



THE TELEPHONE IN AMERICA





On Main Street, U. S. A., the telephone company is a home town institution, run by local people. Linking together home town communities all over America, the telephone makes a neighborhood of the nation.



The Telephone in America



Bell Telephone System

1952



Behind Your TELEPHONE

When you pick up your telephone, you have at your fingertips a communication system that is mainly local in its operations. Probably you will use it most of the time to talk to people in or near your own community, but whenever you wish, it can carry your voice across the continent or even across the seas to other countries. The telephone industry in the United States now includes:

- Telephones serving homes and businesses in 75,000 cities and towns, and on more than 2,000,000 farms.

- A network of wire linking these telephones. About 95 per cent of this wire is in sturdy cables, and three-fifths of the cable is underground.

- More than 19,500 central offices in which telephones are connected by means of switching equipment. About 8,700 of these offices are operated by Bell System companies.

- Literally billions of small parts—relays, condensers, resistors, vacuum tubes—each carefully designed and finely fashioned so that it will work in harmony with all other parts anywhere in the country.

- Radio-telephone links to automobiles, trains, ships, airplanes, and countries overseas.

- A growing system of radio-relay routes used for transmitting both long distance telephone conversations and television programs.

- Highly skilled telephone people living and working in nearly every American community. The Bell System alone employs about 700,000 men and women, who are busy planning, designing, manufacturing, improving, building, operating—all working to fulfill the traditional telephone policy of providing the best possible service at the lowest possible cost.

IN THE TELEPHONE OFFICE

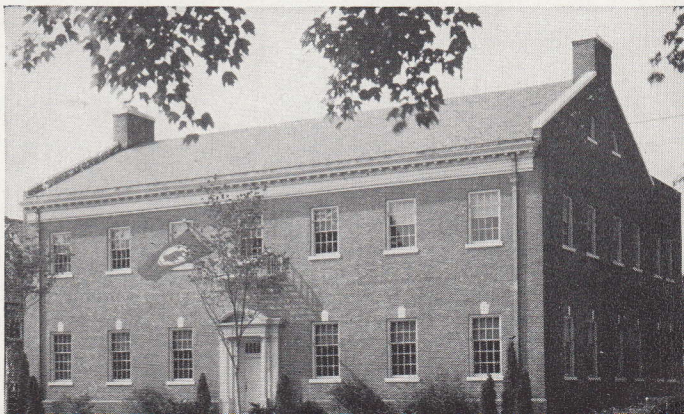
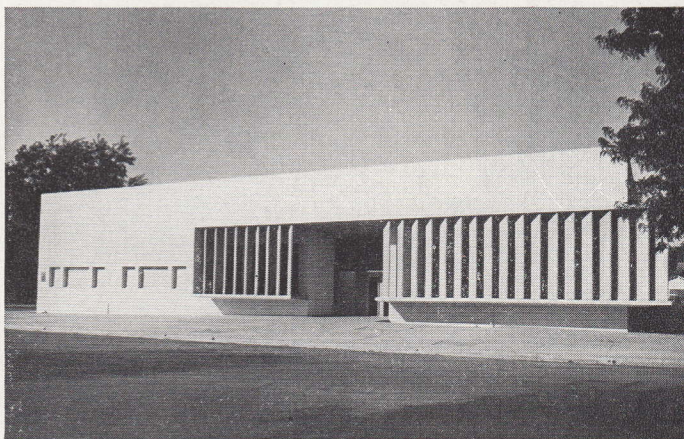
Every time you make a telephone call—either by dialing or by giving the operator the number—you first reach the *telephone central office*. This nerve center of your local telephone system contains equipment through which your telephone can be connected to any other telephone you wish to reach.

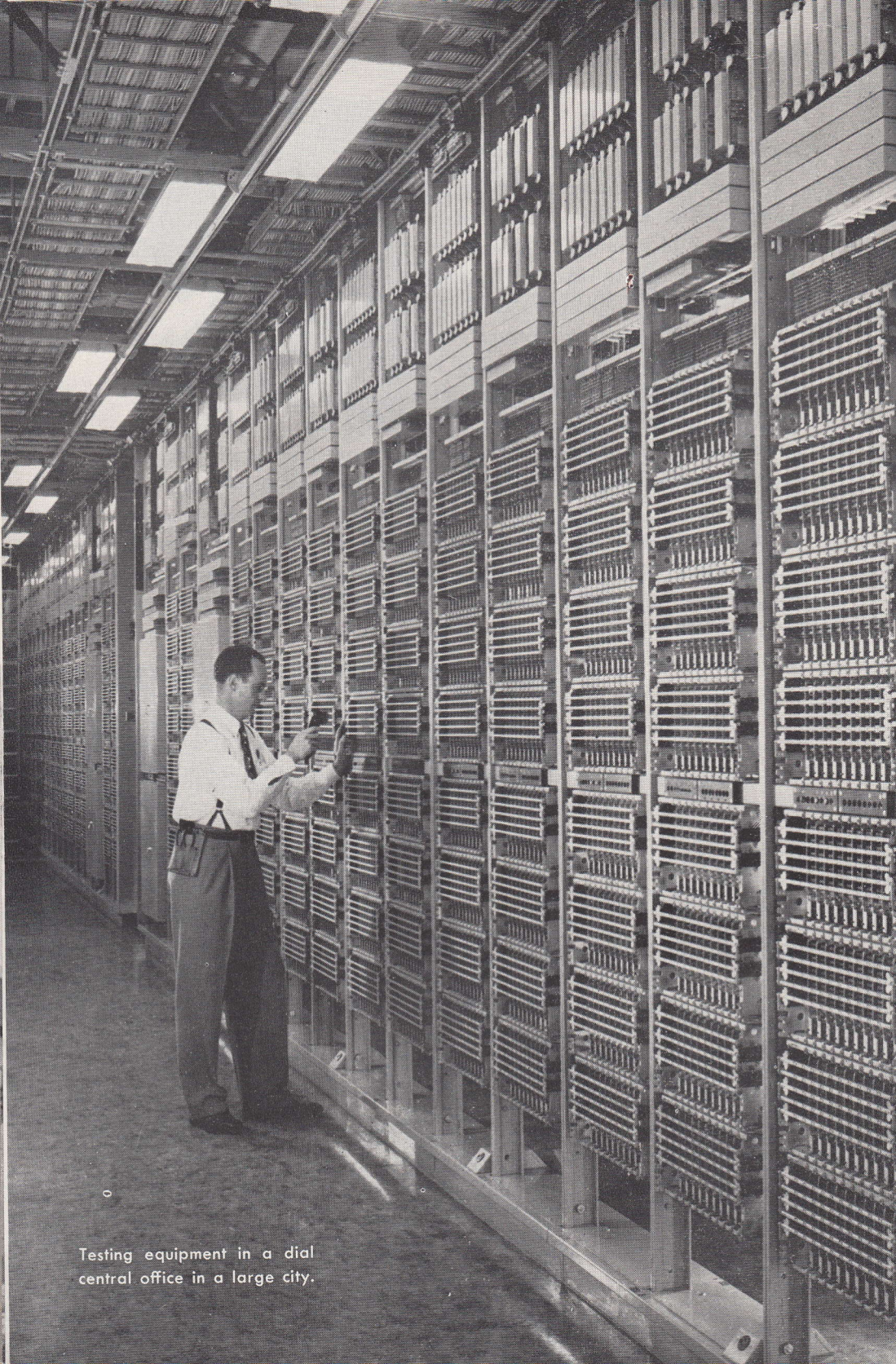
In a small community there may be only one central office. In large cities there are many of them, all joined by trunk lines. The term *telephone exchange* means the whole local area served by one or more central offices.

Over three-quarters of all Bell System telephones are dial-operated. Intricate machinery in the central office makes connections by obeying the electrical signals that you send over your line as you turn the dial on your telephone.

Before you dial, the equipment in the central office tells you it is ready to serve you by transmitting a “hum-m-m-m” over your line. You should hear this *dial tone* before you start to dial. The dial tone serves the same purpose as the operator’s “Number, please!”

Telephone company buildings are designed to fit the character of the communities in which they are located, and to harmonize with their surroundings. Pictured above is a dial central office in a small California town. Below is a dial office in a Connecticut community.





