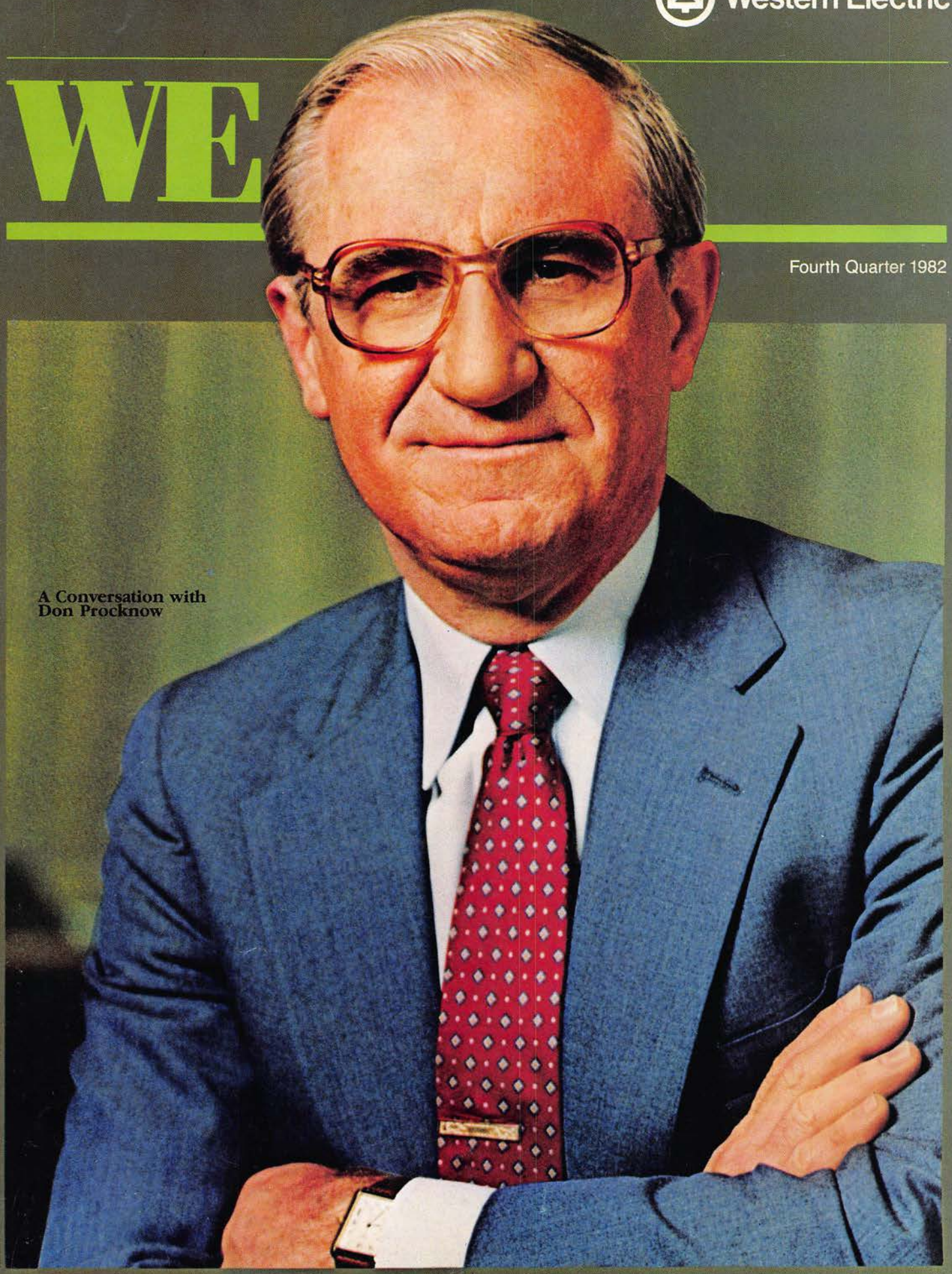
Western Electric

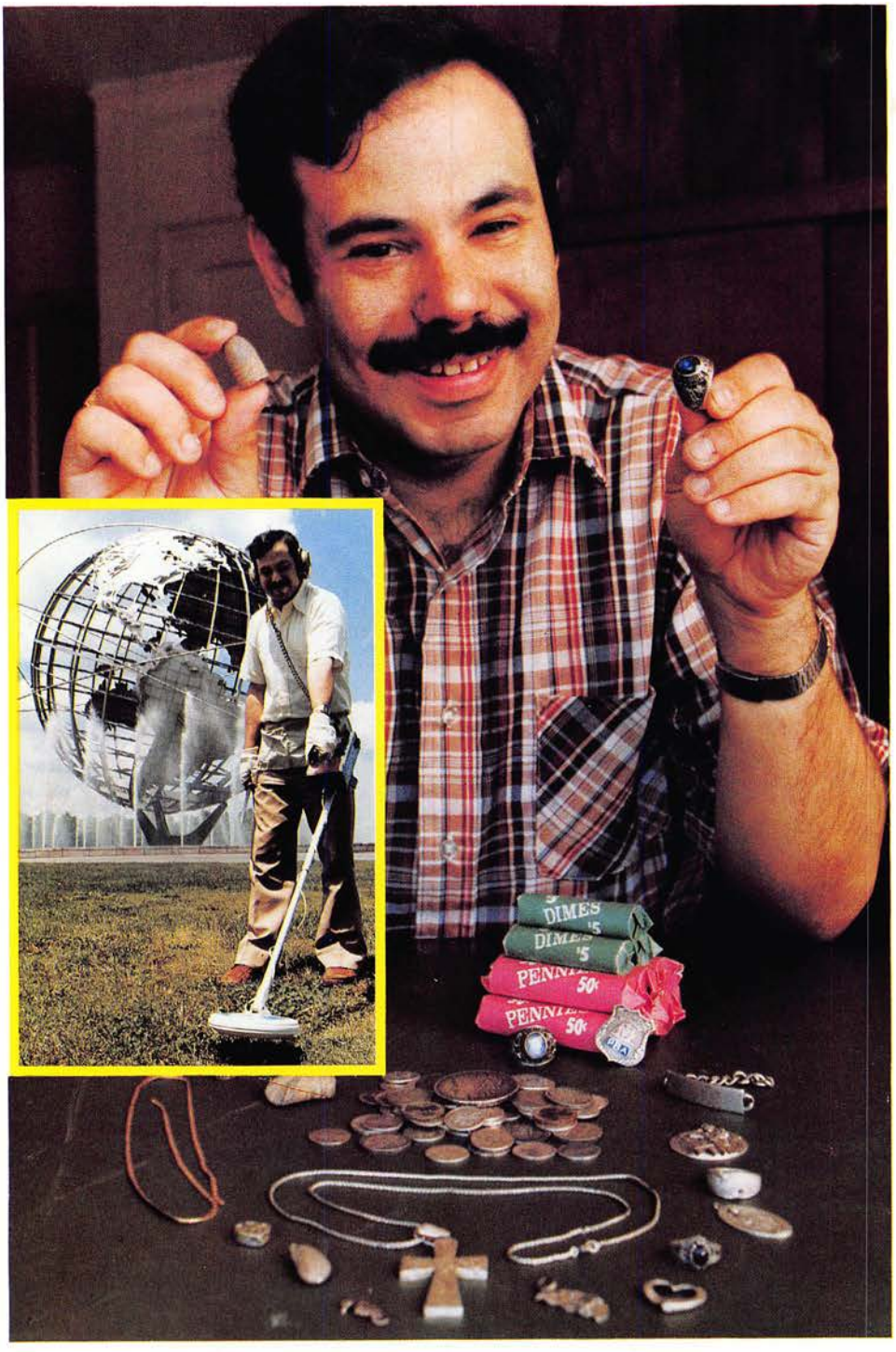
WE

Fourth Quarter 1982



A Conversation with
Don Procknow

WE People



What will Larry Geller find next?

Larry Geller, a price analyst at Headquarters, spends a good part of his workday combing through records and reports to help establish the best price for the products Western Electric sells to the Bell operating companies. He spends a good part of his free time combing through New York City's parks and beaches with a metal detector to locate objects that might turn out to be valuable or at least historically significant. As he puts it, "Usually, I find coins or other small objects. I turn the metal detector on, listen for the right tone that confirms the presence of metals, and dig in the spot where the sound is loudest. Of course, I find more pennies than anything, but I've also found a lot of jewelry—mostly rings and necklaces—and several shell casings from the Civil War. You never know what you're going to turn up. That's the fun of it."

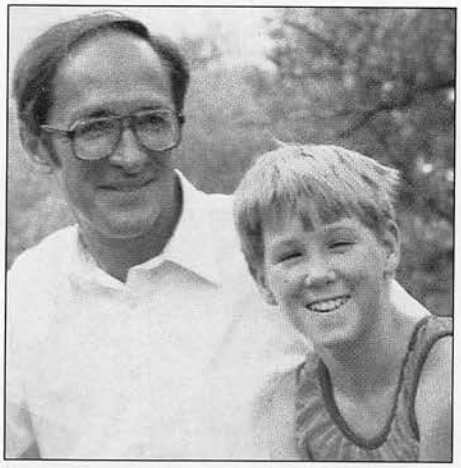
Larry has been treasure hunting in the New York area since 1979. Of the more than 10,000 coins he's found, the oldest has the image of George II, the British king who reigned from 1727 to 1760. Larry has also found several coins from 1853 and 1875 and a few 1865 Indian Head pennies. As an adjunct to treasure hunting, he has learned quite a bit about coin collecting and the values of the coins he's found. According to Larry, "I keep the older coins for their beauty and historical significance rather than for their value." But, he's quick to point out that he keeps everything he's found in a safe-deposit vault.

The technology used in today's metal detectors is directly linked to that of the mine detectors invented during World War II. It wasn't until the 1960s, however, that the devices caught on commercially. Since then, treasure hunting clubs have sprung up all over the country. Larry belongs to a club that sponsors treasure hunts at beaches and parks on the eastern seaboard. "The club," he says, "provides information about the coins as well as about the new machines and techniques for using them. The friends I've made in the club have also helped me to become more aware of environmental issues. I find a lot more trash than I do valuables. If bottle caps, cans, nails, and tin foil were valuable, I'd be rich. When I dig for something, I'm always careful to replace the dirt and grass, if there is any. And, I usually find a garbage pail for the trash I find.

"I really enjoy going out on a sunny day and seeing what I can find. It's great exercise because you can end up walking miles. And, unlike playing tennis or golf, I usually come home with more than I went out with."

Contents

Fourth Quarter
34th Year



Page 10

Page 12

Page 19

On the Cover

Changing times are not new to Don Procknow, and Western's president faces the challenges, problems and opportunities they offer with confidence. Some of his thoughts are expressed in an interview beginning on page 2.

WE

WE is published for employees of Western Electric. President: D.E. Procknow; Secretary: F.C. Childs; Treasurer: R.E. Ekeblad.
Editorial office: 222 Broadway, NY, NY 10038
Telephone: (212) 669-2621

