trunk lines. Thus a complete wire circuit would be established between Deal Beach and Utica.

Deal Beach might be called the jumping-off place, where the message is launched into the ether and where the invisible bond or circuit is established. The radio operator at Deal Beach, when he hears from the toll operator in Utica, calls the ship that is sought until he raises the operator. Of course it is necessary that the receiving operator at the shore receiving station also be on the alert since it is only by this means that the operator in Deal Beach station hears the operator aboard ship. A connection is established between the ship and the shore transmitting and receiving station, and after the passenger has been paged and brought to the radiophone the toll operator in Utica is notified and at once brings her subscribers to the telephone. Within a minute or two the subscriber in Utica is carrying on direct conversation with the person at sea. The

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voice received from the ship transmitter is entrapped in the loop aërial receiver, where it is amplified, placed back on the telephone trunk lines, and carried to the telephone receiver of the subscriber in Utica.

The arrangement that has just been described is by no means crude. It is only a matter of time before through such means the wire telephone system will be tightly bonded to the rest of the world by radio. The experiments that have just been described were instituted on a semi-commercial scale, and they left no doubt in the minds of the engineers who conducted them that the issue had reached a practical stage. Within the next few years talking to ships at sea will probably become a common thing. By referring to the accompanying diagram we shall be able to visualize the entire process involved in establishing a communication channel between a wire subscriber and a passenger on board ship.

It is interesting to note that this great accomplishment was made possible by the little glass bottle that is called the vacuum tube. Before De Forest gave the world the vacuum tube, the amplification of radio signals was practically impossible. Furthermore, the transmission of a perfectly modulated voice was also impossible. It was the vacuum tube that overcame both of these difficulties.

Another instance of the use of a radio link used

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in conjunction with wire service is the installation at Avalon on Catalina Island. Catalina is located off the coast of California, and a telephone subscriber on the island could talk to any one in the United States by wire although no telephone cable was used to connect the island with the mainland. The connecting link was made by a two-day radiophone system, with one set of transmitters and receivers located in Long Beach, California, and the other at Avalon. The receiving and transmitting were done automatically and the wire operators at both places performed the usual duties. Later there was added to this set a device which multiplied its practical usefulness several times. This was a system which gave privacy to conversations, so that they could not be overheard by any one with a radio set. Here is a development that may have a future bearing upon broadcasting.

The installation at Catalina foreshadowed the day when we shall be able to talk to the Philippines, Cuba, or Alaska. The extension of this service will eventually allow our wire telephone service to reach out over the seas and connect us to every telephone subscriber on continental Europe or the British Isles. The question is one of connecting two telephone exchanges together by wire. The human voice has already been sent across the Atlantic Ocean on sev-

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eral occasions. As long ago as 1914 a radio telephone message originating at Arlington, Virginia, was received in the Hawaiian Islands.

In April, 1923, officials of the American Telephone and Telegraph Company and the Radio Corporation of America carried on a direct telephone conversation with officials of the English Marconi Company. It was another of those experimental demonstrations that always precede a great realization.

Within the next twenty-five years, the telephone service of the world will no doubt be bound tightly together by means of radio. The apparent dimensions of the world will become smaller and every one will be within reach of our voice no matter where he may be.

Will the telephone wires one day be discarded entirely? That is the question that is uppermost in the mind of the layman when the future of radio telephony is discussed. If the telephone wires are discarded, we may feel sure that it will not happen within the next fifty years. Radio engineers would have us believe that it will never happen, that it is impossible. But "impossible" is a word that is often rashly used by men of science. Many engineers, indeed, cannot see beyond their engineering noses. To-day it is impossible, to be sure, but what will the morrow bring? The day will come when we shall be

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able to use wave-lengths that may be only separated by one one-hundredth of a meter, with positively no interference. Then real wireless telephony will loom up as an alluring possibility.

It will not be long before the wire telephone systems will be connected with the best trains. A business man on the Twentieth Century, Empire State Express, or Black Diamond will be able to talk to his business associates while he is being rushed along at a speed of sixty miles an hour. Experiments in this direction have been conducted in America and abroad. No discouraging obstacles appear to stand in the path of such a service; there is but a thin wall standing between experimentation and adaptation.

