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# Things worth knowing *about the* **TELEPHONE**

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# THINGS WORTH KNOWING ABOUT THE TELEPHONE

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STATISTICS REVISED TO JANUARY 1, 1931

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*Information Department*  
AMERICAN TELEPHONE AND TELEGRAPH COMPANY  
195 BROADWAY, NEW YORK  
1931

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## THE SPEAKING TELEPHONE.

REMARKABLE RESULTS—A BROOKLYN SONG  
HEARD IN NEW YORK—A CORNET SOLO HEARD  
THREE MILES AWAY.

If Franklin, who caught the lightning with his kite, or Morse, who tamed and put it into leading strings, had been present last evening in one of the quiet parlors of the St. Denis Hotel and heard it talk and play and sing "Hold the Fort," they would doubtless have been as much surprised as they themselves surprised the people of their own day and generation. The occasion was not a public one, yet the interest which attached to it was sufficient to attract a considerable number of gentlemen well known in the scientific world. Among these were President Barnard, of Columbia College; Professors Newberry and Rood; Professor Peet, of the Deaf and Dumb Asylum; Hon. T. N. Gibbes, M. P., of Canada, President of the Dominion Telegraph Company; General Eckert, President of the Atlantic and Pacific Telegraph Company; General Gaylord, Eastman Johnson, Rev. Dr. Armitage and others. It was in obedience to an invitation from these gentlemen that Professor A. Graham Bell, of Boston, delivered a lecture on sound and electricity and gave a striking exhibition of his speaking telephone. To the eye the apparatus used was simplicity itself and might have been taken by a casual observer for the cover of an ordinary sewing machine, except that at one end there was a mouth piece like that which is attached to speaking tubes. A couple of wires ran from the other through the room across the Brooklyn Bridge and into one of the offices of the Atlantic and Pacific Telegraph Company in that city. In a conversational, but clear and succinct manner Professor Bell told the story of his discovery, and described, as well as he could do so verbally, the operation of his machine. Modestly disclaiming anything like perfection and confessing that the telephone was yet in its infancy, and that he was met at every step by strange results and problems, which seemed to leave him deeper in the dark, he nevertheless gave to his audience various illustrations of the wonderful power which he has achieved that must have satisfied the most sceptical person present that we are upon the eve of strange developments in the philosophy of life. For instance, it was startling to hear the lecturer stop in the middle of a sentence and exclaim, "Ah, my friend is talking to me in Brooklyn!" There is a dead silence in the room, and the low monotone of a man's voice is audible.

*From the New York Herald, May 12, 1877*



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## Things Worth Knowing About the Telephone

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### *The Invention of the Telephone*

The telephone was invented in Boston, Mass., by Alexander Graham Bell, a young professor of vocal physiology and student of electrical science, who was born in Scotland on March 3, 1847, moved to Canada in August, 1870, and came to Boston in 1871, as a teacher of deaf mutes.

The day on which Professor Bell discovered the principle of the telephone was June 2, 1875. His continued experiments, based on his discovery, resulted in an instrument that on March 10, 1876, really "talked" to the extent of transmitting a complete sentence—the first connected human speech to be electrically transmitted and heard over a wire. From this crude beginning came the agency of communication that "has made America a neighborhood," and has reached out across the seas to bring distant continents within speaking distance of one another.

### *Bell's Theory of the Telephone*

Others before Bell had had glimpses of the possibilities of the

transmission of speech by wire. In 1854, Charles Bourseul had outlined a method by which he believed that speech could be so transmitted. Phillip Reis, a German, in 1861, working along the lines of Bourseul, produced a mechanism that would transmit pitch but could not transmit speech.

Professor Bell succeeded in producing a speaking telephone because he had thought out the right principle. While experimenting on his harmonic telegraph in 1875, which led to the invention of the speaking telephone, Professor Bell outlined an idea to his associate, Thomas A.



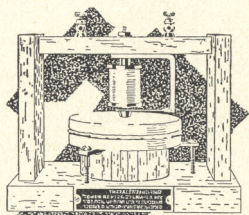
*Alexander Graham Bell in 1876  
When he was Granted His  
Original Telephone Patents*

Watson, as follows:

"If I could make a current of electricity vary in intensity precisely as the air varies in density during the production of sound, I should be able to transmit speech telegraphically."

By using the continuous current and by intensifying and diminishing it just as he had foretold, he was able to transmit speech.

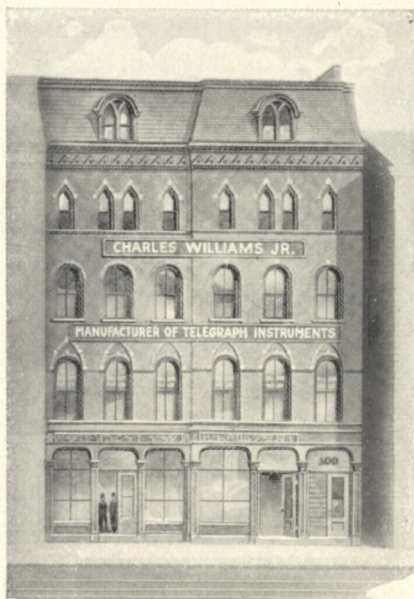




*The Original  
Bell Telephone, 1875*

### *Original Bell Patent*

On March 7, 1876, Professor Bell was granted his original patent for the invention that was destined to be developed into the carrier of millions of messages daily.



*109 Court  
St., Boston, Where  
the Telephone was  
Born*

### *The Telephone Instrument*

In the summer of 1876 Bell exhibited his telephone at the Centennial Exposition in Philadelphia, where it attracted no public atten-

tion until the judges of the Exposition and some visiting scientists had participated in a demonstration and had acclaimed it as a wonderful scientific achievement.

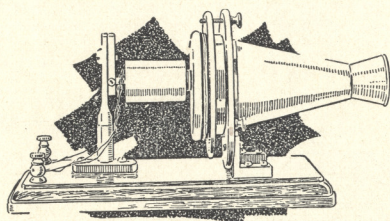
The early telephone apparatus was very crude. It consisted of an instrument to be used alternately as a transmitter and as a receiver, and a length of wire. There have been many changes in the telephone instrument since Bell first designed one that would talk. Since 1877 there have been standardized more than one hundred types of transmitter and more than seventy types of receiver. The modern telephone "set" includes the transmitter, receiver and desk stand.

### *Public Apathy*

One of the disheartening difficulties faced by Bell was an almost complete apathy on the part of the public. Even the endorsement of men of science failed to convince the "practical" men of the day that the telephone was more than an interesting toy. They saw for it no future as a factor in business and social life. They refused to use it and refused to invest their savings in it.



*The Centennial  
Transmitter, 1876*



### *Early Lectures and Demonstrations*

In order to arouse interest in his invention, Bell delivered a series of lectures on the telephone, accompanied by demonstrations. Members of the audience were permitted to talk with friends. At the first of these public demonstrations a representative of a Boston newspaper sent from Salem the first newspaper dispatch ever transmitted by telephone.

The public was slow to realize the usefulness of the device. The first commercial telephones were put out in May, 1877. On June 30, 1877, about fifteen months after Bell had been granted his original patent,

there were only 234 telephones in the whole country. They were leased in pairs or loaned to individuals by Professor Bell and his associates. All the telephoning was over single iron wire, connecting the two telephones, with grounded circuits. Calling or signalling devices were crude, and transmission was poor and uncertain. There were no switchboards.

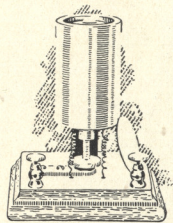
### *First Telephone Organizations*

The first form of business organization to handle the telephone commercially was a trusteeship. It was instituted in July, 1877, by the four

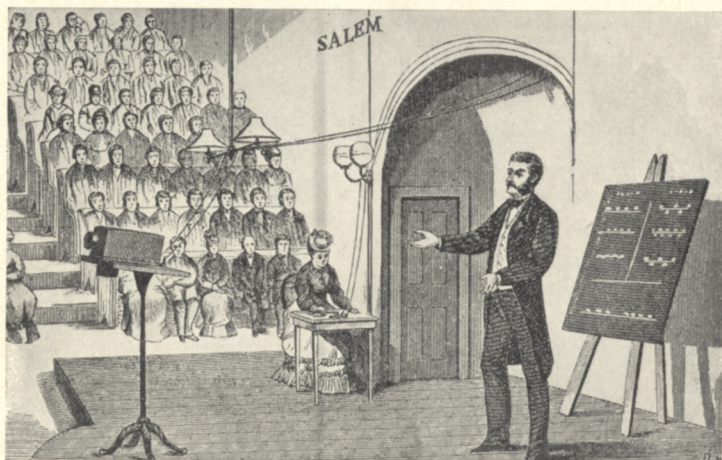


*The Garret, 109 Court St., where Bell Discovered the Principle of Electrical Speech Transmission*





*Bell's Centennial  
Telephone Receiver, 1876*



*Alexander Graham Bell Lecturing and Demonstrating His Telephone at Salem, Mass., 1877*

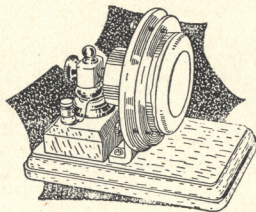
owners of the patents, Alexander Graham Bell, Thomas Sanders, Gardiner G. Hubbard and Thomas A. Watson. The trustee was Gardiner G. Hubbard. By the powers vested in him Hubbard decided upon the policy of renting telephones instead of selling them; and started a system of licenses to authorized agents or licensees in many parts of the country for the commercial development of the telephone as an industry. These license-agencies grew into exchanges and into local companies.

The increasing need of capital for the general development of the telephone resulted, in February, 1878, in the formation of the New England

Telephone Company. The money raised for this company was administered by an executive committee, and was restricted to the development of the telephone business in New England. This more regular form of business organization proved more practical than the trusteeship, and in July, 1878, a similar corporation, called the Bell Telephone Company, supplanted the trusteeship for the commercial development of the telephone in the rest of the country. As there was no adequate reason for the general development of the telephone being divided between two companies, the Bell Telephone Company and the New England Tele-



*Telephone Used in First  
Outdoor Talk, 1876*



phone Company were merged in March, 1879, into the National Bell Telephone Company.

*The American Bell Telephone  
Company*

The growing demand for telephones called for further capital. Accordingly, the business was again reorganized in April, 1880, by the formation of the American Bell Telephone Company. Soon after this reorganization, the original Bell associates, Bell, Hubbard, Sanders and Watson, withdrew from the telephone business.

The next important step toward the attainment of a national telephone service was the organization

of the American Telephone and Telegraph Company in 1885. This company was formed to build and operate long distance lines to interconnect the regional companies that had developed, by merger and growth, from early licensee companies, and that were giving local service.

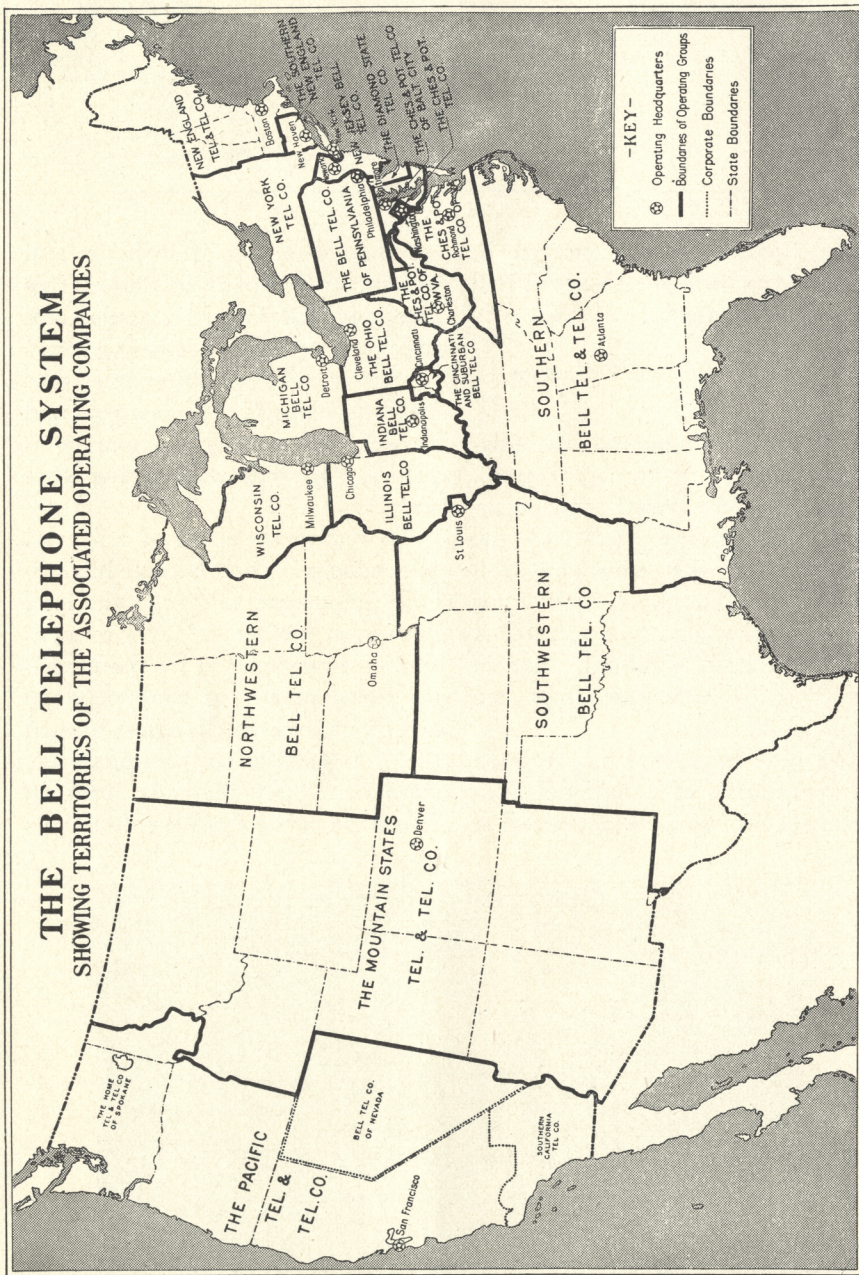
To realize the ideal of universal telephone service, it became increasingly important to extend the long lines even further, to carry on continuous investigation for the practical development of the telephone art, to make further progress toward the standardization of apparatus, equipment and methods, and to centralize administrative functions



*Scientists and Reporters at Boston Listening in on Bell's Program from Salem*



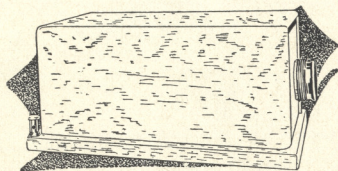
**THE BELL TELEPHONE SYSTEM**  
SHOWING TERRITORIES OF THE ASSOCIATED OPERATING COMPANIES



*The American Telephone and Telegraph Company, the Parent Company Operating the Long Distance Lines, and its Twenty-Four Associated Companies, Together with the Connecting Companies, Comprise the Bell Telephone System*



*The Box Telephone  
Used in 1877*



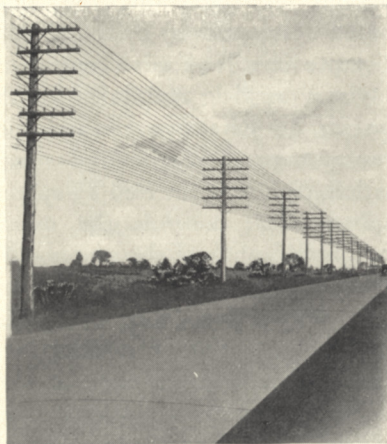
as far as possible in the interest of efficient and economical service. In 1900, therefore, the American Telephone and Telegraph Company absorbed the American Bell Telephone Company, becoming the central or headquarters company of the coordinated federation that is known as the Bell System.

