

BELL
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TELEPHONE QUARTERLY

VOLUME I, 1922



INFORMATION DEPARTMENT
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
195 Broadway, New York

BELL TELEPHONE QUARTERLY

VOLUME I, 1922

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American Telephone and Telegraph Company

BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION AND A RECORD OF PROGRESS

Published quarterly for the Bell System by the American Telephone and Telegraph Company

Subscription, \$1.50 per year, in United States and Canada; single copies, 50 cents

Address all communications to
INFORMATION DEPARTMENT
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
195 Broadway, New York

Vol. I

APRIL, 1922

No. 1

Foreword

B EING a young, active and progressive institution, the Bell Telephone System is continually doing new things, sometimes in service to the public, sometimes in operating technique, sometimes in commercial policy. The new thing may be done in any part of the country. These new things are interesting to telephone men in other parts of the country. If they are experiments in service or technique and are successful, they ultimately become generally known by being standardized and covered by specifications and described in bulletins. There are some even more important innovations, interesting even in the nebulous state and more so as they become accomplished facts, which the presidents and general officers would like to observe during the experimental period. I refer to the type of things which we have usually discussed in conferences of presidents and general managers. As a medium of suggestion, a report of progress and perhaps an announcement of results on matters of that type between conferences, we launch with this number the BELL TELEPHONE QUARTERLY.

H. B. THAYER.

The Radio Telephone Situation

RADIO today is a magic word throughout the country and, like anything else occupying headlines, much has been said of it, both good and bad, which it has not rightfully deserved.

What is radio? While it would probably take volumes to give a complete explanation of radio, yet perhaps it can be briefly explained in the following manner.

In the ordinary alternating current electric light and power circuit, such as used to furnish light to homes and power to factories, the periodicity of the electrical current is almost universally sixty cycles per second. In other words, there are sixty complete reversals of the electrical current every second. At this low periodicity or frequency practically all of the electrical energy is confined to the wire system and none of it radiated into space. However, by sufficiently increasing the frequency or period of oscillation of an electrical circuit and by suitable circuit arrangements a large proportion of the electrical energy generated may be radiated into space as electro-magnetic waves. These electro-magnetic waves travel through space with the speed of light and have frequencies varying from around 15,000 to several million cycles per second.

In order to transmit a telephone message by radio the amplitude of the high frequency waves sent out is made to vary in accordance with the variation of current produced by the voice in an ordinary telephone circuit. The problem of producing these high frequency electrical waves and of thus controlling them by telephone currents has been solved in a satisfactory manner only by means of the three-electrode vacuum tube.

During our development of the vacuum tube in connection with the telephone repeater, we found that it was possible to make larger and more powerful tubes which could be used for radio telephony, and it was this development that brought about the memorable and remarkable experiments of 1915, when we talked by radio to Paris, San Francisco and Honolulu. Subsequently

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the laboratories of the Bell System have diligently continued their development and research work, until today the fundamentals of radio telephone communication are fairly well established, and the kind of equipment necessary is generally known, although it has not been commercially produced except for such real uses as have been found in the field of telephone communication.

THE PATENT SITUATION

At the same time development by others of radio and allied equipment was taking place and, as might be expected, it was not long before it was found that the patent situation was considerably involved and that the public would be unable to obtain the full benefits of radio unless some arrangement could be made between the holders of the patent rights which would permit of unhampered development. Accordingly, at the request of the United States Government, the General Electric Company and the American Telephone and Telegraph Company entered into a cross-license patent agreement, effective as of July 1, 1920. In general, by this agreement the American Telephone and Telegraph Company received licenses in the field of commercial and public service radio telephony, while the General Electric Company received licenses in the field of amateur radio telephony and all radio telegraphy.

Following the execution of the principal agreement between the American Telephone and Telegraph Company and the General Electric Company an extension agreement was entered into whereby the General Electric Company may extend to the Radio Corporation of America any of the licenses which the General Electric Company received under the principal agreement, and likewise the American Telephone and Telegraph Company may extend to the Western Electric Company any of the licenses which the American Telephone and Telegraph Company received under the principal agreement. Subsequently, the Westinghouse Electric and Manufacturing

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Company, who also had been at work in the radio field, entered into the agreement in the same patent license fields as the General Electric Company and Radio Corporation of America.

Prior to all this, the Radio Corporation of America had been formed, had taken over the interests of the Marconi Company in the United States and had entered into an agreement with the General Electric Company whereby it acquired rights to use and sell all radio equipment which the General Electric Company was licensed to manufacture.

The situation today, therefore, is as follows:

In general, radio telephone equipment for commercial or public service uses is provided by the American Telephone and Telegraph Company or through its manufacturer, the Western Electric Company. Amateur radio telephone equipment, radio telephone broadcasting receiving sets, and radio telegraph equipment are manufactured by the General Electric Company and Westinghouse Company and are sold through the Radio Corporation. The underlying principle throughout this cross-licensing agreement is to insure and make available to the public the complete development of radio.

RADIO TELEPHONY A SUPPLEMENT TO AND NOT A SUBSTITUTE FOR WIRE SERVICE

The interest of the Bell System in radio lies in whatever application it may have to the possible future development of telephone services. In the Bell System or any other system based on sound economic principles, the fundamental consideration in any communication problem is the provision of the type of facilities which will give the best and most economical service to meet the particular set of conditions involved. In this there is made no distinction between wires and radio, as the premise is the proper type of communication and the conclusion may be wires or radio. However, it happens that the inherent features of radio telephony are such that

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it has no economic or service application in the United States, or in any other place where conditions are similar, except as a supplement or auxiliary, in certain instances, to the wire service, but in no case a substitute therefor.

The real applications of radio are in communications across wide stretches of water, in ship to ship, in ship to shore, in airships to land, in possibly some other types of mobile stations, in some forms of broadcasting where the same communication is given simultaneously to a large number of people, and in remote cases where, due to geographical or other conditions, it is impossible or impracticable to place wire lines. All of these applications will be recognized as supplements to the regular wire service and not substitutes for them. For the regular telephone services both local and long distance, for which wires are now so extensively employed in the United States, the limitations of radio are such that it cannot be used.

RADIO TELEPHONY CAN NEVER REPLACE UNIVERSAL WIRE SERVICE

The general telephone communication goal in the United States is universal service. This is merely a brief way of saying that any person, anywhere, at any time, can quickly, reliably and at a reasonable cost, talk with any other person anywhere else in the United States, and for this talk these two persons will have available facilities for their personal, private and uninterrupted use. Radio does not meet these requirements. It provides unguided transmission, sending out its message broadcast to anyone within range properly equipped to receive it, while wires, although they came first in scientific development, really represent the refinement of the art and provide guided transmission directed only to the person for whom intended. Scientifically it is actually more remarkable that we are able to guide messages by means of wires than to send them out broadcast by radio.

The number of communications which can be transmitted simultaneously by radio is narrowly limited.

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Daily over 60,000,000 telephone calls take place over wires in the United States. In New York City 4,000,000 calls are handled per day and 100,000 calls per minute during the busy hours. The facilities of the ether within any reasonable practical range are so limited that but a very small fractional part of such an enormous volume of messages could be handled by radio. Further, the real applications of radio as hereinbefore outlined will undoubtedly demand greater facilities than the ether will afford and it is certainly desirable that the ether be conserved for such real and necessary uses. If this is not done, it will be almost hopeless to expect that satisfactory service can be given even in the real fields of radio.

The cost of radio equipment and operation for universal service would be enormous. The investment of the Bell System in the United States today is less than \$200 per subscriber's station, including both local and long distance lines, and comprehending all the poles, wires, cable, conduit, equipment, land, buildings and accessories of the entire system. It is impossible to conceive at any cost any form of radio equipment which would provide the same universal telephone service.

However, suppose an attempt were made to set up such a radio service. It can be imagined to be along either of two lines: First, the apparatus at each subscriber's premises might be kept as simple as possible, and arranged only to connect that subscriber to a central office in a manner similar to that by which each subscriber is now connected by wire. Second, by making the subscriber's apparatus more complicated, the subscriber might be given apparatus enabling him to directly connect with other stations in his vicinity, and he would reach more distant subscribers by connecting to a central office. It is impossible to imagine any arrangement so comprehensive as to enable him to directly reach all other subscribers.

In the first case his apparatus would consist of both

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transmitting and receiving equipment with suitable signaling and power apparatus and with some form of antenna. It would need to be much more complete and reliable than any of the present simple forms of amateur equipment. In this case the radio equipment would merely take the place of the wire connection between the subscriber and the central office, but the cost of the radio equipment would be much greater than the total cost per subscriber of the entire existing telephone wire plant. In addition central offices and trunks, involving very expensive and elaborate radio apparatus, would be required to complete the connections.

On the second assumption, part of the central office expenditures would be avoided, but the cost of the apparatus at each subscriber's station would run into thousands of dollars, and in addition a considerable part of the central office expenditures would still be necessary.

For long distance service radio has a more favorable application than it has for local service, but again it is found here that both in first cost and subsequent cost of operation it is many times more expensive than for wire circuits and does not approach them in reliability or freedom from interference and is not secret.

Thus the cost of a complete radio plant for either local or long distance service or both is far in excess of the corresponding wire plant, and not only is the first cost of radio equipment greater than for wire equipment, but the experience to date indicates that the cost of operation of radio is greater per dollar of investment than for wire plant. This means that radio telephone service, even if it were possible, must have rates, in order to pay the costs of operation, many times greater than charged for the present wire service.

From the above it is evident that the cost of radio service would be excessive and that the character of the very limited service which could be given by radio would be so far inferior to the service now given over wires that the general public, even if they could afford to pay for it, would not tolerate it.

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The words of the Secretary of Commerce, Mr. Hoover, at the recent Radio Conference in Washington are interesting and to the point:

"I think it will be agreed at the outset that the use of the radio telephone for communication between single individuals as in the case of the ordinary telephone is a perfectly hopeless notion."

SOME PRESENT APPLICATIONS OF RADIO TELEPHONY

Let us then consider some of the applications of radio telephony which in the present state of the art can now be foreseen. Between moving vehicles, ships, ships and shore, airships and ground, and similar classes of services radio telephony has an application. All of these are possible fields, and as time goes on, it may be expected that they will be developed into useful auxiliaries to the wire service. Recently interesting and successful experiments on ship to shore transmission were conducted with the United States Steamship *America*, operating by radio in connection with our Deal Beach radio station and thence over land wires to New York and other points. These tests showed that ship to shore service is possible but whether or not it is established as a commercial service must necessarily depend upon its value, which must be great enough to make the service self-sustaining.

Transoceanic wireless telephony is, of course possible, as was demonstrated by us in 1915. However, the present costs are very great and before it can be generally employed, the commercial value, as in the case of ship to shore, will have to be determined and assured. A factor operating seriously against such service is the great difference in time between countries located widely apart.

BROADCASTING

One of the most interesting applications of radio telephony is that of broadcasting, which is not intercommunication but a one-way service. It is in this field

that radio, by virtue of its inherent nature, seems to have great possibilities. At the present time broadcasting is being done by various departments of the Government, by certain manufacturers or agents of radio apparatus, by experimenters, by newspapers, and until recently by amateurs. The existing broadcasting transmitting stations are operating in the particular interest of the owners of such stations and are not providing broadcasting transmitting service for the use of the public in general. The American Telephone and Telegraph Company controls the important patents on radio telephone broadcasting transmitting equipment for general public use and consequently is being besieged with requests to sell radio telephone broadcasting equipment or to provide radio telephone broadcasting service. We are selling the broadcasting equipment and so many of these requests have been received that it has become apparent that if every one who desires his own broadcasting equipment should purchase it, there will soon be so many broadcasting stations all operating on the same or a comparatively few number of wave lengths that real service from any of them will be impossible. Accordingly, we are now establishing in New York on the Walker-Lispenard building a broadcasting station of the latest and best type known to the art. It is not planned that we put on any program ourselves but rather provide the facilities over which others may broadcast at specified rates. We could doubtless provide and broadcast a splendid program, but by such a procedure we would be inviting the public to purchase receiving equipment in order to hear our program and we would be committed to the indefinite continuance of a service for which no revenues would be received. By providing facilities for the use of others it rests with those who broadcast to furnish a class of program to which the general public will desire to listen. It is thought that in this manner the true attitude of the public toward broadcasting may be determined, as it is realized that at present the public is in a more or less optimistic state of mind and that broadcasting must be

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placed on a much more sound basis if it is to remain as a valuable service.

If the experimental broadcasting station in New York is commercially successful, it is our plan to establish, as circumstances warrant, similar stations throughout the country, and not only may each station have available for use in connection with it all of the local lines in the zone served by that station but also at some future time it may be possible that all of such broadcasting stations throughout the country may, if conditions warrant, be tied together by the long line plant, so that any one, from practically any point, may use any number or all of these stations simultaneously if he so desires. It is our thought that only in this manner can the best, cheapest, and most extensive radio broadcasting service be given.

It should be understood that this service will not react to the exclusion of private or other broadcasting service and will not necessarily in any way directly displace such services. However, it is obvious that every one cannot own his own broadcasting equipment, and unless some provision for service such as we have outlined is made, only a limited number of people in the country will have broadcasting service available for their use.

PRESENT LAWS AND PROPOSED REGULATIONS

The present radio laws, which were made originally in 1905 and later modified in 1912 and adopted by Congress, cover principally the international situation with reference to radio telegraphy, as radio telephone service was not practicable at that time. With the rapid development of radio telephony, particularly since the war, there has been a strong realization that the present radio laws are entirely inadequate for the present situation and not only is the international communication question now under consideration but also the national problem. During February the Secretary of Commerce appointed a Committee to consider radio telephone matters. This

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Committee first met on February 27th and has been carefully considering the requirements for radio telephony with the idea, through subsequent legislation, of providing space in the ether for the necessary and real services. It is proposed in the preliminary report of the Secretary's Committee that a large part of the available space in the ether be set aside for various kinds of broadcasting, with a small reservation for ship to shore, for transoceanic and for fixed station service. The temporary assignments which the Committee have suggested for the desirable uses of radio are naturally limited by the ether and by the character of practical apparatus so that no one of the services will probably receive as full an allotment as might be desired.

It is hoped that the proposed legislation will provide reservations in the ether for what now seems to be the possible applications of radio telephony to the public service in order that these applications may have an opportunity for development along proper lines. It is also desirable that there be established and maintained a rigid regulation of radio matters with the end in view that prime consideration will always be given to the necessary and essential uses of radio.

THE BELL SYSTEM AND RADIO

While we have important exclusive rights protected by patents, our interest in the extension of our field of service overshadows any interest in any patent or group of patents. Above all, we do not want to obstruct the work or play of scientists and amateurs. Progress follows experiment and use. In this new art we should experiment and encourage the experiments of others but without prejudice to later enforcement of our rights if and when such enforcement becomes necessary to the efficiency of a public service.

The question of most interest in the Bell System is naturally—"What do we propose to do with radio?" We propose to keep in mind our main purpose which is

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to furnish to the people of the United States as wide a range of communication facilities as possible. It may mean service with ships, railway trains and airplanes. It may mean a transatlantic service, but promises cannot now be made. It may mean broadcasting, the future of which cannot be determined as yet. It should be remembered that radio telephony, with its scope definitely limited by natural conditions, has only reached an elementary stage, even in its possible fields. Bearing in mind our fundamental policy of providing the best and most economical type of facilities to meet any given set of conditions, we shall continue our work of developing whatever possibilities there are for radio in the field of telephone communications.

A. H. GRISWOLD.

The Work of the Bell Telephone Securities Company

THE Bell Telephone Securities Company is the latest addition to the group of companies which form the Bell System. The purpose of its organization is stated in the Annual Report of the American Telephone and Telegraph Company for 1921, and I need not set it forth at length here. It will be sufficient to say that its main function is to disseminate information about Bell System securities to the public, particularly to Bell telephone users, and, when desired, to advise interested investors and to facilitate their transactions in Bell System securities, and thereby to aid in securing a more widely distributed ownership.

Even now there is a wide ownership of the stock and other securities of the Bell System. The savings of several hundred thousand men and women throughout the country have gone into the building of the Bell telephone plant. But it will require the savings of many new investors to take care of future extensions. The demands for service now are heavy and they will continue with the growth of the telephone habit and with increases in population and business.

There are today over 197,000 stockholders of the American Company. The increase has been steady and rapid. In 1900 there were only 7,500 stockholders; ten years later the number had risen to 20,400; by 1915 it was 65,500; and at the end of 1921 it was 186,342. The wide distribution of the shares among individuals is revealed by the fact that 29 was their average holding; 176,085 stockholders owning less than 100 shares each.

Largely because of the fact that the telephone was invented in Boston and first financed in that locality, the Bell System and its securities are better known and understood, and the holdings are largest in New England and New York which today owns approximately 74% of it.

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As the service has been extended, the ownership has spread; but it is desirable to increase this distribution still further. Very many more people over the Nation, who are the Company's customers, can and should acquire some of its stock. They can buy the stock in the market at a price which gives a reasonable return, and this is the only way in which those who are not now stockholders and are not employees can secure the stock.

This wider distribution of Bell System securities will add to the number of those who have safe investments. Customers who became shareholders, will take an interest in the Bell Telephone Companies and will acquire an understanding of their problems and needs. It will also lay broader financial foundations for the Bell System, and will aid it to secure, at a lower cost, the money needed for extensions of the service.

MONEY REQUIRED FOR EXTENSIONS

It is clearly to the interest of the public, no less than to that of the System, that the latter's financial structure should be strong. It takes much money annually to provide for its new business. The requirements of the people for telephone facilities imposes the task upon the System of providing approximately \$215,000,000 each year for additions and replacements. These requirements cannot be ignored. They must be met. The sum involved is huge even to people who recently have been taught to think in billions. Think of it in this way and the meaning of it can be grasped: The Bell Telephone System must provide more money each year, to give the public the facilities it demands, than any government in Europe, except those of Great Britain, Germany, Russia, Austria and Italy, expended annually for all public purposes before the Great War. The sum is greater than the yearly pre-war expenditures of Spain, Brazil, Argentina, or Canada. It is much greater than the present annual expenditure of New York State. It is not much less than the expenditure of Japan in 1913, and it is two and a half

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times that of the United States the year before the Civil War.

The greater part of the sum needed annually must be secured through the sale of stocks or other securities; and the System's financial condition must be such as to attract the funds of investors. No pressure can be brought to bear upon them. The Company cannot, like governments, secure funds through any compulsory process.

It is not contemplated that the plans to promote customer ownership and to secure a wider distribution of securities, will provide a substitute for former methods of raising new capital, but rather that they will supplement and facilitate them. It is expected, however, that they will result in substantial additions to the sum of money secured in other ways, and, especially, that they will promote better relationships.

THE FIRST CAMPAIGN SUCCEEDS

The organization of the Securities Company was completed, and the Company was ready to enter upon the tasks assigned to it on September 15, 1921. Before this date, there had been under consideration a campaign for the sale by the Southwestern Bell Telephone Company of \$2,500,000 of 7% cumulative preferred stock. In a comparatively short time the requisite plans were completed.

The territory of the Southwestern Company is very large, and it was recognized that the task of organizing it would be exceedingly heavy. It was determined to organize it piece-meal and to make haste slowly. It was recognized that the economic conditions of the territory were not satisfactory. In fact, in certain financial quarters, we were assured that there was little or no money in that territory seeking investment and especially in a 7% stock to be sold at par. The Southwest is largely agricultural, and it was well-known that the farmers, especially the cattlemen, were hard hit. The oil boom

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had collapsed; and the lumber industry was much depressed. Still, the officers both of the Southwestern Bell and of the Securities Company, were confident that reasonable success could be obtained.

The territory finally selected for beginning operations was in the division embracing Houston, Galveston and Beaumont. Contacts were established with local banks and investment houses, all of which expressed confidence in the Company and its security and willingness to cooperate. Meetings of the employees were held in each of the cities. Circulars were distributed and the requisite advertising matter was inserted in the leading papers. Immediately following the organization of this division, attention was directed to Kansas and to the development of the work in that State. Later the other divisions in Texas were organized. On November 21, 1921, the machinery was set in motion in Eastern Missouri, especially in St. Louis, and subsequently was extended throughout Missouri, and about the beginning of the new year the necessary steps were taken to begin the selling of the stock in Arkansas and Oklahoma.

On an average for the entire Southwestern territory, the campaign ran approximately three months and a half and the entire amount of the authorized issue was sold before March 25.

In this campaign, 25,000 shares of preferred stock were disposed of to approximately 6,500 people, the average number of shares sold to each purchaser being less than four. It is interesting and significant that at a time of great depression, so many individuals were able to save and willing to invest \$2,500,000 in securities, and by doing so, to assist in providing additional facilities for their own use. These communities gain from being able to retain this sum of money at home for construction purposes, and the individuals gain from their investment in a sound security yielding a reasonable return. The Company welcomes the investors as stockholders, whose cooperation it will have in rendering the best possible service at the lowest possible cost.

TYPICAL AND INSTRUCTIVE INCIDENTS

Many interesting incidents occurred in connection with the sale of this stock. At Wichita Falls, Texas, a blind man purchased five shares of stock from a girl teller in the commercial office. When first told about the stock, the man said he had read nothing about it because he was blind. The girl then told the story of the Southwestern Company's 7% preferred stock, which interested the blind man very much. However, he left without signing the purchase contract. The next day he returned. He asked for the same girl and had her make out a check for his signature covering the payment on five shares. The following day he appeared and asked for the General Manager. He was taken to the Local Manager, to whom he said: "I am now an owner of your Company. I have found out that my next-door neighbor has been trying to get telephone service for over three months. As an owner of your Company I would like to know why you have not furnished him the service." The Local Manager saw an opportunity to clear up a situation. He explained that there were no telephone facilities in the neighborhood at that time and that a special installation in advance of the completion of the regular construction, which was under way, would cost \$400 or \$500. The blind man got the story thoroughly. He slapped the desk emphatically and said: "As one of the owners of this Company I would not let you give that man service at such an installation cost. I will go back there and explain to him that he should wait until your new cable is installed."

In another Texas town, a prominent citizen had a prejudice against corporations in general. A telephone man was at his residence repairing his telephone, and when the job was finished, attempted to sell Telephone Preferred to the gentleman's wife. During the conversation, her husband came in and listened attentively. Finally he told the telephone man that if all the public service companies' employees were as interested and as

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loyal as he, the companies would never have any trouble with the public, the commissions or the courts.

An encouraging result as the campaign progressed was the change of attitude in the financial quarters previously mentioned. After our campaign had been running a few weeks, an offer was made to underwrite \$2,500,000 of the issue. This was not accepted, but investment houses were allotted \$1,000,000 to sell on the same commission as that paid to telephone employees. Other underwriting offers were made by eastern bankers.

The attitude of the banks was decidedly friendly. Many of them made direct sales; all spoke well of the stock when investors sought information from them. They recognized that our partial-payment plan fosters thrift and thus helps the community. The friendly attitude of the banks increased the feeling of confidence among their patrons and had a most helpful reaction throughout the territory.

WISCONSIN MAKES A RECORD

The next large task of the Securities Company was undertaken in cooperation with the Wisconsin Telephone Company. That Company planned to sell \$5,000,000 7% Cumulative Preferred Stock. The resulting campaign which has just closed with an over-subscription of several hundred thousand dollars, is a pointed example of the working out of the formula—

Preparation + Enthusiasm = Success.

In the Wisconsin territory, which is compact, an intensive plan was adopted. Work was to begin March 1st and to last from six to eight weeks. Of the issue of \$5,000,000, it was hoped to sell \$4,000,000 during the campaign, and the remainder during the next few months. Every employee had a place in the selling organization; the necessary routines and forms were ready; and publicity material was prepared and ready for distribution. But on February 22nd and 23rd the State was swept

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by the worst sleet storm in its history. Over 10,000 telephone poles went down, and all forms of transportation were paralyzed.

Because of the damage, the derangement of traffic, and the necessary resulting work of restoration, which fully occupied the Wisconsin Company's plant forces, it was announced that the opening day would be postponed until March 6. However, some of the material was already in employees' hands, and the banks had started their publicity work, so it was decided to let those go ahead who could do so. Under these severe handicaps, the Wisconsin Company made advance sales of \$3,100,000 worth of stock; and before the end of the fourth day after the formal opening (March 9th, to be exact), the entire \$5,000,000 had been over-subscribed. Approximately two-thirds of the stock was sold for cash; employees sold a little more than half the issue; the sales averaged less than five shares for each purchaser; and as a result, the Wisconsin Company has about eleven thousand new stockholders.

While, of course, no pressure was brought to bear on any employees to make sales, yet the fact that everyone was assigned to a definite place in the campaign organization was a great impetus to them. A quota of 6 shares for every employee was used in figuring the quotas of the various exchanges; and on this basis, 22 out of 80 exchanges had "gone over the top" in the first four days. Oconomowoc, the first one to pass its quota, did so by four o'clock the first day announced for the opening of the campaign. Its quota was 132 shares and up to Friday night, March 3, it had sold 404 shares.

In his comment on the campaign, President McGovern says: "One of the outstanding features of this sale is that many people did not seem to look into the real merits of the stock, but relied very largely on what our people said to them. Of course, the fact that most all the banks in the State are favorable to our stock proposition, has very materially assisted in the sales."

FINE PUBLIC RELATIONS

As in the Southwest, so in Wisconsin, there were happenings which reveal not only the enthusiasm and enterprise of the employees but also the good-will of the people and the satisfactory relations which such a campaign establishes.

At Oshkosh, one of the linemen was very much discouraged because he thought that he would be unable to make any sales. His spirit was good, but he was afraid that stock selling was too complicated for him. The plant supervisor did his best to encourage him, but apparently with little success. The next day the lineman came in smiling and said that on his way home he had stopped in to have his shoes repaired and had sold the cobbler \$2,500 worth of stock with very little effort.

Early in the course of the campaign, a charwoman working for the Company, who spoke very broken English, came to the desk where telephone bills are paid and without any comment handed in five \$20 bills. The teller asked her what the money was for. She replied in rather broken English: "Stock—corner grocer." After a great deal of difficulty it developed that the charwoman had sold a share of the stock to a corner grocer, had collected \$100, and had not even given him a contract or receipt.

The first share of stock in the Wisconsin campaign was sold by Miss Bond. This sale was made to an invalid woman, who had read the Company's announcement of the sale of stock and telephoned in, asking to have someone come out and explain it to her. Miss Bond responded and had no difficulty in answering the woman's questions and in making the sale.

In a certain section of Milwaukee, there is a German shopkeeper who is very influential in his community, and who has generally been opposed to the Wisconsin Company. On the whole, he has been rather anti-corporation. One day this storekeeper telephoned in to the security manager's office and asked him to send a number of stock

application blanks to his shop. In explanation, he said that his friends and customers were coming in to his store, that they were discussing the stock, that he thought they ought to be purchasing some, and that he wanted a supply of blanks for them.

The success of this campaign evidences not only the confidence of the people of Wisconsin in the Wisconsin Telephone Company but also their thrift and their readiness to invest their savings in sound securities.

POINTING OUT THE DESIRABILITY OF AMERICAN TELEPHONE AND TELEGRAPH STOCK

A third undertaking of a slightly different type is that in cooperation with the Chesapeake & Potomac Telephone Company in the District of Columbia, West Virginia, Maryland, and Virginia, and the Bell Telephone Company of Pennsylvania, embracing Pennsylvania, Delaware and the southern part of New Jersey, to secure a wider distribution of American Telephone and Telegraph stock in those territories. I have already pointed out that it is desired especially to interest the users of the Bell telephone throughout the Nation, in the stock of the American Company. New stock of this Company, when issued, can be offered only to stockholders, and, under certain regulations, to employees; and the only way in which others can secure the stock, is either by purchasing rights, or by buying the stock at the market. In the territories of the Chesapeake & Potomac Company and of the Bell of Pennsylvania, through the employees of the Company with the cooperation of banks, the attention of subscribers was called to the American Telephone and Telegraph Company stock. Steps were taken to furnish them full information concerning its investment value, and it was indicated that arrangements could be made in many cases, if it was desired, for them to pay for the stock in installments. The undertaking has met with a very hospitable reception and large response. Many who were not acquainted with the stock and its

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value, welcomed an opportunity to know about it and to invest their savings. It is estimated that as a result of this work there will be a net gain in these districts of between 3,500 and 4,000 non-employee stockholders of the American Telephone and Telegraph Company, purchasing from 35,000 to 37,000 shares.

It is clearly desirable that investors throughout the Nation be informed concerning the securities of the Bell System, their safety, and how they can be acquired. Numerous inquiries alone indicate that it is desirable to spread such information. The Securities Company is therefore planning to keep before the people of each community by means of window cards, bill enclosures, and in certain cases through advertisements or circulars, the kind of Bell System securities which subscribers might interest themselves in, and the steps they should take to purchase them. As the securities must be purchased in the open market, we plan to have the purchaser file his order, to assist him in securing its execution with the minimum delay and expense through a bank or a responsible broker with which he may wish to deal, and in certain cases, where payment in installments is desired, to assist him in arranging with some bank to handle the transaction.

These, and other activities of the Securities Company which will develop along appropriate lines as circumstances suggest, will involve in most cases close cooperation with the Associated Companies and the intelligent and enthusiastic participation of their employees. These things we know that we can always confidently count upon; for the keynote of the Bell System is teamwork and high consideration for the Company's welfare as well as for that of the American people whom it serves.

D. F. HOUSTON.

The Telephone's Development

Some of the early history of the development of the telephone art as freely edited from the verbal testimony of John J. Carty, Vice President of American Telephone and Telegraph Company, in charge of development and research, before the Public Service Commission, State of New York, at Albany, New York, March 15, 1922.

IN the beginning of the development of the telephone art—when the telephone was first being introduced to the public—all that there was to the telephone system was a couple of telephones and the principle upon which the telephone could work. That principle was known. There were two telephones that would barely work and there was about 100 feet of wire tying them together. It was almost impossible to hear through the instrument even in the next room. In fact, it was said by some that you could not hear at all, but speech was transmitted. That was all that there was to start with and all that was known about the telephone was known by Mr. Bell and Mr. Watson. Watson was the man who made the original telephone, the man who heard the first words; Bell was the one who spoke them; and between them those two men knew all there was about the telephone and nobody else in the world anywhere knew anything about it. That is what we had to start with.

Attempts were made to talk over an actual line and finally talking was accomplished from Boston to Cambridge; but there were no signalling devices and no telephone circuits as we know them now, so that to start with they copied the telegraph line, which was a line of iron wire run upon house-tops and using the ground as an earth return.

To illustrate how little was known about telephoning at that time: a copy of the instrument exhibited by Bell at the Philadelphia Centennial, in 1876, was taken to

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England by Sir William Thomson who was the greatest scientist of the time. When it reached England it was somewhat damaged and there was nobody there that could make it work.

The instruments were soon modified into a little different type so that talking could be accomplished over a line, say, a mile or two long. It was necessary to talk and listen through the same instrument, there being no special transmitter then, but the telephone was put to the mouth and then to the ear alternately. It was soon found that while the telegraph line worked very well for telegraph it did not work well for telephone because of all sorts of difficulties, noises and cross-talk from telegraph circuits lightning storms and other serious disturbances.

There were no telephone switchboards and the early switchboards were telegraph switchboards used to change a line once a day or so without any regard to speed. The telephone switchboard must change the switching of the lines hundreds of times a day. The problems are quite different. There was no cable of the telephone type that was satisfactory. A half a mile or a mile of the cable was more than these instruments could talk through. For several years the instrument was regarded, and with much reason, as but a scientific toy without business importance. In those places where we succeeded in getting it in business houses, it was largely through favor rather than on the merits of the instruments and it was regarded as a business nuisance and a scientific toy.

With the art in such a miserable state and so much unknown, and such a multitude of difficulties it was found very difficult to make any business arrangements at all to get it introduced because conservative and capable business institutions felt that it was entirely speculative. The plan adopted was to induce individuals in different localities to take out licenses, the object being to introduce the telephone throughout every part of the United States. All through the country licenses were issued to small concerns, men, of course, who had no experience whatever in the business and with absolutely no knowl-

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edge of it, but who were attracted by its novelty and by the arguments that were made to get them to come in.

Difficulties were encountered by everybody who undertook to install the telephone—by all of the licensees—and they knew nothing about the troubles or their remedy, or whether there was a remedy or not. They were constantly appealing to the licensor company for help and arrangements were made to render the service required to give them help in their problems. Laboratories, in which Dr. Bell and Watson worked and in which they invented the telephone, were taken over and Mr. Watson was put in charge and the staff was begun. They first thought that perhaps medical men who knew all about the ear and the voice might be able to solve these problems but they could give no help whatever, although the best of them were consulted. The company then went to professors of physics. There were no professors of electrical engineering at that time because there wasn't any such thing as an electrical engineer, or electrical engineering.

But they gathered together the very best men that could be obtained at that time to advise the licensees, not only on the technical side, but on legal questions, on questions of how to keep books in this new sort of business and other problems that arose. So that there started and grew up at once a nucleus of what is now often referred to as the staff at headquarters, being the general staff. They were what we might now call liaison officers, to obtain the best understanding with the licensees and help them out the best way.

TRANSMITTER AND RECEIVER DEVELOPMENT

For a long time there was no real transmitter as we know it, it being necessary to use what we now call the receiver for talking as well as for listening. The first instruments did not have any permanent magnet so it was impossible to use an ordinary telephone receiver without carrying around a battery with it. One of the im-

portant steps was to introduce a permanent magnet. The receiver passed through the stage to where, I suppose, we tried out thousands of different types, many thousands of different models, and a few years ago, I counted up the number that were actually made standard and there were about 50 different types that had been standardized from time to time and then superseded by others.

Early transmitters were what we call magneto. There was no battery at all. It was just like talking through the telephone receiver and they were very lacking in power and it was possible to talk for only a short distance. Then came the battery transmitter, invented by Blake, the use of which was a very revolutionary step forward, but with the need for greater and greater distances of talking over longer and longer wires, it became necessary to have transmitters that were more and more effective. The transmitter of Blake was superseded, after passing through a long series of evolutions itself, by what is known as the granular carbon transmitter which, instead of fixed pieces of carbon working against a piece of platinum, uses granules of carbon that are actuated by the diaphragm. The original granular carbon transmitter came from a minister of some church in England, the Reverend Mr. Hunning. The Bell Company bought his patent and a long series of experiments was undertaken and finally the idea of Hunning was made available for the public. He would not have known his own transmitter.

From the Hunning transmitter has been developed the transmitter that is now used universally in this country and is also the standard all over the world wherever they have the best instruments. Of course, even now we are constantly working to perfect these instruments still further. Something over 70 types of transmitter have been made standard from time to time and replaced by others.

IMPROVING TRANSMISSION

In the beginning it was necessary to use a telegraph line, which was made of iron. The iron and the telegraph

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construction worked very well indeed for the telegraph, but it did not work so well for the telephone, because the telephone was the most sensitive instrument known and it was capable of being actuated by very minute currents that would not interfere with the telegraph. We had great difficulty with cross-talk and all kinds of devices were tried to remedy difficulties arising from induction. There were literally hundreds of these induction killers. They were very successful in killing the induction but they also were successful in killing the talk so that nothing ever came from that line of development.

A wire was strung from Boston to Lawrence, about 26 miles, on telegraph line. Anybody listening on that telephone line could hear all the telegraph messages. It was as though we had, as I once said, an old-fashioned drum corps and each drummer began drumming a separate tune.

All kinds of experiments were tried. We tried the use of different kinds of steel and iron wire. Wire was run from Boston to Lowell that had a spiral cut all around it. Somebody had a theory that the voice would follow that spiral. A line of four iron wires was built from Boston to Providence and on Sunday, when nothing else was doing on the wires, it was possible to talk on one of them, but if you tried to talk at the same time on the other wire, there was confusion. Then, to make matters worse, a new fangled telegraph system was started which used very high frequency current and that practically destroyed the business of the line altogether.