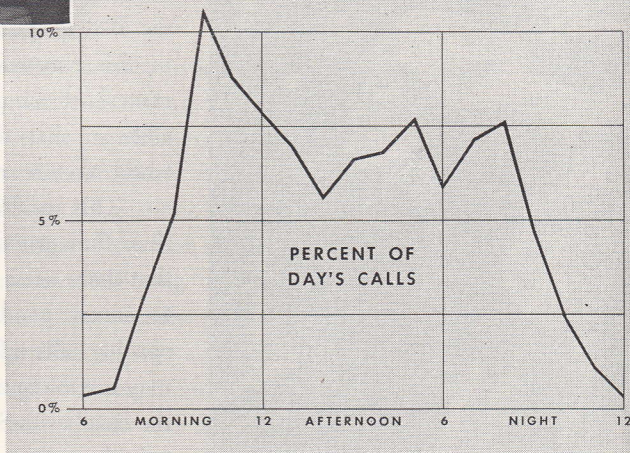
Testing equipment in a dial central office in a large city.



"Dial Service Assistance" operators, who answer when you dial "O" (operator), are always ready to lend a hand if you need help in calling from a dial telephone.

In a typical city, the tide of telephone calls generally reaches its highest peak between 9 and 11 A.M., when business activity gets into full swing. It reaches another business peak between 4 and 5 P.M. Telephones located in residence areas are usually busiest about 7 o'clock in the evening.

TYPICAL TRAFFIC CURVE



Telephones that are not dial-operated are connected with *manual* central offices, where operators seated at switchboards make the connections by hand. Switchboards differ greatly in size. In small villages one or two operators handle all calls. In large cities the volume of calls requires hundreds of operators working at large multiple switchboards. The term *multiple* comes from the fact that the end of each subscriber's telephone line is duplicated or multiplied at intervals throughout the switchboard. For example, a switchboard serving 6,000 customers might have positions for 20 operators. The board would be multiplied so that each operator, answering a call from any of the group of customers assigned to her, could reach his line and connect it with any one of 5,999 others.

The courteous, helpful service rendered by telephone operators has become a traditional part of American life. Even in communities that have dial service, "the voice with a smile" is on the job—to handle long distance calls, to provide telephone numbers not included in the directory, and to



A Bell telephone company installer connects drop wire to provide service in the residence of a new subscriber.

give any other help that customers may desire.

Ever since World War II, the Bell companies have kept on installing new equipment in great quantities to meet the largest demand ever experienced for new telephone service. As the Bell telephone companies pushed forward on this construction job, they made sure that central offices carried the heaviest loads possible so that the greatest number of people could have service.

This resulted in a larger number of party lines than usual. Party line users have found that there are a number of courtesies that help to assure good service for all concerned:—spacing calls a few minutes apart so that others may use the line; educating youngsters to share the line “even-Stephen”; and giving party line neighbors the right of way whenever sickness or accidents occur.

WHERE THE WIRES GO

The arrangement of wires that connects your telephone with the central office and with the telephones of other subscribers is something like a tree. Just as twigs lead to branches, branches to limbs, and limbs to the trunk, so individual telephone wires come together in small *distribution cables*. In turn, these cables come together in *feeder cables* that increase in size as they approach the central office. Often as many as 2,121 pairs of fine copper wires enter the telephone office in main feeder cables about as big around as a baseball bat.

Most wire in city telephone cables lies underground in tile conduits and comes into the telephone office through a *cable vault* in the basement. If the city has more than one central office, *trunk cables* interconnect the offices.

At each telephone office the cables run to the *terminal room*, where their hundreds or thousands of pairs of wires fan out to *terminal blocks* on one side of a large *distributing frame*. Other wires run from the opposite side of the distributing frame to the switchboard or dial equipment. Cross-connections on the distributing frame bring each telephone user's line to its proper terminal in the switching equipment.

A telephone office is dependent on electric power, both direct and alternating. The direct current comes from storage batteries. These are kept charged by generators driven by the regular current supplied by the power company, which also provides the electricity needed for other purposes. Standby generators, usually driven by gasoline or diesel engines, are provided for emergencies in most large offices and in many smaller ones.

Ringling machines generate alternating current to operate your telephone bell and provide the various signals you hear in your telephone receiver. These machines are installed in pairs so that there will be no interruption of telephone service should one machine fail to operate properly.

Preventive maintenance, both inside and outside telephone offices, is

Below, technicians check for trouble at test desk in a central office. Preventive maintenance, outside as well as inside the telephone office, helps provide dependable service.





Good telephone service depends on the teamwork of many people working together at many different jobs. These girls are typing telephone bills in the Accounting department of a Bell telephone company.

vital in furnishing dependable, satisfactory telephone service. Telephone men periodically check the condition of telephone plant. Using steadily improving techniques, they often discover faults or weaknesses and have them corrected before the customer is aware of them.

Test desks, where testmen also track down troubles in the telephone plant, are essential to giving good service. These are special switchboards with equipment that enables the testman to diagnose the cause and location of trouble on a customer's line.

TEAMWORK TO SERVE YOU WELL

In addition to good equipment kept in good condition all the time, good telephone service depends on capable people who are well trained and skilled in their jobs.

Not only must these many people perform many different jobs to give you good service but they must work together as a team. In the Plant de-



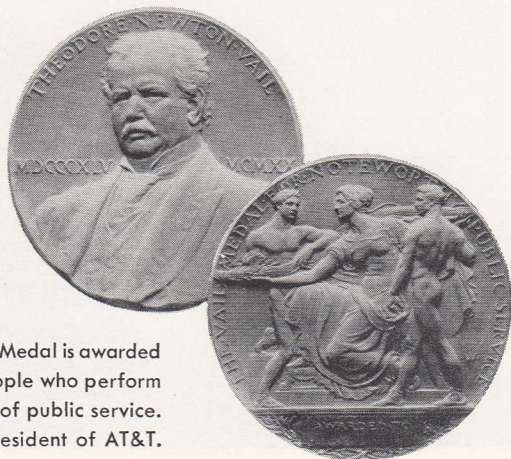
Telephone people strive always to make the telephone company a friendly and helpful institution. This young lady is one of the trained, courteous service representatives who assist customers in the business offices.

partment, linemen, installers, cable splicers, repairmen and others build and maintain the plant so that the operators in the Traffic department can put your calls through as swiftly as possible. Similarly, the members of the other departments of the company do their work in such a way that they help others do theirs.

In every Bell telephone company there are staff people who are specialists in various phases of the business. They assist the front-line forces in meeting day-to-day problems. They find better, more efficient ways of doing things.

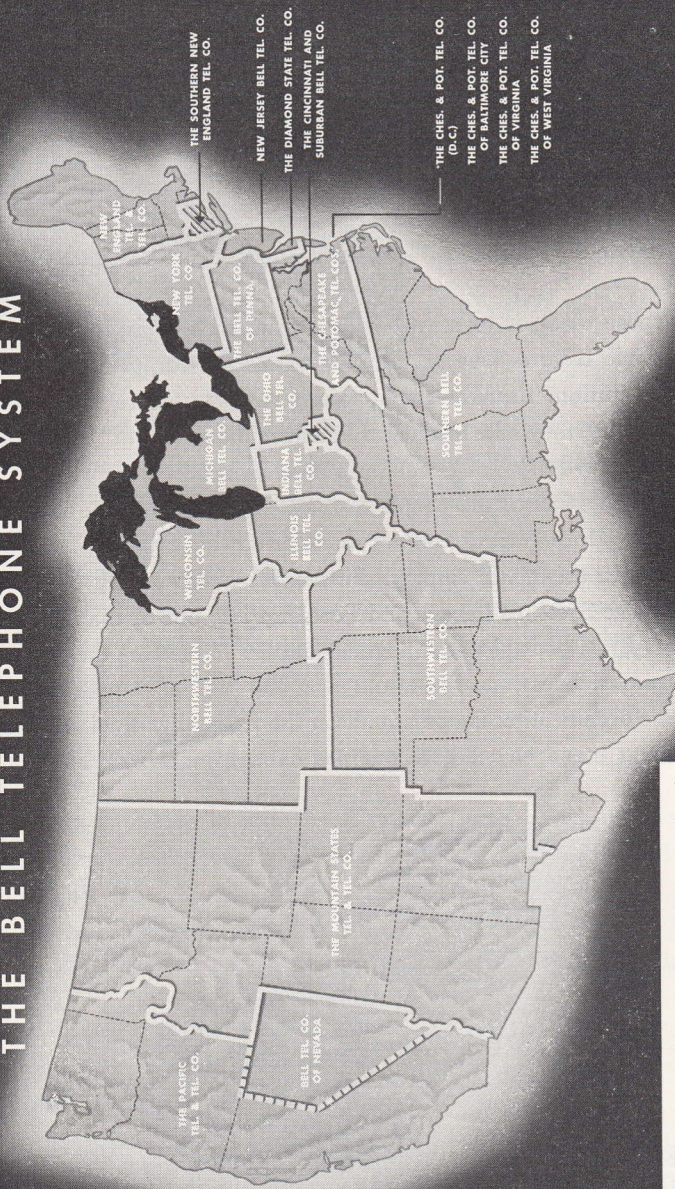
The purpose of all is to serve you well and with unfailing courtesy. Telephone people have a genuine desire to make the company a friendly and helpful institution. Because telephone men and women are good citizens of your community, they take pride in conducting the affairs of the company so that the public will think of it, too, as a good citizen.

