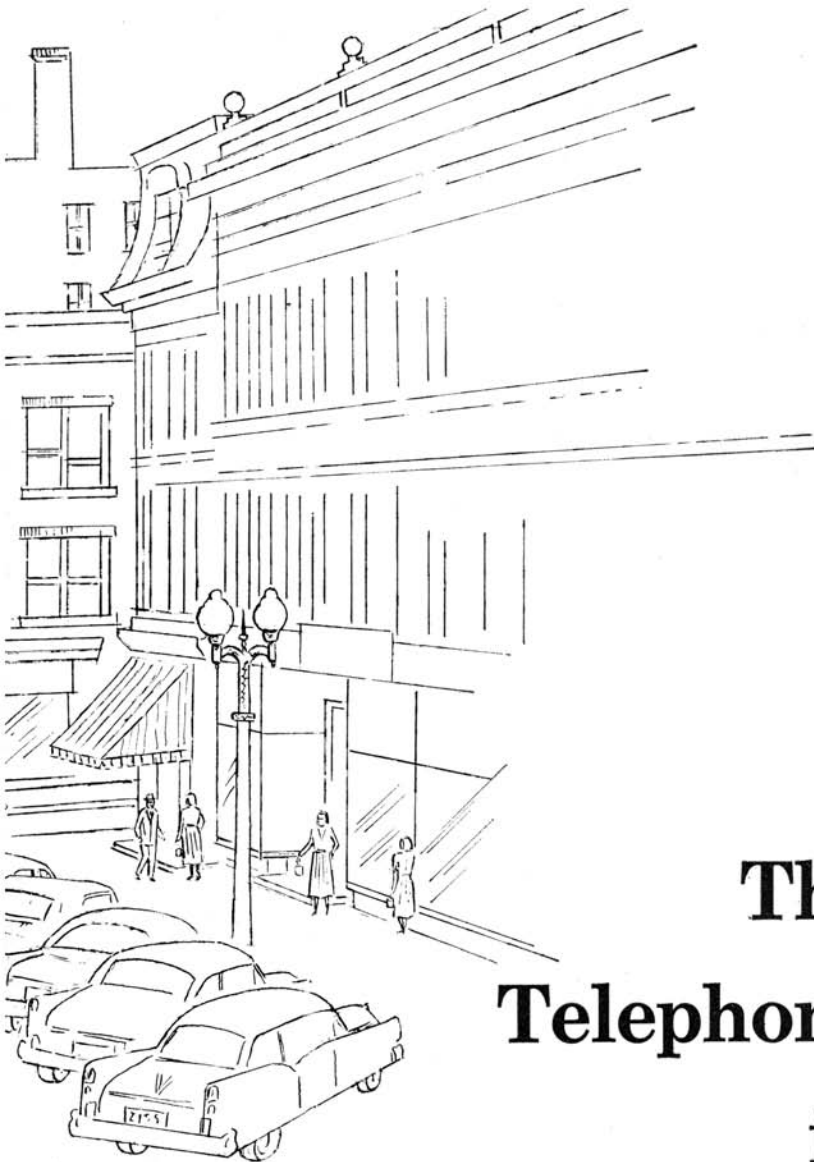


The Telephone in America





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



This radio-relay station on Buckhorn Mountain in Colorado is one of 107 in the Bell System's transcontinental microwave system. Flashed from station to station, telephone calls and television programs first spanned the continent by air in 1951.

The Telephone in America

The telephone was born in America and has reached its highest development in this country. Since 1876, when Alexander Graham Bell first talked successfully over his primitive telephone, a network of voice highways has grown up throughout the nation, linking more than fifty-four million telephones. About four-fifths of these are owned by the Bell System, which is a group of closely associated telephone companies, a research and development organization, and a manufacturing and supply company, all headed by the American Telephone and Telegraph Company. The other telephones are owned and operated by some 5,000 independent telephone companies and about 20,000 rural or farmer lines outside the Bell System but connecting with it.

Bell telephone service is home town service. Linked with thousands of other home town services, it makes a neighborhood of the nation. The company that furnishes your service is part of your community. Its operators, installers and other representatives are your neighbors. Some may be your friends or relatives. Its departments are managed by your fellow citizens—men and women who have come up through the ranks.

Nine out of every ten telephone calls handled by these home town people are local calls. The tenth call may go across the continent or across the ocean. But wherever the calls go, they travel by means of a marvelously ordered world of wires, cables, switchboards, dial equipment, radio and, above all, with the help of people working together to serve the public.

This booklet gives you a personal glimpse of that world. It tells the story of the Bell System, but it should be remembered that much that is said here applies also to the other telephone companies that share with the Bell System the privilege and the responsibility of providing telephone service for the people of America.



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 more than 3,000,000 telephones in rural areas.
- A network of wire linking these telephones. About 95 per cent of this wire is in sturdy cables, and almost three-fifths of the cable is underground.
- More than 25,000 central offices in which telephones are connected by means of switching equipment. Over 9,500 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.

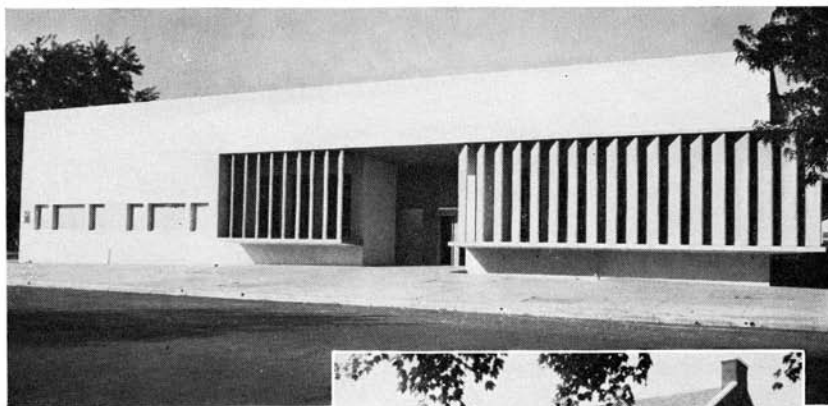
In the telephone office

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.