There was tried out between Boston and Providence, at my suggestion—in fact, I tried the experiment myself —what is now known as a metallic circuit. Instead of using the earth as a ground, a return wire was employed. That is now the standard and the strange thing is that we ever did use the ground.

This metallic circuit experiment was a very great success and we planned to build a line to New York, but there were limitations in the iron wire itself, even using the metallic circuit, and when we put a number of these

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circuits on the same line, we still got cross-talk. These difficulties were overcome by the development of hard drawn copper wire which is one of the most fundamental contributions that has ever been made to telephony. A line was built from New York to Boston, using the hard drawn copper wire, but we still had cross-talk from neighboring circuits and that had to be overcome, so a method of transposition was adopted. All of the licensee companies experienced these same difficulties with line trouble during the early days of the telephone history, and when the general staff worked out a solution for a trouble for one of these licensees, it took care of all the rest at the same time.

In working out the increasing distances over which one could talk, we had to take into account, not only the line, but the instruments. There were two schools of thought. At an International Congress which I attended in France, the best European thought was to solve the problem of talking from New York to San Francisco by loud speaking transmitters. We had studied the problem ourselves and reached the conclusion that the loud speaking transmitter was not the way to accomplish the purpose. If we used the loud transmitter, it would be necessary to put in more complicated apparatus in the subscribers' stations and more powerful batteries and switches, and the cross-talk with these instruments would require a re-arrangement of the switchboards and cables which would cost many millions of dollars, so we made the attack on the line.

When the electric trolley was introduced, it presented a very serious problem because the noise it caused in the telephone circuit made talking difficult and in many cases impossible. Also, current from the trolley wires operated the central office switchboard signals and caused currents also to flow through the ground and onto the lead cables of the telephone companies, corroding the cables by what is known as electrolysis. After a number of years of working, a practical solution of this electrolysis trouble was arrived at and was adopted by all of the licensee companies.

The extension of high tension circuits of power lines also presented serious problems. To meet them, various measures were adopted. One was to devise protectors, an apparatus designed to produce as near practical immunity from fire and personal hazards as possible. The study of the problem of high tension circuits is still being continued because what was high tension at the beginning, is now very low tension. Two thousand volts was high tension and now we are talking about 200,000 volts.

CABLE CONSTRUCTION

As the demand for telephones increased, it became necessary to devise a solution for the problem presented by an increasing number of overhead telephone wires. For physical reasons and also for legislative reasons, we had to put our wires underground. We did not know how to make them work if put underground. That was the problem presented to the general staff, a problem, of course, which they had been working on from the beginning, but very intense work was conducted. While it was possible to talk for considerable distances when the wires were on poles, it was found that a mile of cable would cut down the transmission as badly as 100 miles of open wire. The first cables that were employed were rubber or gutta percha, both of which were good insulators as far as keeping the current on the wire was concerned, but for some reason or other, they seemed to destroy the talk. Early in 1881, I participated in experiments which were conducted by the licensor company when all the possible types of cables we could think of were put down. Cable was run in the neighborhood of Attleboro, Mass., between the tracks of the railroad for a number of miles, in which all sorts of devices were tried out. The first big advance or help that we got was in the introduction of cotton into the cables instead of rubber. Cotton had always been regarded as a very poor insulation but it was found that this was due to the presence of moisture and by heating the cable and driving out the moisture and

quickly covering it with lead pipe, a very high degree of insulation was obtained and it was much less objectionable than the rubber because you could talk farther through such a cable and cross-talk was not so great.

Many experiments were conducted with that type of cable and a great deal of it was put down, but in these experiments of 1881-1883, cable half a mile long of the best that we could manufacture so impaired the transmission over the telephone line that talking to the suburbs of Boston was very greatly hindered, or even prevented, by the interposition of a mile or a half mile of cable.

The cable problem had to be solved before the wires could go underground, and the solution did not come before the wires accumulated so rapidly that the authorities ordered them underground. As a matter of fact, Mayor Grant sent his men out with axes and actually chopped down the poles in New York.

The cotton cable was very greatly improved and finally it was superseded by paper, and the paper cable was put through a process of evolution until now it is the type usually employed. The experiments conducted by the general staff on this problem were continuous and were directed, not only to developing local cable, but also to developing long distance cable. Another way to state this problem is to say that it involved making the cables cheaper and also making cables so that we could talk through them. Of course, there is no use in making a cheap cable if you could not talk through it. So that, as in all the work we do, we have got to look to service first, and then, keeping the grade of service right, go as far as we humanly can in making it more economical.

It is interesting to trace the development of the 2,400 wire cable, which is one of the most recent types, following a long series beginning with the earliest type of rubber cable and thence going, by various stages, to a type of cable that would give only 100 wires in one sheath. That 100 wire cable cost as much, or probably more, than the 2,400 wire cable did. But that is not all. Space underground in New York is so precious that in certain regions,

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it is almost impossible to get any more room for ducts, so that, unless these cable improvements had been made, there would be certain parts of New York where it would be hard to supply service at any cost.

Long distance telephoning was another problem altogether. To talk through long distance seemed, at times, to be forever an insuperable difficulty. One of the important steps was the invention of the loading coil by Dr. Pupin. He had a very good idea and our company obtained his patent rights but, as is usual in such cases, the patent, while explaining the principle, did not by any means show how to make it on a practical scale. Our progress in developing long distance cable transmission was something like this: we succeeded in talking very well through a cable from New York to Newark with the Pupin coils and other arrangements in association with them. Our further work carried us to Philadelphia, and by further research, we were able to talk to Wilmington, Delaware, and finally to Washington. Still continuing to develop, always making new discoveries and advancements, we succeeded in talking all the way underground from Boston to Washington.

The congestion which was encountered in the local wires in the beginning is now being felt in the trunk lines joining the different cities together. They are becoming so numerous that they have to be put into cables, so that the problem having been solved locally, we have to go on and solve it all over again for long distances. At the present time, we have, by means of a remarkable new type of cable, succeeded in talking from Boston to Harrisburg, and our experiments show that we now have a type of cable that will talk all the way from Boston to Chicago, and in fact, the cable is now being extended to that city.

One of the important phases of cable development is the effect of the growth of central offices upon the use of cable. The larger the central office became, the greater the congestion of wires in the neighborhood of the office. One central office in the early days had 2,400 wires coming

in from four directions to the roof, and a sleet storm came, weighted the wires and that pulled over the structure and almost took the roof away. Large central offices would be impossible without cables and when we have advanced the cable art, we have made larger central offices possible. These two factors react on each other.

THE EVOLUTION OF THE SWITCHBOARD

The switchboard in the beginning, as I have said before, was a telegraph switchboard, a very crude type, very good indeed for the telegraph, but not swift enough or certain enough for the telephone. These switchboards were used and soon, under Mr. Watson and his assistants, began to be improved until a very good switchboard was evolved for one operator only. That was about 1878 or 1879, but as the number of lines grew, we had to have more operators, and then more switchboards. These operators had to call out to each other for the lines that they wanted, and the central office soon became a sort of bedlam. The methods of connecting were very imperfect and interconnection between one operator and another, or from one office to another, was attended, even under the best circumstances, by great delay, by extraordinary errors, compared to what we now have, and by constant cutting off and intermittent conversations.

The switchboard immediately began a process of evolution. These difficulties of communicating from operator to operator were overcome in the multiple switchboard which was one of the very important and permanent contributions to the art. By means of the multiple switchboard, if an operator receives a call for a subscriber in her own central office, she could connect directly to that subscriber without asking somebody else to help. That principle is still employed.

The early switchboards had very imperfect signalling devices and in general, were very, very crude. In the beginning, the central office operator had no power generator as we now know it, and she would have to turn a

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crank the way the subscribers formerly did and now do in the country.

The business continued to grow, notwithstanding all these difficulties, and about 1886 and 1887, quite a large number of telephones had to be provided for the downtown offices in New York City. They were scattered in two or three different offices and worked so unsatisfactorily that it was decided to consolidate them. This consolidation presented a very serious switchboard problem because with these large switchboards, the cost seemed to go up, not in direct proportion to the number of subscribers, but in almost geometric proportion, and it was difficult to get them to work, and looking forward at the complications and the expenses of such switchboards, it was really appalling.

The general manager of the New York Telephone Company stated several times at conferences, that the best he could see in regard to the switchboard problem was that it meant that all he had to do was get enough telephones, and the company would go broke. The expense seemed to be going up and would have gone up, if we had kept on that track, at a rate very much more rapidly than the increase of revenue from subscribers and there really was at that time a crisis. The telephone rates were \$150 a year; that was the cheapest telephone you could get in New York City, and the metallic circuit was being put in at \$240 a year.

One point after another was overcome. One type of switchboard after another was devised and the telephone, instead of being greatly restricted in New York as was then feared and as it would have been if we had not made these improvements, spread out all over the city and state. Without these switchboard improvements, of course, the development could not have taken place.

One of the very gratifying developments was the removal from the subscriber's station of the crank which had to be turned and the batteries which had to be renewed. This improvement was made by the introduction of the common battery system. The old type of

instrument was an annoyance to the subscriber and a great expense to the licensee, and the introduction of the common battery system was attended with most gratifying results in the central offices, because without any additional labor, in fact with greater ease, the central office operator could handle a much larger number of calls with really less effort, with much greater promptness and without some of the worst annoyances that attended the working of the previous system. One of them was that under the old system, the operator had to be continually listening in and annoying a customer asking "Are you through?" whereas with the new system, signals are exhibited when subscribers are finished and when they want to talk, so that the operator does not have to, and, as a matter of fact, does not listen in unless the subscriber signals her to do so when he wants attention.

THE MACHINE SWITCHING SYSTEM

There has been a great change in the economics affecting operators. The war placed women in the work which had always been done by men, and women are now continuing in that kind of occupation. It completely changed the situation with respect to the supply of operators. Also with the increase in trunk lines and other complications, the space which an operator can reach is about exhausted and the general staff have studied the problem to see what could be done about it and that brings us to the consideration of the machine switching system, or automatic system. That has been a subject which has occupied our attention for ten or fifteen years pretty steadily, with a view to finding out what place such machinery has in the properly organized telephone system.

Our tendency has been, all the time, to introduce machinery wherever it gives a better result to the public, or wherever it can be attended by economy of any kind. The fundamentals of this system were tried out for a number of years in Newark, and the other features of it were under trial for a long time, in New York City,

for handling trunk lines. The most recent installation was at Omaha, and there much interest was exhibited as to how the subscribers would regard it. The result was that subscribers, a lot of them, sat up until 12 o'clock at night so that they could be the first to send the call. The business started off in the morning and went through almost without a hitch, and the entire comment of the public and the press was most gratifying.

THE PROBLEM OF MANUFACTURE

In the early days there were very few sources available for the manufacture of telephone apparatus. There was a concern at Indianapolis owned by Gilliland; one at Cincinnati, Post & Company; another at Baltimore, Davis & Watts; Charles Williams & Company in Boston which was the firm that manufactured the first telephone ever made for Bell, and the Western Electric Company in New York and in Chicago.

Licenses were issued to these manufacturers but it was found that there was a great diversity in product and it was necessary to have the parts constructed so as to fit into a complete system. The telephone itself, of course, does not work in isolation. Its operation depends, not only on its own condition, but on the condition of the instrument with which the communication has been held, and on the condition of every intermediate thing in the plant, so that the discordant results in construction were very troublesome. Also, it would seem that some of these companies were not as strong as they should have been and that starting to install a switchboard, which would last fourteen or fifteen years, it was not all put in at once; the licensee companies did not put in any more than they could possibly help to save idle investment, but a manufacturing company was committed, when it put in a certain type of switchboard, to add parts to that, so that it was necessary to get some arrangement to insure continuity of supply of all the parts that were needed.

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For these and for other reasons, these manufacturing companies were brought together into a single company. Very little was done with the factories at Cincinnati and Baltimore, but Williams of Boston, Gilliland of Indianapolis, and the Western Electric Company combined their talent, utilizing the best men of each concern, in fact all of their good men were selected and all the workmen that would go, and factories were established in New York City. This was the beginning of the Western Electric Company, as the manufacturing branch of the Bell System.

NECESSITY FOR DEVELOPMENT AND RESEARCH WORK

If we did not continue this work the progress would cease. I don't like to criticize any of the foreign governments, but in order to illustrate my point I must bring out the fact that where we have hundreds and hundreds of men developing, they have four or five. That is, practical development and research as we know it here in America is unknown among the government administrations abroad. They have not conducted these developments in the manner that we have here in this country. And the result is that, looking over the entire contributions that have been made to the telephone art, the developments have been made here in this country, and there has been no substantial contribution to the art that has been made by any of these governments. Now, they have departments for doing these things, but they are not done. The best that they have abroad today is what they have taken from us. But in their method of organizing, their methods of use have not been developed, because they have not had general staffs to develop these systems. Take it even in the matter of their military necessities, the general staff of the French Army under Foch was the most brilliant that was ever known, and it was well known that a communication system was necessary for the conduct of war, but when the war broke their own administration was unable to

provide them with a communication system and it was necessary for the Americans to superimpose upon France and the neighboring countries a communication system within nine months that the foreign governments had failed to provide in forty years.

Now, if we stopped this development work we would dam up progress and we would fall into a condition as bad as there is abroad. Science is constantly advancing. Our country is growing. Business is expanding. New ideas are springing up in business, and new requirements are made. We want to talk greater and greater distances. We must be prepared to talk to South America. We are already talking to Cuba. There is no doubt we will be talking to Europe. We must go on expanding. To stop now would mean that the business would have to grow, but it would be conducted with the methods that we now know, which are well adapted for the present development, but we know they are not best for the development of ten or fifteen years hence. When we start putting in a plant now we are not building it for one year or two; we are building it for a long period and we must have in mind that it must grow, and that that new growth must always be in accord with the demands of the time.

Some Notes on Statistics

With Special Reference to the Telephone Business

THE ORIGIN OF STATISTICS

IN the popular mind statistics is frequently looked upon as a science of recent development which deals with uninteresting figures at its best and with involved mathematical concepts at its worst. Yet the use of crude statistical methods runs back as far as recorded history; and probably the evolution of no subject is more closely interwoven with the needs and development of peoples than is that of statistics. The history of statistics through the past ages is no mere catalog of successive steps in the development of a scientific basis of recording facts, but rather is a story of persistent efforts to obtain a working knowledge of the fundamental elements in the lives of nations—first, with respect to their population and material resources and, later, with respect to their economic and social relationships also. From the earliest records of organized social and political communities, the enumeration and compilation of statistical data has played an integral and vital part in their existence. The apportionment of taxes and the organization of armies were practically impossible without some degree of statistical information concerning the resources in materials and man power of the tribe or nation. One of the earliest known statistical compilations took place about 3050 B.C. and concerned the collection of data regarding the population and wealth of Egypt in order to make arrangements for the construction of the pyramids. Both secular and sacred history are filled with instances of the taking of censuses of population in order to determine the fighting strength of nations and as a basis for levying taxes. Until the 17th or the 18th century, however, practically the sole use of such censuses was to aid the government in its administrative work or in its military aspirations.

THE BEGINNING OF MODERN STATISTICAL METHODS

Modern statistics developed from two apparently independent schools of research, one in Germany which became prominent about the middle of the 18th century and the other in England which originated about a century earlier. Statistics as first used in Germany applied to lectures or books upon descriptive political science and was considered as a science of populations, similar to what is now known as demography. Etymologically, statistics means the science of states, and not until the development of the English school of political arithmetic was statistics looked upon as primarily a study of numerical data.

Interest in statistical compilations was aroused in England during the middle of the 17th century after the disastrous visitations of the plague had caused the publication of weekly reports of the burials, and later the christenings, in London. In 1662 Captain John Graunt of London published his "Observations on the Bills of Mortality" which contained the results of his observation and measurement of the births and deaths in London and is one of the first recorded analytical studies of a strictly statistical nature. This field of study was at that time called "Political Arithmetic," but by the early part of the 19th century it had largely absorbed the descriptive political science school in Germany, from which it took over the term "statistics."

The first journal of the Royal Statistical Society, which was founded in London in 1834, defined statistics as "the ascertaining and bringing together of those facts which are calculated to illustrate the condition and prospects of society." Further expansion in the scope and meaning of statistics took place at this period, and from the name of a science or art of state-description by numerical methods the word was transferred to those figures with which it operated. When this occurred, the term soon lost its peculiar application to data concerning the

state and was used in referring to any collection of numerical data, covering psychology, biology and other sciences, as well as political economy.

Thus statistics in modern usage has come to mean primarily a method or tool by means of which numerical data in any field may be analyzed and interpreted. In its development statistics has, of course, borrowed very largely from the older science of mathematics. Using processes largely mathematical in character, the student of statistical methods formulates the rules of procedure for handling groups of data, and the specialists in various fields of knowledge apply these rules to their own particular problems.

THE APPLICATION OF STATISTICS TO BUSINESS

But while statistics has had a long and distinguished career in the service of public administration and private scientific research, it is true that the application of statistical methods of analysis to business data is a development of recent origin. This is because business administration itself has only recently taken on the aspects of a distinct science, with the process of evolution from small individual enterprises to large corporate organizations which has been coincident with the growth and improvement of transportation and communication. Moreover, the use of statistical methods in business has been facilitated by the recent progress in the invention and manufacture of mechanical labor-saving devices which have made it possible to undertake much statistical work which was formerly prohibitive from the standpoint of both cost and time. The increase in legislation affecting business has also served to stimulate the expansion of statistical work in industry. So long as business was conducted by small units, each with a limited market, there was a tendency to regard statistical work as an unnecessary luxury; but with the development of business as a science, statistical analysis is destined to play the same vital part in business administration as it has

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in the progress of other sciences. Indeed, the progress made in business statistics in the last few years has been so pronounced that "statistical control" is rapidly becoming an actuality in many lines.

BUSINESS STATISTICS DEFINED

To make clear the scope and character of that branch of statistics which has come to be called business statistics, it is perhaps advisable to attempt briefly to define "statistics" as it commonly applies to business administration.

The man in the street looks upon statistics as the systematic collection, classification and tabulation of numerical facts, and his idea of a statistician is a man who knows how many males of foreign parentage, between the ages of twenty and thirty, are employed in mining occupations in the State of Nevada. The more scientific person probably thinks of statistics as a method mathematical in its operation, in which numerical data are analyzed through complex calculations of averages, units and the like.

The business statistician himself, however, thinks of his work as the collecting, classifying and interpreting of ascertained facts—including facts not subject to numerical statement—primarily with the aim of disclosing some further and hitherto unascertained facts. He thinks of his duties as those of assembling and selecting data, analyzing and combining them, and presenting and explaining them in such a way that they tell much more than they do in their primary, unrelated form. The opportunity for work of this character obviously pervades all branches of any business organization. Moreover, the field for such statistical work is not confined merely to the analysis and interpretation of internal operating and financial data, but includes the study of general business and economic conditions and the influence of these conditions upon the individual business.

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THE DEVELOPMENT OF TELEPHONE ACCOUNTING

In considering the progress already made in the field of statistical analysis of business operations, it should be remembered that accounting work is to a large extent the basis of statistics and that the introduction of scientific accounting methods is itself a comparatively recent development. This applies to the telephone business as well as to other lines of industry.

While the telephone was invented forty-five years ago, only for the past fifteen years or so has the telephone been a widespread public service. During this period the first work was naturally the erection of an adequate accounting system to show the financial condition of the business. It was necessary to set up refined methods for the separation of capital and income, the proper treatment of depreciation, etc. Practically all available time was devoted to the development of uniform accounts and standard reports, correct plant and maintenance accounting, suitable records of departmental expenditures and forms of accounts for general publication. Along with all this, careful plans have been worked out for extending the use of accounts by administrative officers, placing in the hands of responsible officials accounts practically arranged as working tools for everyday use. In the Bell System most of this work has been accomplished during the past fifteen years, a period within which the number of company-owned telephone stations has increased from two millions to nine millions.

THE FIELD FOR STATISTICAL ANALYSIS OF INTERNAL TELEPHONE DATA

Under such circumstances it would be surprising if the work of statistical analysis had progressed to the same degree as the accounting work. Development of the business has gone on faster than development of the necessary statistical personnel. Thus, at the present time, the Bell System is in possession of an admirable accounting system and a comprehensive set of primary

records—operating as well as financial—but has not advanced so far in the development and application of methods of statistical analysis. The magnitude of the business has made necessary such a voluminous mass of records and reports that many useful facts as to past conditions now lie buried, while significant elements of current operations are frequently subordinated. It seems apparent, therefore, that we have reached the point where there is not so pressing a need to extend and sensitize the accounting system as a whole as there is need to proceed further with the scanning, sifting and interpreting of results now shown by the accounts and operating records, and the presentation of the significant facts, trends, ratios and units through appropriate graphical and other statistical forms. Even as close cooperation has been established between the Accounting Department and other Departments in the working up of accounting data, in like measure close cooperation can profitably be established between the Departments in the work of statistical analysis. It is a matter of general concern that all accounts are under proper check so that figures finally lodged in the balance sheet are absolutely correct according to the accounting instructions; should not equal care be taken that all accounts and operating records are subjected to suitable and adequate statistical analysis not merely as to the correctness of the figures, but as to the significance and interpretation of the figures? While the accounts show very definitely *what* has happened, statistical work is designed to show, from an analysis of operating as well as accounting data, exactly *where* it has happened, *why* it has happened, and *who* or *what* is responsible.

THE INFLUENCE OF EXTERNAL FORCES

As already indicated, the field of business statistics is by no means limited to the analysis of internal financial and operating records. One of the fundamental characteristics of present-day industrial organization is the

instability of business activity. This instability is manifested in individual businesses and in business as a whole. Business may be improving or it may be growing worse, but it is never static. Because they directly or indirectly affect profits, these fluctuations in business activity are of paramount interest to the business man; and their accurate measurement and analysis through the application of scientific statistical methods is consequently a matter of prime importance. This applies to the telephone as well as to other businesses, even though the telephone business is one of relative stability as compared with business in general.

Perhaps the most common form of analysis of business data is the comparison of crude data for a current month with corresponding figures either for the preceding month or for the same month of the preceding year, or for both. However, direct comparisons of business data either as between different months or periods of the same year, or as between the same month or periods of different years, are in most cases liable to give rise to more or less misleading conclusions, because of the presence in the crude data of the effect of two influences: namely, seasonal variation (which affects the accuracy of the comparison in the first case) and normal growth or long time trend (which affects the accuracy of the comparison in the second case).

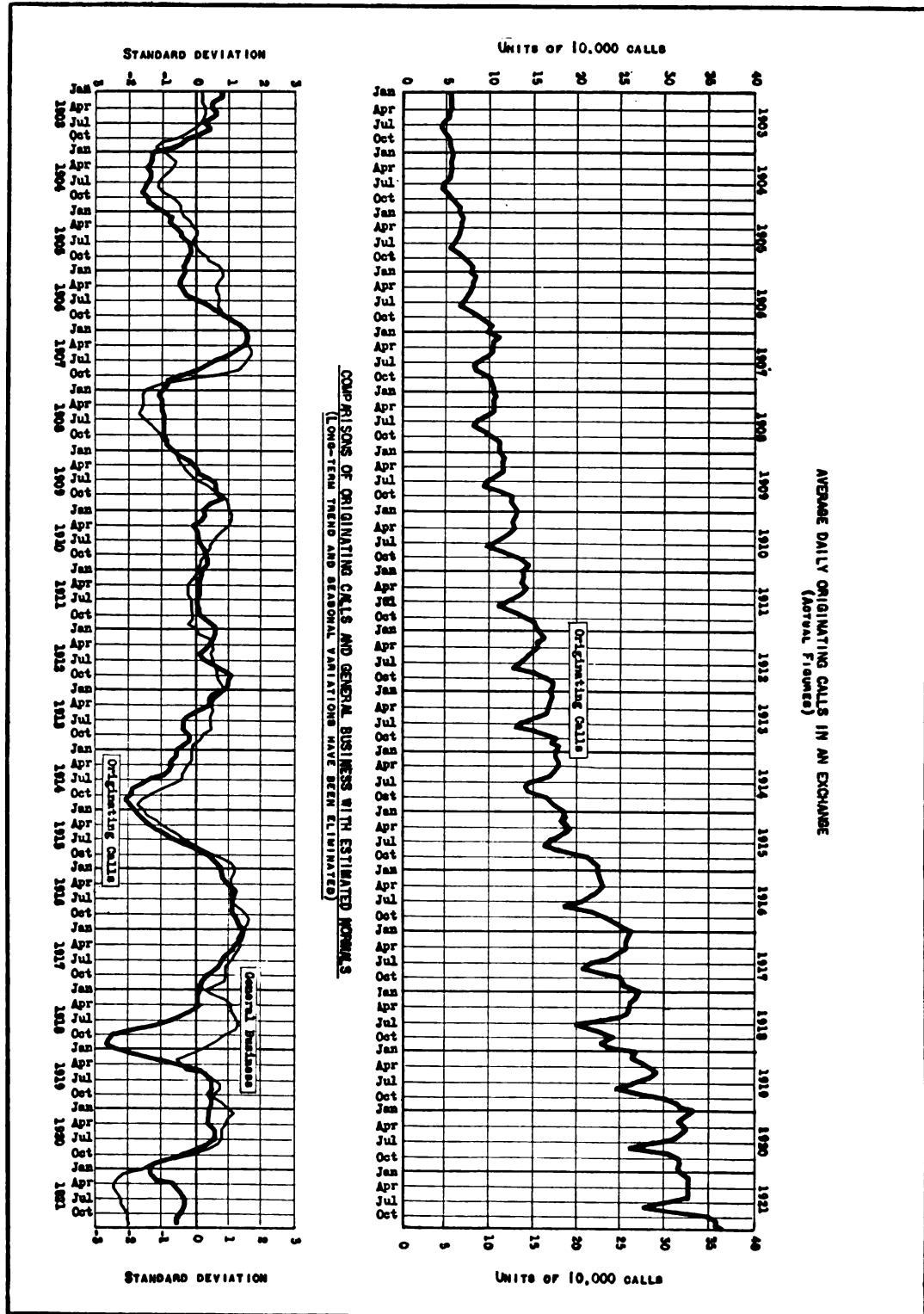
As an illustration of this point, take an example applicable to the telephone business. Suppose, for instance, that the number of originating local calls in a certain exchange area during the month of August is reported as 3% less than the number in the preceding month of July, but 5% greater than the number in the month of August of the preceding year. This comparison of August with the preceding July does not necessarily indicate unfavorable traffic conditions or results in August; indeed, since local traffic in that month is usually less than that in July as a result of the effect of normal seasonal influences, the fact that the decrease in August as compared with July is only 3% may even indicate an

improvement in conditions. In the comparison of August with the same month of the preceding year, the element of seasonal variation is largely eliminated but no allowance is made for the element of normal growth. Thus, the fact that local traffic is 5% greater than in the same month of the preceding year does not necessarily indicate that the volume of traffic is as great as it ought to be. If the normal annual growth in local traffic in the exchange area in question happened to be in excess of 5%, the traffic results in the current August would be unfavorable rather than favorable.

THE STATISTICAL MEASUREMENT OF EXTERNAL FORCES

Therefore, in dealing with business data in which the influences of long time trend and seasonal variation are present, accurate conclusions can generally be reached only if the effects of these influences are eliminated. In a forthcoming Statistical Bulletin issued by the Statistical Division of the American Telephone and Telegraph Company a statistical method is described whereby the effect of these influences can be removed, the method being one which has been carefully tested both in the analysis of general business data and in the analysis of statistics of the telephone business. For purposes of explanation, figures on the monthly production of pig iron over the past 19 years are used in the Bulletin, because reliable homogeneous figures on pig iron production are available for a period of satisfactory length and because these figures are relatively free from complications which are irrelevant to a discussion of the general statistical method involved. The analysis of homogeneous series of figures within the telephone business, however, can proceed along identical lines. The accompanying chart shows the result of the application of the method to local traffic in a certain telephone exchange area.

After the effects of seasonal variation and long-time trend have been eliminated from any series of business



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data, the corrected figures will usually be characterized by a broad wave-like movement similar in general form, though of different amplitude, to the cyclical swings of business activity through its alternate periods of prosperity and depression. In the case of telephone data, the comparison of figures analyzed by this method (where applicable) with external indices of general business, similarly analyzed, will permit proper conclusions to be drawn as to whether the current movements reflected by the telephone figures are reasonable and satisfactory in the light of general business conditions, or whether they indicate the existence of some abnormal condition which warrants examination from an administrative standpoint. The establishment of a consistent relationship, or correlation, between two or more analyzed series of telephone figures will also prove serviceable for administrative purposes, since the development of inconsistencies in these relationships will also generally indicate the presence of some condition warranting administrative investigation.

STATISTICAL AID IN FORECASTS

Not only is accurate analysis of past and present performance serviceable for administrative purposes and necessary for proper conclusions as to the real trend of current movements, but the measurement of the elements of long-time growth and seasonal variation by the statistical method described in the above-mentioned Statistical Bulletin affords, it is believed, an improved basis for forecasts, especially forecasts in which it is necessary to allow for the effect of general business conditions. The normal trend of long-time growth may be projected into the future and, where forecasts by months are desired, the projected annual trend may be translated into monthly figures in accordance with the normal seasonal variation. Such a projection, if limited to a period not more than five years in advance, should prove in the case of most series of telephone statistics to provide a substantially accurate forecast of future trends in so far as these

elements are concerned. If, furthermore, a fairly consistent relationship can be shown to have existed in the past between a given telephone series and some index of outside business conditions, a still more accurate forecast can be provided by modifying the figures indicated by the projected normal to allow for the influence of the probable future course of business conditions.

CONCLUSION

The particular phases of statistical and accounting work discussed above do not, of course, cover the whole field for such work in the Bell System. They are cited merely to indicate in a general way the undeveloped opportunities which still exist for further application of statistical methods of analysis, and to call attention to the need for the progressive development of these opportunities. Much splendid statistical work is already established in all parts of the System, but before the field can be thoroughly covered a considerable amount of experimental work is still to be done.

S. L. ANDREW.

Progress of the Joint Committee on Relations of Supply and Signal Circuits

YOU have all heard of E. K. Hall's "Four C's Program"—Contact, Conference, Confidence, Cooperation. Once again, this time in the matter of our relations with power and lighting companies, the advantage of this method of handling questions, in which both sides have a constructive interest, is demonstrated.

For many years the problems arising from the proximity of supply (electric light and power) circuits and signaling circuits have required the attention of the engineers of both classes of public service companies and, in many cases, questions have arisen requiring also the attention of the executives. These questions have to do with relations between the two classes of circuits—at crossings, at conflicts (that is, close parallelism where there is a chance of physical contact between the wires), on jointly used poles, and in connection with inductive interference. Questions arising from the foregoing relations, and particularly from the last one, inductive interference, have been troublesome and from time to time have created controversies. Occasionally these have resulted in commission or court proceedings. Considering the magnitude of both systems and the opportunities for differences, these have been few in number, but their possibility was always present and somewhat more than a year ago the settlement of some of these questions took on a more threatening aspect. It appeared that the time had come when the industries concerned must either get together and settle the questions concerned by cooperative effort or there would be much controversy, litigation and bad feeling resulting in necessarily unfavorable reactions on the public relations and service of both parties.

Accordingly, an arrangement was perfected between the Bell System and the National Electric Light Association, the great organization of the lighting and power companies of the United States, by which a Joint Com-

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mittee was appointed, this Committee consisting of men of recognized standing in both industries, so that any conclusion reached by them would be generally recognized as having the very highest standing. This Committee held its first meeting on March 26, 1921, at which meeting there was a general discussion of the questions involved and a unanimous decision that it would be to the interest of both industries to work out the questions under consideration in a friendly and cooperative spirit. A Sub-Committee of the Joint Committee consisting of R. F. Pack and Bancroft Gherardi was appointed, and proceeded in accordance with its instructions, to form a committee of engineers to assist it in analyzing the situation and to prepare a report setting forth certain principles of procedure for the treatment of situations of proximity and to recommend such further work as might be necessary. The Committee of Engineers appointed consisted of W. J. Canada, A. E. Silver and F. H. Lane for the National Electric Light Association, and H. P. Charlesworth, S. P. Grace, H. S. Osborne and H. S. Warren for the Bell System.

A second meeting of the Joint Committee was held on March 7, 1922, at which the report referred to above was received and adopted. The Joint Committee also prepared the following letter transmitting the report.

NEW YORK, March 7, 1922.

**MEMBER COMPANIES OF THE N. E. L. A.
ASSOCIATED COMPANIES OF THE BELL SYSTEM.**

We are sending you herewith a copy of the report of the Sub-Committee of this Committee, which report is recommended as a basis for the handling of relations between the electric light and power circuits of the N. E. L. A. Member Companies and the communication circuits of the Associated Companies of the Bell System.

As to the relations between the two classes of circuits at crossings, conflicts, and jointly used poles, the Committee recommends a definite guide to practice, subject to satisfactory agreement as to jointly used poles between the parties concerned as to terms and conditions.

As to parallel construction, general principles are recommended which show the way to a satisfactory solution of specific cases.

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Your Committee has instructed a Sub-Committee consisting of M. R. Bump, R. F. Pack and Bancroft Gherardi to proceed with the further work as recommended under Section II (Standards of Construction and Operation), and to report before May 15.

Your Committee, as soon as standards of construction and operation are adopted, will consider whether principles can be established to aid in the fair allocation of the costs of coordinative measures. In the meantime, your Committee believes that with the cooperative spirit which now is evident, a mutually equitable adjustment can and should be made in each specific case. It is understood that any adjustments made will not be considered as precedents by either party to the prejudice of future understandings.

Your Committee wishes to emphasize the fact that the most important factor in this whole situation, and the one which will contribute in the greatest degree to the solution of all these questions, is close cooperative working between the two classes of companies, and the taking up and working out of problems in advance of the doing of actual construction. It is of primary importance that power and communication companies cooperate in the preparation of such plans with a view to coordinating their construction, both with respect to the immediate construction proposed and general arrangements for future development, as obviously the necessary adjustments can best be made while the work is in a paper stage. With the way clear as to how the solution of these problems may be obtained through cooperative work, it would not seem necessary, and certainly it is inadvisable, to undertake to settle such questions by resorting to controversial proceedings which necessarily produce feelings of animosity which are not limited in their influence to the particular situation in question.

In conclusion, your Committee desires to express its appreciation of the general cooperative spirit in which such questions have been handled throughout the country during the year in which your Committee has been at work in endeavoring to find a solution of the problems satisfactory and fair to both parties.

[SIGNED]

- O. D. YOUNG, *Chairman*, General Electric Company, New York, N. Y.
R. H. BALLARD, Southern California Edison Company, Los Angeles, Cal.
M. R. BUMP, H. L. Doherty & Company, New York, N. Y.
H. M. BYLLESBY, Represented by R. F. PACK, H. M. Byllesby & Company, Chicago, Ill.
J. J. CARTY, American Telephone and Telegraph Company, New York, N. Y.
BANCROFT GHERARDI, American Telephone and Telegraph Company, New York, N. Y.
E. K. HALL, American Telephone and Telegraph Company, New York, N. Y.

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L. H. KINNARD, The Bell Telephone Company of Pennsylvania, Philadelphia, Pa.

MARTIN J. INSULL, Middle West Utilities Company, Chicago, Ill.

ROBERT LINDSAY, Cleveland Electric Illuminating Company, Cleveland, O.

BEN S. READ, The Mountain States Telephone and Telegraph Company, Denver, Col.

PAUL SPENCER, United Gas Improvement Company, Philadelphia, Pa.

GUY E. TRIPP, Westinghouse Electric & Manufacturing Company, New York, N. Y.

M. H. AYLESWORTH, *Secretary*, National Electric Light Association New York, N. Y.

The Sub-Committee Report, with the letter given above, has been printed in full and widely distributed. The recommended plan for the solution of inductive interference situations and the conclusions of this report are quoted below.