George Gray
Editor

Saul Fingerman
Managing Editor

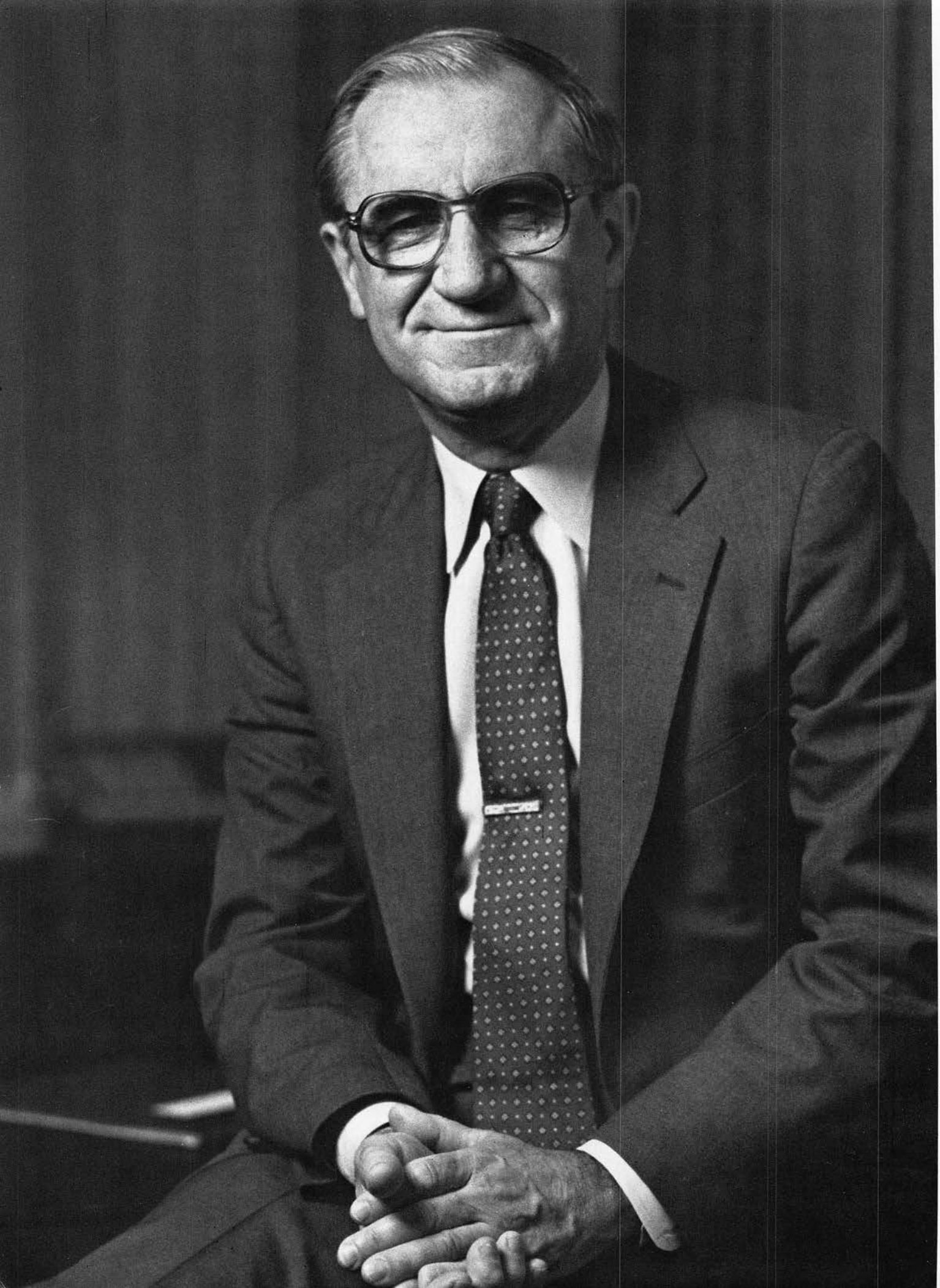
Lydia Whitefield
Associate Editor

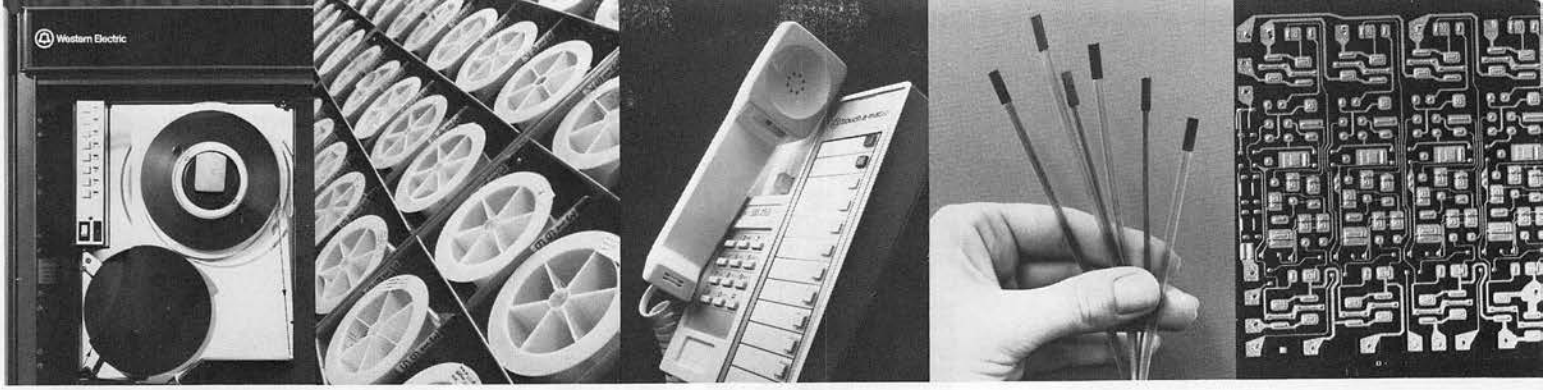
Steve Tomczyk
Design

Leonard Stern
Photography

Thomas J. O'Donoghue
Production

Western Electric





selling components directly to original equipment manufacturers and more products to the independent telephone companies. At the same time, we are actively pushing at more sales to foreign telecommunications administrations. Such sales would be through ATTI, and they offer many future opportunities. Of course, we have to continually assess our priorities and we're doing that right now. It's basically a question of picking those business opportunities for which our skills and resources are best suited.

WE: What products do you see as key in our future?

Mr. Procknow: We have some exciting products right now — such as lightguide, the No. 5 ESS and 3B processors, digital transmission products and a host of innovative software packages. And there are many other exciting products coming off the drawing board in the customer premises area. We've invested very heavily in leading-edge technology at Bell Labs and it's beginning to pay off. In order to grow and develop, in whatever lines of business we enter, we'll need good products at the right prices. I'm confident we'll have them.

WE: The current planning under Computer II is that starting the first of the year, AT&T will operate a fully separated subsidiary to sell de-tariffed telecommunications products to the general public. What will our relationship be with them?

Mr. Procknow: American Bell, Inc., the fully separated subsidiary, is being established to comply with the Federal Communications Commission decision in its Computer II inquiry. For the foreseeable future, only Bell Labs people and a small number of Western Electric people directly involved in development of such "de-tariffed" products will transfer to the new subsidiary. The factories will remain in Western Electric. In essence, WE factories will supply American Bell with telephone sets, PBXs and other customer premises items that they will in turn sell to the general public.

WE: What does the business picture look like for the next year or so?

Mr. Procknow: This year, our sales volume is down about 8 percent from last year. The telephone companies, which are our principal customers, have cut back on construction, and our orders are down. And, frankly, we don't see any big improvement for next year, unless there is a substantial upturn in the economy beginning almost immediately. Realistically, that doesn't seem likely at this point.

All of this, of course, is making it more of a challenge to take advantage of our new freedom and opportunities, but I think we're up to it. Throughout the company, I can see an eagerness to get on with our business and begin what promises to be an exciting future.

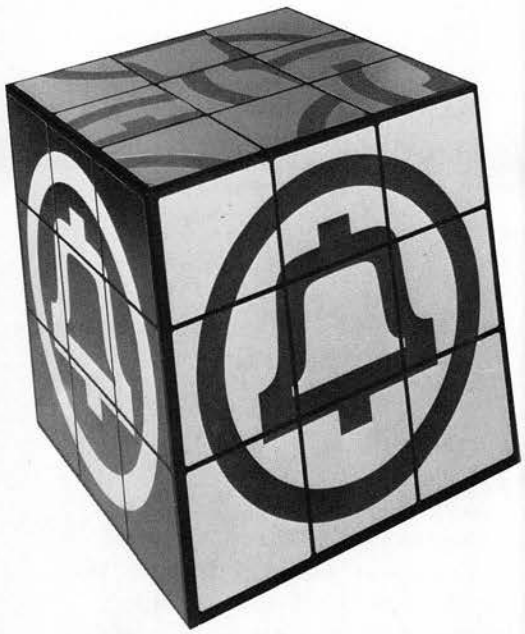
WE: What is the effect going to be on jobs?

Mr. Procknow: Barring any sudden upturn in the economy, there will be further cutbacks in certain areas of the business.

WE: There has been a lot of talk about a new marketing effort. What precisely are we doing?

Mr. Procknow: We have been giving a great deal of thought and attention to the organization and development of our marketing and sales efforts. For

A Conversation with Don Procknow



Early in October, WE editor George Gray interviewed company president Donald E. Procknow on the state of the business and the progress of reorganization. While many specifics about reorganization are still to be resolved, Mr. Procknow talks about the new directions and new initiatives the company is taking.

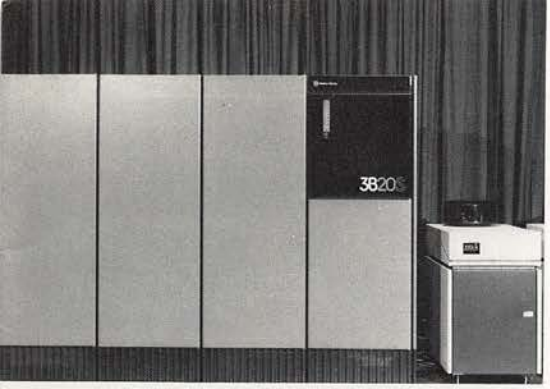
WE: Now that Judge Greene has signed the Consent Decree ending the Justice Department antitrust suit, what do you see happening in Western Electric?

Mr. Procknow: I see several things. Judge Greene's signature signalled the beginning of a new era for Western Electric — an era of new challenges, new markets and new opportunities. We're going to take full advantage of those opportunities. I'm aware of the formidable competition facing us. Well, let me make a few points: First of all, competition isn't a new thing for us. We've been dealing with it for a long time, and we've managed to stay on top.

There's not another team like Western Electric and Bell Labs anywhere in the world. We have been called "a technological powerhouse." We have the technology and the skill to use it well. In other words, we're pretty formidable competition ourselves. What's more, we intend to work hard to keep it that way, and I'm sure most of our employees feel the same way.

WE: Do we have a master plan for the years ahead?

Mr. Procknow: Yes. It's important to realize that we're not approaching this thing haphazardly. We're not simply going to react to events as they occur. Wherever and whenever possible, we're going to shape those events. Looking ahead to the long term, we are in the midst of putting together a new five-year plan based on the new environment. We are actively at work determining the details of how we might broaden our opportunities to sell to new customers — for example,



"We have some exciting products right now . . ."

example, we are continuing to build up and strengthen our account manager groups, who are directly responsible for selling telecommunications products to our traditional customers — the AT&T interexchange operations and the Bell Operating Companies or BOCs. We're going to have to take the initiative and push sales in areas where we've never really pushed before. We're going to pick the brains of consultants and possibly bring in some outside talent to help us position ourselves in what we expect will be a fiercely competitive arena, as traditional or new competitors seek what they think are new opportunities for them as a result of AT&T divesting the BOCs.

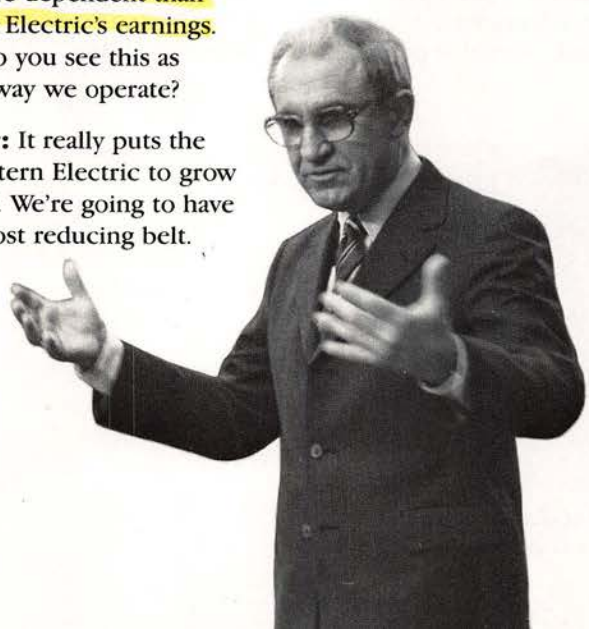
WE: Now that the air is beginning to clear with the breaking apart of AT&T and the local exchange companies, what does this do to the dozens of antitrust cases that have been hanging over our head for years. Are we finally going to be allowed back to running the business or are these legal proceedings going to be with us forever?

Mr. Procknow: Lots of people seem to feel: "It's all settled." Let me put in a word of caution. There's a tremendous amount of work still to be done in finding our way through all the divestiture ramifications. Divestiture is not going to happen overnight. As for other antitrust suits still pending, they will probably keep our attorneys busy for years. We've had no indication that any of the ones now pending will be withdrawn although the possiblility of new ones being added may be less. And on Capitol Hill, the possibility of new legislation for the telecommunications industry is still very much alive.

WE: Since AT&T will no longer be receiving the license contract fees from the BOCs, both AT&T and Bell Labs will be more dependent than ever on Western Electric's earnings. What changes do you see this as bringing to the way we operate?

Mr. Procknow: It really puts the pressure on Western Electric to grow and to earn well. We're going to have to tighten our cost reducing belt. We're going to need more robotics, and software and anything else that will help us become more efficient producers.

I don't want to duck realism, but I feel very positive. We're entering this new era with great strengths. Sometimes when we get to talking about problems of the economy and divestiture, we tend to overlook what a great product line we have and the well-trained workforce, enthusiastic to take on new challenges. We have a history of service and cost-control and quality virtually without peers. And we do see great opportunities for the future.



Teletype in Transition

The Information Age is here and Teletype Corporation is ready for it with new products and new technologies

A new era—symbolized by electronic printers, sleek keyboards engineered for facility of touch, glare-proof video screens, integrated circuitry, and microprocessor-driven consoles—has dawned at Teletype Corporation. Information Age technology that's responsive to the marketplace has been incorporated into every aspect of Teletype's new product line from the model 4543 data terminal to the AP200 high speed matrix printer and the other products.

The processes used to make these new products also illuminate the technological ingenuity behind the new era at Teletype. In the clean rooms, employees clad in white surgical caps, gowns, gloves, and slippers are working at microscopes on tiny semiconductor chips. Computer-controlled machines mount components on printed wiring boards and solder them in place. At video screens, engineers concentrate on integrated circuit patterns and use light-sensitive pens to create the intricate details.

The spirit of the new era is further reinforced by the presence of working Teletype® teleprinter equipment in offices, R&D labs, and on shop floors. Teletype's president, John Pappas, and other Teletype executives have terminals in their offices in order to check shop reports, their calendars, visitors' schedules, and other vital information. The purchasing and transportation organization at the Little Rock, Arkansas plant does most of its "paperwork" on the company's own equipment. And, in the manufacturing areas at Little Rock and Skokie, Teletype terminals are used by engineers, operators, and supervisors to track critical information such as inventory and productivity.

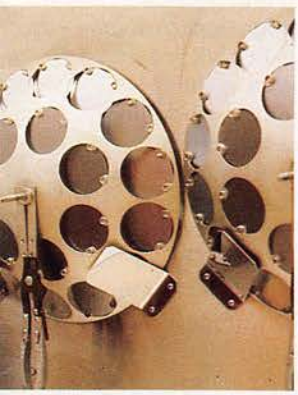
Teletype Corporation is indeed in transition. The products and systems being designed, manufactured, and marketed by Teletype will help its customers manage their businesses better and more productively in the Information Age.

MOS manufacture in Skokie.

Computer aided design is used to lay out circuit boards.

A print of a circuit board is studied in Skokie's computer aided design area.

Doris Forbess, assembler at Little Rock, uses a model 4540 keyboard.



Field service representative Stanley Kucharski checks equipment in a product service center repair lab.

Wilma Hill (standing), Scott Anderson (center) and Stan Rajca inspect wafers.

Robert Gordon (left) and Robert Lewis prepare model 42/43 teleprinters for shipment from Skokie.

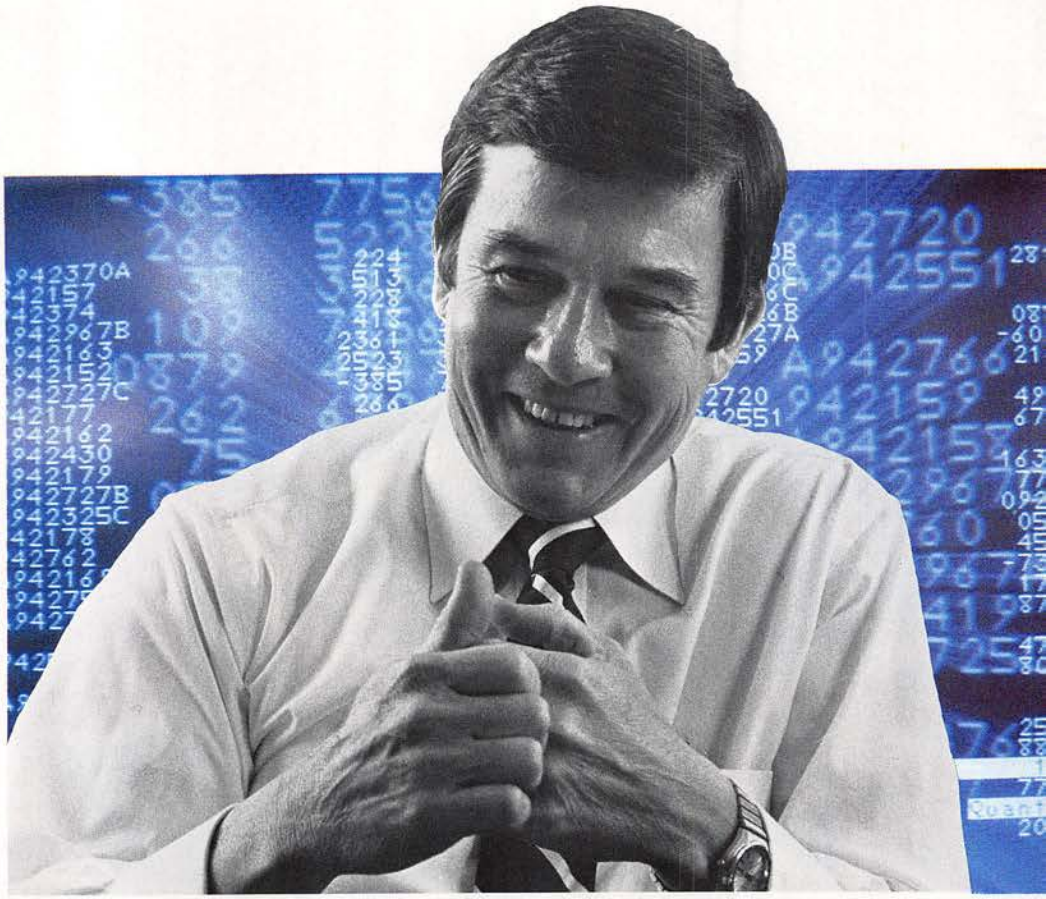
Teletype Corporation has been the Bell System's vital partner for data communications since 1930. Its more than 4500 employees design, manufacture, and market teletypewriters, display terminals, and associated data communications equipment.