A large proportion of the people in the Bell System make a career of telephone work. More than 220,000 of them have been in the business over ten years. Wages are good, employment steady, and working conditions are pleasant. The System's Benefit and Pension Plan, one of the oldest and best in industry, assists employees and their families in meeting the problems that arise from sickness, accident, old age and death. Opportunity to advance in the organization is open to all on the basis of individual ability. Supervisory and management positions are filled from the ranks.



Theodore N. Vail Medal is awarded to telephone people who perform noteworthy acts of public service. Vail was first president of AT&T.

THE BELL TELEPHONE SYSTEM



The principal telephone subsidiaries of American Telephone and Telegraph Company serve generally the areas shown. The Southern New England and Cincinnati and Suburban are associated but non-controlled companies. In nearly all areas other telephone companies operate and connect with Bell System lines.

Organized to SERVE You

As a telephone user, you want to be able to count on your telephone, to be able to call other telephone users anywhere. You expect reliable service at low cost. The kind of service you expect depends on teamwork—among telephone people in your local company, and among the separate companies that make up the Bell System. This is the way the Bell System is organized to serve you. This is what it contains:

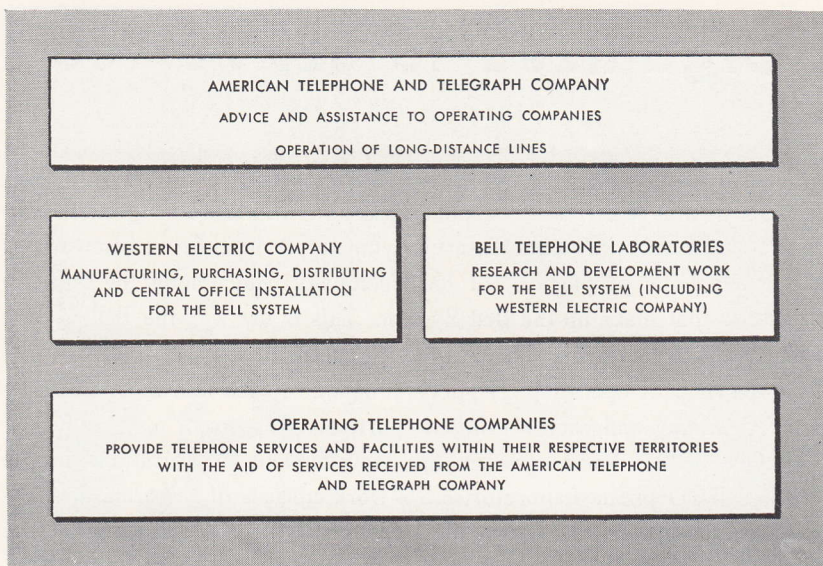
- A group of operating telephone companies, each known as an Associated Company and each serving its particular territory.

- One of the finest research and development organizations in the world, Bell Telephone Laboratories. Its work consists of research, development and design in the communications field. It creates apparatus that improves telephone service, makes it more efficient, and keeps its cost low.

- A supply organization, the Western Electric Company. It manufactures or purchases equipment and supplies for the operating companies on a more economical basis than the individual companies could do for themselves. It distributes equipment and supplies to the various companies. It installs equipment in telephone central offices.

- A headquarters organization, the American Telephone and Telegraph Company. AT&T functions as a general staff for the Bell System, co-ordinating the enterprise and assisting the operating companies. It owns most of the stock of most of the operating companies. It owns nearly all the stock of the Western Electric Company, and it shares with Western Electric the ownership of the Bell Laboratories. In conjunction with the Associated Companies, the AT&T Long Lines Department furnishes long distance telephone service and other communication services over its lines and radio-relay channels.

The organization of the Bell System has grown up in a natural way over a period of many years. The American Bell Telephone Company, predecessor of AT&T, owned the original Bell patents. It licensed local companies to rent Bell telephones to their subscribers. Ownership of the operating companies by the headquarters organization came about because of their need to finance expanding service, and as a means of providing



Principal elements of the Bell System.

the best service at lowest cost. AT&T bought Western Electric in 1882 because it was the best manufacturer of telephone apparatus and because a dependable source of supplies was essential. The Bell Laboratories stemmed from the shop where Alexander Graham Bell made the first telephone. The work of the Laboratories is a continuation, on a much larger scale, of early efforts to discover improvements in the art of telephony.

LONG LINES—WHEN YOU CALL ACROSS THE LAND

Within its own territory your local telephone company provides inter-city service. But when you make a call that crosses the territories of various Bell companies, you are served also by the facilities of the Long Lines Department. This organization is also responsible for radio-telephone service to points in countries overseas.

Americans now make over 300,000,000 calls a year over Long Lines facilities. To handle this volume of calls, Long Lines requires:

- About 26,000 highly trained telephone people, including operators, engineers, maintenance men and construction forces, in 40 states and the District of Columbia.

- Telephone central office forces in 229 cities and towns.
- Telephone equipment and plant, including over 1,700 buildings, in all but one state.
- About 17,000,000 miles of talking circuits.

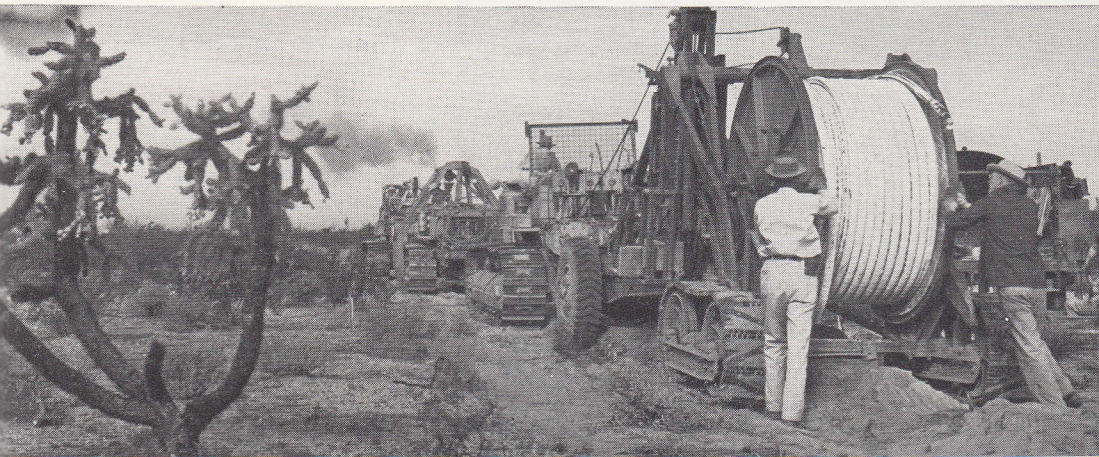
Nine years after the telephone was invented, when the farthest one could talk was from New York to Boston, AT&T announced in its charter its plan to connect every place in the country "by cable and other appropriate means with the rest of the world." Long distance lines reached Chicago in 1892. Gradually, telephone scientists solved the technical difficulties of transmitting speech over still greater distances. By 1915, Bell engineers had developed vacuum tube amplifiers to step up fading voice currents, and the human voice spanned the miles between New York and San Francisco.

WHEN YOU CALL ACROSS THE SEA

In that same year, telephone engineers also made history by establishing experimental radio-telephone connections across the Atlantic between Arlington, Va., near Washington, D. C., to the Eiffel Tower in Paris, as well as to the Hawaiian Islands and Panama.

Although World War I delayed the development of overseas service, years of further experimenting and perfecting led, in 1927, to the opening of regular overseas telephone service between the United States and England. Since then service has been extended to both hemispheres, and it is possible now to reach nearly 96% of the world's telephones in almost 100 foreign lands. Today, overseas conversations take place at the rate of about 900,000 a year. Overseas terminals in New York, Oakland and Miami

A cable-laying train moves across Arizona during construction of one of the Bell System's transcontinental voice highways. Cable is laid in the ground, later is spliced and buried.