RECOMMENDED PLAN FOR THE SOLUTION OF INDUCTIVE INTERFERENCE SITUATIONS

I. General principles.

- A. Cooperative planning for all new construction.
- B. The location, construction and operation of all supply and signal circuits in conformity with generally co-ordinated methods, including precautionary measures which can reasonably be applied under generally prevailing conditions as distinguished from special situations.
- C. Where specific coordinative measures are necessary, those providing the best engineering solution should be applied. This involves—
 1. Meeting service requirements of both systems.
 2. The coordinative measures applied shall be selected without regard to whether they apply to one system, or the other system or both.
 3. The solution to be based as far as practicable on the state of the art at that time.
 4. Measures of coordination wholly by separation should be considered with other measures of coordination where the former will not sacrifice economy and practicability and the convenience of rendering present and future service.

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- D. Neither party should assume to be the judge of the service requirements of the other system, or of what constitutes good practice in that system.
- E. Existing cases to be cleared up in an orderly and systematic way as occasion requires in accordance with the above principles.

II. Standards of Construction and Operation in accord with the foregoing principles.

- A. Adoption of more detailed principles as soon as possible for temporary use.
- B. Preparation by further cooperative work based on the existing state of the art of definite standards covering all classes of inductive exposures.

III. Development Work.

As soon as it can be done without interfering with the work recommended under II above, a cooperative study of the art shall be made in order to determine what practicable measures, if any, may be developed and adopted to lessen the contributing characteristics of both systems.

CONCLUSIONS

Your Sub-Committee believes that great progress has been made toward the solution of the problems arising out of the proximity of supply and signal circuits and to further promote the satisfactory working out of these situations recommends as follows:

1. That the Joint Committee, if they approve, adopt the principles and standards herein set forth and recommend them for general use by the respective utilities.
2. That special emphasis be given to the importance of working out problems of interference before definite plans are made for construction both with regard to immediate extensions and to general plans for future development.
3. That when differences do arise, every effort be made to arrive at a settlement through negotiations rather than resorting to court or commission proceedings.
4. That arrangements be made for proceeding with further cooperative studies along the lines indicated herein.

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We wish to express our appreciation of the broad spirit of co-operation with which the engineers assisting us have approached this matter.

When the Joint Committee adjourned their meeting of March 7th, it was the unanimous feeling of all that "What's well begun is half done."

BANCROFT GHERARDI.

Notes on Recent Occurrences

Ship to Shore Radio Telephone Test, March 5

THE American Telephone and Telegraph Company conducted its first ship-to-shore radio-telephone test for the press in conjunction with the Radio Corporation of America on the evening of Sunday, March 5th. The purpose was to show the progress that has been made by the Bell System engineers toward working out the maximum value of the radio as a supplement to telephony. The test was carried on between the American Telephone and Telegraph Company's radio station at Deal Beach, New Jersey, and the United States Line Steamship *America*, homeward bound from Europe and at the time about 370 miles from Ambrose Light.

Representatives of all the New York newspapers and press associations were invited by the American Telephone and Telegraph Company to meet a group of the Company's engineers on the top floor of its Long Lines building at 24 Walker Street, New York. There direct connection was made with Deal Beach, and sitting around two long tables each guest was supplied with a telephone receiver and listened in on the conversations with the ship in the distant Atlantic, and later themselves talked with some of their friends on board.

The progress that has been made in the work was clearly revealed to the listeners when the difficulties that attended the development of radio service was exposed to them. Everyone is now familiar with the fact revealed by aviation that there are pockets in the air. That similarly there are pockets in the ether was made clear by the "faint spells" which for some time delayed the beginning of successful conversation and the sudden unaccountable interferences that at times broke into the communications. On the other hand the demonstration amply proved that the conditions of the ether have been sufficiently mastered to enable the American Telephone

and Telegraph Company to undertake a guaranteed service on business terms.

The test showed notably that two-way radio communication could be established over the same wave circuit, and that it is quite feasible to connect the radio with the regular nation-wide wire system. Thus anyone on the lines of the Bell System, anywhere in the country, using the ordinary telephone instrument, can talk at ease with friends in the middle of the Atlantic.

These important features of the test were appropriately signalized by connecting Captain William Rind of the *America* with Mr. H. B. Thayer, President of the American Telephone and Telegraph Company, in his country home near New Canaan, Connecticut. Although Captain Rind was 370 miles at sea and Mr. Thayer was talking on an ordinary line connecting with a small exchange, they could hear each other as easily as if they were in adjacent houses. After the greetings natural to the occasion, Mr. Thayer inquired what weather Captain Rind was having. He replied that the *America* had had a stormy voyage, that now after some hours of good weather the sea was beginning to pick up a bit again under a head breeze, and that he expected to reach Ambrose at about four o'clock Monday afternoon and dock by seven. Mr. Thayer then extended hearty congratulations and bid Captain Rind and his ship "Good night!"

The *America* has been specially equipped by the Radio Corporation of America in cooperation with the American Telephone and Telegraph Company for these experiments. The experiments are continuing. In these tests two-way radio telephony has in fact been accomplished over a distance of 1,600 miles. To supply a connection that far, however, cannot be guaranteed. The future depends chiefly upon equipping enough ships with the composite sets, permitting simultaneous operation of the radio telephone and the radio telegraph, so that radio telephoning will not have to be discontinued while radio telegrams are being received and sent. But

on the evening of March 5th it was made evident that long distance telephony is practicable at sea as well as on land.

**General Carty's Address at the Civic Forum,
Philadelphia, March 8, 1922**

AT a meeting of the Philadelphia Forum, held in the Academy of Music on the evening of Wednesday, March 8th, John J. Carty, Vice President of the American Telephone and Telegraph Company, delivered an address on *World Electrical Communication*. General Carty recounted many of the major technical developments in telephony since the founding of the art. The telephone amplifier or loud speaker was used, so that although General Carty spoke in an ordinary tone of voice, every word that he said could be heard by every one of the more than 2,800 persons present with a clearness and ease that was surprising to them and evoked their spontaneous enthusiasm.

General Carty in his introductory remarks referred to the fact that the telephone was born in 1876, just 100 years after the founding of the Republic in the Declaration of Independence. Another striking parallel to which he called attention was that as Franklin, America's foremost electrical pioneer, was born in Boston but early moved to Philadelphia to begin his great career, so, too, the Telephone was born in Boston and came to Philadelphia at the Centennial Exposition of 1876 to receive its first notable recognition.

After the more formal part of his address General Carty had a motion picture shown depicting the assembling of a telephone instrument. The audience found it both very instructive and most amusing. General Carty then had the Academy of Music connected with the transcontinental circuit to San Francisco, and the audience by means of the amplifying of the loud speaker was impressed and entertained by conversation with the test-board men in San Francisco, by phonograph music

played in San Francisco, and by a violin solo by Miss Betty Bates, the twelve year old daughter of Harry Bates, the commercial representative of the American Telephone and Telegraph Company in California. This demonstration was notable in that it was the first in which two-way transmission had been secured across the continent over a two-wire circuit. Indeed, as Miss Bates was furnished with a telephone receiver, she was able herself to hear the applause in Philadelphia that greeted her playing.

A circuit was then set up to the offices of the *Philadelphia Public Ledger*, and the editor, John J. Spurgeon, without leaving his desk addressed the audience and read them news dispatches from Washington, Chicago, Tokio, London, and Guatemala, which would not be available to the public in the newspapers until the following morning.

The demonstrations were closed by radio broadcasting from the Bell System transmitting station at Deal Beach, New Jersey. In order to avoid the great amount of interference from electric sign and other power circuits which would be incurred if the radio receiver were installed in the city itself, it was set up at Narbeth, six miles west of Philadelphia, and the messages carried on into the Academy of Music by wire. This had the advantage of showing that the coordination of the radio and the wire systems is entirely practicable. Once more the loud speaker made every sound easily audible to every person in the audience. In this way they listened to weather reports, bugle calls, music, conversation and even radio messages from ships at sea. During these demonstrations neighboring transmitting stations very kindly refrained from sending, in order to leave the ether clear for the Philadelphia Forum.

The audience was intensely interested and showed their hearty appreciation by frequent applause. The various demonstrations of the evening had convincingly proven to them what General Carty had told them in his address that the American Telephone and Telegraph

and its Associated Companies are introducing to the world "an electrical system of communication which reaches out to the uttermost limits of the earth and carries with it the sublime hope that some day it will be utilized in bringing together the people of all nations into one common brotherhood."

**Mr. Gifford's Address at Boston,
March 9, 1922**

THE Boston Directors of the American Telephone and Telegraph Company gave a dinner at the Copley Plaza Hotel in that city on the evening of Thursday, March 9th, to Mr. H. B. Thayer, the President, and Mr. W. S. Gifford, one of the Vice Presidents of that Company. About eighty of the more important Boston bankers and brokers were invited to meet and talk with Mr. Thayer.

At a meeting in the evening to which some 600 other prominent people were invited, Mr. Gifford made an address on the financial aspects of the telephone business. He pointed out that the remarkable nation-wide service of the Bell System required for its maintenance an organization employing 250,000 persons and an equipment valued at over \$1,500,000,000. He showed that while the population and the business of the United States have grown about 50% since 1900, the telephone service, indicated by the number of telephones in use, had increased 900%, to 14,000,000 in the same time. The audience learned that at the present time 47% of the 195,000 stockholders of the American Telephone and Telegraph Company, holding 53% of the \$555,000,000 of stock, are in New England.

Leading up to demonstrations of recent achievements, Mr. Gifford stated that the research and development work done by the scientists and engineers of the American Telephone and Telegraph Company resulted in the saving of millions of dollars to the Associated Companies and consequently to their subscribers all over the country.

Mr. F. A. Stevenson, Director of the Long Lines Department of the Bell System, then conducted a demonstration of radio telephony transmitting speaking and music from the Company's radio station at Green Harbor, Massachusetts, 40 miles away. A telephone amplifier, specially installed for the occasion, enabled every one present, sitting in their chairs and without any individual telephone receiver, to hear with perfect ease and distinctness. Neighboring transmitting stations cooperated by giving the Green Harbor-Copley Plaza demonstration right of way through the ether.

This was followed by a demonstration of the telephone service of the Long Lines Department over its two longest circuits by a roll-call from Boston to Havana, Cuba, a distance of 1,827 miles, including 100 miles of submarine telephone cable between Key West and Havana, and then a roll-call from Boston to San Francisco, a distance of 3,593 miles. In both cases the telephone amplifier enabled the audience to hear the conversation and music in Havana and in San Francisco as clearly as they could Mr. Thayer, Mr. Gifford, and Mr. Stevenson talking in their presence.

In closing Mr. Gifford confirmed Secretary Hoover's statement that the use of the radio telephone for private communication between single individuals was quite hopeless and in view of the achievements of long distance telephony entirely unnecessary. He defined the real value of wireless to be for purposes of broadcast publication and for supplementing the wire system in cases when connection by wire is impracticable as between ships at sea or between ship and shore.

The Patent Suit of General Squier

THE system of multiplex telephony and telegraphy now in use by the American Telephone and Telegraph Company, by which it is possible to transmit several telephone conversations and a large number of telegraph messages over one line, simultane-

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ously, has been made possible only by the ingenuity and persistence of the engineers of the Bell System in overcoming the many obstacles to the use of such a system on commercial circuits, and by the advent and perfection of such inventions as the wave filter and the distortionless amplifier which are covered by patents owned by the American Telephone and Telegraph Company.

The basic requirements for such a system have long been known. There are a large number of patents, both United States and foreign, bearing dates from 1892 on, which disclose the fundamentals of such a system. Among these are the United States patents issued in January, 1911, in the name of George Owen Squier, now Major General of the Signal Corps, which he asserts are infringed by the system now in use.

These patents were taken out under the provisions of an early law which remits the government patent fees, provided the patentee stipulates that the invention may be used by government officials in government work, "or by any other person in the United States." Until recently this has been construed by every one, including the telephone company, General Squier himself and the United States Patent Office, to mean that the inventions of such patents were free to any member of the public. Subsequent to the commercial installation of carrier current systems by the telephone company, General Squier has contended for a different interpretation of that law. It is the view of the telephone company that General Squier's present interpretation of the law is erroneous and further that his acquiescence in the former interpretation during the development and installation of these commercial systems estops him from now adopting an inconsistent attitude.

The Squier patents, moreover, are believed by the telephone company to disclose no advance over the systems shown in prior patents, and it is further convinced that the telephone company's system does not infringe those patents, even assuming a margin of invention for them.

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Negotiations between the telephone company and General Squier have been in progress for some time past with a view to determining what, if any, rights he has under the patents. The telephone company, on the other hand, has been anxious to accord to General Squier what credit may be due him for advancing this art and to pay him whatever his contribution might be worth, while on the other hand, it has realized that unless the patents were valid and contained features of substantial value and especially unless his title to non-government use of the patents was valid, it would not be justified in paying a substantial amount for a license under them.

As a solution of the difficulty, the telephone company has taken an option under which it may acquire the right to use the inventions of the Squier patents, if it shall be judicially determined that its views as to the validity and scope of the Squier patents and their dedication to the public, are wrong.

A suit for the determination of these questions was begun on March 14, 1922, and will be pressed to the earliest possible determination by both parties.

The Annual Meeting

THE annual meeting of the stockholders of the American Telephone and Telegraph Company was held at the headquarters building at 195 Broadway, New York, on March 28th and all the directors were re-elected by a vote of 3,542,132 shares, there being no dissenting votes cast.

The stockholders representation was very satisfactory, there being over 100 shareholders present in person and over 123,000 shareholders represented by proxies.

President Thayer spoke briefly on some of the matters covered by the annual report and by unanimous vote the transactions of the past year were approved.

Organization Changes

UNDER this caption will be announced only elections or appointments to the offices of President, Vice President and General Manager with brief statements of service in the Bell System of new incumbents.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Edgar S. Bloom elected a vice president:

Construction engineer for New York City, New York Telephone Company, 1897 to 1905; general plant superintendent, Pacific Telephone and Telegraph Company; plant superintendent for State of New York, except New York City, New York Telephone Company, 1909; general superintendent of plant operations, American Telephone and Telegraph Company, 1910; second vice president, Southwestern Bell Telephone Company, 1912; one of the receivers of the Central Union Telephone Company, 1914 to 1919; elected president, Central Union Telephone Company, 1919; president of the Indiana Bell Telephone Company and the Cleveland Telephone Company (name changed to Ohio Bell Telephone Company), vice president, Illinois Bell Telephone Company, 1920; chairman of the Board of Directors of the Ohio Bell Telephone Company and Indiana Bell Telephone Company, 1921.

NEW YORK TELEPHONE COMPANY

Eugene S. Wilson elected a vice president:

On account of the prolonged illness of General Counsel Swayze, Mr. Wilson has taken charge of the presentation of the Company's case in the State-wide rate case. Appointed special counsel for the Southwestern Telegraph and Telephone Company, 1913; went to Chicago as special counsel for the American Telephone and Telegraph Company in the case of William A. Reed vs. American Telephone and Telegraph Company, 1914; general counsel for the Central Group at Chicago, 1916; vice president of the American Telephone and Telegraph Company, in charge of rate matters, 1920.

ILLINOIS BELL TELEPHONE COMPANY

W. R. Abbott elected president:

Cashier of Westchester Telephone Company (New York), 1889 to 1890; order clerk, Metropolitan Telephone and Tele-

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graph Company (New York), 1890; Chicago Telephone Company, 1893, serving as order clerk, chief clerk to general superintendent, special agent in charge of rights of way and claims, superintendent of suburban division, general commercial superintendent and general manager; vice president and director, 1920.

F. O. Hale elected vice president and general manager:

Entered the traffic department of Bell Company operating in Eastern Pennsylvania, Ohio and West Virginia, 1903; superintendent, 1907; entered engineering department of the American Telephone and Telegraph Company, 1909; appointed chief engineer of the Southwestern Bell Telephone System, 1912; later general manager for the States of Missouri and Arkansas; appointed chief engineer of the Illinois Bell Telephone Company, 1921.

SOUTHERN BELL TELEPHONE & TELEGRAPH COMPANY AND CUMBERLAND TELEPHONE & TELEGRAPH COMPANY

Frederick H. Reid elected operating vice president:

Entered employ of Company as clerk in office of General Superintendent, 1902; chief clerk to General Superintendent, 1904; chief clerk to General Manager, 1907; assistant to Vice President and General Manager, 1913; assistant general manager, 1915; general manager since 1920.

WISCONSIN TELEPHONE COMPANY

W. R. McGovern elected president:

Entered telephone business at Milwaukee, 1901; chief engineer of the Central Group of Bell Telephone Companies, at Chicago, 1916 to 1919; general manager, Wisconsin Bell Telephone Company, 1919; vice president, 1920.

WESTERN ELECTRIC COMPANY

Dr. Frank B. Jewett appointed vice president in charge of engineering manufacturing and service to telephone companies:

Entered employ of the American Telephone and Telegraph Company, 1904; assistant chief engineer of the Western Electric Company, 1912, in charge of all development and research work; chief engineer, 1916; elected a vice president and director of the Company, 1921.

Single Copy, 50c

\$1.50 per Year

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PRESIDENTS OF BELL SYSTEM IN CONFERENCE AT YAMA FARMS, JUNE, 1922

BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION AND A RECORD OF PROGRESS

Published quarterly for the Bell System by the American Telephone
and Telegraph Company

Subscription, \$1.50 per year, in United States and Canada; single copies, 50 cents

Address all communications to
INFORMATION DEPARTMENT
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
195 Broadway, New York

Vol. I

JULY, 1922

No. 2

What Are We Trying To Do?

The presidents of the Associated Companies of the Bell System met with the executives of the American Telephone and Telegraph Company for a five-day conference at Yama Farms on June 3rd. During the meeting a photograph was taken which appears as a frontispiece in this issue of the Bell Telephone Quarterly.

President H. B. Thayer of the American Telephone and Telegraph Company presided and gives the keynote of the conference in the statement which follows.

EVERY business enterprise, of course, has a purpose. It may be to make money for its owners and nothing more. It must make money if it is sound. Its purpose as well as its methods may be narrowly conceived or the reverse. What is the purpose of the Bell System, and how does it propose to accomplish it? In charting a course it is necessary for a mariner to locate his present position. In defining our objective, it will assist us not only to locate our present position but also to remember how we reached it.

With one or two changes in corporate form, the American Telephone and Telegraph Company's history begins with the invention of the telephone. It took the

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telephone as a laboratory model and made it an instrument of national service, a service wider than can be found in any other country, and of a quality not elsewhere approached. In short, its life spans the whole history of the telephone and the character of its service is unrivaled.

The Bell System is the only organization, outside the Federal Government, which carries the whole responsibility for national service. The only other agencies that may come to mind in this connection are the railroads and the telegraphs. But the railroads individually cover only certain sections of the country and there is more than one telegraph company attempting a national telegraph service.

There are certain peculiarities in the Bell System situation and service which must be noted. While it discharges a national function, it is governed by state laws, and in some states must operate through state corporations. This necessitates a number of operating units and a central organization rendering the services for them which can most efficiently and economically be centralized. A consumer may not be directly concerned as to whether or not a distant friend or correspondent has certain facilities or conveniences. He may not be interested in discovering whether this distant correspondent or friend has electric light or electric power for transportation. But it is likely to be of interest to him and possibly may be of vital interest to know that he has a telephone and that it is possible for him to be quickly connected with him. Coordination of functions and the standardization of plant are essential to a national telephone service. They make a central organization necessary and render it efficient and economical.

The operating companies are largely owned by the American Telephone and Telegraph Company. That is owned by more than 200,000 stockholders, investors not speculators, and as the result of conservative financing and careful management, after forty-five years there is back of every dollar of capital stock of the American

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Telephone and Telegraph Company approximately two dollars' worth of property.

Having briefly surveyed our present position as a part of the nation's equipment, let us consider what we should try to do in the future.

Can there be any doubt? Is there more than one course open? Is there any difference in interest between the public and our stockholders? I cannot see any. If we serve our stockholders wisely and efficiently, we shall render the largest benefit to the public. The success of the Company depends upon the measure of good-will of the community which it can get and hold. We must give the best and broadest service possible. We must provide a service which will not only keep pace with the growth of the country, but also with the constantly increasing use of the telephone. We must make our charges low enough to enable every person who ought to have a telephone, to have one, and at the same time we must earn enough to attract capital to take care of this growth. To earn more than is necessary to maintain and extend the service, would evidence poor judgment and in the end would be bad business for our stockholders: to earn less would be an injury to the public. There must be no waste. The best brains we have must be applied increasingly to effect economies in construction, maintenance and operation. We must struggle unceasingly for better service and lower rates, but in the interest of the public, as well as of our stockholders, we must resist every misconceived attempt to decrease rates to a point which would make it impossible for the Company to keep up and give the best service any one knows how to give. We cannot have fat years and we must not have lean years.

We must stand by our tested traditions and principles. The Bell System is a continuing organization and it is dedicated to a high and important service. We, who are responsible for its direction, must not temporize. We must have guiding convictions and take a long look into the future. We are responsible to the nation, to our stock-

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holders, and to those who come after us, for the continued success of the Bell System. While yielding nothing that is good in our organization and its methods, we must continually strive for whatever is better. Conservatism in principles and progress in methods are the traditions of the Bell System, and they must be maintained.

That is what we are trying to do.

H. B. THAYER.

Some Thoughts on Organization and Executive Work

WHAT is organization? And why is organization? What are the functions of an executive?

We hear a great deal about organization in the business world. We hear that this man is a great organizer, or that man is a capable executive. We still hear at times of "Captains of Industry." We occasionally hear of a good Administrator, although the terms "administrator," "administration," and "administrative" are largely confined to governmental affairs. In business we hear more and more of "Committees" and "Conferences." All of these words and phrases are descriptive of certain types of machinery by which modern business is carried on.

In the hope that others might be stimulated to think about the subject, I have set down some notes as to the significance of these terms. They are simply suggestions based to some extent on personal experience and conviction, and even more upon observation of successful executives in their work.

In the first place, we are not in the business of being organizers as such, or executives for the sake of being executives—though indeed one might believe the reverse of this to be true, judging by the requests for employment which we frequently receive from men who "want a job as an organizer or an executive." These men might almost as well say they would like a job somewhere as a captain, and feel perfectly well qualified to fill the job whether it be a captain in the army or captain of an ocean liner.

Organization and all the machinery associated with it are not ends in themselves, but tools for the accomplishment of some desired result. This seems too obvious to need to be stated; but it is easy to forget the obvious unless we are constantly on guard. We must constantly study our organization to see if it is best fitted to give

results. Moreover, we must not overlook the fact that while it is a tool, and in most cases an indispensable tool, it is not the only tool needed for accomplishment.

Organization is a rather simple tool to construct. The difficulty lies in first analyzing clearly the job to be done. For example, here are five men who want to unite to build a cooperative apartment house. Each of the five must not start off independently to buy lumber or engage an architect or dig the foundations. They must first lay out and plan what they want and then determine what needs to be done to secure what they want. After this has been done, the problem becomes one of setting up the organization. This involves a decision as to what part each can do best, and an agreement that some one of the five shall be in charge of coordinating the work.

ORGANIZATION A MEANS TO AN END

Organization means order. We may of course become so fascinated with organization in itself and for itself, with the game of organizing, that we overdo it. We may, for instance, become so enamored of organization charts that because a particular set-up, which we know works well and is useful, cannot be charted, we change the organization.

There are real temptations to the lover of order and system. His protection lies in constantly keeping in mind the end to be attained and making all of his plans with that end in view. To be a good organizer requires sound judgment, ability clearly to perceive the goal sought, an analytical mind, and a certain fondness for order. A real organizer is always creative: it requires a man with a creative imagination clearly to perceive the goal sought.

Many of us are asked from time to time for a good book on organization. It is true that much could be written on the fundamental principles of organization, but no book could be written which would properly instruct exactly how any particular work or business

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should be organized. Study and books may help define the problem somewhat and perhaps lay down some fundamental principles which will assist in solving it, but no text-book where you would find your problem stated and the answer given in the back of the book would be a safe guide.

There is nothing mathematical about organization in business. It is true, for instance, that probably no chief executive should have more than five or seven people reporting to him. This, however, is due to the average limitations on the part of the average man to direct and coordinate comfortably a number of functions. The exceptional man might find it quite possible to carry on his work as a chief executive with as many as twelve people reporting to him, or another man who might also be successful as an executive might prefer only three. In other words, you can never escape from the human side of the business and the fact that you are dealing not with machines but with human beings. So that even after you have organized your job and laid out the theoretical organization which can best accomplish it, you will almost always find it necessary to make variations from this theoretically sound organization to meet the peculiarities and temperaments of the individuals who are to carry on the work. It is always a good plan to have the ideal in mind and to work toward it; but by all means do not try to crowd human beings into a theoretical scheme when they do not fit.

DUTIES OF AN EXECUTIVE

The executive may be merely an executive; that is, he may carry out plans and programs which have been laid down for him. That is in fact the primary job of an executive. He must deal with men and women; therefore he must have sympathy, tact, and force, and must know when to be firm and when to be conciliatory. His mind must not be a single-track mind—he must be alert and able to see many things at the same time, but must not permit himself to be overwhelmed by details. He must

always watch for actual results—must know the difference between real accomplishment and making a show of accomplishment. Above all must he be just and fair in his treatment of his subordinates, and should always be a leader.

An executive generally must be even more than this. He must be also an administrator. That is, he is not only expected to carry out plans laid down for him, but he is expected in part to make plans and carry them out on his own initiative and to assist in determining broad policies for the business as a whole. He must therefore have initiative, imagination, and judgment. These qualities are inherent; they cannot be acquired. They can, however, be improved by training and experience.

There are several ways of performing the functions of an executive. Sometimes a man's personality will enable him to be a good executive even though he disregard many of the generally accepted methods of supervising a large organization. Generally speaking, however, a good executive should not be too busy. This is particularly true if in addition to being an executive he is to do some general administrative work. The mistake should not be made, however, of assuming that because an executive's desk is always clear, he is a good executive. It is an admirable thing to have a clear desk, but with it must go certain principles of work which will keep the executive in touch with his department and enable him to impress his personality upon it.

MORE THAN A CLEARING-HOUSE

I remember once hearing of a boy who asked a man what sort of work he did in a company. The man was a high executive. His reply stated his job too modestly, but it illustrates the point. He replied that people came in to see him, stated what they wanted to know, and then he referred them to the proper department of the organization. The boy said he understood perfectly, because in his father's business they had an usher—he sat at the desk out in the hall—who did just that. An executive who does just that may really be somewhat

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more than an usher, but not much. He does not impress his personality upon his work. He is merely a sort of clearing-house.

It is necessary, of course, for an executive to see that work is properly distributed and coordinated in his organization, but it is also necessary for him to keep in constant touch with his men and with the work which is being done under him. He should always be available to his immediate subordinates. In my opinion, this is more important than that he should be accessible to people outside of his organization. He should discuss their problems with his subordinates and give them the benefit of his advice, and avail himself of every means of keeping in touch with them and keeping them in touch with him.

Besides this, an executive should have some line of contact with the men in his organization below the rank of those who report immediately to him. He should call for information from anyone in his organization from time to time—although, of course, he should never issue instructions or orders except through his immediate subordinates. By thus calling for information from anyone he is able to get a first-hand knowledge of the men working in the business and of their mental attitude toward their work. This seems to me a very important point, although its soundness from an organization standpoint is frequently questioned. People who are in love with organization as such feel that everything should "follow the lines of organization," with the result that a single fact wanted will often have to be requested through eight or ten people and after the fact is ascertained will have to be reported back through the same eight or ten people. Such a procedure reminds one of the old nursery rhyme, "Stick won't beat dog, dog won't bite cat," etc.

GETTING THE WORK DONE

It cannot be too frequently stated that really to be effective an executive must always keep his mind on

what it is that he is trying to accomplish. Of course this will never be anything but what is for the good of the business. So it be consistent with the good of the business, ambition is a good thing, but the desire for self-aggrandizement and the desire for power not as a means to an end but as an end in itself, are most serious human failings to be dealt with in running an organization. From the standpoint of getting the work done, it often makes no material difference whether a particular line of work is in one branch of the organization or in another. The organization as a whole will never function without cooperation between the branches, and with cooperation, the placing of work in one department rather than another is often of no material consequence. A desire, however, on the part of one executive to build larger at the expense of some other executive is very often a cause of friction and difficulty. With the successful executive the problem is not one of finding additional work to add to his organization, but of preventing jobs which do not belong to his organization being assigned to it. The executive who works hard to add to the size of his department condemns himself as a good executive.

Another difficulty in the practical operation of a large organization is frequently due to a lack of clear definition of responsibility and authority. Every executive is entitled to know clearly where his responsibilities begin and end, and he is entitled to have definitely the authority which will enable him to meet his responsibilities. Not only is every executive entitled to this, but when he in turn divides up his responsibilities and authorities among his immediate subordinates he must be especially careful to see that those authorities and responsibilities are clearly defined and understood. He cannot under any condition blame a subordinate for something for which the subordinate has no authority because without authority he cannot properly be held responsible.

A good executive realizes that there are a good many ways, and probably several very effective ways, of

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accomplishing a given result. He will have no foolish pride of opinion, no troublesome prepossessions. He will welcome intelligent opposition and suggestion from anyone and be quick to surrender a prejudice. While he will impress his personality on his organization, he will not insist that everything be done his way, as this will kill initiative and enthusiasm and make his organization a mere machine.

A GOOD JUDGE OF MEN

Finally, a good executive must be a first-rate judge of men. Perhaps his most important task is the selecting of his department heads. If he does this wisely and successfully, a good part of his task is done. Having selected them, he must trust, inspire, and lead them. He must command and retain their confidence and must be frank with them and fair to them. A successful general is one under whose leadership a staff and rank and file will work and die with enthusiasm.

While authority and responsibility must be clearly defined for executive work, there is, as I have already pointed out, another type of work which I have called administrative. It is not altogether possible to define the authority and responsibility for administrative work. The responsibility for such work is to some extent joint with all the higher executives of an organization. The final decision undoubtedly rests with the head of the organization, but he will wish to take counsel frequently with those who are not primarily responsible for the matter under discussion.

This counsel the chief executive may obtain by discussions with one individual at a time, possibly asking the opinion only of those whose judgment concerning the matter in question is especially valued. Some executives from temperament or even preference have been known to follow this plan only.

It is my personal belief that by far the best results are obtained by Conference. To some minds Conferences are a waste of time. Much is said that does not appear

to bear upon the point under discussion. There is often a good deal of talk, but when important matters of policy are to be decided, I feel sure that the time used or even used up in conferences is very much worth while. When the chaff has been winnowed out, the wheat will be found.

It is important in a conference that everyone be given an opportunity to talk at length, that ideas expressed be listened to with tolerance by all. A prominent man once said that people's personalities and peculiarities meant no more to him than the weather. While this is going too far, nevertheless a conference held with a view to determining policies is not a place where tact and finesse are so necessary as freedom of speech. I realize that in business, one-man authority and responsibility, with the speed of action which results therefrom, is thought by many to be a great deal more effective than the slower process of conferences. I feel sure, however, that in an organization where large matters are at stake and where military authority and discipline are not required, the only safe and efficient way to determine policies is to confer deliberately and at length. Of course, the head of the organization must finally decide, and after deciding, act with firmness and confidence.

THE USES OF COMMITTEES

Another type of machinery, excellent for the accomplishment of certain results, is the "Committee." A committee differs in my mind from a conference in that it usually has definite responsibility and authority and acts by unanimous or majority vote. The committee is a slow way of accomplishing results, but where several branches of an organization are involved and each is responsible for a part of the answer, it is proper under some circumstances that the final decision should be made by a committee in which every part of the organization represented thereon assumes joint responsibility. The race is not always to the swift, and to accomplish our end which we are constantly keeping in sight, in

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some circumstances a committee is a splendid piece of machinery.

A committee, it seems to me, should always have a chairman. I recall an incident during the war when the Secretary of War appointed a number of committees, each composed of representatives of our army and some of the Allied military representatives who were in Washington. The committees were appointed without chairmen. A most distinguished representative of one of our Allies respectfully suggested to the Secretary that their experience in the war had shown committees to be of little value unless a chairman, or at least a "convener," were appointed. No action was taken, however, and the next day the inevitable happened: the committees failed to meet, no one knew who was to call meetings, and in fact no one was quite sure who his associates were on the committees. It was a very striking example of the failure of committee work to function properly without a chairman or at least a "convener."

Organization inherently imposes some restrictions upon freedom. Organization means teamwork, and teamwork means working for the good of the team. Pride of authorship, desire to be personally in the limelight, any tendency to build up one's own reputation by criticizing or belittling others, are all disastrous to the successful working of an organization. After all, common sense and hard work, combined with a sympathetic consideration for others and pride in the institution will result in each man going ahead as far as his inherent abilities will permit, in spite of the size and complexity of large organizations. "Captains of industry" belong to the pioneer days that are past. Large modern business organizations require executives who are also wise administrators. It is the day of statesmanship in business.

W. S. GIFFORD.

Sleet Storms

IT is very pleasant, opening the front door on the morning after a sleet storm, to look upon the fairy-land to which the familiar surroundings have been suddenly transformed. The wind has ceased and the tall trees, encased in ice which sparkles like diamonds in the sunlight, are very beautiful as viewed upon their background of blue sky. Delicate icicles are pendent everywhere and flocculent masses of snow upon bushes and fences are glazed with a coating of glittering ice enamel. You observe with some regret how the sleet has crushed the bushes and that the trees have lost many of their boughs. However, this does not spoil the frosty splendor of the morning. Returning indoors you take down your telephone to find that it is out of commission. The same sort of icy load which has maimed your trees and hundreds of others in the vicinity has also broken down hundreds—perhaps thousands—of telephone circuits, destroying in a night property which was months or years in building.

In the early days in the telephone business the exchange distribution plant and the toll lines were entirely aerial and exposed to the weather. As a result of years of research and development work carried on by telephone engineers, means have been developed whereby it has become possible to place a great part of the exchange distribution plant in underground and aerial cables where it is well protected from damage by sleet storms; cables have been developed in recent years for toll circuits which are economical under certain conditions.

Despite the development of greatly improved types of outside plant and the investment of many millions of dollars in its installation, there remains and probably will long remain a very considerable amount of plant which is exposed to weather conditions. It is not economical, even though it might be technically possible, to provide the extremely expensive types of protected cable routes unless the number of circuits is sufficiently large to

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reduce the cost of their installation and operation to a point somewhere near the costs of aerial wire circuits; to do otherwise would result in making the cost of service too great for the average user.

However, the types of aerial plant now in use are such as to withstand all weather conditions excepting storms of a violent character. Sleet storms cause the most damage and in these days constitute about the only adversary, short of some general catastrophe, which can stop the service for more than a very brief space of time.

THE COMBINATION OF ICE AND WIND

The damage done by sleet to the wire plant of a telephone system is more severe and disastrous where the duration of the storm is considerable, especially if accompanied by high winds. Sleet is by nature the precipitation of water vapor, condensed in the upper atmosphere, which approaches the ground in a partly frozen condition. Its beginning may be either as rain, in which case to turn to sleet it must fall into a stratum of air colder than that in which it originated, or as snow, in which case the opposite must have taken place; that is, the snow in its descent must have encountered an air temperature slightly above freezing point. Under typical sleet conditions the chilled rain falls upon the trees, telephone wires and other objects, and through a decline in the temperature is frozen thereupon. The freezing process continues as long as the rain continues to fall and the temperature does not rise. The icy coating may grow until the accumulated weight becomes enormous and the stoutest structures barely support their burden.

If sleet falls for a number of hours, each single telephone wire may acquire a solid ice coating three inches thick vertically and accompanied by even longer icicles. Whereas the weight of the wires in the normal span between two poles in a 40 wire lead is less than 200 pounds, such an ice coating may add a weight of about 15,000 pounds to the load supported by each pole. If a heavy gale is blowing, the pole is further subjected to a

bending force due to the wind pressure on the sleet-covered wires. Subjected to such tremendous stress, the line frequently fails. When the line might stand the strain, nearby trees are often crushed or blown down upon it, bearing it to the ground and smothering it with masses of shattered boughs. The forces which nature unloosens in the sleet storm are too powerful for us to contend with. We have to suffer the blow, be it what it may, then clear away the debris and make a fresh start.