The greatest radio telephone experiment ever conducted was carried out by the American Telephone and Telegraph Company on February 14, 1921, when a person on Catalina Island talked by telephone to a passenger aboard the steam-ship *Gloucester*, plying off the coast of New Jersey. From Catalina the conversation was carried by radio to an automatic station at Long Beach and thence to Los Angeles. From there it took the usual transcontinental wire route through San Francisco, Salt Lake City, Denver, Chicago, Harrisburg, and New York, and from the terminus at New York to Deal Beach, New Jersey, where the conversation again

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left the wires to be picked up by the radiophone receiver aboard the steamer. A two-way conversation was carried on. In view of such an accomplishment, who can predict what the future of radio telephony will be?

A very interesting article outlining the place of radio in the communications field appeared in a recent issue of the "Telephone Review." It covers the subject so well that it might be of interest to the reader.

It has been the policy of the Bell System to build a telephone plant which would give universal service of the highest possible quality. In building up the nation-wide plant required to give service to the people in all parts of the United States, the solution of the technical problems arising in the business has at all times been undertaken in accordance with the thorough methods of scientific research. The scientific laboratories of the Bell System, which sprang from a tiny workroom with but two workers, have grown until they employ 2,800 persons. In these laboratories—the largest industrial laboratories ever devoted to the application of science to human affairs—not only has no effort been spared to develop wire transmission, but also the most careful examination has been made of other recognized means of transmitting the human voice, especially the radio or wireless telephone. By the development of many different radio methods and systems, and the design and construction of different types of radio equipment during the past decade, the staff of the Bell laboratories has made numerous and very fundamental additions to the knowledge of this method of communication.

In this connection it may be pointed out that the first

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wireless transmission of speech by means of electromagnetic waves was accomplished by Alexander Graham Bell in 1880 with his so-called radiophone. Instead of employing the long wave lengths with which wireless messages are to-day transmitted, this device made use of the very short waves of the visible spectrum, a beam of light being varied in intensity in accordance with the variations of the speech waves.

Turning to a consideration of the modern developments of the radio art, it will be recalled that the engineers of the Bell System transmitted speech by wireless telephone from Arlington, Va., to Paris and Honolulu in the autumn of 1915, thereby establishing the historic record for American engineers of being the first to transmit the voice across the Atlantic Ocean. Furthermore, in transmitting the voice to Honolulu a long distance record was achieved which has not yet been equalled by others.

The Bell engineers had a notable part in solving the many radio problems which arose during the recent war, and designed many types of radio equipment for the American forces both for communicating with ships and with airplanes.

No commercial uses have yet been made of the Company's transoceanic telephone development because of the many practical difficulties which are involved in the application of radio, chief among which are the disturbances due to "static" and other interferences.

More recently, the first two wireless telephone stations available for public use have been erected on the California coast. These stations supply every-day telephone service between the Island of Santa Catalina and the Mainland, and are an integral part of the Bell System so that a subscriber on the Island can call any number in Los Angeles, or in fact any number throughout the entire Bell System. A submarine cable would give better and more economical service to the Island than the radio telephone, but manufacturing conditions growing

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out of the war were such that this cable could not have been obtained within the time desired. In view of this fact, together with the fact that the installation of a wireless system would provide valuable experience regarding the use of the radio telephone in rendering commercial service, the decision was made in favor of the radio system.

The Company has also performed extensive investigations into the matter of ship-to-shore telephony. For a year past, an experimental equipment has been maintained by the Bell engineers on the Steamships *Gloucester* and *Ontario* in conjunction with their radio stations on the Massachusetts Coast and on the New Jersey Coast. Utilizing these experimental stations, they have conducted practical scientific investigations into the best methods of maintaining communication between ships at sea and the wire plant of the Bell System throughout the United States.