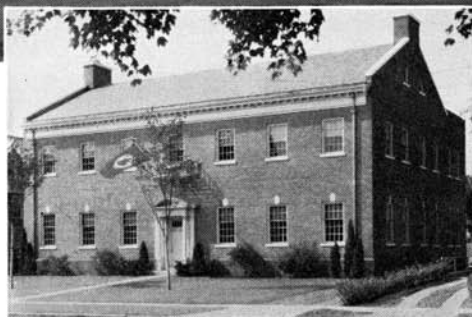
In a small community there may be only one central office. In large cities there are many of them, all joined by trunk lines. The term *telephone exchange* means the whole local area served by one or more central offices.

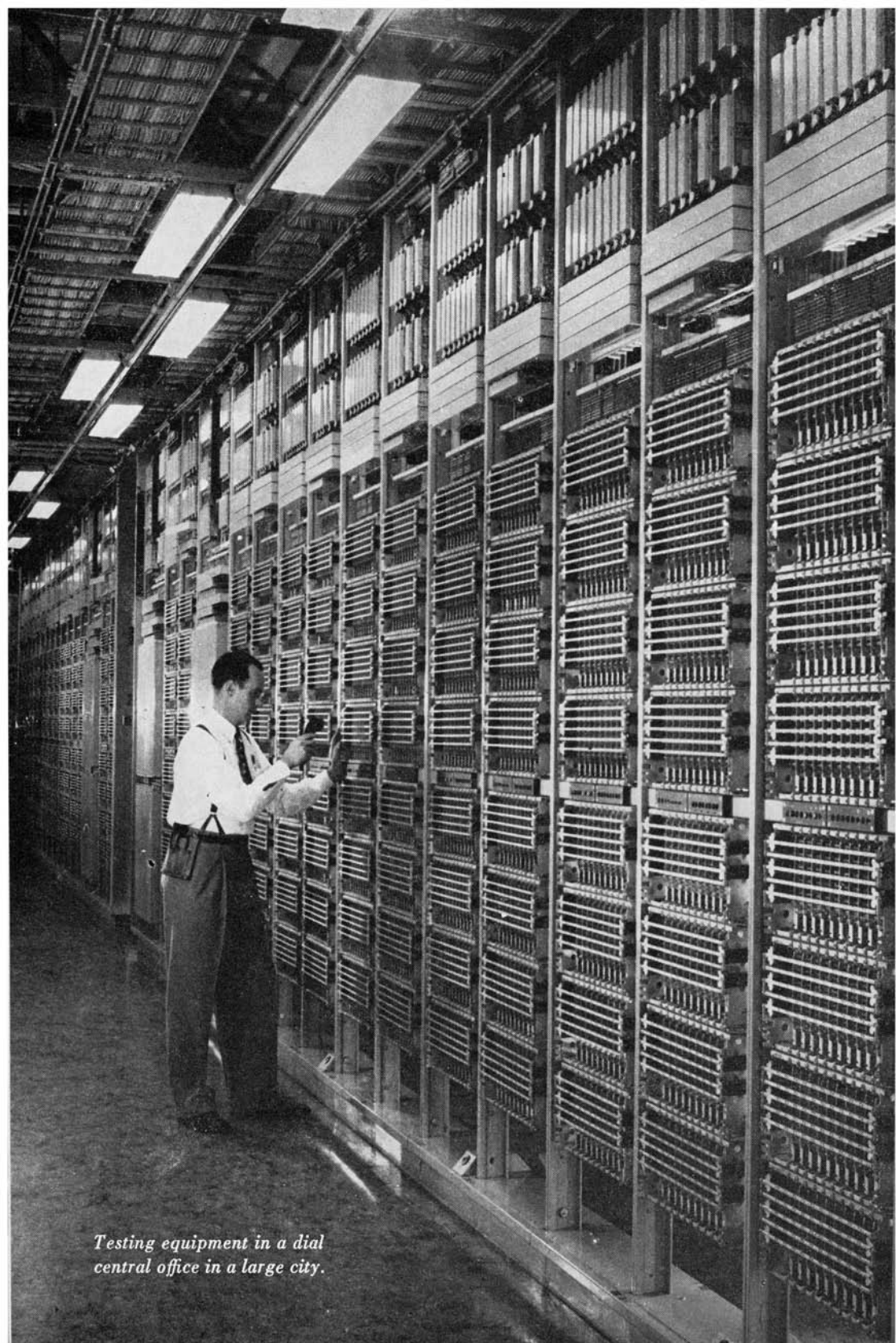
Over four-fifths of all Bell System telephones are dial-operated. Intricate machinery in the central office makes connections by obeying the electrical signals that you send over your line as you turn the dial on your telephone.

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 built to harmonize with surroundings in communities where they are located. Above, a central office in California. Right, another one in Connecticut.





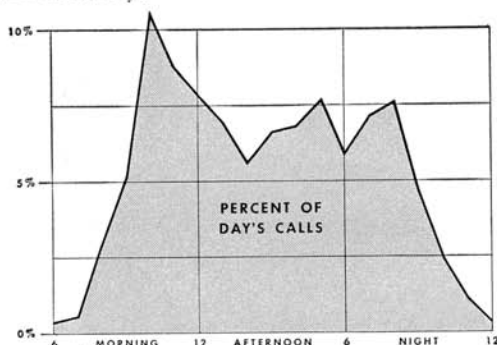
Testing equipment in a dial central office in a large city.

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 the 5,999 others.

Written as well as spoken messages are handled through switchboards. Teletypewriter Exchange Service (TWX) does for the written word what the telephone does for the spoken word. This service transmits typewritten messages over any distance through connections made by operators at switchboards. It is especially valuable for business firms; there are now some 37,000 listings in the TWX directory.

Typical traffic curve

City telephones are generally busiest between 9 and 11 A.M., when business is in full swing. There is another business peak between 4 and 5 P.M. Residence telephones are usually busiest about 7 P.M.



Operators, who answer when you dial "O" (operator), will lend a hand if you need help in calling from a dial telephone.

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 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.

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



Left, splicers "cutting in" wires in a new cable, below the street in manhole. Right, Bell telephone installer connects drop wire to new subscriber's home.