#### *The Bell Telephone System*

Thus, a few years after the telephone's invention, the organization took the same form as that of the American Union of Federal and State governments, in order to function efficiently and economically as an agency of national service. The American constitution provides a central form of government, equipped to perform national functions adequately, leaving to local governing bodies the responsibility of local affairs, and the Bell System is similar in structure and purpose. Because of this form of organization, the System has been able to expand with the growth of the country, and telephone service is unified and nation-wide.

#### *Associated and Connecting Companies*

There are twenty-five Associated Bell Companies, including the Amer-



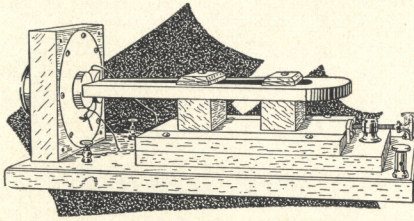
*Section of Open-wire Toll Line*

ican Telephone and Telegraph Company, composing the Bell Telephone System. In addition, there are about 7,000 independently owned companies, together with nearly 30,000 rural lines and systems, which are connected with the Bell System lines for the interchange of toll calls, thus making possible an intercommunicating telephone system for over 70,000 cities, towns and rural communities in America.

#### *American Telephone and Telegraph Company*

The American Telephone and Telegraph Company is often called the headquarters of the Bell System.





*Interior View  
of Box Telephone*

Besides interconnecting the Associated Companies by means of long-distance lines, it affords a centralized advisory service; maintains for the system an extensive research, investigating and experimental organization, including the Bell Telephone Laboratories; controls the manufacturing branch of the system (the Western Electric Company); and furnishes the Associated Companies with engineering assistance and operative advice, as well as with assistance and advice in legal, commercial, accounting and financial matters.

#### *A Centralized "General Staff"*

Through the functioning of the American Company's centralized general staff, wasteful duplication of effort among the Associated Companies is avoided, and the problems of each Associated Company, involving as they do the efficient and economical expenditure of vast sums of money and the operation of a large and intricate plant, are solved and the results made available to all the companies.

Millions of dollars are spent each year in scientific, engineering and other forms of research looking to the improvement and development

of efficient telephone service. Inventions of a highly refined and intricate character have marked the

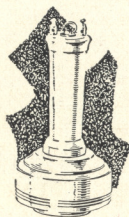


*Bell Telephone Laboratories, Inc. Building,  
New York City*

progress of the telephone industry, and have had to find their place in an art or industry made up of many interdependent operations and services. Each new scientific conception, no matter how novel and important, has had to be adapted to the present highly organized system to make it serviceable. It has been and is the work of the general staff



*Wooden Hand  
Telephone Used in 1877*



to give effective expression to all of the improvements in the telephone art suggested by invention and research, to cope with the managerial problems that arise, and thereby to increase the value and availability of the telephone service. Some of its members, therefore, are working on problems of improving and perfecting poles, wires and underground conduit systems and cables, telephone apparatus, switchboards and buildings and the development of radio telephony; others devote their time to the problems connected with the handling of telephone calls; and still other groups are engaged on problems of finance, accounting, and

law, and in the carrying forward of a great number of other necessary functions. Thus, it is possible for the Bell System to give the best, the most economical and the most comprehensive telephone service in the world.

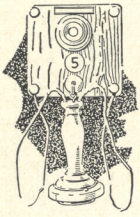
*Bell System Ownership Widely  
Diffused*

The total number of owners of Bell System securities is more than 750,000. The American Telephone and Telegraph Company alone was owned on Dec. 31, 1930, by 567,694 stockholders, including more than 100,000 employee stockholders, and there were about 330,000 employees



*A Counterless Telephone Business Office where Customers Receive Personal Attention  
at the Representative's Desk*





*Wall Telephone  
Used in 1878*

of the Bell System subscribing for this stock under the company's partial payment plan for telephone workers.

The average number of shares of the American Company's stock held per stockholder was 32. Of the total number of stockholders on December 31, 1930, more than 200,000 held 5 shares or less each; more than 430,000 held 25 shares or less each; and about 535,000 held less than 100 shares each.

#### *Fundamental Policies of the Bell System*

In a speech before the National Association of Railroad and Utilities Commissioners at Dallas, Texas, a few years ago and in successive annual reports to the stockholders, President Walter S. Gifford of the American Telephone and Telegraph Company has outlined the fundamental policies of the Bell System. These policies relate to the carrying out of the management's three-fold obligations to its investors, to the telephone using public, and to its employees, and are predicated upon the fact that there are more than 550,000 stockholders of the American Telephone and Telegraph Company; nearly 400,000 employees of the Bell System, including the

Western Electric Company, and that the Bell System owns more than three-quarters of the telephones in the United States and connects with nearly all of the remainder, affording facilities for interconnection among 99 per cent of the telephones in the country. The policies as laid down by President Gifford may be summarized as follows:

1. The fact that the responsibility for such a large part of the entire telephone service of the country rests solely upon the American Telephone and Telegraph Company and its Associated Companies imposes on the management an unusual obligation to the public to see that the service shall at all times be adequate, dependable and satisfactory to the user.

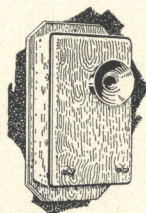
2. The fact that so large a share of the responsibility for meeting the telephone needs of today rests upon the Bell System implies that it must also be responsible for meeting the needs of the future. It has a peculiar obligation to carry on the research and experimentation necessary for the further development of the telephone art.

3. The fact that the ownership of Bell System securities is so widespread and diffused imposes an unusual obligation on the management to see that the savings of these hundreds of thousands of people are secure and remain so.

4. The policy which recognizes



*Transmitter  
Used in 1878*



these obligations to the telephone-using public of today and of the future and to its investors recognizes equally the Bell System's responsibilities to its employees. It is and has been the policy and aim of the management to pay salaries and wages in all respects adequate and just and to make sure that individual merit is discovered and recognized.

Obviously the only sound policy that will meet these obligations is to continue to furnish the best telephone service at the lowest cost consistent with financial safety.

Earnings must be sufficient to assure the best possible telephone service at all times, the further development of the art and the continued financial integrity of the business. Earnings that are less than adequate must result in telephone service, in the present and in the future, that is something less than the best possible. Earnings in excess of these requirements must either be spent for enlargement and improvement of the service furnished or the rates charged for the service must be reduced.

This is the four-fold basis of the fundamental policy and purpose of the Bell System—the most telephone service and the best, at the least cost to the public, consistent with these obligations.



*A Telephone Building that Harmonizes with  
its Surroundings in a Residential District*

### *Some Physical Assets of the Bell System*

The vast amount of equipment and the gigantic organization employed to maintain efficient telephone service to meet all the telephone requirements of a nation of over 120,000,000 people are shown by the following comparisons:

In the Bell System there are:

**POLES.** More than 16,000,000 of them, enough to build a solid trans-continental fence 30 feet high from New York to San Francisco. Sixteen million poles represent a forest over 800 square miles in extent.

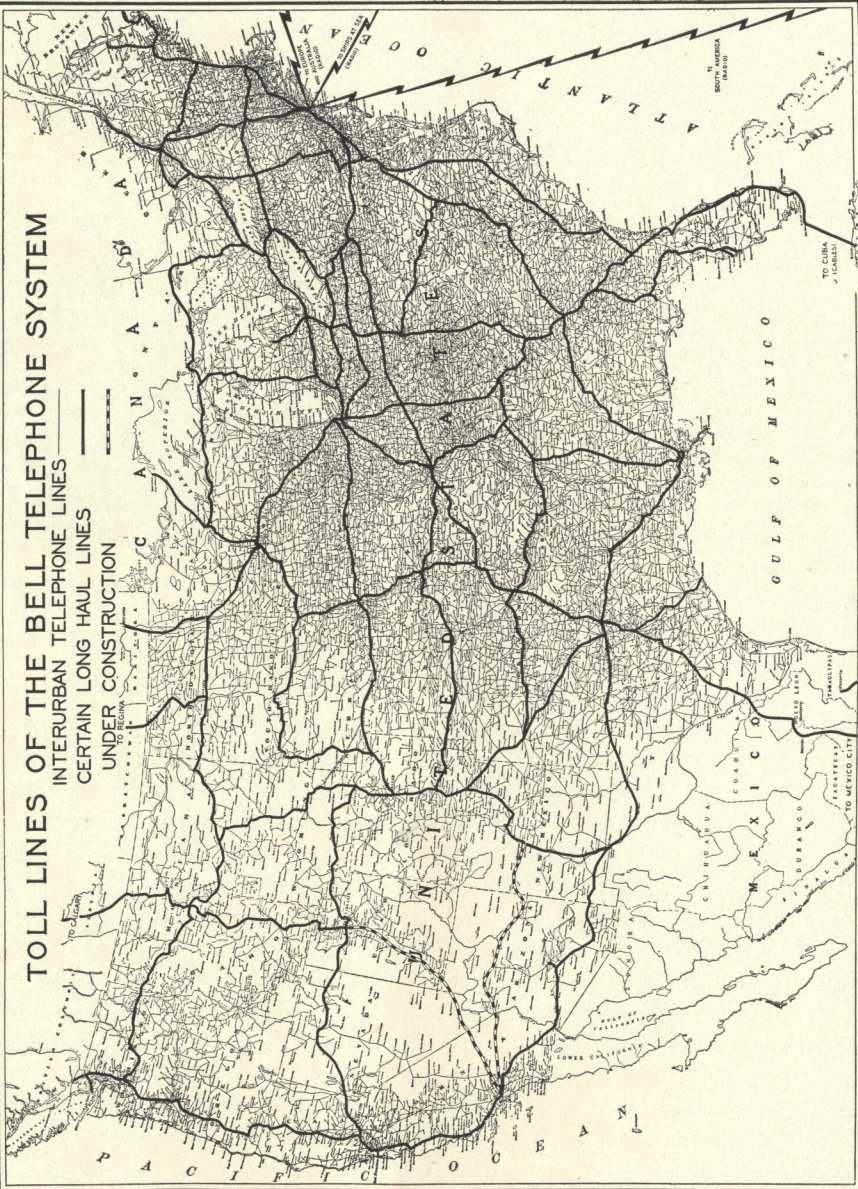
**WIRE.** More than 76,000,000 miles of exchange and toll wire. This is enough to reach from the earth to the moon and back again



## INTERURBAN TELEPHONE LINES

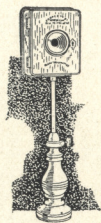
## CERTAIN LONG HAUL LINES

## UNDER CONSTRUCTION





*Desk Telephone  
Used in 1879*



more than 150 times, and is almost twice as much telephone wire as there is in all Europe.

**CABLE SHEATH.** About two billion pounds, an alloy of lead and antimony. It would fill 20,000 fifty-ton freight cars, making a train 150 miles long.

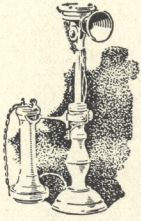
**UNDERGROUND CONDUIT.** More than 575,000,000 duct feet. This would go through the earth about fourteen times from pole to pole.

**TELEPHONES.** More than 15,600,000 Bell-owned and about 4,400,000 Bell-connected, representing in the aggregate about 57 per cent of the total telephones in the world. Practically any two of these 20,000,000 telephones may be interconnected, and, in addition, service is available between them and more than 12,000,000 other telephones in North America, South America, Europe, Africa, Australia and Java.

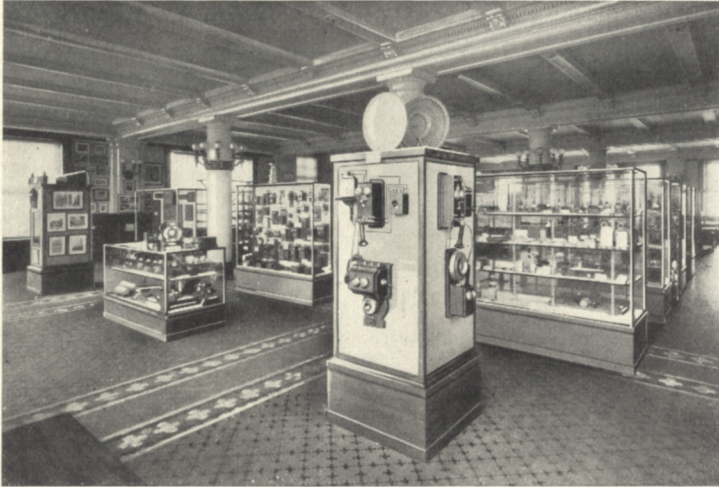


*Administration Building of the New York Telephone Company,  
New York City*





*Desk Telephone  
Used in 1886*



*A View of the Bell Historical Museum, New York City*

**BUILDINGS.** About 2,500 of them, which, if grouped together, would make a substantial business city. During the past fifteen years the Bell System has spent on net plant additions alone more than \$3,000,000,000, or enough money to build seven Panama Canals and seven Holland Vehicular Twin Tunnels. About 75 per cent of the present investment in Bell System plant has been made during the past 15 years.

**MOTOR VEHICLES.** Over 20,000 in use. If arranged in single file, they would make a column over 150 miles in length.

### *Telephone Directories*

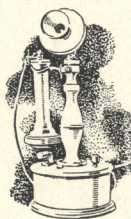
For the use of Bell Telephone subscribers, about 3,100 telephone directories are printed in a year, including two issues of all the larger books. This directory service requires an aggregate of 33,000,000 copies, which need 100,000,000 pounds of paper stock annually.