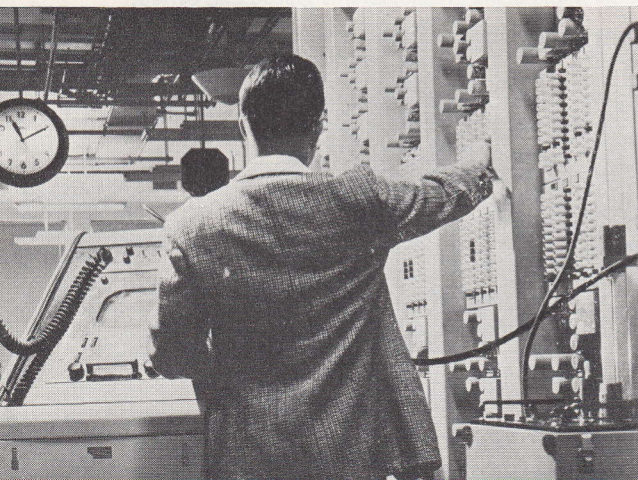
Telephone calls to overseas points are handled by operators at three terminals. This Long Lines operator at the overseas switchboard in New York City is putting through a call to Paris.

furnish the overseas service, handling calls in much the same way as other long distance calls.

RADIO AND TELEVISION NETWORKS

Not everybody realizes that network radio programs go over telephone channels from point of origin to the local radio stations that actually broadcast them. In order to link the nation's radio and television stations, Long Lines now operates about 160,000 miles of program transmission circuits. And within their own territories, the operating telephone companies also furnish some program transmission circuits.

The Bell System's experience in serving radio broadcasting networks dates from 1923 and has been invaluable in helping the System solve the problems involved in transmitting television programs over networks. Bell System scientists pioneered in sending television images from one place to another, by both wire and radio. As of 1952, the System linked 109 television stations in 66 American cities.



Split-second timing is often necessary in Long Lines' television network control center. Technician is making a switch in intercity channels.

BELL SYSTEM TELEVISION NETWORK ROUTES

..... Connecting Facilities

The map illustrates the Bell System Television Network Routes across the United States. Major cities are marked with dots and labeled, including Seattle, Portland, San Francisco, Los Angeles, San Diego, Phoenix, Salt Lake City, Denver, Omaha, Minneapolis-St. Paul, Milwaukee, Grand Rapids, Ames, Des Moines, Rock Island, Chicago, Indianapolis, Columbus, St. Louis, St. Paul, Bloomington, Louisville, Memphis, Nashville, Atlanta, Birmingham, Jacksonville, Miami, Fort Worth, Dallas, Houston, San Antonio, Austin, New Orleans, Jackson, Savannah, Charleston, Greensboro, Raleigh, Durham, Charlotte, Norfolk, Richmond, Washington, Baltimore, Philadelphia, New York, New Haven, Providence, Hartford, Springfield, Albany, Rochester, Syracuse, Buffalo, Cleveland, Detroit, Lansing, Toledo, Cincinnati, Pittsburgh, Lancaster, Harrisburg, and Boston. Solid lines represent the main network routes, while dotted lines represent connecting facilities. The map shows a dense network of routes connecting major cities across the country.

Private line service may simply connect two instruments, or may consist of far-flung networks connecting many instruments.

Teletypewriter exchange service permits the interconnection through switchboards of any subscriber's machine with any one of 30,000 others, making up a nation-wide system for transmitting typewritten messages.

Serving the local communities in their territories is the responsibility of the operating companies. There are, however, general problems shared by all the companies. In order to handle these problems efficiently and at reasonable cost, the operating companies contract with the AT&T Company

for those things that a centralized organization can do better and more economically.

This contractual relationship is an outgrowth of the original licensing arrangement, in which the first telephone companies obtained instruments for the use of their subscribers. It was founded on the necessities of the business. It exists today for the same reason.

To meet this responsibility, AT&T is organized to serve the operating companies on matters of engineering and operation, finance, accounting and law, and to assist them in other ways that may help them in conducting their business.

Through AT&T, patent rights covering the results of Bell System research in communications are made available to the operating companies. It is the System's policy also to make licenses under such patents available to others outside the System on reasonable terms and on a non-exclusive basis.

Among the many AT&T staff services to the telephone companies are those described as "operation and engineering." These include the entire range of construction, operation, maintenance, methods and practices. The AT&T general staff constantly studies new ideas for improved equipment and practices that may originate anywhere in the System. Promising ideas are developed and tested, usually in collaboration with the Bell Telephone Laboratories. Improvements that result are spread over the whole Bell System.

One group in the general staff, for example, develops new methods for the System's construction forces—a new and more economical way, let us say, for plowing cross-country cable underground.

Recently placed in service by Long Lines, this teletypewriter system is the "nerve center" of an airline. It automatically relays messages between the airline's offices.





Principal offices of the American Telephone and Telegraph Company are located at 195 Broadway in downtown New York. In the foreground is St. Paul's Chapel (1763), the oldest public building in Manhattan.

Another group studies System-wide experience with buildings and applies the knowledge to the design of new telephone central offices. Another group studies ways to increase speed and accuracy in handling telephone calls.

Besides operation and engineering services, other AT&T groups help the telephone companies devise better business and office routines. Still other groups advise the companies on the most efficient methods in accounting, statistical analyses, public relations and advertising activities, and in all the many other phases of the telephone business.

No single regional company could make these studies for itself with the same efficiency or so economically.

OUT OF THE SAVINGS OF THE MANY

One of AT&T's most important services to the operating telephone companies is financial assistance. This is especially true in periods of rapid growth, like the present. In these times the telephone companies need vast sums of money for equipment and buildings to expand and strengthen the nation's communications network for defense, and to meet the public demand for telephone service.

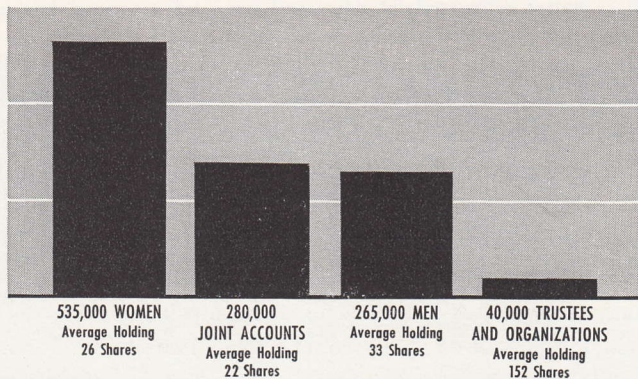
The money for improving and expanding telephone service comes from people in all walks of life. It comes from the savings of the many, not the wealth of the few. Most of this money is invested in securities of the AT&T Company, which in turn supplies funds to the operating companies.

AT&T is the first business in history to be owned by more than a million people. On the average, more than one in every 45 families across the country is represented in the ownership of the AT&T Company. These families, truly a cross-section of America, live in 19,000 cities, towns and rural areas. More than 270,000 of the AT&T share owners have held stock for 15 years or longer.

Besides the direct owners of AT&T, many other people—such as insurance company policy holders and bank customers — help indirectly to finance the business through the AT&T shares held by organizations and trustees. The largest AT&T shareholder is a nation-wide investment firm

DISTRIBUTION OF A. T. & T. SHARE OWNERS JUNE 30, 1952

A. T. & T. has over 1,100,000 share owners—more than twice as many as any other corporation.





Above, Mr. and Mrs. Brady Denton are typical of the many Americans whose purchase of AT&T shares has made possible the growth and development of the telephone system. In 1951, Mr. and Mrs. Denton became, jointly, the one-millionth share owner of the AT&T Company. Mr. Denton works as an automobile salesman in Saginaw, Michigan.

that holds stock for thousands of customers. Among other institutional holders are 2,100 churches, 1,100 hospitals and homes, over 1,000 schools and libraries, over 500 foundations and charities.

Over 250,000 Bell System employees have purchased AT&T stock under a payroll savings plan. Many more thousands are now buying shares that way.

Such widespread ownership by investors helps make possible the good telephone service you get today.

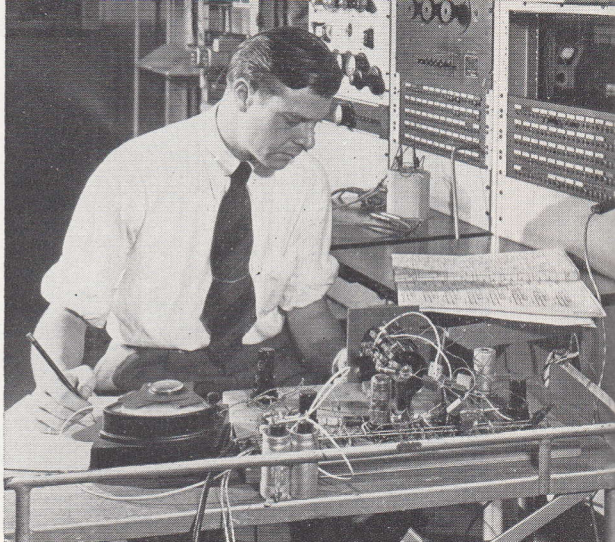
IDEALS AND AIMS

The management of the Bell System recognizes its responsibility to treat fairly *telephone users, employees and share owners*. It believes that the interests of these three great groups of people are linked closely together.

