

WESTERN ELECTRIC

A CENTURY OF

A CENTURY OF

**A CENTURY OF
COMMUNICATIONS
SERVICE**

COMMUNICATIONS

SERVICE

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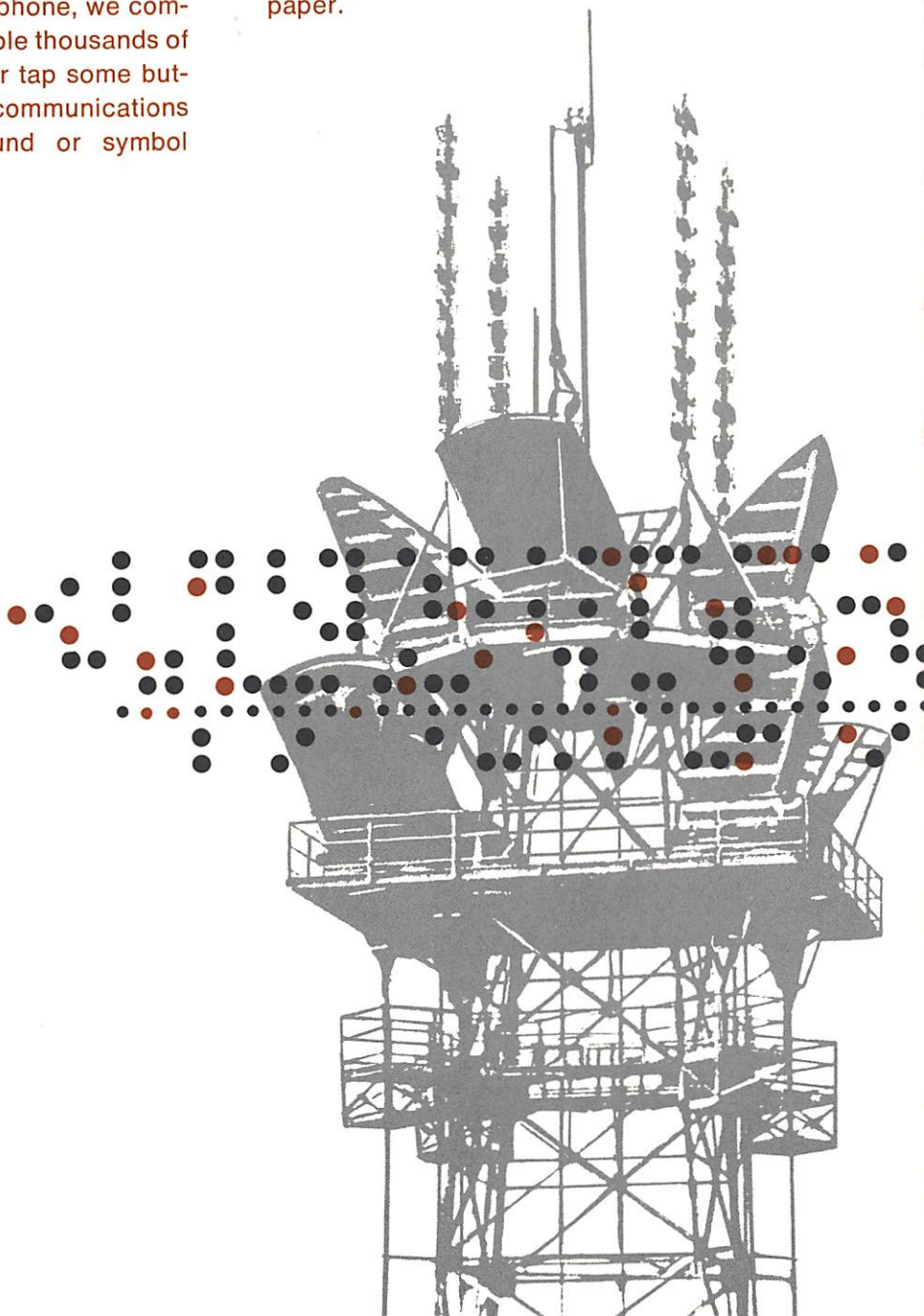
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Alexander the Great sent messages to his field commanders by dispatching men on horseback. So did George Washington, more than two thousand years later. Two thousand years had passed with no significant development in communications technology.

Today, one hundred years after Alexander Graham Bell invented the telephone, we communicate—instantly—with people thousands of miles away. We twirl a dial—or tap some buttons—and we activate a vast communications network that can send sound or symbol

through any of 5 million billion possible connections to any of a hundred million locations throughout the country.

Some of the components in this network—the Bell Telephone System—operate in 40 nanoseconds (40 billionths of a second). In that time a 600-mile-an-hour jet would travel a distance about equal the thickness of this paper.



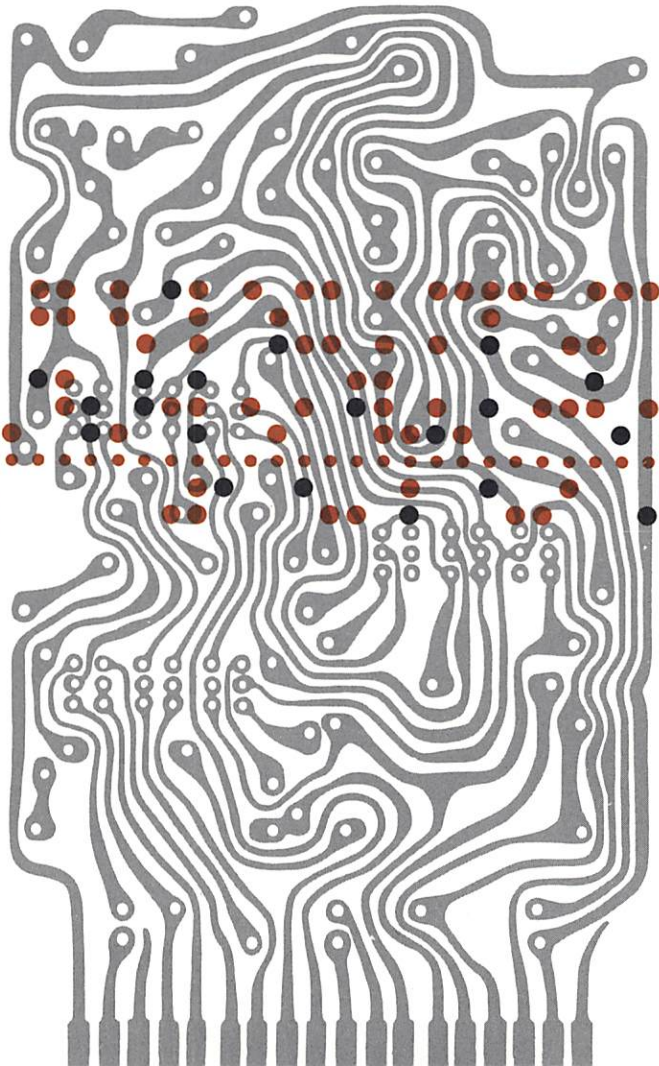
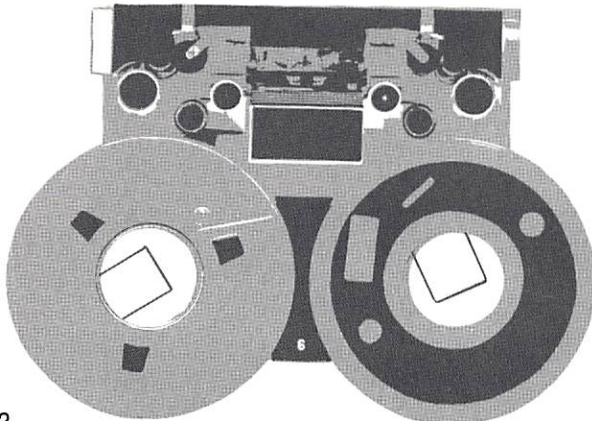
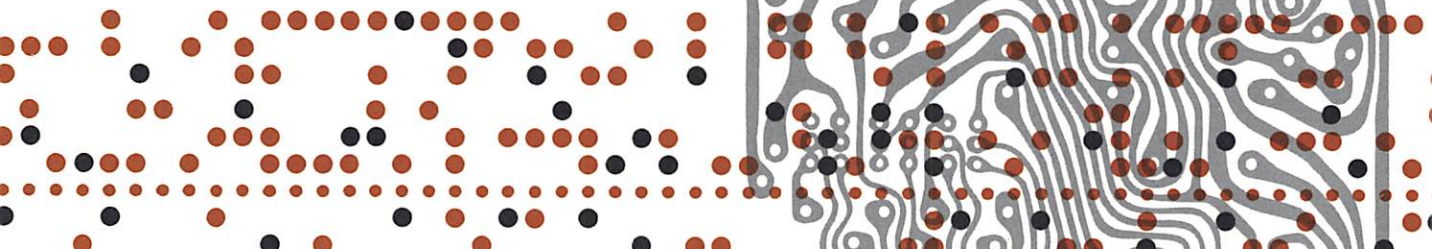
Because of the extent of the Bell System, and the speed and efficiency with which it operates, the United States has the finest communications service in the world. In part, the quality of our nation's life depends on that service.