### *The Bell System Historical Museum*

Only a little over a half century bridges the gap between Alexander Graham Bell's discovery that human speech could be transmitted over a



*Desk Telephone  
Used in 1892*



wire and the successful test of a two-way transatlantic telephone conversation in March, 1926.

Physical expression of the scientific and technical achievements that have crowded this brief span is found in the apparatus and equipment that have been developed to speed the spoken word ever more clearly and ever farther.

The years have been filled with scientific discoveries of immense value to mankind and with notable practical development of these discoveries. The story of the growth of the telephone art has been written, chapter by chapter, in this constant effort to improve the transmission of speech in the Nation's service.

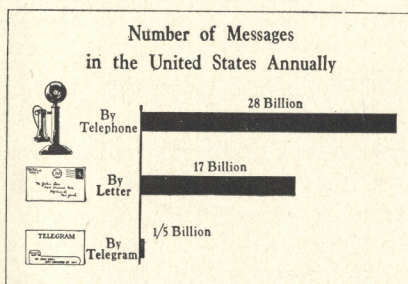
Concretely illustrating the story are the apparatus, instruments and equipment items, all triumphs of scientific imagination in their day, all for a while the latest and best of their kind, that have given way to new achievements.

Gathered together in the Museum of the Bell Telephone Laboratories, in New York City, these monuments to unceasing effort in the development of the telephone art provide both an invaluable record of the past and inspiration for the present and the future. Much more than

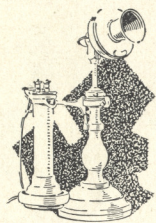
mere exhibits are the instruments of types long since obsolete, the switchboards that bore the early burdens of inter-communication, the sections of cable that mark by stages the conquest of barriers to progress in the art. All these historic things, from the piece of wire that bore the first spoken sentence between two rooms to treasured transmitters that have carried presidential utterances to multitudes, are symbols of the continuing search for what will serve the people best.

### *Public Contacts*

There are more than 20,000,000,000 exchange messages and nearly 1,000,000,000 toll messages over the Bell System wires yearly, or an average of one conversation daily for every two persons, men, women or children, in the country. The institution which ranks next in







*Desk Telephone  
Used in 1895*

point of number of contacts is the Federal Post Office, which handles about 17,000,000,000 letters and post cards annually.

### *The Public Telephone*

Public telephones form an important link in America's nation-

world is the use of the public telephone so common as in the United States.

### *Personnel*

Behind the telephone instrument is a world peopled with thousands of men and women who are engaged



*The Larger Bell System Exchange Buildings Have Well-Equipped Lunch Rooms for Employees*

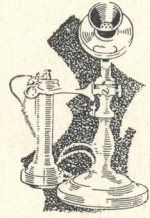
wide telephone service. Located in hotels, railway stations, stores and other public and semi-public buildings, they make telephone service available when one is away from one's office or home—make it doubly a public service. Nowhere in the

in a vitally important public service, but who are rarely seen by the public they serve.

Of the men in the telephone service the telephone user sees something—the installer, the repairman, linemen on a country road, a



*Desk Telephone  
Used, in 1896*



cable gang working in a city street.

Of the women in the telephone service he sees almost nothing. Through his telephone receiver, as through a half opened door, there come to him the trained voices of his telephone operators, each reflecting courteous efficiency, pride in a worthwhile work, devotion to duty. By these voices and by them alone, America knows the young women who, guarding a web of wires which crosses and recrosses the continent, have helped to transform a commonwealth of widely separated States into a single vast

community. And there are thousands of women who, in other capacities, help to maintain the telephone service.

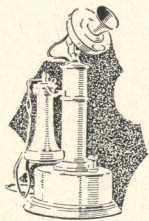
#### *Bell System Employee Statistics*

The two men who comprised the telephone industry at its beginning have been increased to a vast army of 366,661 employees, as recorded by the Bell System employee census of December 31, 1929. This total does not include employees of connecting companies, nor those of the Western Electric Company, Inc. and the Bell Telephone Laboratories, Inc.



*Attractive Rest Rooms Are Provided for the Switchboard Operators During Their Periods of Relaxation*





*Desk Telephone  
Used in 1897*



*Student Operators Receive Practical Training Before Entering Upon Their  
Switchboard Duties*

Out of the 366,661 Bell employees, at the time this latest study was made, 3,308 had been in the Bell System for 30 years or more and had witnessed the growth of the System from 666,700 telephones to more than 15,700,000 owned telephones. There still remained 190 employees of the 5,766 who were in the Bell System in 1885. Their combined term of service totals 9,061 years.

The total length of service of all employees on December 31, 1929, was over 2,000,000 years, or an average period of  $5\frac{1}{2}$  years of service for each person. Twenty-

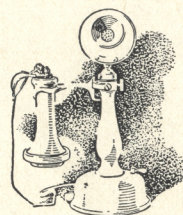
five per cent of the men have been in the System over 10 years, and more than 45 per cent have had over five years of service. These records are all the more remarkable when it is considered that they have been attained notwithstanding the rapid growth of the Bell System and the resultant influx of new employees. There are 100,000 more employees on the Bell System payrolls today than there were but nine years ago.

#### *Employee Benefits and Thrift Plans*

It is the aim of the Bell System to offer employment on a basis that will enable its employees to meet



*Desk Telephone  
Used in 1899*

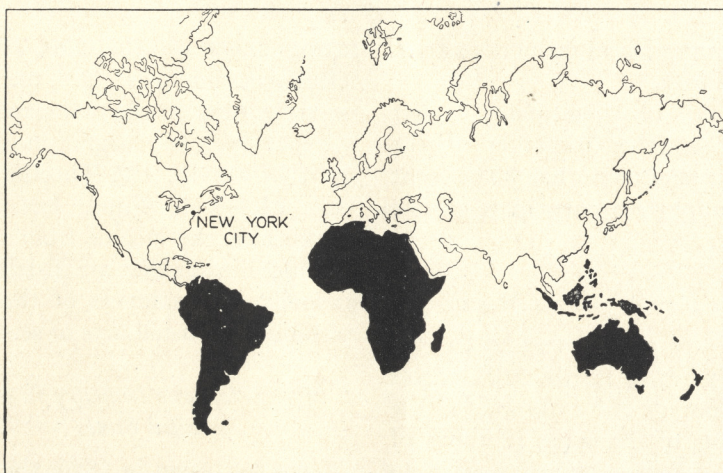


the vicissitudes of life with the maximum assurance possible. To this end all of the Associated Companies of the Bell System have adopted a uniform benefit plan which, without cost to the employee, provides payments in case of sickness, accident or death while in the service, and pension on retirement.

If it becomes necessary for employees to move from one part of the country to another, the nationwide scope of the Bell System organization makes it possible for them to find a new position, without loss of benefit, pension or other rights.

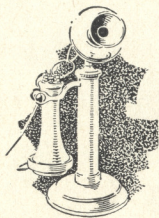
At the same time to aid employees

in providing for themselves a higher degree of economic security all of the companies of the System have thrift plans to encourage employees to save. An employees' stock purchase plan enables employees to provide for the future by investing in the stock of the parent company of the system on an advantageous partial-payment basis. In addition, there is a payroll deduction plan for life insurance under which practically all the standard life insurance policies are obtainable by Bell employees, who authorize the employing company to pay the premiums to the life insurance company

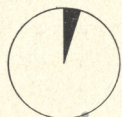


*More Telephones in One City in United States than in Three Continents*





*Desk Telephone  
Used in 1900*



The United States with only  
5% of the world's Area



and 6% of the  
world's Population



has 57% of the world's  
Telephones



by small periodical deductions from their salaries.

The use of these plans is left entirely to the discretion of the employee and more than 80 per cent of all employees participate in one or more.

#### *The Vail Memorial Medals*

Stories of the heroism of switch-board operators in times of danger; of the courage and endurance of the guardians of the wires in times of stress; of extraordinary service to the public through intelligent, pains-

taking effort on the part of the telephone employees, are parts of the daily news in the newspapers of the country. In recognition of this spirit of service the Theodore N. Vail Memorial Fund has been established, the income from which provides medals that are distributed annually to employees of the Bell System for unusual acts of service.

#### *The Telephone Industry in the United States*

Since its origin in 1876, the telephone industry has evolved from the



*Desk Telephone  
Now in Use*



modest beginning made possible by the genius of Professor Alexander Graham Bell to the point where it provides universal service and is a vital factor in the economic and social existence of the world.

In the United States the telephone has not only grown with the nation but has helped the nation to grow and has contributed a real addition to the wealth and resources of the country. There are now upwards of 20,000,000 telephones serving the people in this country, which is more than sixteen telephones to every one hundred of the population. About 57 per cent of all the telephones in the world are in the United States.

A great deal has been accomplished, particularly in recent years, in increasing the speed and ac-

curacy of the service. More than 82 per cent of the long distance calls are now handled while the calling party remains at the telephone.

The demand for telephone service in the United States is attested not only by the extent of the development but by the use of the service. During the year 1929 there were, on an average, 225 telephone conversations to each inhabitant, including both those transmitted over Bell System wire and those handled by other telephone companies. This is considerably more than the number in any European country.

Another indication of the magnitude of the telephone industry in the United States is the number of its employees. Including both the operation of the telephone systems and the manufacture of telephone equipment and apparatus, this industry as a whole—Bell and non-Bell combined—employs about 475,000 persons.

Furthermore, this industry has an investment in operating telephone plant and equipment of more than four and a half billion dollars. It is owned not by a few persons, but by hundreds of thousands of holders of its securities. Ex-

#### U.S. Far Ahead in Telephone Facilities



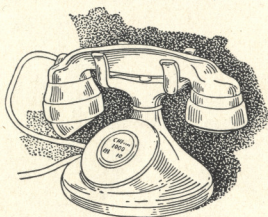
UNITED STATES  
100 People  
16 Telephones



THE REST OF THE WORLD  
100 People  
1 Telephone







*Modern  
Hand-set  
Telephone*

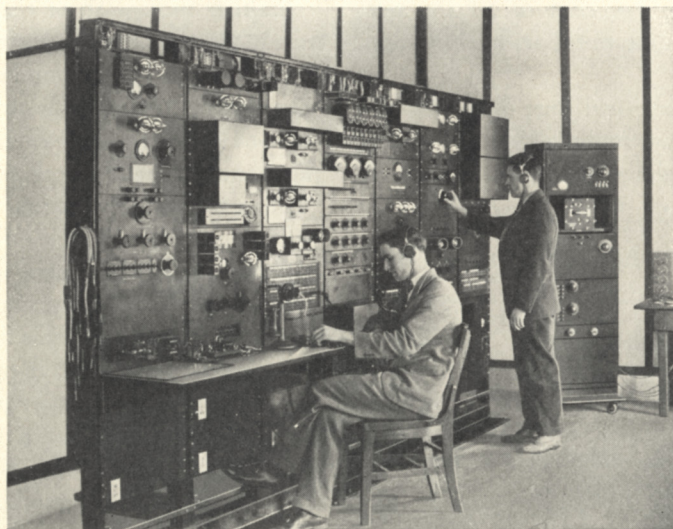
cluding duplications, there are more than 750,000 holders of Bell System securities alone. In other words, about one person in every 160 in the United States is a Bell System security holder.

The comprehensive development of the telephone industry in this country has been made possible by the cumulative effect of inventions and improvements, great and small, in all the apparatus and equipment required for the transmission of speech; by the creative genius, foresight and business acumen of those

who have directed the policy of the Bell System from the beginning; and finally by the fact that telephone development in this country has been left to private enterprise under reasonable governmental regulation.

### *The World's Telephones*

The latest statistics available showing the distribution of telephones throughout the world relate to January 1, 1929. On that date, the United States, which had only about 5% of the earth's land area and 6% of its population, had 19,-



*Transatlantic Radio Telephone Receiving Apparatus at Houlton, Maine*



*Operator's Set  
in 1880, Weight 6 lbs.*



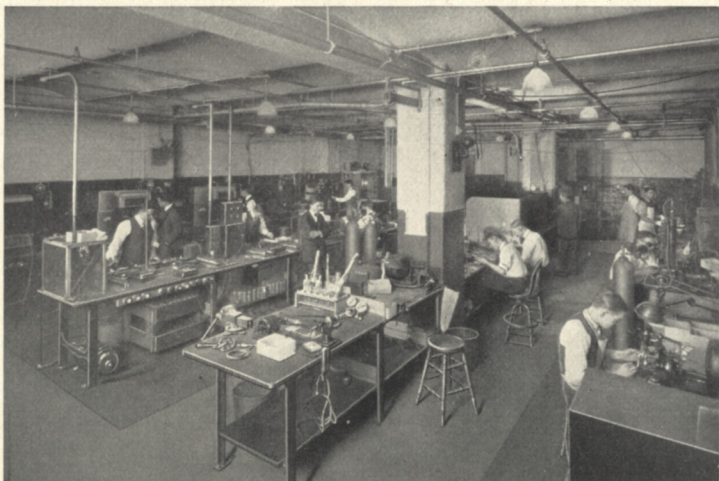
341,000 telephones, or about 59% of the 32,712,000 telephones then in use throughout the world.

On the basis of telephones per 100 population, the United States, with 16.3, had almost ten times the telephone development of Europe as a whole, and more than seven times the development of France, more than four times that of Great Britain, and three and one-half times that of Germany.

With the exception of Germany and Great Britain the number of telephones in the whole of each foreign country in the world on January 1, 1929, was exceeded by the

number in at least one American city. Thus New York, with 1,702,889 telephones on that date, actually had more telephones than all of Canada, with 1,334,534. The city of Chicago had more telephones than Japan. Los Angeles had more than Italy, while San Francisco had more than Switzerland.