Management's aim and responsibility is to see that telephone users get the most and best possible service. The cost of service must be as low as may be consistent with good wages and working conditions for employees and with a reasonable return for share owners on their investment in the business.

The Bell System believes that the *most and best possible service* means telephone service for the nation that, so far as possible, is free from imperfections, errors or delay—service that enables anyone, anywhere, to pick up a telephone and talk to anyone else, clearly, quickly, at reasonable cost.

RESEARCH Improves Telephone Service



Bell Laboratories engineer tests how well people will hear over a circuit containing new equipment.

Telephone research began in 1876 in the Boston attic where Alexander Graham Bell carried on his first successful experiments on the "electric speaking telephone." From Bell's modest beginning has evolved the Bell Telephone Laboratories of today, where over 8,000 scientists, engineers, technicians and other specialists constantly seek ways to improve telephone service, widen its usefulness, and keep its cost low.

Some members of the Laboratories are engaged in *pure research*. They explore the physical sciences—physics, mathematics, chemistry—seeking basic knowledge that may contribute to better communications. *Fundamental development* is the second step in the chain leading toward manufacture and use. In the third step, groups engaged in *systems engineering* plan how the new knowledge and discoveries of pure research can be used to create new facilities for telephone service, improve service, or reduce costs. Final step is the specific *development and design* of new systems or products. This involves the construction of laboratory models, trial models, service tests, and preparations for mass production.

This description is, of course, a highly simplified account of the work of the Laboratories. The broad functions of research and development constantly merge. At all times there must be close co-operation among various groups in the Laboratories, between the Laboratories and the telephone companies, where models are tried out, and between the Laboratories and Western Electric, where products are manufactured.

Here is just one example of the way research has extended telephony, improved it, and reduced its cost:

Many years ago, the use of a pair of wires instead of a single, grounded wire greatly improved transmission and made it possible to talk longer distances. This increased the demand for service but also increased the number of wires strung on telephone poles. The large number of wires on towering poles along city streets began to cast shadows of doubt on the prospects for further growth. Compact cables had to be developed and a way found to run them underground. Years of painstaking study and trial accomplished this. Now some exchange cables contain as many as 2,121 pairs of wire.

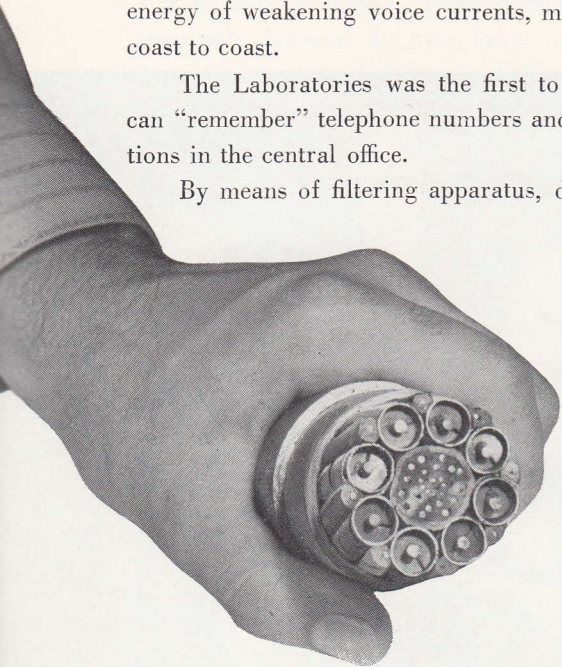
Cable development illustrates the dollar value of telephone research. The standard cable of 1888 contained 50 pairs of wires and cost more than \$150 per pair-mile to install. In 1951, despite rising costs, cable was installed at a cost of about \$12 per pair-mile, and much of it was 2,121-pair.

A FEW MILESTONES IN RESEARCH

Through the years Bell Laboratories has led progress in communications and electronics. No scientific achievement has had more far-reaching effects on communications than the Laboratories' work in the development of the vacuum tube. Bell scientists were the first to devise a practical amplifier tube which, placed at intervals in long distance lines, restored the energy of weakening voice currents, making it possible to telephone from coast to coast.

The Laboratories was the first to develop automatic equipment that can "remember" telephone numbers and perform other complicated operations in the central office.

By means of filtering apparatus, developed by the Laboratories, one



Hardly bigger than a man's wrist, coaxial cable transmits hundreds of telephone conversations simultaneously or carries television programs over intercity networks.

high frequency "carrier" can carry many speech currents at the same time. Largely because of carrier telephony, the Bell System has been able to reduce greatly the cost of long distance telephone service.

The Laboratories pioneered the development of coaxial cable and microwave radio relay systems. Both can be used to transmit television programs and hundreds of telephone conversations.

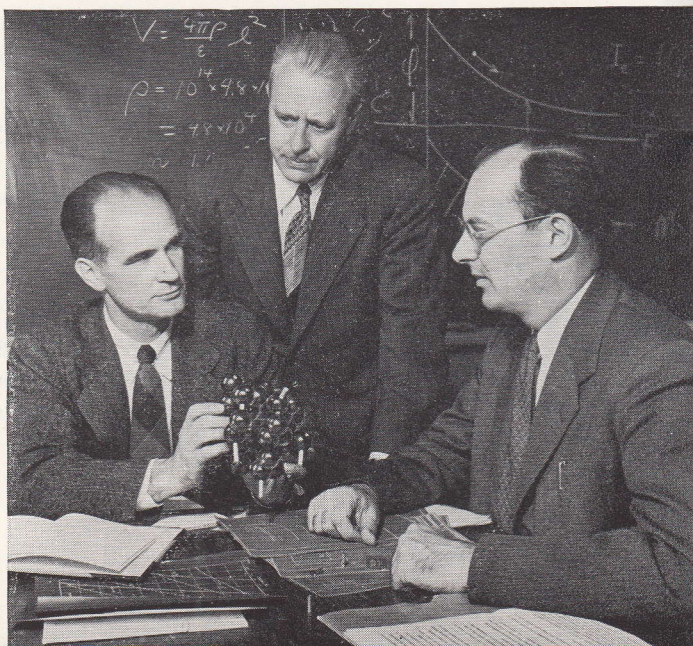
Among the many other achievements of the Laboratories have been important contributions to the design of computers—the amazing electronic machines that can work out problems that might otherwise take months or years of work by mathematicians.

And just recently the Laboratories invented the *transistor*. This is a radically new device, simple in design and tiny in size, that performs most of the functions of the vacuum tube and does other things besides. Its effect on communications technology promises to be revolutionary.

THE LABORATORIES AND NATIONAL DEFENSE

During World War II the Laboratories devoted a major share of its work to military developments, especially in the field of communications, radar, submarine detection, control of gunfire, electronic bombsights and guided missiles. After the outbreak of the Korean conflict, the nation's military program was again enlarged, and the Laboratories now devotes a large part of its efforts to military projects.

Three scientists whose work resulted in the invention of a revolutionary new device, the transistor, "talk shop" at the Bell Telephone Laboratories. Small in size but mighty in its potentialities, the transistor performs many of the functions of the much larger vacuum tube and can do other things.



The Laboratories makes its services available to the armed forces for work to which it is uniquely suited. It specializes in military communications and those instruments of war that depend heavily on communications and electronics.

In carrying out its military responsibilities, the Laboratories follows the same time-tested pattern that guides its Bell System activities. Its military work grows out of *pure research, fundamental development, systems engineering*, and finally specific *development and design*.

Reliability and trouble-free operation throughout long life are objectives of the Laboratories in designing new equipment and products for the Bell System. The same objectives are also very important in designing military equipment. Because of this similarity in the two fields, scientists and engineers in the Laboratories often divide their working days between Bell System and military problems. Personnel moves frequently between the two fields of endeavor. Thus the Laboratories' long experience in the peacetime science of telephony helps strengthen the nation's defense—and discoveries that grow out of military preparedness help strengthen and improve the nation's telephone system.

One of the newest weapons in America's defense arsenal, this guided missile is directed in its flight by electronic controls designed by Bell Laboratories. The control system "tells" the missile just where it should meet and destroy the enemy. Western Electric makes the missile's guiding equipment.



Service of MANUFACTURE and SUPPLY



The manufacture of reliable, standardized telephone apparatus is a major responsibility of another Bell System unit, the Western Electric Company. It supplies to the operating companies telephone equipment of high quality at reasonable prices.