And yet, in this era of incredible technological change, it is not enough merely to maintain excellent service. The Bell System must anticipate the future, and—through a spirit of constant innovation and advances in the science of communications—be able to provide the new and expanded services to meet the demands of that future.

Picturephone® or see-while-you-talk service is already a functioning reality. Touch-Tone® dialing and Electronic Switching Systems are already commonplace.

With Touch-Tone dialing, the telephone subscriber can have access to the wonders of the computer. Some day, this combination will . . .

- Help children with homework . . .
- Provide background information for decision making and report writing . . .
- Help prepare tax returns . . .
- Pay monthly bills automatically.



Shopping by telephone might become routine. Dial a favorite store for a Picturephone fashion show, make a choice and arrange for payment over the phone.

Telephones will probably be able to start coffee percolating, lock the front door, turn on the lawn sprinkler or turn out the lights . . . all from a car or long distance.

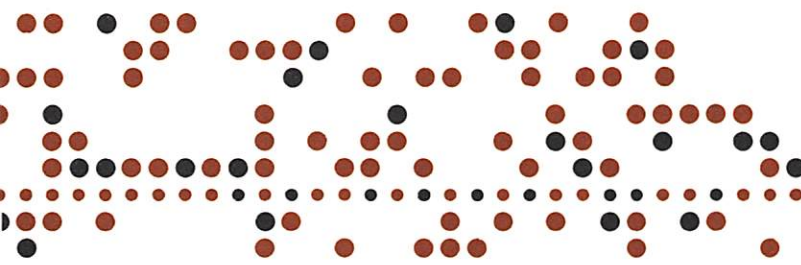
Whatever the capabilities of tomorrow's telephone and the communications network through which it operates, they will be entirely dependent upon the *manufacturability* of new products and components.

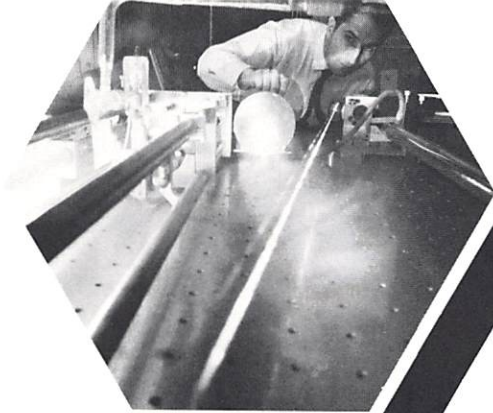
It is the job of Western Electric to turn

these dreams of the future into working realities . . . into equipment that will function with the existing network . . . and at a cost that will make the new developments available to all.

Western Electric—organized in 1869—is the manufacturing and supply unit of the Bell System.

In the following pages is the story of how Western Electric performs its essential communications role of serving the American people through the Bell System.





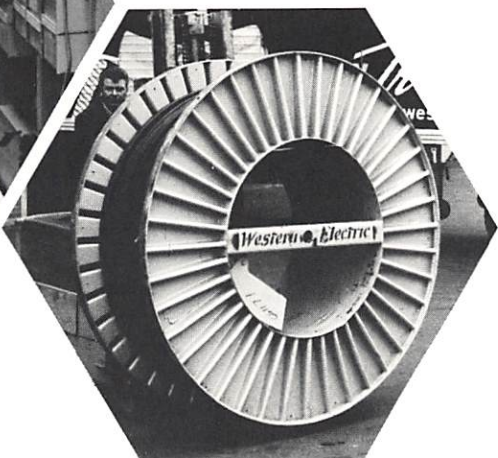
AT&T

**BELL
TELEPHONE
LABORATORIES**

**BELL
TELEPHONE
COMPANIES**

**WESTERN
ELECTRIC**





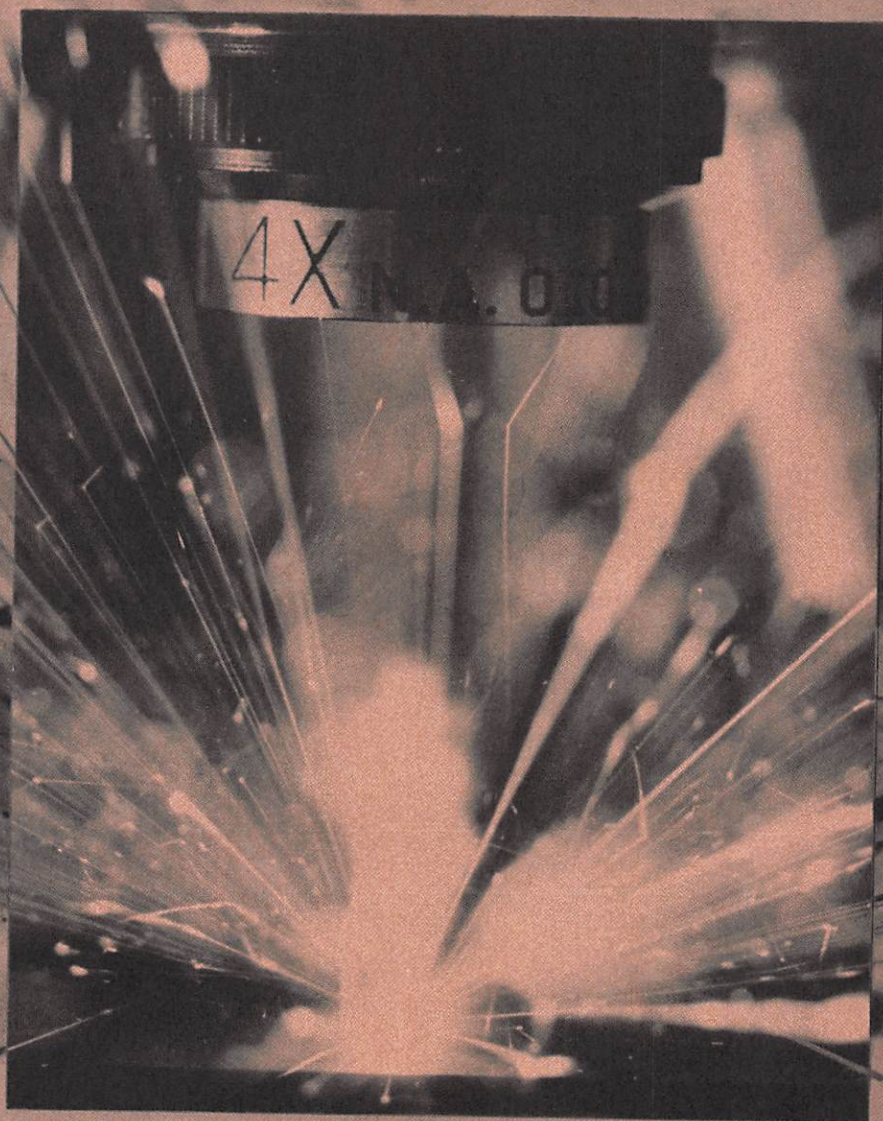
THE BELL SYSTEM is not only a group of companies in the telephone business . . . it is also a network of millions of miles of communications circuits . . . over a hundred million telephones and other communications devices feeding into thousands of central offices handling billions of telephone calls a year, thousands of television programs and uncountable bits of data.

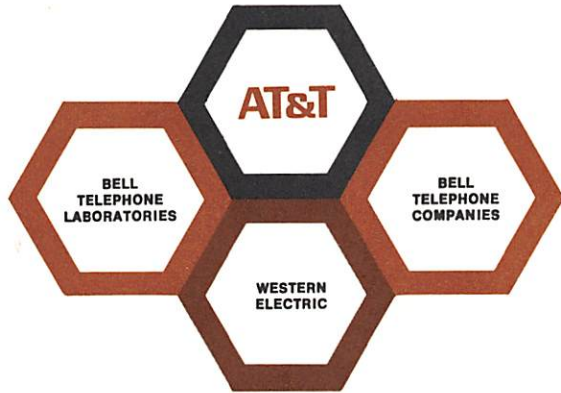
The Bell System network is of incredible size and complexity. The job of keeping it running and expanding to meet the country's needs is tremendous.

The Bell System works because it is harmonious—all the parts work together. The Bell System companies work closely together. And, as the telephone switching system grows and improves, new equipment is designed and manufactured to mesh with old. Everything is part of the same unit.

Western Electric makes and buys the parts of the unit. These parts can be as commonplace as the telephone, as exotic as the thin film circuit, as large as an equipment bay or as small as a microscopic transistor.

Western Electric also distributes, installs and tests equipment for the Bell telephone companies . . . and, when necessary, Western Electric services and replaces it.