Teletype is Western Electric's largest subsidiary and the only one with its own research and development, manufacturing, distribution, marketing, sales, and service organizations. Headquartered in Skokie, Illinois, it has manufacturing facilities there as well as in Little Rock, Arkansas. In addition, the company boasts 82 service centers in the United States and one in Canada.

John Pappas, President of Teletype since April 1981, describes the company as a "significant asset to the Bell System as it moves into the new, highly competitive, detariffed mode." He continues, "Because of our size, and the fact that we're a self-contained organization, our response time is reasonably fast. We can look at the marketplace and determine its potential and needs. While our single biggest customer is Bell, we also have a large number of non-Bell customers. We have the proven ability to compete and to stay out front—on the leading edge in a highly competitive environment."

In 1907, the founders of Teletype invented a machine for transmitting printed messages to supersede the telegraph system. This was the world's first teletypewriter. Teletypewriters caught on, and by the second World War, were carrying coded messages around the world. Since then, demand has grown with the data explosion resulting from the use of computers.

In its traditional teleprinter business, where the corporation started 75 years ago, the number of competitors has grown from five to about 100. In data transmission, the other segment of Teletype's business, where there is a person-to-computer set up with a terminal, there are also about 100 competitors. Pappas asserts that the marketplace is presenting new opportunities as well as many changes. "We keep hearing about all the great opportunities that lie ahead. And they're there. Our biggest strength is our reliability and quality. We have an understanding of our business day to day. But now we are looking from the threshold and wondering about what lies beyond. The next few years are going to require strong leadership in the Bell System to help people get through the threshold and accept the changes.



Teletype President John Pappas is enthusiastic about the company's future.

"The greatest potential for Teletype's growth," according to Pappas, "is in the international sales arena. Over the years, Teletype built up a network of international dealerships in 60 countries outside the United States. In February 1982, AT&T International assumed these dealerships, thus permitting Bell System technology, products, and experience to be available to our overseas customers through one Bell System entity. We view this association with AT&TI as a very positive one for Teletype. Traditionally, our international sales have been primarily for message, or Telex, applications. We see an opportunity to expand on that base, and almost unlimited opportunities to grow in the data area."

Teletype is facing the challenges of growth by manufacturing high-quality, leading-edge products. Queen Nicholson is a section chief at Little Rock on a line that didn't exist ten years ago: the "card shop." These cards, or printed wiring boards, are assembled partially by machine and partially by hand. The solid-state technology that's at the heart of many of Teletype's products is a symbol of the transition at Teletype. "This line is only 10 years old and has a greater number of employees than any other department at Little Rock," Nicholson says proudly. "One of the most important things we've got to keep in mind is that there is competition and lots of it in this field. I try to stress this to my operators and I think they have responded positively.

"We have a productivity program here at Little Rock called OPEC—Our Push for Efficiency and Competition. It is a way to promote productivity by having sections compete against each other for quality—always quality first—and for productivity. Our department won one month. Let me tell you, the men and women in the card shop are proud to wear their 'OPEC Winner' T-shirts. It's one way for us to stay one step ahead. Working for high quality and working efficiently is a way of growing with Teletype and I sincerely believe that when the smoke clears in Washington, we will be off and running."

This year, Teletype will offer several new features on its model 42 teleprinter line. Characters and even paragraphs can be moved or deleted or changed on these enhanced 80-

Queen Nicholson

Ida Boles

Vernon Brown

Wayne Dwyer

column printers. They also have "buffers" that store messages so they can be sent and received simultaneously, and the ability to search the memory for certain messages as needed. There is also a new series known at this point only as the "BCT" family of equipment.

Pappas calls the new family of equipment, "price competitive with choices of features for different functions and full modularity." He continues, "Modularity is becoming increasingly important because we can offer a full range of choices in terms of features, functions, and price. We've identified three separate groups of customers for our peripheral equipment and we've designed modular consoles, video screens, and printers for these different groups.

Pappas stresses that Teletype's ability to stay on the forefront of the technical changes in data transmission is dependent on its employees who must adapt to the changing needs of Teletype's customers in the 80s.

Ida Boles, who has worked 16 years in Little Rock, remembers when all of Teletype's products were electromechanical rather than electronic. "Today," she says, "I'm a section chief on the line that assembles circular bases for the video consoles that are part of the 4500 terminals. The bases contain all of the circuitry—microprocessor controlled—in a lightweight compact housing. It's a completely new world and all of us have had to learn about a lot of new processes for assembling products. And we have to be quick on our feet to match the speed of the R&D people and the engineers. The quicker we can respond to customers' needs, the better off we'll be in this highly fluid environment."

Vernon Brown, a senior engineer at the Little Rock plant, has, as he puts it, "kept himself current in technical areas." He elaborates on what staying current means, this way, "I was a supervisor in test set construction and I decided to take courses at the University of Arkansas and to learn as much as I possibly could about microprocessors. The transition from relays and wires to microprocessors and memory chips has an impact on every aspect of this business. I wanted to stay on top of those changes." Brown has developed what is now called the SHOP system at Little Rock. SHOP stands for Shop Hourly Operators Progress. The model 40 printer operators and the cable shop operators are now using Teletype terminals—manufactured at Little Rock—to report time charged to various jobs and to calculate earned output during each shift. Using the new computerized system increases productivity and accuracy. Brown and his colleagues who programmed the computers to handle this information think of it as a way to use the most up-to-date Teletype technology in order to keep Teletype up to date.

"One of the things that hasn't changed here at Teletype," asserts Pappas, "is our attention to quality. Our new advertising theme is 'value sets us apart' and I think that says it all. We are manufacturing and marketing reliable products that are tested rigorously. Then we back those products up with a strong service organization to keep them up and running. This commitment to quality and service is going to be as important in the 80s as it was in the past."

Wayne Dwyer, who maintains tests sets in Little Rock, has learned some of the testing processes as an adjunct to his job. "I maintain the test sets that are used in the manufacturing process," he says, "and the changes in this area have to stay in step with the progress on the product lines. I knew I'd better learn about solid-state technology in order to stay with it, so I took courses and since then I've picked up new skills as I stay current on the new lines. What's really been helpful is that the engineers here take the time to explain the new technology. We put the equipment through tougher tests than it would get out in the field. I think we make a good solid product—high-quality, good-looking—we're strong competitors."

Teletype is building on 52 years of Bell System experience in the field of data communications. Pappas calls this experience the "stepping stone" for attracting new customers. "Our business customers," he says, "are telling us that they're bogged down in paperwork and in reams of unrelated and disorganized facts. They say that they can't seem to assemble the relevant information to be truly effective managers. We at Teletype can help them to manage the information. We back our products up with strong support and proper training. I'm very enthusiastic about what's coming for Teletype and what we'll be offering our customers in the data communications field."

Weekend Brothers

Giving youngsters what they need the most

Dan Roman, an engineer at Allentown Works, has been active in the Big Brothers movement since 1974, and he's very good at it. Ask Donnie Keich (11), who has been Dan's weekend kid brother for the past two years or Bill Hayden, now in the Army, who benefited from Dan's help and guidance during six hectic teen years.

Big Brothers—and Big Sisters—who are all part of the same national group, work primarily with youngsters from broken homes. Often, as in the case of Donnie, there are several young children in the family and a mother who is so busy trying to make ends meet that there is no time left for play with the kids.

Many of the children are referred to the program by police and probation officers as well as school counselors. On the other side, the Big Brothers are carefully screened to weed out well-meaning volunteers who aren't really prepared to cope with disadvantaged youngsters.

"There are so many youngsters like Donnie who benefit," says Roman. "You become important to them and they become important to you. They're looking for a sympathetic ear. Somebody to do things with. The family budget is usually limited. The program requires that we spend four hours a week together. Usually, I spend much more—a big chunk of every weekend."

"How in the world did you ever get involved?" we asked Dan, who is a bachelor and fortyish. It takes a lot of stamina to keep up with a teenager.

"There was a recruiting campaign here at the plant," Dan explained. "They were asking for volunteers. I'd just completed nine years of night school and I had some free time, so I volunteered. In the Army they used to say never volunteer, but I don't regret it."

Big Brother Dan Roman from Allentown Works pauses in the park with his weekend ward Donnie Keich.

Upgrading the Subscriber Loop

New products and ideas are raising transmission quality and holding down costs

One of the fastest-changing, most complex and exciting parts of the telecommunications network is the subscriber loop—that portion that links a customer's telephone to a central office. Today, Bell System loop-plant equipment connects some 19,194 central offices to more than 142-million telephones.

Over the years, the Bell System has invested upwards of $37-billion in the subscriber loop, and currently the exchange companies are spending another $4-billion a year to operate, maintain and expand it. A significant driving force is the fact that terminals other than telephones are being connected to the loop, and these new terminals—data sets, for example—tie up a lot of transmission capacity.

Over the past decade, in an attempt to help telephone companies meet service demands—especially those of customers in rural and suburban areas—Bell Laboratories has greatly increased its activities aimed at upgrading transmission quality and reducing per line costs in the loop. Western Electric too has redoubled efforts and introduced a number of new cables as well as new transmission equipment designed especially for the loop. We also offer the telephone companies exciting new software based systems that reduce costs in designing, operating and maintaining the loop transmission network.

A traditional loop consists of a pair of wires connecting the customer to the central office. How do you upgrade that? Isn't a pair of wires about as basic as you can get?

You upgrade by making those pairs of wires already in place carry double, triple, quadruple or even 10 times the traffic over much of the distance so that the only additional wire needed is that from the new house to the utility pole or increasingly to a pedestal marking a buried distribution cable.

Over the next decade, the communications services provided in the subscriber loop will become much more exotic than today's basic voiceband message telephone service. We are evolving toward digital systems and stored program control which support all sorts of sophisticated service offerings.

Loop Electronics

In coming years, low-cost electronics in the form of integrated circuits and minicomputers will have as profound an effect on the subscriber loop as they previously have had on the long distance plant. Electronic systems already have significantly cut the cost of serving customers.

In order to get more transmission capacity out of existing cable, Bell Labs came up with the Loop Switching System (LSS), which Western Electric introduced about 1977. It triples the number of customers who can be served on an existing wire pair by using a microcomputer to direct calling traffic over idle lines.

Electronics is also used to transmit multiple conversations over the same line, using a technique known as multiplexing. The Subscriber Loop Multiplexer (SLM*) system, an early carrier/concentrator, electronically interleaves many conversations on four wire pairs to bring efficient single-party service to 80 customers.

The introduction of each new electronic system in the past few years has made possible great economies for the telephone companies, largely because the cost of solid state electronics on which these systems are based is continuing to decline. Take, for example, the carrier systems that use a technique called pair gain to place more than one customer on a single pair of wires. The SLM Subscriber Loop Multiplex system, one of the first of the modern loop carriers, cost about $750 per pair of telephone wires gained. It could compete with copper cable on only the longest rural loops. The SLC*-40 Subscriber Loop Carrier system, which was introduced in 1974 for use on heavy routes, can provide the equivalent of 40 pairs at a cost of about $460 per pair gained.

The SLC-8 Subscriber Loop Carrier system, used on thin rural routes, makes it possible for one wire pair to carry up to eight simultaneous conversations at significant savings per pair gained.

The major impact of electronics technology on the subscriber loop in the 70's was to offset the high cost of installing new cable in rural areas. Even more dramatic savings have come with the introduction of the latest generation of subscriber loop carrier, the SLC-96 Subscriber Loop Carrier system, which is even replacing small unattended community dial offices (CDOs) in some suburban areas. It provides service to 96 customers over eight pairs plus two for protection. And it costs on the order of $295 per pair gained.

A key point about the SLC-96 Subscriber Loop Carrier is that it brings digital capability much closer to the user. Many of the new computerized services being offered by the Bell System and its competitors require bandwidths broader than voiceband and transmission quality of a very high order. To meet these requirements in the subscriber loop, additional cable may be required, expensive cable reconditioning may have to be done, or the line has to undergo electronic treatment. The over-all objective nationwide is to give the loop a data handling capability of 64 kilobits per second as soon as possible.

New Cables and Connectors

Advanced cable designs, new insulating materials and special cable connectors are also helping hold down the cost of providing telephone serv-

Story continues on page 18.

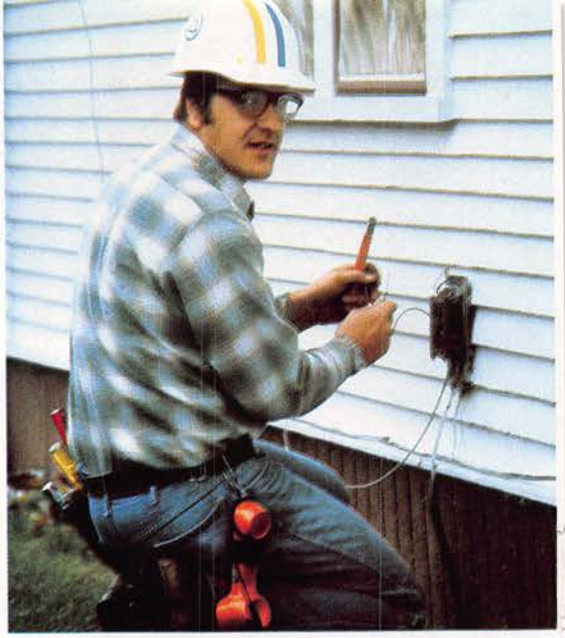
*Trademark of Western Electric

WE engineers from Atlanta oversee placement of a SLC-96 maxihut in a new housing development in Miami.