Western Electric also buys for the operating telephone companies supplies that it does not itself produce. Since large quantities are required, this arrangement results in important economies.

Western Electric speeds delivery to the telephone companies of the right equipment and materials, at the right time, from stocks maintained in distributing houses from coast to coast.

Also, specially trained Western Electric forces install for the Bell companies most of the complicated central office equipment required to connect all parts of the telephone system.

Experience has proved the great value of centering these responsibilities in an organization that works as a unit of the System toward the same goals as the telephone companies—a service steadily improving and increasing in value to more and more people.

EVOLUTION OF AN INDUSTRY

In the first few years after the telephone was invented, six different manufacturers made telephone apparatus for the Bell companies. Each



Manufacture of the familiar Bell telephone instrument is centered in the modern Western Electric plant located in Indianapolis. These girls are performing one of the many assembly operations that are required.

produced equipment of different design and quality. It quickly became apparent that progress depended upon standardized equipment of the best possible quality.

In 1882, the Bell System purchased the Western Electric Manufacturing Company. This company had grown out of a partnership formed in 1869 by Enos M. Barton and Elisha Gray. It had specialized at first in telegraph and then in telephone equipment. Ownership of Western Electric gave the System assurance of standardized equipment of high quality, reasonable prices, and a dependable source of supply.

Growing with the System, Western Electric became an enterprise of national stature. Its manufacturing operations are principally in Chicago, Ill., Kearny, N. J., Baltimore, Md., Allentown, Pa., Tonawanda, N. Y., Indianapolis, Ind., and Winston-Salem, N. C.

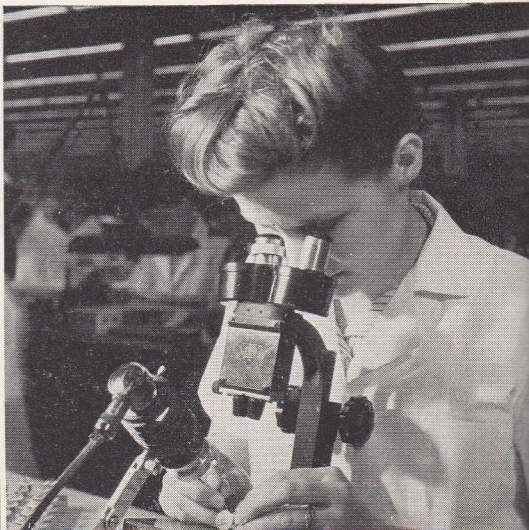
Since the end of World War II, Western has built two new plants that are the last word in industrial efficiency. One is at Allentown, Pa., where electronic equipment is produced; the other is at Indianapolis, Ind., where telephones are manufactured.

The company also has rented or purchased other plants to obtain the manufacturing space required for the dual job of furnishing equipment needed by the armed forces while continuing to meet the requirements of the Bell System.

As manufacturing unit of the Bell System, Western Electric must be ready at all times to produce some 150,000 different kinds of apparatus and component parts for telephone equipment. Each year, about 50,000 of these are required and manufactured. The quantity of each item produced varies from one to as many as 50,000,000. Mass production methods are used wherever possible, but the items required in large quantities are very much in the minority. In a recent year, less than one per cent of the 50,000 products produced were made in quantities of over 100,000. About 30 per cent were made in quantities of less than 10.

SUPPLIES—WHEN AND WHERE NEEDED

Telephone equipment manufactured for the Bell companies in Western Electric plants meets rigid standards of accuracy, precision and endurance. Below, *left*: applying lead sheathing to telephone cable. *Right*: high-powered optical apparatus is needed to maintain the hair-splitting tolerances necessary in making miniature electronic tubes.



Western itself does not make, so that these will meet the Bell System's high standards. Western also helps them develop better production methods.

In a recent year Western Electric purchased from 24,600 large and small suppliers located in 2,300 towns and cities in all the 48 states. Purchases included, in addition to all kinds of raw materials, finished products ranging from pencils and pen points to automobiles and telephone poles.

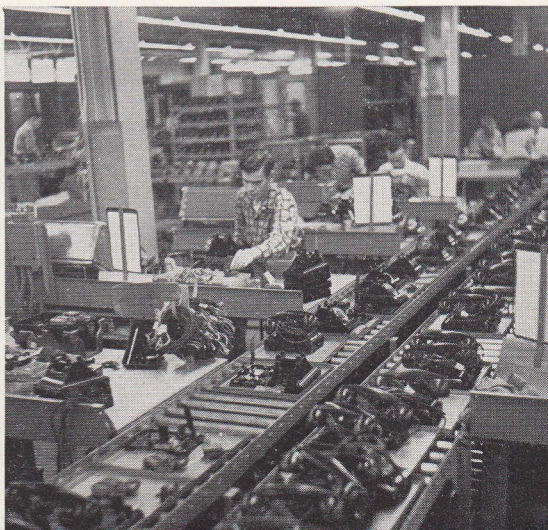
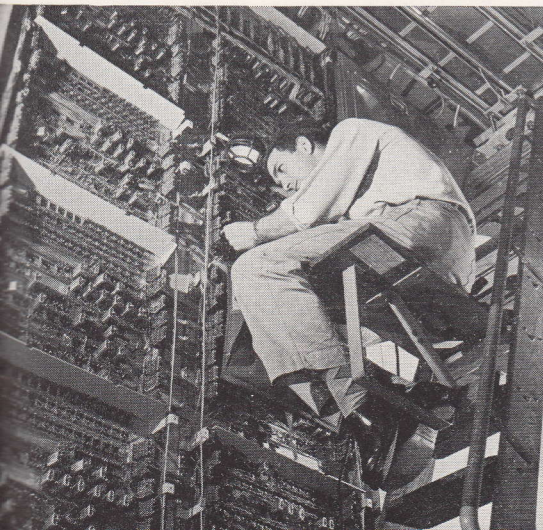
Western Electric maintains 29 distributing houses through which materials flow to the Bell companies. Each is set up to meet the requirements of the telephone company it serves. It works hand in hand with the telephone organization to deliver the goods promptly and efficiently. Each distributing house maintains a repair shop to recondition service-worn telephone apparatus so that it will give good service again, or to dismantle it for salvage. In a recent year the repair shops reconditioned \$100,000,000 worth of used equipment for the telephone companies, including 3,500,000 telephones.

Highly trained Western Electric men install central office equipment for the Bell telephone companies. Altogether, Western Electric is able to supervise all steps in making the equipment ready for use, from purchase of raw materials to finished installation. This assures the telephone companies that new apparatus will give the best possible service.

A NATIONAL ASSET

Time and again the unified service of supply within the Bell System has proved to be a national asset. After hurricanes, floods and fires, when

Below, left: A Western Electric installer, one of a nation-wide team, puts the finishing touches on central office switching equipment for a Bell telephone company. Right: each of Western Electric's 29 distributing houses maintains a repair shop where used telephone apparatus is reconditioned so it will give good service again.



telephone company people go "all out" to restore service, Western Electric swings into action to deliver the needed equipment and supplies. And this equipment is standardized. It is familiar to all telephone people and can be installed quickly anywhere.

Western's productive capacity is ready also in any national defense emergency. Throughout World War II all of the company's resources were devoted to the needs of the United States and its allies for electronic and communications equipment, including radar, sonar and various types of radio equipment.

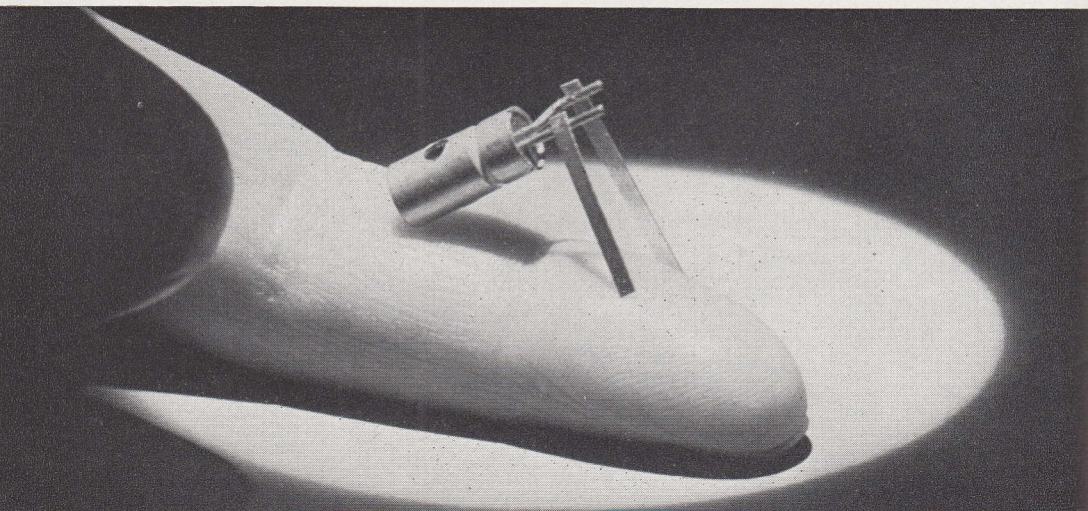
In the present national defense program, Western is not only helping to expand and improve America's telephone system, but is using experience gained in its regular telephone job to supply specialized military equipment to the armed forces.