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.

Ringing 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 vital in furnishing dependable, satisfactory telephone service. Telephone men periodically check the condition of telephone plant. Using steadily



Technicians check for trouble at a test desk in a central office. Preventive maintenance, outside as well as inside telephone offices, helps provide good service.

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 department, linemen, installers, cable splicers, repairmen and others build and maintain the plant so that the operators in the Traffic department can

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





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

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.

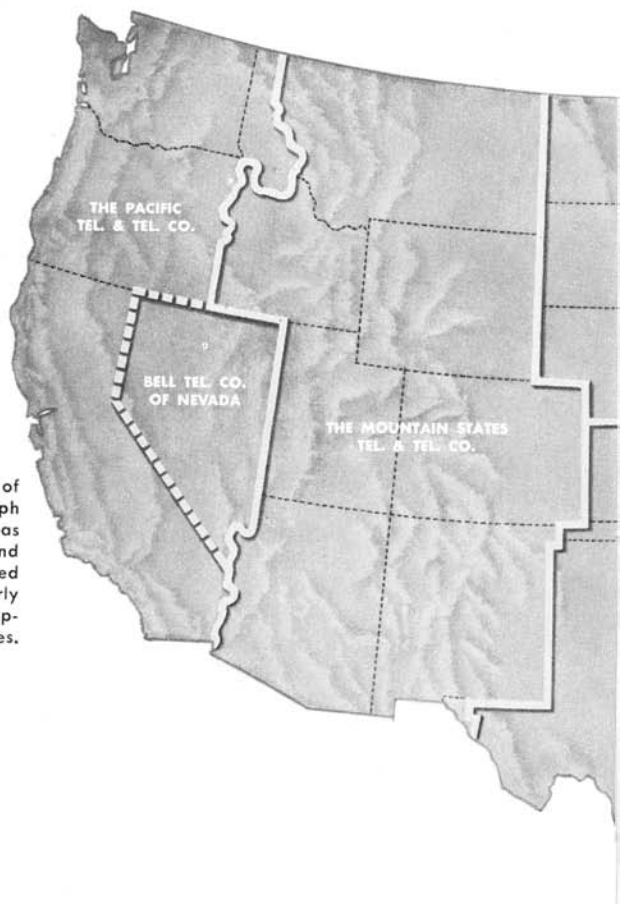
In every Bell telephone company there are staff people who are specialists in various phases of the business. They assist the front-line forces in meeting day-to-day problems. They find better, more efficient ways of doing things.

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 245,000 of them have been in the business over ten years. Wages are good, employment steady, and working conditions are pleasant. The Bell companies' Benefit and Pension Plans, among the oldest and best in industry, assist 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.

THE BELL TELEPHONE SYSTEM

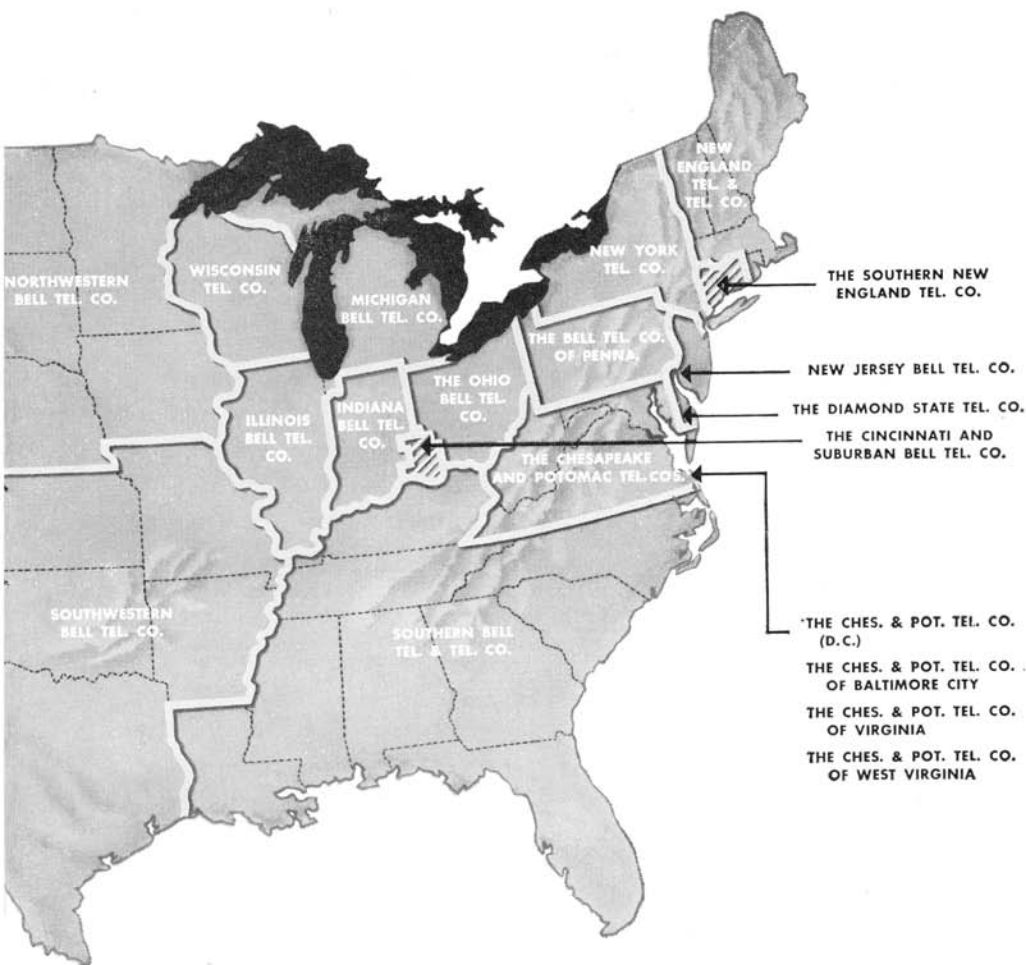
The principal telephone subsidiaries of American Telephone and Telegraph Company serve generally the areas shown. The Southern New England and Cincinnati and Suburban are associated but non-controlled companies. In nearly all areas other telephone companies operate and connect with Bell System lines.