LAST WINTER'S STORM TOLL

The winter of 1921-22 distinguished itself by some terrific storms, making it memorable to many thousands of telephone workers.

On November 27, 28 and 29, 1921, a storm of unusual violence swept the New England States. This was the earliest storm of last winter; the latest was on April 10, 1922, when Minnesota and Nebraska were visited by a storm which destroyed over 21,000 poles of the Northwestern Bell Telephone Company, disrupting the telephone service at more than 70 exchanges. On January 25, 1922, a heavy storm traveled Northwest through North and South Carolina, the sleet continuing intermittently three days and three nights. The City of Savannah, down in the "Sunny South," was covered with a mantle of ice. A newspaper account states that "Fairyland in all its glory could not have presented a prettier sight." However, the conditions held no charm for the telephone construction men as the rain continued for several days after the storm and it was only after the hardest kind of a fight in rain, mud, slush and swamp that service was eventually re-established.

In Michigan and Wisconsin a storm of unusual severity raged over a wide area on February 21st, 22d and 23d. The damage to the telephone plants in both of these states was enormous. The Storm King was evidently not satisfied with his efforts in Michigan, for on March 29th he most unexpectedly re-visited that

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state and again destroyed an immense quantity of plant. There is room for disagreement with King Sleet as to the thoroughness of his first onslaught, for he made an almost complete wreck of the wire systems throughout the Northern half of the main peninsula of Michigan. Succeeded as it was by bitter cold and high winds, the storm cut off from all communication with the outside world some dozens of cities, towns and hamlets. The residents of these places were without telephone or telegraph communication, without mail or railroad service, without electric light or power. It was dangerous to walk along the streets because of falling branches, trees, wires, signs or roofing material. Life in this section slowed down almost to a standstill. The plants of many small public utilities were practically wiped out, and in some cases resulting financial ruin so far deters their reconstruction.

THE WORK OF RESTORATION

As the extent of the storm became evident the Michigan State Telephone Company organized for the work of restoration on a huge scale. Supplies of all sorts in immense quantity were rushed to strategic points for distribution, without waiting to learn precisely where and in what amount the poles, wires and other items would be required. Crews of men were recruited and equipped and sent forward by rail as far as possible and thence on snowshoes. The distribution of the extremely heavy telephone equipment presented a most difficult task. Even with chains on all four wheels, trucks could not operate; horses could not be kept on the roads. Only by dint of Herculean efforts on the part of the men were the stores pushed into the devastated districts.

So aggressively, however, was the work carried on that by the middle of March circuits had been restored to all Michigan State Telephone Company points. Many had been re-established it is true in temporary form, but every town on the Bell routes was again connected up with the outside world.

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North of the sleet area in Michigan there was one of the hardest snowstorms that the inhabitants have any knowledge of. Snow was piled fifteen and twenty feet deep. Buildings such as small barns, granaries and coops were literally buried. It illustrates the difference between sleet and snow storms that in the snow belt the Bell toll lines and exchange plant stood up very well, in contrast to the havoc further South.

WISCONSIN'S EXPERIENCE TYPICAL

The conditions in Wisconsin were very similar to those in Michigan. The following extracts from a report by the Bell representative at Oshkosh are typical:

"Everybody was on the job early the morning of the twenty-second and we were all needed. Wires, poles, crossarms and trees were groaning under their load of solid ice and commencing to fall. Ole Rasmussen started North on the Marinette line and got out as far as Jackson Street road, when the big fifty-foot poles began to fall around him. Ole was completely penned in with his machine by poles falling in front and behind him and he was mighty lucky to escape injury or possibly death. He walked back to the office, delivered his report, then, nothing daunted, headed North again on foot.

"At 6 P.M. there was no possible way to get word into headquarters at Appleton; trains were at a standstill, trolley lines and other modes of transportation out of the question. One of our men waited all night at the depot, but could get no information as to the probable movement of trains. On the morning of the twenty-third, Oscar Bahr and Charles Erbersberger volunteered to walk it. They took our reports and in the teeth of the blizzard they headed North. They fought their way through and arrived at Neenah at 4 P.M. with a complete report of line conditions between Fond du Lac and Neenah which they delivered to the district wire chief, Carl Thomas, who had come down from Appleton. Oshkosh was in darkness and there was no power for three days, but thanks to the emergency gas engine we managed to keep things going."

How the storm affected the telephone girls can be glimpsed from the following report by a supervisor at Superior, Wis.:

"J. E. Bonnell, district traffic supervisor, Eau Claire district, had arrived in Superior early Tuesday afternoon. Upon

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attempting to reach the office next morning, he encountered a large snowdrift immediately in front of the hotel and in the center of the drift, a young lady, almost exhausted from her efforts to get through. Investigation disclosed that it was one of the operators, Miss Crowley, who, notwithstanding her diminutive size, had battled her way six blocks to get to work. At about this time, William Deharde, wire chief, came along and after a time they reached the office. They found the night force still on duty and in addition the chief operator and assistant and two or three of the day girls. These people were almost exhausted from their fight to reach the office but were bravely tackling the job of rendering telephone service to a storm-bound city. At about 8:30 A.M., twelve girls had arrived and breakfast was obtained for the night force. Folding cots and blankets were also provided and a supply of dry clothing for those who had come through the storm. Miss Gilbert, local supervisor, came in after fighting her way through twenty blocks of drifts and storm, and after changing to dry clothing and resting a bit took her place at the board. From this time on the girls came in one by one, some in overalls and boots, others in hiking clothes and still others in their ordinary street clothes; all wet and cold but ready to help in relieving the load of the others. By eleven a force of twenty-five people had arrived and in the afternoon six others reported; the load was being handled in nice shape and the regular reliefs were started. Those operators who lived within two or three blocks of the office made their way to their homes to sleep and the balance either slept on the cots provided at the office or at the hotel."

THE DAMAGE IN NEW ENGLAND

The three days' storm which smote the New England States in November last, began on Saturday, the 26th, with a light drizzling rain which continued almost constantly during the next two days. Early Sunday morning the freezing process began and the rain froze rapidly upon anything it touched. On Sunday afternoon the first total telephone failures were reported and by the early hours of Monday trouble was widespread in general. The Southern parts of New Hampshire, Vermont and Maine, all of Massachusetts, except the seacoast, and portions of Rhode Island and Connecticut were literally overwhelmed. The country in the afflicted areas looked much as it must have appeared in the ice age; the sleet-

covered trees looked like glaciers adrift in a sea of ice. Highways were like rivers of smooth, unbroken ice bearing the ruin of great trees, thousands of fallen telephone poles and a confusion of debris carried by the furious wind. Thousands of miles of costly copper wire, ice-coated, strewed the highways in hopelessly tangled and twisted masses. The work of clearing the wreckage and renewing telephone service was both arduous and dangerous. Work was begun long before daybreak and continued far into the night. One man tells of seeing an emergency cable spliced by the light of a bonfire built of limbs of trees torn off by the storm. At the time it was bitterly cold and so dark that a man fifteen feet from the fire was invisible. From the same locality comes a story of two linemen who carried an emergency cable through a swamp, waist deep in icy mud, climbed out, dried off before a roaring fire and resumed their work. Men frequently labored with trees and wires falling about them. One foreman saw eighteen poles come down in a row near where he was working. The breaking of a pole was accompanied by a crack like the report of a rifle, followed by a loud crackling as the ice was shaken from hundreds of feet of telephone wire, then came a "boom" like the distant roar of a big gun as the heavy pole crashed to the earth.

HEAVY SUPPLY REQUIREMENTS

The restoration of the Bell telephone service after the several storms of last winter was in each case effected with reasonable promptness. The fine spirit of the employees was everywhere evinced and some idea of the quantity of materials which the Western Electric Company was called upon to deliver this winter on emergency shipments may be had by reference to the following list of a few principal items ordered following the storms in New England in November, and in Michigan and Wisconsin in February:

Sleet Storms

10,000 poles
20,000 crossarms
42,000,000 feet of bare copper wire
8,000,000 feet of covered wire
420,000 glass insulators

The assembly and shipment of these major items together with much miscellaneous material was entirely completed in nine days in each case, more than 50 per cent. of the whole being shipped in the first three days.

Loss DUE TO STORMS PROVIDED FOR

The losses in the property investment occasioned by sleet storms are, under the standard accounting of the Bell Companies, provided for, like other depreciation losses, by the reserve for depreciation. Suitable reserves are, of course, imperative in view of the hazards to which the telephone plant is exposed, both from the standpoint of the company, whose property may be destroyed and revenue cut off, and from that of patrons whose business and social needs require substantial continuity of telephone service.

The depreciation reserves of the Bell System are built up by charging to operating expenses regularly in monthly installments the amounts necessary, on the average, to provide for depreciation costs—including those caused by storms—during the service life of plant. This is the sound policy for the protection of the investor in Bell Telephone securities. In its absence the sleet losses of the past winter would be at this time a most dangerous and unsettling financial factor. As matters actually stand, the reserves of the Companies are charged and will absorb, without detriment to the investors, the entire storm depreciation costs, which were in excess of \$7,500,000. This covers only the original cost of the plant destroyed and the cost of extraordinary repairs, including temporary facilities used in restoring service, minus net credits for salvage recovered. While an immediate expenditure of cash capital is required to reconstruct the

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plant, this new capital is represented by new plant. In addition there must be reckoned the very considerable losses in revenue due to plant being temporarily out of service. Such losses cannot, of course, be charged as expense but must be absorbed by the telephone companies out of their margin of surplus earnings of the past. Of the total storm destruction mentioned, the New England Bell Telephone Companies suffered to the extent of more than one and a half millions of dollars. The damage to the Long Lines Department of the American Telephone and Telegraph Company was nearly one million dollars. The damages to the Wisconsin Telephone Company and Michigan State Telephone Company were approximately two millions of dollars. The Northwestern Bell Telephone Company had over nine hundred thousand dollars of plant destroyed, and The Pacific Telephone and Telegraph Company about six hundred thousand dollars. Not a single Bell Telephone Company in the country escaped. This storm damage is recognized as a part of the cost of furnishing telephone service. Some years it is heavier than others, but it is always a factor.

ALLEN B. CRUNDEN.

The Recent Parliamentary Investigation of the Telephone Situation in Great Britain

THE telephone system of Great Britain comprises about 1,000,000 telephone stations, together with some 450,000 miles of toll, or "trunk," wires. The whole telephone plant is now owned by the British Government, with the exception of the local exchanges in the city of Hull and on the island of Guernsey in the English Channel, which are owned by the respective local authorities. The Government system is operated by the Post Office, which also operates the national telegraph system as well as the postal service.

BRITISH TELEPHONE HISTORY

While the operation of telephone service in Great Britain is now practically entirely in the hands of the Government, the telephone was introduced (in 1878) and was first developed by private companies. Almost from the very beginning of the service, however, the attitude of the Government was distinctly unfavorable to its development under private auspices. Ten years before the introduction of the telephone, legislation had been enacted which declared the operation of public telegraph service to be a Government monopoly, and the Government had accordingly acquired the various privately owned telegraph properties. Telephone service had not long been in operation before the Postmaster General secured a court decision to the effect that a telephone system was a telegraph system within the meaning of the provisions of the Act creating the Government telegraph monopoly. Upon this decision the Government did not at once acquire the private telephone systems as it was empowered to do, but adopted a policy of issuing limited licenses to private telephone companies. The terms of these licenses were such as to impede rather than to stimulate the development of the telephone business. They imposed restrictions upon the companies as to areas of activity and the acquisition of rights-of-

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way; they levied a substantial royalty upon the gross earnings of the companies; and, finally, the licenses terminated in 1911 with no provision for the conduct of the business thereafter. Even under these restrictive licenses, however, a number of private companies undertook to develop telephone service in the various parts of the country; but by 1892 the various small companies had been consolidated into the largest company, the National Telephone Company, Ltd. In 1896 the toll lines of the National Telephone Company were acquired by the Government and the operation of the lines thereafter was given over to the Post Office. Local telephone service, however, was still left in the hands of the National Company.

At this stage in the history of British telephony there arose a theory that competition in the telephone business would be desirable from the standpoint of both rates and service; and in 1899 legislation was enacted permitting municipalities to establish and operate telephone systems in competition with local exchanges of the National Telephone Company. But while telephone competition had considerable support in theory, it made little progress in actual practice. Very few municipalities took advantage of the legal authority accorded them to enter the telephone business; and of the municipal systems actually established only the two already mentioned—those at Hull and Guernsey—have survived up to the present time. In 1900, the Post Office undertook the construction of a competing exchange in London; but even before this exchange had been completed and brought into operation, the Government recognized the futility of telephone competition and in 1901 made an agreement with the National Telephone Company which provided for a division of the London business, with identical rates and free intercommunication. In 1905 the Government, having definitely decided not to extend the license of the National Telephone Company, agreed to purchase the entire property of the Company at the expiration of its license in 1911. The property

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thus acquired, comprising 561,738 stations, was turned over to the Post Office.

RESTRICTIVE INFLUENCES UPON TELEPHONE DEVELOPMENT

So far as underlying physical and economic conditions are concerned, it might reasonably be expected that the telephone development of Great Britain would be as high as, if not higher than, that in any other country in the world. The territory of Great Britain is compact and is densely inhabited by a homogeneous population; her activities are chiefly industrial and commercial, and she ranks high in point of national wealth. As a matter of fact, however, the telephone development of Great Britain is exceeded by that of a number of other foreign countries, and in comparison with that in the United States is very low indeed. At the end of 1921 the number of telephones per 100 population was only 2.2 in Great Britain, as against 12.8 in the United States.

It is perhaps true that the British people are characterized by a certain conservatism towards the adoption of new methods, such as those involved in a widespread use of the telephone. But the failure of Great Britain to attain a telephone development commensurate with her natural advantages may be attributed only in small part to the influence of national habits. Undoubtedly the chief causes of the relative backwardness of British telephone development are to be found in conditions arising out of the relationship of the Government to the service. Governmental authority assumed virtual control of the telephone when the new art was first introduced into the country. The Government at once committed itself to a policy which, by the restrictive provisions incorporated in the franchises of the companies, distinctly hampered the free development of the service by private enterprise. By the time that efficient and adequate toll service had become an important factor in stimulating telephone growth, the

Government had already acquired all the toll lines of the country and development was retarded by an insufficiency of toll facilities, with resulting adverse reactions upon service, which still persists. Moreover, at the stage of telephone progress when, judging from experience in the United States, a very rapid expansion, aided by proper rate policies, might have been expected through the extension of the service among the smaller users—with the consequent increase in the value of the service to the larger users—the Government further restricted the incentive of private enterprise by indicating that the National Telephone Company's license would not be extended after its expiration in 1911. The actual acquisition by the Government of the entire control and operation of the service in 1911 was a natural culmination of a policy adopted thirty years previously.

THE LATEST PARLIAMENTARY INVESTIGATION

Public dissatisfaction with the British telephone service has been vigorously expressed for years. This dissatisfaction has been evidenced by constant criticism on the part of the press, by frequent complaints by public bodies, and by investigations by special committees of Parliament. The adverse criticism has been directed not against the character of the plant and equipment, which is in general comparable with the character of the physical property of the telephone systems in this country, but rather against the defects in the scheme of administrative organization of the service and the resultant limitations upon efficient and economical operation. The purpose of this article, however, is not to analyze the deficiencies which have been pointed out in these criticisms, but merely to consider the more important aspects of the present telephone situation in so far as they are disclosed by the recent report of the latest Parliamentary investigation.

In 1920, a proposal involving further considerable general increases in telephone rates—a substantial increase in rates had been effected during the war period—

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was brought forward by the Post Office authorities after an investigation by a Departmental Committee on Telephone Rates. Strong public opposition to this proposal developed, and a Parliamentary committee was appointed, which, after a short investigation, approved the increases desired by the Post Office; and these increases were put into full effect April 1, 1921. Public dissatisfaction with the new rates continued, however, and assumed such proportions that the Government felt it advisable to have a second Parliamentary committee appointed "to inquire into the organisation and administration of the Telephone Service and the method of making charges." This committee was not able to complete its work before the close of the Parliamentary session of 1921, and early in 1922 its members were re-appointed to constitute a third committee to complete the investigations of the second committee and to report its findings upon those matters which had been included within the scope of the second committee's inquiry.

In March, 1922, this third committee submitted a report* embodying its conclusions based upon the voluminous testimony taken by its predecessors, including memoranda of investigations made by members and representatives sent to the Continent and to the United States.

There is no indication that the Committee was influenced by political considerations; its report was a unanimous one, and impartiality and breadth of view are evident throughout its pages. This fact is important, because the impartiality and thoroughness of the Committee not only lend added weight to its formal conclusions, but also put significance into some statements in its report which might otherwise pass with little notice. At the same time, it should be borne in mind that the members of the Committee were, of course, not experienced in telephone operations; however, their suggestions as to the organization and business aspects of the

*Report from the Select Committee on the Telephone Service 1922, together with the Proceedings of the Committee. Ordered, by the House of Commons, to be printed, 20th March, 1922.

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telephone service can undoubtedly be regarded as well founded.

At the very beginning of the Committee's report occurs this significant statement:

"Before dealing in detail with the terms of the reference, it seems proper to mention one observation or conclusion which has a general bearing. We have been impressed with the capacity, assiduity and single-mindedness of the officials of the Post Office who have given testimony before us. They are men devoted to the public service, keenly watchful for its welfare, well skilled in their calling, untiring in their efforts, and with an intimate knowledge of their duties. Yet there is something wanting. No one acquainted with the evidence before your Committee can fail to be struck with the almost universal antagonism—often, it may be, unreasonable—manifested so widely and persistently against British telephone administration. From study of or personal experience in the Scandinavian kingdoms your Committee learn that this spirit is not so prevalent there, nor in Canada, nor in the United States, nor in Switzerland. The public in those countries are more disposed to approve the telephone management, and when they do not, they enter, in a sense, into friendly partnership with it to discuss alterations and devise improvements. In the British Isles this disposition is conspicuously absent. The public have little mind to help the Post Office, which we think unfortunate; the Post Office, on the other hand, have given some ground for saying that it appears to believe that the public was made for the Post Office, and not the Post Office for the public. It tends too much to a cast-iron application of regulations in an improper way. We do not wish to lay undue stress upon these characteristics, but we cannot leave them out of sight in submitting this Report."

The above passage is significant in emphasizing the necessity for the cultivation of good relations between a public service and the public served.

MATTERS OF ORGANIZATION

In dealing in detail with the question of the organization of the telephone service, the most important aspect which is discussed in the Committee's report is the proposal, often made before, that the operation of the telephone and telegraph services be separated from that of the postal service. The Committee recognized

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that the wire services are commercial in character to a greater degree than the mail service, and are much more technical. To quote—

“We have given much consideration to the question whether the Telegraph and Telephone Departments of the Post Office should be separated from the Postal Department or not. So far back as 1898 a Select Committee on Telephones reported with reference to telephone competition that it should be carried on by a distinct and separate branch of the Post Office, and should in future be conducted under strictly business-like conditions by a staff specially qualified for such a duty. This recommendation seems to have been put aside on the ground that the telegraph service had been merged into the postal service, and that there were serious objections to separating the department which was responsible for telephones from that directing the telegraphs. At that period this fortuitous combination of circumstances may have been natural, but we think it was a mischance for the telephones. In Sweden, Norway and Denmark the telegraph and telephone department is quite separate from that of the mails, and after years of experience this arrangement is in those countries held to be entirely justified. In Canada and the United States the mails are in the hands of the State, and the telegraphs and telephones are under private management with a certain degree of State control or regulation; and the marked progress of telephone development in all these countries is quoted as showing that the telephone administration has been handicapped in this country by its association with the mails. In the United Kingdom the carriage of letters has always been upheld as the main foundation on which Post Office management rests, and when the telegraph and telephone undertakings were in turn transferred to the Post Office, it seems to have been decided to patch them into the existing organisation rather than to alter the organisation to suit the extended conditions. This plan cannot rightly subsist if great telephone extension is the need of the country and should be its policy. Telephone business is essentially commercial, and if it is to be developed adequately it must be administered on commercial and somewhat independent lines. The official Post Office witnesses stated in evidence that the separation would involve great difficulties, while other competent representative authority supports it.

“Your Committee consider that the re-organisation of the telephone administration on more commercial lines is the fundamental requirement for efficient development, and that if it is carried out wisely it will prove a solution of most of the failings which have been disclosed. They accordingly recom-

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mend the separation of the telegraph and telephone department on the one hand from that of the mails on the other."

In suggesting methods whereby its recommendation as to the separation of the wire services from the postal service might be effected, the Committee recommends the creation of a Department of Communications organized along functional lines—at least in so far as supervisory positions are concerned—the development of this organization to be entrusted "to a body largely composed of men of wide administrative experience not connected with the Civil Service."

The only other point of general interest in the report in regard to organization is a brief but perhaps significant reference by the Committee to the possibility of turning the telephone service back to private operation:

"There is another topic which should be touched upon under the heading of organisation. It is not within our reference to consider the restoration of the telephone service to private enterprise, for which practically all United States authorities claim advantages."

MATTERS OF ADMINISTRATION

Under the heading of administration, the Committee discussed many matters, chief among which from the standpoint of interest to telephone men in the United States is the matter of service in rural areas.

The almost total failure of the British Post Office to provide service for the population of the rural areas is well known. Indeed, rural development is practically unknown, or at least entirely inadequate, in the case of nearly every country in which telephone service is operated by the Government, largely because the needs of the farmers have not been properly considered in the preparation of Government rate schedules. This fact is recognized by the Committee, which takes the position, in general, that if the Post Office itself is not prepared to furnish service in rural areas, it should not unreasonably restrict the initiative of the farmers in arranging to provide telephone service for themselves:

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"Another fundamental question of policy is the following. It must be definitely determined whether the Post Office telephone administration is to be entirely responsible for the development of all telephone service, or should on occasions let someone else perform it under Post Office sanction. Take, by way of illustration, sparsely-populated agricultural districts. Is the Post Office to employ its own official exclusively to maintain the service, or ought it to delegate a certain amount of responsibility to the subscribers themselves? Upon the correct solution of the problem here involved hangs largely the future of rural telephone development.*** The witness who represented the National Farmers' Union advocated semi-private lines under Government supervision or licence, and seemingly desired that farmers should put up the wires and maintain the line. In Canada and the United States there are hundreds of small rural telephone companies or groups where the members construct and operate a telephone system for their own use, linking up with the central system and paying a flat rate of from \$3 to \$9 per telephone for switching service. ***"

"Your Committee are of opinion that the Post Office has not taken a sufficiently broad view of this general question of rural telephone development, and has failed to realise that the advantages of extending the system into rural areas are shared by other classes of subscribers. It is incumbent on our telephone administration to have a definite policy of development, and it should consider how far, in the interests of the system as a whole, it is prepared to go towards making the telephone service available throughout the Kingdom at a cost within reach of the inhabitants of rural areas. In other countries the initiative is usually taken by the prospective subscribers, and, though allowance must be made for different national characteristics, your Committee believe that a great deal might be done in country districts here to stimulate greater co-operative effort."

American telephone men will naturally agree with the principle involved in the Committee's recommendations as to the employment of private initiative in the development of rural areas. Even under British conditions, however, there are probably two sides to the proposition somewhat timidly advanced by the Committee that municipalities and other local authorities not necessarily in rural areas be permitted to meet their own telephone needs under certain circumstances and

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with certain safeguards. It seems significant that the Committee should recommend that:

“Any area should be allowed to become responsible for its own telephone system on condition that it can show that (i) telephone facilities are not available at reasonable rates; (ii) a responsible authority is prepared to undertake the work; (iii) proper financial guarantees are forthcoming; and (iv) definite plans and estimates have been prepared, and opportunity given to the Post Office for approval or criticism. Should the purchase of existing plant be contemplated, the value would be assessed by the Railway and Canal Commission unless the parties could agree upon the price to be paid. If new plant is required, it might be supplied at cost price through the Post Office, which by reason of the large purchases the Post Office makes ought in ordinary circumstances to be at less cost than the responsible authority could purchase for themselves.”

It is also interesting to note that the Committee made no sweeping declaration either in favor of or against automatic telephony. After briefly commenting on this type of apparatus, the report states:

“The quality of the service is a point on which public opinion has a right to be heard, but the means of attaining it is a technical matter which is chiefly one for the administration.”

In the domain of finance, the Committee was naturally desirous of suggesting possibilities for reductions in expenses which would permit a general rate reduction; the report, however, contains only two recommendations of this character. First, it recommends that there be a substantial reduction in the amounts currently charged against revenue in respect of depreciation. The reasoning behind this recommendation is by no means clear, and it is impossible without more information on the accounts and finances of the system in recent years than has been made public to reach a definite conclusion as to the soundness of the Committee's views in this technical matter. Second, the Committee recommends a change in accounting practice by which the overhead expenses in connection with new construction and renewals would be charged to capital account and to the “Depreciation

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Account," respectively, instead of being "debited to the year's revenue" as is the present practice. So far as the brief reference to the matter in the report permits conclusions to be drawn, and without a clear understanding of the term "overhead expenses" as used, the changes involved in this recommendation appear to be in accord with the Bell System accounting practice whereby certain overhead expenses are distributed over direct charges to Construction, Removal and Maintenance costs—the portion cleared to Removal expense being charged ultimately to the Depreciation Reserve. The Committee estimated that the reductions in operating expenses that would result from the adoption of these recommendations would be equivalent to a horizontal rate reduction of probably not less than 8 per cent.

Before leaving the subject of administration, the Committee cited an example of the unfavorable reaction of deficient administration upon service:

"Delays in transmission are traceable to several sources, the chief among them being an insufficiency of trunk lines. The trunk system, which has been operated by the Post Office since 1896, is admitted by them to compare unfavourably with the long distance service in America, and your Committee believe the main cause to be that the Post Office do not persistently grasp the fact that the public will not freely use the system unless they can rely upon prompt communication at the lowest possible tariff, and that the provision of really adequate facilities creates a demand for trunk service."

RATE MATTERS

In considering the comments and recommendations of the Committee in regard to telephone rates, it should be remembered that the rates in effect at the time of the Committee's inquiry were substantially those proposed by the Post Office Departmental Committee on Telephone Rates in 1920 and put into full effect April 1, 1921. These rates put every subscriber in Great Britain upon a readiness-to-serve charge system of rates, without differentiation between business and residence service.

The readiness-to-serve charge was \$37.40 (£8-10-0) in London; \$35.20 (£8-0-0) in the largest four cities except London (Birmingham, Glasgow, Liverpool and Manchester); and \$33.00 (£7-10-0) *in all other places*. The rate for each local call was $2\frac{3}{4}$ cents ($1\frac{1}{2}$ d.) and was *the same throughout Great Britain*. Party lines were not provided for, except in the case of subscribers distant more than a mile from a central office.

It would be interesting to undertake a detailed comparison of telephone rates in Great Britain and in the United States. It is obvious, however, that such a comparison would be exceedingly difficult, if not impossible, since proper allowance cannot be made for the influence of such factors as the difference in price levels between the two countries, the radical difference between the structures of the rate systems, and the equally important differences in the scope and quality of service provided under the rates. Nevertheless, it is possible to compare approximately the average telephone rate increases which have taken place in the two countries since the beginning of the World War. In Great Britain the increases carried by the rates introduced on April 1, 1921, brought exchange rates to a level officially estimated to be 80 per cent. over pre-war and brought toll rates to about 100 per cent. above pre-war. In the United States the exchange rates of the Bell System were only about 35 per cent. higher at the end of 1921 than in 1914, while the toll rates were only about 20 per cent. higher.

In setting up their rate system, the Departmental Committee on Telephone Rates was largely influenced by the cost-of-service theory of rate-making. The Committee attacks this theory in the very first paragraph of that section of its report which deals with rates, quoting with approval an American statement made in 1901, or over 20 years ago, that "it is wise and just to base rates on other considerations than cost" in large as well as small communities. In the Committee's own words:

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"The preceding observations bring into prominence the conclusion that general telephone extension and rural telephone development are very closely allied, because rural development has little chance of taking place freely without distribution of expenses on the basis, just suggested, of value for services rendered. *** It is an acknowledged circumstance that a high development in residence telephones is a great factor in accelerating general development, and this consideration leads to the prevalent practice in Canada, the United States, and other countries of offering residence connections at lower rates than business connections, although such a course cannot always be justified on a cost basis. ***

"It is no doubt easier to make a uniform rate which applies to the whole of Great Britain. *** But the inflexibility of such a rate militates against development, as it ignores local conditions and the linking-up of community of interests which can so judiciously foster it. In agricultural districts, for instance, communication with a market town is often a crucial matter, and such rates cannot be satisfactory if based on absolute distance. Numerous instances of hardship inflicted by the rigid application of one adamantine rule for differing conditions have been brought before us. Forceful argument has been adduced against rural areas, which have natural disadvantages arising from few or remote subscribers, having to pay the same uniform rate as in town areas. If they cannot be supplied more cheaply, they ask to be allowed to try for themselves. While your Committee fully recognise the necessity for basic principles, the application of these principles to local requirements should be a matter of careful study with a view to obtaining the maximum traffic at the lowest possible cost."

These are strong statements, but there will be little inclination on the part of telephone men in this country to dispute the principles which they express, or to disagree as to the restrictive effect upon development of the kind of rate schedule to which they refer.

In regard to the total abolition of flat rates in all exchanges and the setting up of a universal system of readiness-to-serve charges with no differentiation between business and residence service, which were effected by the April 1, 1921, rate change, the recommendations of the Committee are either not comprehensive or not technically sound. The utmost that the Committee felt able to recommend is the following ("message rate"

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being the equivalent of "readiness-to-serve" in Bell System terminology):

"Your Committee, after giving their most careful attention to all the above considerations, have arrived at the following conclusions:—(i) We recommend that the message rate be the broad basis of any method of charging; (ii) we are convinced that for business lines in a large city the flat rate stands condemned, while for very small places or for residences in restricted areas, although theoretically objectionable, it may be the means of accelerating development; and (iii) on the ground that development will be encouraged, we think that, without departing very largely from the basis of the message rate, some principle of differentiation or elasticity is desirable, as, for instance, by charging a lower annual installation rental for residences than for business premises."

Experience in the United States indicates that the conclusion that the readiness-to-serve charge system of rates is the proper basis for charging is fundamentally incorrect. Such a system of rates restricts use of the telephone to a marked extent, thereby reducing the value of the service and tending to restrict development. It would appear that the desire of the Committee, frequently expressed in its report, that telephone service should be widely distributed in Great Britain is not likely to be realized under such a rate system.

The final conclusion of the Committee as to rate reductions, which is of a very general character and is based apparently upon their consideration of possible reductions in operating expenses, is given in the following statement:

"If our conclusions are approved, we recommend an immediate reduction of 10 per cent. on subscribers' accounts provisionally and without prejudice to any subsequent rearrangement to carry out our recommendations."

The Committee's report ends with the following comment:

"Your Committee are very much alive to the fact that the financial success of some of these recommendations is dependent upon a better spirit of co-operation between the Post Office and the public. To secure this success a more sympathetic recogni-

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tion is vital by the Post Office, on the one hand, that the public are human beings with human feelings and frailties, and not mere automatons for making the telephone accounts balance; and by the public, on the other, that there are often real hidden technical difficulties and that an attitude of chronic suspicion does not help to solve them."

THE AFTERMATH OF THE INVESTIGATION

Just what will be the ultimate effect of the findings and recommendations of the Committee upon the future administration of telephone affairs still remains to be seen. As regards telephone rates, a downward revision of rates to take effect July 1st of this year was announced by the Post Office shortly after the publication of the Committee's report, this revision apparently being based upon the decline in wages, amounting to about 20 per cent., which has arisen out of the reduction of cost of living bonuses which has followed the fall in prices. However, the announcement of the new rates indicates that no change in the readiness-to-serve charge system of local rates has been made, except that a moderate differential has been provided in the readiness-to-serve charge as between business service and residence service.

As regards the organization and administration of the service, Post Office authorities have definitely stated that the Committee's proposal for the separation of the wire services from the postal service will not be accepted; and, so far as is known, no official action has been taken as to any of the other vital improvements which were so forcefully recommended in the Committee's report.

In its report, the Committee was not slow to praise American telephone organization and its results; and the telephone men and women of the United States may rightfully feel gratified at the favorable recognition accorded by the Committee to the service, development and administrative methods for which they are responsible. However, when the adoption of American methods

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is recommended in government organizations, the inflexibility of governmental institutions proves an insurmountable barrier.

S. L. ANDREW.

Editorial Note:

It is difficult to reach an exact conclusion as to the amount of reduction in the new rates, announced by the Postmaster General to take effect July 1st, as compared with the rates which were superseded. Apparently, however, the new rates still leave the general level of exchange rates about 60 per cent., and of toll rates about 80 per cent., higher than before the War. The following extract from a debate in the House of Commons on May 4th on Post Office affairs shows that some of the suggestions made by the Parliamentary Committee were considered by the Post Office in determining the new rates, and also illustrates some of the difficulties which arise in attempts to compare British rates with American rates:

"THE POSTMASTER GENERAL (Mr. Kellaway):"

"I come now to a part of the service which has always occupied my mind a good deal, and that is the provision of improved telephone facilities in the country districts. The present charges are undoubtedly prohibitive, and amount in a great number of cases to a rental of as much as £20 (\$88.00) per annum. This is due to the fact that you have heavy capital charges in connection with most of the rural extensions. The Select Committee attach great importance to this point, and I have been influenced a great deal by their recommendation on this subject in the proposal which I am about to make. Where not less than eight subscribers can be obtained the rental will be £8 (\$35.20). The instalment rental will be £8 (\$35.20) per subscriber, the local and trunk fees being charged according to the ordinary tariff, and in the case of subscribers at a distance of more than one mile extra mileage will be charged at the standard rate. I think that is a very substantial reduction compared with the present rates. (An Hon. Member: 'What is the amount of the reduction?') The present charge is £20 (\$88.00) and it is proposed to reduce it to £8 (\$35.20), and therefore the amount of the reduction is £12 (\$52.80). A day service only will be provided for this class of users, but the cost of the night service, if required, can be met by an additional charge on the subscribers themselves.

"LIEUT. COLONEL WHEELER: 'What does a day service actually mean?'

"MR. KELLAWAY: From 9 A.M. to 7 or 8 P.M. It will be necessary in this case to ask for an agreement for a minimum of three or eight years, according to the capital cost involved."

(Rates in Great Britain have been converted into U. S. dollars at the current rate of exchange.)

Conference of Personnel Group

If anybody was to ask me what was discussed at the recent conference of the Personnel Group which I had the privilege of attending in April, I should answer in two words—"Team Work." The conference held continuous sessions for a week and all of the papers and the discussion dealt with team work and the results which can be accomplished through it—team work between all employees and all departments; team work, which involves everyone from the youngest splicer's helper to the superintendent of plant; from the newest operator to the superintendent of traffic; from the clerk last enrolled in the commercial office to the general commercial superintendent; from the office boy to the general manager and the president. Team work was discussed from every point of view: from the point of view of the morale which must go with it; of the confidence there must be between the various individuals of the organization and the various sections of the organization; from the point of view of the information that the members of the team must have as to objectives, and from the point of view of what the objectives themselves were and should be.

Comparatively speaking, the team work of the Bell System has always been good. The system has been noted among industrial and public service corporations for this characteristic. During and immediately subsequent to the war, however, there was a general let-down in the morale of all organizations and the Bell System was not free from the effect of these influences. Immediately after the management of the telephone properties was returned from Federal control by the Postmaster-General, an intensive study of this question was taken up and efforts were made throughout the whole Bell System, not only to restore the morale and the team work to the pre-war standards, but to exceed these standards wherever possible, and without question it is always possible to exceed a team work standard, because

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it is impossible to conceive of team work which is so perfect that it cannot be better.