Equally striking, as showing the superiority of the telephone development in the United States, are figures on the development of the less populated sections as compared with the urban centres. In the United States, places having less than 50,000 people were served on

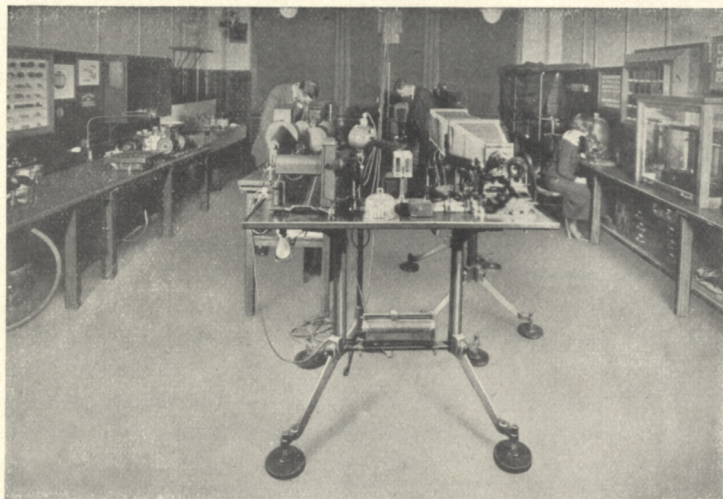


*One of the Vacuum Tube Research Laboratories of the Bell Telephone Laboratories*





*Operator's Set  
Today, Weight 17 oz.*



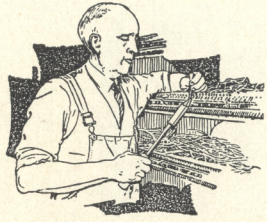
*The Photo Micrographic Laboratory*

January 1, 1929, by 12.6 telephones per 100 population, as against 21.8 telephones per 100 population for communities of 50,000 population and over. In no other country was the telephone development of the smaller places as high as that of the United States. In fact, in all countries other than Canada, Denmark and New Zealand, the development of the less populated regions was relatively so low that it is no exaggeration to say that the telephone service of these countries is confined almost entirely to their important cities. For example, London on January 1, 1929, had more

than one-third of the total telephones in Great Britain, and Paris had over one-third of the total number in France. Even Germany, with its otherwise progressive rural communities, had more than 25% of all its telephones concentrated in the four cities of Berlin, Cologne, Hamburg and Munich.

Direct comparisons of the telephone development of the large United States cities with that of large cities in foreign countries, show that this country leads in telephone development in the larger as well as in the smaller communities. In proportion to population, on Janu-



*Soldering the  
Switchboard Connections*

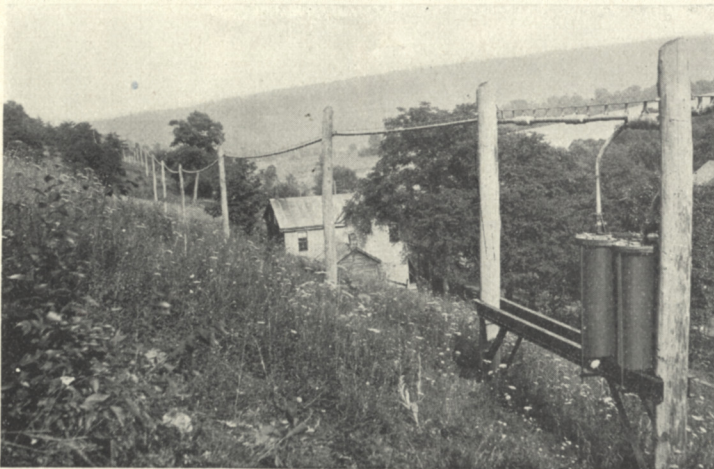
ary 1, 1929, New York had more than three times as many telephones as London; Chicago, on the same basis, had two and one-half times as many as Berlin.

These figures indicate how large a place the telephone fills in the American mode of life. They reflect, too, the activity of the telephone companies in calling attention to the possibilities for maximum comfort and convenience afforded by adequate telephone facilities.

*Development and Research*

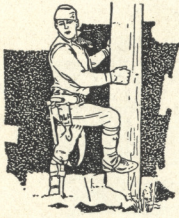
The importance of scientific research in the development of the

telephone early became apparent. The Bell System pioneers who laid the foundation upon which America's telephone system was to be erected found that they had to create a new art. Nothing then existing provided a precedent for what they were to undertake. Isolated theories and unrelated facts were all that other sciences could contribute, and these had to be wrested by the new science from its older sisters by patient research and experimentation. Hard-earned advances blaze the trail of telephone progress, each problem successfully solved being a monument to untiring effort.



*Intercity Aerial Cable Line Showing Pots Containing Loading Coils*





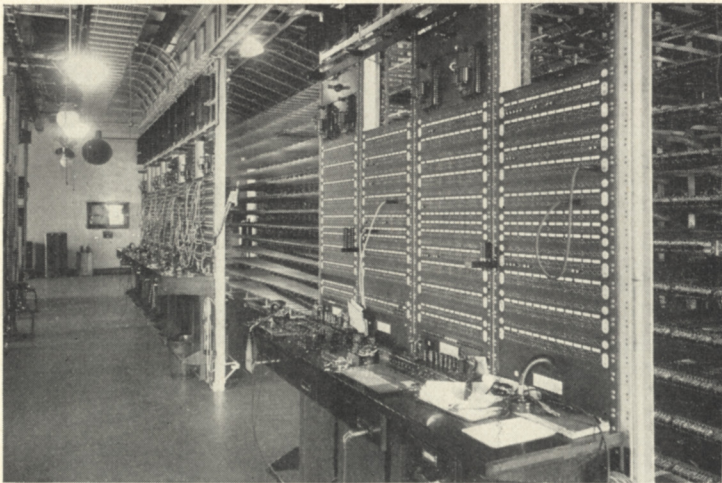
*The Telephone  
Lineman*

The progress still continues—must continue, for the telephone serves the needs of a growing nation and itself must grow in order to meet the ever-increasing demands upon it. Research in the telephone art never ends. Telephone development is never completed. Each year brings new problems; each problem solved brings progress.

These problems the American Telephone and Telegraph Company is continually engaged in solving for the benefit of the twenty-four operating telephone companies associated with it to form the Bell System.

### *Bell Telephone Laboratories*

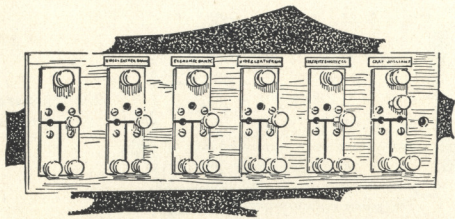
The staff of the Bell Telephone Laboratories comprises about 5,300 people of whom approximately half are scientists, investigators and technical specialists, who continually carry on research and experimentation in the fields of the two fundamental problems of electrical communication—the electrical transmission of intelligence and the development of the channels for such transmission. Numerous collateral studies, relating to the general science and art underlying electrical communication and allied subjects, are also carried on. This research



*Interior of a Repeater Station Showing Test Board and Repeaters*



*First Switchboard,  
Boston, 1877*



work has been of inestimable value in extending the scope of electrical communication service and in improving it in economy, efficiency and dependability.

### *Progress of the Telephone Art*

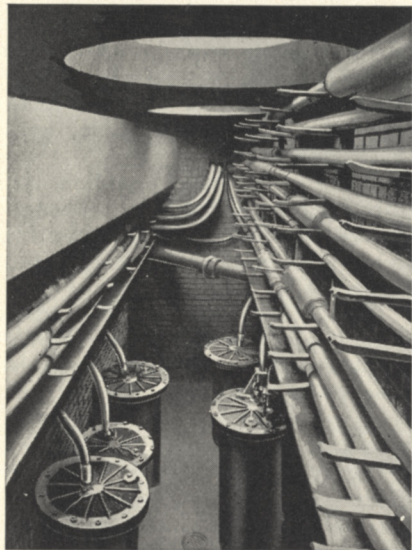
In the fifty-six years of telephone history the telephone engineers have overcome one by one the barriers of speech transmission. From the very beginning the progress of the art has been marked by epoch-making advances due to inventions and improvements in apparatus and equipment. Some of the more notable achievements in the development of the art have been as follows:

The development of the switchboard without which no interconnecting group of telephones would be possible, which was the beginning of the telephone exchange system.

The discovery of the process of hardening copper wire and its application to telephone circuits, improving transmission and making long distance telephone circuits possible.

The substitution of a pair of wires for a single wire with ground return, thus very much reducing the disturbances caused by adjacent power circuits or other telephone circuits and greatly improving transmission.

The multiple switchboard, making possible the expansion of the exchange system by providing posi-

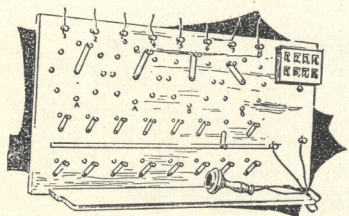


*Interior Manhole Showing Cables, Racks and  
Pots Containing Loading Coils*

tions at the switchboard for a large number of operators, each answering the calls on a certain number of subscribers' lines, and because of the duplication of all the subscribers' line terminals at each section of the switchboard, each operator able to connect the calling subscriber with any other subscriber in the same central office, be they one thousand or ten thousand.

Successive improvements in the design of the telephone instrument, not only increasing its efficiency as a means of communication, but giving it a more attractive appearance. The early "box" telephones were superseded by various types of wall





*Switchboard  
At New Haven, 1878*

and desk sets, some of which are shown in the illustrations at the tops of the pages in this booklet. Now the convenient and graceful hand telephone is made available, with or without the dial.

The transposition of telephone circuits, thereby minimizing the interference with other telephone circuits and of high power electric light and feed wires.

The development of the underground cable, enabling the removal of pole lines from the main thoroughfares of the large cities, and the aerial cable, reducing the number of cross-arms and the size of the poles.

The phantom circuit, which is made possible by utilizing two physical telephone circuits to create a third independent circuit.

Carrier-current telephony, in which the telephone current is combined with a high-frequency current,

transmitting this combination over a line wire and at the receiving end removing the high-frequency current and leaving the telephone current, making it possible to transmit simultaneously several telephone currents over a telephone circuit.

The application of the repeater or current amplifier to long distance circuits, further increasing the range of long distance telephony; also, its application to overhead and underground cables, making it possible to extend greatly the use of cables in place of open-wire construction and also allowing the use of smaller gage wire. General improvement in speech transmission was also accomplished.

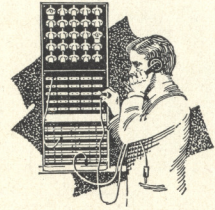
The range of possible use of cable has been gradually increased until by 1920 conversation was possible through 2,000 miles of cable. Methods have since been developed which



*Transcontinental Telephone Line Crossing Humboldt Flats, Nev.*



*Universal Board  
Used in 1879*



will make conversation through 3,000 miles of cable practically as good as a conversation from one room to another in the same building.

Improvements in the design and in the methods of manufacture of cables for local exchange use have made it possible to increase greatly the number of wires which may be within a cable sheath of given size. By employing wires of smaller diameter than those heretofore used, the maximum number has been still further increased, until now as many as 1,818 pairs of wire are carried in a single cable.

Improvements in dial telephone apparatus and systems, enabling dial telephones to be used more advantageously in large Metropolitan areas as well as in smaller cities and communities.

The discovery of the new magnetic alloys—permalloy and permivar. The former has revolutionized the submarine telegraph cable art by permitting speeds five times greater than before. It has also made possible reducing the size of loading coils and is employed in telephone apparatus.

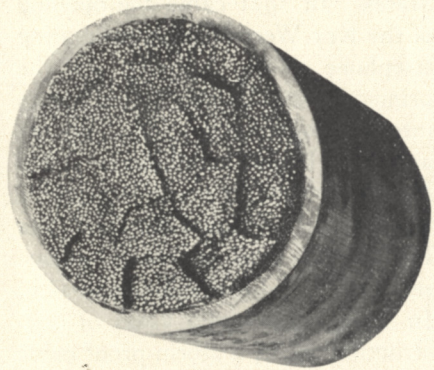
Developments in submarine cables including the use of single conductor cables, the telephone amplifiers and terminal telegraph apparatus and the devices for permitting the telephone and telegraph to operate simultaneously, all differing radically from past practice.

The perfection of apparatus to transmit directly photographs, draw-

ings, signatures and finger-prints over telephone lines.

### *Advances in Long Distance Transmission*

The cumulative effect of improvements and inventions in telephone

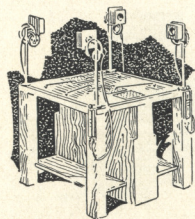


*This cable 2 $\frac{5}{8}$  inches in diameter  
contains 3,636 wires.*

apparatus and equipment is shown in the progressive advances in long distance transmission which have been made from time to time.

In 1880 the Boston-Providence line, 45 miles long, was opened; in 1884 the New York-Boston line, 235 miles; in 1892 the New York-Chicago line, 900 miles; in 1911 the New York-Denver line, 2,100 miles, and in 1915 the New York-San Francisco line, 3,400 miles. In 1920 regular commercial radio telephone service





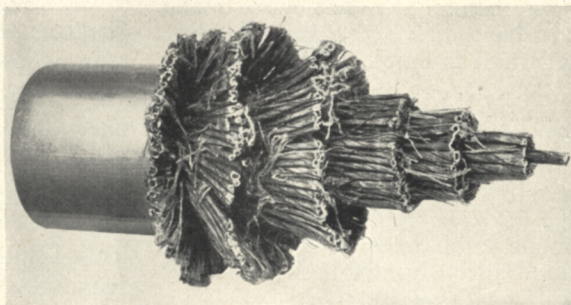
*The "Law" Board  
Used in 1880*

was established between Santa Catalina Island, about 30 miles out in the Pacific Ocean, and the mainland near Los Angeles, California, at the latter point making junction with the local and long distance wires of the Bell System throughout the United States. In 1921 came the opening of the Key West-Havana submarine telephone cable, bringing all the principal places in the United States into communication with Havana and other important places in Cuba. In 1923, submarine telephone cable was laid connecting Santa Catalina Island with the mainland, superseding the radio telephone service. In 1925, after seven years of construction work, a storm-proof cable 861 miles in length, connecting New York and Chicago, was finished and put into service. The extension of the New York-Chicago all-cable line to St. Louis, 344 miles long, was completed and formally opened for service on December 15, 1926.

To the original Transcontinental Telephone Line, opened in 1915, have been added two additional

routes for coast-to-coast service. A southern route by way of New Orleans, El Paso and Los Angeles was completed in 1923 and in January, 1927, a Northern Transcontinental Line was completed and opened to public service, which west of Chicago passes through Minneapolis, Fargo, Bismarck, on to Seattle. A fourth Transcontinental Line is now being built between the present Southern and Central Transcontinental Lines.