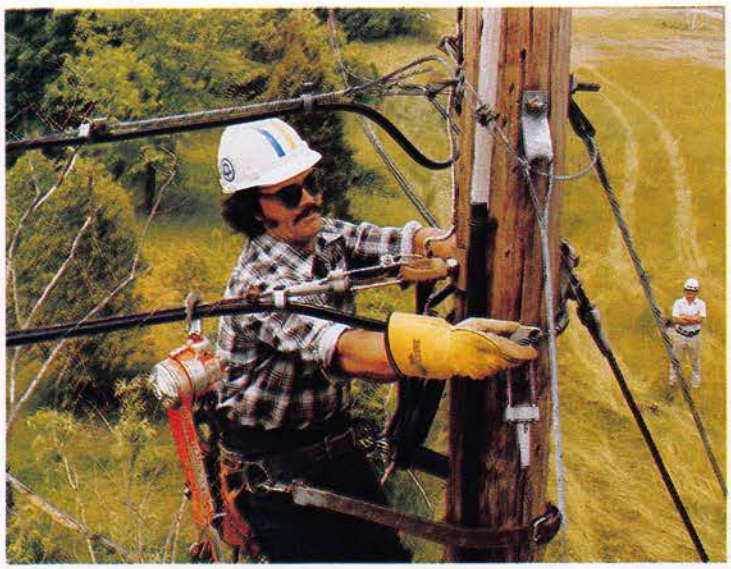
Subscriber Loop

In terms of investment, the subscriber loop is one of the most significant parts of the Bell telecommunications network. The dollar value of the plant in place is upwards of $37-billion, with another $4-billion a year spent on maintenance and modernization.

The loop's function is to connect a subscriber's residence or place of business to the central office. To do so, it uses mostly pairs of wires, along with needed connectors, protectors and all sorts of ancillary hardware. Increasingly, the subscriber loop is going electronic—and digital.



At your residence, the telephone lines attach to an electrical protection block.

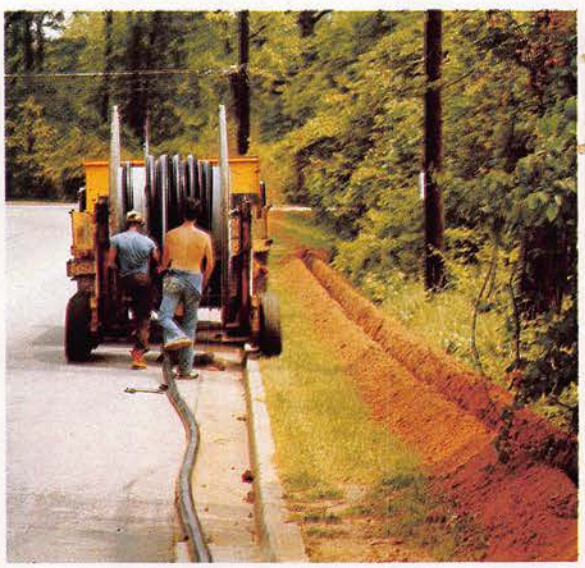


From high atop their enclosed cages, workers are either stringing cables or . . .

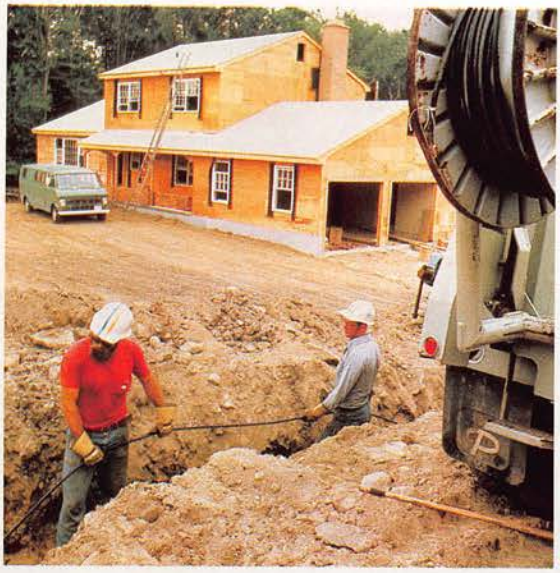
splicing cable between utility poles

A distribution interface connects service lines to the exchange.

Loop cables are usually buried in the ground.



Unreeling some new cable in a surburban Atlanta community.

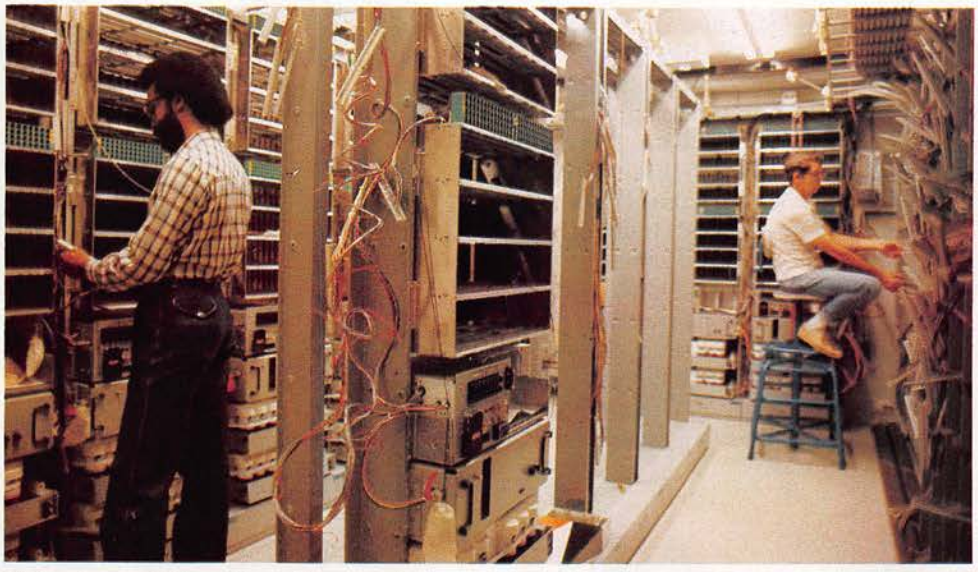


In new suburban developments, the trend is to bury all service wires.

Your service lines are connected to a curbside pedestal.

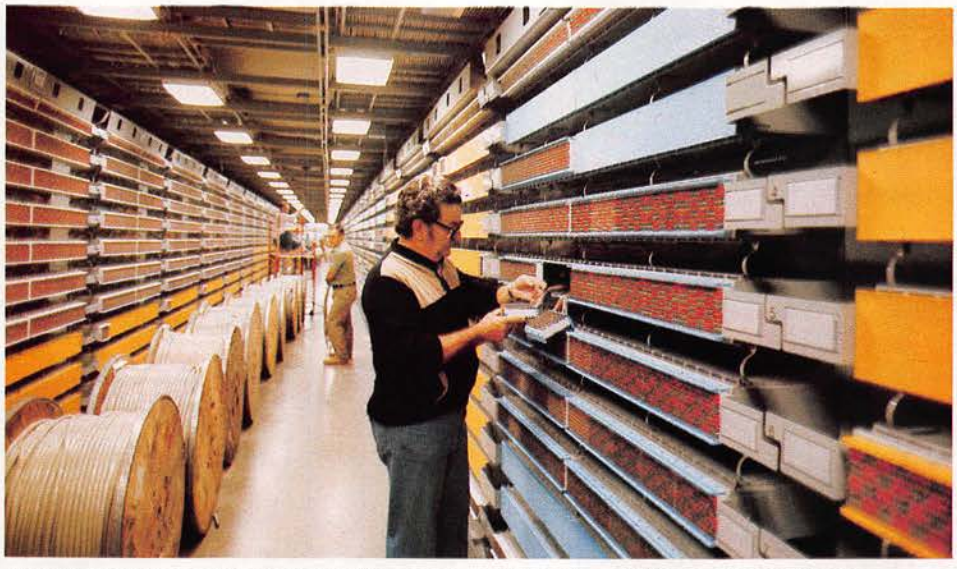
Sometimes, you need a cherry-picker to work on the loop.

These 710 connectors simplify the splicing of aerial cables.



This air conditioned equipment shelter or "maxihut" can hold up to 20 SLC (subscriber loop carrier) systems.

Incoming cables are connected to the central office's main frame.



Cosmic II frames in central offices systematize the addition of new lines.

Manufacturing the SLC-96 System.

Production of the SLC-96 Subscriber Loop Carrier system has risen steeply each year since 1979. It is now the backbone of the business at North Carolina Works, with many other locations including Kearny, Allentown, Richmond, Columbus and Merrimack Valley contributing essential ingredients.

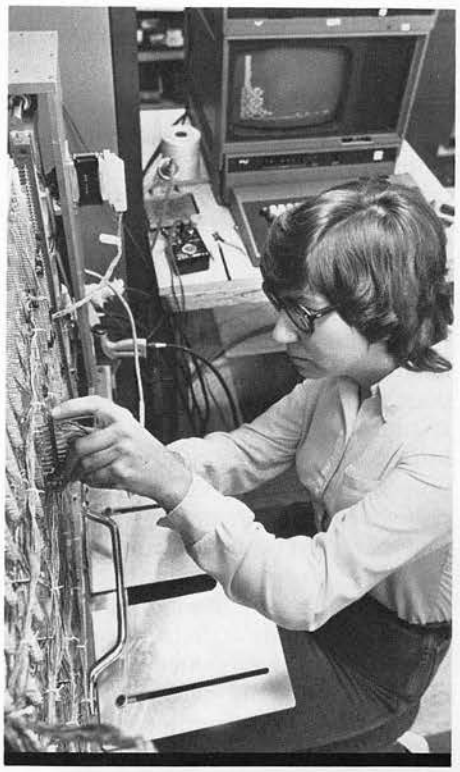
When loop electronics systems were first introduced, the operating companies were not sure when and where to use them. There were many financial considerations. And when they did decide to install a loop electronics system, the craftspeople and the loop distribution engineering people were unfamiliar with the new technology and had difficulty getting the systems up and running. Western embarked on a mammoth training program at the North Carolina Works. More than 1,000 telephone company supervisors, engineering personnel and craftspeople have now received training in the care and feeding of the SLC-96 Subscriber Loop Carrier system which is now saving them huge amounts of money.

Assembling shelves for a SLC-96 unit are Kaye Griener and Mary Galloway at the North Carolina Works.

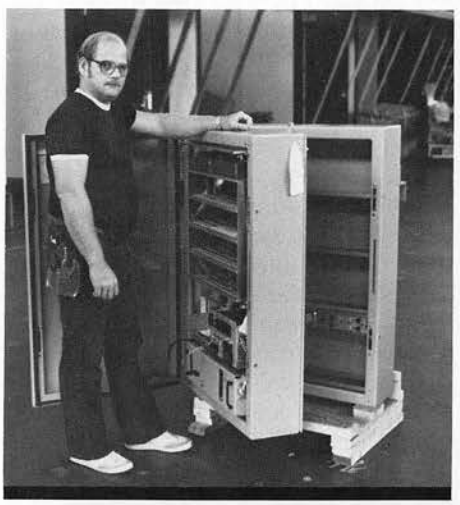
Engineering Associate Alan Gunn working on a trouble-shooting guide for SLC-96 circuit boards.

Cender Reed runs the final assembly tests of channel units for SLC-96.

An overview of the transporter, distinctive feature in the assembly of circuit boards at North Carolina Works, where about 1,000 people are involved in the manufacture of SLC-96 systems.



Sharon Stickland is testing a central office terminal unit for a SLC-96 system.



In Atlanta staging area, Installer George Palmer poses with a completed 36B cabinet for SLC-96 system.

(Continued from page 12)

ice in the subscriber loop.

One of the newer items for the subscriber loop is a reinforced self-supporting cable that is manufactured at Baltimore Works. Available in a wide range of sizes from 6 to 300 pairs, the new design incorporates a steel strand right inside the cable sheath to provide extra support between poles. Inside the cable itself, there is an aluminum shield as well as a layer of corrugated steel. All of this protection within the polyethylene jacketing helps prevent damage caused by thrashing tree branches, errant shotgun pellets, nosy woodpeckers and hungry rodents.

To protect buried cable, a water-resistant compound called Flexgel* filling compound is now available. And a new polyurethane material introduced in the last few years, called D-Encapsulant, is used to waterproof buried cable splices inside splice closures. To prepare this encapsulant, a craftsperson simply mixes two liquids together, then pours the compound into the closure containing the splice. The substance solidifies within minutes and is highly water resistant. Closures can be reopened easily for maintenance of the splices.

Splicing or connecting cable, always a time-consuming job, costs the Bell System more than $500-million a year. To speed the job and reduce costs, engineers have developed connector modules and new splicing tools. One family of connectors is the 710 system and associated pressing tool. It permits a craftsperson to connect 5 or 25 pairs at a time. An associated test set quickly and automatically checks the connectors.

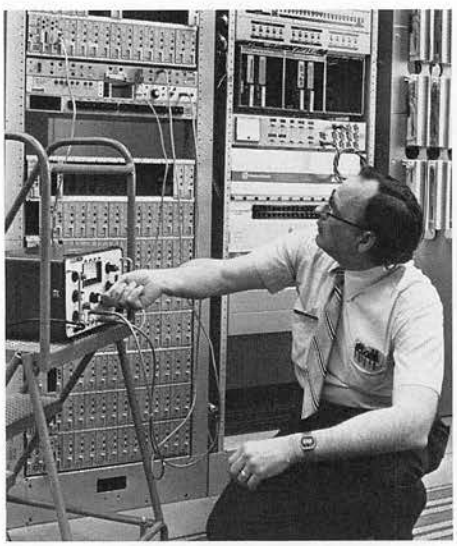
With the Connectorized Exchange Cable Splicing System (CONECS), these 710 modules can be prewired to cables at the factory when the precise length of the run is known. These prewired connectors can be snapped together in the field, joining 25 wire pairs simultaneously, in a quarter the time it used to take.

Computers and Software

Computer programs are being used increasingly throughout the Bell System to provide many efficiencies and economies and this is particularly true of the subscriber loop area. There are now computer programs that streamline many time-consuming activities, such as connecting a customer to the telephone network via the main distributing frame in the central office. A new modular frame, known as Cosmic* II Main Distributing Frame, helps minimize wire congestion by reducing wire lengths and permitting one person to make connections and changes. For this and conventional frames, Bell Labs has developed Computer System for Main Frame Operations (COSMOS) to handle many details of customer service requests. This system automatically assigns phone numbers and switching equipment, evenly distributing the over-all switching load. It also selects the best and shortest wire connection path between each new line and the appropriate switching equipment.

Similar operations systems are streamlining the Repair Service Bureau. One, called Loop Maintenance Operations System (LMOS), controls mechanized line testing, and processes and analyzes trouble reports. It provides instant information on a customer's telephone line record in the short time that the customer remains on the line. LMOS keeps track of several million lines.