Organized to Serve You

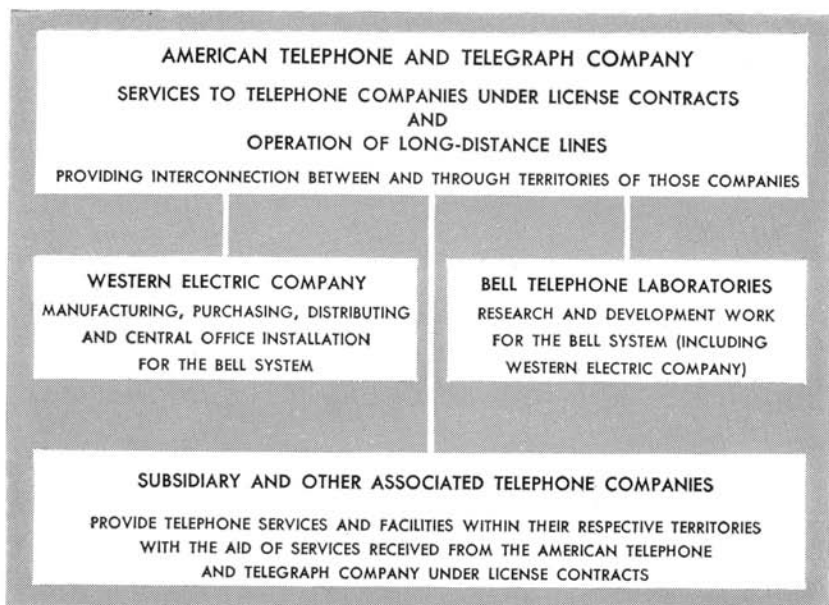
As a telephone user, you want to be able to count on your telephone, to be able to call other telephone users any time, anywhere. You expect reliable service at low cost. The kind of service you expect depends on teamwork—among telephone people in your local company, and among the separate companies that make up the Bell System. That 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



Principal elements of the Bell System

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 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.

Motor launches pull first segment of the new transatlantic telephone cable toward the Newfoundland shore from HMTS Monarch, world's largest cable ship. The new underseas cable will link this continent with Great Britain.

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 responsible as well for overseas telephone service to points in countries abroad.

More than 337,000,000 conversations a year are handled over Long Lines facilities. To handle this volume of conversations and its various other services, Long Lines requires:

- About 27,000 highly trained telephone employees, including operators, engineers, maintenance men, construction forces, Commercial and Accounting people in 40 states and the District of Columbia.
- Telephone central office forces in 233 cities and towns.
- Telephone equipment and plant, including almost 2,400 buildings, in all but one state.
- About 27,000,000 miles of talking circuits.

Nine years after the telephone was invented, when the farthest one



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.



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 more than 100 countries and territories overseas, and it is possible now to reach some 96% of the world's telephones from any telephone in the United States. Today, overseas conversations take place at the rate of over 1,000,000 a year. Overseas centers in New York, Oakland and Miami furnish the overseas radiotelephone service, handling calls in much the same way as other long distance calls.



A Bell Laboratories and a Long Lines engineer check the quality of a full-color picture at a special monitoring position in one of the Bell System television network control centers.

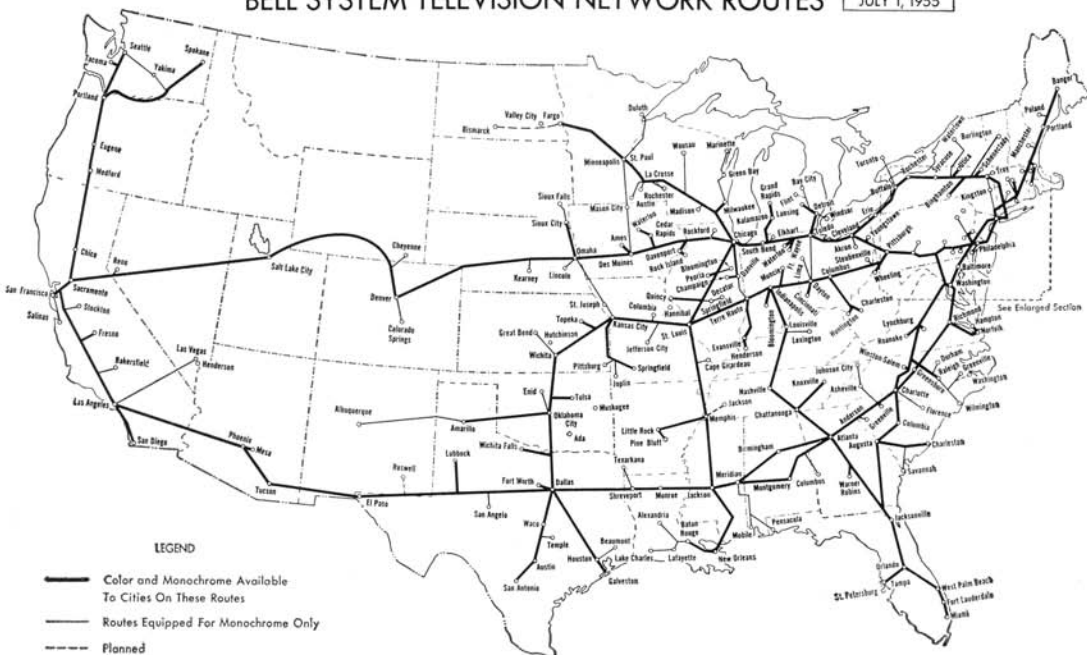
Now, to handle more calls and for greater dependability in telephoning between this continent and Great Britain, the first transatlantic cable is being built. Another cable is being built to Alaska. Each will be able to carry 36 conversations at a time, and will be immune to atmospheric disturbances that sometimes affect radiotelephone circuits. There is also a new method of radio transmission, called "over-the-horizon," soon to be introduced between Florida and Cuba. This will provide needed additional telephone channels and will also open up the possibility of television service over the route.

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. The Bell System's experience in serving radio networks dates from 1923, when network broadcasting began. Today, in order to link the nation's radio stations, Long Lines operates about 200,000 miles of program transmission circuits. And within their own territories, the operating telephone companies, too, furnish some program circuits.