The progress made in this work is well illustrated by a demonstration given lately in honor of the delegates to the International Communications Conference during which conversation was exchanged between Catalina in the Pacific Ocean and the S. S. *Gloucester* in the Atlantic. Speech was transmitted by radio telephone from the *Gloucester* through the New Jersey station, and thence by wire across the continent to Los Angeles, and thence by radio telephone to Catalina. More recently, apparatus has been developed whereby a single land station can maintain a different two-way conversation with each of three ships at the same time.

Still another achievement fresh in the mind is the joining of the overland wire circuit from Key West to Los Angeles with the new submarine telephone cable to Cuba and with the radio telephone to Catalina, to the end that speech was transmitted between an island in the Atlantic and an island in the Pacific.

The extensive experience of the Bell engineers in trans-

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oceanic and ship-to-shore radio telephony, and in supplying commercial radio telephone service on the Pacific Coast, has provided trustworthy data whereby they can judge concerning the practicability of radio in the various fields in which it might be applied. Their studies show that the characteristics of wireless transmission are such as to make it particularly useful as a means of supplementing the wire systems in those instances where, from the nature of the case, it is impossible or impracticable to employ wires.

Thus the broadcasting of information of general interest over land and water is a service which cannot well be rendered by wires and for which radio with its messages carried in all directions at the same time is exactly suited. The broadcast distribution of time signals and weather and market reports to mariners, farmers, and the like, and the simultaneous dissemination over a wide area of important items of news is likely, as time goes on, to become one of the most important uses of radio communication in which both the radio telegraph and telephone will play their respective parts. For these purposes, the fact that the messages can be picked up by all who have proper receiving stations is a decided advantage.

On the contrary, however, when radio messages are intended only for certain stations, the fact that they spread out in all directions, causing lack of secrecy, is a defect. For the distribution of press dispatches intended only for particular stations, radio could not be employed unless some method of preventing the reading of messages at unauthorized stations is obtained.

In the transmission of news, speed is an essential factor, and while it is not impossible at the present time to put news dispatches in cipher by ordinary methods, the time required for enciphering and deciphering makes these methods objectionable. Accordingly, the Bell research laboratories have worked on the problem of applying to radio telegraphy the

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quick cipher or secret method of wire telegraphy which their engineers developed and which was used with marked success upon wires by the Signal Corps during the war. It is a secret means of telegraph communication, and while the ciphered message may be heard at all radio stations, it can be interpreted only by those who have the cipher apparatus and key. This instantaneously enciphers the message at the sending end and deciphers it at the receiving end, where it appears immediately in printed page form ready for use. The work done upon this system of secret telegraphy by the engineers of the Bell System promises to be generally available and for the benefit of radio telegraphy.

The Bell engineers have also attacked the problem of privacy in radio telephony and have given an experimental demonstration of a method which they have devised, whereby ordinary receiving stations can hear nothing but unintelligible sounds, yet at all stations equipped with the necessary apparatus and in possession of the requisite operating information, the spoken words can be understood.

Before the advent of radio there was no very effective means of communicating with ships and other moving stations, and it is by virtue of the inherent characteristic of all radio messages—that they spread out in all directions—that the wireless telegraph has greatly increased the safety of travel at sea, becoming a blessing to the mariner and to those who entrust themselves to his care.

In the future, it is expected that the wireless telephone will also play an important part in this field in which the wireless telegraph is now of inestimable value. As noted above, the developments necessary to this end have been carried well toward completion by the Bell engineers, and when certain problems, largely commercial in their nature, which are peculiar to ship-to-shore telephony, are disposed of, the wireless telephone will serve to put ships in com-

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munication with the telephone lines on land to the same extent that the Island of Catalina is now connected to these lines.

In addition to its uses in navigation, the wireless telegraph has taken its place beside the submarine cable as a means of transoceanic communication. In this field, the wireless telephone is expected to play its part, for while it is possible to signal by telegraph through the transoceanic submarine cables, it is not possible to talk through them.

The wireless telegraph finds its best field across large bodies of water such as the Atlantic and Pacific Oceans where the only wire communication possible is by means of submarine cables. The rate at which messages may be transmitted over ocean cables is very slow compared with the rate attainable on land cables of the same length. Across the oceans the relative advantages of the cable and the radio are difficult to appraise. Each has advantages over the other, and each has its disadvantages, and each is successfully carrying its share of the international telegraph traffic of the world.