Still other operations systems are helping Bell System companies analyze telephone network design and calling patterns, forecast construction needs, and improve engineering methods. The first, Exchange Feeder Route Analysis Program (EFRAP) helps outside-plant engineers develop long-range plans for cable and conduit in densely populated urban and suburban areas. It has been available from Western Electric since 1964. Since then, many analytical computer programs and design methods have been developed. One, known as Rural Area Network Design, simplifies rural network design and helps Bell System companies get maximum use from long loops in sparsely populated areas.



Chris Brewer runs SLC-96 training program at North Carolina Works.

Just recently, Bell Labs has computerized the Pair Gain Planning (PGP) procedure for telephone company engineers assigned to providing digital capability in the subscriber loop. Since many of the steps and calculations are done automatically, what used to take two or three days using the old manual method can now be done in two or three hours. And in this much shorter time, the user gets to consider a greater number of alternatives.

The Future

Some evolving new technologies may someday significantly affect loop plant capabilities and help expand the range of telecommunications services offered to Bell System customers.

There is, for example, a major effort underway to develop a centralized data base and a computer network that will provide compehensive surveillance and control of loop operations. The system will integrate loop planning, design, engineering and maintenance programs to provide even greater economies and efficiencies than are now possible.

For the somewhat more distant future there is lightguide for the subscriber loop. Work is well underway at Bell Labs for a "fiber" SLC, Subscriber Loop Carrier system, and we have had one BTL experiment at their Chester, N.J. location. Lightguide would be used to connect the system's remote terminal directly to a switcher in the central office. The volume of traffic that could be handled over such a line would be enormous.

The first applicational field trial of fiber SLC is scheduled for the fourth quarter of this year at Chester Heights, Pennsylvania. However, lightguide has been previously used extensively as a trunk facility between central offices, and there has been some use in the subscriber loop.

Eventually, the Bell System hopes to be able to capitalize on lightguide's space and cost savings, and use its high information carrying capabilities to offer customers new data, facsimile and video services right in the home.

Bell Labs
A Record of Achievement

The Wall Street Journal has called the Labs one of the scientific and technical wonders of the world

By Saul Fingerman

Seminal events are rarely perceived for what they are until they blossom and bear fruit. So it was on January 1, 1925, when AT&T and Western Electric announced the creation of Bell Telephone Laboratories, Inc., "...in order that the continuous program of research and development necessary to the progress of the (Bell) System should be carried on in the most efficient manner...."

The dry, matter-of-fact announcement elicted scant attention from the media and the new company quietly and just as matter-of-factly went ahead setting up shop in a Western Electric building overlooking the Hudson River in downtown New York City. Even the principal players, such as AT&T president Harry B. Thayer and the Labs' first president, Frank B. Jewett, could scarcely have foreseen the rich harvest of scientific and technological developments their creation would produce in the years ahead. In a few decades, the media went from nearly total indifference to energetic and nearly continuous coverage of these developments as an on-going story.

The subject of that story has grown considerably since 1925. What began as a relatively small operation in a turn-of-the-century Western Electric plant in New York has blossomed into an organization of almost 23,000 regular employees working at 19 locations in several states.

Part of that growth was simply the natural expansion that followed in the wake of a growing Bell System. Part was necessary for the Labs' fulfillment of its World War II obligations. But most of it was due to the Bell System's early recognition that its future lay increasingly in proliferating technology—with Bell Labs doing most of the proliferating. Telecommunications was born of research and development; matured and thrived on research and development; and can only continue to prosper through research and development. This is particularly true in this era of fierce competition—ironically, much of which was made possible by Bell Labs innovations.

A comprehensive list of these innovations would fill several issues of this magazine—as would a similar listing of the awards those innovations have earned over the years. Working closely with Western Electric, Bell Labs has led the way in coaxial cable, submarine telephone cable, microwave radio, satellite communications and digital transmission. It developed successive generations of switching systems, from electromechanical to fully electronic—each more versatile than its predecessors. In 1959, it demonstrated the feasibility of time-division digital switching. In 1965, the Bell Labs/Western Electric team introduced the world's first commercial electronic exchange office; and, in 1976, installed the world's first digital toll switching system—the No. 4 ESS.

Ever mindful of the telephone subscriber, Labs scientists and engineers developed Direct Distance Dialing, TOUCHTONE® calling, DATAPHONE® II service, and computerized systems for speedy handling of collect and credit card calls. In between these major developments, came the hundreds of more fundamental and, often, brilliant conceptual advances that made them possible. The negative feedback amplifier, for example, conceived by Harold Black, who wrote it down (as though for a Hollywood script) in the margin of a newspaper while riding the Hudson River ferry to work one morning, was one of those elegant concepts that is as fundamental to telecommunications as the wheel is to transportation.

Equally prolific was the Labs' outpouring of non-telephonic innovations, which included sound motion pictures, high fidelity and stereo sound recording; the first long distance TV transmission in the United States; pioneering work in analog and digital computers; the invention of the solar cell and the conception of the laser.

In a class by itself, not so much for what it *was* as for what it would *lead to* was the transistor. Invented in 1947 by J. Bardeen, W. Shockley and W. H. Brattain, the "mighty midget" earned its inventors Nobel awards and gave the world a hard shove forward into the new era of solid-state electronics. The ways we conduct business, communicate, entertain ourselves, and so many other aspects of our lives would never be the same again.

Appropriately enough, most of the major processes developed since 1947 to produce transistors, integrated circuits and microcomputer chips have also come from Bell Labs and Western Electric. In short, as Bell Labs president Ian Ross aptly notes, "Not only did we launch the solid-state revolution nearly 35 years ago, but we have been pacing its advance ever since."

It's not surprising, then, that many people consider the Labs a national asset. "The most distinguished and productive research operation of any business corporation in the world" was the way the *Washington Post* summed it up in a May 1982 editorial.

The key words here are, "most productive," and nobody disputes them. Over 20,000 patents—an average of one a day since it started up in 1925—form a mountain of productivity you can't argue with.

What makes the Labs so successful? There are several contributing factors. These include substantial financial support by Western Electric and AT&T; the Bell System's integrated structure, which permits the free exchange of information between the Labs and its partners; the ability to attract scientists and engineers of the highest caliber; and a challenging and clearly defined mission. Basically, that mission has been to create and provide to the Bell operating companies the technology they need to furnish the best telecommunications

Comments on the Bell Labs-Western Electric Relationship

Paul Zweier
Senior Executive V.P.
Western Electric

"The opportunity to compete in free markets will undoubtedly stimulate what is already a formidable development/manufacturing team. We can now bring our technologies into other marketplaces, both here and abroad, with products such as commercial information systems, medical instrumentation and data networks. The range of possibilities is broad.

"The design/manufacturing process will be much more sharply focused on customer needs and economic criteria. We will take on AT&T's difficult task of prioritizing BTL development projects, and we will work even more closely with them than we do now. In addition, network and systems engineering functions will have to be strengthened to make sure we continue furnishing telephone companies with the best products possible. *More than ever before, we will have to earn our position as their preferred supplier.*

"High technology products demand that superior designs be supported by superior manufacturing processes—and this is where we have the competitive edge. We are already world leaders in several manufacturing technologies; and our Engineering Research Center, still the best of its kind in the world, acts as a powerful reinforcement of that leadership.

"Both WE and BTL will be reshaped to interface most efficiently—a process already in progress. Inevitably, there will be more personnel exchange between WE and BTL. The end goal is to be more price competitive and responsive to our customers' needs than ever.

"To those who wonder if we will be as successful in the future as in the past, I say, 'More.' Look at our technological base: Our microelectronics are the best in the world. Our catalog of software is unique, as is our capability for producing more. And we are the only company in the world capable of handling *all* aspects of lightwave technology. In short, we are a technological powerhouse.

"As of now, we are in charge of our own destiny, and our future will be what we make it. Let's roll up our sleeves and get on with showing the world what the WE/BTL team can do with the opportunities now available to us."

John S. Mayo
Executive V.P. Network Systems—Bell Labs

"Bell Labs and Western Electric work together in an excellent manner. We always have, although there have been changes in our relationship since the Labs was first formed. Fifty years ago, we developed and you manufactured. Today there is more of a continuum from development to manufacture. Increasingly WE people are present at the beginning of the project and their presence grows until they take over at the end of Bell Labs involvement.

"The Bell Labs-Western Electric team has proven many times that it can put high technology through low-cost manufacturing. We believe we can do in the future that which we did in the past, and are doing now.

"Software and microelectronics are pacing technologies, and they are forcing change in the Bell Labs-Western Electric relationship...

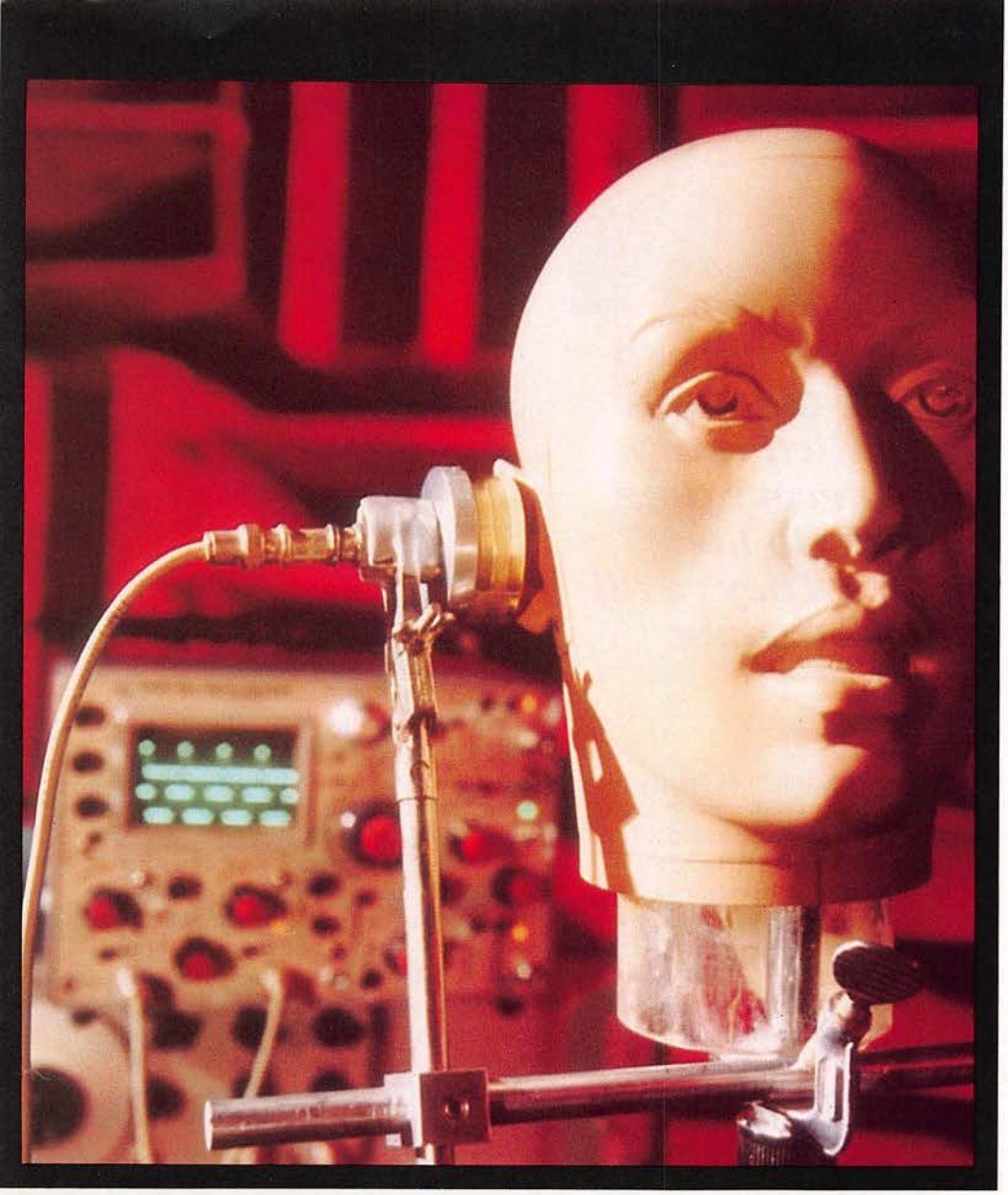
"And of course software in the form of computer aids to design is greatly enhancing both our design efficiency and your manufacturing efficiency. The same software often serves both of us. We will increasingly transfer designs by having our computer 'talk' to yours. It's changing the way we work together...

"Microelectronics and software are sweeping in a wide range of digital systems, allowing a lot more standardization. For example, with Bellpac® (a set of standard equipment shelves, wiring boards, and design tools) we can design things once and then use them in many places. Circuitry in transmission might be the same as in switching. This not only brings Western manufacturing divisions closer together, it brings Western and the Labs closer...

"Microelectronics and software also make robots feasible. With robots controlling manufacture, the designer must be intimately coupled to the robots' capabilities. We are working very closely with Western Electric in this area.

"Restructuring should bring us even closer together. We continue to share a common destiny...

"And there is hardly any job more important than caring for the needs of the divested BOCS. They will continue to look to the Western Electric-Bell Labs team to fulfill their major system needs because we will continue to offer them the best products and services..."



Unperturbed, this manikin lends his ear to research on experimental receivers and acoustic filters.

service in the world. Implicit in this mission is a high degree of practicality. For all its aura of academe, the Labs is no ivory tower. Former BTL president William Baker put it rather bluntly in a newspaper interview a few years ago: "Science," he said, "is not degraded by being used."

Even more to the point is Arno Penzias, Vice President, Research and a 1981 Nobel laureate (along with co-researcher Robert Wilson): "Bell Labs is very different from a research laboratory run by the government or a university," he says. "It has to make money."

And it does. In fact, the Labs has probably paid for itself many times over. A single development, for example—the use of plastic cable sheathing instead of lead, saved the Bell System enough money to fund the Labs for several post WW II years.

Besides its practicality and a worldwide reputation that attracts the best scientific and engineering minds, Labs people often attribute their success to still another factor—size. The Labs, they say, is large enough to provide a

At Holmdel, N.J., Bell Labs engineers use an interactive computer system and a color graphics display terminal to design integrated circuits like the ones in the futuristic photo above.

Lightguide fibers are drawn from glass preforms such as this one.

"critical mass" of people and scientific disciplines. S. J. Buchsbaum, Executive Vice President Customer Systems, explained the concept this way: "Some of the more challenging problems in telecommunications require the ability to draw on the skills of many experts. For example, five people might represent a critical mass for research on plasma phenomena in solids, but it took over 50 people several years to develop the technology for mobile radio; over 500 people to develop the NO. 4 ESS; and over 2,500 to develop SAFEGUARD."

But, he is quick to point out that critical mass is more than just numbers of people. It also requires that those people have access to expertise in all the sciences and technologies relevant to the task at hand. Or, as Executive Director, Bob Lucky (Research, Communications Sciences) puts it: "The nice thing about the Labs is that you can walk down the hall and talk to the greatest experts on just about any kind of science you can think of. We have a rich, fertile environment in which we can get advice of all sorts."