Bell System scientists pioneered also in sending television images from one place to another, by both wire and radio. The years of experience in serving radio networks have been invaluable in solving the problems of TV network transmission. As of July, 1955, the System linked about 365 TV stations in about 240 American cities. To keep pace with the latest developments, the nationwide TV network has been equipped for color programs, which are available to over 230 stations in about 130 cities.

BELL SYSTEM TELEVISION NETWORK ROUTES JULY 1, 1955



Other “Custom-tailored” services

Long Lines and the operating companies also provide extensive private line services—that is, service for customers who have a large enough volume of communications between two or more points to need facilities for their exclusive use, tailored to their individual requirements. The private line services are provided by means of both wire and radio, for a specified period of time and usually on a recurring basis. Many American industries, the press and governmental agencies use these services, which include telephone, teletypewriter, teletypesetter, radio and television network transmission, facsimile and telephotograph.

Teletypewriter service transmits typewritten messages from one point to another, whether the sending and receiving machines are in the same building or across the continent. *Teletypesetter* service, by means of electrical impulses sent over Bell System circuits, makes it possible to set type for newspaper or other publication use speedily and from a distance. *Facsimile* service reproduces documents, drawings and maps at the distant end and *telephotograph* service does the same for pictures.

"General Staff" services benefit all

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.

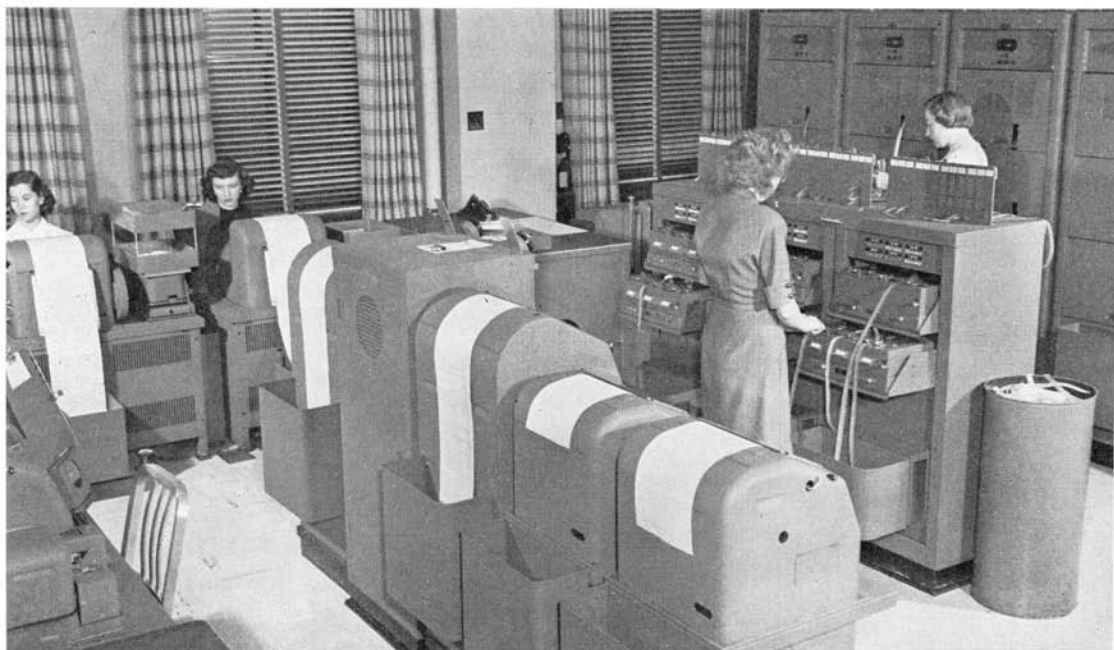
This contractual relationship is an outgrowth of the original licensing arrangement, in which the first telephone companies obtained instruments for the use of their subscribers. It was founded on the necessities of the business. It exists today for the same reason.

To meet this responsibility, AT&T is organized to serve the operating companies in 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

Placed in service by Long Lines, this teletypewriter system is the "nerve center" of a large business having main offices located in many states.



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.

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.

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.

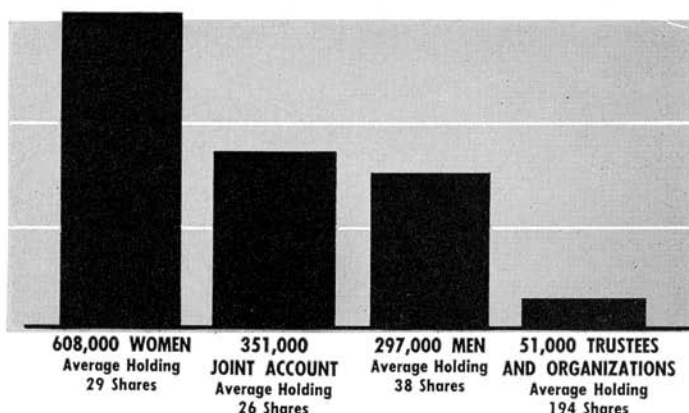
By mid-1955 AT&T was owned by about 1,375,000 people. These owners live in all parts of the country, in large cities, small towns and rural areas. They are truly a cross-section of America.

Many AT&T share owners are long-time investors. More than a fourth of them have owned their AT&T stock ten years or more. And over 60 per cent of these have increased their investment during those ten years.

About 351,000 of the shareholdings represent two persons — husbands and wives, mothers and daughters, sisters and brothers — who have invested savings in their joint names.

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

DISTRIBUTION OF A. T. & T. SHARE OWNERS END OF 1954



More than 200,000 Bell System employees own AT&T stock purchased under payroll savings plans. Many of these, together with other employees, are now buying shares under the current payroll savings plan.