While the radio telegraph does not function as successfully over large areas of land as over corresponding areas of water, the telegraph wire cable over land is vastly more efficient than is the submarine cable of an equal length. The submarine cable consists of one conductor, whereas the land cable, although less than 3 inches in diameter, may carry as many as 600 conductors. Such a cable, when constructed and operated in accordance with the latest scientific discoveries, can be made to carry over 5,000 telegraph messages at one time, as compared with only two messages carried at one time by the submarine cable.

While the number of land cables may be increased without limit and can carry traffic far in excess of that which ever will be required, the number of messages which radio can carry at one time is distinctly limited due to the fact that

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each radio message tends to spread out in all directions, thus traveling through the same region in which many other messages are traveling. As has been said, the ether is a universal party line constituting a single conductor which must be used in common by all the world. Although ingenious methods have been devised whereby the number of simultaneous radio messages may be largely increased, the ether can at best carry only a small portion of the total world traffic. The best field of radio is for long distance transoceanic communication, for broadcasting, for the radio compass and for auxiliary radio fog signals given out by lighthouses, for innumerable military and naval purposes, and for transmitting messages to and from moving stations and between places where wires are not available. When all of these necessary services are fully provided for, the capacity of the ether for conveying messages simultaneously without interference will be taxed to the limit.

Thus the characteristics of radio messages, causing them to spread out over large areas and enabling radio to be of inestimable service in certain fields, stand in the way of its extensive use on land where it is possible to provide wires which are nothing more nor less than pathways for guiding or directing the electric waves in the ether between any desired points, however numerous they may be or wherever they may be situated. By means of these wire guides, millions upon millions of messages may be carried simultaneously without interference with each other. It has often been said that, had the course of scientific development been reversed so that radio transmission preceded transmission by wire, the discovery that wires can be used to guide the ether waves would be considered one of the marvels of science. By their use, the otherwise uncontrolled ether waves are caused to follow any predetermined pathways, flashing thousands of messages to and fro under our city streets without the

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slightest interference, each message following its allotted course, whether up through the intricate structure of a thirty-story office building, or out across the plains, under rivers and over mountains, to the far side of the continent, there to be received by him—and him alone—for whom it is intended.

The natural characteristics of radio and wire transmission are, therefore, fundamentally different. Each, due to its unique capabilities, is performing a service for which the other is unsuited, and each is supplementing the other to the end that all important needs for communication are being provided for as rapidly as they arise. For the large amounts of traffic on land, both telegraph and telephone, which must be handled with certainly and a minimum of cost, the use of wires is necessary. But as an agency for communicating over wide stretches of water, and moving conveyances generally, for a host of maritime and military purposes, and for the broadcasting of information, radio to-day is rendering services of the greatest value, and all considerations point to the conclusion that in these fields its use will become of ever greater importance.

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CHAPTER XXI

CAN WE TALK TO MARS?

A FEW years ago that inimitable author scientist, H. G. Wells, wrote a book which he entitled "God, the Invisible King." A short time later William Archer prepared a small volume which he called "God and Mr. Wells." In the introduction to this work Mr. Archer said, "If an astronomer discovered a new star, I would be the last man to brush the fly off the end of his telescope." It is with Mr. Archer's spirit that the writers comment on the subject of radio communication with Mars, a subject that is now being revived.

We are separated from Mars by no less than two hundred and fifty million miles of black, frigid, and lonely space. Now, two hundred and fifty million miles is a mere trifle as celestial distances are measured, but for ordinary purposes it is inconceivably great. We can send radio waves to any corner of our earth without difficulty, but can we send them out in such a manner that they will be carried to our neighbor Mars?