Lucky's "rich, fertile environment" is well seeded with scientific talent. There are enough PhDs at Bell Labs to staff several large universities—over 3,000 at the last count. In addition, there are over 5,000 at the master's level and nearly that many at the bachelor's level.

The efforts of about 8 percent of these highly creative people are devoted to research—as was about 8.5 percent of the Labs' 1981 budget of $1.6 billion. The percentage of research people has dropped slightly in the past few years relative to the growing number of development people. However, Executive Director Dick Kelley feels the Labs is generally well staffed in research.

"When you already have good people in fields of interest to you," he says, "you don't necessarily profit just by adding to their numbers. The fact is that research doesn't have to grow in proportion to development, because it generates basic knowledge that can be shared by *all* development groups. If you think of development people as writers and research people as the group that turns out the dictionary they work from, you'll get the idea. You don't have to enlarge the number of dictionary people every time you add to the writers. They're all using the same words."

"You don't have to enlarge the number of dictionary people every time you add to the writers. They're all using the same words."

Staying with Kelley's interesting analogy, one can't help thinking that, if the development people often turn out sheer telecommunications poetry, it's at least partially due to the research people giving them "words" that sing.

Those "words" describe a host of scientific investigations, covering all the fields of science that relate to telecommunications. That this covers a lot of territory is made abundantly clear by a look at a list of current research projects. Included are items as diverse as *magnetic properties at ultra-low temperatures, memory processes in living systems, acoustic microscopes,* and *natural language understanding by computers.*

Aware that applied technology thrives on a constant diet of pure research, Labs president Ian Ross has said, "Do not imagine for a moment that all the pressure for more products *now* dilutes our need for more forward-looking work. We will not trade away our future to meet the needs of the present."

But, even though research ensures the future, Ross is equally aware that development and systems engineering—the Labs' two other major divisions of effort—are vital to fill the needs of today.

Funded mainly by Western Electric for specific projects, development is the area to which the Labs devotes most of its resources. In 1981, Western Electric paid the Labs $838-million for development work. Such projects can range from the very small to the very large, such as the No. 4 ESS.

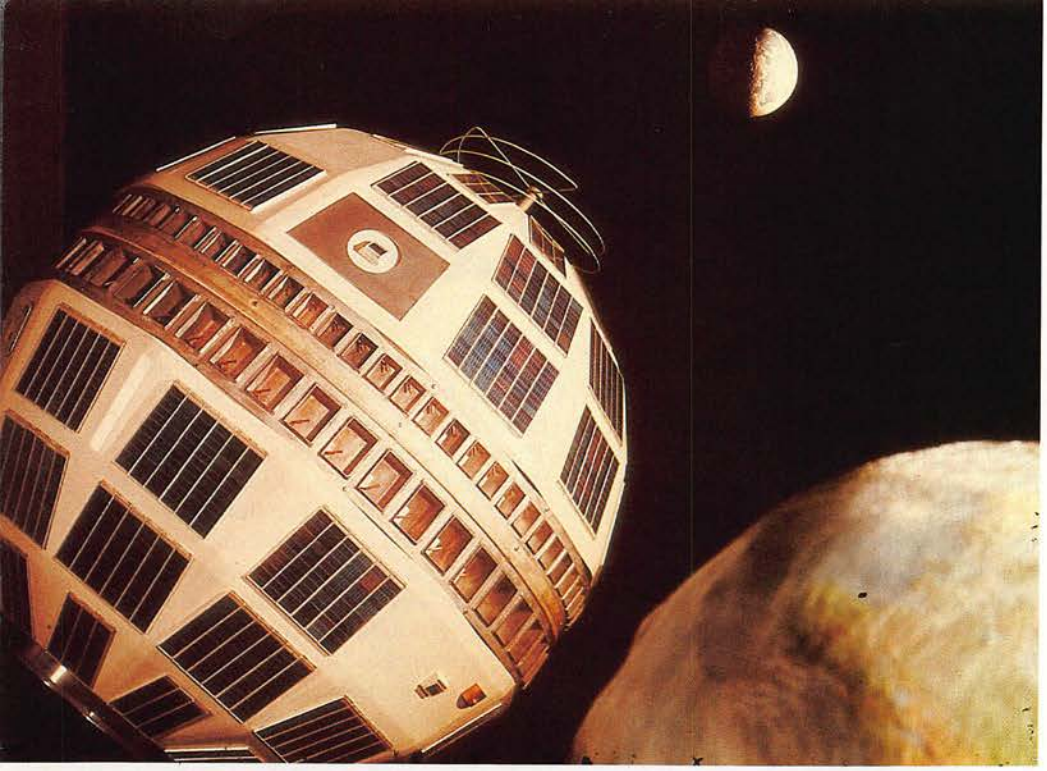
Systems engineering can be equally important. A unique and not too well understood area, systems engineering has two primary functions. The first is to plan the evolution of the network while devising the most efficient engineering tools and procedures for the operating companies to use in planning, installing, operating and maintaining that network.

Systems engineering's second function is to turn all the new technology coming out of the Labs to the best advantage—principally in terms of the features, functions, performance and economics of new products.

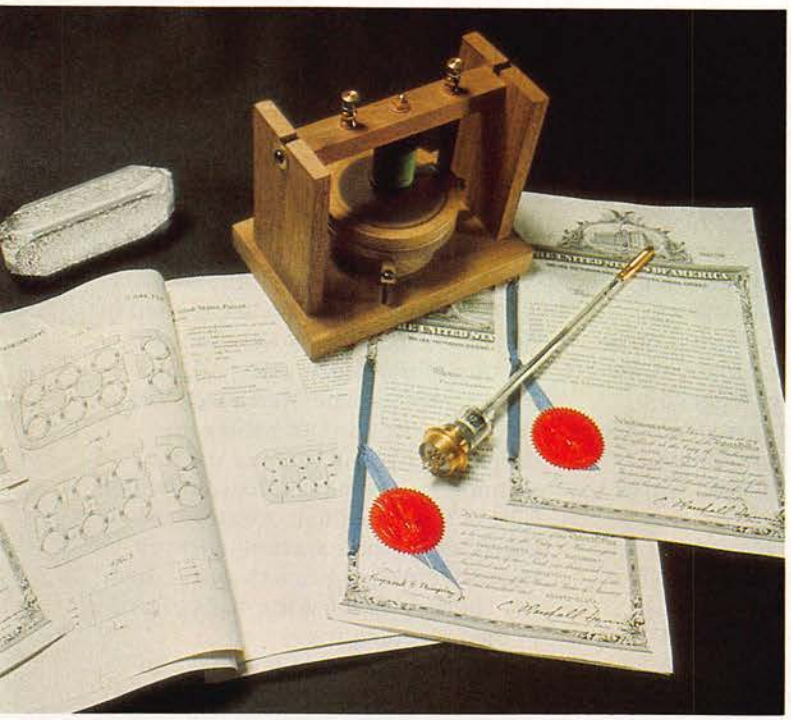
Despite the differences in the work they do, systems engineering people, development people and researchers share many attributes. There is, in fact, a constant flow of personnel among the three groups, with many people spending parts of their careers in two, or even in all three areas. Similarly, there is a steady interchange of information with each group intellectually nourishing the others.

Much of that information also goes to the outside world, including hundreds of competing telecommunications firms (See "Competitors," Third Quarter 1982). Since it is rare that research results are not published, it is not surprising that the numbers of papers and patents are staggering. In recent years, Bell Labs scientists and engineers have been publishing more than 2,000 papers a year and presenting a similar number of talks at professional conventions and symposia. And, then, of course, there are those thousands of patents Bell Labs inventors have been garnering for over half a century

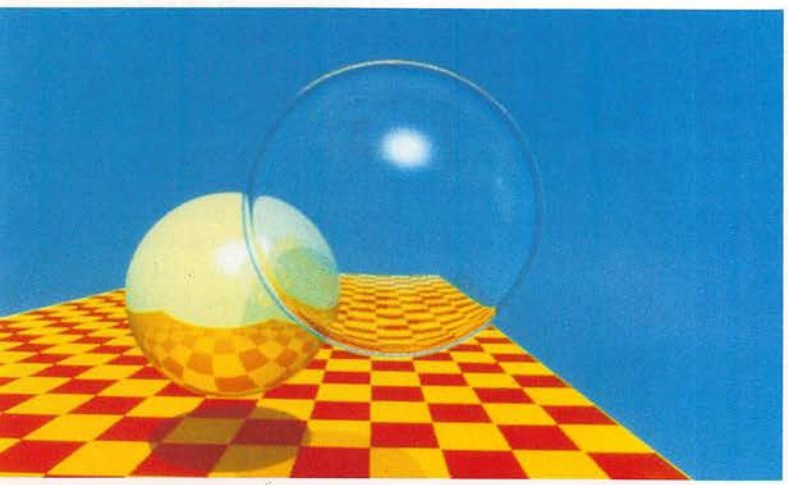
Those patents represent a host of technologies, four of which are critical to the dawning Information Age. The four are *software, microelectronics, photonics,* and *digital.* The latter



Launched July 10, 1962, Telstar I was the world's first active communications satellite.



Bell Labs inventors have earned nearly a patent a day for over half a century.



The techniques used to create this computer-drawn scene may also help design yellow page ads and integrated circuits.

three are briefly explained in the accompanying article on the branch labs (see page 24).

Software programs provide the intelligence for most modern telecommunications equipment and are pervasive throughout the Bell System. In fact, software has become so important that 40 percent of Bell Labs technical employees are currently working on its development or support. To date, they have created over 18-million lines of original software code, making the Labs one of the largest software enterprises in the world. More than half a million lines of new code are generated every year, much of it to provide new or improved features for switching systems such as the No. 5 ESS. In addition, hundreds of Bell operating companies efficiently manage their planning, maintenance, billing, inventory and all the other aspects of day-to-day operations.

"Software," as Ian Ross has noted, "is a very difficult subject, and it will take a long time before Bell Labs is as comfortable with large software projects as it is with large hardware projects."

But, if software is a difficult beast, the Labs—and Western Electric—have made considerable progress in taming it. They have to. As more and more computerized intelligence is distributed throughout the network, the network will require more and more software. "The ultimate goal," says Bob Lucky, "is to automate software development and let the computers do their own programming.

"Otherwise," he adds with an elfish grin, "the world will be full of programmers."

A visionary with a sense of humor, Lucky thinks the world is also going to be full of computers in a few years. In a recent *Newsweek* interview, he looked ahead to a time when powerful computers will probably "...come as prizes in breakfast cereals, but you won't even bother to open the little cellophane bag in which they're packed, since your house will already be littered with them."

The president of a large cereal

Branch Labs

"We will not trade away our future to meet the needs of the present."

company was so intrigued by this he wrote Lucky to find out when he could begin packaging these terrific prizes. But, as Lucky regretfully told him, he was a little premature. Even the Labs can't always rush the future.

In addition to developing software, the Labs is deeply committed to making computers and other software controlled machines more "sociable."

"The computer is intolerant," says Hal Alles, Director of Computer Systems Research. "If you don't speak its language, it won't have anything to do with you." Thus, the computer must be made more understanding and tolerant. This involves learning how people think—which is one reason Bell Labs has 120 PhDs in psychology.

Many of these psychologists, along with most Labs researchers, do their highly esoteric work at Bell Labs headquarters in Murray Hill, N.J. First occupied in 1941, this sprawling complex of terra cotta colored brick buildings on 202 hilly acres was designed to suggest a college campus—even to having ivy-covered walls. Over the years, however, three major building additions have tended to give it more of a modernistic look, while simultaneously increasing its space to nearly two-million square feet—roughly the size of Western's Columbus Works.

The configuration of this space keeps changing because Murray Hill is totally modular. It was, in fact, the nation's first modular laboratory building. All of its interior walls are moveable, each one being rearranged an average of once every seven years. Even the laboratory where the transistor was invented was dismantled long ago—proving, perhaps, that science can't afford the luxury of nostalgia.

In startling architectural contrast to Murray Hill stands Holmdel, the largest of the Labs' 19 facilities. An hour's drive from Murray Hill, Holmdel houses nearly 5,000 scientists, engineers and support personnel in a mirrored-glass monolith that is also in the process of being expanded. Most of Holmdel's people work on systems engineering; R&D for switching; transmission and customer equipment; and network planning.

Nine other New Jersey facilities house as many as 3,000 people, at Whippany, to as few as 40 at sparsely populated Chester. Their work ranges through virtually the whole gamut of Labs activities. Except for branch laboratories at seven Western Electric manufacturing locations, Indian Hill, in suburban Chicago, is the only major Labs installation outside of New Jersey. It is devoted to developing electronic switching systems, electronic computers and their software.

One oblique indication of how software keeps changing the way things are done is the constantly growing ratio of office space to laboratory space as more and more work is done with and on computers. Holmdel, for example, was originally designed to have twice as much lab space as office space. But, when the new addition is completed, the space division will be fifty-fifty.

As for the future, all indications are for continued growth and an explosion of new products and services. After warning that, "Technologists have often missed the trends," Bob Lucky went ahead anyway and briefly summed up some of the trends. "Generally, I see photonics replacing electronics; digital replacing analog; microelectronics continuing to double the number of components on a chip every year; more growth in computer-aided design; integrated optics; friendlier human-machine interfaces; and more and more silicon intelligence spreading throughout the network."

Then, smiling, he added, "You know, all history has shown us we just don't know how these things will go. Some person down the hall might be working on something right now that will change everything."

At Bell Labs, that's a distinct possibility.

About 15 percent of Bell Labs' work force is located at seven Western Electric plants across the country. These unique enclaves are known as "branch laboratories," a term probably coined by M.J. Kelly, the Bell Labs president who created them.

As early as 1943, with a degree of foresight bordering on the prophetic, Kelly envisioned the coming of all-out competition and the need "...for making the design-to-manufacture sector of our efforts as uniquely creative, efficient, and fast moving as possible." He predicted that, unless something were done, problems would arise because of "...the separation in organization and location of the Laboratories design and Western engineering for manufacture groups." And that's what the branch labs are all about—eliminating that separation so that the best possible products can be most efficiently, economically and swiftly put into production.

The seven branch labs are located in Denver, Colo., Indianapolis, Ind., Columbus, Ohio, Reading, Pa., Allentown, Pa., Atlanta, Ga., and Merrimack Valley, Mass. Because the latter three are deeply involved in three of the four technologies being emphasized by Bell Labs, *WE* visited them. As previously noted, those three technologies are microelectronics, photonics and digital. The fourth, software, was covered in the preceding pages.

The three directors *WE* spoke to have several things in common: They all meet formally and informally with their Western Electric counterparts a few times a week; they all fervently believe in the absolute need for close-knit BTL-WE teamwork in bringing products into production; they all agree that the processes developed to manufacture a product profoundly influence the original design of that product; and they are all justifiably proud of their people and their accomplishments. What follows is a brief sampling of some of their comments.