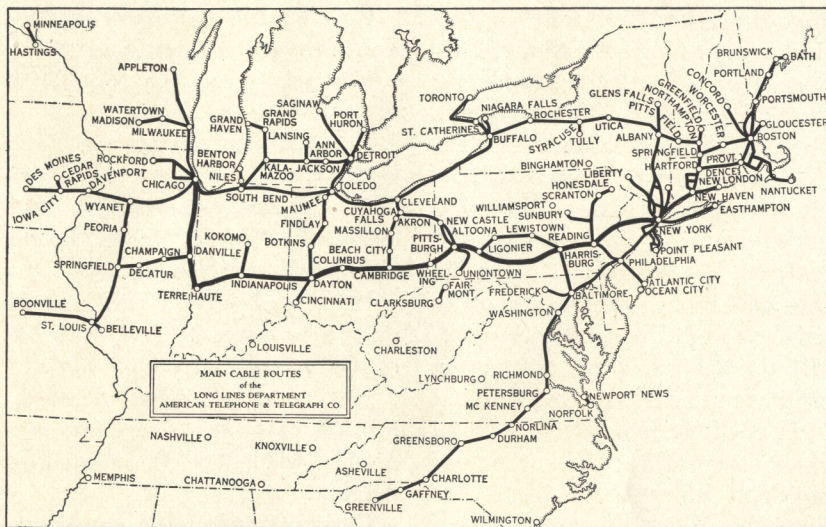
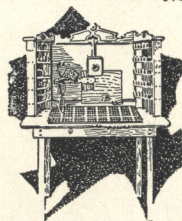
On September 29, 1927, a Long Distance telephone circuit between Washington, D. C., and Mexico City was formally opened by the Presidents of the two Republics. This circuit, together with another opened in 1930, affords communication between points in the United States and most of the principal cities of Mexico.



*Section of an Aerial Telephone Cable fanned out to show the Telephone Circuits*



*Gilliland Board  
Used in 1880*



*Network of practically storm-proof Telephone Cables in the most highly industrialized Section of the Country*

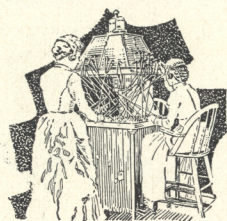
### *The Bell System's Underground System*

Of the Bell System's 76,000,000 miles of wire, more than 50,000,000 miles are enclosed in lead-covered cables in underground conduits, including about 5,500,000 miles of toll wire. More than 70 per cent of the exchange wire of the Bell System is in underground cables. These cables are laid in more than 575,000,000 duct feet of conduits; enough to go through the center of the earth, from pole to pole, fourteen times.

### *First Underground Experiments*

The Bell engineers early discovered that the problem of speaking through long underground cables or over great distances could not be solved by increasing the loudness of the transmitter or receiver. The fact that one mile of underground cable cuts down the transmission as much as about thirty miles of high-grade, open-wire toll lines threatened to check permanently the growth of the telephone system. In 1881 the Bell engineers began to apply themselves to the special





*Pyramid Board  
Used in 1882*

study of overhead and underground cables and the improvement of telephone lines. In 1882 experimental cables were laid for a short distance along a railroad track in Massachusetts.

Within a year or so after that the first underground cables for commercial use were laid in Boston and Brooklyn, but subscribers using the cable could not talk satisfactorily farther than to the suburbs.

By January 1, 1886, there were only 3,417 miles of wire underground in the Bell System out of a total wire mileage of 155,791. This underground mileage could be contained in less than one mile of modern 1,800 pair cable.

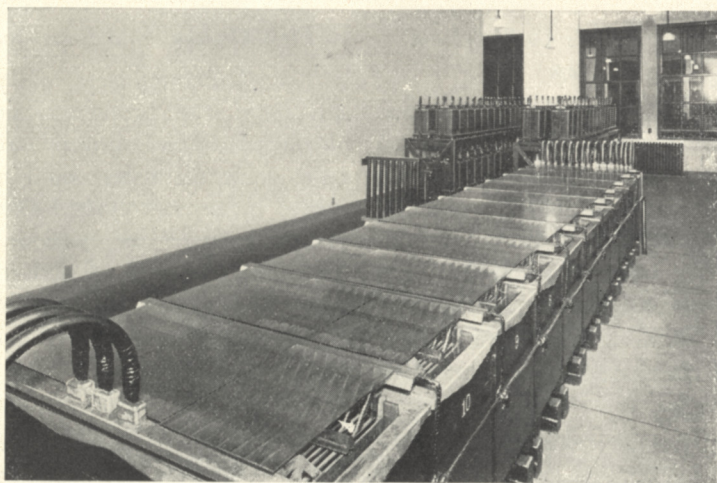
In 1887 the successful introduction of the twisted pair, underground conductor, paved the way for the extensive use of cables.

In 1902 the application of the loading coil, together with other improvements, permitted the installation of a "loaded cable" between New York and Newark, N. J.

In 1905 a loaded cable, twenty miles long, extended from New York in the direction of Philadelphia.

In 1906 an underground cable, 90 miles long, was successfully operated between New York and Philadelphia.

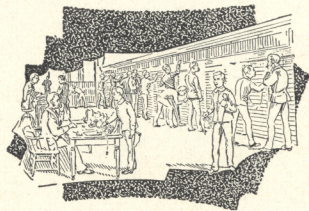
Early in 1909 a sleet storm swept the Atlantic seaboard, paralyzing



*The Battery Room in Central Office Power Plant*



*Boy Operators  
Employed in 1879*

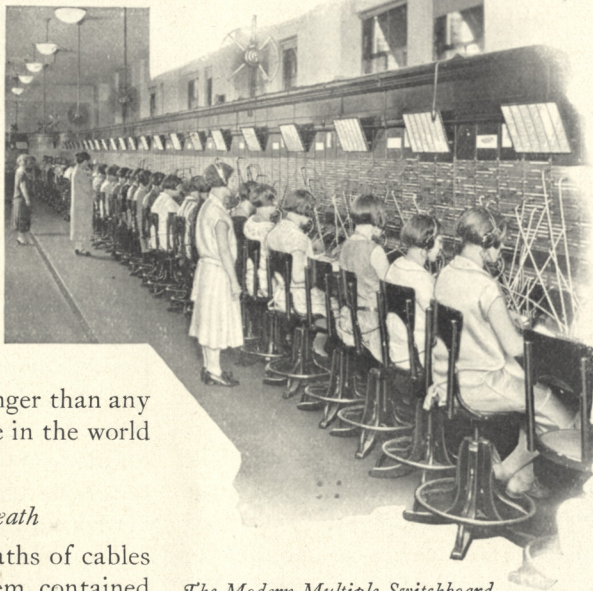


communication and isolating the capital at the time of President Taft's inauguration. The next morning the Chief Engineer of the Bell System received from Theodore N. Vail, who was then President of the American Telephone and Telegraph Company, a note beginning with these words: "Put those wires underground. I know that the present state of the art of telephony does not make such wire-burying possible. But experiment—." The Bell engineers did experiment and by 1911 they had designed an underground cable, capable of giving satisfactory conversation between Boston and Washington. By 1912 a cable connection had been laid between Washington and New York. By 1913 the cable had been extended between Washington and Boston, 455 miles, several times longer than any other underground line in the world at that time.

#### *The Cable Sheath*

Up to 1912, the sheaths of cables used in the Bell System contained

about three per cent of tin alloyed with lead. Back in 1907, development work was undertaken to discover a new alloy that should prove at least as satisfactory as the lead-tin alloy and less expensive. After laboratory experiments and field trials extending over several years and covering a wide range of alloys, a new alloy was adopted, consisting of about one per cent of antimony alloyed with lead, and this alloy is now used for both underground and aerial cables.



*The Modern Multiple Switchboard*





*Twisting Rings  
On Messenger Strand*

### *Cable Development*

Cable development illustrates concretely the value of the research work carried on by Bell System engineers. In 1888 the standard cable was capable of accommodating only 50 pairs of wires and cost between \$150 and \$160 per pair-mile to install, including the cost of ducts. Through constant experimentation, means have been found of increasing the number of the wires, so that at present a cable  $2\frac{5}{8}$  inches in diameter contains as

500 telegraph messages may be sent simultaneously.

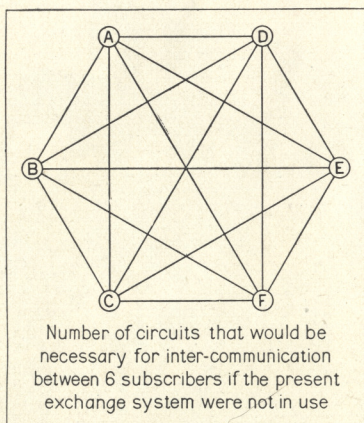
### *Forecasting the Nation's Telephone Needs*

When a new subscriber is provided with a telephone, there is given over to his use a share in the pole lines, underground cables and conduits, switchboards, exchange buildings and in every other part of the complex mechanism of the telephone plant.

Obviously this equipment could not be installed for each new connection. Practically everything but the telephone instrument must be in place at the time service is demanded.

This anticipation of the public's need involves a forecast by specialists among telephone engineers and statisticians that calls for intensive study and analytical skill in order to arrive at judgments that are of such far-reaching importance to the public. Increases in population in city and country must be calculated, the growth of business districts must be figured, if a workable estimate of the number of possible telephone users and their approximate location may be obtained.

The fields of sociology and economics, of geography and geology, of



many as 1,818 pairs of wires. The type of cable which is used on the New York-Chicago-St. Louis long distance route has a capacity of about 250 telephone circuits while



*Breaking Pavement  
With Air Drill*



commerce and industry, are explored in this search for factors to be studied that may affect the growth of the community or district under consideration.

Where the coming generation will live and work is the concern of these engineers. Homes, shops, banks, theatres, factories, office buildings, transportation systems yet to be built, are in the forecast. Indications of growth and development in every department of civic expansion are traced and studied. Communities and other service areas, as they will exist two decades or more in the future, are what this forecast seeks to imagine, and upon this picture is imposed the most economical and efficient telephone system possible that shall continue equal to the ever-growing needs of the people.

The construction, operation and financial programs of the Bell System have their foundation on these scientific investigations. The necessity of foresight is evident when it is realized that during the last five years an average of more than 600,000 telephones has been added to the Bell System each year and that during the same period the Bell System has spent more than \$450,000,000 on an average each year for additions, betterments and replace-

ments to meet the nation's ever-increasing need for service. As a measure of this demand, in proportion to population, the System's extension in 3 years is equal to the total telephone progress of Europe since the telephone was invented fifty-six years ago.

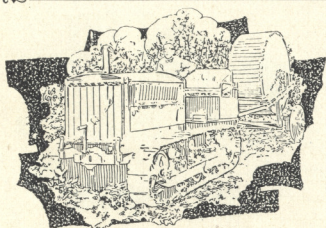
### *The Telephone Central Office*

The telephones first placed in the hands of the public were leased in pairs. The lessee put up his own telephone wire to connect his telephone with that of a friend or neighbor, or ran the line between his home and his place of business. At first, there was no way whereby



*A Local "A" Board Operator*





*Tractor Hauling  
Cable Reels*

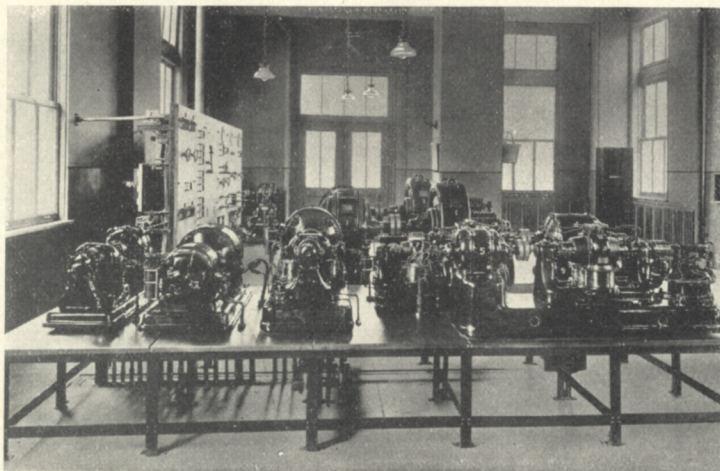
he could talk by telephone with the other individuals in the community who, like himself, had leased a pair of the early instruments.

It was the development of the telephone switchboard that made possible the interconnection of individuals and of communities, and thus broadened the telephone's usefulness to the public. What gives the telephone its great value today is the fact that it can be connected any time with any one of more than 20,000,000 other telephones in the United States alone.

The switchboard and apparatus associated with it is known as a central office. The lines, instru-

ments, switching facilities, and accessories by which the telephones of a community are given service, are called collectively a telephone exchange. In small communities an exchange may include only one central office, while in larger communities it may contain many of these offices, in which case the community is known as a multi-office exchange. Central offices are connected by telephone lines called trunk lines. The lines that connect exchanges are called toll lines.

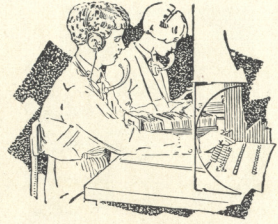
The most widely used method of making telephone connections utilizes switchboards with attendants, usually young women, who are



*Central Office Power Plant Showing Dynamos, Ringing Machines and Power Switchboards*



*Operators at  
Information Desk*



called operators. Because the work of establishing the connections and disconnections is done by hand, switchboards of this type are called manual switchboards. When all this work is done mechanically, the telephones are equipped with dials and the central offices serving such telephones are called dial system central offices.

Manual switchboards are divided into two kinds, depending upon the manner in which power is supplied for the talking circuits, and the method of signalling the operator. In one type of switchboard the power is supplied from a central plant that is located at the central office. These are called common battery switchboards and the subscriber signals the operator by removing the receiver from the hook. In magneto switchboards, on the other hand, the talking current is supplied by batteries installed on the subscriber's premises, and the subscriber signals the operator by turning a small crank on a magneto generator. Magneto switchboards are used only in relatively small communities. The form of switchboard most generally used in cities and larger communities is the common battery manual board.

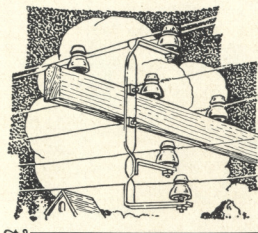


*A "B" Board Operator*

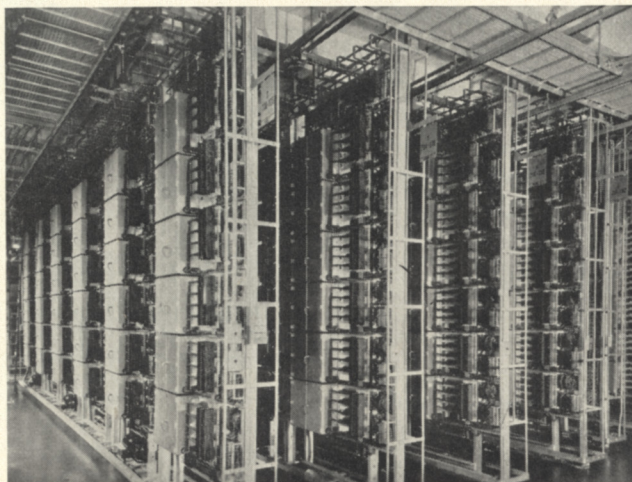
### *What the Switchboard Does*

Three segregated pairs of telephones give three talking lines. Unite three pairs of telephones by means of a central office switchboard and an intercommunicating system is formed which permits establishing 15 different communications where only three were possible before. An exchange system with 10,500 telephone lines gives 55,119,750 lines of communication. Putting it the other way around, if it were physically possible to connect 10,500 telephones, without a central office switchboard, so that communication would be possible from each telephone to every other telephone in the group, it would require 55,119,750





*Transposition Brackets  
on Long Open Lines*



*General View of Sender Frames in a Panel Dial Central Office*

talking circuits—that is, there would have to be 5,250 circuits multiplied 10,499 times.