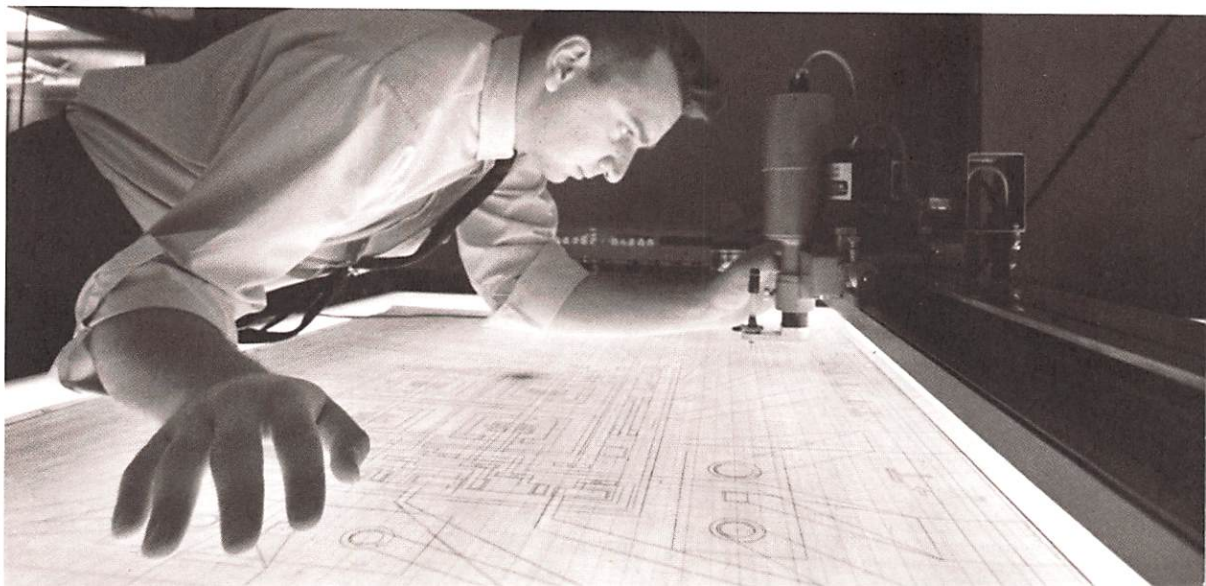
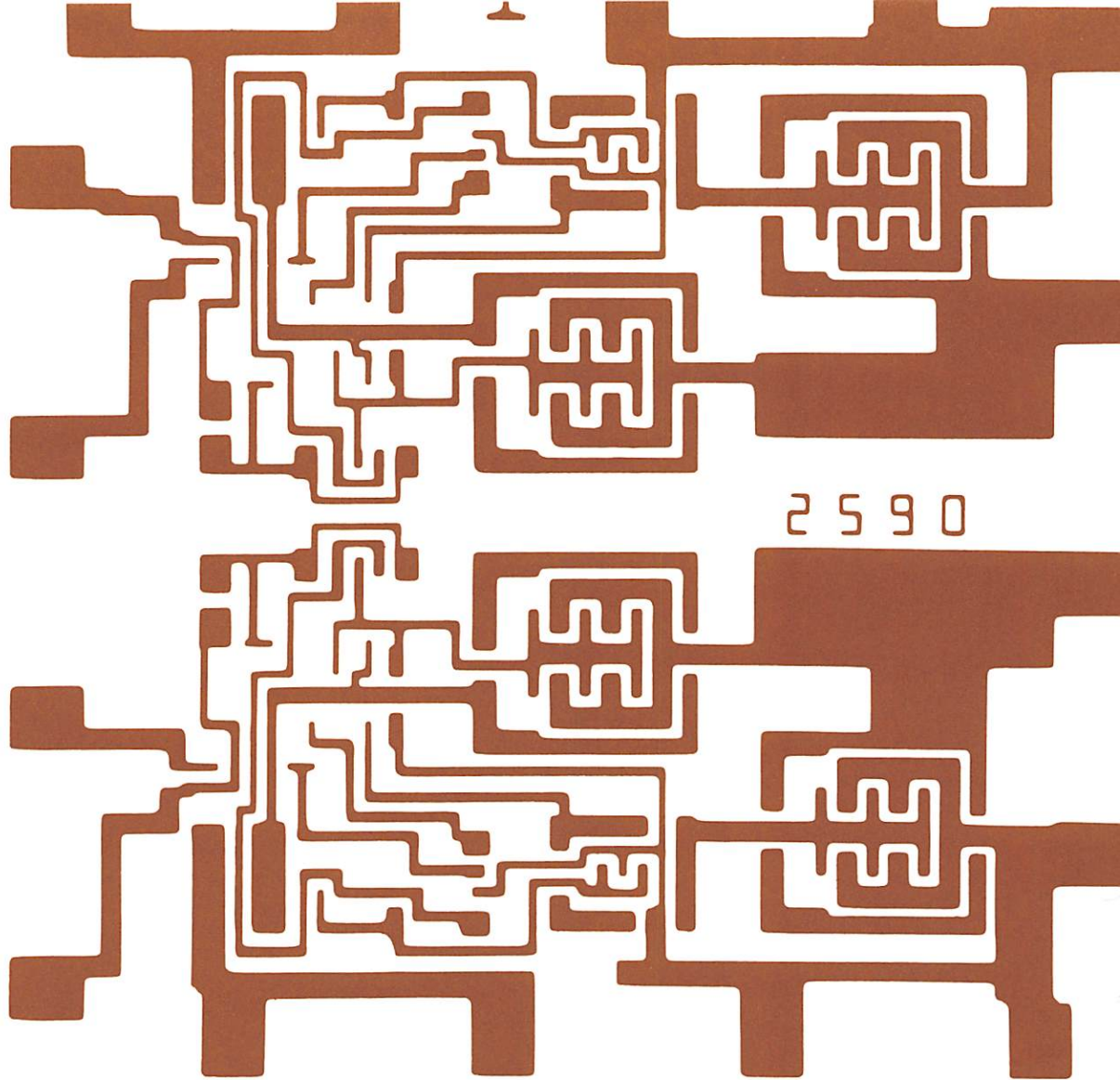
Western Electric was first with the industrial application of the laser. The new tool was used for drilling holes in industrial diamonds. It can also be used for inspecting integrated circuit photo masks, controlled fracturing of ceramics, and measuring the diameter of fine wire.

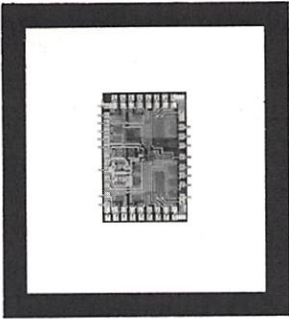
CAPACITY FOR INNOVATION is one of the ways in which Western Electric measures its performance for the Bell System.

Innovation is a very large part of the company's business. Sixty percent of the products Western Electric will manufacture in 1970 will have been introduced since 1960. The whole Bell System is constantly changing to meet the needs of the times. Many of these changes start at Bell Telephone Laboratories.

Bell Telephone Laboratories, jointly owned by Western Electric and AT&T, has a far reaching reputation for innovation. Bell Labs has been responsible for some of the most revolutionary developments of the century. A partial list might include: the transistor, foundation of the modern electronics industry . . . the first industrial use of the laser . . . the first digital computer . . . the first communications satellite . . . talking movies. And digging into the possibilities of technology continually goes on . . . they haven't stopped dreaming at the Labs.

Since Western Electric must turn Bell Labs designs into usable, reliable communications equipment, the closest working relationship is essential. Thus Bell Labs has branch laboratories at many Western Electric plants. Several thousand Laboratories personnel work side by side with Western Electric engineers, easing the transition of new products from the drawing board to the assembly line.





Integrated circuits are replacing discrete devices in communications equipment. Resistors, transistors, diodes and some interconnection leads are incorporated in a circuit small enough to fit through the eye of a needle.

Early work on integrated circuits, at Western Electric's Allentown Works, was a joint effort with Bell Telephone Laboratories.