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About two years ago operators in several of the large Marconi stations in Europe received very mysterious messages sent on a wave-length that was of unusual length. How all of these operators tuned their receivers to this wave of unusual length at the same time has never been explained, and we must look upon it as a coincidence. Nevertheless, the wave of unusual length created much excitement and stimulated the imagination of many scientists. Whether the wave was a huge piece of publicity for the benefit of the Marconi Company or an honest-to-goodness wave of unknown origin will probably never be known. But Marconi himself, on his recent visit to the plant of the General Electric Company at Schenectady denied that he had ever heard such a message. Of one thing we are certain, at least. The wave was not of such great length that it could not have been propagated by transmitting instruments of ordinary design. Perhaps the message was sent out by some experimenter or research worker. Regardless of the mysterious wave, the subject of radio communication with Mars is interesting. It holds out many possibilities.

Every radio wave that leaves a transmitter on the earth starts out on an endless journey through space. Marconi's first message is still sweeping through the ether lanes billions upon billions of miles beyond the

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earth. It will go on forever. Every ether wave that leaves the earth touches the planet Mars a few minutes later. By the time an ether wave reaches Mars, however, much of its energy is spent, and it is questionable if the Martians, if they do really exist, have instruments sensitive enough to detect it.

The late Charles Proteus Steinmetz believed that a radio transmitter of tremendous power would be necessary to bridge the gap between Mars and the earth. According to his calculations, the combined power of all the radio transmitters in the world would not be sufficient for the purpose. He proposed the construction of a super-plant that would need for its operation at least five hundred million horse-power. Five hundred million horsepower are enough to run all the railroads and factories of the United States. Of course, the construction of such a plant at present would be impossible. When we discover atomic energy the plant might be practicable, perhaps; but for the present we shall have to forego the task of arousing our heavenly neighbors by radio—if Steinmetz was right, and he might not have been.

Commenting on the "direct-to-Mars" station, Mr. Steinmetz pointed out the necessity of using gigantic steel towers. He also suggested the use of helium-filled balloons to hold the long aërial wires aloft. The

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wave-length of such a station would have to be several thousand miles, since the shorter waves that we now employ for earthly purposes would not have the necessary carrying power. Once the wave got beyond the earthly sphere, outside of the huge envelop of air in which we live, it would travel practically without resistance until it reached its destination.

How long would it take a wave to reach Mars? That, of course, depends upon the position of Mars in relation to the earth. The nearest Mars ever came to the earth is thirty-five million miles. About four minutes of time would be necessary for a radio wave to traverse this space. The greatest distance that Mars gets from the earth is two hundred and fifty million miles. Twenty-two minutes would be required for a message to flash across this great space.

At least one serious attempt has been made to receive signals from Mars. This was made by no less a person than Professor David Todd, former head of the observatory of Amherst College. He experimented in Omaha, Nebraska, where he constructed a super-sensitive receiver tuned to very long wave-lengths. He was assisted by the army, the navy, Rockefeller Institute, and Johns Hopkins University. A specially constructed balloon handled by

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an expert was sent up, and specially constructed instruments were put in use. Although many long hours were spent listening, not a sound was heard. A mistake was made in these experiments by not attempting to tune in waves of a very short length. Our experimenters who would communicate with Mars are too sure that the Martians are using waves of great length. Perhaps the reverse is true. They might be using powerful waves of a very short length.

Mr. Preston Bassett, a research engineer of the Sperry Gyroscope Company, would communicate with Mars by the aid of powerful searchlights. He suggests grouping together no less than one hundred and twenty billion-candle-power lights, which would give a total candle-power of one hundred and twenty billion. This, Mr. Bassett figures, would be sufficient to penetrate the darkness of space and cast a bolt of light upon Mars of such intensity that the inhabitants would be able to see it, provided they had in their possession optical instruments as powerful as those we use upon the earth. The power necessary to operate the search-lights need not be very great, since our present-day lamps are highly efficient, and a small fraction of a horse-power is sufficient to produce a light of an intensity of several million candle-power.

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The contemplated project of signaling to the neighbor planet by means of light, however, has one serious drawback. Many scientists are of the opinion that the earth, like the sun, may appear to one side of Mars as a flaming ball of light, which would render any man-made glare indistinguishable. The only possible chance, therefore, seems to lie in arranging the tests for such time as the night sides of the earth and Mars were exposed to each other.

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