### *Dial Telephones*

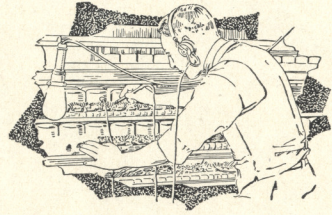
Exhaustive investigation and experiments by Bell System engineers and others over a long period of years resulted in the production of types of dial operated central offices which meet satisfactorily even the most exacting service conditions. For some years the Bell System has been systematically introducing the dial system, where economic and service conditions warrant, as a means of guaranteeing during all hours of the day and night, holidays

and Sundays, the highest standard of service at the least cost to the telephone users. During 1930 more than 800,000 telephones were changed from manual to dial operation, and at the end of the year there were 4,977,000 dial telephones in the Bell System—nearly one-third of the total owned.

With the dial system the subscriber, after taking the receiver from the hook, instead of giving the number wanted to an operator at the switchboard, “dials” it by means of the dial on the base of the telephone instrument, the dial central office apparatus performing



*Testing Cord  
Circuit Repeating  
Coils*



mechanically what the operator does at the manual board. The dial central office cannot be operated entirely automatically. It uses many operators for special purposes, and requires more trained men than a manual office. It is interesting to note that when conversion to dial began in the Bell System in 1921 there were about 128,000 operators and in 1930 with about one-third of the telephones dial there were 155,000 operators.

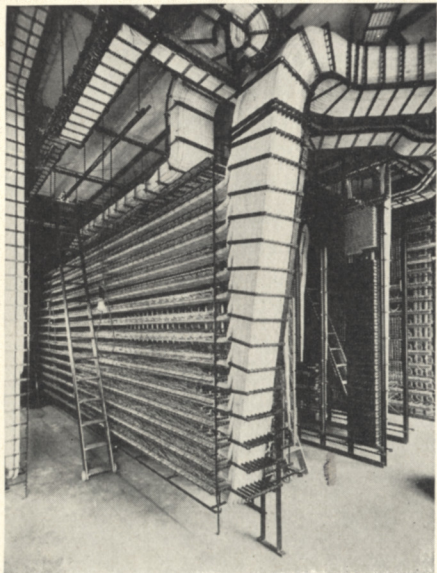
#### *Early Switchboards*

The first telephone switchboard was installed in the office of E. T. Holmes, in Boston, in May, 1877, and connected four banks and a manufacturing concern. It served as a telephone system by day and as a burglar alarm system at night.

In the fall of 1877 the first real telephone exchange was established at Bridgeport, Connecticut. This exchange was operated for mutual benefit and not for profit.

On January 28, 1878, the first switchboard for commercial telephone exchange use was installed at New Haven, Conn., with 21 subscribers and three days later a similar board was installed at Meriden, Conn. Among the other exchanges established in 1878 were San

Francisco, Calif., on February 17, 1878; Albany, N. Y., on March 18, 1878; Chicago, Ill., in March, 1878; Wilmington, Del., in April, 1878; St. Louis, Mo., May 1, 1878; Detroit, Mich., on August 15, 1878, and Philadelphia, Pa., October 10, 1878. The following year saw the establishment of an exchange in nearly all of the remaining states and territories, but Florida, West Virginia, Utah, and Dakota territory had no exchange until the middle of 1880.



*View of Central Office Terminal Room Showing  
Cable Runs, Distributing Frames, etc.*





*Splicing  
Underground Cable*

As the demand for telephone service grew, it became necessary to increase the size and capacity of the switchboards. Switchboards of various designs served their purpose for a while until discarded for later designs embodying new ideas and combining greater speed and capacity, until the efforts of the telephone engineers culminated in the manual and mechanical switchboards developed for use in all large exchanges.

The first multiple switchboard was installed in Chicago in January, 1879.

Differing in size and capacity from their big brothers of the large cities are thousands of other switchboards serving the smaller cities and towns and the rural communities. Each of these switchboards is located in a central office and is the center of an exchange group of telephone subscribers. There are more than six thousand five hundred of these central offices in the Bell System all linked together by trunk, toll and long distance lines into one great system of intercommunication covering the country.

#### *The Multiple Switchboard*

The "multiple" switchboard gets its name from the fact that each subscriber's line that terminates at the switchboard is duplicated or

"multiplied" on every section of the board. A switchboard having a capacity to serve 6,000 subscribers' lines and consisting of 20 sections has 20 times 6,000 or 120,000 points of connection. By this arrangement each switchboard operator in answer to a call from any of the subscribers whose lines are assigned to her can connect that subscriber's line with any one of the 5,999 other subscribers' lines that terminate at the switchboard.

The multiple switchboard is built in sections and is composed of a myriad parts of the finest workmanship. Switchboards of the largest type have more than two million tiny soldered parts, 15,000 electrical signal lights, and wire enough to span the continent, more than 4,000 miles of it.

#### *Terminal Room Apparatus*

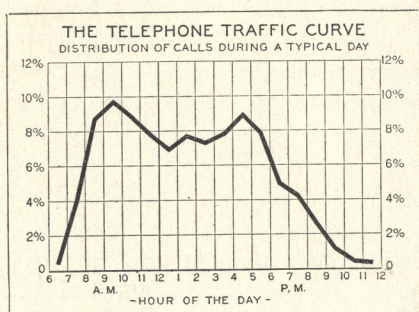
In the large commercial centers the telephone wires have been placed in underground cables which pass from their subways into what is called the cable vault of the central office building, and from there to the terminal room. Here are assembled the items of central office equipment, without which the multiple switchboard could not perform its functions.



*The "Trouble Shooter"  
Ready for Service*



Scarcely less intricate than the switchboard itself are the main and intermediate distributing frames. The function of these frames is to bring the telephone wires, entering the central office, to their proper places on the switchboard and to make it possible to change the location of the lines on the switchboard whenever necessary.



*Telephone Traffic Curve reflects the Activities of the Community*

At the main distributing frame the telephone circuits first pass from the cables to the "protectors," which are effective devices for warding off lightning discharges and stray currents from high tension wires and from other electrical sources. The wires then pass to the intermediate frame where they are so distributed that any line may be connected with any position on the switchboard.

From the intermediate frame the switchboard wires reach the "line and cutoff relay rack," where electrically controlled switches operate the lamp signals that show on the switchboard when subscribers lift or replace their telephone receivers.

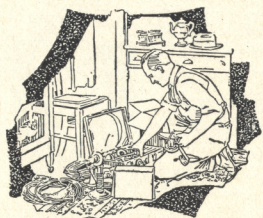
*Wire Chief's Equipment*

The testing apparatus under the supervision of the "wire chief," that is so important in detecting and locating "wire trouble," is also a part of terminal room equipment. Every report of such line trouble that is made by a subscriber or an operator is quickly checked by the supervisory force of the operating room, and then goes to the wire chief for expert diagnosis by his staff who then proceed to remedy the trouble indicated. The wire chief has equipment that enables him to be connected with any subscriber's line and to test the condition of the line. Because of his routine tests of all exchange equipment, he is frequently able to detect trouble and have it remedied before the subscriber is aware that such trouble has existed. His test board is a marvel of ingenuity and efficiency.

*The Power Plant*

In the Terminal Room or in larger offices in a separate room is the





*The Telephone  
Installer*

power plant where dynamos charge the storage batteries and provide electricity to carry the voice over the wires and also located here are the ringing machines which operate the subscribers' bells and provide various other signals. Here, too, are the power switchboard, the battery fuse panel, and other control equipment. Adjacent to it is a room containing the storage batteries.

A source of direct or continuous current is necessary for talking, while an alternating current is used for the bell signals. The current strength required to operate the talking circuits, though small for each circuit, in the aggregate for the many circuits in the larger offices amounts to several hundreds, or even thousands, of amperes furnished by machines using hundreds of horsepower.

### *The Traffic Curve*

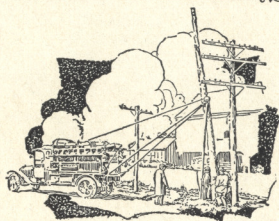
The tide of traffic rises and falls with the business and social activities of the community which each particular exchange serves. In general, it follows a certain uniform curve in the large communities, which is known as the "traffic curve."

In a typical city the highest

traffic point, or "peak of the load," is reached between 9 and 10 o'clock a. m. That is when business begins to get into full swing—the stores and offices open and telephone exchanges in the business sections of the city are taxed to their capacity. The traffic drops gradually until the lunch hour between 12 and 1 o'clock and rises again until it reaches another peak between 4 and 5 o'clock. In the shopping districts calls reach the highest point between 3 and 4 o'clock p. m., and in residential sections there are two high points, one around 9 o'clock in the morning when the housewife is placing her order with the butcher, baker, etc., and the other about 7 p. m., when evening engagements are made. After that the traffic dwindles away, till midnight finds the switchboard practically idle.

But the traffic curve may without warning give a most spectacular illustration of how sensitive it is to the public pulse. A big fire or accident will send thousands of anxious people to the telephone and the traffic curve will shoot upward. A rainy day that drives people off the streets or the interruption of transportation service increases the number of telephone calls very noticeably.



*Raising Poles  
With Derrick*

It is a fundamental of Bell System service that careful estimates of probable traffic are made in advance, and dial central office and other equipment is engineered with a view to providing adequate facilities for satisfactory handling of the anticipated traffic. Where manual switchboards are in use a careful adjustment of the operators' schedules, in line with the volume of traffic indicated, is made to insure that, at any given time of day, an adequate but not excessive operating force is provided.

#### *Training Operators*

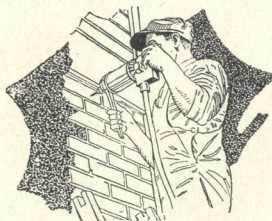
The work of the telephone operator is of such importance in main-

taining efficient and dependable service that it cannot be undertaken in a hit or miss fashion. It is a work that can be done properly only by one who is especially trained for it. The text books of the student operators are the standard operating practices that have been carefully prepared for Bell System operators after long study and practical experimentation. Under the guidance of instructors who were themselves once operators, the student operator is taught the best way of doing the things she will be called upon to do when she really goes to work. Her training period is from two to five weeks. She becomes a telephone

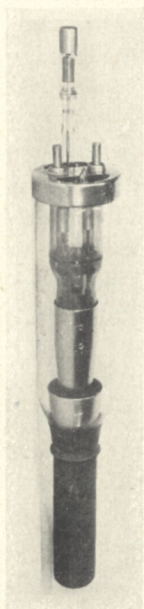


*Transmitting Station of Overseas Radio Telephone Service, Lawrenceville, N. J.*





*Operating  
Electric Drill*



*Vacuum Tube—10 Kw, Used in Trans-  
atlantic Telephony*

employee, however, the moment she begins her work in the training course and her pay begins at once.

Besides her class room work, the prospective operator learns at practice switchboards the proper method of operating both the "A" and "B" boards in real central offices, at which calls from the subscribers connected with her office and calls for them from other central offices are handled respectively. She is taught to think quickly, to keep cool

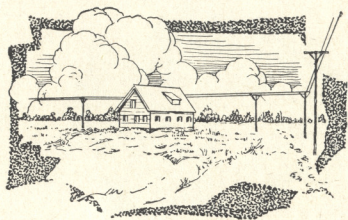
in emergencies, to make her head guide her hands. Early in her telephone career she begins to absorb unconsciously the spirit of service that has become traditional among the men and women of the Bell System. When her training is completed, she is assigned to a central office, at the switchboards of which actual service is being given. Here, as at a great loom, is woven the warp and woof of the business and social life of her community and, indeed, of the nation. Her position at the switchboard becomes, in effect, the center of the nation-wide communication system.

### *Working Conditions*

Throughout the Bell System everything possible is done for the health, comfort and convenience of the telephone operators. Working hours are arranged so that they will not be overtaxed. Rest rooms are provided where operators and other women employees spend their leisure time when off duty. At the larger central offices there are dispensaries, physicians and nurses, and many of these offices have completely equipped lunch rooms where meals are obtainable at cost.



*Radio Receiving  
Station, Houlton, Me.*



### *The Importance of "Information"*

So rapid is the increase in the number of telephone subscribers that each issue of the telephone directory soon becomes incomplete to the extent that the names of many new subscribers are not listed therein. As human supplements to the directory, information operators are provided in order to advise telephone users of the numbers of subscribers whose names cannot be found in the published lists. In the larger cities these operators have at their finger tips thousands of additional listings.

To permit the regular local operators to answer the inquiries now referred to the information operators would materially slow up service on regular traffic and render it inefficient.

### *Public Welcomed at Central Offices*

Subscribers and others are always welcome at the central offices of the Bell System, where the intricate apparatus is gladly explained and full information given regarding the many details of telephone service. Public school classes and technical students find much to interest them in the operating and terminal rooms. All Bell companies court the widest

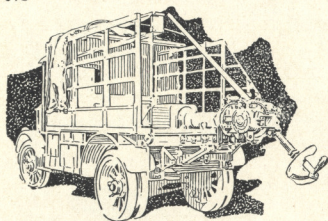
public familiarity with the methods and equipment in use.

An inspection of a central office will amply repay the visitor, in interest and in instruction. Here one sees a mechanism which is marvelously intricate in construction, yet marvelously simple in operation. Miles of wire thread their way through the back of the switchboard, each to its proper place—a veritable maze of circuits at which the visitor stands in wonder. Yet the operators—the “Weavers of Speech” who sit at this huge loom—go about their duties with an apparent ease, an absence of confusion, that is hardly



*Antenna at Long Wave Receiving Station of  
Overseas Radio Telephone Service, Houlton,  
Maine*





*The Earth-  
Boring Machine*

less a miracle than the mechanical perfection of the machine at which they work.

Here one receives something more than an accurate understanding of telephone apparatus and telephone operating methods. One comes away from a central office with a deeper appreciation of the telephone itself—his own telephone. It is no longer simply a piece of mechanism, but a part of a greater machine into which thousands of men and women have put their own personality and made it an instrumentality of nationwide, universal service. And now this means of communication has reached out across national boundaries to lands beyond the sea.

### *Radio Telephony*

Thorough research and extended experience demonstrate that the field of the wireless telephone is in maintaining communication between ship and shore, from ship to ship, or for talking from the ground to moving aircraft, or from airplane to airplane, or as an extension of the wire system bridging strips of desert or bodies of water, where it is impracticable to employ wires.