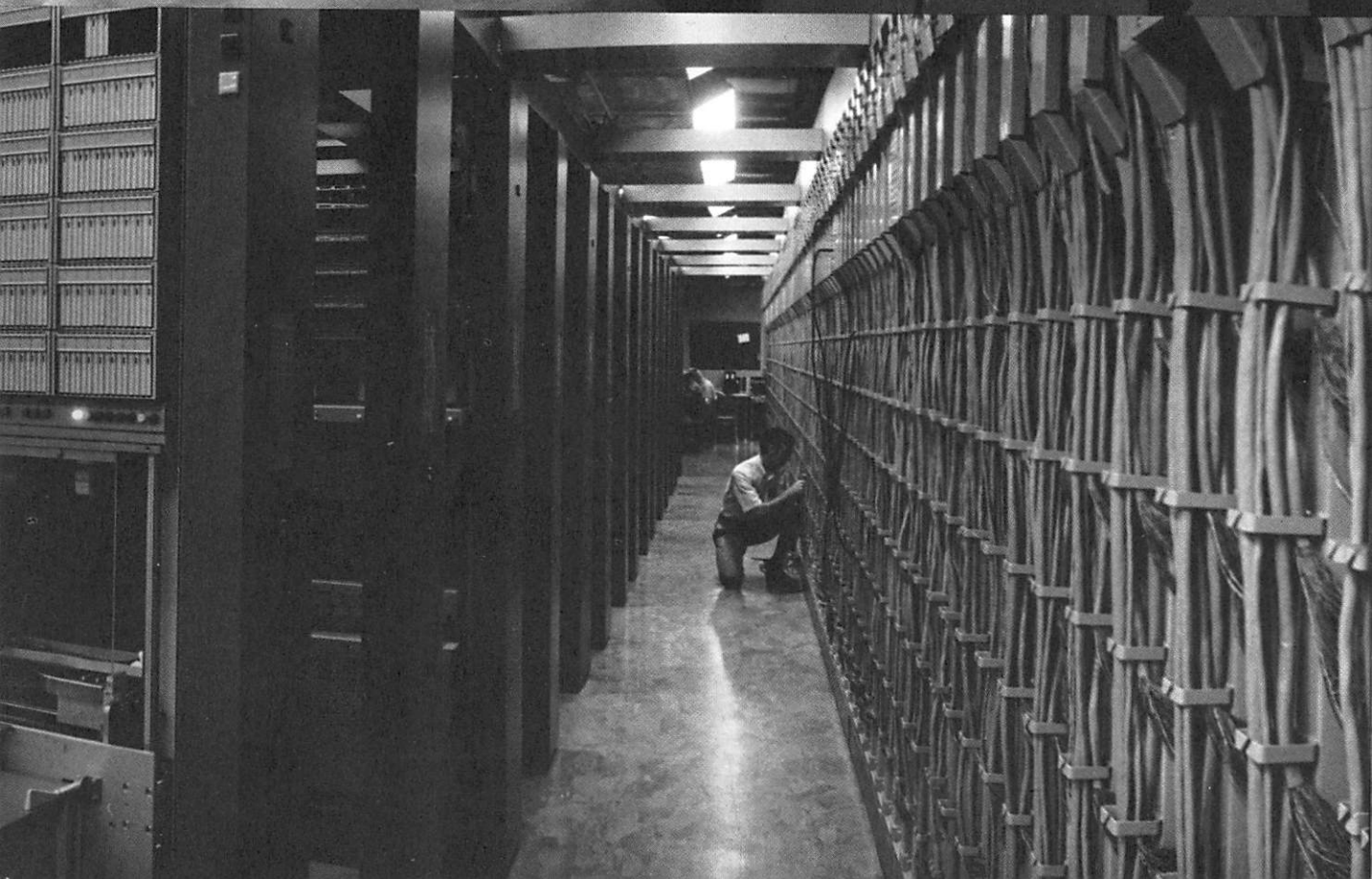
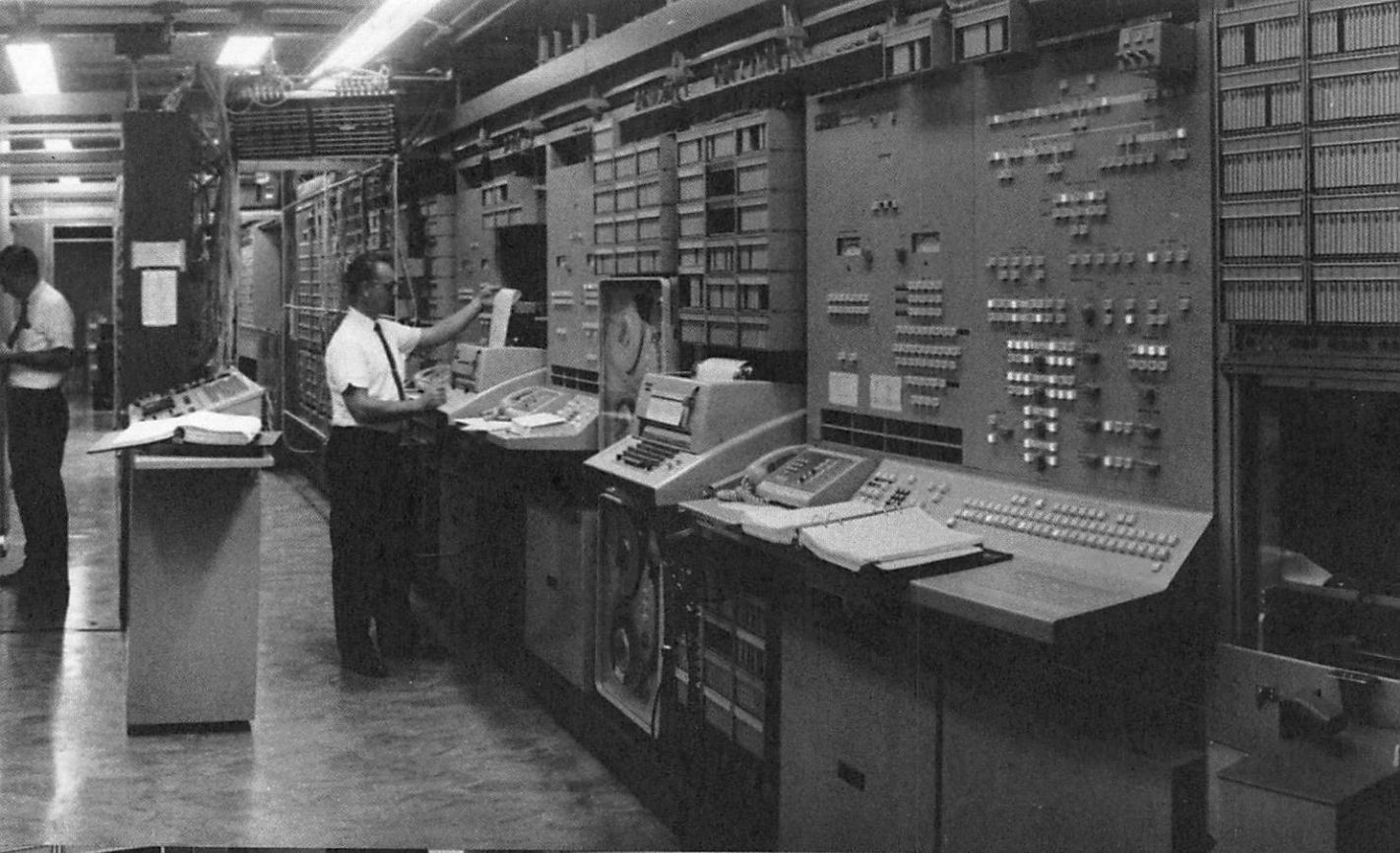
Below left, a man verifies the accuracy of the mask for the circuit pattern shown in the top picture.

One of the biggest considerations in the period between drawing board and assembly line is the cost of manufacturing the product. Cost avoidance is the name Western Electric gives to the work done by Western Electric and Bell Labs engineers as they experiment with different design models and manufacturing processes looking for the most efficient way to produce a new product.

While Bell Telephone Laboratories looks for new things to make, Western Electric's Engineering Research Center looks for new, better, more economical ways of making things. Thus, its primary job is the development of production processes.

It is, in a sense, a problem-solving center: how can we produce this new product most efficiently, or, how can we improve the efficiency of this standard manufacturing process?

The Research Center's contribution to Western Electric's innovative role in the Bell System has been significant. High pressure metal forming—which allows metal to be shaped like plastic without heat—has saved the company about \$1 million a year.



The artificial quartz crystal shown here, used in carrier systems, was grown at Western Electric's Merrimack Valley Works. The company found that it cost less to grow quartz crystals of the quality it needed than to buy those found in nature.



The Electronic Switching System (ESS) is one of the most significant and far-reaching innovations in recent telephone history. ESS is the switching system of tomorrow, designed for vastly increased flexibility, speed, and load capacity. This one, being installed in Trenton, New Jersey, can handle the calls of seven central offices that used older switching equipment. The clean, crisp console above serves as the control center for the mass of complicated equipment, a portion of which is shown below.

Cost reduction, while similar to cost avoidance, refers to products already in manufacture. Cost reduction is a continuous effort.

A good example of cost reduction at work is the 500 type desk telephone most people have in their homes. Introduced at \$13.90 in 1949, it has been through 2400 changes in design and manufacturing process. The result: the same set cost \$10.90 in 1968.