The record of achievement which was reported at the conference was truly a remarkable one, not only in what had already been accomplished, but in the clear indications of what still can be attained by continued and further applications of the work discussed. What took place at the conference may be naturally divided into three parts.

First—reports by representatives of the general staff in regard to the objectives and plans in connection with operation and the part that employees' representation could take in assisting in the attaining of these objectives. Mr. R. H. Burcher, Assistant Vice President, presented a paper on "Operating Objectives of the Bell System and How and Where Personnel and Public Relations Activities Can Help to Attain Them." Mr. R. F. Estabrook, Traffic Results Engineer, presented a paper entitled, "Carrying Out the Public Relations and Personnel Relations Policies in Traffic Work," and Mr. F. P. Valentine, Assistant Commercial Engineer, gave a paper on "Some Business Aspects of Telephone Operations."

These papers combined gave a picture of the operating problems from the Plant, Traffic and Commercial standpoints, discussing the objectives and showing how through team work and the cooperation of all results could be obtained which otherwise were not obtainable.

Second—were a number of papers of operating officials of various Associated Companies dealing with the work already accomplished through employee representation. Mr. H. L. Badger, General Superintendent of Plant, Bell Telephone Company of Pennsylvania, described employee representation in the Plant Department of that company. Mr. Verne Ray, Superintendent of Maintenance, Illinois Bell Telephone Company, described the operation of the public relations committees and the pink ticket plan in use in Chicago. Employee representation in the Traffic Department of the American Telephone and Telegraph Company was discussed by

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Mr. J. L. R. Van Meter, General Traffic Manager of the Long Lines Department, and the operation of service committees in the Traffic Departments was described by Mr. R. L. Barrows, General Supervisor of Traffic, Bell Telephone Company of Pennsylvania; Mr. Hermann Thomas, General Supervisor of Employment, Long Lines Traffic Department, American Telephone and Telegraph Company, and Mr. B. J. Bowen, General Superintendent of Traffic, New England Telephone and Telegraph Company. "Demonstration Switchboards—Their Usefulness with Employees and the Public," was presented by the Honorable Franz C. Kuhn, President of the Michigan State Telephone Company.

Third—were papers which dealt particularly with team work for other than the operating features of the telephone problem. The Hon. D. F. Houston, President of the Bell Telephone Securities Company, gave a talk on telephone financing and sale of preferred stock to subscribers; Mr. W. P. Banning, of the Information Department of the American Telephone and Telegraph Company, talked on "Motion Pictures for Employees and the Public," and Mr. W. J. O'Connor, of the Southwestern Bell Telephone Company, on the "How and Why of Personnel Work in the Bell System."

The papers referred to above, all of which except Mr. Houston's have been printed and distributed, by no means include all that came before the conference. Oral reports were made by many operating officials and others of the results which they had been obtaining. These reports were equally as interesting as the papers, and even they left undescribed much which is going on in various companies. Mr. J. P. Downs, General Traffic Manager of the New York Telephone Company, discussed public relations work in the Traffic Department of that company, and Mr. W. H. Winter, General Superintendent of Plant of the Bell Telephone Company of Canada, made a most interesting statement as to the results of work through employees' representatives in the plant department of the Bell Telephone Company of Canada.

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Reversing the usual procedure of former conferences of the Personnel Group, this conference was developed along the lines of a report to the Personnel Representatives of the Bell System, from people directly concerned with operating conditions, as to what had already been accomplished through personnel work to improve the morale and team work within the system and to improve public relations through the contacts of the operating departments with the public, together with numerous suggestions as to what might be accomplished in the future.

The records presented definitely established the following facts with reference to the efforts to secure better team work. That it has resulted in a higher degree of satisfaction on the part of every employee in his work; that it is a powerful aid to greater efficiency and economy in the day to day operations of the business and in improving its public relations, and that in the future, to an even greater degree than in the past, the ability to effectively lead in such work will be among the important characteristics which will be found in successful operating executives.

Another vital fact which was definitely established by the record seems to me to be that under the right treatment and given proper information in regard to the business and their relations to it, all employees appreciate as never before that their interests are identical with the interests of the management, the owners, and the public, and depend in the long run upon the success of the enterprise. One of the most striking features brought out has been the response of the general forces to the information given them enabling them to appreciate their relations to the large objectives of the business. The response of the general forces to such information indicates perhaps that there has not been in the past a full appreciation of the high intelligence and the keen interest which the general forces take in their jobs. In some cases it may have been felt that the younger forces especially would not understand or be interested in

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facts about the business, but recent experience shows they are not only interested, but can deal with the facts skillfully and helpfully once they get them. All of the general forces are essentially the same type of human beings as the supervisory forces (most of whom have been developed from the general forces) and while they may not in most cases have had the same opportunities or experiences, they are working for the same objectives and, if they have the proper information in regard to the business, with the same and often with even greater enthusiasm.

I know that every man and woman at the conference, left deeply impressed with the effectiveness of "team work" and determined that in the Bell System, we should work to the end that each member of the organization should know the objective of the business so as to do, understandingly, his or her part of the work and be able to contribute in the highest degree to the ideal "Good service, continuously rendered at as low rates as consistent with a fair return to the owners."

BANCROFT GHERARDI.

Business Principles in Organization Practice

CONSIDERATION of many telephone problems, and close contact with a large number of telephone men, has led to the belief that the following observations, by no means new, are worth reiteration.

In nearly all countries the telephone service, whether privately or governmentally operated, is furnished, in principle at least, as a commercial service in the sense that it is expected to be self-supporting. When governments operate, the theory is avowed that the service should neither be a charge upon the general revenues of the government, nor a substantial contributor to the general revenues. In practice, the government-operated systems do not succeed as businesses, and fail either to be self-supporting or to be adequate from a service standpoint.

In the United States, telephone service is not only furnished as a commercial service, but it is successfully operated as a business. It is almost universally the opinion of telephone men in this country, based on observation, comparison and experience, that telephone service can be and is best rendered as a commercial service. This means that the service is best managed in accordance with business principles.

The organization of the Bell System is such as to promote the conduct of the telephone business as a whole in this country along sound business lines to a greater extent than probably obtains in any other industry in the country. Despite the fact that this organization is nicely adjusted to facilitate the conduct of the enterprise as a whole along consistently sound business lines, the necessity for sound business management, particularly in local operations, should be continually emphasized. The size of the organization, its subjection to public regulation, the necessity for great specialization in the work for technical reasons, and the requirement of universal service, are all factors which tend to obscure the essential character of local operations, and to make

Business Principles in Organization Practice

difficult under many conditions the application of business principles in detail.

PROGRESS A BUSINESS NECESSITY

The most important principle in any business is that it must persistently progress. I doubt if any useful business, regardless of its character, can be successfully continued except on the basis of fundamental progress. This progress must be real. In practical terms, it means that product must be improved and real prices reduced. In the telephone business, it means that the ultimate objective of the entire organization in doing the day's work is that service will be better and cheaper as time goes on. Such progress has consistently been made by the Bell System from the beginning. Telephone service was never better, more extensive, or so cheap as it is today; and such nominal increases in rates as have been necessary in very recent years do not refute this statement, for they have not approached the corresponding change in the value of money.

The necessity for fundamental progress as a business proposition will hardly be questioned. The essential problem of business management is to accomplish this progress in a balanced and systematic way. Net earnings must always be adequate, or retrogression, not progress, is the immediate result. Service should not be improved without regard to the value of the improvement to the public, or without regard to the cost to be borne by the public; nor should costs be decreased at the expense of adequate service. The standard of transmission, the speed of answer, the speed of installation, the speed of maintenance, the frequency of directories, the terms of credit, the quantities of spare, the flexibility of plant and of organization—these are a few of innumerable cases where the essential problem is one of business management. The correct solution is a continuing problem, calling for constant adjustment for differing and for changing conditions. The objective is constantly to increase the value of service, not merely or necessarily to make it technically

perfect; and to reduce costs by increase in efficiency, not by reduction of service.

The two most important single factors, from the standpoint of organization, in the progressive reduction in cost and improvement of service simultaneously, have been the functional organization of operations, and the centralization of development work, which is correspondingly functionalized. Without these two organization developments, it seems certain that progress in the business could not be had, or would be disastrously limited. They have almost automatically made progress; but they must be perfected to result in the coordination of technical and functional progress to business and service progress as a whole.

IMPROVING FUNCTIONAL ORGANIZATION

It seems to me that continued and intensive attention is required that may be described as effort in the direction of *perfecting* the functional organization. This effort must be exercised along three different lines. The first two have been given a great deal of consideration, and will be only briefly mentioned here. The last method is one to which I believe special emphasis is due now.

1. Maintenance of cooperative attitude between department officials.
2. Establishment of interdepartmental instructions that provide improved methods of interdepartmental work, and of departmental instructions that facilitate businesslike treatment of departmental and interdepartmental business.
3. Development of the practice of promoting and transferring men to different departments.

The first method has to do with supervision, education, morale, and team play; the second with forms of organization, authorities, and organization machinery; and the third with the qualifications of men and the training of management personnel.

Business Principles in Organization Practice

From the business standpoint, the test of every functional officer should be first as to his telephone business qualifications. He must, of course, be able to conduct functional activities expertly, but he must be able to make the functional performance harmonize with and contribute to the business and broad service objective, and so as not to conflict with and detract from the results as a whole. Men must not be known merely as accountants, traffic men, plant men, commercial men, engineers, but first as good telephone men assigned to the management of accounting work, traffic work, plant work, commercial work, engineering work.

ADVANTAGES OF EXPERIENCE

Good telephone business men are not made by calling them by new names. The name must be justified by the fact. One of the methods of securing the proper development of telephone business men is to avoid extremes in the confinement of men to single functions. There will always be a reluctance to transfer men from one function to another, or for men to welcome transfer, because of the loss in technical proficiency temporarily suffered, and because some uncertainty is inevitably involved in any change. It will be necessary to take a broad attitude, and to insist that to attain exceptional technical proficiency, at the expense of adequate all-around business sense in the organization, retards business and individual progress.

It is especially true that in the commercial department, all-around telephone business men are required. In general, men can more safely be relied upon to properly represent the Company or to advise soundly on local telephone business problems, who know the telephone business as well as outside conditions and how to deal with them. Good traffic men and good plant men who like affairs in general and individual and mass contact with the public, should be given opportunities to manage the "commercial" part of telephone work. This promotes the business as a whole, and therefore the proper development of true departmental efficiency.

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The job is to find out what the people want to buy, to sell what they want to buy without asking them to pay for what they don't want, and to produce it and deliver it in a manner satisfactory to the buyers, so that they will be glad to pay for it. To do this better every year is good business and good service. Nothing else is either good business or good service. This is the standard we set ourselves in serving the public, and should be the first to consider in shaping organization and in selecting the management personnel.

C. I. BARNARD.

Progress in Cooperation with the National Electric Light Association

THE annual convention of the National Electric Light Association held at Atlantic City in May marked another milestone in the progress of our cooperative relations with the electric light and power utilities. At the invitation of the Association, about fifty representatives from the American Telephone and Telegraph Company and nearby Associated Bell Companies attended the convention and the cordial spirit in which they were received by the electric light and power representatives shows how effective have been the efforts to "get-together with the other fellow" and argues well for the future of our joint work.

An outstanding feature of the convention was the presentation of the second progress report of the Joint General Committee of the National Electric Light Association and Bell Telephone System on the Physical Relations between Electric Light and Signal Systems. This second report presents detailed principles for the inductive coordination of supply and signal systems and prepares the way for the early formulation of a code of practices. Copies of the report have been sent to all the Associated Companies.

The Joint General Committee earnestly recommends the adoption and consistent application of these principles by the respective utilities, and expresses their belief that the principles should prove of great benefit in meeting the mutual problems of the utilities and that they point the way to the practical solution of inductive interference situations. Gratification is also expressed by the Committee as to the constantly increasing spirit of cooperation evidenced by the satisfactory way in which the mutual problems of the two utilities are being dealt with.

This second report of the Joint General Committee was presented at the Atlantic City convention by Mr.

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Pack for the National Electric Light Association and Mr. Gherardi for the Bell System. The keynote of Mr. Pack's statement was that by establishing close contact between representatives of the two utilities so that they would have full confidence in each other, the way was paved for the proper coordination of facilities in accordance with the principles set up in the report. He also called attention to the great progress in solving the problems between the two utilities in the past year and said that he hoped the spirit embodied in the reports would be continued in the application of the principles in the field. Mr. Gherardi also emphasized the satisfactory progress which has been made in the mutual understanding of the problems between the two utilities and stated that it was being brought about by better contact and increasing confidence. If he could make but one contribution to the solution of the problem, Mr. Gherardi said it would be to have the employees of one utility know, personally, the corresponding employees of the other utility with whom they deal, for through such contact a sympathetic understanding of our mutual problems will be promoted. The discussion of the report showed that through friendly personal relations and frank discussions the way had been opened to the proper engineering solution of the problems between the two utilities.

Among others who spoke in connection with the presentation of this report were engineers from several state public service commissions, and they expressed their appreciation of the successful efforts being made by the utilities to solve their mutual problems through the formulation of constructive guides to practice.

As a result of the meetings and discussions between the representatives of the National Electric Light Association and those of the Bell Telephone System at the Atlantic City Convention, it is believed that the mutual friendship and understanding between the two utilities have been greatly strengthened.

H. P. CHARLESWORTH.

Technical Papers Published During the Quarter Just Ended

*Analysis of the Energy Distribution in Speech,*¹ by Dr. I. B. Crandall and Dr. D. MacKenzie, gives the results of over 13,000 observations on both continuous speech and separate syllables and yields, among others, the result that about 60 per cent. of the energy of speech is concentrated in frequencies below 500 cycles per second. This is at variance with the work of earlier investigators.

*The Nature of Speech and its Interpretation,*² by Dr. Harvey Fletcher, making use of the results of the preceding paper in addition to a very extended series of observations which Dr. Fletcher has collected, arrives at the important conclusion that in a telephone circuit in which all frequencies below 500 cycles per second are suppressed and in which therefore 60 per cent. of the energy in speech is suppressed (see preceding paper) the "articulation" or intelligibility of the speech is reduced only 2 per cent. below that of a perfect telephone circuit. If all frequencies below a thousand cycles are suppressed, only 16 per cent. of total speech energy remains to be transmitted by the telephone circuit while the loss in articulation is only 14 per cent. It is pointed out by the author that these striking results may be of use to medical specialists in alleviating the handicaps of deaf and dumb persons as well as being of value to the telephone engineer and in turn to the telephone using public.

*The Physical Examination of Hearing and Binaural Aids for the Deaf,*³ by R. L. Wegel, discusses many of the recent results of speech analysis arrived at in the Bell System laboratories with special reference to pathological conditions of the ear.

¹See *Physical Review*—Vol. 19, p. 221-232, 1922.

²See *Journal of the Franklin Institute*, Vol. 193, p. 729-747, 1922.

³Presented before the National Academy of Sciences—Washington, D. C.—April 25, 1922. To appear shortly in the *Proceedings*.

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*The Relative Sensitivity of the Ear at Different Levels of Loudness,*⁴ by Dr. D. MacKenzie describes an alternation phonometer which makes it an easy matter to adjust to equal loudness two tones of different pitches. He finds that the sound energy necessary to produce a given loudness is smaller the higher the pitch within the frequency range from bass G to C 5.

Loud-Speaker Developments: At the meeting of the National Academy of Sciences in Washington on April 25th, Dr. F. B. Jewett, Vice President of the Western Electric Company, read a paper⁵ discussing the technical aspects of the loud-speaker. Dr. Jewett reviewed the history of loud-speaker development pointing out that all attempts, prior to the coming of the distortionless amplifier, were doomed to failure. It was only when such an amplifier became available that the engineer, in designing a loud-speaker, could choose his transmitter on the basis of distortionless reproduction rather than on the basis of efficiency of conversion of sound waves into telephone current. The amplifier has made the use of the distortionless transmitter possible.

However, the problem of the loud-speaker does not lie entirely in the amplifier. After the telephone current has been generated by the transmitter and its energy has been amplified possibly a thousand million-fold by the amplifier, it is then necessary to reconvert it back into sound waves. To accomplish this, a special receiver and the proper type of horn to attach to the receiver are necessary. The receiver and horns which the Bell engineers have perfected represent a joint development since a horn when attached to a receiver brings about a marked change in the operating characteristics of the latter.

*Composite Telegraphy and Telephony,*⁶ by Mr. J. H. Bell of the Engineering Department of the Western

⁴Read before the National Academy of Sciences—Washington, D. C., April 25, 1922. To appear shortly in the Proceedings.

⁵To appear shortly in the Proceedings.

⁶Post Office Engineers' Journal, Vol. 15, p. 1-12, 1922.

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Electric Company, describes the American practice as being of interest to readers of the British Post Office Engineers' Journal.

Planning a Big Business Ahead: In this article, appearing in "The Nation's Business," for April, 1922, Mr. S. L. Andrew, Chief Statistician of the American Telephone and Telegraph Company, discusses briefly some aspects of the statistical work of that Company in so far as it concerns future planning for the Bell Telephone System. The article points out the need for careful statistical measurement of the influences of both internal and, especially, external forces upon the movements of the business. It emphasizes the value of scientifically determined estimates over estimates reached by "hunch" methods. Mention is made of the graphic records of the movements of the principal elements of its business which are prepared by the American Telephone and Telegraph Company for purposes of executive information and control. The opinion is expressed that effective statistical work is profitable from every point of view, not only in the telephone business but in every business. Any business that wants to know what is ahead must first have at its disposal all practical knowledge of what is behind.

Notes on Recent Occurrences

THE SHIP-TO-SHORE RADIO DEMONSTRATION AT HARRISBURG

THE first public demonstration of the combined use of ship-to-shore radio telephony, the regular telephone system and the telephone loud-speaker was held at Harrisburg, Pa., on the evening of April 6, in connection with an address by John J. Carty, Vice President of the American Telephone and Telegraph Company, in charge of development and research, before the members of the Harrisburg Radio Association and their guests.

Earlier in the day General Carty and Leonard H. Kennard, President of the Bell Telephone Company of Pennsylvania, had been guests of honor at a luncheon given by the association. The evening meeting was held in the ballroom of the Penn-Harris Hotel, which was crowded to capacity by the 500 or more members of the association and their guests. A special installation of the telephone loud-speaker had been made under the direction of engineers of the Long Lines Department, and this was used by General Carty in delivering his address, as well as in connection with the demonstrations which followed it.

General Carty's subject was "Achievements in Telephony." He outlined graphically the development of the telephone art from the date of the invention of the instrument by Dr. Bell to the present time and briefly discussed its probable future, particularly with regard to the use of radio telephony. He was roundly applauded when he declared, "The progress which we have made, and some of which I will endeavor to sketch briefly for you tonight, justifies me in the belief that in due course American scientists will show the way to construct a telephone system connecting the entire world, so that the tens of millions of telephone users in the United States can readily talk, not only as they now are doing among

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themselves, but also with anyone who has a telephone, wherever he may be located on the face of the earth."

On the wall of the ballroom was hung a map of the United States and Cuba, showing the Transcontinental Line and the Key West-Havana cable. Repeater stations were indicated by lights, which were illuminated as General Carty "called the roll of the continent," a light flashing as each repeater man came into the circuit and answered as the name of his station was called. General Carty talked for some time with H. G. Bates, commercial representative of the Pacific Telephone and Telegraph Company, in San Francisco, the entire conversation being heard by the audience. A musical program followed, an attractive feature of which was a violin solo by Mr. Bates' fourteen-year-old daughter.

The circuit to Havana was built up and the audience heard General Carty's conversation with F. T. Caldwell, chief engineer of the Cuban Telephone Company, as well as phonograph selections played at Havana.

Demonstrations of receiving wireless telephone messages sent from the Deal Beach, N. J., radio station were given and General Carty introduced a touch of the dramatic when he announced that an attempt would be made to talk with a ship at sea. This feature of the program had not been advertised and caused something of a sensation among the guests.

The Shipping Board liner *America*, then en route for New York, was about 400 miles off the coast. Communication with the ship was established without difficulty, wires being used from Harrisburg to Deal Beach and radio communication being effected by means of two radio stations, Deal Beach for sending from shore to ship and Elberon for receiving from ship to shore. General Carty talked with the *America*'s radio operator, the conversation being distinctly heard by the Harrisburg audience. The operator declared that he clearly heard the applause which followed his exchange of greetings with General Carty.

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Following the demonstration a motion picture film illustrating the principle of the audion or vacuum tube, an essential factor in both radio telephony and wire telephony where repeaters are used, was shown, as was a short film showing the "trick assembly" of a telephone desk set. Many of the members of the association and guests took advantage of an invitation to inspect the control room, in which was installed the vacuum tube amplifying apparatus used in connection with the loud-speaker.

Among the guests at the luncheon and the evening meeting were many of the executives of the Bell Telephone Company of Pennsylvania, and state and city officials, including John S. Rilling, of the Pennsylvania Public Service Commission, who is president of the Harrisburg Radio Association and who presided at the luncheon and introduced General Carty in the evening.

ANNUAL CONVENTION OF THE NATIONAL
ELECTRIC LIGHT ASSOCIATION

Atlantic City, N. J., May 16-19, 1922

THE Convention was held on the Million-Dollar Pier, and in order to aid the meetings held in the large auditorium a loud-speaker was installed and used to amplify the voices of local speakers on several occasions. On the night of the 18th, it was connected to the transcontinental circuit terminating in San Francisco, and Mr. J. C. Nowell, Vice President and General Manager of the Pacific Telephone and Telegraph Company, Mr. John A. Britton, Vice President of the Pacific Gas and Electric Company, and Mr. R. H. Ballard, Vice President of the South California Edison Company, addressed the Convention from San Francisco. Before the speeches were delivered from San Francisco, Mr. Gherardi called the roll from Atlantic City to the Pacific coast and the meeting was closed with a "Good Night" roll call.

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Secretary Hoover was unable to attend the meeting in person, so on Friday morning the loud-speaker was connected to a Washington circuit and he delivered a short address from the Chesapeake and Potomac Telephone Company's office in Washington. On each occasion the loud-speaker was used with entire success.

THE GRANT CENTENNIAL

Point Pleasant, Cincinnati, Ohio, April 27, 1922

THE Centennial was celebrated at Point Pleasant, General Grant's birthplace, with President Harding as the principal speaker. In order to carry the words of the President to the entire crowd which it was expected would gather at Point Pleasant, the Bell loud-speaker was installed. By adopting, on a small scale, the arrangements which were used at the Armistice Day Ceremony, the words of President Harding were transmitted by a telephone circuit to Cincinnati also, where they were amplified and projected by the loud-speaker.

It is estimated that 15,000 people heard President Harding in Point Pleasant and 25,000 in Cincinnati.

ANNUAL CONVENTION OF THE NATIONAL CHAMBER OF COMMERCE

Washington, D. C., May 16-18, 1922

THE Annual Convention was held in Convention Hall in the City of Washington and as a result of the successful use of the loud-speaker at the National Chamber of Commerce Convention in Atlantic City last year, the request of the Chamber to make it available again this year was granted. Convention Hall seats about 4,000 people and the loud-speaker proved of great service in assisting those who addressed the convention, among whom were President Harding and Secretary Hoover, to reach their audience.

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DEDICATION OF THE LINCOLN MEMORIAL

Washington, D. C., May 30, 1922

THE installation of the Bell loud-speaker used in connection with the Dedication of the new Lincoln Memorial may be looked upon as ranking in importance with the installations for President Harding's Inaugural address and for Armistice Day. Although the audience did not reach the records set by the two earlier events, the number of persons present was so great that no speaker unaided could have been heard by more than a small fraction of them. The loud-speaker again demonstrated its capabilities by satisfactorily projecting all of a widely varied program including the selections rendered by the Marine Band.

The use of the loud-speaker on this occasion proved interesting from another point of view as it demonstrated how quickly the residents of a city will come to place implicit confidence in it. Had the dedication occurred in any other city than Washington, it is quite likely that the assembling crowds would have arranged themselves very differently than occurred in Washington. There the early arrivals, realizing that they could hear perfectly for at least a quarter of a mile from the Memorial, chose comfortable and shady seats under the more or less distant groves of trees, and it was only after these more desirable locations were all occupied that the audience began to collect in any considerable numbers about the base of the Memorial.

LOUD-SPEAKER DEMONSTRATIONS BY THE
BELL TELEPHONE COMPANY OF PA.

Pittsburgh, Pa., April 28-29, 1922

THREE demonstrations were given, the first to specially invited guests from the city of Pittsburgh, the second on Saturday afternoon to the pupils of the technical and high schools of Pittsburgh, and the third

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on Saturday evening to telephone employees. The roll of cities was called from Pittsburgh to San Francisco and also from Pittsburgh to Havana. Following this, the Havana and San Francisco circuits were connected together at Pittsburgh, music being received from each end and the two terminals talking together with Pittsburgh listening in. A demonstration of radio broadcasting was also given, the program being sent out from the Bell System radio station at Deal Beach, New Jersey. It was received at Pittsburgh and amplified by the loud-speaker.

On Saturday afternoon and evening, in addition to the use of the San Francisco-Havana circuit, a wire radio demonstration was included in the program, the circuit being operated as follows: by wire from Havana to Deal Beach, by radio from Deal Beach to New York and thence by wire from New York to Pittsburgh. This circuit demonstrated the use of a radio link such as is already in operation between Los Angeles and Catalina. On Saturday afternoon and evening, Gen. John J. Carty addressed the audience from New York, telling briefly of the development and future of the telephone.

THE LOUD-SPEAKER AT FIRST AID CONTESTS

THE Bell Loud-Speaker or telephone amplifier was used on several occasions in connection with First Aid contests held by Associated Companies of the Bell System, notably that of the Pittsburgh Division of the Bell Telephone Company of Pennsylvania at Pittsburgh on April 26, and that of the New Jersey Division of the New York Telephone Company at Newark on May 15.

Each of these contests attracted several thousand telephone employees and guests, and the amplifying apparatus was of great assistance to the chief judges and other officials in making announcements, in stating the First Aid problems to be performed by the contesting

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teams, and in announcing the results of the contests and awarding prizes.

In both cases brief addresses were made by company officials, whose voices were carried to the farthest corners of the large exposition building and the armory in which the contests were respectively held. An additional feature of the Newark program was the presentation of Theodore N. Vail medals (bronze) to six New Jersey Division employees by President H. F. Thurber of the New York Telephone Company.

NEW RADIO LAW AND RADIO REGULATIONS

THE Committee appointed by the Secretary of Commerce has made its final report, which is known as "The Report of the Department of Commerce Conference on Radio Telephony." With this report as a basis, Senator Frank B. Kellogg of Minnesota and Representative Wallace B. White, Jr., of Maine, have drafted a bill which has been presented to Congress. This bill provides only for such points as it is necessary to cover as a matter of law and largely leaves to the Department of Commerce the regulation of radio matters in detail. This seems to be very wise, as it would be unfortunate to hamper the development of a new and unformed art with fixed laws which it would be difficult to modify as the necessity arose. Accordingly, if the new bill passes Congress and becomes a law, it may reasonably be expected that the final report of the Department of Commerce Conference Committee will form a substantial part of the basis of such regulations as the Secretary of Commerce may issue.

EXPERIMENTAL BROADCASTING STATION

New York City

OUR new broadcasting station at No. 24 Walker Street, New York City, is completed and ready for service. The Department of Commerce has refused us a

Notes on Recent Occurrences

special wave length of 400 meters and we have been assigned the common wave length of 360 meters. This means that we must operate in common with fourteen other broadcasting stations in this zone. The stations which are now operating are using all of the available time and we are now negotiating in an endeavor to obtain suitable hours during which we may begin operations. In order to start in an experimental way and more in the nature of a demonstration of what we can do, we have requested that we be assigned the hours of 11:00 to 12:00 A.M.; 4:30 to 5:30 P.M. each week day, and Thursday evening from 7:30 P.M. to midnight. It is expected that we will receive this assignment in the very near future, and we will then start negotiations with our prospective users of the facilities. Already, without any soliciting or canvassing, approximately one hundred persons have made application.

SUBSCRIBER OWNERSHIP IN WISCONSIN

HOW well the sale of the preferred stock of the Wisconsin Telephone Company carried out the purposes aimed at, namely the distribution of this stock among the users of the service, is illustrated by the following table showing the subscriptions to the stock from various groups of people:

Vocations	Total		Vocations	Total	
	Subs.	Shares		Subs.	Shares
Abstractors.....	8	61	Book Binders.....	2	2
Architects.....	10	29	Bookkeepers and		
Artists.....	11	37	Accts.....	399	1,477
Bakers.....	37	239	Brass Workers....	1	10
Bankers.....	73	2,629	Brokers.....	14	67
Barbers.....	40	109	Butchers.....	86	354
Beauty Parlors....	17	30	Candy Makers....	4	12
Blacksmiths.....	13	48	Caretakers.....	6	16
Boarding House Prop.....	6	18	Carpenters.....	52	137
Boat Builders.....	4	25	Carpet Weavers...	1	5
Boiler Makers.....	7	23	Casket Trimmers..	2	15
			Chauffeurs.....	29	62

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<i>Vocations</i>	<i>Total</i>	<i>Subs.</i>	<i>Shares</i>	<i>Vocations</i>	<i>Total</i>	<i>Subs.</i>	<i>Shares</i>
Cheese Makers....	2	5		Laborers.....	271	661	
Chefs and Cooks..	24	48		Laundry			
Chemists.....	10	35		Employees.....	10	26	
C. S. Practitioners..	6	13		Lawyers.....	90	813	
Chiropractors....	6	28		Leather Workers..	11	47	
Cigar Makers....	20	30		Librarians.....	8	13	
City and County Employees.....	106	541		Locksmiths.....	1	1	
Clergymen.....	53	285		Managers.....	386	3,108	
Clerks.....	1,045	2,593		Manufacturers....	159	3,016	
Commission Merchants.....	2	110		Marble Workers...	5	40	
Conductors.....	9	40		Masons.....	9	35	
Contractors.....	64	504		Mechanics.....	191	548	
Coopers.....	1	3		Merchants.....	464	3,025	
Dentists.....	74	412		Metal Workers....	4	12	
Doctors.....	183	1,363		Messengers.....	2	2	
Draftsmen.....	33	103		Millers.....	5	16	
Dray and Expressmen.....	19	72		Milliners.....	23	80	
Dressmakers.....	92	321		Miscellaneous....	869	3,281	
Druggists.....	126	487		Motormen.....	7	54	
Dry Cleaners....	3	6		Moulders.....	5	25	
Electricians.....	80	240		Musicians.....	8	81	
Engineers.....	63	324		Newspapermen....	66	207	
Estates.....	12	187		Nurses.....	85	198	
Farmers.....	110	495		Optometrists....	1	15	
Firemen.....	5	17		Painters.....	33	103	
Fishermen.....	1	2		Paper Makers....	36	70	
Foremen.....	79	417		Pattern Makers...	8	55	
Garage Employees	64	220		Photographers....	16	50	
Geologists.....	2	20		Picture Framers...	1	10	
Government Employees.....	89	361		Plasterers.....	3	9	
Grocers.....	136	588		Plumbers.....	30	129	
Harness Makers...	2	6		Pool Room Prop..	9	22	
Hotel Employees..	7	9		Printers.....	68	255	
Hotel and Restaurant Prop.	47	178		Railroad			
House Maids....	40	156		Employees....	173	568	
Housewives.....	2,148	10,410		Real Estate & Ins.	54	505	
Inspectors.....	13	82		Retired.....	271	2,365	
Janitors.....	37	158		Sailors.....	6	30	
				Salesmen.....	464	2,244	
				Secretaries.....	31	111	
				Shipping Clerks...	4	9	
				Shoemakers.....	38	98	
				Shoe Shiners.....	3	3	
				Steam Fitters....	11	35	

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<i>Vocations</i>	<i>Total</i>	<i>Subs.</i>	<i>Shares</i>	<i>Vocations</i>	<i>Total</i>	<i>Subs.</i>	<i>Shares</i>
Stenographers.....	435	965		Textile Workers...	25	50	
Students.....	143	382		Theatre Prop.	8	20	
Superintendents...	79	694		Tinsmiths.....	10	29	
Surveyors.....	1	2		Toy Makers.....	1	1	
Tailors.....	55	222		Undertakers.....	16	61	
Teachers.....	400	1,550		Upholsterers.....	2	7	
Teamsters.....	26	62		Wagon Makers....	2	2	
Telegraph Employees.....	10	39		Waiters.....	17	35	
Telephone Operators.....	289	426		Watchmen.....	9	39	
Other Tel. Employees.....	171	612		Welfare Workers..	8	21	
				Window Washers..	1	1	
				Wire Weavers.....	1	4	
				Total.....	11,283	53,473	

THE BELL SYSTEM TECHNICAL JOURNAL

IT has recently been decided to undertake the publication of a scientific and engineering magazine devoted to the technical aspects of electrical communications. It is to be known as "The Bell System Technical Journal."

In order that the various engineering branches of the Bell System be directly represented, an Editorial Board has been appointed consisting of Messrs. J. J. Carty, Bancroft Gherardi, F. B. Jewett and E. B. Craft with whom will be associated L. F. Morehouse, O. B. Blackwell, H. B. Charlesworth and E. H. Colpitts. The Information Department of the American Telephone and Telegraph Company has been designated to publish the Journal and R. W. King will act as Editor.

The number of fields of science and engineering which are contributory to electrical communications has increased materially in the past few years and a further change in the same direction is to be expected in the future. The need, therefore, is apparent for a technical journal which will serve to collect, in the most available form, articles in the many diverse fields of engineering and science which in one way or another bear upon electrical communications.

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For the time being the contents of the Technical Journal will probably consist entirely of contributions from the technical staff of the Bell System, but it is not intended that this preclude the acceptance of articles by engineers and others who are unaffiliated with the System. The range of subjects treated in the Journal will be as broad as the art of electrical communications itself, including not only the technical researches which underlie new developments in apparatus, but also such subjects as traffic and commercial engineering and the economic studies which precede important new installations.

For the present the Journal will be issued quarterly but with the thought that in the not distant future the volume of articles available may be such as to justify a bi-monthly or monthly appearance.

The Journal will be distributed gratis to interested employees of the Bell System.

THEO. N. VAIL HONORED BY OLD TIME TELEGRAPHERS

IT has been announced that the postal card vote by the membership of the Old Time Telegraphers as to the five men who did the most for commercial development of the telegraph and the welfare of telegraph employees, resulted as follows: Vail, 392; Eckert, 211; Mackay, 200; Clowry, 194, and Carnegie, 181. Consequently, Mr. Vail's picture was selected for a medallion to be distributed during the Association's annual convention in September.