Before the advent of the three electrode vacuum tube, attempts to communicate by radio telephony

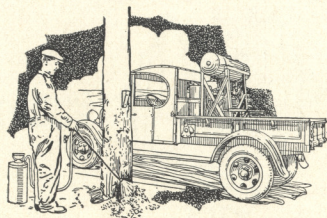
were discouraging. In 1912 telephone engineers began development of the tube as a long distance wire telephone amplifier or repeater. So satisfactory were the results that work was immediately begun on much larger tubes, to be applied to radio telephony.

The first successful demonstration by Bell System engineers of radio telephony, employing vacuum tubes, took place in 1915 when speech was transmitted from Montauk Point, Long Island, to Wilmington, Delaware, a distance of 250 miles. Later in the year, messages from Montauk Point were received at Jekyll Island, off the Georgia coast, 900 miles away. Messages from New York, carried by land lines, were automatically relayed to the radio equipment at the Long Island station and received in Delaware and Georgia—the first use of radio as a supplement to wire telephony.

The World War saw the revolutionizing of most methods of warfare and it also revolutionized communications for many military and naval purposes. As a means of establishing quick communication with airplanes and between naval vessels, such as units in a submarine-chaser flotilla, the wireless telephone proved particularly useful.



*Spraying Poles  
at Ground Line*



During ship-to-shore radio experiments in 1920, two-way telephone communication was maintained for several months between several cities and two ships, the messages going by wire between these cities and the Bell System's experimental radio station at Deal Beach, N. J., and thence to the ships by radio.

In 1929 ship-to-shore service was established on a commercial basis, affording connection between all Bell System telephones and the *S. S. Leviathan* of the United States Lines while at sea. Subsequently this service was extended to a number of other transatlantic liners.

### *Radio Broadcasting*

The year 1921 saw the advent of radio broadcasting on a scale which

attracted hundreds of thousands of listeners. Broadcast programs, at first, comprised those given only in the radio station "studios." As radio audiences increased in size, however, it became evident that greater diversity of programs would increase their popular interest.

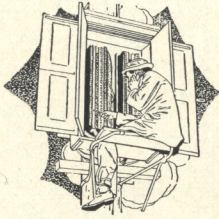
Beginning in 1922 grand opera, public meetings, athletic contests, etc., were made available for broadcasting by the installation, at the location of the programs, of microphone transmitters, including those used by expert announcers, which were in turn connected with the broadcasting studio by telephone lines, often hundreds of miles long and especially adapted for the purpose.

The long distance telephone lines also made possible the simultaneous



*Overseas Telephone Connections of the Bell System*





*Lineman at  
Terminal Box*



*Booth Used in Two-Way Television  
Demonstration*

radiation of one program from several widely scattered broadcasting stations. One of the first events of national importance to be thus given to the public was President Coolidge's first message to Congress on December 6, 1923, which was simultaneously broadcast by six radio stations, in New York, Washington, Providence, Kansas City, St. Louis and Dallas. To date the largest number of stations connected in the United States to broadcast the same event is 131, at the time of the dedication by Pope Pius XI

of the new radio station at Vatican City.

### *Transatlantic Radio Telephony*

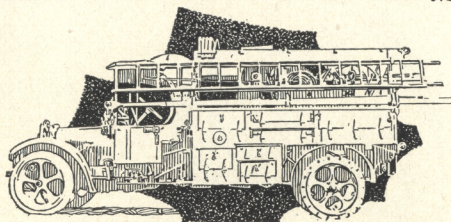
Experimental transoceanic telephony by radio was first achieved in October, 1915, when speech was carried by electric waves from the Arlington station, near Washington, D. C., across the Atlantic to the Eiffel Tower, Paris, and also across the American continent and the Pacific to Honolulu, Hawaiian Islands. This latter distance is over 5,000 miles. A telephone message was sent by wire from New York to Washington and thence by wireless to San Francisco.

Bell System experiments in transoceanic radio telephony resulted, in January, 1923, in one-way transmission of speech from New York to London. On January 14, 1923, telephone officials talked continuously for two hours by wire and radio from their offices in New York to a group of scientists and engineers assembled in London for the test. On March 7, 1926, for the first time in the history of communications, groups of people both in America and England conversed together by wire and radio during a test of two-way transatlantic telephony.

The goal of this long experimenta-



*Heavy Telephone  
Construction Truck*



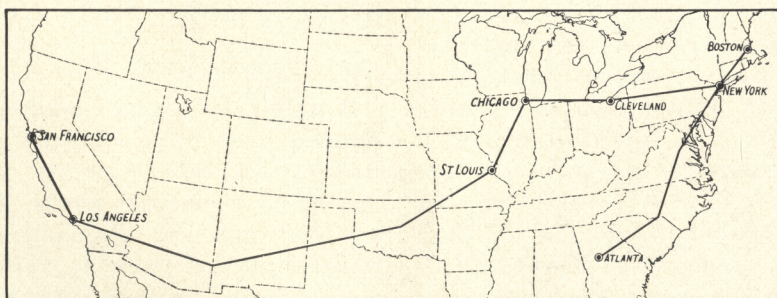
tion was commercial service between America and England through the combined use of wire telephony and radio. On January 7, 1927, President W. S. Gifford of the American Telephone and Telegraph Company formally opened commercial service between New York and London.

The scope of the service was thereafter gradually extended on both sides of the Atlantic, the hours of service were lengthened and the charges reduced. The transatlantic radio telephone service now connects the telephones not only of the United States, but of Canada, Cuba, and the principal cities of Mexico with the telephone systems of practically all the countries of Western Europe and with one point in Africa: Ceuta, Spanish Morocco.

The demand for the service in-

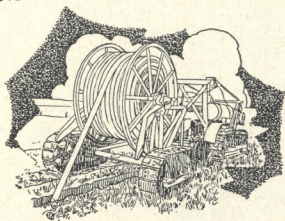
creased to such an extent that it became necessary to supplement the original long wave radio circuit by several short wave circuits.

In 1930 the Bell System, in cooperation with the International Telephone and Telegraph Corporation, established radio telephone service between North America and Argentina and parts of Uruguay and Chile, in South America. In the same year service was extended to the eastern part of Australia via the transatlantic circuit and a radio circuit between Great Britain and Australia. In 1931 service was established between North America and Java. Communication is over the transatlantic circuit, then via the Continent of Europe and over a radio telephone circuit connecting either the Netherlands or Germany (depending on the time of

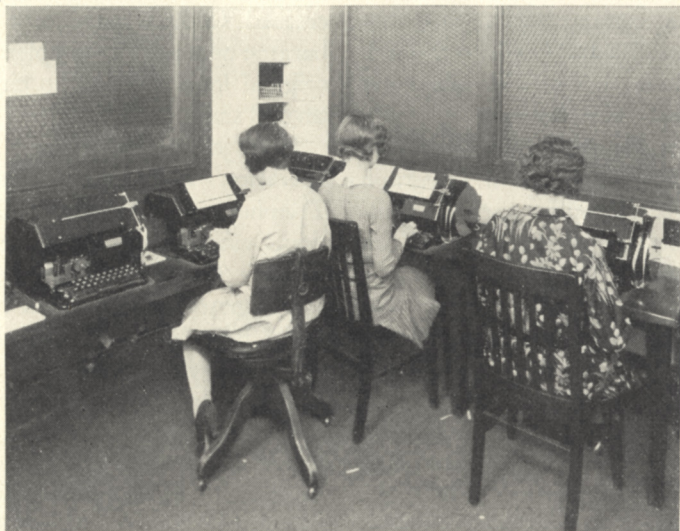


*Map Showing Cities Linked by Picture Transmission Service*





*Laying Tape-armored Cable in Trench*



*A View of an Installation of Teletypewriters*

day) with the Dutch East Indies. Plans are also well advanced for the establishment of radio telephone service across the Pacific to Hawaii and, ultimately, to the Far East.

The radio transmitting station for overseas service for the long wave circuit is at Rocky Point, Long Island. That for the short wave circuits is at Lawrenceville, N. J. The receiving station for the long wave circuit is at Houlton, Me. The receiving station for the short wave circuits is at Netcong, N. J. Transmitting and receiving stations for ship-to-shore service are main-

tained at other points in New Jersey and sites have been acquired in California for the construction of radio telephone transmitting and receiving stations for the proposed transpacific service.

#### *Telephotograph Service*

A method for the transmission of pictures over telephone lines developed by Bell engineers was opened to commercial service several years ago; and telephotograph transmitting and receiving stations are maintained at New York, Boston, Atlanta, Cleveland, Chicago,



*Central Office Apparatus Kept  
in Condition by Experts*



St. Louis, San Francisco and Los Angeles. This service is used not only for the transmission of news photographs but also for the sending of proofs of advertisements and the like, for speeding photographs of new styles across the continent and for the transmission of finger prints and photographs of persons wanted by the police, etc.

*Teletypewriter Service*

The teletypewriter is a device combining the features of the two principal accessories of the modern office,—the telephone and the typewriter. It is a carrier of written conversation, just as the telephone is a carrier of vocal conversation. The machine is similar to the ordinary typewriter and is operated in the same way. Words typed on one machine are, through electrical impulses, reproduced instantaneously on one or a number of other machines, which may be in offices across the street or across the continent.

There are two types of teletypewriter. One reproduces messages on standard size pages; the other types on a narrow strip of paper tape similar to that of ticker machines. This tape may be gummed on the reverse side and mes-

sages pasted on forms for filing. By the use of a switchboard, connection may be established between any two or more teletypewriters connected with the same network.

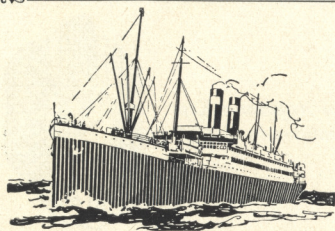
Teletypewriters are extensively used by the large press associations for transmitting much of their telegraphic news traffic over Bell System circuits. The rapidity of the service makes it especially useful in sending out stock exchange reports.

Brokers, too, are large users of teletypewriter service for the speedy transmission of short statements, requests for prices and other market information between their offices.

The teletypewriter has proved of great value, also, in the administration and control of large business enterprises with plants, warehouses, branches and offices at widely separated points. Orders, specifications, inquiries, reports, price changes and other messages in which speed and accuracy are essential are rapidly transmitted by teletypewriter among the various branches of large steel, oil, manufacturing and other companies.

The United States Department of Commerce uses teletypewriter circuits for the transmission of weather reports along the air routes throughout the country connecting more



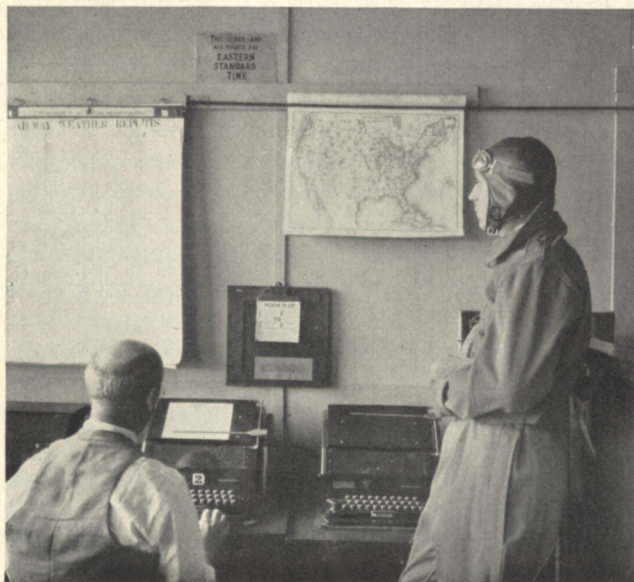


*Ship-to-Shore  
Telephone Service*

than 100 airports. Commercial aviation companies are also users of the service, which effectively promotes safety in flying by furnishing departing aviators with up-to-the-minute information as to weather conditions that will be encountered. In many cases the information thus transmitted to the airport is relayed to aviators in flight by radio telephone.

The teletypewriter is also rendering invaluable service to the police as a means of sending out alarms for escaping criminals, descriptions of

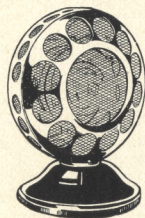
missing persons and of stolen property and the like. In these days when the fast automobile has facilitated quick getaways, electrical communication is especially necessary for the interception of fugitives from justice. Teletypewriter installations connecting police headquarters with outlying precincts, or linking up the police stations of neighboring towns throughout a county or a State, provide the means for sending alarms to all the connected points simultaneously and do away with the need to call up



*A Departing Aviator Receives Weather Information by Teletypewriter*



*The Microphone  
for Broadcasting*



each place in turn. State-wide teletypewriter systems serve the police of Pennsylvania, New Jersey and Connecticut. Westchester County, N. Y., has a comprehensive system, and New York City, Boston, Washington and numerous other cities have also availed themselves of this means of combatting crime. Some of these systems in adjacent States are interconnected, so that an alarm may be quickly sent, for example, not only throughout New Jersey but also to police headquarters in New York and in Pennsylvania.

#### *Television Demonstrated*

The first public demonstration by wire and wireless of Television or "Distant Seeing," as developed by the technical staff of the Bell System, took place on April 7, 1927. Participating in the demonstration at Washington, D. C., and New York were notable gatherings of leaders in the fields of science, industry and public affairs. Those who talked from the Bell Laboratories in New York were able to see plainly the features of those in Washington with whom they conversed over the long

distance circuits of the Bell System. By means of a larger screen and loud speakers all those present at New York were able to see the speakers at the National Capital and to hear the conversations over the wire.

This Television demonstration between Washington, D. C., and New York over the telephone circuits of the Bell System was followed by a demonstration of Television by radio in which the audience at the Bell Laboratories in New York saw the artists visualized on the screen and heard a varied program from the radio experimental station of the Laboratories at Whippany, N. J. In 1929 Television in color was demonstrated at the Bell Telephone Laboratories in New York.