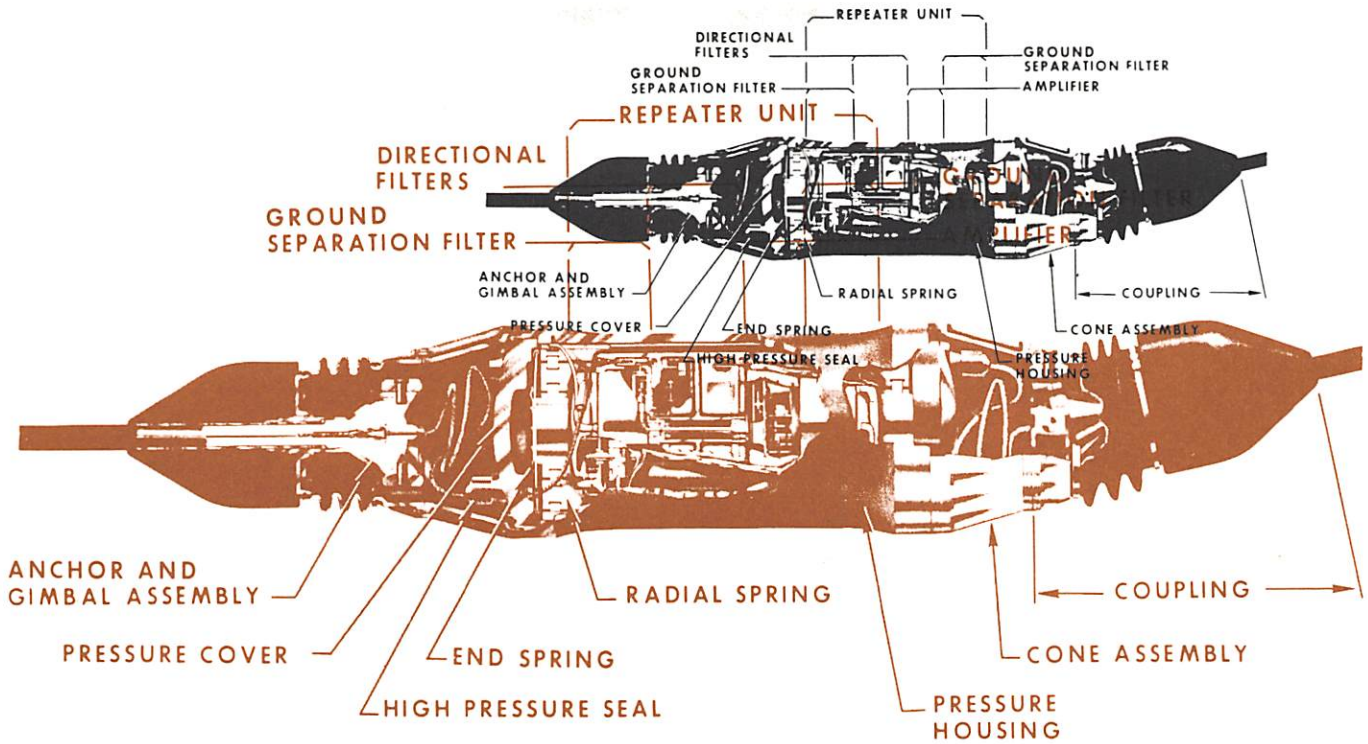
Manufacturing is not the only area where costs have been reduced. Systems equipment engineering, distribution, purchasing and installation have also been responsible for significant cost reductions.

The in-line vacuum machine—which maintains a high degree of vacuum while remaining open at both ends to permit the passage of an assembly line—made economical the large scale production of thin film integrated circuits.

The industrial use of the laser—for drilling holes in diamonds used for drawing wire—reduced a process that used to take days to a matter of minutes.



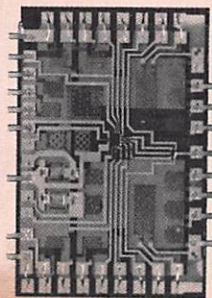
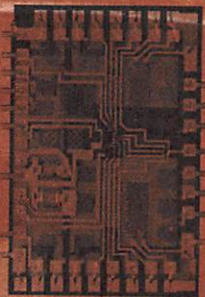
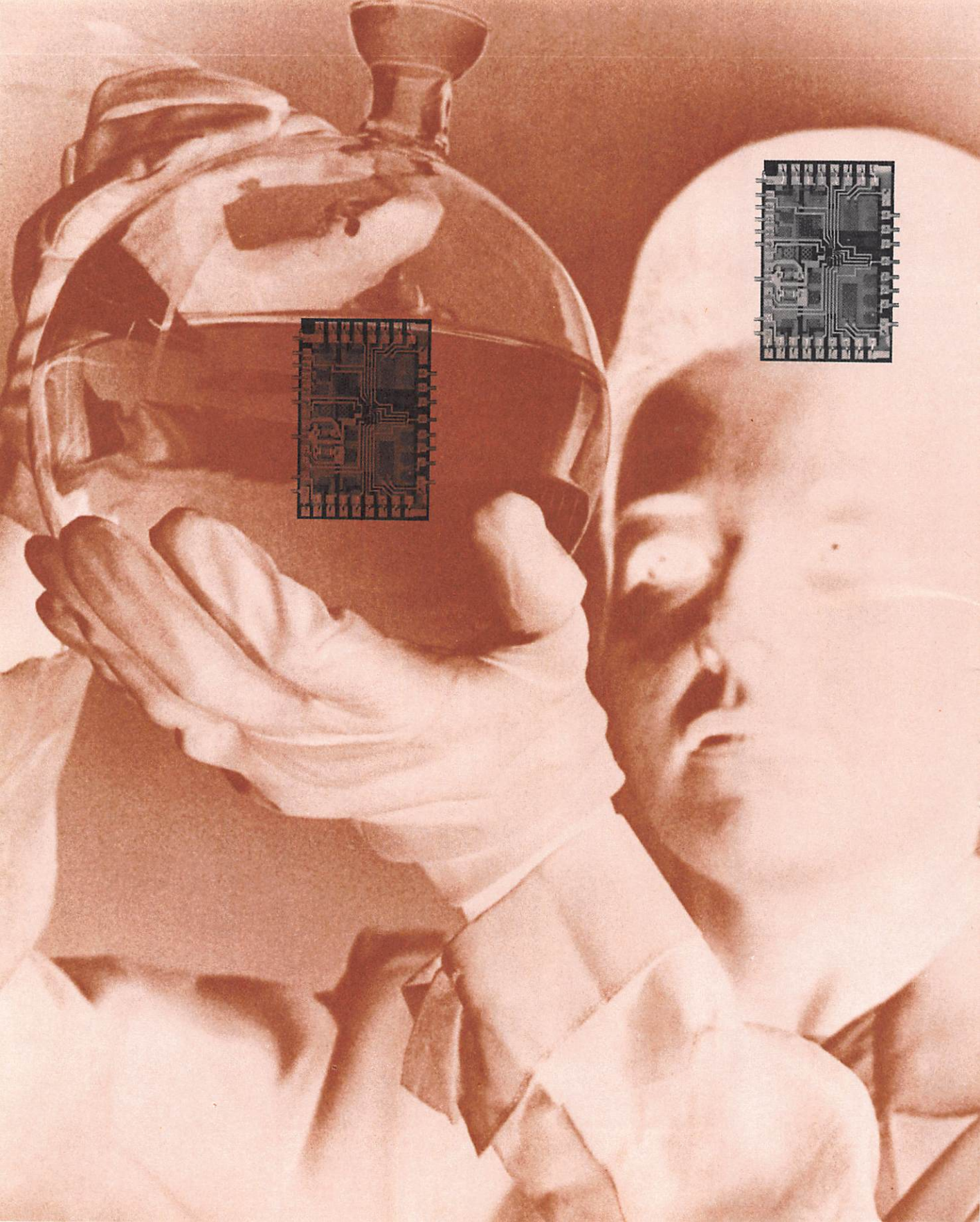
LONG LINES

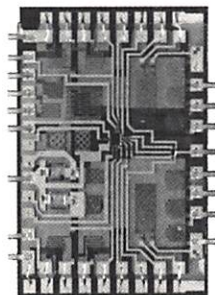
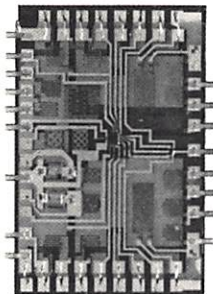


The repeater, above, is part of the cable placed on the floor of the ocean by AT&T's cable laying vessel, *Long Lines*.

BELL SYSTEM STANDARDS are very high . . . they have to be. Efficient, dependable phone service is basic to American life. As manufacturer and supplier for the Bell System, Western Electric has prime quality control responsibility.

The undersea repeater is a good example of Western Electric's insistence on quality control. Repeaters amplify telephone signals and are placed about every 20 miles along trans-oceanic cables. Some engineers refer to the repeater as "the perfect product." Repeaters are built to work continuously on the floor of the ocean for 20 years . . . without maintenance.





As the incredible pace of technological development and miniaturization in electronics continues, greater areas of Western Electric's manufacturing locations will look like operating rooms. Many of the circuits Western Electric people work with are so small that a single dust particle may render them defective. The woman at the left holds a flask of de-ionized water which is used as a wash during the processing of these integrated circuits.