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

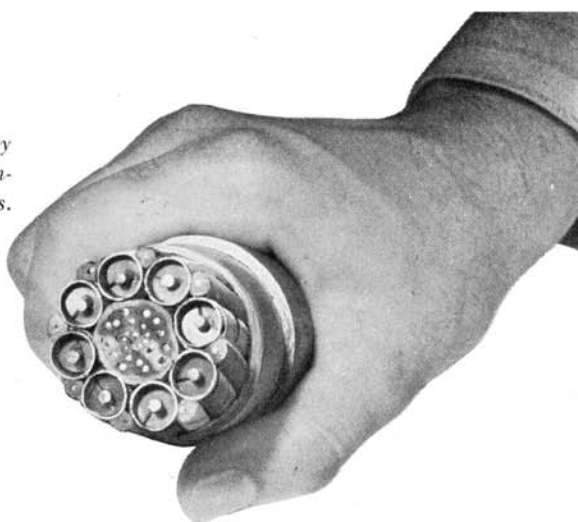
Ideals and aims

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 delays—service that enables anyone, anywhere, to pick up a telephone and talk to anyone else, clearly, quickly, at reasonable cost.

Coaxial cable can simultaneously transmit hundreds of telephone conversations and several TV programs.



Research Improves Telephone Service

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 9,000 scientists, engineers, technicians and auxiliary personnel constantly seek ways to improve telephone service, widen its usefulness, and keep its cost low.

Some members of the Laboratories are engaged in *basic 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 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 and development have 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.

This cable evolution illustrates the dollar value of telephone research and development. The standard cable of 1888 contained 50 pairs of wires and its installed cost was more than \$150 per pair-mile. In 1954, despite rising costs, underground cable cost in the order of \$20 per pair-mile in place, 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 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.

A few years ago, scientists at 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.

Early in 1954, the Laboratories announced a device that realizes one of the ancient dreams of mankind — the Bell Solar Battery, which converts the sun's light directly into useful amounts of electricity. Research that led to the transistor led also to the battery — and to a tiny and durable switch that one day may handle the automatic switching of your telephone calls, and other things not yet imagined.

The Laboratories and national defense

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 *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

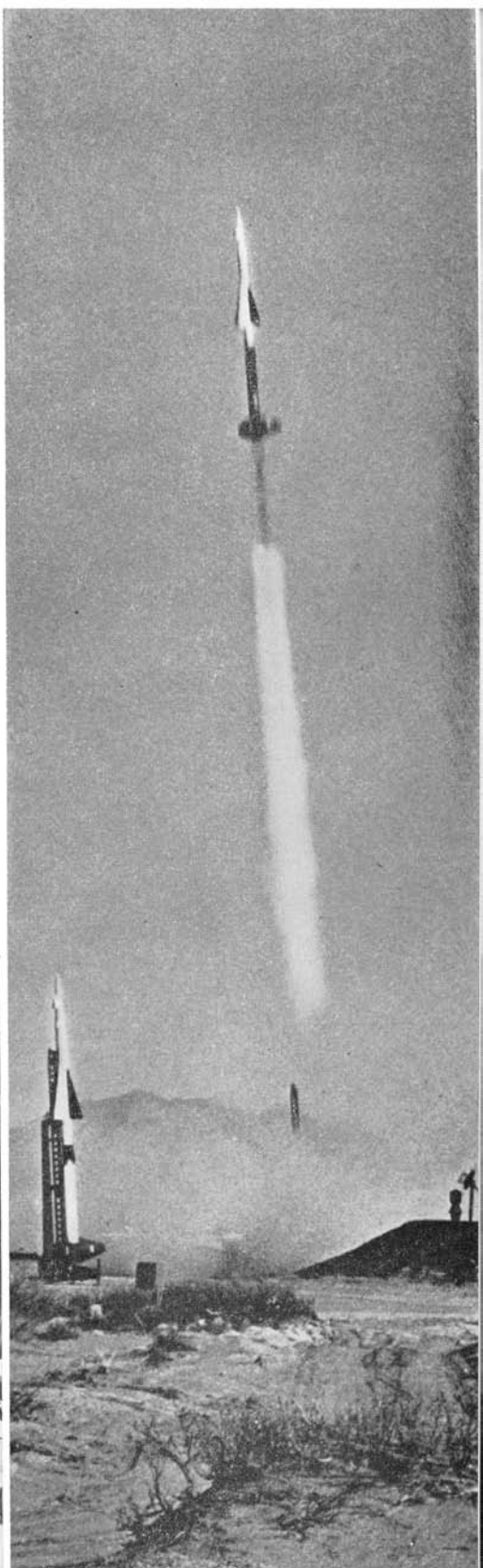
Bell Telephone Laboratories at Murray Hill, New Jersey



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.

***Right, "Nike,"** one of the new weapons in America's defense arsenal. This guided missile is directed in flight by electronic controls designed by Bell Laboratories and made by the Western Electric Company.*

***Below,** scientists responsible for the invention of the Bell Solar Battery examine its characteristics at Bell Laboratories.*



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.

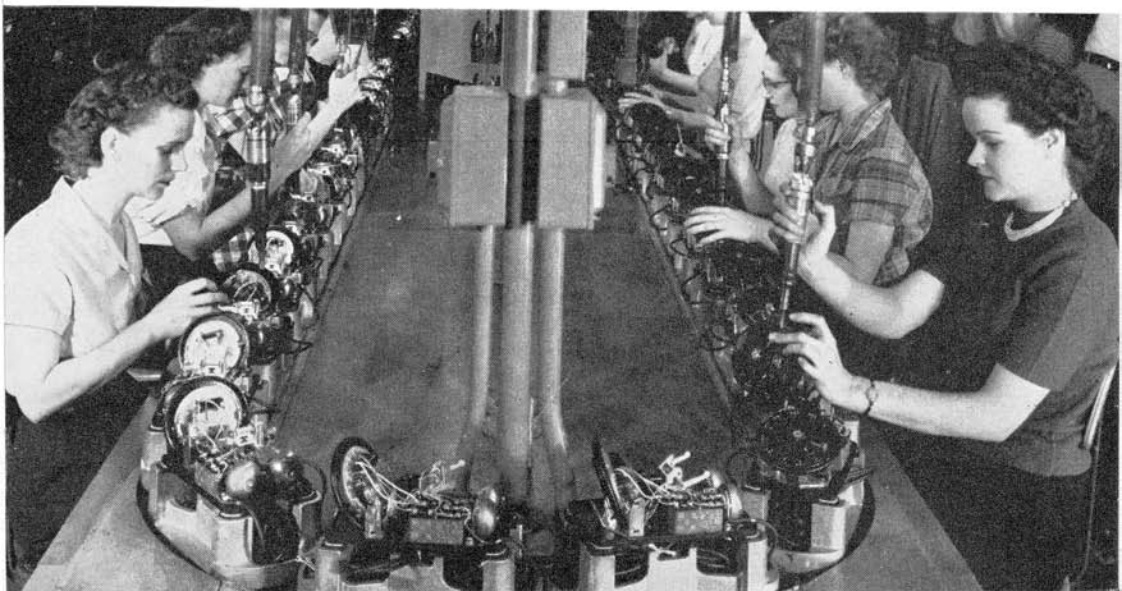
Western Electric also buys for the operating telephone companies supplies that it does not itself produce. Since large quantities are required, this arrangement results in important economies.