Merrimack Valley

"If we didn't take a close look at every detail, we'd be in trouble."

The seven branch labs are where Western Electric and Bell Laboratories really come together

Bill Scheerer
Executive Director
Transmission Systems—
Merrimack Valley

"We've got 850 people here in four labs, plus staff support. Three labs are devoted to developing transmission systems, and the fourth to providing the components, processes and computing support we need to make those systems. Most of the people are electrical engineers, and they're unique. They're unique because there just aren't too many people around who know how to handle microwave radio.

"When this branch lab was first set up 27 years ago, its mission was a lot different from what it is now. At that time, our function was to do only the last edges of final development—that is, to take "breadboard" designs and get them ready for manufacture. In the early 60s, that concept changed drastically, and, now, we do everything from exploratory development right on through to final development.

"Why are we going digital? It's a combination of technology, economics and customer demand. Since we introduced T-carrier in the early 60s, digital has "proven in" over analog in the exchange area. Silicon integration lends itself to digital technology, so we can make cheaper digital terminals than analog ones—and, for short systems, it's the terminal costs that dominate. What's more, with digital systems, we can integrate all the terminal functions, including special applications.

"Analog is still cheaper over long distances because it requires less bandwidth per circuit than digital. But lightwave and low-bit-rate voice circuits will help drive down long-distance digital transmission costs. And, finally, we're being driven to digital because of the need for new services and because more and more signals are starting out as digital signals—computers talking to other computers, and that kind of thing.

"You might say that the digital equipment coming out of the Valley here laid the foundation for a digital network. The constant feature enhancement and cost reduction of our channel banks and T-carrier accelerated their introduction into the network and helped make the Bell System the world's largest handler of digital communications.

"Our biggest product lines are the T-carrier family and D4 channel banks, which digitize voice signals and are flexible enough to accommodate almost any kind of signal combination there is. In fact, we make about two million digital channel terminations a year.

"We're also going full speed ahead in digital radio. Both our DR6 and DR11 systems give us economical digital radio capability for the short haul environment, which means anything up to 300 miles. In some cases, they are more economical for connecting exchanges than T-carrier. This is an extremely competitive area, by the way. We took the lead here, because we came out with more advanced features than any of our competitors have been offering.

"With competition as fierce as it is, every dime is important. If we didn't take a close look at every detail, we'd be in trouble. I recently accompanied five Western Electric people on a visit to some Japanese plants, and I can tell you *they* sure pay attention to detail!

"I believe very strongly in branch labs. Our closeness with Western is what enables us to respond in timely fashion to competitive pressures and the needs of the Bell operating companies."

Atlanta

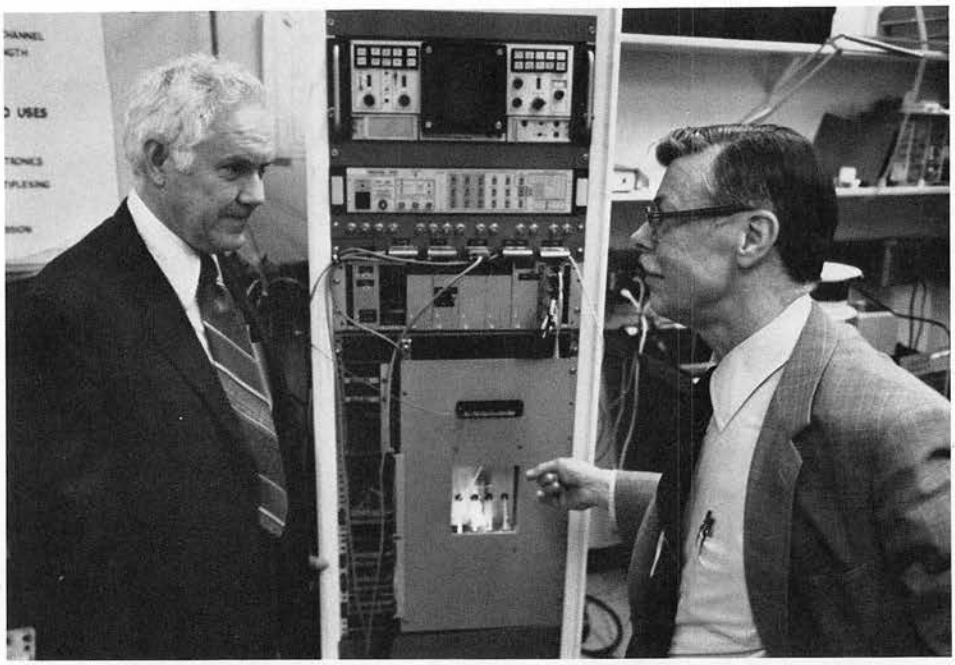
Jim McCrory
Director

"We're not a typical branch lab—if there is such a thing. We're the smallest, with about 180 Bell Labs people, but they represent an extraordinary diversity of disciplines. We have electrical engineers, mechanical engineers, physicists, chemists, ceramicists, metallurgists and mathematicians, and I've probably left out a couple.

"We're responsible for the transmission media used by the Bell System, meaning the cable, wire, connectors and splice cases, both metallic and optical fiber. The entire process, from exploratory work and analysis to development and design is carried out here, and that's why we need such a variety of technical skills in our people.

"In metallic transmission media such as multipair cables, we develop new or improved designs, often by the application of new materials combined with new geometries and structures, and with our colleagues from the Western Electric PECC (Product Engineering Control Center) designing the manufacturing process concurrently with the product design. A good example is dual-expanded plastic-insulated cable, or DEPIC. While we did the chemistry, transmission analysis and design, the PECC was concurrently inventing a new extrusion process that made it all possible. The result was a cable that used half the copper in previous designs and yet improved the transmission performance of digital carrier systems.

"We're also developing improved flame-resistant materials for wire and cable use in buildings and low smoke producing inside wiring. For example, we developed B-plenum cable recently, which is as flame retardant and low smoke producing as Teflon, but a whole lot cheaper. Overall, our work on multipair cable has enabled Western to keep its competitive position.



Jim McCrory (right) discusses an experimental lightguide switch with John Stallknecht.

"But lightwave is clearly the up and coming technology. You can get a good idea of how fast it has grown from just one fact: Only ten years ago, we had just one man working on lightwave half his time; now, more than half of our people are working on it. And they're doing great things.

"One indication is the rapidity with which the lightwave business is growing, and Western's competitive position. Lightguide cables designed and manufactured in Atlanta are going in all over the country, and it's my guess that their volume exceeds what the rest of the world combined has produced.

"So far, these are multimode lightguides. A next generation, which we're now developing, is a single-mode lightguide technology. Single-mode lightguides will have wider bandwidth and lower loss, but a whole new set of technical and practical problems. One great challenge is developing a means for butt-joining single-mode lightguides in the field. Their cores are so small in diameter—about 3 or 4 average-sized bacteria—that if the lightguide were misaligned by a thousandth of an inch the cores would miss one another completely. But this is well on the way to solution, and in the future we'll see single-mode systems providing long distance digital connectivity for the Bell System.

"Our relationship with the Western Electric PECC is superb. The best way to describe it is to say that the WE people are over here all the time, and my people are over at the PECC all the time.

"As John Stallknecht (the recently retired director of the Atlanta PECC) says, 'The line between BTL and WE is so transparent, most of the time you don't know when you've walked across it.

"Although people realize that the manufacturing process is a function of the design, they often don't realize that a good design is a function of the manufacturing process. Some people think a designer hands the manufacturer a completed design and says, 'Figure out a way to make it.' Not so. The smart way is to have early interaction between the designer and the manufacturer, so as to take into account what is feasible to manufacture. It wouldn't do us any good if we managed to make a super lightguide in a lab using clouds of PhDs, if we hadn't also figured out how to mass produce it on a shop floor with production workers.

"One of the most crucial decisions ever made around here was the decision of the Atlanta PECC to get into fiber optics long before it was known whether it would ever be a practical medium. It was a rare act of industrial statemanship."

Allentown

Bruce Darnall
*Director Silicon Device Development Laboratory**

"Allentown is the biggest branch lab as well as the oldest. The Works opened in 1948, and so did we. And, like the Labs as a whole, we've been growing ever since. We've got about 700 people, plus 250 more at nearby Cedar Crest and Fullerton, because we haven't got room for them here. These people work in three main areas—silicon integrated circuits, silicon lightwave subsystems and hybrid integrated circuits. When you include the 300 BTL people in Reading, about three quarters of the Bell Labs integrated circuit effort is in Pennsylvania. Our design engineers are mostly electrical engineers, but our processing engineers are physicists, chemists and metallurgists.

"Since integrated circuits were first developed in the early 60s, the trend has been to double the number of elements on a chip every year. This means that more and more equipment functions are finding their way onto chips. We've reached the point now where we can put whole systems or subsystems on chips—things like echo cancellers and digital signal processors and 32-bit microprocessors.

"The payoff of getting these large functions on chips is reduced system size and cost, increased performance, higher reliability, and significantly lower energy requirements. It has also changed hardware and software designs, because designers no longer have to struggle with the limitations of having only a few transistors on a chip. In the past, when transistors were expensive, hardware designers used to spend a lot of time trying to find clever ways of creating simple logical functions with as few transistors as possible. Their challenge now is to take full advantage of the very large number of low-cost transistors available on a single chip. Similarly, the design of software in the past placed a premium on tailoring programs to use as little memory as possible. This made programming costly and increased the difficulty of making software changes. Today, the cost of memory is so low that it pays to use lower cost modular software systems even when this leads to the need for more memory.

"What all this is doing is making it possible to bring a lot more than POTS (Plain Old Telephone Service) into the home and office. The chips offer virtually unlimited potential, and each new scale of integration has created whole new markets.

"The major thrust of our silicon integrated circuit effort in Allentown is aimed at meeting the custom needs of system developers. However, a list of the most important things we've done here would have to include the entire semiconductor memory line, beginning with the lowly 64-bit chip and running right up to the industry-leading 256K chip Allentown is just putting into production. Incidentally, we use memory chips to introduce new processes and provide Western with learning experience. All our custom logic chips use technology that's been proven in by memory. You might say that, 'memory steps on all the land mines.' It's been a very successful strategy.

"Mr. Kelly was certainly right on the mark when he introduced the branch lab concept. First of all, both the development and manufacture of integrated circuits requires enormous capital investment, which we want to use as efficiently as possible. With the branch lab, our people can develop processes and prove-in new designs, and Western people can then refine manufacturing techniques on the same equipment. This sharing of facilities gives them early access to new processes and tools while giving us the ability to test our development in a manufacturing environment.

"Even more important is the fact that something as complex as the 256K memory would be extremely difficult to introduce into manufacture just by sending a package of instructions across the river from Murray Hill. It wouldn't work. With the problems that come up constantly, we have to be able to get to each other in a matter of minutes. Also, we have to develop new tools and processes at the same time we're developing product designs. Being right on the premises lets us jointly work on all aspects of the product. The result is a graceful handoff from us to Western.

"All in all, I see a rosy future. The Bell Labs/WE combination will continue strong, with many opportunities to increase our strength in additional markets."

Bruce Darnall holds a wafer of 256K memory chips—each one capable of storing over a quarter of a million bits of memory.

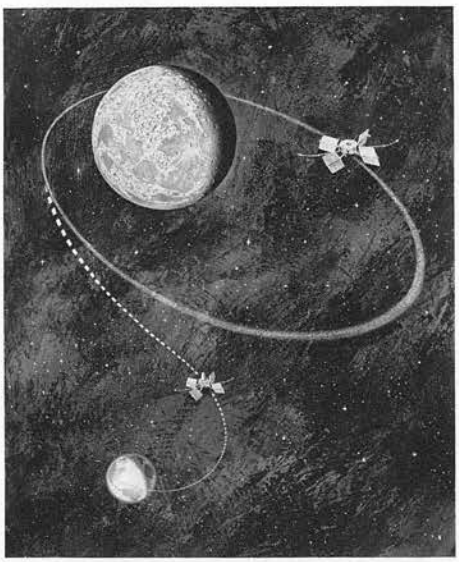
*Now Associate Executive Director, Electronic and Photonics Devices Division

Technology for Defense

For all but the first few years of its existence, Bell Labs, working under Western Electric contracts, has been engaged in one kind of defense work or another. As a matter of policy, this vital work has always been perceived as a duty to our country, and profit has never been its prime motivation.

Through the years, defense projects of all sizes have reaped the benefits of the Labs' vast expertise in R & D, supported in almost all cases by Western Electric's equally vast manufacturing capabilities. The range and magnitude of these contributions to national defense have been enormous, and those illustrated here are but a few historical highlights.

The BTL-developed/WE manufactured M9 gun director was one of the first electronic computers manufactured. It was the most advanced system for controlling anti-aircraft artillery during WW II. It helped shoot down 76 percent of the V1 bombs launched against London.



Bell Labs work on guidance equipment for the TITAN 1 and THOR missiles led to guidance systems that have been responsible for steering more than half of the free world's unmanned satellites into precision orbits in space. Over 400 satellites have been successfully launched with the help of these systems, including Telstar 1, Echo 1, and the anchored Interplanetary Monitoring Platform (AIMP) shown here.

One of the top secret projects of 1942 was an air-launched acoustic torpedo to combat the growing U-boat menace. In the first demonstration, the torpedoes were loaded with plaster instead of explosives and dropped on a U.S. guinea pig sub. All of them hit their mark, and the sub's skipper was so impressed he advised everyone to stay out of submarines.

After WW II, the Bell Labs/WE team developed and produced an evolving series of anti-aircraft systems that began with the NIKE Ajax system and culminated with the NIKE-HERCULES system, whose missiles were nuclear tipped. Although largely phased out of continental U.S. air defense areas, today, the NIKE-HERCULES system is still a part of the air defense system of NATO and other allies. In fact, in 1981, BTL/WE modernized these systems by replacing their analog computers with digital equipment and updating other electronic components of the system.

During all of WW II, virtually all Labs people were engaged in military work. One of the most important tasks was the development of radar systems. Before the war was over, WE had produced 57,000 radar units of 70 different types for airborne, ground and naval use.

One of the largest BTL/WE postwar defense jobs was the project collectively identified as the Far North Communication and Detection System. Stretching halfway around the world, this system includes the Distant Early Warning (DEW) line, White Alice, Polevault, and many others—each one a major project in its own right. This desolate outpost is part of the DEW line, which stretches across the top of our continent.

In the 60s, the massive effort on missle defense evolved to a very sophisticated system known as SAFEGUARD. However, as a result of SALT 1 talks, deployment was limited to only one site, Grand Rapids, N.D. The system includes the exceptionally versatile perimeter acquisition radar (PAR), which can identify and track targets at tremendous distances.

In the mid-50's, the Army asked Bell Labs to develop a defense against intercontinental ballistic missiles. It was by far the most difficult assignment to date. The ICBMs were over 25 times faster than aircraft and had radar cross sections only 1/1000 their size. The task was likened to trying to hit a bullet with a bullet. But, hit the bullet they did. In 1961, eight out of eight ICBMS fired from California were intercepted in the Pacific some 4,500 miles away. The photo shows an intercept over the Pacific.