The job of manufacturing the repeater required new machines and new processes. Five thousand precision components are placed with meticulous care in a cylinder 13 inches in diameter and 26 inches long. Every one has to be in exactly the right position and each meets exacting standards of its own. If one of those components failed, vital trans-oceanic telephone service could be interrupted. The cost of replacing a repeater would run to hundreds of thousands of dollars. Repeaters have to work—the first time—and every time thereafter for 20 years.

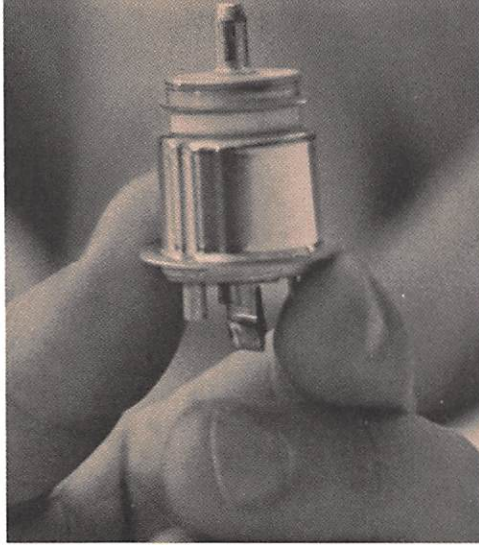
The same kind of careful, meticulous attention goes into the manufacture of all Bell System equipment. Telephone sets are tortured; they're twisted, banged, smashed, heated and frozen to find out just what they will take. Western Electric makes sure they can take more than they have to. And the packaging that surrounds the delicate equipment during shipping is tested to make sure it delivers maximum protection. Transistors are whirled on the end of a centrifuge at great speeds to see what gravitational pressure they will take.

Material Western Electric buys for the Bell System has to meet the same exacting standards the company sets for its own products. In fact, just to make sure they will



As microwave relay systems play an ever larger part in Bell System long distance service, the little tube at right grows in importance.

The new tube—in conjunction with microwave equipment modifications—has made it possible to double the circuit carrying capacity of the TD-2 radio relay system at minimal cost.



These telephone handset molds were part of a major engineering cost reduction achievement. The dies were reformed to accommodate a less expensive plastic. The first year savings was about \$1.5 million.

hold up on the job, many of the more than 150,000 items sold to Western Electric are subjected to an ordeal of endurance tests in special laboratories in New York.

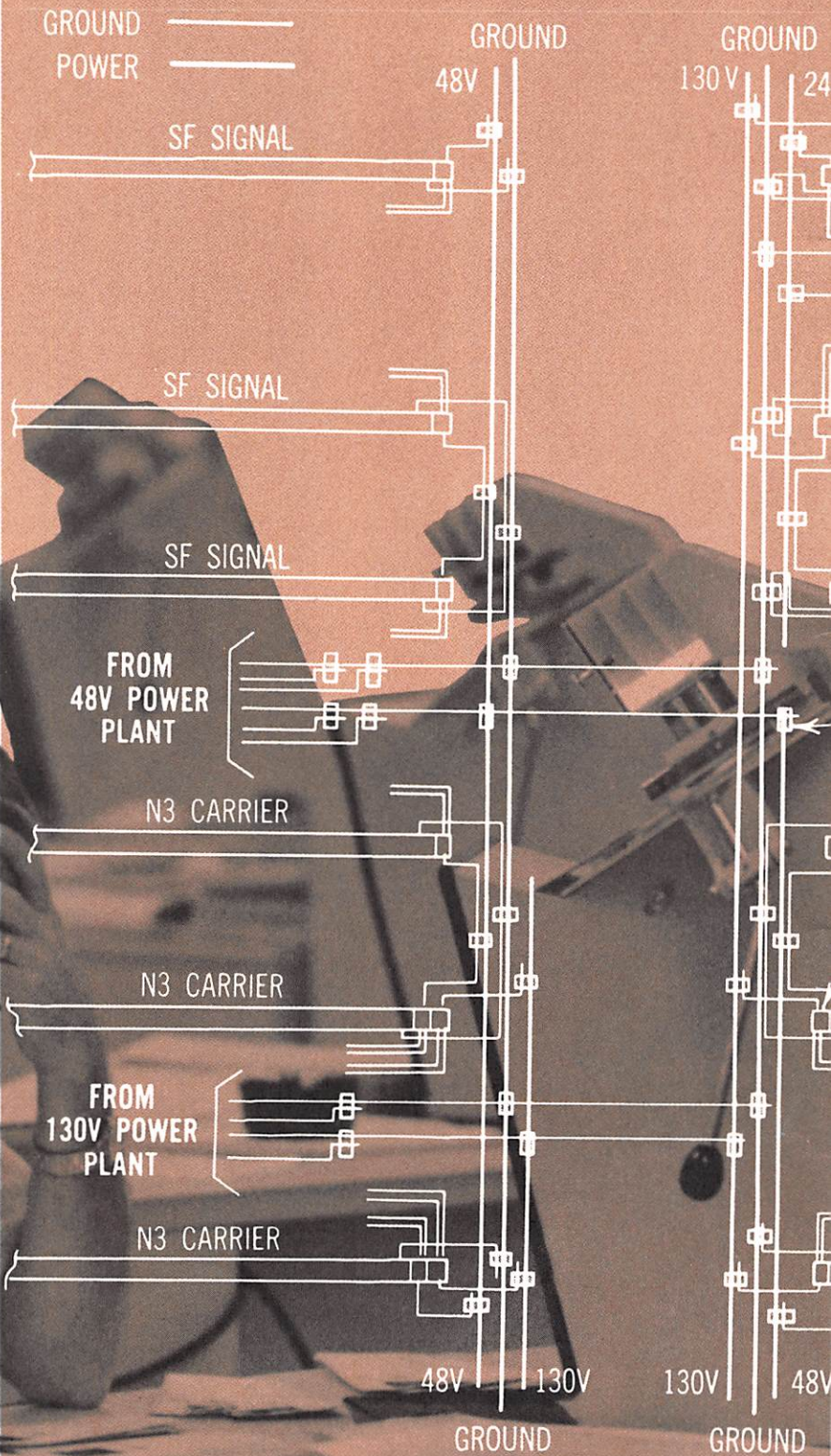
Western Electric's Supplies Inspection Organization is dedicated to assuring quality through destruction. Items are tested, measured, broken down, worn out, pulled, folded, burned, weighed, subjected to every pressure they might encounter while in service. The Supplies Inspection Laboratory is a scientific torture chamber. If an item makes it through there with passing grades, it will make it just about anywhere.

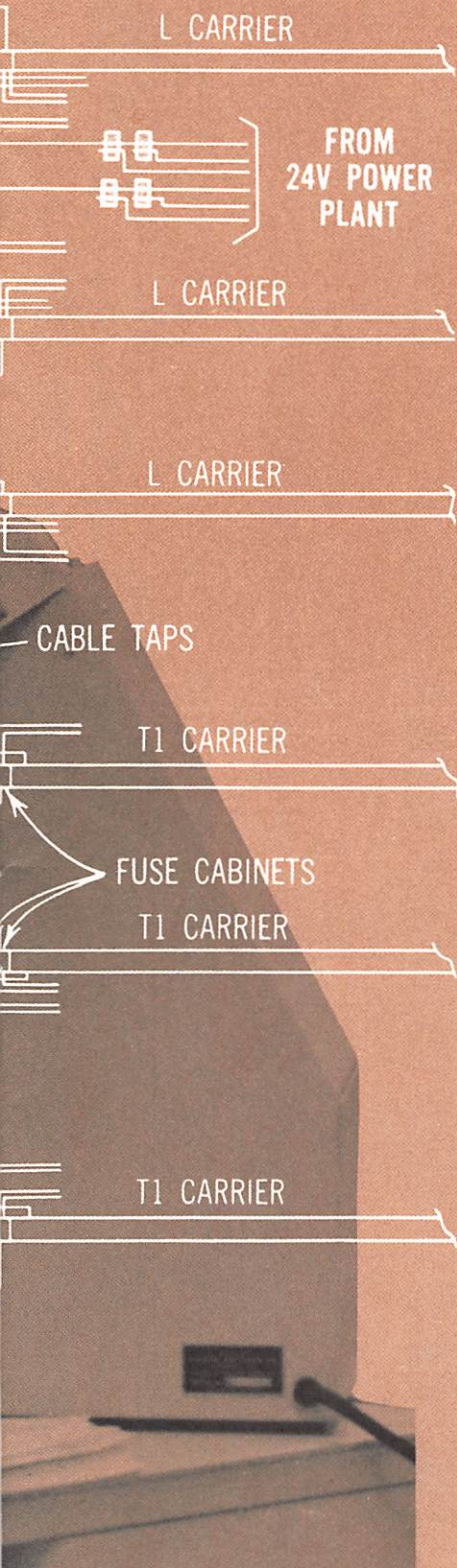
Quality is not the only consideration of Western Electric's purchasing department. One of the ways in which the company keeps the cost of telephone service down is centralized purchasing.