Western Electric speeds delivery to the telephone companies of the right equipment and materials, and 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.

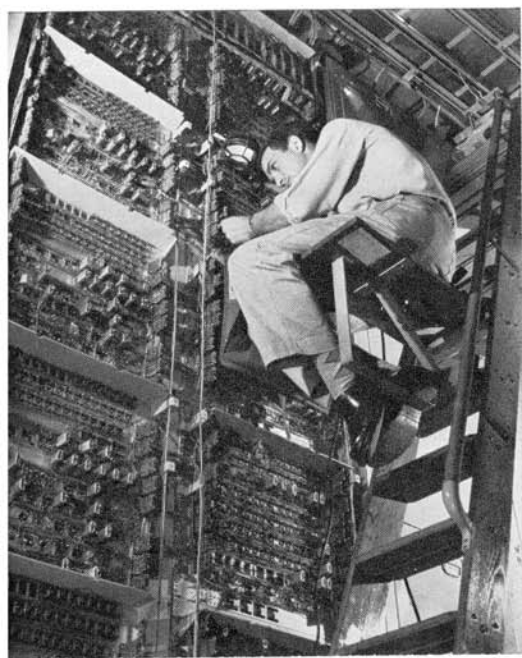
One of many assembly operations in making Bell telephones at a Western Electric plant in Indianapolis. One-fifth of these sets are now produced in colors.



Evolution of an Industry

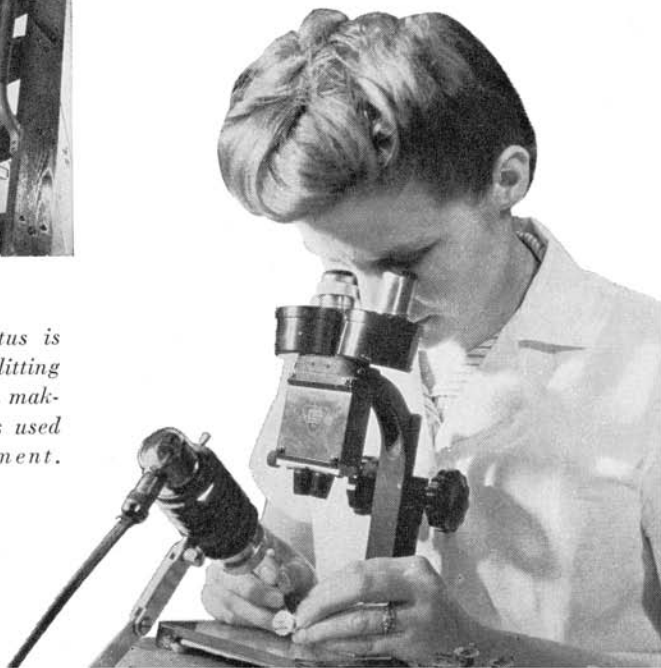
In the first few years after the telephone was invented, six different manufacturers made telephone apparatus for the Bell companies. Each produced equipment of different design and quality. It quickly became apparent that progress depended upon standardized equipment of the best possible quality.

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.



A Western Electric installer, one of the members of a nation-wide team, puts the finishing touches on new central office switching equipment installed for a Bell telephone company.

High-powered optical apparatus is needed to maintain the hair-splitting tolerances that are required in making miniature electronic tubes used in communications equipment.



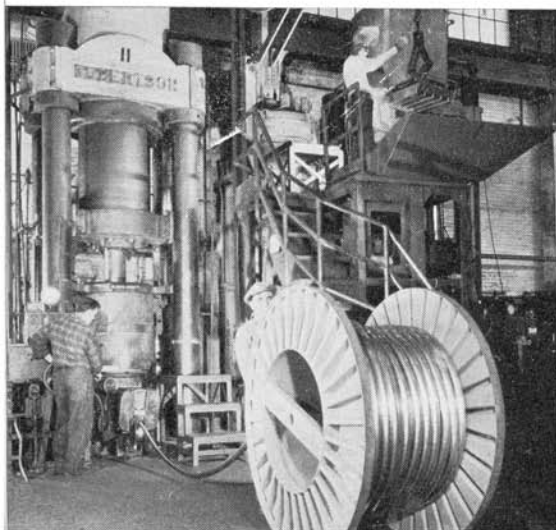
Growing with the System, Western Electric became an enterprise of national stature. Its manufacturing operations are principally in Chicago, Ill., Kearny, N. J., Baltimore, Md., Allentown, Pa., Tonawanda, N. Y., Indianapolis, Ind., and Winston-Salem, N. C.

In the years since World War II the company's manufacturing facilities have undergone an almost continuous modernization and expansion. In addition to building a number of new factories, the company has rented or purchased other plants to obtain the manufacturing space required for the dual job of furnishing equipment needed by the armed forces and continuing to meet the requirements of the Bell System.

A complex manufacturing job

As manufacturing unit of the Bell System, Western Electric must be ready at all times to produce over 200,000 different kinds of apparatus and component parts for telephone equipment. Each year, about 70,000 of these are required and manufactured. The quantity of each item produced varies from one to many millions. 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 products manufactured were made in quantities of over 100,000. About 30 per cent were made in quantities of less than 10.