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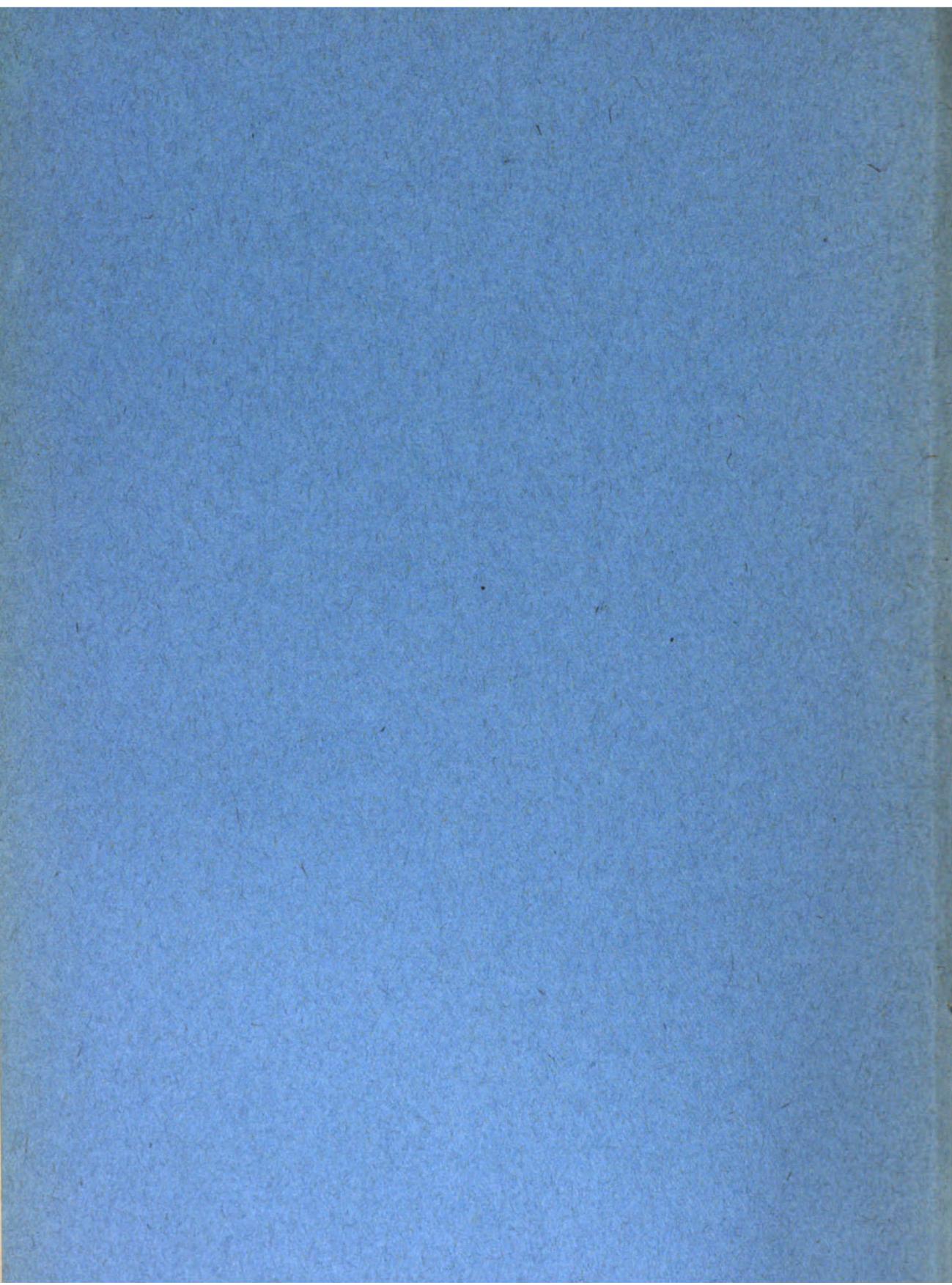
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American Telephone and Telegraph Company



BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION AND A RECORD OF PROGRESS

Published quarterly for the Bell System by the American Telephone and Telegraph Company

Subscription, \$1.50 per year, in United States and Canada; single copies, 50 cents

Address all communications to
INFORMATION DEPARTMENT
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
195 Broadway, New York

Vol. I

OCTOBER, 1922

No. 3

Ideals of the Telephone Service

A TRIBUTE TO THE MEMORY OF ALEXANDER GRAHAM BELL

*Presidential Address Delivered at the Ninth Annual Meeting
of the Telephone Pioneers of America*

THIS is the Ninth Annual Meeting of the Telephone Pioneers of America, although our association is now entering upon its twelfth year. On account of the war, during three years no annual meetings were held. The Pioneers were then engaged in the great struggle to save civilization.

The membership of our association is made up not only from those who took part in the first development of the telephone, but also from those who have been in the telephone service for a period of twenty-one years. We have in the service tens of thousands of zealous men and women doing Pioneer work now, but because they lack in years, though not in achievement, they have not been enrolled. We and they are looking forward to the day of their formal admission. To these our fellow-workers we extend our greetings and our appreciations. In their hands, lies not only the future of our society, but the future of our art.

Our first meeting took place eleven years ago, at Boston, the birthplace of the telephone. At that meeting,

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the inventor of the telephone, Alexander Graham Bell, was present and delivered to us an address which must always be memorable in the history of our Society. Today, we recall with peculiar sadness these words which he then spoke to us:

"This is a great day for me, the first meeting of the Telephone Pioneers of America and of the world. It gives me great pleasure to meet with you all today, and yet there is a feeling of sadness about it. I am the first telephone pioneer and my memory goes back to the very beginning, and I miss the faces I remember so well, the faces of the old pioneers whom I wish were here today.

* * * * *

"I feel it a little presumptuous on my part to try to speak of the telephone to telephone men. You have all gone so far beyond me. Why, the little telephone system that I look back upon, what is it compared to the mighty system that goes through the whole extent of our country today? It is to you that this great telephone development is due, and I feel that it behooves me to speak very modestly of the little beginning that led to this great end. I cannot tell you anything about the telephone. I cannot speak to you about undulating current, intermittent current, and pulsatory current. I belong to the past; you belong to the present."

Here stand revealed those lovable qualities of the great pioneer—generosity and modesty—which endeared him to us all. It is true, indeed, that he belonged to the past, though then he still belonged to the present. Now he belongs to the ages. ¶

Alexander Graham Bell died on Wednesday, August 2, at the age of seventy-five, at his summer home in Nova Scotia, near Baddeck. He was buried on August 4, at sunset, on the summit of a mountain overlooking the Bras d'Or Lakes. As a tribute to his memory, telephone service was suspended for one minute throughout the United States and Canada during the simple ceremony.

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The manifold activities of his life, devoted to the service of mankind, would require volumes to portray. The medals and other honors which he received from learned societies, his honorary degrees from Universities at home and abroad, and special recognition by Governments, all testify to the esteem in which he was held. His scientific researches in the field of heredity and eugenics, his experiments in aeronautics, his work in improving the phonograph, and in teaching the dumb to talk, and his invention of the photophone, reveal the scope of his mind. This record alone is enough to insure his fame, but his discovery of the method of transmitting articulate speech by electricity, and his invention of the apparatus to do this marvel, have placed his name among the immortals.

Dr. Bell was born March 3, 1847, in Edinburgh, Scotland. He went to Canada in 1870, and the next year, at the age of twenty-four, he removed to Boston. After introducing into New England schools improved methods of teaching deaf mutes to speak, he was appointed Professor of Vocal Physiology in Boston University.

In his spare time, he conducted experimental researches in electrical wave transmission. He was assisted financially in these experiments by two gentlemen of Boston, Thomas Sanders and Gardiner Greene Hubbard. By the summer of 1874, he had worked out his theory that the transmission of speech by electricity could be accomplished by producing "electrical undulations similar in form to the vibrations of the air" which accompany the original words or sounds. In spite of great difficulties and discouragements, he succeeded in reducing his theory to practical form, when, at Boston, in the summer of 1875, he invented a telephone which faintly transmitted parts of words and even entire words.

Mr. Thomas A. Watson, Bell's assistant, relates that it was on March 10, 1876, over a line extending between two rooms in a building at No. 5 Exeter Place,

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Boston, that the first complete sentence was ever spoken and heard through the electrical telephone. It was spoken by Bell and heard by Watson, who recorded it in his note book at the time. It consisted of these words: "Mr. Watson, come here; I want you." Thus the telephone was born.

After completing his fundamental invention, Bell in a remarkable document predicted with amazing foresight the telephone system of the future. He also invented the photophone which was the first method of transmitting speech by electricity without wires, and the induction balance and the telephone probe for which he was awarded the honorary degree of Doctor of Medicine by the University of Heidelberg. To his successors in the laboratories in which he was the original worker, he left the further conduct of telephone research and development.

Turning to other departments of science, he displayed his remarkable intellectual gifts by the fruitful researches which he conducted. In his work on behalf of the deaf, which he continued to the end, is revealed a dominant motive in his life.

To Bell was accorded a privilege so often denied to those who have advanced the world by their discoveries—he lived to see the triumph of his great idea. When the first sentence was transmitted, the public regarded the telephone as a scientific toy. Then, the telephone plant of the entire world could be carried in the arms of a child. Today, vast telephone systems of intercommunication have been developed, extending the spoken word among the peoples of the nations.

The advances of the telephone art made by the successors of Bell were always a source of great satisfaction to him. Some of these, epoch-making in their nature, gave him special gratification.

On January 25, 1915, the transcontinental line, spanning Bell's adopted country from ocean to ocean, was in the presence of dignitaries of state and nation, dedicated to the public service. This was a day of

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triumph for Bell, for, using a reproduction of the original instrument, he once again spoke the memorable words, "Mr. Watson, come here; I want you." But this time Bell was at New York, and Watson who heard him with perfect ease, was three thousand miles away in San Francisco.

Another advance attained the greatest distance over which the transmission of speech had ever been achieved. Early in the morning of September 30, 1915, words were spoken through a radio telephone at Arlington, Virginia, to the Hawaiian Islands where they were plainly heard. But, as if to proclaim the telephonic conquest of time as well as space, the words reached these distant islands of the Pacific when it was there still the evening of September 29.

There yet remained to be realized that prophetic dream of the telephone pioneers—the bridging of the Atlantic by the human voice. But the day of its fulfillment was not far off for on October 21, 1915, during the dark days of the war, speech was for the first time in history successfully transmitted across the Atlantic Ocean. This was accomplished by the radio telephone, which carried the words spoken at Arlington, to the Eiffel Tower at Paris.

The last memorable telephone development destined to occur in the life of Bell will always be associated with a great historic occasion. At the burial of the Unknown Soldier at Arlington, on November 11, 1921, the voice of President Harding, by means of the new loud speaking amplifiers, was easily heard by the great concourse of a hundred thousand people about him, even by those in the most distant parts of the vast cemetery. Corresponding multitudes numbered by tens of thousands, at New York and San Francisco, heard over the wires every word spoken by their Chief Magistrate, as clearly as though in his actual presence. These distant multitudes heard also the invocation of the Chaplain, the music and the hymns, and the words of the commitment service used by the Bishop at the grave. They joined with each

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other and with those at the cemetery in the singing of the hymns, and they united with the President in reciting The Lord's Prayer with which he closed his address. They heard in amazement the salvos of artillery fired at the grave, and even those on the shores of the Pacific caught the loud reverberations thrown back by the Virginia hills. At the end, in profound silence and with heads bowed in sorrow, they listened to the plaintive notes of the trumpet sounding the soldiers' last farewell.

On that day, the achievements of science imparted a mystical power to the most solemn national ceremony in the history of America. This ceremony, its deep significance so enriched by the art of Bell, we can now believe contained an exalted sanction of the greatest of all the achievements of his life.

These are but some of the advances which have been made in the first half century of the telephone art, which is now drawing to a close. They belong to the golden age of communications which has achieved the extension of the spoken word throughout both space and time.

But this golden age has not yet ended, and when we contemplate the possibilities of the future we discover that it has only just begun. It is to the future that we must now turn our minds and direct our endeavors. It is true that we Pioneers belong to the past, but it is equally true that we belong to the present. As individuals, we must all pass away, as did the First Pioneer; but our Association, the Telephone Pioneers of America, will continue to live. The greatest work which our society can do, is to exemplify the ideals of our service, and to transmit to its future members the splendid traditions of our art. It should be our purpose to encourage and to sustain among the men and women of the telephone system their ever-increasing zeal for the public service.

While it is beyond my power to put into words these ideals of our service, they already exist within your hearts and mine, where we all can feel, though I cannot express, their potency. These feelings which

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form the mainspring of our actions, do not arise from mere wishful thinking, nor do they spring from an idealism which is disconnected from reality. They rest upon a solid basis of achievement, and represent the practical purpose of that great telephone system of intercommunication which bears the name of our First Pioneer.

It is interesting to note that the biologists were the first to appreciate the peculiar importance of electrical communications in the social organism, and to Herbert Spencer, writing more than fifty years ago, we are indebted for some analogies which have not yet been sufficiently studied either by the biologist or the engineer. In tracing the analogy between the telegraph system of his day and the nervous system of the animal organism. Spencer expressed the view that probably when the then rudimentary telegraph systems were more fully developed, other analogies would be traceable. This development has already been provided by the telephone art, and national telephone networks have now become a vital part of the social organism. I believe that the study of these networks from the standpoint of biology is destined to yield important results, and indeed, that an investigation of the remarkable developments of the automatic machinery used in modern telephone switchboards might even throw light on the mechanism of the mind itself.

Scientists have long been studying the theory that man has advanced to his present high estate by upward progress in the biological scale from a microscopic speck of protoplasm forming the biological cell or unit of life. They have pictured him as composed of countless millions of these living creatures forming an organic entity marvelously designed, each cell performing its allotted part in that exquisite division of labor which characterizes this biological State.

We commonly compare a nation to a complex living organism. "We speak of the body politic, of the functions of its several parts, of its growth, and of its diseases, as

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though it were a creature. But we usually employ these expressions as metaphors, little suspecting," as Spencer says, "how close is the analogy, and how far it will bear carrying out. So completely, however, is a society organized upon the same system as an individual being, that we may almost say that there is something more than analogy between them."

Each cell has its allotted and specialized work to do. Each cell must be fed, and live, and grow. Sustenance must be obtained, prepared, and assimilated, and the waste removed. The physiological mechanisms for doing these things and many other things besides, have their striking counterparts in the structure of organized society, and furnish instructive material for the philosophic student. But to us of the telephone art, the most marvelous thing of all is the nervous system, that inconceivably complex communication network, by which the activities of both individual and society are regulated and without which paralysis and death would result.

We are told that the cells which compose the nervous system are the latest to appear in the upward march of the organism, and that the degree of their complexity and the extent of their differentiation furnish a criterion for determining the stage of progress which has been attained. Because of the high function, almost spiritual in its nature, performed by these nerve cells, they have been called the noble cells. I have long felt and often expressed the feeling that because of this the workers in the telephone art are engaged in a high calling, building up the noble cells which constitute the nervous system of the Nation.

As in the animal body, these cells were the latest to appear, so in the structure of organized society the highest form of electrical communication, the telephone, is the latest to appear—it comes only at the stage of higher development. And again as in the animal body, the stage of development of the nervous system is an index of its place in the evolutionary series, so I believe it will be found in any social organism that the degree of

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development reached by its telephone system will be an important indication of the progress which it has made in attaining coordination and solidarity.

The use of the spoken word to convey ideas, distinguishes man from all other created things. The extension of the spoken word by means of electrical systems of intercommunication serves to connect the nervous system of each unit of society with all of the others, thus providing *an indispensable element* in the structure of that inconceivably great and powerful organism which many biologists feel is to be the ultimate outcome of the stupendous evolution which society is undergoing.

That such an organism, thus so magnificently conceived, would be the outcome of the higher evolution of man, I have long believed; but its form and the nature of its functioning, I could not imagine. But the great work of Trotter, who has studied the gregarious instinct in the lower animals and in man, permits us to contemplate this evolutionary entity from a new point of view. He has pointed out that nature, having failed in her giant organisms, in which so many individual cells were crowded into such animals as her giant lizards and the mammoth and the mastodon, was to try a new method which was to dispense with gross physical aggregations of cells combined into one body. He points out that the flock, the herd, the pack, the swarm—new organizations—were to be devised by nature, and to flourish and range throughout the world, and that in one of these new organizations, human society, the individual man is still to be regarded as the unit, but not constrained as is the cell in the animal body, but free to move about, the mind alone being incorporated into the new unit by the marvelous power of intercommunication. He shows that the power of these organisms depends on the capacity for intercommunication among their members, and that this power expands until the limits of this intercommunication are reached.

How fundamental, electrical communication systems

are, in the tremendous evolution of the human race which is now being manifested in the organization of society, and how vital to the welfare of mankind is the daily work of telephone men and women everywhere, is being made more and more apparent by the discoveries of the new school of biologists.

Speaking always of communication in its broadest meaning, but emphasizing the importance of speech, Trotter says: "The capacity for free intercommunication between individuals of the species has meant so much in the evolution of man, and will certainly come in the future to mean so incalculably more, that it cannot be regarded as anything less than a master element in the shaping of his destiny."

And again, in speaking of human society as a gregarious unit, he says: "The ultimate and singular source of *inexhaustible* moral power in a gregarious unit is the perfection of communion amongst its individual members."

As long as intercommunication was limited, he tells us, the full possibilities of nature's new experiment were concealed. But at length appeared man, a creature endowed with speech, in whom this capacity for intercommunication could develop indefinitely. "At once a power of a new magnitude was manifest. Puny as were his individuals, man's capacity for communication soon made him master of the world. . . . In his very flesh and bones is the impulse towards closer and closer union in larger and larger fellowships. To-day he is fighting his way towards that goal, fighting for the perfect unit which nature has so long foreshadowed, in which there shall be a complete communion of its members, unobstructed by egoism or hatred, by harshness or arrogance or the wolfish lust for blood. That perfect unit will be a new creature, recognizable as a single entity; to its million-minded power and knowledge no barrier will be insurmountable, no gulf impassable, no task too great."†

† "Instincts of the Herd in Peace and War"—W. TROTTER.

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Here we have portrayed the forward march of humanity toiling ever onward to attain its goal. The realization that their wonderful art is destined to play such an important part in this final attainment, opens up a never-ending source of power and inspiration for telephone men and women everywhere. It adds a new dignity to their calling. Already, as we have seen, the human voice has been carried with the speed of light across the Atlantic Ocean, and across our continent, and far out into the Pacific; but still greater things are sure to come.

It is the mission of the Pioneers and their successors, and their associates among all the nations, to build up a telephone system extending to every part of the world, connecting together all the peoples of the earth. I believe that the art which was founded by Alexander Graham Bell, our First Pioneer, will provide the means for transmitting throughout the earth a great voice proclaiming the dawn of a new era in which will be realized that grandest of all our earthly aspirations—the brotherhood of man.

JOHN J. CARTY.

Notes on Radio

THE following notes may be of some help to those who are trying to gain a better idea of radio and what it means to the telephone business. The first part is intended to assist in forming a clear picture of the physical nature of both wire and radio transmission. The latter part is a brief discussion of the fields of use for which radio has been developed, or for which it is being considered.

CHARACTERISTICS OF WIRE TRANSMISSION

It is undoubtedly the popular idea that in our wire circuits the telephone waves are inside of the conductors, somewhat in the manner that a liquid is inside of the pipe conducting it. This is a very incomplete picture. It is true that electrical currents are in the wires, but the energy of the electromagnetic waves is largely outside of the wires, and surrounds them. We must imagine these invisible waves, in the case of our open wire circuits, filling up all the space around the wires, and within a distance of several feet of them, and rushing along the circuit at a speed of many thousands of miles a second, but prevented from spreading and guided by the wires to exactly the place to which we wish the waves to go.

In these wire systems, the electromagnetic waves (except in the recent carrier systems) are transmitted just as they come from the telephone transmitter, that is, they have the same frequencies as does the voice which causes them. They consist, therefore, of constantly changing complex waves, made up of frequencies varying from perhaps 200 cycles or less to over 2500 cycles per second.

CHARACTERISTICS OF RADIO TRANSMISSION

In a radio system, on the other hand, while electromagnetic waves are also used, these are transmitted

Notes on Radio

into wire arrangements which we know as "antennae," so designed that a part of the waves become entirely detached from the wires and spread out in all directions, with no wire guides whatever, and limited in spreading only by the surface of the earth and perhaps also by layers of the upper atmosphere which have such electrical characteristics as to reflect them back.

Thus, in our radio systems, we have no line problems. We have acquired, however, several new sets of problems. I refer to (1) putting the voice waves into such a condition that they may be radiated into space and received from space, (2) separating the different radio messages from each other, and (3) the problems arising from the transmission characteristics of the space through which the radio waves travel.

Our ordinary telephone waves do not radiate appreciably from our circuits, partly because they are of too low frequency to be effectively sent out from structures of any ordinary size, and also because our wire circuits are not of a form which radiates easily. However, if these waves were liberated into space, they would travel just as well, and in fact somewhat better than the higher frequencies used in radio. Supposing they could be liberated, however, it is evident we would be met by the difficulty that all of our messages would interfere one with another, since they would all have the same range of frequencies, and since radio waves spread out in all directions.

The above difficulties are overcome in radio by generating a high frequency current for each message we wish to send, and causing the voice currents to control the magnitude of the high frequency waves that are sent out. It is a characteristic of high frequency waves that they may be radiated from comparatively small antennae systems. By employing a different high frequency for each of the telephone messages which we wish to send, we may at any receiving point separate any particular message from other messages which may be in space at the same time, provided the message we

desire is at a frequency differing sufficiently from the frequencies of the others. This separating is done by using so-called electrical tuning or electrical filter systems, which will let through the desired frequencies, but will stop all others.

It should be noted that in discussing radio, we refer to a message being sent out at a certain "frequency," or at a certain "wave length." All radio waves travel practically at the same speed, that is, the speed of light, which is 300,000,000 meters in a second. Now the distance traveled in a second is the frequency multiplied by the wave length. If we know the frequency, therefore, we can divide it into 300,000,000, and obtain the wave length and vice versa. The longer the wave length, therefore, the lower the frequency.

A good example of the difference in frequency required for separate messages is in the case of broadcasting. Until recently, all private broadcasting had been at a wave length of 360 meters, which is a frequency of about 830,000 cycles per second. It has now been decided to permit broadcasting simultaneously at a second wave length of 400 meters, which is a frequency of 750,000 cycles per second. If the waves were any closer together in frequency than this, it would not be possible, in some sections, for many of the present types of receiving sets to listen to the entertainment being sent out on one without also overhearing the other in sufficient amount to cause interference. The number of simultaneous messages, therefore, is limited by the degree to which the receiving sets can pick up one message and separate it from all others, and by the total range in frequencies which can be used in radio.

"MESSAGE CAPACITY OF THE ETHER"

In discussing radio we commonly think of space as being filled with a medium called the "ether," and that it is this medium through which the electromagnetic waves are transmitted. There is considerable question

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whether this is a proper physical picture, but it is anyhow a convenient manner of speaking. We should note, however, that if there is an "ether," the electromagnetic waves which we employ in our wire systems are transmitted through it just as truly as are the radio waves. With wire transmission, however, the electromagnetic waves travel through, and disturb only a relatively small region in the ether immediately surrounding the wires, whereas the radio waves disturb the ether for a very large region extending in all directions from the transmitting station.

We sometimes hear in radio the expression "message capacity of the ether." By this is meant the number of simultaneous radio communications that can be carried out in any region without interference. Evidently this depends greatly on the locations of the stations, on the type of apparatus used, and on the amount of interference permitted. Roughly speaking, however, it can be said that if the entire range of frequencies which have been developed for radio could be applied to radio telephony, it would be possible with the type of sets in general use to establish perhaps twenty-five simultaneous non-interfering two-way channels in any given region. In view, however, of radio telegraphy and radio broadcasting, of the radio compass and beacon stations which the government is establishing, and of the setting aside of wave lengths for military purposes, difficulties have already arisen in obtaining non-interfering wave lengths.

The radio conference which was brought together by the Department of Commerce to consider the matter recommended an allocation of wave lengths which, if carried out, would leave the radio telephone situation as follows:

For the ship-to-shore business, a range of frequencies is allocated which would permit two simultaneous conversations to be carried on in any one region, by making use of the best methods which have been developed in the art. This space, however, is not set aside exclusively for telephone service, but may also be occupied with

certain types of ship-to-shore telegraph. This might seriously interfere with the telephone service.

For trans-oceanic telephony no space was definitely set aside, although a range of frequencies was designated which would be sufficiently wide for one conversation, and it was recommended that tests of such transmission be permitted in this range.

For connection between fixed points, there were set aside two narrow frequency bands. These are at wave lengths best adapted for distances of several hundred miles. Each of these, with a small amount of further development work, could be made to carry a single conversation. They are not assigned exclusively to telephony, and so may be interfered with by telegraphy.

In each of the above cases, we have in mind two-way communication which could be connected into the wire system so that the radio would be an extension of the wire service, and without the necessity of the talkers using "push buttons" or other mechanical contrivances for switching their sets from the talking to the listening condition. The present art requires two wave lengths for such a radio communication, since the same wave length cannot ordinarily be used for each of the two directions.

Comparatively liberal provision was made by the committee for broadcasting purposes. Space was set aside in the general region in which broadcasting is now being done, permitting at least four simultaneous broadcast channels with present sets in the districts along the coast. This could be increased by at least two in the interior of the country by using, in addition, wave lengths which along the coast are employed in marine telegraphy. Furthermore, a space was set aside using much shorter wave lengths, in which several more broadcast stations could work, although these wave lengths would probably be less satisfactory for such service. The above is in addition to several frequency bands set aside for government and other official broadcasting.

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It is evident that the above does not give much room in which radio telephony, aside from broadcasting, can develop. However, methods have been worked out theoretically, and to some extent in practice, by which it would be possible to increase the message capacity by several times. Such systems bring in considerable complexity and expense, and these increase rapidly as the channels are crowded closer together. With developments along this line, however, and with the further developing of shorter wave lengths than are now in use, we believe that the radio message possibilities can be increased sufficiently to take care of the services which require radio.

TRANSMISSION CHARACTERISTICS OF THE "ETHER"

Radio transmission is generally more variable than is wire transmission. This depends, however, largely on the wave lengths employed, and the distances covered. As an example, the power received from the usual type of broadcasting station at a distance of 30 miles is usually fairly constant. At 200 miles, if the distance is over land, the power received may vary hundreds of times within a few hours, or even within a few minutes. For longer distances the amount of variation rapidly increases.

Radio transmission over water is much less variable than over land. The amount of variation increases rapidly as the wave length is shortened.

Perhaps the most unhappy feature of transmission through space is the well-known "static." This appears to come from lightning and other electrical disturbances in space, and varies tremendously in volume from summer to winter, from day to day, and from hour to hour. Tests made at a point in northern New Jersey for long wave lengths show the average static at that point this summer about 50 times as great in power as the average static last winter. Variations of 25 times in static power were recorded within single days. As it is generally possible with modern receiving sets to amplify the received signals to the point where static interference

becomes so loud that further amplification is useless, this large variation in the static means a large variation in the distance to which the station may be heard.

It is because of these great variations in transmission and in static that it is nearly impossible to state the "range" over which a station may be heard. For example, under favorable conditions, a broadcasting station in the vicinity of New York has been heard far out on the Pacific Ocean. Under unfavorable conditions, the same station could not be heard satisfactorily at a 30 mile distance.

DIRECTIVITY AND SECRECY

Directivity in radio consists in the use of an antenna system so arranged that it does not radiate equally in all directions, but sends out or receives very much better in the direction of the station with which it is operating than it does in other directions.

The advantage of directivity at the transmitting end is a saving in power, since a larger percentage goes in the desired direction, and an increase in the degree of privacy of the message, since fewer stations will be in the region where it can be effectively picked up. A large difficulty here is that it is a physical law that it is not possible to devise a radiating system which will be efficient and which will also give sharp directivity unless the antenna structure is large compared to the wave length. As the radio waves which are generally in use are comparatively long (for example the usual broadcast waves are over 1000 feet in length, and the longest trans-oceanic radio telegraph waves over ten miles), it is not possible, without large expense, to give such waves more than a small degree of directivity at the transmitting station. In receiving systems, however, efficiency is not so important, as it can be made up to a considerable extent by amplifiers, so that a moderate degree of directivity at the receiving end can be frequently employed. This has the advantage of cutting down the amount of disturbance from static or from other

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stations which may be coming in from directions other than that from which the desired message is being received.

Reports have been given out of tests carried on in England covering directed radio system with 15 meter wave lengths (20,000,000 cycles) and giving a much greater degree of directivity than with the usual wave lengths. There is considerable question, however, as to the usefulness of so short wave lengths, in view of the readiness with which they are absorbed.

Various means have been proposed for giving some degree of secrecy to radio telephone messages. These have depended generally on some action at the sending point, such as distortion of the voice waves, adding a noise frequency to them, continuously varying the wave length on which they are sent out, or similar propositions which would make it difficult for them to be picked up and understood. At the desired receiving point these systems depend on arrangements for removing the distortion or noise, or compensating for the changing wave length. While it is undoubtedly possible to devise a secret radio method which it would be practically impossible to tap, it would involve so great complication as to make it unsuitable for general use. Other systems have been developed which, while not "secret" are "private," in that they could be tapped only by those intending to do so, and using apparatus not generally owned by the amateur. Even with such systems, however, the complication and expense of any so far developed are larger than radio services can generally afford.

With this general discussion of radio, it will be interesting to consider some of the fields for which radio has been developed or considered.

TELEPHONE SERVICE TO SHIPS OR OTHER MOVING VEHICLES

A radio station was established at a point in New Jersey, and radio connections set up to a ship at sea through this station and then by wires to points as

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distant as San Francisco and Los Angeles. In some of the tests, connections were established simultaneously to two ships and to a third land station. The nominal range of the station is considered to be 200 miles. Under favorable conditions, it has talked to a ship 1600 miles distant. Local conditions in summer may interrupt the service at distances less than 200 miles. The ultimate range given the station must, of course, depend on commercial requirements as well as the technical questions involved. Since the course of the trans-oceanic liners parallels the coast for a considerable way, it would be possible to reach such ships after they are out of range of a New Jersey station, by other stations on the coasts of New England.

A paper giving technical details of this system is in preparation, and will be published during the winter. At the present time, no further development work is being done on this system, awaiting the working out of the commercial problems which are involved in it.

Another development now being considered and which may be undertaken is a short range telephone system for use around the important harbors. This might be of considerable importance to the railroads and other companies operating tug boats, as it would permit the tug boat dispatchers to keep closely in touch with their craft, thus more efficiently keeping them in use. It is possible that no wave length assignment can be found for this service in the range now generally used for radio, and it will be necessary to go to shorter wave lengths.

Radio is of peculiar importance to airships, in that it furnishes a means by which they may be guided to their destinations. If they ever become of importance from a passenger or express-carrying standpoint, they will bear a relation to the Bell System similar to that of the ships at sea.

Another use of radio telephony which may ultimately be made is that of connection to moving trains. This is entirely a feasible proposition, but the cost of develop-

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ing, setting up and operating such a system at present would, we believe, be too large in comparison with the probable amount of service which would result.

RADIO ACROSS NATURAL BARRIERS

Perhaps the most spectacular service for which radio will probably be applied in the future is the connection of the wire telephone system in America with the wire telephone systems in Europe and in other continents. Communication over such distances was shown possible by the tests of the Bell Telephone engineers in transmitting from Arlington to Paris and Honolulu in 1915. Large developments have been made in the art since that time, but considerable further work remains to be done before such a system can be established and operated at an annual charge sufficiently low to justify it commercially. There may also be difficulty in obtaining suitable wave lengths.

The Catalina Island system was the first radio telephone system to go into regular commercial use. It spans a 25 mile gap of water between the mainland near Los Angeles and Catalina Island. The details of this installation have already been published in the Proceeding of the Institute of Radio Engineers for December, 1921. It is the only case, at least in so far as information has been published, in which radio is furnishing a commercial service, and meeting in both transmission and signaling, but not as regards secrecy or economy, the ordinary requirements of wire service.

There are undoubtedly a large number of other cases in this country where radio will be used for establishing connections with districts to which it would be difficult or impossible to maintain wires. This will probably not be done on any large scale, until radio apparatus, by further development has been somewhat simplified and cheapened.

In many of the cases where radio will be used for reaching outlying points, the necessary reduction in

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cost to prove it in will be obtained by making use of systems which do not meet the requirements of ordinary wire systems, but which will be sufficiently good for the limited service required by these points. For example, in one case recently considered it was thought satisfactory for the system to operate merely between a pair of telephone sets, one at each terminal, with no signaling devices whatsoever, and with communication carried on only for a few hours each day, and then at appointed times.

BROADCASTING

A service for which radio, by its inherent nature, is particularly fitted, is that of broadcasting music, news, etc., to a large number of people who can listen to it by means of comparatively simple receiving sets. This type of system has become so thoroughly known as to require no explanation here. It is not a two-way service, and is not, therefore, of the same type as the usual telephone service. In this case the usual difficulties with radio of lack of secrecy and of spreading out over a large territory are the particular features fitting it for broadcasting economically over a wide area.

TELEPHONE SERVICE FOR RURAL COMMUNITIES

While, from the inherent nature of radio, it is entirely absurd to consider it for carrying on the usual telephone service in place of wire systems in districts which are well developed in population, we have attempted to determine whether it could be developed to give telephone service at a sufficiently low cost to find a field in very sparsely settled country districts.

In this connection, it should be pointed out that radio is purely a method of transmission of messages. In giving telephone service, it is necessary that we not only have means of transmitting our messages, but also means of connecting the transmitting channels together, so that any two subscribers may be permitted to talk. This is the function of the central office, and of the

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operators who are employed there. Radio in no way avoids the necessity for this switching function.

As in the case of a multi-party wire line, it would be possible to arrange with radio so that a small group of subscribers could directly connect with each other. This, however, would not relieve the necessity of their being able to connect through a central office into the wire system, in order to reach more than a very restricted district.

A radio system, for connecting together a group of farmers and connecting the group to a central office, would need to include transmitting and receiving apparatus, and also the necessary power supply and calling devices, in addition to ordinary substation apparatus. Since a part of the apparatus would need to be continuously energized to receive signaling, tube renewals would be an important factor in the annual charges. It is evident that the radio art, as it now exists, cannot meet these requirements at anything like the \$2.00 or \$3.00 per month which the farmer usually pays for his wire service. Even with an optimistic estimate as to changes which can be brought about by development, it appears that in the rural field, as elsewhere, radio telephony will be limited to giving telephone service to comparatively isolated places, or under conditions which make the maintenance of wires more than usually difficult.

This does not mean, however, that low power radio transmitting sets, perhaps for use in combination with broadcast receiving sets, may not be used in considerable numbers as an amusement, permitting a number of people in a community to talk together as a group in the evenings or at other appointed times.

SOME CONDITIONS OF RADIO DEVELOPMENT

The tremendous range of frequencies and energies employed in radio bring in many difficult but interesting technical problems. The frequencies employed vary

from around 50,000 cycles per second, which was used in telephoning to Paris and Honolulu, to frequencies of around 20,000,000 cycles per second, which have been employed in experimental radio work. The energy put into the antenna in the usual broadcasting radio station is about $\frac{1}{2}$ kilowatt. In experimental telephone work, powers have been produced up to 100 kilowatts. These should be compared to about 0.1 watt, which is the maximum voice wave energy, under usual conditions, that is put on our wire circuits. At the receiving end of radio the powers are extremely small. At a distance of say 30 miles from a broadcasting station the usual amateur antenna will pick up perhaps a few millionths of a watt.

From the discussion which we have given it may be evident why it is that the development engineer has viewed radio with somewhat conflicting emotions. In perhaps no other part of the communication art have there been developed more beautiful technical methods or apparatus, or is there presented to him a more intensely interesting group of technical problems. It has opened up possibilities of giving new fields of telephone service, and the results which it has yielded and promises to yield in these fields appeal greatly to his imagination, as they do to that of the general public. Yet in perhaps no other field has the development engineer dealt necessarily with factors inherently so variable, or so little under his control, or has the development work yielded so little in results of practical commercial importance, as compared to the large expenditures made. Furthermore we know that to put radio telephony into such shape that it can give those services for which it is fitted will require that we continue intensive development for many years.

We have in mind, however, that with the constantly increasing demands for all types of communications the radio field, limited though it is in scope, may be expected to grow to considerable proportions. Furthermore we are watching with large interest the apparently great

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appeal of radio telephone broadcasting to the general public. As already noted, the difficulties of radio for ordinary telephone work, that is, the spreading out over wide territory and non-secrecy are just the characteristics which are desirable in broadcasting. It may be that here there is a service in which radio telephony can assume considerable commercial importance, and much more than justify the large amount of development work which must be given to it.