A Tale of Two Old Timers

None of the young engineers knew what a "capacity unbalance set" was. Ed Fry not only knew — he had one

Photos by Chuck Lewis

Hardly a day goes by that Public Relations in New York does not receive a glowing letter or breathless phone call from someone who believes he has struck gold. While browsing through a flea market or cleaning out a grandfather's barn or poking through a commercial building about to be demolished, he or she comes across an item carrying a Western Electric name plate.

"It's very old," the caller invariably begins, "but in good condition for its age. It still works. They really made things to last in the old days."

We have to agree. The company certainly did employ great craftsmen. The woodworking on some of the items is akin to fine furniture, and the gears and other metal workings are clocklike.

"Precisely how old is it?" our caller asks. "Is it valuable? Will Western Electric buy it?"

Taking the questions in order, we can generally date a product of our manufacture within a year or two by checking old catalogues and brochures. On value, we can occasionally place the finder in touch with a collector's association if the product is one that has a big following, such as glass insulators from old telephone poles. On most items, unfortunately, all we can say is that the value is what a willing buyer will pay. If you paid 50 cents for it in the flea market, that's probably all it's worth.

As for the company's purchasing it, the answer is usually "No." The problem is largely one of where do you put it, and how do you get it in working order. Occasionally Pioneers have lent a hand on items used in historical displays in the Hawthorne Museum and at the Advanced Communications Center in New York. But the items that are most popular in such exhibits are old telephone sets and old Western Electric home appliances. The great bulk of our products, which were seen only by telephone company personnel in central offices or in manholes or repeater stations, don't have very wide-spread public appeal and so they just sit in boxes taking up expensive space.

Occasionally, one of these behind-the-scene items, long since "manufacture discontinued," is desperately needed again, and there follows a lot of scurrying around trying to locate one still in working condition.

One such case came up late last spring. The item in question was an unusual, old-fashioned measuring device called a "Capacity Unbalance Set." We found a brochure and dated the product as 1926. In answering the original inquiry, we turned up an unusual story involving two Bell System retirees.

Bert Covey (84), long since retired from AT&T, had been called in as a consultant on a cable problem in Malasia. They were using a cable of a type not seen in the Bell System in 40 years, but on which Mr. Covey had virtually written the book. This cable had been specified for use on a jungle route by a well-known construction firm because of the humidity. Mr. Covey told them they needed a capacity unbalance set to test out the lines. None of the young engineers knew what he was talking about and neither did their normal equipment suppliers.

Bert got a lead through a collector's network that exists in the telephone companies. If anyone has one, he was told, it's Ed Fry in Elveson, Pa.

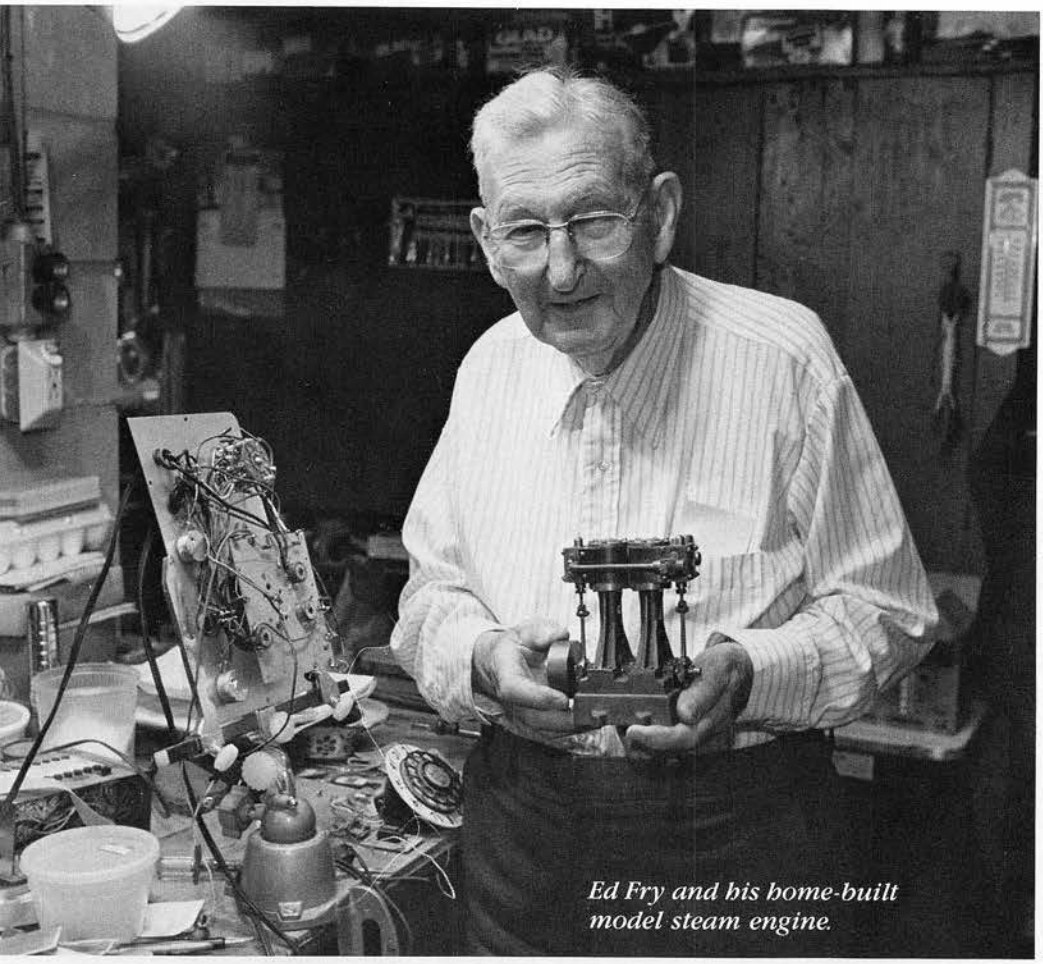
Ed Fry (87), who retired as District Plant Superintendent in Philadelphia in 1955, has been a collector of telecommunications gear for more than 60 years and he has some very unusual items. Most of what he has works—or he has plans to put it in working order when he gets "a little spare time." Everything he has was at one time considered "junk" and he's brought it back to usability.

At Bert Covey's urging we went to visit "the old fellow" as Covey called him on a rainy day last summer. He loaded us down with a number of unusual items for use in historical exhibits, which some of you will undoubtedly admire in the years ahead. What we admired most, however, was the alertness and depth of knowledge of the two old timers, and the respect with which they regarded the Western Electric equipment.

Ed Fry began his Bell System career at the Western Electric Distributing House on York St. in Philadelphia in 1910, where he received 10 cents an hour and worked 50 hours a week repairing telephone transmitters and receivers. After about nine months he transferred to Installation and helped put in the Dickinson exchange and others in the Philadelphia area.

In 1912, he was hired by Long Lines. "They hired me and then they raised Cain about it. They weren't supposed to move people from one part of the system to the other. For a while I thought I was going to lose out on both jobs."

It meant a big jump in pay. He started with AT&T at $12 a week for



Ed Fry and his home-built model steam engine.

Bert Covey and capacity imbalance machine destined for Malasia.

48 hours. "We generally got Saturday afternoon off," he recalls. "We got no overtime, but we did get 50 cents supper money if we had to stay late. It bought a good meal in those days."

Since he had started working at age 15, everything Ed knows about communications he picked up on the job or through company training courses. And he has kept up.

When we visited him, some local youngsters had brought in an electronic diagnostic kit for automobiles for him to check out. They couldn't get it to work. "They had diagrams from a Sears model and their's came from Montgomery Ward," he says. "There were no similarities at all. I had to trace out each circuit and I gave them a list of missing parts they needed." He's also built himself an electronic computer that he programs using a telephone dial. It buzzes to alert him to upcoming events.

His wife died four years ago and he has a local Amish woman come in to clean house for him. She provided another project. Her mantle clock wasn't keeping time so Ed took it apart. "It's still running a little slow," he said, but we're getting there." He also showed us a grandfather's clock he had just built from a kit himself. "It was very simple," he said. "It's not finished. It needs another coat of varnish."

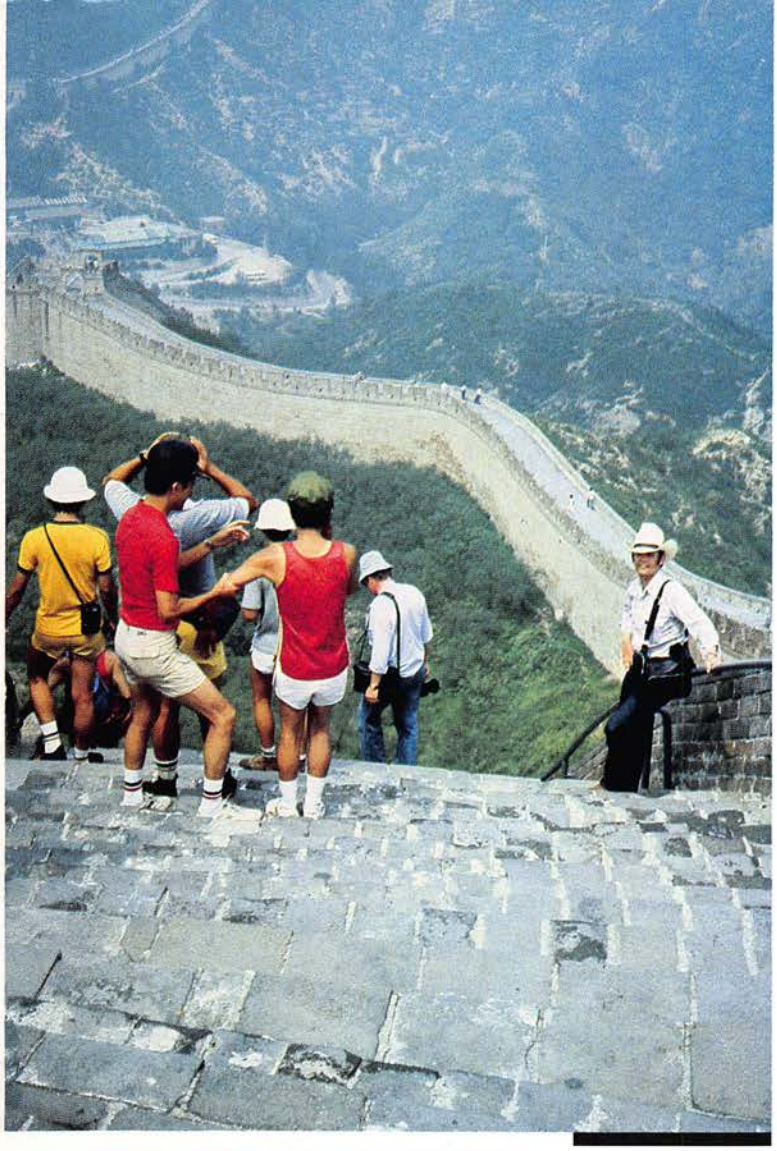
Ed's basement, is tinkerer's paradise. It has all kinds of tools accumulated over a very long lifetime. And practically everything is in working condition. There's a 5-inch TV set that dates back before World War II and a large drill that goes back to World War I. There are old voltmeters and ammeters like you saw in 1930's Buck Rogers serials.

And then there was the empty space where the capacity unbalance set had been sitting for 35 years.

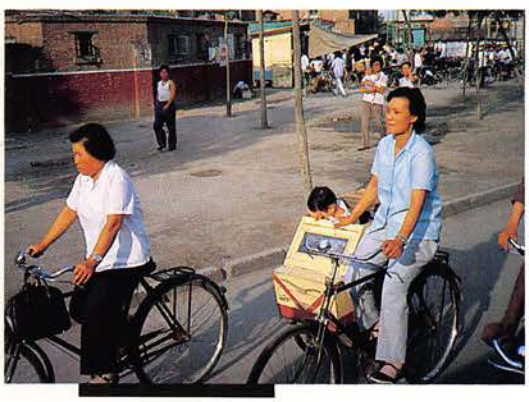
Shanghai Passage

Obviously, feeding the "animals" is okay in Peking's Forbidden City. The stone turtle is centuries old.

These soldiers were shy but friendly to McClatchey's homey diplomacy.



McClatchey takes a breather on the great wall of China—the only man-made structure big enough to be seen from space.



Private citizens can't own cars, so bicycles are the main mode of transportation.

Food is too scarce to waste on larger pets, so business is brisk for these vendors of caged birds.

Most of us are willing to lend a helping hand when it's needed, but only a few of us will travel 7,000 miles at our own expense to do it. James McClatchey is one of those few.

The 7,000-mile trip took him to Shanghai, China, where he recently shared his expertise in industrial safety and human-factors engineering with a country anxious to acquire such specialized knowledge.

A department chief in the Engineering Division at Western Electric headquarters in New York City, McClatchey had been experiencing a vague yearning "to do something significant and different," when a brochure showed up in his mailbox telling how a Harvard University sponsored technical exchange team was being assembled for a three-week visit to China.

"It was pure dumb luck that the brochure came when it did," says McClatchey, who immediately determined to be part of that team. He had already been working with the Chinese Mission of Science and Technology at the United Nations, outlining possible safety and health programs for China's expanding industry and offering his help. After some initial problems at the United Nations, including a flat rejection by the Chinese bureaucracy in Peking, McClatchey's dogged tenacity ultimately won him membership on the 34-person team selected to go.

In spite of the fact that the trip was to include tours of several factories, he turned out to be the only one representing industry. "Almost all of the other people were academic types, or came from government agencies or labor organizations."

After clearing the trip with his wife, two children and the company, McClatchey spent the next two months preparing himself by taking a course in Chinese. "I learned enough to let people know I was American, what kind of work I did, and why I had come." The first part of this was probably unnecessary. In his cowboy hat, boots and faded jeans—his traveling clothes for the entire trip—McClatchey could hardly have been mistaken for anything but the Texan he is. However, explaining what kind of work he did and why he had come was another story. Although China has made great strides in its intensive drive toward modernization, when it comes to things like human factors engineering and industrial hygiene and safety, "They're still back where we were in the 30s and 40s" says McClatchey. "But they're catching up fast."

It's no surprise, then, that the Chinese found his concepts and recommendations new and exciting and gave the paper he presented at a two-day conference at the Shanghai First Medical College an enthusiastic reception.

Not all of the trip was technical. In addition to visiting industrial facilities in five cities where everything from silk to pharmaceuticals were being manufactured, McClatchey got to see the Great Wall, the Forbidden City and the Temple of Heaven. Most of all, he got to see the people, whom he found to be warm, friendly and not at all adverse to being photographed, as is demonstrated by these pictures.

Working on the "loop." See page 12.

To change address below, please notify your supervisor; retirees, your benefit branch office.