After World War II Western Electric produced record-breaking quantities of equipment to meet America's telephone needs. It increased its production tremendously to meet the big demand for telephones, willingly undertaking the financial risks of a big expansion program so that the operating companies could serve millions of people faster than otherwise possible.

Since the end of World War II, prices of manufactured goods of all kinds have gone up, but Western Electric prices have gone up far less than the average—as of Fall, 1952, they had gone up less than half as much.

Because it works as a unit of the System rather than toward a separate end of its own, Western Electric plays an essential part in furnishing Americans with the best telephone service at the lowest possible cost.

Perched on a fingertip, this is a "2A" transistor—one model of the astonishing electronic device invented by Bell Laboratories and now being manufactured by Western Electric.





"Mr. Bell, I heard every word you said—distinctly!"

From BELL to Bell System

The telephone we use today is very different in design from the first instrument invented by Alexander Graham Bell, but it works on the same principle. As soon as Bell proved his invention practical, he foresaw it could link homes with offices, sweep aside the isolation of farms, and bind together cities and nations with electrically transmitted speech.

Alexander Graham Bell had prepared himself to follow the professional footsteps of his father and grandfather in the teaching of proper articulation and the correction of speech defects. He became a teacher of speech to the deaf. Early in his training, his investigations into the nature of sound led him to study electricity. It was out of this work, together with his understanding of the organs of speech and hearing, that his invention grew.

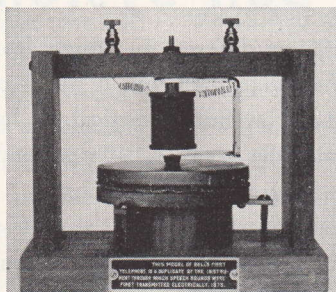
He attempted to apply sound to telegraphy in a device called the harmonic telegraph. He hoped it would transmit several Morse messages tuned at differing levels over the same circuit simultaneously. While he was working with this device, Bell conceived the principle of the telephone.

He told his young mechanical assistant, Thomas A. Watson: "If I can get a mechanism which will make a current of electricity vary in intensity

as the air varies in density when a sound is passing through it, I can telegraph any sound, even the sound of speech."

THE TWANG OF A REED

This idea was clear in Bell's mind by the summer of 1874, but he did not then know how to reduce it to practice. On June 2, 1875, he succeeded in doing so. In adjoining attic rooms at 109 Court Street, Boston, he and Watson were trying out several pairs of harmonic telegraph instruments, each consisting of an electromagnet with a steel organ reed vibrating over it. One reed stuck. Watson plucked it with his finger to start it again, but it did not come free, so Bell heard an unusual sound. Instead of hearing a series of electric pulsations, he recognized the twang of a vibrating reed! He knew then that, as Watson has put it, "he was hearing, for the first time in human history, the tones and overtones of a sound transmitted by electricity." That afternoon Bell directed Watson to make the instrument that was to be the first Bell telephone. This instrument transmitted voice tones, but not until March 10, 1876 did Bell succeed in transmitting an intelligible sentence of speech.



Left: Model of Bell's first telephone. Right: newest Bell telephone, known as "500" set.

THE TELEPHONE TALKS

On the evening of that day, as the young inventor prepared a crude experimental transmitter to try to send his voice over a wire to a room down the hall where Watson was listening, he upset the acid of a battery. It spilled over his clothes. Impulsively, Bell called out, "Mr. Watson, come here; I want you!" An instant later Watson burst into the room shouting "Mr. Bell, I heard every word you said—distinctly!"

Bell exhibited and demonstrated his telephone at the Philadelphia Centennial in June, 1876, where it won the enthusiastic approval of leaders in the scientific world. But the general public showed little interest. The young inventor had no financial backing other than that of Thomas Sanders and Gardiner G. Hubbard. In the fall of 1874 these men had agreed to supply funds for Bell's telegraph experiments in return for a share in whatever patent rights might result from his experiments. His telephone patents were later included in this agreement.

Bell's first telephone patent had been granted on March 7, 1876, but was earning no return. Sanders and Hubbard had advanced all they could. In order to eke out his small personal income as a teacher, and to provide funds for further experimentation, Bell began, early in 1877, to give lectures at which he demonstrated the telephone. These were well attended, and accounts of them were widely published. A few forward-looking people began to realize the usefulness of the telephone. In May, 1877, the first telephones were put into use on a commercial basis. Soon people throughout the country began to inquire about how to get into the telephone business.

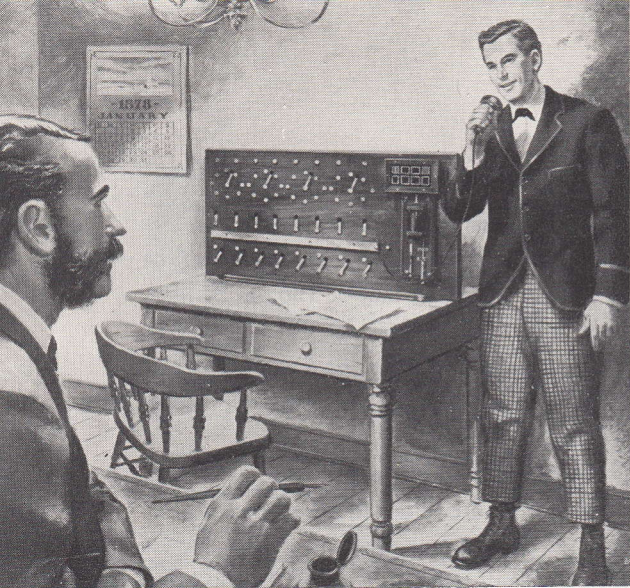
HOW THE BELL SYSTEM WAS FORMED

The commercial development of the telephone had begun and the time had come for a more definite organization than the rather informal arrangement that had been made between Bell, Sanders and Hubbard, into which Watson had by this time been admitted.

This took the form of a trusteeship, instituted in July, 1877, by these four owners of the patents. Hubbard was trustee and virtual executive head of the enterprise. It was he who introduced the policy of leasing instruments instead of selling them and who introduced the system of licenses to authorized agents or licensees throughout the country for the commercial development of the telephone, laying the foundation for the Bell System of today.

Telephones first were leased in pairs. The lessee put up his own wire to connect his telephone with that of a friend or neighbor, or ran the line between his home and place of business. There was no way he could talk by telephone with others in the community who leased instruments.

The interconnection of these individual subscribers awaited the development of the telephone switchboard. The first switchboard was installed in the office of E. T. Holmes, in Boston, in May, 1877, and connected four



Artist's conception of the first commercial switchboard. It was placed in service in 1878 to interconnect 21 subscribers in New Haven, Connecticut. In the early days of the telephone, operators were men.

banks and a manufacturing concern. It connected these few telephones in the daytime by wires that were used for a burglar alarm system at night. New Haven, Conn., became the first city in the world to have a commercial telephone exchange. A switchboard connecting eight lines and 21 subscribers went into service there in January, 1878.

Two years later, in April 1880, the American Bell Telephone Company was organized. It greatly developed the telephone organization and business throughout the country. A line from Boston to Providence was built in 1881. Service between Boston and New York, 235 miles, opened in 1884.

An important step in the attainment of a nation-wide telephone service was the organization of 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.

To attain the ideal of universal telephone service, it became increasingly important to extend the long distance lines even farther, to carry on continuous investigation in the practical development of the telephone art, to make further progress toward the standardization of apparatus, equipment and methods, and to handle economically and efficiently the many general problems shared by the telephone companies. In 1900, therefore, the American Telephone and Telegraph Company took over the assets of the American Bell Telephone Company and became the headquarters company of the Bell System.

The FUTURE Holds Great Promise

Year after year, the Bell System has provided service of steadily increasing value to more and more people. Through times of boom and depression, during all-out war and postwar readjustment, and now in a period of defense preparation, the Bell companies have improved and strengthened the communications network in order to do the best possible job for the nation. Here are some of the accomplishments that have been made in the period since 1920:

- Fast, accurate dial service has been extended to more than three-fourths of all Bell System telephones.