For many items, Western Electric acts as central purchaser for Bell telephone companies. Buyers go to market with huge shopping lists, representing the needs of the local telephone companies. The buyers fill those needs by doing business with some 45,000 companies; ninety percent of them are small businesses.

The buyers can be responsible for anything from paper for telephone directories to the most delicate microwave equipment.

Systems equipment engineers work with specifications including schematics such as the one at right. They insure that the equipment Western Electric supplies the telephone company will provide the service the community needs.





SYSTEMS EQUIPMENT ENGINEERING is the first step in a process that plays a large part in keeping American phone service as effective and economical as it is: the custom tailoring of local service.

Before a telephone company central office is erected or modified, Western Electric systems engineers, working with telephone company long range forecasts, help the telephone company determine the precise needs of the local community.

The engineers determine exactly what equipment will be needed to give the area the service it needs. How big will the office need to be? What kinds of calls will be made? Is it a business or residential area? Is it mixed?

The systems equipment engineers get a traffic report from the phone company answering these questions. Then they begin to prepare the specifications for the new central office.

From the traffic report the engineers make up an equipment order, the equipment goes into manufacture and is delivered to the site.



All those cables and wires at left have a place to go. The installer knows where. He will follow specifications worked out by the telephone company and Western Electric to make order out of that pile of crates and jumble of wire . . . a telephone switching center out of chaos.

THE WESTERN ELECTRIC INSTALLER also works closely with the local telephone company. He is the man who comes on the location after the systems equipment engineers have done their job. The installer's job: to install in proper working order all the equipment needed to build or improve the Bell telephone switching system.

The installer is the man who unpacks the wire, frames and components and puts them all together. The building of the telephone equipment center is Western Electric's job. Only after the equipment is installed, tested and working does the phone company take over and put the office into service.

But the company's service function is most clearly manifest in the 35 Service Centers strategically located around the country. There is at least one Service Center in every Bell telephone company area.

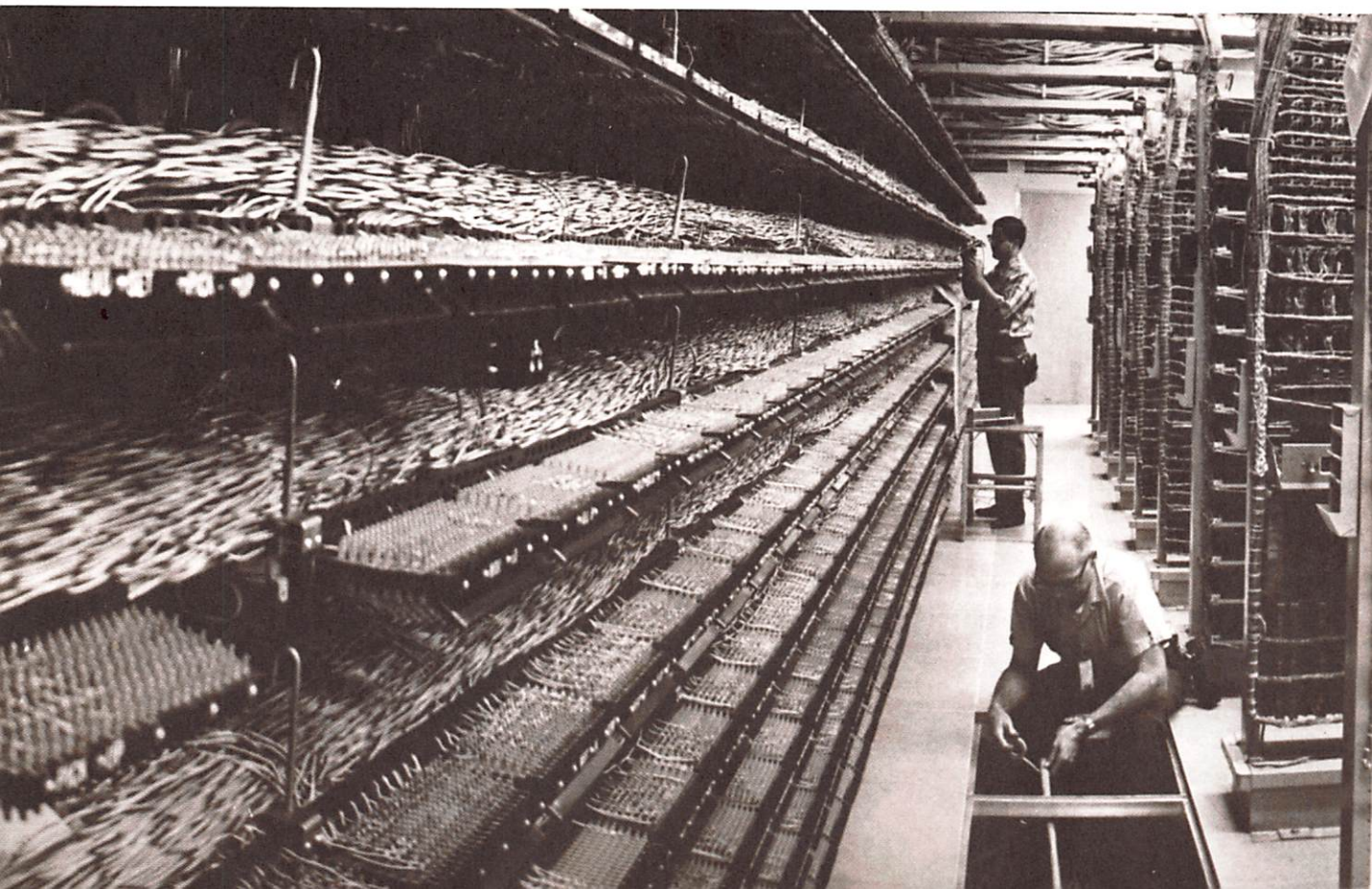
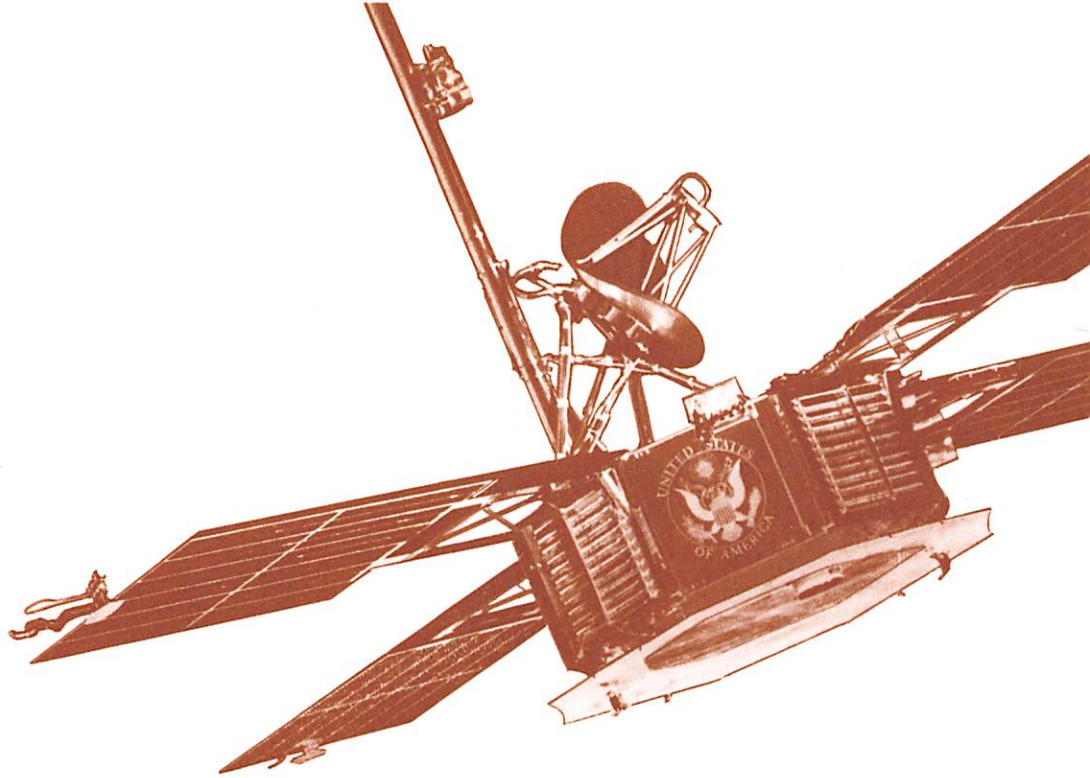
Each Service Center serves as both warehouse and shop. The Service Center provides the local telephone company with a vast array of supplies and equipment ranging from anti-freeze for the truck fleet to the most intricate piece of internal communications equipment.

In unusual cases, the Center's shop will make what it does not have in the warehouse. Sometimes this means building equipment from scratch; at other times, just a modification of standard equipment. Some newer Service Centers also act as headquarters for installers in the region.

However, the main function of Service Center shops is the refurbishing of equipment.

Regular household telephone sets provide a good example of this operation.