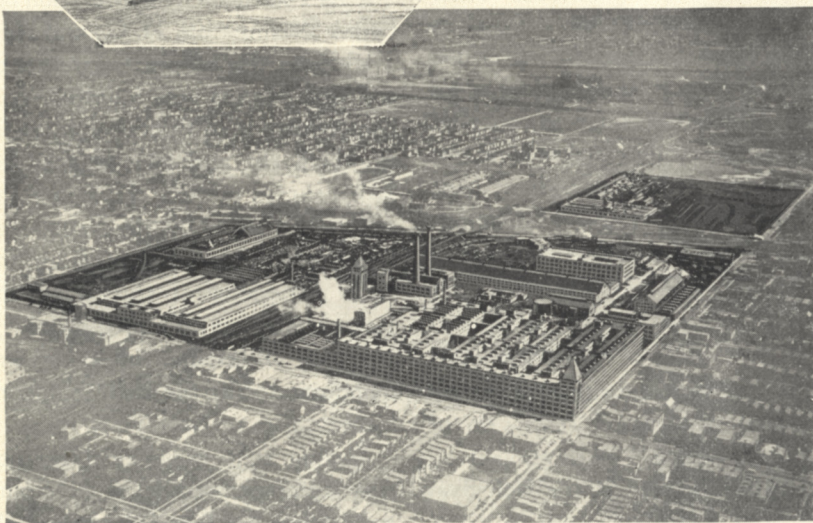
During 1930 two-way Television was demonstrated over a circuit connecting the Bell Telephone Laboratories with the headquarters of the American Telephone and Telegraph Company. Persons in booths two miles apart were enabled to see moving images of each other while they conversed. Television, however, is still in the development stage, and is not available on a commercial basis.



## The Telephone Workshop



*The Western Electric  
Co. Plant in 1877*



*The Hawthorne Works of the Western Electric Company in Chicago*

### *Standard Equipment Necessary*

Early in the development of the telephone service it was found that good transmission was dependent upon equipment and apparatus of uniform design and quality. Satisfactory transmission could not be obtained with a good telephone instrument on one end of a line and a poor one on the other; nor be-

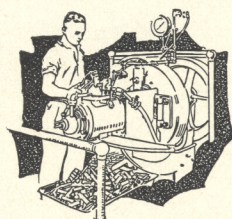
tween two good telephones connected by a poorly constructed line. Moreover, repairs could not be made promptly and satisfactorily when the telephones and equipment of various designs were used.

### *First Telephone Workshop*

Until 1878 all the Bell telephones had been made by Thomas A. Wat-



*Operator at  
Swageing Machine*



son in the little electrical shop in Boston, where the first telephone was constructed.

When this limited source of equipment supply became inadequate, licenses were granted to four other electrical concerns to use the Bell patents in the manufacture of telephone apparatus. Besides these companies, in 1869, Enos M. Barton and Elisha Gray had formed a partnership which, in 1872, became the Western Electric Manufacturing Company, the predecessor of the Western Electric Company.

#### *Birth of the Western Electric Co.*

In 1881 a consolidation of all these companies was effected and the Western Electric Company was organized. In 1882 the Western Electric Company became the headquarters for Bell telephones, apparatus and equipment.

In that capacity it conducts extensive manufacturing activities. What it does not manufacture for the Bell System, it buys. These purchases amount to many millions of dollars a year and make the Western Electric Company one of the largest buyers of raw materials and supplies in the world.

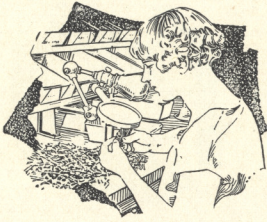
The Bell telephone workshop,

keeping pace with the growth of the Bell System, has itself expanded tremendously. It now embraces three principal plants, the Hawthorne Works at Chicago, the Kearny Works in New Jersey, and a third that more recently began operations at Baltimore, Maryland. The Queensboro Works, a smaller plant located in Brooklyn, New York City, is devoted principally to making telephone booths.

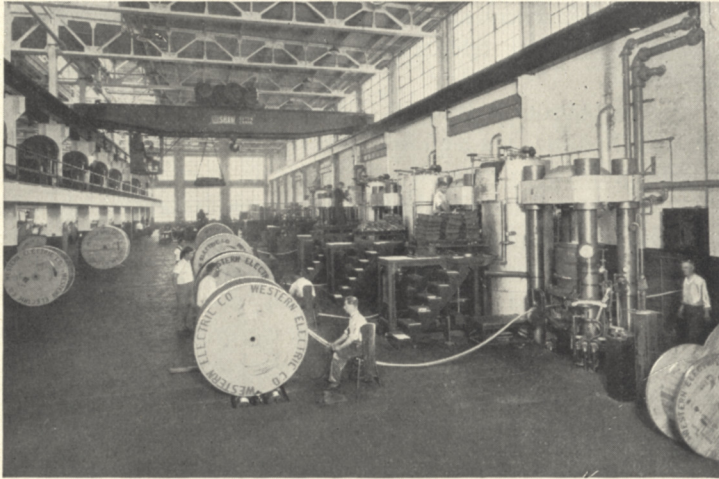
In addition, the Western Electric Company maintains 32 distributing warehouses in the principal cities of the United States. Through these it furnishes the equipment to the telephone companies. In still another department, several thousand men scattered through the country are engaged in installing central office and associated equipment for the Bell System.

The Western Electric Company owns and operates the Teletype Corporation which manufactures at its plant in Chicago all kinds of printing telegraph equipment. It also owns Electrical Research Products Inc. This company, as its name implies, provides a means for the commercial development, in fields outside the telephone industry, of inventions of the Bell Telephone Laboratories and the Western





*Inspecting Multiple  
Bank Springs*



*Lead Press Room Where Sheath is Placed on Cables*

Electric Company, some of which while primarily developed for the telephone industry may be used to advantage in other fields.

### *An Industrial City*

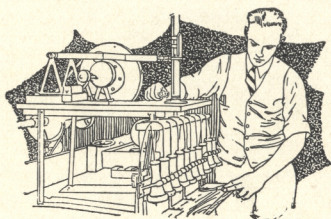
Each of the manufacturing plants is like a city within a city. Its population includes nearly every trade and profession—iron workers, carpenters, blacksmiths, cabinet-makers, painters, steamfitters, wrappers, packers, machinists, inspectors, firemen, patrolmen, doctors, lawyers. During the last three years the total population at these plants averaged 45,800 individuals.

### *A Model Community*

The Hawthorne Works at Chicago covers approximately 203 acres and has about 89 acres of floor space. It is laid out according to the most modern ideas of city building.

The streets of the telephone city radiate from the big water tower in the center, which looms above the other buildings. It has a railway system of its own and among all the big buildings trains are moving away finished product or bringing raw material. Within the city's gates are a gas plant, an electric



*Endurance Test  
For Receivers*

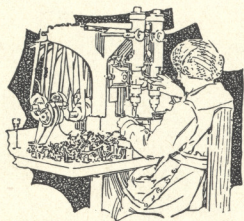
*The Western Electric Company Plant at Kearny, N. J.*

plant, an independent water supply, several restaurants for employees, a hospital, a library and lecture rooms where employees of the company can take special courses—all these, in addition to the huge factory buildings where the telephone apparatus is made. Nor is this a city of strenuous toil alone, for it provides for recreation hours, baseball diamonds, tennis courts, a gymnasium, and an athletic field of no mean proportions.

*Another Industrial City*

The Kearny Plant was started in 1923 to provide telephone products in sufficient quantity to meet the growing demands of the Bell System. It has had a phenomenal growth. In 1923 it was a swampy meadow plot of sixty acres fronting on the Passaic River. In the spring of 1925, its first cable shops were put in operation and a year later, in the summer of 1926, its first multi-story telephone shops were





*Drilling Machine  
in Operation*



*Forming Cables for Machine Switching Panels*

opened for operations. By the beginning of 1928, there were some 25 acres of floor space in actual use. A year later this had been increased to 31 acres. The Kearny Works now embraces a floor space of 64 acres.

The original 60 acres of land have been increased by the acquisition of the adjacent Ford property, a tract of 89 acres, with modern buildings.

#### *The New Industrial City*

Early in 1929 the Western Electric Company purchased a 118 acre tract of land in Baltimore and began

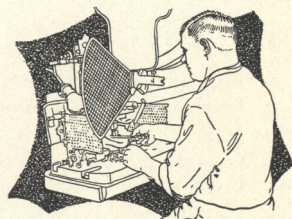
the erection of a new plant there for the manufacture of telephone cable, apparatus and wire. A bulkhead was constructed and a large area, previously useless, was reclaimed from swamp and water, giving this new industrial city a site of 172 acres. The first buildings were placed in operation in 1929. The new plant's location is at Point Breeze on the waterfront in Baltimore's extensive harbor.

#### *Mines and Forests Furnish Raw Materials*

To keep these workshops supplied with raw material, men are toiling



*Safety Device  
Protecting Worker*



in the mica mines of India, in the platinum mines of the Ural Mountains, in the forests of the northwest, and in the iron, copper and lead mines, in steel works; and in the forests and jungles of far-off India, Africa and South America.

In making your telephone, nineteen different kinds of raw materials are used, gathered literally from the four corners of the earth. Of the precious metals, platinum, gold and silver are required, and of the baser metals, copper, zinc, iron and steel, tin, lead, aluminum, nickel and brass. Rubber, mica, silk, cotton, asphalt, shellac, paper and carbon in the form of coal enter into the manufacture of the marvelous instrument that transmits and receives the human voice, regardless of distance.

In a single year the shops transform into finished telephone apparatus great quantities of material. It is difficult to imagine the labor, the transportation, and the outlay required to bring to the doors of the shops the raw and fabricated materials represented by the following figures:

Lead.....	100,000 tons
Copper.....	85,000 "
Steel.....	26,000 "

Iron and steel, wire and strand.....	15,000 tons
Antimony.....	1,900,000 lbs.
Brass rod, sheet, tubing..	12,000,000 "
Cable paper.....	16,000,000 "
Silk and cotton.....	5,500,000 "
Lumber.....	18,600,000 bd. ft.

### *The Output*

To take one instance, the cable stranding machines used have a capacity of 900 reels of wire and produce 50 to 100 linear feet of cable per minute. One of the record months in the output of lead-covered cable required over 4,200,000,000 feet of wire—enough wire to give everybody in the world a two-foot piece for a souvenir, and still have enough to stretch several times around the Earth at the Equator. During the year the output of lead-covered cable was over 20,653 miles, containing 38,900,000,000 conductor feet of wire.

### *Known the World Over*

While the Western Electric Company manufactures other communication equipment, its principal activity is the making of the standard Bell telephone apparatus, and the excellence of its product is known the world over.



## CHRONOLOGY OF TELEPHONE PROGRESS

- 1876 First complete sentence transmitted by telephone.  
First conversation by overhead line, 2 miles—Boston to Cambridge.
- 1880 30,872 Bell telephones in the United States.  
Conversation by overhead line, 45 miles—Boston to Providence.
- 1881 Conversation by underground cable,  $\frac{1}{4}$  mile.
- 1884 Conversation by overhead line (hard-drawn copper), 235 miles—Boston to New York.
- 1890 211,503 Bell telephones.
- 1892 Conversation by overhead line, 900 miles—New York to Chicago.
- 1900 676,733 Bell telephones owned and connected.
- 1902 First conversation by long-distance underground cable, 10 miles—New York to Newark.
- 1906 Conversation by underground cable, 90 miles—New York to Philadelphia.
- 1910 5,882,719 telephones in the Bell System.
- 1911 Conversation by overhead line, 2,100 miles—New York to Denver.
- 1913 Conversation by overhead line, 2,600 miles—New York to Salt Lake City.  
Conversation by underground cable, 455 miles—Boston to Washington.
- 1915 First conversation by transcontinental line, 3,650 miles—Boston to San Francisco.  
Speech transmitted for the first time by radio telephone from Arlington, Va., across the continent to San Francisco, over the Pacific to the Hawaiian Islands, and across the Atlantic to Paris.
- 1920 12,601,935 telephones in Bell System.
- 1921 Conversation by deep sea cable, 115 miles—Key West, Fla., to Havana, Cuba. First conversation between Havana, Cuba, and Catalina Island by submarine cable, overhead and underground lines and radio telephone—distance 5,500 miles. Extension of Boston-Philadelphia cable to Pittsburgh—total distance 621 miles.
- 1922 Ship-to-shore conversation by wire and wireless between Bell telephones in homes and offices and the *S. S. America* 400 miles at sea in the Atlantic.
- 1923 Successful demonstration of transoceanic radio telephony from a Bell telephone in New York City to a group of scientists and journalists in New Southgate, England. First broadcasting of a presidential message to Congress, December 6.  
Completion of Southern transcontinental line.
- 1924 First public demonstration of picture transmission over telephone circuits—New York and Cleveland.
- 1925 Completion of the New York-Chicago telephone cable—overhead—underground.  
16,720,224 telephones in Bell System.
- 1926 Successful test of two-way transatlantic radio telephony.  
Completion of extension of New York-Chicago, all-cable telephone line to St. Louis.
- 1927 Telephone service by wire and wireless inaugurated between the United States and Great Britain; later extended to all points in the United States and Great Britain.  
Northern transcontinental telephone line formally opened.  
First public demonstration of Television by wire and radio.  
Telephone service opened between the United States and Mexico.
- 1928 18,365,486 telephones in Bell System.  
Transoceanic telephone service extended to principal countries of Western Europe.
- 1929 Ship-to-shore telephone service established.
- 1930 Transoceanic telephone service extended in Europe and opened to parts of Argentina, Chile and Uruguay in South America, and to parts of Australia via London. Ship-to-shore service extended to additional liners. Two-way television demonstrated by Bell engineers.
- 1931 More than 20,000,000 telephones in Bell System.  
Fourth telephone cable to Cuba opened. Service established to Java.





*"SERVICE TO THE NATION IN PEACE AND WAR," sculpture in bronze and marble by Chester Beech in the Headquarters Building of the American Telephone and Telegraph Company, 195 Broadway, New York City*



## THE UNSEEN COURIERS *of* THE SPOKEN WORD

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THE FAMILIAR TELEPHONE that stands upon your desk at the office or in your home is only a very small part of the great communication system that enables you to talk across the miles with such surprising ease.

Behind it are complicated exchanges, a carefully trained organization of more than four hundred thousand men and women and eighty million miles of wire. These are the forces that make efficient telephone service possible. These are the unseen couriers of the spoken word.

Tirelessly, day or night, without rest or sleep, the Bell System awaits but the lifting of the receiver to carry your voice to any one of thirty-two million other telephone users in this country and abroad, and on ships at sea. It is done so quickly and with so little trouble that few people stop to consider what goes on between the giving of the number and the completion of the call.

Some time every day—perhaps many times a day—you use some part of a telephone system that has taken fifty years and more than four billion dollars to build. The simple words “long distance,” which you speak so casually into your telephone, place millions of dollars of equipment at your disposal. Yet the cost of a call from New York to Chicago is only three dollars and but a fraction of that for lesser distances.

Equipment of comparable cost is also needed to connect your home with the thousands or hundreds of thousands of other telephones in your town or city. Yet the charge for local service is only a few cents a day.

In relation to service rendered, the cost of the telephone is one of the smallest items in the monthly business and family budget. Few things purchased are of such real, constant and increasing value.