O. B. BLACKWELL.

Service in the Making

IT is easy to define good service. From the view-point of the person desiring to talk, it consists in being able to reach promptly and without confusion any person desired and to talk satisfactorily and without interruption. To give good service, however, under present conditions is a difficult problem for the telephone companies and it becomes increasingly so year by year. It is also seldom appreciated how important a part the subscribers themselves play in the giving of telephone service. The person desired must have a telephone or be near one and he should answer a call promptly and courteously. He should have sufficient telephone facilities so that his lines will not be busy an undue portion of the time. If he has a private branch exchange, he should provide himself with competent operators, and if he does not answer the telephone himself, he should make provision for someone else to answer it properly. The calling subscriber should know how to make his calls, he should give the call accurately and clearly to the operator, and he should pay attention to her repetition. He should know how to use the transmitter and receiver so as to obtain the maximum efficiency from those instruments. He should know the significance of such signals as the audible ringing signal, and he should know how to signal the operator. Subscribers on party lines should refrain from interference with other persons on their lines who may be talking. If there is failure in any of these ways, the subscriber cannot receive satisfactory service although the telephone company does everything in its power.

RESPONSIBILITIES OF THE TELEPHONE COMPANY

Coming to the responsibilities of the telephone company, mention should be made of the commercial department which handles the business relations with subscribers and which aids them in providing themselves with proper facilities to handle their telephone business. It must

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also provide adequate directories so that the subscriber may know with whom he can talk and it must see that proper attention is given to all suggestions or complaints. However, the functions of the telephone company in giving service which are most commonly recognized are the provision of adequate plant properly maintained and the work of the traffic department which operates the plant and performs the actions necessary to connect one subscriber with another. It is with traffic work that this article is primarily concerned, but any description of telephone service which did not mention the important functions of the subscribers themselves and of the commercial, plant and engineering departments would be incomplete.

PROBLEMS OF THE TRAFFIC DEPARTMENT

The most difficult problem of the traffic department is to maintain a satisfactory grade of service in the face of the continual increase in size and complexity of the telephone system. If we think of the early days of the telephone when subscribers were few and exchanges small and not inter-connected, the operating work seems simple as compared with the problems of today. I have in my office a copy of the first telephone directory issued in 1878 and it contains fifty names and no numbers. If you can now visualize such an exchange, the subscribers would call by name for the few other people having telephone service and it would be easy for an operator to handle the simple equipment and to make connection with one of the few lines which might be desired, to ring on that line and to take down the connection when the conversation was over. No record need be made of the call since the charges would be on a flat rate basis, and beyond ordinary attention and courtesy, the requirement for telephone operators would be simple. But conditions such as those are not found today and the present Bell Telephone System with its Connecting Companies consists of a vast and complicated

network, representing an investment of over two billion dollars and providing means for connecting any two of nearly 14,000,000 stations which may be located anywhere in the United States or in Cuba or in portions of Canada and Mexico.

The most complicated portions of the telephone system are naturally those in large cities and the surrounding territory, and in the case of the largest metropolitan area, New York, some 1,400,000 stations connected with 260 offices are located within a thirty-mile radius. Even in the case of a call between two subscribers in the same office, the work of the traffic department has long since changed from the simple conditions forty years ago and it becomes increasingly difficult year by year. Ten thousand lines and upwards of twenty thousand stations may be connected to a single office and to make even the simplest kind of connection in large cities, the services of at least two operators are now required. It would be physically impossible to make telephone connections now with the apparatus of early days and the development of improved telephone plant has more than kept pace with even the enormous growth in business. To provide good service to the subscribers, to assist the operators, and to aid in overcoming the increasingly difficult conditions, vast amounts of machinery are now provided, much of which is automatic in operation, and the operator of today must be skilled in the use of all this modern plant. For example, the operator no longer rings the called subscriber but that important action is performed automatically and mention might also be made of the methods for distributing the calls so as to assure prompt attention by any one of a group of operators, of the call circuits by means of which the operator answering the subscriber enlists the aid of another operator necessary to complete the connection, and of the many automatic signals by means of which the operator follows the progress of the call, advises the subscriber if the line is busy and attends his wishes if further action is necessary. By means of these automatic

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signals the operator knows at all times, without listening on the connection, whether the subscriber is at his telephone, whether he has answered the call, whether he has finished talking and hung up and whether he wishes to make another call or attract the operator's attention for some other purpose. These automatic signals are transmitted over considerable distances and in the case of a call between New York and Philadelphia, for instance, one operator has control of the connection and is provided with just as complete signals from the subscriber at the distant point as from the one in her own city. Development work is now being carried on which will extend still further the distance over which automatic signals can be transmitted and thus improve the service and simplify the work of the operators.

MACHINE SWITCHING SYSTEM

There is a marked tendency to make the apparatus more and more automatic so that the subscriber himself can follow the progress of his call and know when a line called is busy or when the bell is ringing and the called subscriber is slow to answer, without waiting for the operator to advise him on these matters. The latest development in this direction is the machine switching system which is now coming into use and on which the general staff was working for a long time. This system calls for apparatus more complicated than any previously employed in telephone work but it provides means for the entire handling of a local call by machinery under direction from the subscriber. It might be thought that the introduction of the machine switching system would mean the gradual elimination of the telephone operator, but such is not the case. The growth of the business is so rapid and there will always be so many calls, including long distance, toll and special, as well as local calls, which cannot be handled entirely by machinery, that very large numbers of operators will always be required and for a good many years to come the use of

the machine switching system means simply that the increase in the operating forces will be less than if the manual system were retained.

With the great growth of the business, it has become necessary to count the calls at the larger places in order to make the charges fair to all patrons, and for this purpose there are registering devices and special clocks for the operators' assistance. With the continual movement among subscribers, furthermore, means must be provided so that the operators will know, without stopping to refer to a list, if a subscriber has given up his telephone service, if he has moved to another office, or if for any reason his line is in trouble, and the operators must be constantly alert to note and report those conditions to the calling subscriber.

COMPLICATIONS IN METROPOLITAN AREAS

The preceding description has been concerned largely with a single office, and even one of these large offices is a tremendously complicated set of machinery requiring in some cases the services of as many as four hundred operators. Within thirty miles of New York, however, there is not one, but two hundred and sixty offices, many of which are as large as the present design of apparatus will permit. The calling subscriber, furthermore, expects to be connected promptly with any one of these two hundred and sixty offices, and the operators must know instantly the proper method of making connection to each office, and she must have facility in using the machinery provided for those connections. Direct trunk circuits are provided to offices to which there is a considerable amount of business. Offices to which there is less business are reached through other offices by tandem or double tandem methods, the essential circuit arrangement, operating methods and service being similar to that where there are direct trunks. In the case of a call which is double tandemed, however, four operators are required to complete a single connection.

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Offices to which there are relatively few calls, usually those in the outlying sections, are reached by special operating methods through what are known as toll boards, and three of these connecting centers are required to reach all of the 260 offices. Beyond the metropolitan area, calls are handled through another form of toll or long distance board, of which more will be said a little later. When we consider that the subscriber simply announces the office name and number desired, it will be evident that the operator must be well trained and expert to know instantly through which one of many channels that office is reached and the proper operating method and equipment to employ in each case. The resulting complications of the switchboard itself are necessarily very great, with facilities for operating in hundreds of different directions. It is difficult to give a comprehensive picture of the intricate trunk plant connecting the different offices, but it may be of interest to state that in the city of New York as much underground cable plant is required to inter-connect about one hundred offices as is needed to connect 1,000,000 stations with their own offices. While the New York metropolitan area has the largest population and the most complicated telephone system, there are similar conditions in the case of all large cities, and the problems of the traffic department are constantly increasing with the growth in the business.

TOLL AND LONG DISTANCE CALLS

Mention has been made of toll and long distance calls, which are those between two offices not in the same exchange area and for which a special charge is made in proportion to the distance. In no phase of telephone work have the developments been more startling than in extending the range of long distance calls. The first toll circuits were short and consisted of open wires connecting nearby cities. The operating methods were relatively simple and the operator answering the sub-

scriber could herself make connection over the few toll circuits then existing. Today, however, a subscriber can talk across the continent and even to islands beyond the continent, as in the case of Cuba—by means of submarine cables, and Catalina—by means of wireless working from the mainland. Whereas the first toll circuits consisted of a few miles of open wires, it would take several pages to even describe a telephone circuit connecting Boston, for example, with Catalina Island or Havana. In addition to thousands of miles of open wire, there are hundreds of miles of cable either underground or aerial, there are loading coils to overcome the capacity of the cables, there are repeaters to supply new energy to the conversation on its long journey, there are submarine cables or wireless links to cross the rivers and the sea, and there are innumerable equipment devices at the many offices through which the calls must route. The wires stretch across deserts and over mountains where they are frequently the only indication of civilization. When we consider that the slightest break in the 7,000 miles of wire or in any of the many pieces of apparatus would prevent a transcontinental conversation, it is a constant marvel that telephone plant can be built and maintained with the necessary degree of perfection. The work of operating a long distance call is also difficult and it is an enormous stride from the early days of short toll circuits over which two operators could complete a call to the present transcontinental connections, to handle each of which from ten to sixteen or more operators are necessary. A call, for example, from Augusta, Maine, to Catalina Island must be switched at Portland, New York, Chicago, San Francisco, Los Angeles and Long Beach, and the operating methods must be carefully worked out and the operators themselves must be expert in order that there may be perfect cooperation on such a call. That sort of call is a striking illustration of the necessity for uniform and standard operating methods and practices throughout the Bell System and a large force of men is continuously engaged

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in the study of these methods and in the development of improved practices.

MAGNITUDE OF TRAFFIC WORK

The magnitude of traffic department operations can perhaps be visualized by the statement that the Bell owned companies alone employ 130,000 operators to serve some 9,000,000 stations, which make over 11,000,000,000 calls a year, and we are still far from the end. If we look forward to 1940, there will probably be 25,000,000 telephones in the United States, and the complexities of telephone plant and operations increase much more rapidly than the number of stations. The 130,000 operators are located in 5,800 offices, and it is a difficult problem to properly house and care for this large force. The telephone buildings and land alone represent an investment of over \$150,000,000 and, as an interesting detail, in the single item of lunches, which are provided only in the larger cities where the girls cannot conveniently go home for lunch, there is a considerable business turning over some \$8,000,000 a year.

In spite of the great growth in the business and the enormous increase in its complications, American telephone service today is the best that it has ever been, and the telephone operators and the traffic supervising forces may well be gratified at the record they have made and are making in public service. It is no time, however, to rest on past accomplishments, since the traffic problems of the future will be more difficult than those of the past. If the traffic departments continue to work with the same zeal and intelligence, there is every reason to believe that they will be equal to the demands upon them, and I hope that this short article will give some picture of their problems and of the work of telephone operating, which has become one of the principal and best considered occupations for women.

K. W. WATERSON.

Poles

NEXT to the telephone instrument itself, the element of telephone plant which is most familiar to the public is the pole. In attempting to visualize the enormous number of poles required by the Bell System, it may be helpful to consider that the nearly 15,000,000 poles now in use would furnish sufficient material for a railroad trestle, thirty feet high, reaching from Chicago to Buenos Aires. Additions and replacements call for three-quarters of a million new poles each year, or enough to build a telephone line two-thirds of the distance around the earth. These comparisons may also serve to indicate the magnitude and the consequent importance of the pole problem in the Bell System.

Much work has been done by Bell System engineers to enable pole lines to be designed so as to meet service conditions most economically. This has included investigations of the stresses in the poles and other portions of the line under such wind and ice loads as may reasonably be expected to occur in the locality where the line is constructed, experiments to determine the strengths of many different kinds of timber and researches into the effects of various preservatives in increasing the durability of poles.

The most economical poles for use in any particular section of the country are those poles which will withstand the required load at the minimum annual cost.

The load carried by a pole depends upon the weight of the wires or cables which it sustains and the pressure of the wind upon them. The most severe loads occur when the wires or cables are heavily coated with ice and a strong wind is blowing in a direction at right angles to the line.

Factors which affect the load, in addition to the number and size of wires and cables, are the lengths of spans between poles, the climatic conditions (wind and ice) to

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which the line is exposed, and the degree of shelter of the line, as by hills, forests or buildings.

The annual cost, which includes return on investment, taxes, reserve for replacement and maintenance, depends chiefly on first cost and length of life.

Into the first cost of the pole, in place, enter such items as the price at the woods, the freight rate (depending on the weight of the pole and the distance of the place where it is to be used from the point of supply), and the cost of hauling and erecting.

The length of life depends upon a variety of factors, the most important of which (apart from questions of inadequacy and obsolescence) are the character of the timber, whether or not a preservative treatment is employed and, if so, the nature of the treatment, the local climatic conditions and the original size of the pole.

The importance of the latter factor, the original size of the pole, is due to the fact that those who are responsible for the plant and the service have to decide, for every type of construction, taking into account all the conditions of location, exposure and use, how little sound wood may remain at the ground line section of the pole before it should be replaced on account of decay. If the original size of the pole is only slightly more than this critical size at which replacement should be made, the life of the pole will be very short as decay will reduce the size at the ground line to the critical size within a few years.

On the other hand, whereas a pole of huge size at the ground line would have a very long life before decaying sufficiently to require replacement, the cost of so stout a pole might readily be so great that its annual cost would exceed that of a smaller and cheaper pole.

PRINCIPAL KINDS OF POLE TIMBER

The principal kinds of wood used for poles are eastern cedar, western cedar, chestnut, and yellow pine. The eastern cedar now used for poles comes mainly from

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Minnesota. There are also extensive tracts in Canada, and some in northern Maine. In years past enormous quantities have been cut in both the northern and southern peninsulas of Michigan, and in northern Wisconsin. Locations in swamps and along streams afford favorable conditions for the growth of this timber. Under normal conditions cedar poles require from one hundred to two hundred years to grow. Western cedar grows on both the eastern and western slopes of the Cascade Mountains and on the western slope of the Rocky Mountains in the extreme northwest section of the United States and adjoining parts of Canada. Chestnut is found principally along the Atlantic Coast and in the Appalachian Mountain regions. North of Virginia, chestnut has within recent years been practically exterminated by the chestnut blight. While the blight-killed trees have been available for poles, this region, after being cut over, will, in general, cease to be a source of future supply, at least for many years. To what extent the blight will enter the region south of Virginia, where are found the principal stands of chestnut timber, cannot be answered at the present time. Chestnut grows more rapidly than cedar, an average chestnut pole requiring from forty to sixty years to grow. Yellow pine grows principally in the south Atlantic and gulf states. Pine grows quickly, on the average taking somewhat less time than chestnut to produce poles.

STRENGTH AND WEIGHT

Chestnut, yellow pine, and western cedar are about equal in strength. Eastern cedar has about 70 per cent. of the strength of these timbers. The values as to timber strength which form the basis for pole line design in the Bell System have been derived by our engineers from experiments on poles which have been tested by breaking them under measured loads. The figures are considerably smaller than those frequently found in text books on strengths of materials. The difference

Poles

is due to the defects found in the actual poles, whereas the small specimens subjected to the ordinary laboratory tests are so selected as to be clear and straight-grained. Tests recently conducted on some old cedar poles that had been many years in service show that there is but little, if any, tendency for the fibre strength to deteriorate when the wood remains sound.

There is considerable difference in the weights of the different pole timbers. This has a direct bearing on the costs of transportation and distribution and, to some extent, affects the cost of erecting. Chestnut and creosoted yellow pine poles weigh almost twice as much as cedar poles of the same size. In the case of yellow pine the treating process adds about a third to the weight of the untreated pole. The degree of seasoning has a considerable effect on the weights of poles. Chestnut poles are ordinarily shipped in a fairly green condition, whereas cedar poles are frequently held at a concentration point for a sufficient time to season partially, at least. Except in the case of unusually tall poles, the weakest section is at or close to the ground line. For poles of a given length and kind of timber, the breaking strength varies theoretically with the cube of the diameter at the weakest section. This relation serves to show why it is that thick poles are so much stronger than slim poles. For example, a pole 12 inches in diameter at the ground line is 70 per cent. stronger than one 10 inches in diameter, and a 15-inch pole is 240 per cent. stronger than a 10-inch pole. This relation also explains why it is that a limited amount of "hollow heart" has only a trifling effect on the strength of a pole.

Only those kinds of timber which are most durable after the trees are cut are suitable for poles. Hardness and density of the wood seem to have no effect on its durability. The durability of short-lived timber can, however, be increased greatly by suitable preservative treatment. This is necessary in the case of yellow pine, and is advantageous in many cases with other kinds of timber. The action of the preservative in retarding

decay can perhaps be more readily understood after a brief explanation of the nature of decay in timber.

NATURE OF DECAY

Wood is composed of a multitude of minute elongated cells which lie closely side by side to form the wood structure. The surfaces of these cells are in contact with each other and are held together firmly by a cement-like tissue. When timber is fractured there is a tearing away of these cemented surfaces. The decay of timber is caused by the activity of low forms of plant life, principally in the form of fungus threads, which feed upon and dissolve the walls of these wood cells. These organisms are so minute that a powerful microscope is required to see them, yet their work results in the destruction of billions of feet of timber every year. They can grow either in light or darkness, but all of them require certain amounts of air, moisture, heat, and food; the latter being the wood itself. If one or more of these things is lacking the organism cannot live and the decay of timber will not take place. Wood constantly submerged in water does not rot, because there is an insufficient supply of air. On the other hand, if wood can be kept dry it will not decay, because there will then be too little moisture.

The decay-producing fungi do not flourish in ordinary soils at a depth of more than about two feet, on account of the lack of air. The atmospheric moisture is sufficient to permit the development of the dry-rot fungus. Wood freshly cut contains enough water at all seasons of the year to enable the decay organisms to flourish. In the case of cedar and chestnut poles, the portion of the pole above ground does not ordinarily decay, except at a very slow rate. The butt end of the pole, deeply buried in the ground, although frequently permanently damp, does not get sufficient air for rapid decay to take place. It is near the ground line, where the earth holds the moisture and keeps the wood damp for long periods in the presence of air, that decay is most rapid. Pre-

Poles

servatives act antiseptically to kill the fungus growths that produce decay. They are also effective to some extent in preventing the entrance of moisture by plugging the pores of the wood.

PRESERVATIVES

Various metallic salts, such as zinc chloride, copper sulphate, and corrosive sublimate, have been used in this country and in Europe for preserving timber for various uses, but experience has shown that dead oil of coal tar, usually termed coal tar creosote, or simply creosote, is more effective for pole preservation than these metallic salts. While the preservative action is probably due to the poisonous effects of water soluble constituents of the preservative, it is also important that the preservative as a whole should not be freely soluble in water as then it would be leached from the timber too quickly. It is also obvious that the use of materials poisonous to human beings and domestic animals is undesirable.

Bell System engineers early appreciated the advantages of creosote as a preservative, and for fully twenty-five years they have been acquiring data as to the results obtained from its use. This has been done by placing large numbers of experimentally treated poles alternately with untreated poles in lines in various parts of the country and, at regular intervals, usually every three years, carefully measuring the extent of decay in both the treated and untreated poles. Examinations thus made of thousands of poles treated in various ways have enabled trustworthy and reliable results to be obtained from which to determine the added life resulting from the treatment.

While our experiments have largely been directed toward discovering the best methods of using coal tar creosote, we have by no means neglected to test many other kinds of preservatives. In fact, our experiments have included every known preservative which has offered promise of success. At the present time numerous

preservative materials and processes are undergoing preliminary trial in a special laboratory room maintained at a temperature and humidity favorable to decay, where test specimens of timber, to which the new materials and methods have been applied, are placed in close proximity to the decay-producing fungi. By this means results are obtained in a few years which are fairly comparable to those which would require considerably longer under actual service conditions.

Yellow pine, although a strong and otherwise satisfactory pole timber, decays rapidly, particularly in the South, if used without preservative. Moreover, the decay is not confined to the ground line, but speedily affects the entire pole in the absence of suitable treatment. Fortunately, the structural character of this timber is such that it can readily be treated. All yellow pine poles used in the Bell System are creosoted throughout their entire length. The usual method of applying this treatment requires a somewhat elaborate plant, the principal feature being the treating cylinder, of which there are several at each of the larger plants. The average modern treating cylinder ranges from 120 to 130 feet in length and from 6 to 7 feet in diameter. It is constructed like a steel boiler shell, with one or both ends hinged so that they can be opened. The timber to be treated is piled on small cars which run on rails that lead directly into the cylinder at one end. After the timber is moved into the cylinder the latter is tightly sealed and filled with steam. The timber is steamed for several hours, the length of time and the temperature being regulated by the specifications which our engineers have prepared in the light of all their experience with these matters. The steaming softens and opens the wood cells and liquifies and removes the resinous and sappy constituents of the timber. After the steaming is discontinued a vacuum is applied to the cylinder. This assists in evaporating the water left in the timber after the steaming process. When the vacuum has done its work, the pumping is stopped and the cylinder filled

Poles

from a large tank containing hot creosote. After the cylinder is completely filled, pressure sufficient to force the specified amount of oil into the timber is applied. After the pressure is released the oil is pumped back into the tank and the difference in the initial and final readings of the gauge attached to the tank shows the amount of oil that has been absorbed by the timber.

In the case of cedar and chestnut the portion of the pole above the ground line has normally a very long life. It is the portion of the pole at or just below the ground line which decays most rapidly. For this reason much attention has been given to methods for applying preservatives to the butt end of the pole, extending up for about a foot above the ground line, and leaving the upper portion of the pole untreated. The simplest way of doing this is to apply the preservative like paint with a brush. In order that definite information might be obtained as to the value of these brush treatments, the American Telephone and Telegraph Company, in 1902, initiated a series of experiments jointly with the United States Forest Service. Several hundred poles were included in these tests. All the preservatives used were carefully analyzed. The experiments included brush treatments with several different kinds of carbolineum, dead oil of coal tar, and a number of kinds of wood creosote. Some of these poles were set in the coast region of Georgia, where conditions are favorable to rapid decay, and some were set in western Pennsylvania and New York. The treated poles were set alternately with untreated poles, in order that comparisons might be made.

Another line of experimentation which has been carried out by this company in cooperation with the Forest Service has been the treatment of pole butts with creosote by the so-called "open tank" process. With this method the butts of the poles are placed in a tank and immersed in creosote to a point about one foot above the ground line. The creosote is then heated above the boiling point of water, generally by means of steam pipes within the tank. This converts the water in the wood

cells into steam, most of which escapes by bubbling through the oil. The air in the wood cells is also expanded and partially expelled. After the pole has been thoroughly heated in this manner, the hot creosote is quickly replaced by cool creosote, or the poles are quickly transferred to another tank containing cold oil. In either case the effect is to form a partial vacuum in the wood cells, allowing the creosote to be forced into the timber by atmospheric pressure. These poles have been inspected regularly and a large amount of information obtained as to the extension of their life resulting from the treatment.

Improvements in treating have recently been made whereby, by perforating the sapwood of the pole for a short distance above and below the ground line, it is made easier for the creosote to enter the wood at this section of the pole, and more uniform depths of penetration are secured. The perforations are generally from a quarter to a half inch deep, and are closely spaced.

Untreated chestnut rots considerably faster than untreated cedar. For this reason, coupled with the expectation of future scarcity of chestnut, work is being actively pushed which is expected to lead to the installation of local treating plants, within the areas from which the supply of chestnut poles is now being drawn, so that the poles may be concentrated at these points and given an effective treatment, extending from the butt to a point above the ground line when the pole is set. The first of these plants, with a capacity of 10,000 poles a year, is scheduled for completion by the end of this year.

Creosote contains various volatile and soluble constituents, which very gradually escape from treated timber during protracted exposure to the elements. Creosoted poles that have been in service from 10 to 25 years have been removed from the line and the creosote extracted from them and analyzed with great care. As the original composition of the creosote had been very carefully determined by analysis at the time when the poles were treated, it has been possible to discover what

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changes had taken place in it. Investigations of this kind are still going on. They are important in that they furnish data that enables our engineers to revise the specifications for the creosote in order to obtain the grade that is best suited to the work. They are showing that most of the constituents of the creosote tend slowly to escape from the treated timber, the action being more rapid in the portions of the poles which are above ground. The rate of escape, however, is so slow that the value of the treatment is well established.

POLES OF STEEL AND CONCRETE

The question is sometimes asked why poles of steel or of reinforced concrete are not more generally used instead of wood poles. Our engineers in 1909, designed a series of concrete poles of which a large number were constructed. Some of these were tested and their actual breaking load was found to be close to the computed values. The remainder of these poles, about 500 in all, were placed in actual service in pole lines in various parts of the United States, in order that their behavior under the stresses due to wind and sleet loads, the vibration caused by the wires and cables, and the effects of frost, lightning, and other actions of the elements might be observed. The poles are being inspected every three years.

The most expensive element in a reinforced concrete pole is the steel reinforcement. Steel is vastly more expensive per cubic foot than either concrete or wood. In order to obtain reinforced concrete poles comparable in strength with the wooden poles generally used in the telephone plant, so much steel is required that poles of reinforced concrete or steel are much more expensive than wooden poles, even at the prices which obtain at the present time.

LOOKING INTO THE FUTURE

These concrete poles have not been made with the thought that they or any other concrete poles will gen-

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erally supersede wooden poles within a short time. They have been placed in service so that experience with them will be obtained which will serve as a guide to our engineers in the future, should the time ever come when the relative costs of these poles in comparison with wood are such as to indicate that their use might be justifiable.

It is the aim of our engineers in the conduct of this, as well as all of our experimental work, to anticipate future conditions and such new requirements as may be brought about thereby, sufficiently in advance so that we shall be able to develop and have ready thoroughly tried-out materials and methods when these are required, to the end that the orderly expansion of the business will not be checked and the Associated Companies forced to install new and untried materials in their plants. This work is one portion of the Bell System policy of preparedness.

FREDERICK L. RHODES.

World's Telephone Statistics

ON January 1, 1921 there were 20,850,550 telephones in the world; of these 13,329,379, or 64%, were in the United States and 12,601,935, or 60%, were connected to the Bell System. The number of telephones in all the countries of Europe combined was 5,289,606, or 25% of the world's total; all other countries had 2,231,565 telephones, or only 11% of the world's total. During the seven years 1914 to 1920, inclusive, 5,962,000 telephones were added to the telephone systems of the world, an increase of 40%. The total number of telephones at the beginning of 1921 was equivalent to 1.2 instruments for each 100 of the world's population.

THE SCOPE OF THE STATISTICS

These figures summarize the results of a compilation of the world's telephone statistics for January 1, 1921 recently completed and published by the Chief Statistician's Division of the American Telephone and Telegraph Company, from which the accompanying tables and charts have been taken. Owing to the war, which interrupted our lines of communication with many foreign countries on statistical matters, this compilation constitutes the first complete summary of its kind which has been made since that for January 1, 1914. Upon the termination of the war, communication was gradually reestablished with officials of foreign telephone systems, both Government and private; and it is upon data obtained through the courteous cooperation of such officials that the present compilation is based. It should perhaps be pointed out that the preparation of such a compilation, depending as it does upon the relatively slow processes of correspondence with various types of organizations in all quarters of the globe, necessarily requires the expenditure of considerable time if complete results are to be secured.

Despite the disturbed conditions which have prevailed in many parts of the world, accurate official information

TELEPHONE DEVELOPMENT OF THE WORLD, BY COUNTRIES, JANUARY 1, 1921

		Number of Telephones	Per Cent of Total World	Telephones per 100 Population	Per Cent Increase in Telephones since Jan. 1, 1914†
NORTH AMERICA:					
United States	181,930	13,329,379	63.92%	12.4	39.7%
Canada	6,337	674,336	4.11%	9.8	71.4%
Central America	9,613	856,266	0.85%	0.3	102.4%
Mexico	1,860	42,924	.21%	0.3	7.0%
West Indies:					
Cuba	464	33,912	.16%	1.1	113.5%
Porto Rico	555	7,415	.04%	0.6	81.5%
Other W. I. Places*	2,958	7,180	.05%	0.2	53.5%
Other No. Am. Places*	40	3,160	.02%	0.8	37.0%
Total	194,144	14,107,919	68.59%	9.8	41.3%
EUROPE:					
Austria	133,480	.....	64%	2.2	-22.5%
Belgium	62,867	.....	.30%	0.8	-3.3%
Bulgaria *	5,000	.....	.02%	0.1	38.6%
Czecho-Slovakia	77,195	.....	.37%	0.6	XX
Denmark (March 31, 1921)	245,091	252,321	1.21%	7.7	95.4%
Finland*	45,000	45,000	.22%	1.3	12.5%
France	473,212	473,212	2.27%	1.2	43.3%
Germany	1,809,574	1,809,574	8.68%	3.0	27.4%
Great Britain	985,964	985,964	4.73%	2.1	26.3%
Greece	4,700	4,700	.02%	0.1	46.9%
Hungary	57,009	57,009	.27%	0.7	-32.1%
Italy (June 30, 1920)	79,934	114,977	.55%	0.3	25.2%
Jugo-Slavia	16,439	16,439	.08%	0.1	XX
Netherlands	160,733	161,933	.78%	2.4	87.3%
Norway* (June 30, 1920)	73,372	135,372	.65%	5.0	64.0%
Poland*	47,450	25,000	.35%	0.3	XX
Portugal*	1,800	13,621	.07%	0.2	74.2%
Roumania (March 31, 1921)	24,701	24,701	.12%	0.1	23.5%
Russia*	200,000	200,000	.96%	0.2	XX
Spain*	5,000	65,000	.34%	0.3	105.9%
Sweden	386,341	1,789	1.86%	6.6	66.3%
Switzerland	152,336	152,336	.73%	3.8	57.7%
Other Places in Europe*	30,365	1,160	.15%	0.2	XX
Total	4,794,702	494,904	5,289,606	25.37%	1.2
					31.9%

*Partly estimated.
 †No allowance has been made in these figures for any change in territory since January 1, 1914. Minus sign preceding a figure denotes decrease.

	Number of Telephones		Per Cent of Total World	Telephone per 100 Population	Per Cent Increase in Telephones since Jan. 1, 1914†
	Government Systems	Private Companies	Total		
SOUTH AMERICA:					
Argentina.....	116,553	116,553	.56%	1.3	56.8%
Bolivia (Jan. 1, 1920).....	2,517	2,517	.01%	0.1	0.7%
Brazil.....	83,844	85,091	.41%	0.3	117.2%
Chile.....	29,867	29,867	.14%	0.8	51.6%
Colombia.....	6,843	6,843	.03%	0.1	115.3%
Ecuador.....	2,521	3,946	.02%	0.2	34.9%
Paraguay.....	268	406	.01%	0.04	-18.6%
Peru.....	8,560	8,552	.04%	0.2	113.6%
Uruguay.....	22,381	22,381	.11%	1.5	64.7%
Venezuela.....	8,233	8,896	.04%	0.3	76.9%
Other Places (Jan. 1, 1920).....	1,898	1,898	.01%	0.4	34.3%
Total.	5,373	281,577	1.38%	0.4	72.4%
ASIA:					
British India.....	13,000*	21,268	34,268	.16%	0.01
China*.....	52,500	21,960	74,460	.36%	0.02
Japan.....	330,597	.....	330,597	1.59%	0.6
Other Places in Asia*.....	49,473	4,847	54,320	.28%	0.04
Total.	445,570	48,075	493,645	2.37%	0.1
AFRICA:					
Egypt (March 31, 1920).....	22,280	.....	22,280	.11%	0.2
Union of South Africa.....	51,402	.....	51,402	.24%	0.7
Other Places in Africa*.....	27,076	1,448	28,524	.14%	0.02
Total.	100,758	1,448	102,206	.49%	0.1
OCEANIA:					
Australia (June 30, 1920).....	224,000	.....	224,000	1.08%	4.3
Dutch East Indies.....	33,225	1,279	34,504	.16%	62.8%
Hawaii.....	.....	14,376	14,376	.07%	132.5%
New Zealand (March 31, 1921).....	88,439	.....	88,439	.42%	97.4%
Philippine Islands.....	1,955	10,496	12,451	.06%	79.0%
Other Places in Oceania*.....	2,073	237	2,310	.01%	84.3%
Total.	349,692	26,388	376,080	1.80%	0.6
TOTAL WORLD	5,890,239	14,960,311	20,850,550	100.00%	1.2
*Partly estimated. †No allowance has been made in these figures for any change in territory since January 1, 1914. Minus sign preceding a figure denotes decrease.					

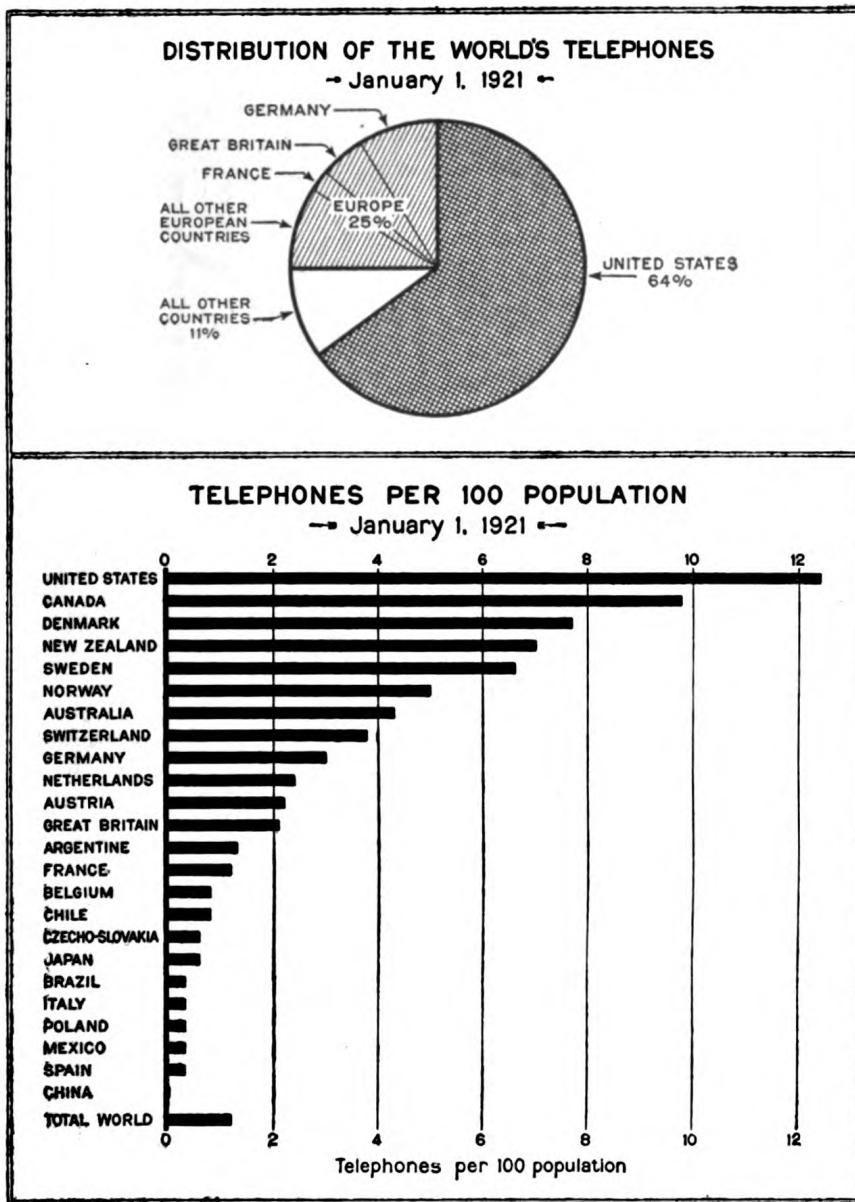
was received for almost all countries, including the new European states created as a result of the peace treaties. In the case of those countries for which it was impossible to secure wholly authoritative figures for January 1, 1921, estimates were, of course, necessary; but practically without exception it was possible to base these estimates upon official data for earlier years, and accordingly the margin of error to which they are subject is undoubtedly very small. In the table on "Telephone Development of the World, By Countries", it was not considered practicable to show data separately for each individual country; for purposes of condensation the less important countries and political divisions in each of the major continental divisions have been grouped under the designation "Other Places". In the case of Europe, "Other Places" include Albania, Armenia, Azerbaijan, Azores, Canary Islands, Dantzig, Estonia, Faroe Islands, Fiume, Georgia, Gibraltar, Iceland, Latvia, Lithuania, Luxembourg, Madeira, Malta, Monaco, and Turkey; and the fact that official data were secured for nearly all of these places in which there were any telephones at all is an indication of the completeness of the figures. In the preparation of the compilation, statistics on telephone revenues and investment were secured; but as a result of the inflated condition of many foreign currencies, these statistics have little comparative significance and consequently have not been published.