- Sturdy cable lines, capable of carrying thousands of conversations, now reach from border to border, and from coast to coast. These transcontinental cable lines are invaluable for maintaining communications in case of a national emergency.

- A microwave radio-relay route, carrying both telephone conversations and television programs, now spans the nation.

- The regional companies of the Bell System have enlarged their facilities in order to take care of about 148,000,000 telephone conversations per day—four times as many as 1920.

- Drawing Americans closer together, long distance facilities have been expanded in order to handle 2,000,000,000 intercity calls a year, compared to about 270,000,000 in 1920.

- Radio-telephone provides regular service overseas, to ocean liners, coastal and inland watercraft, motor vehicles, trains and airplanes.

YOUR TELEPHONE IS MORE VALUABLE

Your telephone is a much better “buy” than ever before. Many more people now have telephones, and local calling areas have been extended. You can call more people, and more can reach you.

These days, when the cost of nearly everything is higher than ever before, the price of telephone service has remained relatively low. On the average, since the Korean War, the cost of telephone service has gone up much less than the cost of other things you buy.



By pressing keys, these operators dial calls straight through to telephones in distant places.

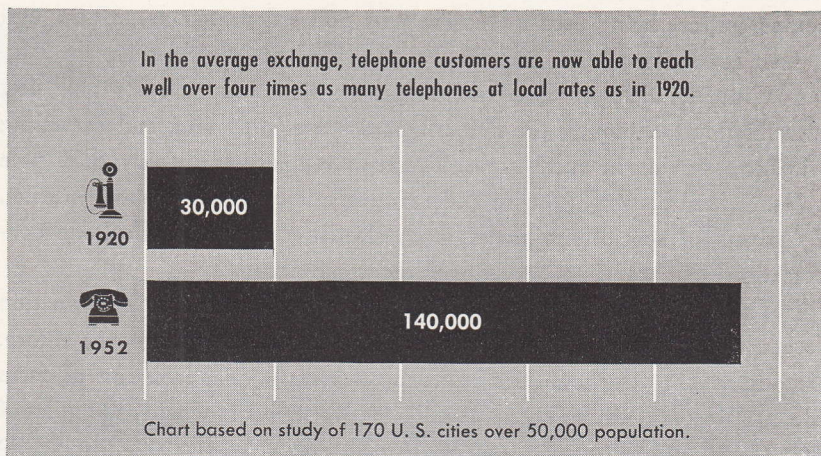
Over the years there has been a remarkable reduction in long distance rates. Between 25 of the principal cities in the country, the average day rate for station calls has dropped from \$6 in 1920 to about \$1.55 today. The day rate for a New York-San Francisco station call has been reduced from \$16.50 to \$2.50. Overseas rates have been cut drastically since the service opened in 1927. A New York-London call that cost \$75 in 1927 now costs only \$12 in the daytime, or \$9 nights and Sundays.

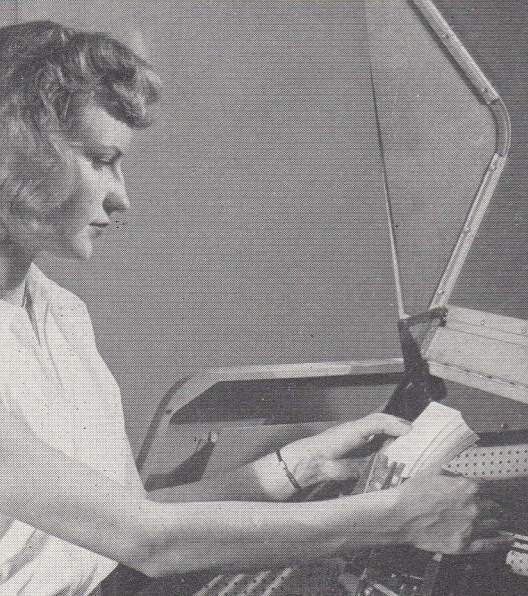
THE GOAL—CONSTANTLY IMPROVING SERVICE

The Bell System strives constantly to improve service. New devices, new systems, promise more and better telephone service at the lowest possible cost.

Dial service is being extended, of course, to more and more communities. Also, new equipment now enables operators to dial many long distance calls straight through to distant telephones without the assistance of other telephone operators along the route. Operator toll dialing networks now crisscross the country, reaching out to more than 1,600 cities and localities. Soon other localities will be joined to these networks.

In the town of Englewood, N. J., a special installation enables customers to dial their own long distance calls to any of 11,000,000 telephones in and around a dozen cities from coast to coast. An “electrical brain” receives the number as it is dialed and completes the call. An automatic accounting





Left: All information for billing toll calls is punched on paper tape by this automatic message accounting machine. *Right:* an ambulance driver talks over a mobile telephone.

system gathers the information for billing. Bell telephone engineers are studying the Englewood installation in order to gather information that will prove helpful in the future, as nation-wide dialing is expanded.

Bell System mobile telephone service is now a reality in most major cities and on many highways. "Traveling telephones" are numerous on ships that ply coastal and inland waterways, and a growing number of passenger trains now offer regular telephone service. In addition, private line mobile telephone systems, leased and serviced by the various Bell telephone companies, are being used increasingly by police departments, utilities and industrial concerns.

With the help of fast, economical construction methods and new transmission techniques, the Bell companies are improving and extending telephone service in rural areas. Power-driven augers quickly drill pole holes. Special plows place wire underground and cover it, in one operation. By means of special equipment, both electric power and telephone conversations can travel to farms over the same wires.

These methods have helped telephone engineers and construction forces put in rural telephone facilities three times faster than ever before. Gradually, the telephone is eliminating the traditional isolation of farm life. Rural localities have been linked by literally tens of thousands of miles of new pole lines, by modern central office buildings, by the most up-to-date

switchboards. Great strides are being made in improving the quality of rural telephone service.

Since the outbreak of the Korean war, the Bell System has taken many steps to make sure that America's defense needs will be met. The telephone companies have a good foundation to build on. Telephone buildings are of unusually strong construction. The entire United States is blanketed by a network of telephone circuits. American cities are underlaid by networks of underground cables, which, as wartime experience in Japan showed, would not generally be destroyed even by atom bombs.

The nation is now spanned—coast to coast, and north to south—by “backbone” communication routes. Calls between cities can be routed over many alternate paths, and destruction of telephone facilities at one point would be like throwing a pebble through a huge spider web. While service at the one point might be temporarily interrupted, the nation-wide communications web would continue to function. Largely because of the strength and flexibility of the telephone network, the basic means of communication in the nation's Civil Defense setup has been built around the telephone.

Throughout America the work of improving and strengthening the telephone system goes on. The goal is to help make the nation invulnerable against attack, and to provide the public with the best possible service, at reasonable cost, in rural communities, in cities, and on intercity routes.

Below, left: Power driven augers help speed the construction of rural telephone lines. Right: Civil Defense activities depend mainly on the telephone for vital communications.



Service in PEACE and WAR

Neither chance nor mere good fortune has brought this nation the finest telephone service in the world. Americans enjoy good telephone service as a result of their own enterprise and common sense.

The people of this nation have learned more and more ways to use the telephone in their daily lives. They have encouraged initiative and invention. They have made the job of providing telephone service a public trust. At the same time, they have given the telephone companies, under regulation, the freedom and resources to do their job as well as possible.

In this climate of freedom and responsibility, the Bell telephone companies have provided service of steadily increasing value. And the quality of service has been steadily improved.

In the years since World War II, the public demand for service has been so great that the Bell System has carried out the most extensive construction program ever undertaken in so short a time by any single enterprise. The people of America made this program possible. Since the war they have invested over five billion dollars of their savings in Bell System securities, and this money has been used to construct new telephone buildings, buy new equipment, and extend service.

There is still a tremendous amount of work to be done. Most important is the Bell System's responsibility in national defense. If an enemy ever attacks America, telephone service will be of the utmost importance to military men, civil defense workers, and the public. At such a time, all the communication systems in the country will concentrate their efforts on serving the disaster agencies and the armed forces. The Bell System regards its role in this service—or the possibility of such service—as its No. 1 responsibility.

Bell System people have a tradition of public service in times of disaster. Hundreds of thousands of Bell telephone men and women are ready to go into action during an emergency. They have had years of experience in maintaining service during floods, hurricanes, and ice storms. Their experience and skill—backed up by the flexibility of the Bell System's network of wire, cable, radio-relay and mobile radio-telephones—make the telephone organization a strong national resource in both peace and war.

In military camps, the "voice with a smile"
helps servicemen keep in touch with home.