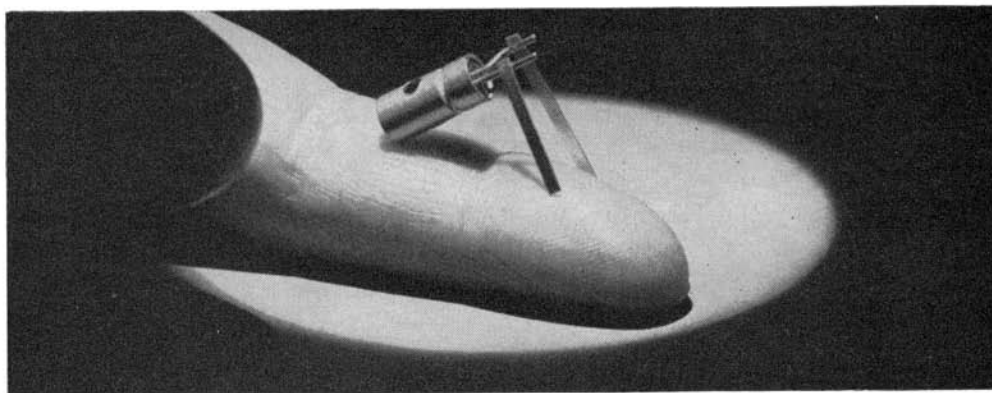
Left, applying lead sheathing to telephone cable. Right, each of Western Electric's 29 distributing houses maintains an efficient repair shop where service-worn telephone apparatus is reconditioned so that it will give good service once again.



Because telephone equipment must be tailor-made—much of it in small quantities—it is necessary for the manufacturing and supply unit to have intimate knowledge of Bell System plant everywhere. And since telephone plant must give trouble-free service 24 hours a day, telephone equipment must be of the highest quality and built to exact, uniform standards. Experience has proved that the design, manufacture and operation of standard telephone equipment can be accomplished best when the designers, the makers, and the operating people work closely together on the same team.

Supplies—when and where needed

Western Electric's purchasing people constantly study world markets, prices and potential sources of raw materials and finished products. They work closely with suppliers that provide equipment and supplies that



A fingertip view of a "2A" transistor, one model of the astonishing electronic device invented by Bell Laboratories and now being produced by Western Electric.

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 28,000 large and small suppliers located in over 3,000 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 operates 29 distributing houses through which materials flow to the Bell companies. Each house is set up to meet the supplies requirements of the telephone company it serves. It works closely 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, if not economical to repair, to dismantle it for salvage. In a recent year the repair shops reconditioned over \$155,000,000 worth of used equipment for the telephone companies, including 5,400,000 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 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.

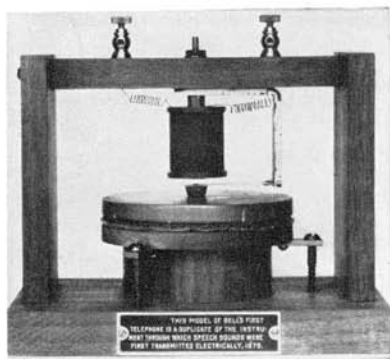
In the present national defense program, Western is not only helping to expand and improve America's telephone system, but is using experience gained in its regular telephone job to supply specialized military equipment to the armed forces.

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 the end of 1954, 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.

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.

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 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.

Artist's conception of the first commercial switchboard, placed in service in New Haven, Conn., in 1878. In the early days of the telephone industry, operators were men.



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 four-fifths 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 160,000,000 telephone conversations per day—more than four times as many as in 1920.
- Drawing Americans closer together, long distance facilities have been expanded in order to handle more than 2,600,000,000 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.



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

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.

In the average exchange, telephone customers are able to reach over five times as many telephones at local rates as in 1920.

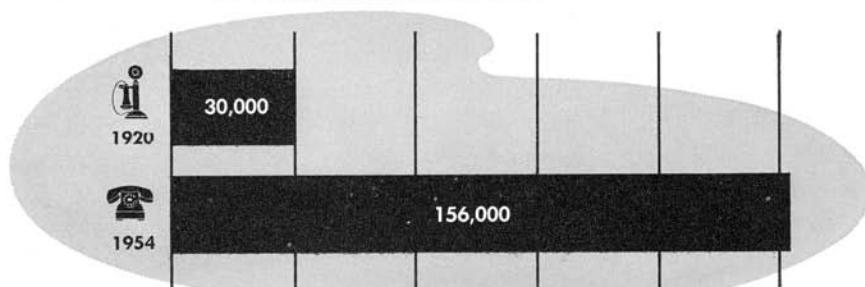


Chart based on study of 170 U. S. cities over 50,000 population.

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 long distance dialing networks now crisscross the country, reaching out to about 3,600 cities and

localities. Other localities are constantly being joined to these networks.

In more than 40 towns special installations enable customers to dial long distance calls directly to more than 14,000,000 telephones from coast to coast. An "electric brain" receives a number as it is dialed and completes the call. An automatic accounting system gathers the information for billing. Bell telephone engineers plan the extension of this Direct Distance Dialing to serve the whole nation in a decade or so.

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

Left, information for billing toll calls is punched on paper tape by automatic message accounting machine. Right, ambulance driver talks over mobile telephone.



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.

With the steady pressure of world tensions, 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. 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.

Left, power driven augers help speed construction of rural telephone lines. Right, Civil Defense air raid warning network relies mainly on telephone communications.



Story without an ending

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

The people of this nation have found 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, and through 1954, they have invested about seven 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.

Now, some ten years after the war, the term "extend service" means much more than being able to provide a telephone for those who want it. Today, the telephone in America has gained many new dimensions as the Bell System offers more and more things to meet the wants of the American people—things that add even more variety and convenience to its service. Telephones in attractive colors that blend or contrast with any decorative scheme; telephones with illuminated dials that can be seen in the dark; telephones with push buttons to answer as many as six lines; equipment that will automatically answer calls when no one is in, and give and take recorded messages—these are only a few of many.

Bell System men and women, with experience and skill, backed by the great flexibility of their communications network, are writing the story of steadily improving telephone service—a story that will have no ending.