COMPARATIVE TELEPHONE DEVELOPMENT OF COUNTRIES

In point of the extent of telephone service relative to population, the table on "Telephone Development of the World, By Countries" shows that the United States, with 12.4 telephones per 100 population on January 1, 1921, still leads all other countries by a substantial margin. Moreover, it is significant that the countries next in rank in telephone development—Canada with 9.8 telephones per 100 population and Denmark with

World's Telephone Statistics

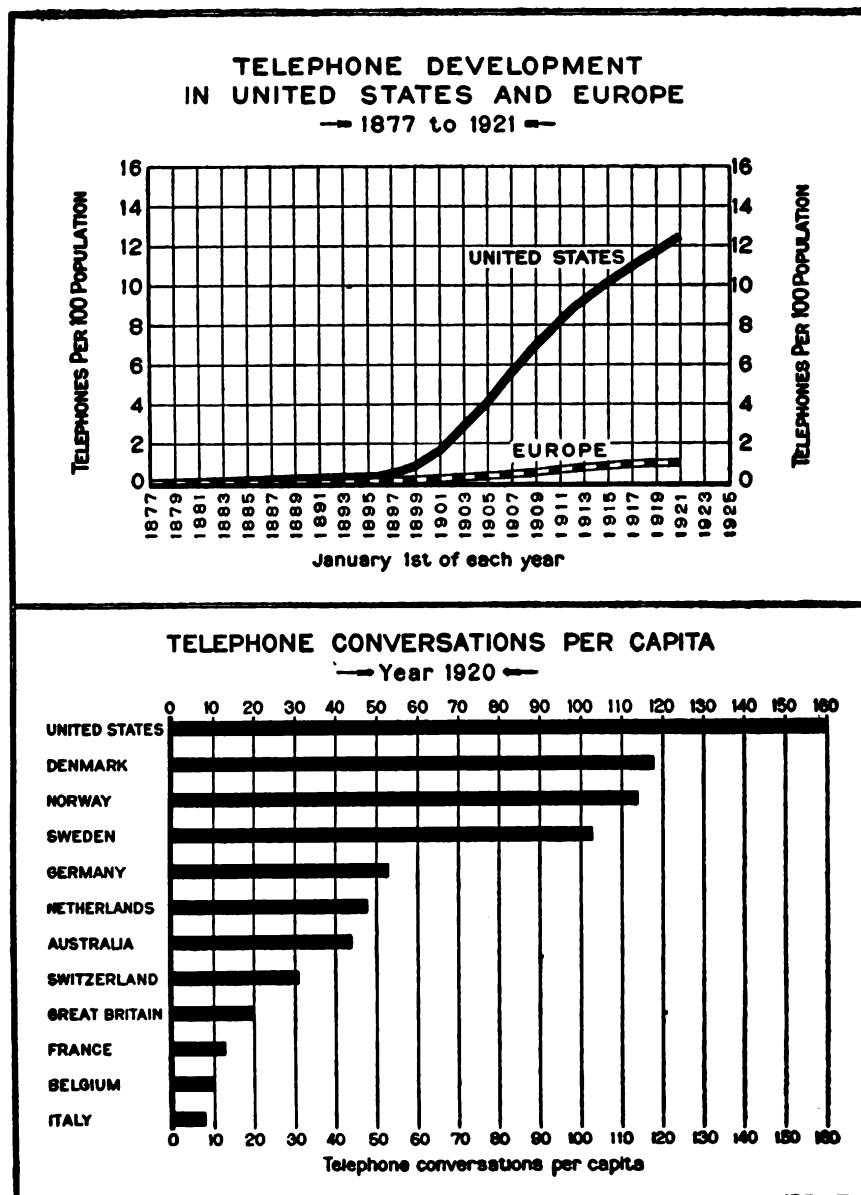
7.7—are countries in which private operation of telephone service predominates.



Europe as a whole has only 1.2 telephones per 100 population, a stage of development reached in the United

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States as early as 1900. Among the individual European states, the highest number of telephones per 100 popula-



tion is found in the Scandinavian countries—Denmark (7.7), Sweden (6.6) and Norway (5.0)—in all of which

World's Telephone Statistics

the service has been developed largely by private initiative, although in Sweden the Government has now acquired most of the private systems. Despite the fact that Germany has only 3.0 telephones per 100 population, it ranks ahead of Great Britain with 2.1 and France with 1.2. Italy has only 0.3 telephones for each 100 of its inhabitants, a figure which is equalled by Poland and exceeded by Czecho-Slovakia.

In South America, the best developed country from a telephone standpoint is Uruguay, which can boast of 1.5 telephones per 100 population, whereas Argentine shows only 1.3. As is to be expected, Japan leads the Asiatic states in telephone development; but with all its progressiveness, Japan still has only 0.6 telephones per 100 inhabitants. Africa is as barren telephonically as is Asia. In Oceania, Australia (4.3) and New Zealand (7.0) rank high as against those comparable European countries in which telephone service has been controlled by Governmental agencies, but their development is low when compared with United States standards.

CHANGES SINCE 1914

The last column in the table on "Telephone Development of the World, By Countries" shows the percentage increase since January 1, 1914 in the number of telephones in each country. These percentage increases should, of course, be interpreted in the light of the absolute number of telephones at the beginning of the period, since those countries which had relatively few telephones on January 1, 1914 naturally tend to show the largest increases in terms of percentages. With this qualification, however, the figures afford a good indication of the progress that has taken place in the telephone world during the years 1914-1920, inclusive.

In the United States, the number of telephones increased by 40%, as compared with an increase of 32% in Europe. In absolute numbers, the increase in the United States was about 3,800,000 telephones,—a figure

almost equal to the total number of telephones in use in all Europe on January 1, 1914. Among the European countries, telephone growth has been diversely affected by war influences and by changes in territorial boundaries. In Austria and Hungary loss of territory substantially reduced the total number of telephones, though telephones per 100 population have increased in both countries because the lost territory was, as a whole, the least developed. Of the new states created as a result of the war, the largest number of telephones (77,195) is in Czechoslovakia, though Poland with 72,450 telephones is not far behind. In the neutral countries telephone growth has naturally been more rapid than in the belligerent nations; indeed, in most of the former countries the war gave an exceptional stimulus to the extension of the service. Thus, in Denmark the number of telephones almost doubled during the seven years covered by the table, while the increases in The Netherlands, Norway, Sweden, Spain and Switzerland were also relatively large. In Belgium, German invasion and occupation seriously crippled the service; but the recovery after the war was rapid and on January 1, 1921 there were almost as many telephones in use in Belgium as in 1914. In France, Great Britain and Italy telephone growth was practically halted during the war, but substantial increases were recorded in the years 1919 and 1920; in the case of France, the increase was augmented by the acquisition of Alsace-Lorraine and the purchase of the telephone system of the American Expeditionary Forces. In Germany the number of telephones apparently increased slightly throughout most, if not all, of the war period; and despite its territorial losses the absolute gain in telephones during the seven years 1914-1920 was greater in Germany than in any other European country.

In South America, Asia, Africa and Oceania a steady extension of telephone service is indicated in almost every country.

TELEPHONE DEVELOPMENT OF IMPORTANT CITIES, JANUARY 1, 1921

Country and City (or Exchange Area)	Estimated Population (City or Exchange Area)	Number of Telephones	Telephones per 100 Population
AUSTRALIA: [*]			
Melbourne.....	767,000	48,461	6.3
Sydney.....	899,000	58,594	6.5
AUSTRIA:			
Vienna.....	1,842,000	98,000	5.3
BELGIUM:			
Antwerp.....	502,000	10,028	2.0
Brussels.....	885,000	23,809	2.7
DENMARK:			
Copenhagen.....	666,000	96,008	14.4
FRANCE:			
Lyons.....	562,000	10,986	2.0
Marseilles.....	586,000	11,859	2.0
Paris.....	2,906,000	159,692	5.5
GERMANY:			
Berlin.....	2,170,000	199,555	9.2
Cologne.....	634,000	35,514	5.6
Dresden.....	529,000	33,150	6.3
Hamburg-Altona.....	1,155,000	85,748	7.4
Leipzig.....	604,000	38,830	6.4
Munich.....	631,000	42,174	6.7
GREAT BRITAIN: [*]			
Birmingham.....	1,273,000	26,477	2.1
Dublin.....	387,000	11,213	2.9
Edinburgh.....	420,000	16,561	3.9
Glasgow.....	1,260,000	43,263	3.4
Leeds.....	536,000	12,999	2.4
Liverpool.....	1,190,000	38,475	3.2
London.....	7,069,000	330,002	4.7
Manchester.....	1,591,000	46,313	2.9
HUNGARY:			
Budapest.....	926,000	24,205	2.6
ITALY:			
Milan.....	718,000	15,000 [‡]	2.1
Naples.....	780,000	6,800 [‡]	0.9
Rome.....	689,000	13,000 [‡]	1.9
Turin.....	517,000	7,500 [‡]	1.5
JAPAN:			
Osaka.....	1,253,000	33,004	2.6
Tokio.....	2,173,000	64,564	3.0
NETHERLANDS			
Amsterdam.....	642,000	31,392	4.9
The Hague.....	353,000	22,393	6.3
Rotterdam.....	510,000	24,848	4.9
NEW ZEALAND: [*]			
Auckland.....	158,000	9,791	6.2
Wellington.....	107,000	10,375	9.7
NORWAY: [†]			
Christiania.....	256,000	29,802	11.6
Bergen.....	97,000	6,970	7.2
PORTUGAL:			
Lisbon.....	820,000	9,939	1.2
SWEDEN:			
Göteborg.....	202,000	23,778	11.8
Stockholm.....	376,000	118,180 [°]	31.4 [°]
SWITZERLAND:			
Berne.....	112,000	10,016	8.9
Geneva.....	136,000	13,714	10.1
Zurich.....	211,000	20,023	9.5
UNITED STATES:			
New York.....	5,708,000	892,198	15.6
Chicago.....	2,755,000	575,840	20.9
Total of the 30 cities in U. S. with over 250,000 population.....	25,176,000	4,201,614	16.7

* Statistics as of March 31, 1921. † Statistics as of June 30, 1920. ° Number of subscribers.
 The greater part of this development was secured by a private company which was purchased by the Government in 1918. On January 1, 1921 the process of merging the company's plant with the Government's local system was not fully completed and the total number of telephones still included a certain number of duplicates.

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COMPARATIVE TELEPHONE DEVELOPMENT OF CITIES

Referring to the table on "Telephone Development of Important Cities", the superiority of telephone development in the United States is again clear. With the exception of a few cities in the Scandinavian countries and one city in Switzerland, none of the foreign cities has a development as high as 10 telephones per 100 population, while the 30 United States cities with over 250,000 population show an average development of 16.7 telephones per 100 inhabitants. Indeed, several American cities have as many telephones as there are in the whole of such important European countries as France or Italy. From an American standpoint, even such metropolitan centers as London and Paris are woefully under-developed. In the case of Stockholm, for which a development of 31.4 telephones per 100 population is reported, the number of telephones includes a certain number of duplicates and the development is consequently overstated. Due to the energetic initiative of the Stockholm Telephone Company, which operated the greater part of local service in Stockholm up to 1918, it is true that this city has attained a far higher telephone development than any other foreign city; but it is probable that if proper allowance were made for duplicate telephones, Stockholm would be found to rank below the highest developed cities in the United States.

In comparing the development of the cities shown in this table with the development of the corresponding countries as shown in the first table, a marked disparity between the development of the cities and that of the countries in which they are located will be noted in the case of most of the foreign countries. This disparity reflects the fact that in foreign countries telephone service is confined principally to the cities. One-third of all the telephones in France are in Paris; London also has one-third of all the telephones in Great Britain. Except in the United States and Canada, rural telephone service is almost unknown.

S. L. ANDREW.

Abstracts of Recent Technical Papers from Bell System Sources

*Measurement of direct Capacities,*¹ by Dr. G. A. Campbell. In distinction to "mutual capacity" and "grounded capacity" the concept and measurement of "direct capacity" is very useful to the telephone engineer, enabling him to control cross-talk and to determine more completely how telephone circuits behave under all possible connections. The article describes typical methods for measuring direct capacity, direct admittance and direct impedance and indicates that the substitution alternating current bridge method, devised some years ago by Mr. E. H. Colpitts, Assistant Chief Engineer of the Western Electric Company, is a very satisfactory method.

*Education and the Art of Electrical Communication,*² by E. B. Craft. On July 21, Mr. E. B. Craft, Chief Engineer of the Western Electric Company, delivered an address on the above subject from his office, to a large gathering of teachers, assembled in the Lincoln School of Teachers' College, New York City. The address was carried over a telephone circuit and projected by the Bell loud-speaker in the manner which has now become so familiar. Mr. Craft pointed out that while the problems of the teachers are steadily becoming more complex, it may be possible to adapt many of the developments of present day science, including some of those which the telephone engineers have originated, to aid in the solution of teaching problems.

The speaker emphasized the great importance, to those who are preparing for technical positions in the industries, of broad fundamental training as well as a super-structure of specialized training. To quote "There is no part of education, from the primary school to the highest training of the graduate school, in which we [the

¹See Bell System Technical Journal—July 1922—Page 18, and Journal of the Optical Society of America and Review of Scientific Instruments—Aug., 1922.

²Issued in pamphlet form by the Western Electric Company.

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Bell Telephone System] do not have a vital interest and do not feel the "effect of every improvement in educational methods."

Mr. Craft also outlined briefly the training courses which the Western Electric Company has established for those of its employees who must, for one reason or another, close their academic training upon graduation from high school. This course runs for three successive years, and in character and difficulty is entirely comparable to the courses offered by high-grade technical schools.

*The Frequency-Sensitivity of normal ears,*¹ by H. Fletcher and R. L. Wegel. A large amount of work has been done during the last fifty years in an endeavor to determine the minimum amount of sound that the human ear can perceive, but the results of different investigators have varied throughout a wide range. It is important for the proper engineering of the telephone plant to know the sensitiveness of the ears of the average telephone user. For this reason, the present investigation was undertaken. Apparatus is described for producing pure tones, ranging in frequency from 60 cycles to 6000 cycles, and in intensity from tones so faint as to be inaudible, to tones which are so loud as to be painful to the ear. Frequency-sensitivity curves have thus far been obtained for approximately 100 normal and 20 abnormal ears. On the average, the minimum audible pressure variation decreases regularly from about 0.15 dyne/cm² at 60 cycles, to 0.001 dyne/cm² at 1000 cycles, and is then approximately constant up to at least 4000 cycles. Persons who require throughout the speech range (600 to 4000 cycles) about 0.1 dynes/cm² are called slightly deaf; those requiring 1 dyne/cm² can still follow ordinary conversation; those requiring 10 dynes/cm² belong to the class who may be benefitted by ear trumpets or amplifiers. A pressure variation of approximately 1000 dynes/cm² can be felt and produces a sensation of pain.

¹Physical Review—Vol. 19, p. 553, June, 1922.

Technical Papers

Static interference as a function of wave length,¹ by H. T. Friis and L. J. Sivian. The purpose of this note is to comment upon a recent theoretical investigation by M. Abraham of the relative immunity from atmospheric disturbances in closed loop and open aerial forms of receiving antennas, and upon a subsequent paper by L. B. Turner on the ratio between signal intensity and static intensity as a function of signal wave length. The calculations in the latter paper are based on Abraham's results which are believed to be an error by the present authors. They arrive at results which indicate that for any given range of signaling the optimum wave length is the same for both loop and open antennas.

The Fire-fly as an illuminant,² by Herbert E. Ives. The purpose of this paper is to review the results of a series of studies made some years ago on the physical properties of the light emitted by the fire-fly. Much interest has been bestowed upon the fire-fly's light because it appears to be produced very efficiently and its secret, when understood, may have great practical value. The most important practical questions to be answered in studying an illuminant are three: *How much* light does it produce; *how efficiently* does it produce the light; *what is the quality of the light?*

These questions the author considers in turn. He finds that although the amount of light which the fire-fly emits per unit area of its body is very small compared to a flame or heated filament, it is sufficiently intense to be entirely practicable for many illuminating purposes. The efficiency of the fire-fly's light can only be roughly estimated but appears to be ten or even twenty times that of the best artificial illuminants. Spectrum analysis of the light from the species *Photinus Pyralis* revealed the fact that practically all the rays lie in a narrow region of the spectrum between the orange and green. The light, although it lies in that part of the spectrum for which the human eye is most sensitive and

¹Wireless World and Radio Review—June 3, 1922.

²Journal of the Franklin Institute, Vol. 194, p. 213, August, 1922.

would be very useful for making fine detail visible, would, of course, not render true color values.

*Critical Frequency Relations in Scotopic Vision,*¹ by Herbert E. Ives. If the eye is fixed upon a source of light before which a black revolving disc with openings in it periodically intercepts the light, for low speeds the revolution of the disc will be apparent as a "flickering" of the light's source. At very rapid speeds, no flicker will be apparent, the source of light appearing steady. There will be an intermediate speed at which the flicker just becomes apparent as the rotation of the disc is decreased and just disappears as its rotation is increased. The present paper is a study of certain phenomena of vision which are encountered in working with such flicker apparatus. The author shows that so long as the intensity of the light source is large enough to give color or "cone" vision, the critical speed at which flicker just appears, or disappears diminishes steadily as the intensity of the source of light is diminished. When the intensity has been reduced to the point at which "cone" vision disappears and only colorless or "rod" vision remains, the critical speed remains constant although the intensity of the light may be still very much reduced.

The relationship between critical speed and the shape, or wave form of the intercepting segments of the rotating disc is also discussed and an empirical relation arrived at.

The Voltage-Current relation in central anode Photo-Electric cells, by Herbert E. Ives and Thornton C. Fry. The paper supplies a theoretical discussion of the fact noted by one of the authors that in the case of some potassium cells, the voltage required to give the saturation value of the photo-electric current increases as the frequency of the light used to excite the emission is raised. The results of the analysis agree as to order of magnitude with observations to the effect that 40 volts and 160 volts were required in a certain photo-electric

¹Journal of the Optical Society of America and Review of Scientific Instruments—Vol. 6, p. 254-268, May, 1922.

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cell to give saturation for wave lengths 5500 Å and 4500 Å respectively. This effect should be taken into consideration whenever cells of the type specified are used to compare the intensities of radiations of different spectral distributions.

*Philadelphia-Pittsburgh section of the New York-Chicago Cable,*¹ by J. J. Pilliod. Engineering and construction features involved in a complete telephone cable system over 300 miles in length and connecting Philadelphia and Pittsburgh, Pa., are described in this paper. The cable is designed to operate as an extension of the Boston-Washington under-ground cable system with which it connects at Philadelphia. It is also designed for operation in connection with the Pittsburgh-Chicago cable now under construction, and other cable projects included in a comprehensive fundamental plan.

Beginning with the fundamental factor of public requirements for communication service between cities separated by various distances, there are next considered the methods available to provide this service. Small-gage, quadded, aerial cable, which was decided upon for use in this section after careful economic studies, is described in a general way and the important advantages of the application of loading and telephone repeaters are outlined. The use, in connection with this cable, of the recently developed metallic telegraph system for cables is referred to and some facts are given regarding power plants, test boards and buildings. A few of the many possible combinations of cable and equipment facilities into complete telephone circuits, each of which will furnish the required service in the most economical manner are illustrated.

The necessity of complete coordination of the many factors involved in a project of this kind is emphasized.

The relation of the Petersen System of Grounding Power networks to inductive effects in neighboring Communication

¹See Bell System Tech. Journal, July 1922, and Journal of the A. I. E. E. August 1922.

*Circuits,*¹ by H. M. Trueblood. This paper discusses, with reference particularly to its inductive interference aspects, a method of grounding power system neutrals due to W. Petersen, a German engineer. The distinctive feature of this system is the employment in the connection between neutral and ground, of an inductance adjusted to resonate at fundamental frequency with the total direct capacity of the system to ground. It is pointed out that this arrangement, proposed originally solely as a means of protecting the power system from the effects of accidental grounds, also possesses advantages of considerable importance from the standpoint of inductive interference. Chief among these are, first, the prevention of the large residual currents of fundamental frequency which occur in systems grounded through zero or a low impedance at times of accidental grounds, and which may induce high voltages in exposed circuits; and, second, the prevention, under normal operating conditions of triple harmonic residual voltages and currents which are frequently a troublesome source of noise in telephone circuits exposed to power circuits grounded in the manner common in this country. The paper also explains the characteristic action of the resonant system, by virtue of which the reactance coil functions as a protective device for the power system at times of accidental faults, and discusses the possibility of overvoltages at times of fault. A comparison in some detail of the Petersen system with other methods of grounding (including the non-grounded system), with respect both to fundamental and harmonic frequencies, is given.

The sensitivity and precision of the Electrostatic Transmitter for measuring sound intensities,² by E. C. Wente. The transmitter described is the same in principle as that described by the author in 1917 and now generally known, but certain changes have been made which render its sensitivity independent of changes in temperature,

¹Bell System Technical Journal, July 1922; also Contribution from the Jefferson Physical Laboratory, Harvard University—Vol. 15, 1921-22.

²See Physical Review—Vol. 19, p. 498, May, 1922.

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pressure and humidity. The sensitivity is also constant over long periods of time. Combined with an amplifier of ordinary design the transmitter has an overall sensitivity which is practically uniform from 25 to 8000 cycles. The apparatus can also be made highly selective and almost any desired sensitivity can be obtained by using a tuned amplifier in connection with a vibration galvanometer. The average sensitivity of the transmitter alone is about 0.35 millivolts per dyne per square centimeter.

*A new type of High Power Vacuum Tube,*¹ by Dr. W. Wilson. This paper describes two remarkably powerful water-cooled vacuum tubes which have been developed in the Bell System Research Laboratory. The small tube is capable of delivering about 10 kilowatts of high frequency energy and the larger tube, although less than three feet in length and weighing only ten pounds, is capable of generating 100 kilowatts. The principle of operation of the water-cooled tube is identical, from an electrical point of view, with that of the small tubes which are now so familiar as telephone repeaters and radio detectors, but their practicability has only been made possible by a new and striking development in the art of sealing metal to glass. To Mr. W. G. Houskeeper, of the Bell Laboratory, goes the credit for the development of the type of vacuum seals which are utilized in the new tubes.

¹See Bell System Technical Journal—July 1922—Page 4.

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DEATH OF DR. ALEXANDER GRAHAM BELL

AMONG the most impressive of the tributes to the memory of Alexander Graham Bell, who died on August 2, was that of the telephone system which bears his name.

As the body of the inventor was being laid at rest on the summit of Beinn Breagh, near his summer home at Baddeck, Nova Scotia, on August 4, service was suspended for one minute on all lines of the American Telephone and Telegraph Company and its associated companies, both in the United States and Canada. There could be no more striking illustration of the importance of Bell's invention, or a more fitting testimonial to the regard in which his name is held by those who are carrying on the public service which he began, than that, in honor of the genius who first gave voice to the telephone, nearly 14,000,000 instruments—which trace their lineage to his first, crude device—should become momentarily silent.

Immediately upon receipt of the news of Dr. Bell's death H. B. Thayer, president of the American Telephone and Telegraph Company sent the following telegram to Mrs. Bell:

"In behalf of all the men and women of the telephone system which bears his name, I extend our deepest sympathy and express our grief in the passing of Dr. Bell. History will record the inestimable value of his services to mankind, but we who are carrying on in the telephone art founded on his great discovery are peculiarly appreciative of his genius."

To this message Mrs. Bell replied:

"Thank the men and women of the Bell Telephone System for their message of sympathy. The consideration and affection they have always shown him whenever occasion offered has always touched me deeply and is my comfort now."

Simultaneously with the sending of President Thayer's message it was directed that flags on all buildings through-

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out the system should be flown at half-mast until after the funeral services.

Memorial resolutions were passed by the Directors of the American Telephone and Telegraph Company at a meeting held on August 15. Quite fittingly this tribute is recorded as coming, not merely from the Bell System as an organization, but on behalf of the hundreds of thousands of telephone workers of the world.

The resolutions follow:

"In the death of Alexander Graham Bell the civilized world mourns for a man who thought fearlessly, worked tirelessly and served generously to relieve the unfortunate and to benefit humanity.

"He was the inventor of the telephone because his thoughts adventured into new and untried fields of science, because his enthusiasm for discovery was sufficient to overcome all difficulties, because his practical mind demanded a consummation of his theories in practical results, and because he was inspired to contribute greatly to the common good.

"As an investigator he was intelligent beyond the genius of his age. In the invention of the telephone he founded the art of transmitting speech electrically, a new and invaluable contribution to the humanizing of mankind.

"He was one of the few in history who lived to see the child of his brain developed into a world-wide service. This was the only reward he sought and this reward was fully his.

"Whereas, this company was founded upon and is devoted to the development of his invention for the service of humanity, it seems proper that we, the directors of the American Telephone and Telegraph Company, for ourselves and in behalf of the men and women of the Bell System, should spread upon our records our recognition of the debt owed to Alexander Graham Bell by the hundreds of thousands of telephone workers of the world for the opportunity for service which his invention made possible."

NINTH MEETING OF THE TELEPHONE PIONEERS OF AMERICA

THE ninth meeting of the Telephone Pioneers of America was held at Cleveland, Ohio, on September 29 and 30, 1922. Sixty delegates, representing nineteen chapters, and ten of the twelve officers attended the sessions of the General Assembly. Members of the

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association and their relatives brought the total attendance up to 1200.

The organization has more than doubled its membership since the last meeting, the report of the secretary showing that since January 1, 1921, the enrollment has grown from 1742 to 4276, a net gain of 2534. The adoption, a year ago, of a new form of organization under which local chapters have been instituted in various sections of the country, has tended to increase interest in the work of the Pioneers. Twenty-one years of service in the telephone business is one of the requirements of membership.

The General Assembly which, under a constitutional amendment also passed a year ago, is the legislative body of the organization, adopted several important changes in the by-laws and elected officers for the coming year as follows: President, Leonard H. Kinnard, President of the Bell Telephone Company of Pennsylvania; Senior Vice-President, F. A. Stevenson, Director of the Long Lines Department, American Telephone and Telegraph Company; Vice-Presidents, James T. Moran, President of the Southern New England Telephone Company; J. A. Stewart, Vice-President of the New York Telephone Company, E. A. Reed, President of the Ohio Bell Telephone Company. The secretary and the treasurer are appointed by the executive committee.

Members elected to the Executive Committee for one year were B. A. Kaiser, American Telephone and Telegraph Company, and J. E. Warren, Southern Bell Telephone Company, while Verne Ray, Illinois Bell Telephone Company; Miss Mary Miller, Bell Telephone Company of Pennsylvania, and E. K. Hall, Vice-President of the American Telephone and Telegraph Company, were elected for two-year terms.

At the annual meeting of the association John J. Carty, the retiring president, made an address in which he paid an eloquent tribute to Dr. Alexander Graham Bell, inventor of the telephone. This address appears in full elsewhere in this issue of the QUARTERLY. The

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association also took suitable action in memory of Dr. Bell.

One of the features of the gathering of the Pioneers was a meeting in the new Municipal Auditorium, at which a crowd of about 15,000 listened to a demonstration of the loud speaker, with "roll calls" of the repeater stations along the line between San Francisco and Havana, Cuba. Musical programs were presented at each end of the line. Newton D. Baker, former Secretary of War, and Mayor Fred H. Kohler of Cleveland addressed the audience.

An informal get-together dance, an outing at the Cleveland Yacht Club, at which the Pioneers were the luncheon guests of the Western Electric Company, and a delightful entertainment by employees of the Ohio Bell Telephone Company were other attractions. The banquet, an annual event at which the American Telephone and Telegraph Company acts as host to the Pioneers and their guests, was held at the Masonic Temple. General Carty presided and addresses were made by President H. B. Thayer of the A. T. & T. Co. and L. H. Kinnard, President-elect of the Pioneers organization.

DR. BELL'S APPRECIATION OF THE TELEPHONE SERVICE

AT the meeting of the Telephone Pioneers, the President, John J. Carty, read this letter from Mrs. Alexander Graham Bell, which shows that there is no foundation for the published rumor of Dr. Bell's dislike for the telephone.

"BEINN BHREAGH, NEAR BADDECK, N. S.

"*Dear Mr. Carty:*

"I am beginning to get distressed over the many statements the papers have been publishing of Mr. Bell's dislike of the telephone.

"Of course, he never had one in his study. That was where he went when he wanted to be alone with his

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thoughts and his work. The telephone, of course, means intrusion by the outside world.

"And the little difficulties and delays often attending the establishment of conversation in even well managed telephone circuits did irritate him, so that as a rule he preferred having others send and receive messages. But all really important business over the telephone he transacted himself.

"There are few private houses more completely equipped with telephones than ours at 1331 Connecticut Avenue, and there was nothing that Mr. Bell was more particular about than our telephone service here. For nearly all of the thirty-five odd years we have been here he saw personally to its proper working. We never could have come here in the first place or continued here, but for the telephone which kept us in close touch with doctors and neighbors and the regular telegraph office.

"He saw to it that we should be able to reach that at any time, day or night. It was owing to this telephone system that we were able to come and stay up here last summer. Our physician lives sixty miles away in Sydney.

"I, myself, called him up at half-past five A.M. that last day; he answered immediately, and all through that day the telephone served Mr. Bell faithfully and well, bringing to him first one then another whom he called for. Afterwards the telegrams from all over came pouring in day and night—telephoned over without delay or mistake.

"It even accomplished what seemed almost impossible—the reaching of Mr. Charles Bell at Megantic Camp, Maine.

"There were relays, of course, but it was done by telephone—not from one big city to another—but from one isolated country station to another—from Canada to the United States.

"Mr. Bell did like to say in fun, 'Why did I ever invent the Telephone,' but no one had a higher appreciation of its indispensableness or used it more freely when need was—either personally or by deputy—and he was

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really tremendously proud of it and all it was accomplishing. He appreciated the honor of being first to talk from New York to San Francisco, was awed by the wonder of its performance at that dinner at the New Willard, followed with interest its usefulness during the war, and the development shown at Arlington last autumn.

"Mr. Bell's one regret about the telephone was that his wife could not use it or follow his early work in sound.

"I honestly believe this had much to do with his not going on with the photophone experiments and engaging instead in aerial work the progress of which I could see as well as he.

"I shall always be so thankful that the telephone worked so well that last day—serving its father so loyally.

"Yours very sincerely,

"MABEL G. BELL.

"August 24, 1922."

PREFERRED STOCK ISSUE OF THE NEW YORK TELEPHONE COMPANY

THE New York Telephone Company recently offered \$25,000,000 worth of its preferred stock to its subscribers. The subscription was open only one day. The amount offered was \$82,500,000 and the applicants numbered 107,754.

Like similar issues offered during the past year by other Associated Companies of the Bell System, this issue was a preferred, cumulative stock, offered at par. Applicants were given the option of paying for their allotment in full or in monthly payments of \$5 or multiples thereof, with interest at six per cent on installments as paid. The dividend rate on the issue is six and one half per cent.

A majority of the applicants elected the partial payment option and applications for small allotments predominated. Under the single payment option, there were 41,648 applications for a total of 470,268 shares.

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The applications under the partial payment plan totaled 66,106 for 326,447 shares.

Applications for ten shares or less constituted over 70 per cent of those received, while over 60 per cent were for five shares or less. There were 22,124 applications for one share, 17,737 for two shares, 5,483 for three shares, 2,290 for four shares and 15,514 for five shares. The applications for from six to ten shares totaled 12,630, representing \$12,091,500 and the applications from eleven to nineteen shares numbered 1,379 and represented \$1,996,700. Applications for the maximum number of twenty shares numbered 24,609 and represented a par value of \$49,218,000.

The allotment basis was:

1 to 2 shares inclusive.....	1 share
3 to 8 shares inclusive.....	2 shares
9 to 15 shares inclusive.....	3 shares
16 to 19 shares inclusive.....	4 shares
19 to 20 shares, inclusive.....	5 shares

Realizing that subscribers might be disappointed because of the cutting down of allotments and might wish to obtain stock for investment purposes, it was arranged to offer to them a number of shares of the stock of the American Telephone and Telegraph Company sufficient to enable each one to bring the total number of his shares up to the number he originally applied for. This stock was offered at the prevailing market price, to be paid for outright or in installments, as provided in the case of the original offer. Approximately 60,000 shares of the A. T. & T. Co. stock were applied for under this offer by over 9,500 persons.

NEW ISSUE OF AMERICAN TELEPHONE AND TELEGRAPH COMPANY STOCK

IN order to provide plant to meet existing and expected demands for service, the Directors of the American Telephone and Telegraph Company on August

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24 offered to holders of record as of September 8, 1922, an issue of new common stock, on the basis of one share of new for each five shares outstanding. Upon this basis the amount to be offered will be approximately \$115,000,000.

The purpose of the issue and the circumstances which prompted the decision of the Directors to offer it were explained in a statement of President H. B. Thayer which accompanied its announcement. He pointed out that the demand for telephone service shows no abatement, that the growth of the business provided an opportunity for the investment of additional funds, and that any further issue of stock was improbable for a considerable period to come.

Mr. Thayer said:

"During the past two years of adverse business conditions the demand for telephone service has shown no abatement. During that period there have been a million telephones added to the Bell System and there are now on file unfilled applications for about 200,000 telephones.

"This continuing expansion of the telephone business requires additional plants and, in view of the prospects of better general business, even greater than normal growth is expected.

"By a substantial issue of stock at this time the growth of the business for a considerable period to come will be provided for without further stock offering to stockholders.

"The company is in funds to meet the balance now outstanding of its \$50,000,000 note issue, due October 1, 1922, and the funds from the stock issue will provide for extension of the National telephone system."

In business and financial circles unusual interest was evinced in the company's announcement as indicative of the national business trend and it inspired much comment on the remarkable development of the telephone business and the soundness of telephone securities by reason of this development.

The privilege of subscribing for the new issue is evidenced by warrants for full shares or fractional shares, which have been mailed to stockholders of record as of September 8. Certificates of the new stock will be issued only upon warrants calling for full shares, but combina-

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tions of rights for fractional shares may be made by their purchase and sale. The rights evidenced by the warrants may be transferred by assignment.

Payment for the shares subscribed for is to be made in three installments of \$20, \$40, and \$40, on November 1, 1922, March 1, 1923 and July 2, 1923, interest at the rate of six per cent per annum on the respective payments from their due dates being allowed. The full amount may be paid on November 1, 1922 or March 1, 1923, with adjustments as to dividends and interest.

The subscription privilege closes on November 1, 1922.

EXPERIMENTAL BROADCASTING STATION NEW YORK CITY

IT was announced in the July number of the QUARTERLY that a license would probably be issued shortly for the new broadcasting station at 24 Walker Street, New York City. This license became effective July 25th and as expected permitted the station to operate during certain daylight hours and on Thursday evenings. This restricted time schedule was made necessary by the fact that the United States Department of Commerce was not ready at that time to issue a broadcasting license for other than 360 meters.

On October 2nd the original license was superseded by one granting permission to broadcast on 400 meters. As a result, a new time schedule has gone into effect assigning the afternoon hour from 4:30 to 5:30 every week-day and the evenings from 8 to 10 on Monday, Wednesday, Thursday and Saturday.

Beginning July 25th when the first license was issued, steps were taken to interest prospective users of these broadcasting facilities. The results obtained up to October 2nd were very encouraging but it was apparent that a license to operate only one night a week constituted a very real handicap to the building up of business. The new time schedule with permission to use

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a wave length of 400 meters has materially improved this situation. With a desirable hour every afternoon and four evenings a week every effort will be made to popularize this new radio service, and it is expected that in the near future evidence will be at hand indicating how extensively it will be used by the public.

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