Once a telephone set is removed from service, it is sent to the Service Center by the telephone company. Those phones that can be refurbished are taken apart, reconditioned, parts are replaced; they are cleaned, buffed and put into warehouse stock. In short, the phone is rebuilt. When it goes into the warehouse it is as good as new. If a phone is not repairable, it is set aside and what is salvageable is taken out.



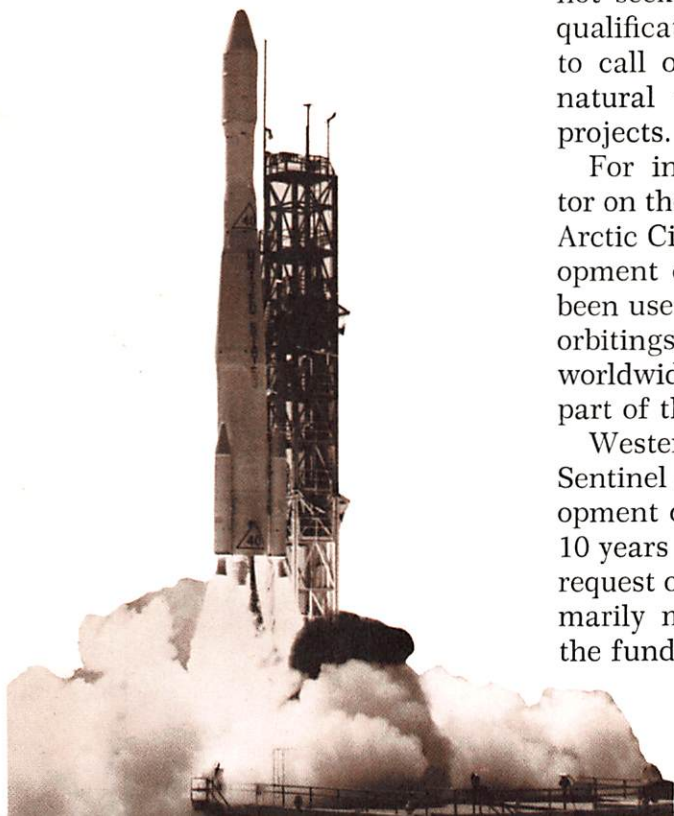


Below left, technicians make modifications in Western Electric switching equipment under the Jet Propulsion Laboratory's spaceflight command center at Pasadena, California. Western Electric built and installed the communications system designed to link spaceflight personnel during interplanetary missions.

THE UNITED STATES GOVERNMENT is also a large Western Electric customer. Western Electric does not seek government work, but the company's unique qualifications—its communications expertise and ability to call on the resources of the Bell System—make it natural that the government turn to it for certain projects.

For instance, Western Electric was prime contractor on the DEW (Distant Early Warning) line across the Arctic Circle. It collaborated with Bell Labs in the development of the Command Guidance System which has been used successfully in hundreds of scientific satellite orbitings. It acted as prime contractor for the Mercury worldwide communications network which then became part of the Apollo communications system.

Western Electric was named prime contractor for the Sentinel anti-ballistic missile system. Sentinel is a development of Bell Telephone Laboratories and grew out of 10 years of research and development undertaken at the request of the government. Western Electric's role is primarily managerial, with approximately 70 percent of the funds being subcontracted.





30 | Zn
ZINC

29 | Cu
COPPER



Metal reclaiming processes at Nassau Smelting and Refining Company are so efficient that the company manages to supply Western Electric with about 30 percent of its copper needs every year.

WESTERN ELECTRIC has three major subsidiaries.

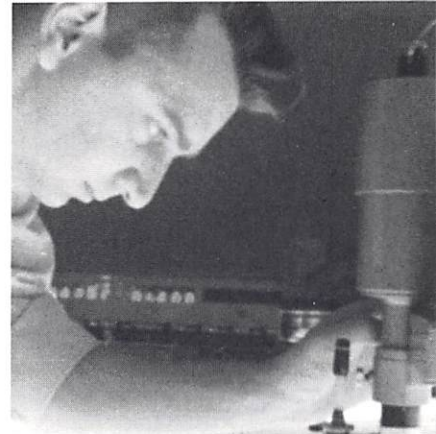
Teletype Corporation, located in Skokie, Illinois and Little Rock, Arkansas, manufactures teletypewriter equipment used in the Bell System. Teletypewriter exchange service (TWX) operates through the Bell System switching network.

* * * *

When Bell telephone equipment is taken out of service, much of the non-ferrous metal is reclaimed by Nassau Smelting and Refining Co., Staten Island, New York for use in the manufacture of new equipment. Nassau helps assure an adequate supply of such metals as copper, silver, lead and solder products for use in Western Electric manufacturing operations.

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Sandia Corporation is a non-profit organization under Western Electric management, operating laboratories for the Atomic Energy Commission in Albuquerque, New Mexico and Livermore, California. The laboratories are engaged in basic research into ordnance phases of nuclear weapons design and several non-weapons projects.



THE PEOPLE OF WESTERN ELECTRIC feel their job—providing the equipment and service for the Bell System—is an exciting one. They are sure it is demanding. The success of the Bell System, and to some extent the quality of the nation's life, depend on how well they do it.

But concern with maintaining and improving the quality of life in the United States is not just a nine-to-five job at Western Electric. All over the country, thousands of Western Electric people can be found working with countless programs to aid the underprivileged and disabled. The company runs employment, education and training programs of its own. Western Electric is conscious of the necessity of giving minority groups the chance to continue the climb up the skills ladder and the economic scale.

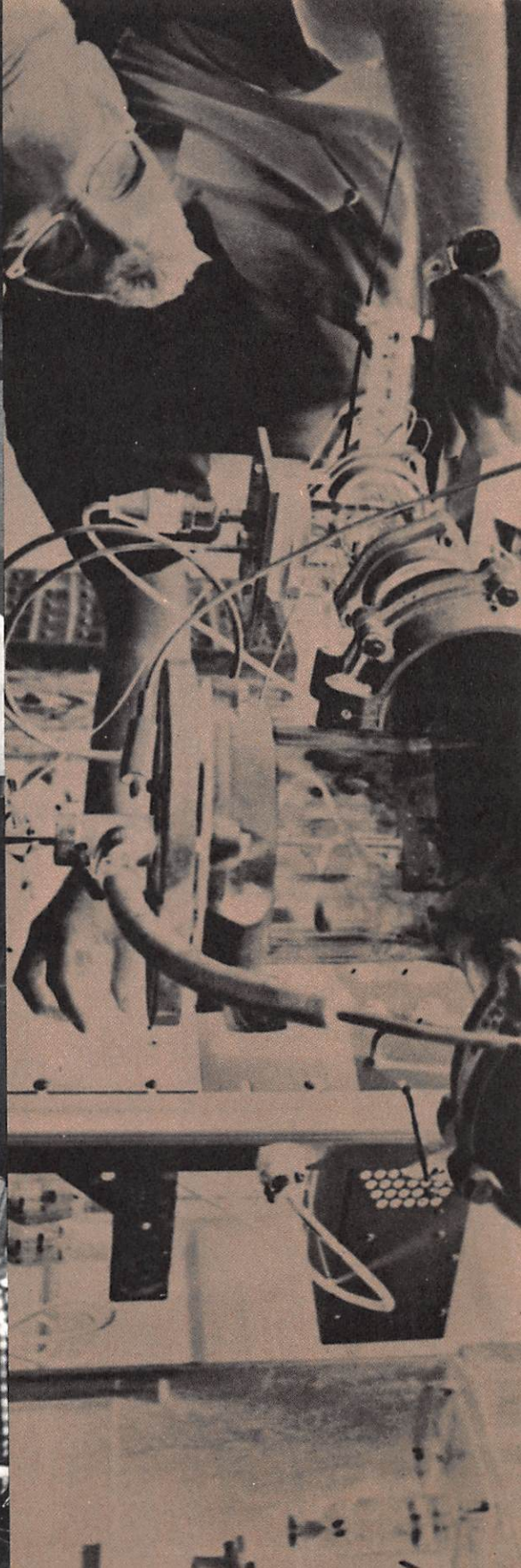
Western Electric is also aware of its debt to the nation's educational institutions. They provide the brains and skills that make the Bell System go. In recognition of that debt, the company is a significant contributor of personnel, money and equipment to colleges.

If Western Electric has done its job well, it is because the company gets and holds good people, maintains a good working relationship with the communities of which it is part and works well with its Bell System partners.

As the company embarks on its second century, it is determined to continue to build on this solid foundation in order to fulfill its service obligation to the Bell System and the American public.



Western Electric





PRINCIPAL LOCATIONS

- ★ GENERAL HEADQUARTERS
- MANUFACTURING LOCATIONS
- SERVICE CENTERS
- ▲ INSTALLATION AREA OFFICES
- SERVICE DIVISION REGIONAL HEADQUARTERS
- * SUBSIDIARIES
- ENGINEERING RESEARCH CENTER





Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM