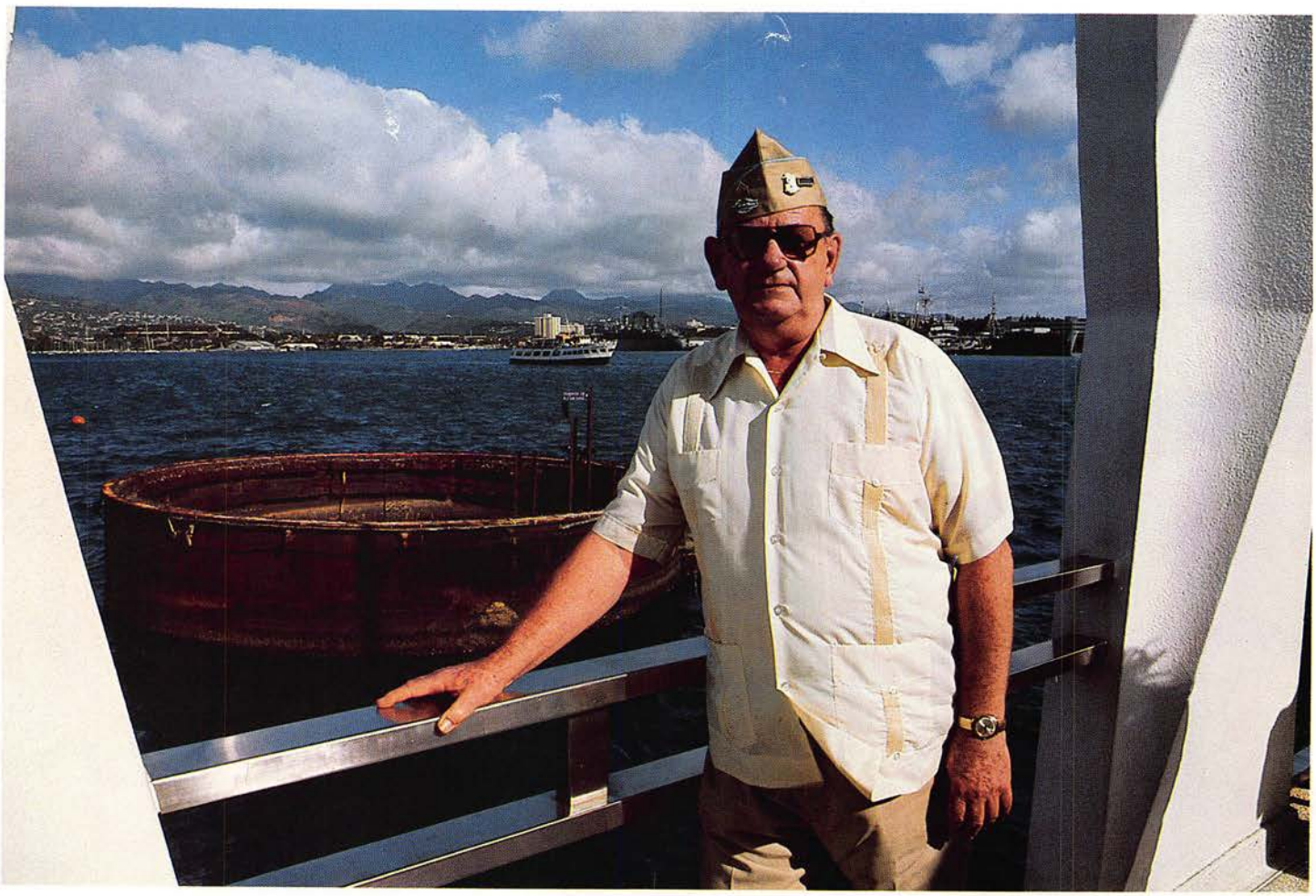
Western Electric

WE

Third Quarter 1982

Technology for
the Eighties

WE People



Tom Day *really* remembers Pearl Harbor

On Sunday, December 7, 1941, "a date which will live in infamy," Tom Day began his breakfast at Schofield Barracks in Oahu where he was stationed with Company C of the 21st Infantry Regiment. He remembers that morning vividly. As he puts it, "At the time of the attack on Pearl Harbor, I had just begun to eat my pancakes. All of a sudden, everything just blew up. Pancakes and everything. I went head over heels over the chair. No one knew what had happened. It was chaos. I was lucky though—I am here to remember."

After World War II, Tom started working for Western Electric. He now has 37 years' service. For most of those years, he installed power equipment in central offices. For the past three years, Tom has been working at the Advanced Communications Center in New York City, where he is responsible for installing and maintaining Western Electric's demonstration models of business and residence products. A large part of his job involves installing exhibits of WE equipment that AT&T sponsors at trade shows and conventions. He considers himself an expert on the Dimension® PBX, the Horizon® communications system, and the Dataphone® data sets. His job takes him all over the country and, fortunately, he enjoys the travel.

By a stroke of luck, he was asked to install an exhibit in Hawaii in December 1981. "I jumped at the chance," Tom says, "to go back to Hawaii. I'd always meant to go back, but somehow I never got around to it. When this assignment came up, I added some vacation time onto the assignment so that I could spend some time catching up on the 40 years of changes that have taken place since I was there. I was able to take part in the 40th reunion of the Pearl Harbor survivors. I visited Hickam Field, Schofield Barracks, Diamond Head, and, of course, Pearl Harbor. It was a lot of fun to see my old Army buddies, although we were reminiscing about a terrible event."

Tom did one more thing before coming back to the mainland. "Best of all," Tom says, "I sat down for breakfast on December 7, 1981, in the shadow of Diamond Head, and I ordered pancakes. Forty years later, I finished my breakfast with no mishap."

Photo by Ken Sakamoto

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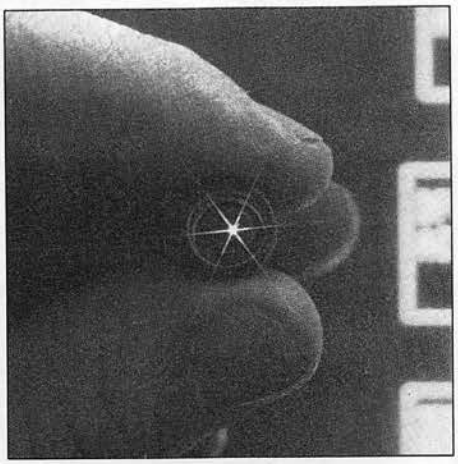

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On the Cover

Using a touch of surrealism, artist Ed Lindlof has tried to capture the essence of some of the Bell System's major "Technology for the Eighties." (See page 6.) These are photonics, microelectronics and stored-program control. All three technologies are moving us towards an all-digital network, as symbolized by the *ones* and *zeros* threading their way through the picture.

WE

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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

Elizabeth Perlman
Associate Editor

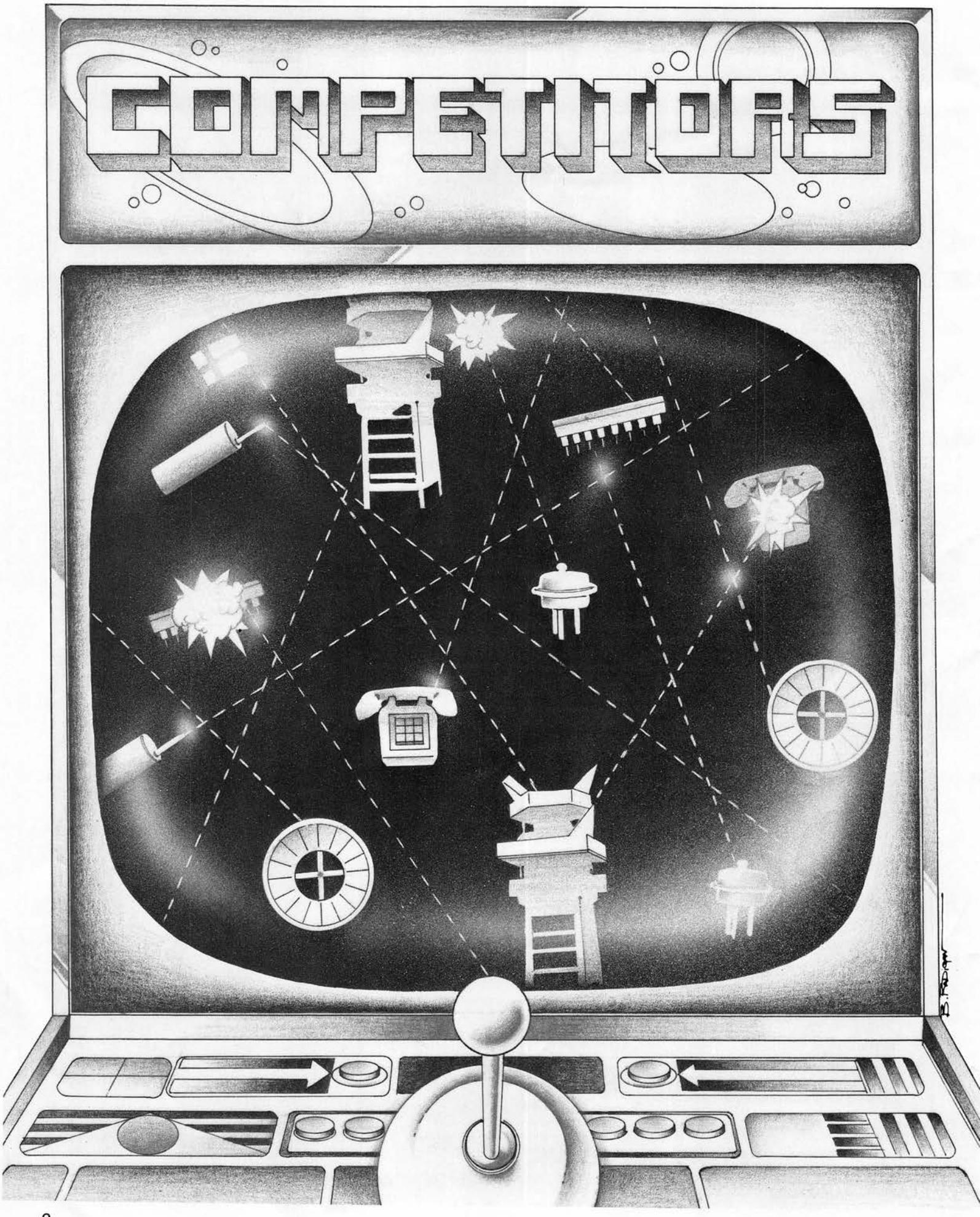
Peter Lewis
Design

Leonard Stern
Photography

Thomas J. O'Donoghue
Production

Western Electric

COMPETITORS



WE talked with Executive Vice President Gerry Freche about the impact of competition

Massive changes have taken place in the U.S. telecommunications industry in the past decade, partly because of technological innovation, partly because of regulatory imposed changes and finally because of the entry of new players. Hundreds of new companies have entered the field as service or equipment providers. The modified Consent Decree recently agreed to with the Justice Department portends even greater change in industry structure.

Since one of the major factors in Western Electric's planning process is competition, we asked Gerry Freche, Executive Vice President, Network Planning and Management, about the impact of this intensifying competition on the company.

WE: Just how serious is the competitive challenge? We have heard talk about competition before, but our sales and earnings keep going up. We can't be doing too badly.

FRECHE: What you say is what some of our people believe, and it could give them a false sense of security. They are deluding themselves. The competitive challenge we face is real and getting more serious everyday. The recent settlement of the Justice Department case will intensify the competition to supply the local exchange companies. We also see the intensity of competition for intercity telecommunications increasing steadily.

WE: How has the competition changed? Aren't they the same familiar names, just grown bigger and bolder?

FRECHE: Many good companies are emerging, some of whom are entirely new in this area. There are many more names today. A dozen years ago, the annual Buyers' Guide issue of *Telephony* listed 344 firms as suppliers in the telecommunications business. Last year, the listing ran to 1,234 names. There is no claim of absolute accuracy or completeness in either of the lists, but I believe the 250 percent increase is indicative of the trend. A dozen years ago, following the landmark Carterfone Decision by the Federal Communications Commission—which in effect allowed interconnection of privately owned terminal equipment to the Bell switched network—the competition that we talked about was almost entirely in the customer premises sphere, that is, telephone sets, PBXs and data modems.

The effect on Western Electric's total sales was not too noticeable because the economy was booming and the telephone companies were

"Much of the competition we face today is an outgrowth of our own innovation"

buying more of everything in an attempt to keep up with the burgeoning demand for service. Today, however, the impact of competition is being felt on all parts of our product line. For nearly every product we make and every service we perform, other companies have products, capabilities and large appetites for sales growth. We face a constant challenge to prove that ours is the best buy for the money.

WE: The competition charges that we have the Bell segment of the telecommunication market locked up. How true is that?

FRECHE: It is certainly not true now, and I doubt that it ever was. We have always earned the business we got. Currently, AT&T estimates that the Bell Operating Companies are buying about $2½ billion worth of telecommunications products made by suppliers other than Western Electric. In 1977 the comparable figure was $1¼ billion, so that the value of these purchases has doubled in less than five years.

WE: What caused the change?

FRECHE: For years we tended to think of telecommunications largely in terms of the Bell System. But events outside our control are making it clear that the world is rapidly changing with many telephone administrations and many equipment suppliers who also have financial and technological resources. Moreover, many of our competitors are large foreign companies sponsored by, or protected by, their governments. This makes for a rather difficult situation in trying to sell our wares abroad; in effect, to compete on our competitors' home ground. Many government regulatory and political actions in this country, however, have thrown open the door to these same foreign suppliers and in many cases virtually insist that the Bell operating companies buy from competitors, including foreign suppliers.

WE: How strong are we technologically, as contrasted with these foreign competitors?

FRECHE: We are very sound technologically, financially and managerially. In fact, the basis of our success over the years has been our preeminence in the electrical and electronic areas. But it is a situation that can change. Our foreign competitors are large, well-established, financially sound firms with very fine research and development groups. Some perform R&D directly in this country; others have acquired high technology companies here to develop new products for the American market. They are strong, well-run firms to be taken seriously.

WE: A great deal has been said in the press during the course of the Justice Department case about barriers to entry into the telecommunications equipment business. Is it really that difficult to get in and survive in this business?

FRECHE: The facts, it seems to me, speak for themselves. I've previously mentioned the growing numbers of firms listed in *Telephony's* Buyers' Guide, which is one indicator of expansion of the industry. Another is the increase in revenues. A number of our new competitors may have started in garages but they outgrew them very quickly. A number of competitors in the $50-million range increased their volume of business by 50 percent to more than 100 percent in just the last year. The foremost example is Mitel, the Canadian manufacturer of PBXs, whose business volume grew by about 125 percent. Micom Systems, Para-

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As of July 1, Mr. Freche became president, New England Telephone Co.

dyne, California Microwave, M/A-Com and Scientific Atlanta are some other examples of growth firms, although a shade less spectacular than Mitel.

WE: Who is our most serious competitor from an across-the-board point of view?

FRECHE: I would put Northern Telecom at the top of the list. They were at one time our Canadian affiliate and many of their operating procedures are very much like Western Electric's. In recent years, however, they have spread out of Canada into the United States, so that their investment here is now larger than in Canada. Northern Telecom has sold substantial amounts of switching equipment to the Bell operating companies, including digital central offices, which are big ticket items.

WE: Who would you put next?

FRECHE: ITT, GTE and Nippon Electric. Speaking from strictly a transmission point of view, Rockwell International probably is the next most important, largely because of its Collins Radio subsidiaries. We worked closely with Collins in the Saudi Arabian project. That points up another of the problems we face when we talk competition.

Sometimes companies are suppliers and subcontractors in one sphere and competitors in another or both at the same time.

WE: You've mentioned the assault on the American telecommunications marketplace by foreign-based companies. How are they going about it?

FRECHE: They are operating for the most part through American subsidiaries and affiliates. They have been buying up high technology firms right and left. The trade press is filled these days with news of consolidations, acquisitions and joint ventures. For instance, Northern Telecom has acquired an interest in more than a dozen U.S. firms in the telecommunications equipment, data processing and testing fields since 1978. Siemens AG of West Germany has acquired almost as many and, in addition, has formed a partnership with Corning Glass Works—Siecor—to produce optical fibers. Philips NV of the Netherlands and L. M. Ericsson Telephone Co. of Sweden have also acquired American companies. The Japanese firms, on the other hand, have relied more on establishing their own U.S. subsidiaries, than on acquisition.

Initially the firms acquired by the foreign companies were active in the so called "interconnection" market, but as they have become better capitalized they have approached the Bell switched network as a primary market.

WE: What effect has competition had on employment? What do you see for the future?

FRECHE: Lost sales very definitely impact on employment. And if we continue to lose sales, it is certainly going to reduce employment further—overhead as well as direct. Competition also puts a squeeze on profits, which puts a squeeze on R&D,

"Our foreign competitors are large, well-established, financially sound firms with very fine R&D groups"

which is where new products and services come from. It is a circular challenge.

WE: If the competition gets an increasingly large share of the local exchange companies' equipment business, what can we do to grow and prosper in the years ahead?

FRECHE: To prosper, we must quicken our pace of introduction of new products and services to protect our present sales base. To grow we must expand our product and service offerings beyond our traditional telecommunications base. Our marketing efforts must be strengthened and better focused. We also have to aggressively step up our cost-reduction efforts to keep our company a low-cost producer. We'll have to cultivate new business. We are going to have to go out and beat the bushes for government work, make sales to other than Bell or former Bell companies, and become more active in the international sphere.

The business that Western is in is universally characterized by people outside of our company as an extraordinarily attractive business. Many in the financial community forecast that the telecommunications industry of the 80s will be as attractive as was the computer industry of the 60s. Consequently, the financial community has on occasion been willing to finance new telecommunications entrants who have little more than a good idea and a garage to work in. For Western and its employees, this is a good news and a bad news situation. The good news is that it's great to be in a leadership position in an attractive business; the bad news is that many others are attracted to the business and they will be taking dead aim at us.

WE: How are we fixed to meet the competition?

FRECHE: We know that in the new environment we are going to have to do many things differently. However, your question seems to imply that we have not faced competition before. That's not true. We have always faced competition in our part of the business. We have the technology, the people, the experience and the facilities to do an outstanding job.

We have a history of being able to offer our customers complete systems—not just individual products. Everything works compatibly. It's designed to do so, manufactured to do so, installed to do so. Our customers look to us as a total systems supplier.

WE: In what areas are we strongest?

FRECHE: We are strongest in the full range of telecommunications, products and services. Our team has honed its skills to a high order in basic electronics, software, manufacturing proficiency and systems logistics. What a lot of people forget is that Bell Laboratories invented the transistor and Western Electric perfected the manufacturing processes to make possible the mass production of all semiconductor devices. Much of the competition we face today is an outgrowth of our own innovation. Similarly, the Bell switched network is a giant computer, operated by software, which is again one of the hallmarks of the new competition. But again it's an area where we have tremendous expertise. I believe we are strongest in the areas of greatest potential for the future.

Quiz

Western Electric is the world's leading manufacturer of telecommunications equipment. Increasingly, our position as industry leader is being challenged. The quiz below makes no claim to cosmic completeness. It is designed simply to familiarize you with the names of some of our more active competitors—names you will be hearing much more insistently from here on. Conditions have changed and will change even more as our products are offered for sale in world markets.

Q. Who are the ten largest across-the-board competitors that Western Electric faces in world markets?

A. CIT Alcatel (France)
Fujitsu (Japan)
GTE (USA)
ITT (USA)
L.M. Ericsson Telephone Co. (Sweden)
Nippon Electric (Japan)
Northern Telecom (Canada)
Philips NV (Netherlands)
Siemens AG (West Germany)
Thomson-CSF (France)

Q. In the transmission area who are our major competitors in the provision of carrier equipment—excluding the foreign big ten?

A. Exxon-Reliance
Harris-Farinon
Lenkurt (GTE)
Lynch Communications Systems
Rockwell International-Collins

Q. Who are the world's leading producers of fiber optics?

A. Hitachi
Insilco-Times Fiber
Nippon Electric
Siecor (Siemens-Corning)
Valtec (M/A-Com-Philips)

Q. Who are the major manufacturers of telephone sets world wide—again besides the big 10?

A. Plessey (Great Britain)
General Dynamics-Stromberg-Carlson

Q. Among the foreign suppliers of telecommunications equipment—excluding provision of telecommunications service—who is the largest manufacturer of electronics equipment in the world?

A. Philips NV of the Netherlands is No. 1

Q. Who are the major suppliers of processors for telecommunications operations?

A. Digital Equipment Corp.
IBM
Hewlett-Packard
Honeywell, Inc.
AMDAHL
Sperry Univac

Q. Who are the major producers of integrated circuits?

A. Gould-American Micro System
Fujitsu
Intel
Motorola
Mostek
National Semiconductor
Nippon Electric
Philips
Schlumberger-Fairchild
Siemens
Texas Instruments

Q. What is a niche competitor?

A. A company that specializes in one product or a limited product area.

Q. Who are the major manufacturers of PBXs worldwide besides the big 10?

A. Mitel (Canada)
Rolm

Q. Who are the major producers of wire and cable for telecommunications?

A. Atlantic-Richfield-Anaconda
Essex Wire & Cable
GK Technologies-General Cable
Insilco-Times Wire & Cable
ITT-Standard Telephone and Cable
Phelps Dodge
Simplex

Q. Aside from the Bell operating companies, which telephone companies or administrations are the largest worldwide in terms of number of telephones served?

A. Nippon Telegraph & Telephone Public Corp. (Japan—51 million)
Federal Ministry of Posts and Telecommunication (West Germany—25 million)
British Telecom (United Kingdom—21 million)
Ministry of Posts & Telecommunications of the USSR (21 million)

Q. In the United States, aside from AT&T Long Lines, what other companies are major providers of long distance service?

A. American Satellite
Graphnet
GTE-Telenet
ITT-DTS, USTS
MCI
SBS
Southern Pacific Communications Co.
Tymshare-Tymnet

CIT Alcatel

FUJITSU

GTE Switching & Telephone Products

ITT

Ericsson

NEC Nippon Electric Co. Ltd Tokyo, Japan

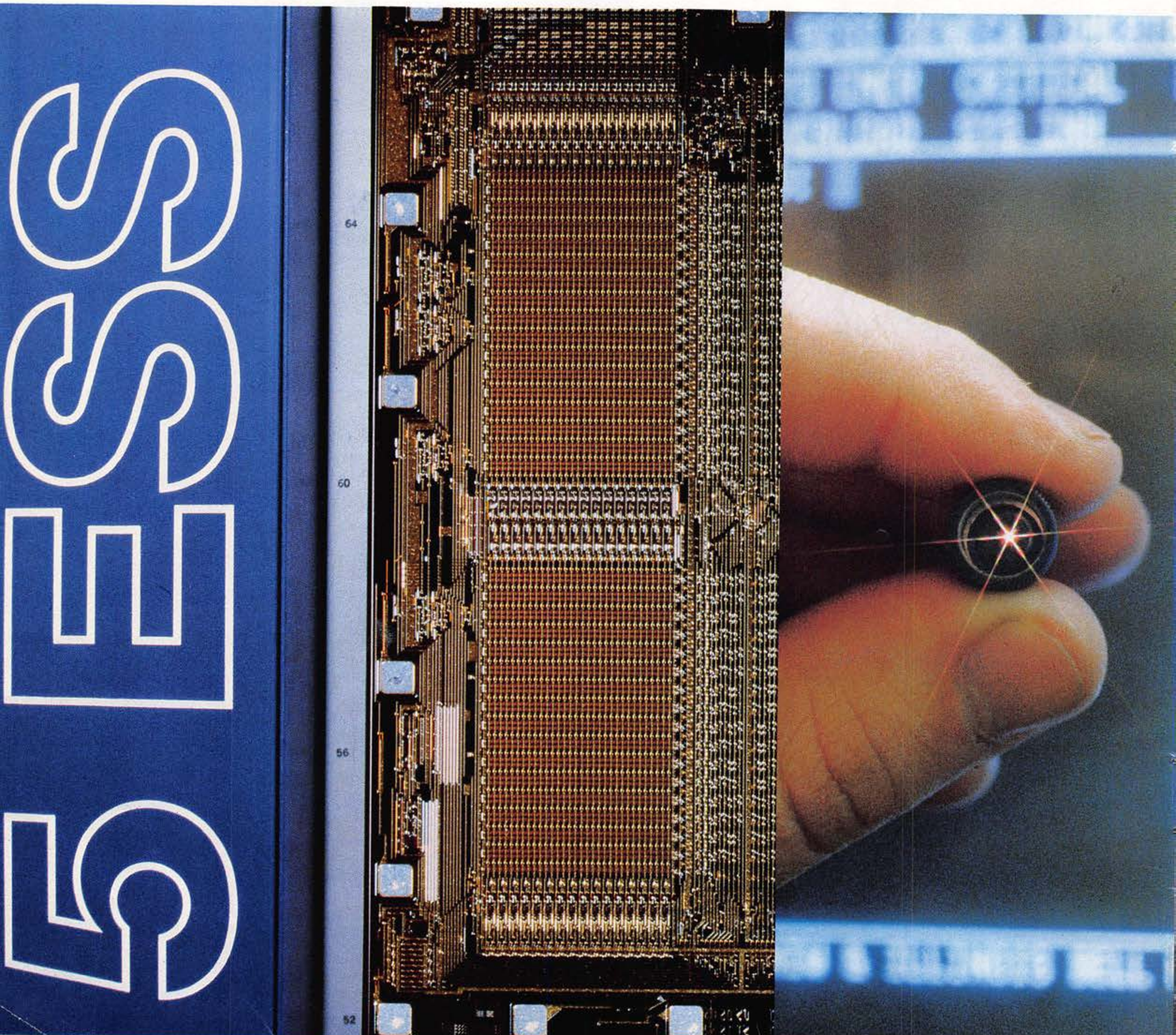
nt northern telecom

PHILIPS

SIEMENS

THOMSON-CSF

Our ten largest across-the-board competitors


5ESS

Technology for the Eighties

Technology is what the Bell System's future is all about. Here is where it's taking us and how it's happening

In our rapidly changing world, the thing that keeps changing most rapidly is technology—and the *rate* of such change keeps accelerating. More new science and technology have been created in our century than in all of man's previous history.

Not surprisingly, Western Electric, which, in partnership with Bell Laboratories, has significantly contributed to this state of technological flux, has been, and continues to be, profoundly affected by it. The products we make, the ways in which we make them, the skills required to make them—even, in some cases, the environments in which we make them—are all quite different from what they were 20 or 30 years ago. As a leading-edge manufacturer, our name is virtually synonymous with change.

This dynamic situation is, perhaps, best exemplified by a single fact: over 40 percent of the thousands of products we ship today were introduced into manufacture within the past five years. Similarly, many of the processes and much of the equipment used to make and test them are equally new.

Three basic technologies underlie the electronic revolution that marked our entry into what has come to be called, "The Information Age." These technologies are *microelectronics, photonics,* and *software.* All of these are intertwined and mutually supportive of the Bell System's massive effort to create an Integrated Services *Digital* Network—a nationwide, end-to-end digital network that will provide a wide variety of services.

The key word here is *digital.* It refers to the fact that all signals, be they voice, data or video signals, are transmitted and/or switched as streams of distinct pulses rather than as continuously varying electrical currents that vary in analogous mimicry of the voices or other signals they represent. It's worth noting here that the Bell System network began as (and largely remains) an analog network. This is simply because we live in what is essentially an analog world. Speech, for example, is analog—continuous changes in air pressure that vibrate our eardrums in accordance with the speaker's words. Digital signals, on the other hand, are strictly electronic creations.

Three forces are driving the once all-analog Bell System network towards its all-digital future. They are new technology, economics, and customer demand. Solid-state devices, lightwave transmission systems and stored-program control are most efficient when operated in the digital mode. One might say that they tend to be inherently digital in nature.

Solid state memories, for example, store bits—the ones and zeros that make up the fundamental alphabet of digital languages. Lightwave systems are by far most efficient when the signals they carry are pulses of light. Although they can carry an analog of the human voice as a continuously varying light beam, this would use a much greater bandwidth to carry the

same small amount of information. It would be akin to using the enormous capacity of the Alaska pipeline to send only a trickle of oil.

Of the three technologies underlying a digital network, software is the most digital of all. It is, among other things, written to control stored-program-control processors which are computer-like machines that control electronic switching systems. Such machines "talk" in digits. Since more and more of our customers are involved in data processing of one kind or another and need to ship increasing quantities of digits from one location to another, customer demand for digital service is growing.

As for economics, the picture here is much more complicated, being affected by things like new equipment costs, the number of circuit miles involved, and the types of equipment already in place.

As Don Leonard, formerly Vice President, Engineering, (now Vice President-Switching Systems at Bell Labs) notes, "When we began looking into the feasibility of digital transmission in the late 50s, we saw that digital trunks of 10 miles or longer between central offices in metropolitan areas would be cheaper because, even then, it was becoming clear that digital terminal equipment would be cheaper than analog terminal equipment because of the transistor."

By 1962, this realization had led to the introduction of the world's first digital telecommunications system—T-1 Carrier. Further advances in technology since then have made digital metropolitan trunks cheaper even for lengths as short as three miles. Today, about 70 percent of Bell System interoffice circuits are on T carrier—and that figure is expected to grow to 90 percent by 1990.

For long distance transmission, the economics still generally favor analog systems, so that only a little more than one percent of the Bell System's intercity facilities are digital. However, by 1990, this figure should rise to about 30 percent.

Another major step towards the all-digital network was taken in 1965 with the introduction of the first stored-program-control switching system—the No. 1 ESS. Eleven years later, Western Electric installed its first No. 4 ESS—an all-digital stored-program-control toll switch with a capability of handling over 550,000 calls per hour.

What makes the No. 4 ESS all-digital as compared to the No. 1 ESS is that it uses something called a *time-division* network and can only switch digital signals. However, although the No. 1 uses a *space-division* network, in which every signal is provided with a separate metallic path, it should be noted that, in addition to analog signals, it can also efficiently switch digital signals up to 64 kilobits per second (per channel). Thus, the ability to switch or not switch digital signals does not depend on time-division switching alone.

In a time-division switch such as the No. 4 ESS and the more recent No. 5 ESS, the input and output signals to the network must be digital and are assigned to separate time slots and switched by high-speed solid-state circuits. Both of these switches only handle digital signals and, therefore, analog signals must be converted to digital in order to be switched.

In a mixed analog and digital network, multiple conversions add expense, pointing up why network planning on an overall basis is so important. An all-digital network will reduce the expense of such conversion equipment as well as the cost of its maintenance.

"Ultimately," says Leonard, "the tech-

nology is taking us where we want to be—digital all the way—and that means right into the home and office."

Towards this end, Western Electric is producing a whole family of digital subscriber loop carrier systems such as the SLC*-96 system. Known as pair-gain systems, because they make it possible to send up to 96 voice signals over as few as three pairs of wires, this equipment can keep signals digital all the way out to the feeder terminals where they can be separated and distributed to individual homes and offices in either analog or digital form. For that last step—digits into the home, we are getting ready to manufacture a digital telephone and a time-division PBX.

However, far more important to the evolution of an all-digital network than either a digital telephone or PBX is something called, "digital synergy." In essence, this says that the more digital transmission and switching equipment you already have in place, the more economical it is to add more. For example, a central office with a preponderance of digital T-1 trunks and the opportunity to add digital loops has a much greater economic incentive to install a local digital switch such as the No. 5 ESS than a central office with a preponderance of analog trunks and loops and little growth opportunity. With over 100 million circuit miles of T-Carrier and over five million circuit miles of digital radio in place—plus the growth of digital satellite signals and special data transmission systems—the digital incentive grows larger every year.

Western Electric has been reinforcing this incentive by constantly adding to its already substantial line of digital products and systems. Most promising of these new additions is the already mentioned No. 5 ESS; a local time-division switch flexible enough to handle from fewer than 2,000 lines to more than 100,000.

"It's a state-of-the-art system in every sense of the term," says Leonard. "It incorporates a host of innovations, the most important of which is described in the phrase, 'distributed processing and architecture.'" This means its "intelligence" is provided by a number of microprocessors and digital signal processors distributed throughout the system, rather than concentrated into a single unit. This distributed intelligence is glued together via an innovative software architecture which makes for greater modularity, flexibility and ease of growth.

Several other kinds of very large scale integration (VLSI) chips are also used, including 64K random access memory (RAM) chips that can store over 64,000 bits of information and coder-decoder chips (codecs) that translate speech and other kinds of analog information into digital pulses and back again as needed.

Another kind of integrated circuit chip, called the gated diode crosspoint (GDX) provides an economical interface for those loops which are still analog. It has the high voltage characteristics required to function in the hostile loop environment of zaps and surges caused by lightening. The GDX is smaller, faster and cheaper than any of the mechanical switches it supplants. The No. 5 ESS uses fiber lightguides to interconnect its various units. Because of their high information-carrying capacity, these fibers substantially reduce the number of cables needed for interconnection. In addition, since they are not susceptible to electromagnetic interference, the lightguides reduce the amount of electrical noise and crosstalk introduced into the system.

"Ultimately, the technology is taking us where we want to be—digital all the way"

Microelectronics is the fuel stoking the digital engine

In addition to switching equipment, we continue to develop better digital transmission banks and multiplexor equipment in support of the Integrated Services Digital Network. ATTS, which stands for Automated Transmission Terminal System, encompasses a number of vital transmission units. One of these, the D5 channel bank, now under development, will be microprocessor controlled. It handles analog-to-digital conversion (and vice versa), important maintenance and operating functions and a number of revenue-generating special services. This design concept will substantially reduce the amount of equipment required in a central office, again through innovative design and architecture.

DACS, which stands for Digital Access & Cross-Connect System, consolidates high volumes of digital signals and also multiplexes T1 (1.5 megabit) and T1C (3 megabit) bit streams. More importantly, it can electronically set up, test and rearrange special services circuits—all from remote locations. Without DACS, such circuits have to be manually rearranged every time a change is called for by the customer.

MICROELECTRONICS (VLSI)

Microelectronics can be looked upon as the fuel stoking the digital engine. Since the early 60s, when the first integrated circuits were developed, the trend has been to double the number of components that can be fabricated on a single silicon chip every year. More and more equipment functions have found their way onto chips. Western Electric manufactures thousands of different kinds of integrated circuits, and Bell Labs designs over 60 new ones every year.

"We're at the point," says Leonard, "where we can put an entire system or subsystem on a chip the size of your fingertip. Some of these chips perform circuit functions that used to require whole racks of equipment."

The net result has been a constant decrease in the cost of digital electronics, with every decrease bringing the reality of an all-digital network a little closer.

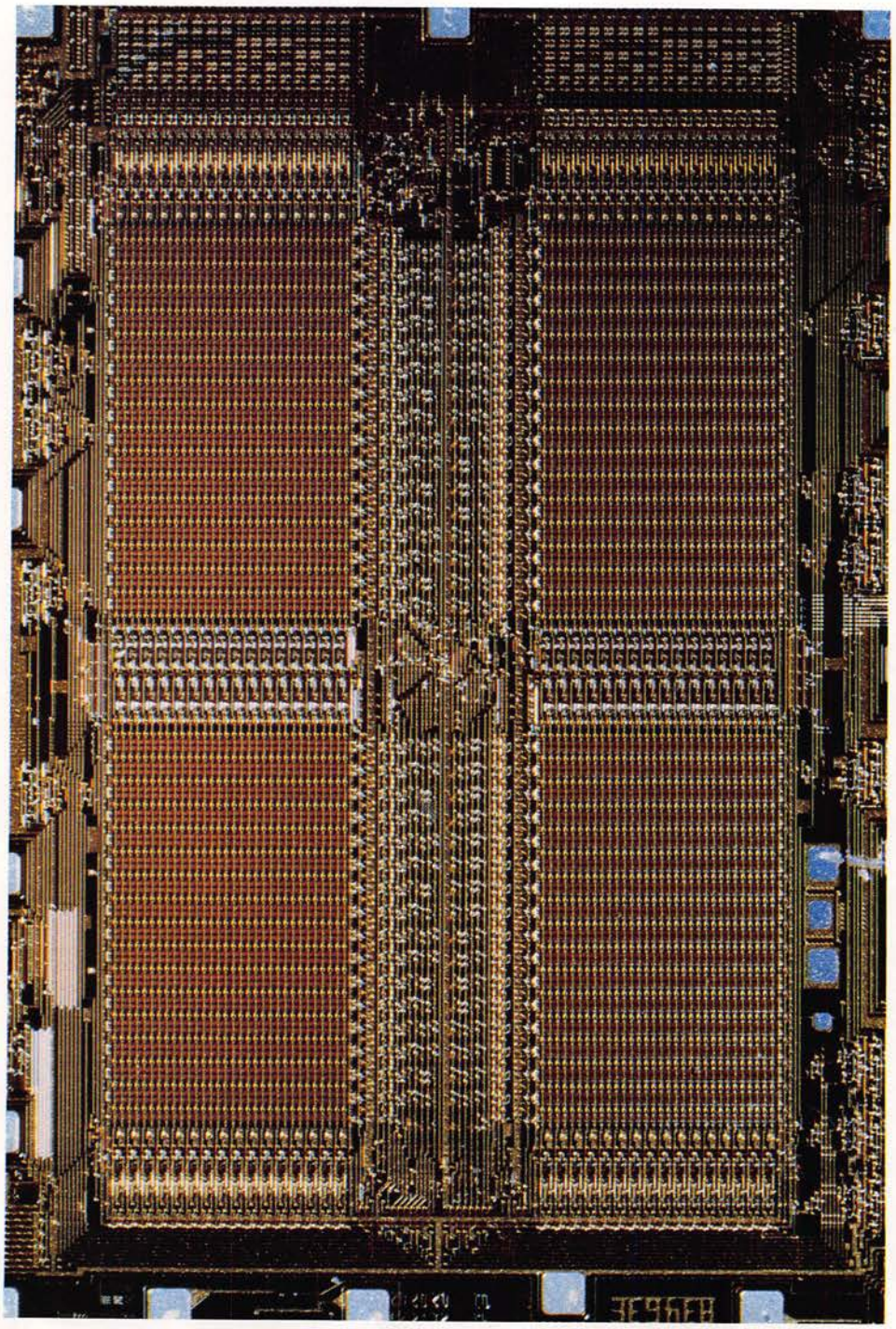
Leonard notes the dramatic difference that very large scale integration has made between a typical 10,000 line No. 1/1A ESS and the No. 5 ESS in terms of numbers of components. "The No. 1/1A ESS," he says, "uses 640 different kinds of discrete compo-

*Trademark of Western Electric

nents, such as diodes and capacitors, and 124 different kinds of integrated circuits. If you add up all the transistors on those integrated circuits, plus all the discrete components, the total comes to about seven million components.

"The No. 5 ESS, on the other hand, uses only 30 different kinds of discrete components and only 64 different kinds of integrated circuits. Yet, if you add up all the components on these chips, the total comes to a staggering 250 million. This means a lot more capability and complexity in a lot less space, with a lot less power and assembly time required."

Another important aspect of VLSI is that it has helped reduce—or, at least, hold down—the cost of software development. It is primarily memory chips that have been doubling their bit capacity every year, and the large number of "cheap" bits they offer has helped ease the burden of developing software that rigidly minimizes memory use. Software development is totally professional labor intensive and having to squeeze the utmost out of every available memory cell can be very costly. Anything that reduces program development time is a plus, and cheaper memories do just that by enabling programmers to trade off expensive development time for cheap memory space. Here, again, economics are at work and ultimately decide the limits of such tradeoffs.



Although the Western Electric/Bell Labs team had to play "catch-up" in the early days of solid-state memories, it did so with a vengeance and led the world in introducing the 64K RAM into production. "We're still ahead of everybody else in 64K technology," says Leonard, "in terms of reliability and speed."

He also feels we're ahead with the 256K RAM, which Allentown Works will begin producing before the end of this year.

The 256K RAM, which like its predecessor, the 64K, seems to have skipped a generation (we made neither a 32K nor a 128K memory), can store over a quarter of a million bits of information and will provide the memory for delivering Information Age services. It is incredibly fast, with an average access time of just over 100 billionths of a second. And it is as reliable as it is fast, because it is relatively insensitive to outside interference such as alpha particles and power-supply "noise." It packs more than half a million components—mostly transistors—onto a chip of silicon slightly larger than a half-inch long by a quarter-inch wide.

What makes this high density possible is the chip's use of feature sizes as small as 2.3 microns (or 90 millionths of an inch). Initially, the smallest feature sizes—technically called "design rules"—on the 64K RAM were 3.5 microns. Even so, most of the equipment used to make the 3.5-micron chips can be used to make the 2.3-micron chips, although some new processing techniques will be required.

It is, of course, just such new processing techniques—new *technology*—that has enabled us to go from only a few components on a chip to over half a million in less than 20 years. A history of this rapid progress would—and, in fact, *does*—fill several volumes. It is worth noting here that, in addition to the transistor, itself, which led to microelectronics, most of the technology that made VLSI possible came out of the Bell System—that is, our Engineering Research Center, Bell Labs, and the manufacturing engineering forces. A 1978 *Fortune* article listing 18 major advances in semiconductor electronics pointed out that 12

of them had come from the Bell System. These included techniques for growing single crystals of transistor quality from molten silicon; techniques for removing unwanted impurities from such crystals (zone refining); techniques for growing one kind of crystal onto an electronically different kind of crystal (epitaxy); and techniques for printing microscopic circuit patterns on semiconductor surfaces (photolithography).

Since then, several new processing techniques have been added to Western's manufacturing arsenal, including plasma etching and laser repair of memory chips. The former uses a plasma of ionic gas to "carve" circuit features into silicon wafers. It eliminates the pyramiding that comes with traditional acid etching—a problem resulting from the fact that acid cuts silicon away just as quickly in the unwanted horizontal direction as it does in the desired vertical direction. Plasma etching neatly carves out VLSI features with clean-cut vertical walls, permitting the fabrication of smaller features and components.

The laser-repair technique, which is used on the 64K RAM, and will also be used on the 256K RAM, greatly increases chip yield by making it possible to substitute spare memory elements on a chip for ones found to be defective due to crystal defects or specks of dust picked up during manufacture.

Several other techniques and processes presently under development will ultimately make it possible to fabricate long-lasting masks with sharper line definition and smaller features and, then, to dry etch those smaller features onto chips.

Along with the 256K RAM, Western is preparing to put into full production a remarkable new microprocessor chip that can process 32 bits at a time—as compared to the 4, 8, or 16 bits most microprocessors are limited to. Called the BELLMAC* 32A microprocessor, the new chip's 150,000 transistors and other circuitry give it as much computing power as many contemporary minicomputers are capable of. It is fast, uses very little power, can work with very large memories, and has an instruction set that can efficiently handle sophisticated operating systems and high-level computer languages.

Already in production are the BELLMAC* 4 microcomputer and the BELLMAC* 8 microprocessor, the first of which provides intelligence for customer premises equipment such as the Touch-a-matic® S telephone and the second of which does the same for switching machines, operating support systems and transmission systems.

Gallium technology is also being studied. But, when asked if—as one newspaper story recently predicted—Silicon Valley might soon become Gallium Gulch, Leonard smiles and shakes his head.

"Silicon," he says, "is a very mature technology. It has been around for a long time and it will be around for a long time to come, because we understand it. Gallium promises higher speeds, and we're using it for things like lasers and light-emitting diodes, but we don't understand it as well as silicon. I suspect, for this decade, gallium will continue to find its major applications in improving our photonics and digital radio."

We're still second to none in lightwave technology

"It's tremendously important for our manufacturing engineers to understand computers and software"

The latter reference is to a gallium arsenide field effect transistor Western Electric uses as the power amplifier in the DR-6 digital microwave radio system. Called GaAsFETs for short, these tiny chips replace the expensive and short-lived traveling wave tubes previously used—another small example of the technological synergy smoothing the network's progress towards digitalization.

PHOTONICS

"Without vision, planning and, most importantly, an understanding of science and technology, our third major Information Age technology—photonics—would never have entered the network as swiftly as it has," says Leonard. About ten years ago, Bell Labs' and Western's ERC started working on lightwave technology. Today, the Bell System has over 25,000 kilometers of Western Electric manufactured optical fiber in working lightwave transmission systems—more than has been installed in all of the rest of the world. But the best exemplar of fiber technology's growing importance is the lightwave fiber and cable manufacturing plant within the Atlanta Works—a factory within a factory that is capable of producing tens of thousands of kilometers of lightguide a year.

"We're still second to none in this technology," says Leonard emphatically. "Our systems expertise is excellent, and the proof is in the short time it has taken us to come from a 45-megabit system (the FT-3) to a 90-megabit system (the FT3C). And we're not stopping there. On the 600-mile long Northeast Corridor, we'll be using wavelength multiplexing to obtain three 90-megabit channels per fiber."

An old concept in a new field, wavelength multiplexing makes it possible to send three separate lightwave signals through a single fiber simultaneously by using different wavelengths for each one. The different wavelengths are essentially different colors that are combined into a single fiber by optical filters and separated again by similar filters at the receiving end.

Also under development are long wavelength lasers, single-mode fibers, deepsea lightwave cable, integrated optics, and a fiber version of the SLC-96 system.

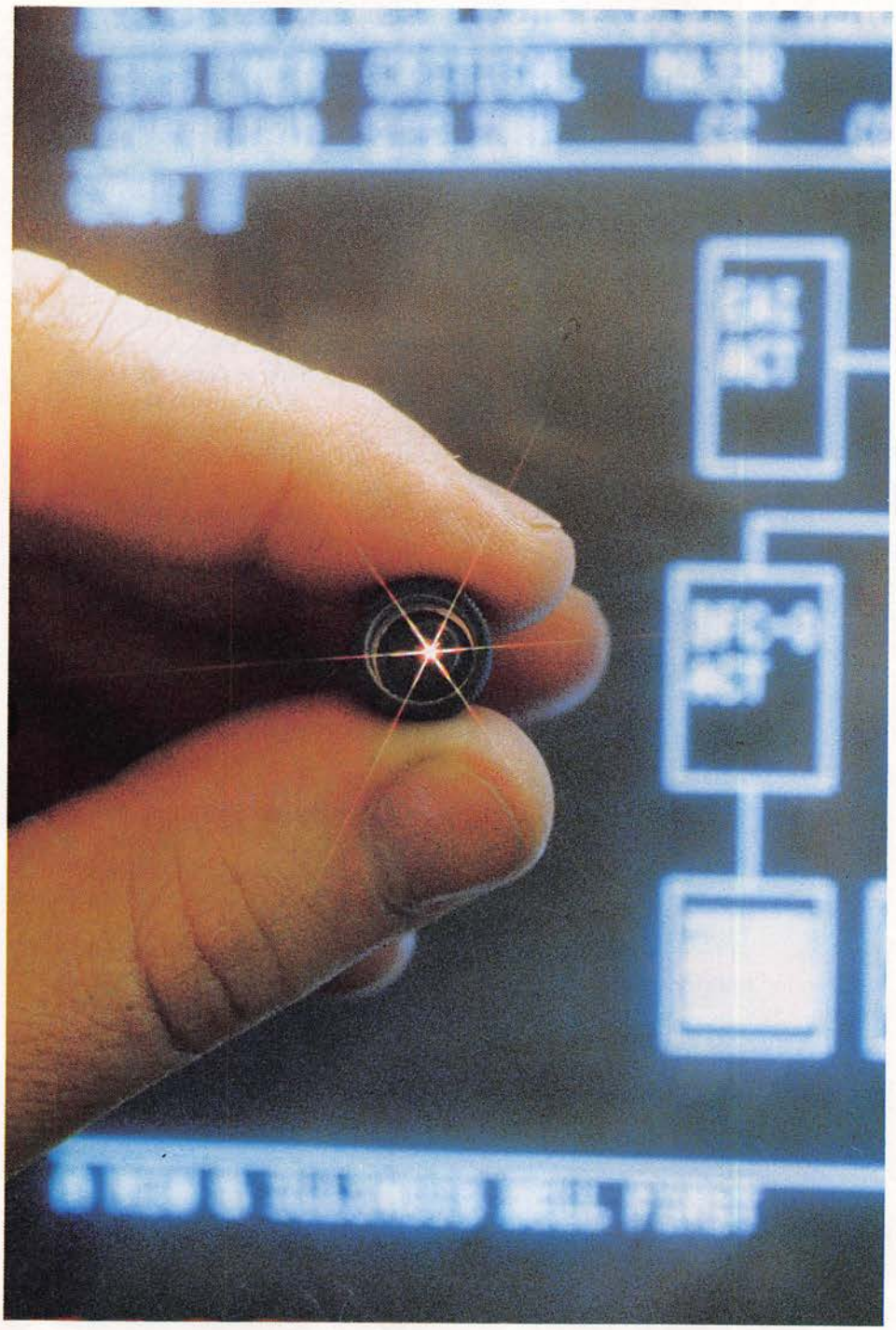
The long wavelength laser is important because light at the wavelength it emits (1.3 to 1.5 microns) suffers less loss through the fiber than light at short wavelengths. Lower loss means fewer repeaters and more economical systems.

The single mode fiber is potentially very important, because it promises

*Trademark of Western Electric

lower losses and wider bandwidths. Wider bandwidths, of course, mean greater transmission capacity with all that portends. However, single mode lightwave technology is a whole new ball game and will require new manufacturing processes, new electronics, and, above all, new connectors and splicing techniques. One reason is that the core of single mode fiber is only about one-tenth the diameter of the core in the multimode fiber presently being used—and the present core (50 microns) is *only two-thousandths of an inch in diameter.* A tenth of that is down to germ size. It must be remembered that, as tiny as lightguide is, what we see is more than half glass cladding. It is only the core that actually carries the light signals. With a core only as big as three or four bacteria, a splicing mismatch of only a few millionths of an inch could lose the whole signal. "Still a great deal of progress has been made, and there is no doubt in my mind that we will soon bring a high-performance, single mode system into existence," says Leonard.

Integrated optics represent an attempt to combine digital, lightwave, and microelectronics technologies into a single solid-state chip that will perform all the functions necessary to keep lightwave pulses sharp and strong as they traverse long distances. A single, integrated optics chip will be able to (1) detect an incoming light pulse, (2) convert it into an electrical signal, (3) amplify, or *regenerate* it, and (4) convert it back to light for retransmission. The potential savings of such a chip keep growing as more and more fiber permeates the network.



The SLC-96 system has already been described. A fiber version would replace present copper cables between the terminals with glass, thus extending lightwave technology into the subscriber loop, as well as digital.

"Ultimately," says Leonard, "we have the same goal for light as we have for digits: we'd like to stay in light all the way into the home or office, eliminating the need for any conversions whatsoever.

"Actually," he adds, "we have the technology to do that right now. We can even get enough light power into a fiber to ring an electronic telephone 'bell,' but the economics don't justify it, yet."

STORED-PROGRAM CONTROL (SOFTWARE)

Software, without which the stored-program-control concept would be meaningless, has become one of Western's fastest growing product lines. This was inevitable since, as Leonard notes, "Over the years, telecommunications switches have come more and more to resemble computers. Even the languages used to write their programs have come increasingly to resemble the languages used in information processing machines. In fact, the Bell System network constitutes the largest single software system in the world."

The growing importance of software—as well as the magnitude of the task of creating it—is best illustrated by our commitment to supporting software development at Bell Labs as well as by our new Network Software Center in Lisle, Illinois. Its five buildings of approximately 600,000 square feet will house about 2,500 employees—many of whom are moving in even as this article is being written. Most of these people will complement Bell Labs in the design of computer programs for Bell System telecommunications equipment, including our entire family of electronic switching

systems. Their work extends into three basic areas called, *traditional, ESS generic,* and *special projects.*

Traditional software—so called because Western Electric people have been working in this area the longest—are the programs that handle the enormous data bases unique to each and every central office. Often containing over a million items of information, these data bases include things like trunking routes, equipment addresses and billing information.

The generic programs provide the basic intelligence that enables electronic switching systems to swiftly route calls through the network. It includes special services capabilities—such as Call Forwarding.

Special projects develop different kinds of programs, such as one that makes it possible for police, fire, and other emergency bureaus to instantly obtain the street address of people calling the emergency 911 number.

In addition to software for the traditional generic and special projects areas, Bell Labs—and, increasingly, Western Electric—produce software for things like operations support systems that simplify management and maintenance of the network; for customer premise equipment such as PBXs; and, of course, for the manufacture, testing and inventory control of the tens of thousands of Western Electric products we make.

"It is tremendously important for our manufacturing engineers to understand computers and software," says Leonard. "Not only are more and more of our products using software, but more of our engineers are using computers and software to design them than ever before. That's why we have over 56 courses on these subjects at the CEC—more than for any other discipline—and more are being developed."

One of our software systems has become world famous. Called the UNIX* system, it is a highly versatile operating system that makes it fairly easy for people to develop software. Its features for editing, data managing and compiling have greatly improved the productivity of software generation. There are over 1,200 UNIX systems in use in the Bell System and even more in the outside world under license. The UNIX system works exceedingly well with Western's 3B20 processor, the duplex version of which provides intelligence for No. 5 ESS, TSPS, and CCIS. It also operates in a simplex mode as a stand-alone, general purpose computer in over 30 Western Electric locations.

Asked if he envisioned Western developing consumer software, such as TV games, Leonard was quick to answer, "No."

"Just because we have all kinds of capabilities," he said, "doesn't mean we'll use them for all kinds of things. We have printing presses for some of the technical support material we generate, but that doesn't mean we'll get into printing wedding invitations.

"Our mission," he concluded, "is to remain a first-class, leading-edge telecommunications manufacturer—and we will."

As for the future, Leonard is optimistic. "We've got a lot of smart people working on a lot of things. And, even though you can't schedule inventions, I predict our future will sparkle with as many innovations as ever. Meanwhile, our need is to continue increasing productivity and to encourage in our people the vision of tomorrow and drive to overcome obstacles, so that we reach our goals first. Our competition is formidable, but we don't like to be, and we don't intend to be, second."

*Trademark of Bell Laboratories

DIGITAL VS ANALOG

To technical people, the difference between analog and digital transmission is so basic as to require no explanation. But, for nontechnical types, the words often have no meaning at all.

The simplest way to think of an analog signal—let's say a voice signal over a pair of wires—is as a continuous flow of electrical current that varies in exact proportion to the voice it is representing. At the receiving telephone, this current creates a fluctuating electromagnetic field that vibrates a metal diaphragm. The diaphragm recreates the original voice by pushing a vibrating column of air into your ear.

Digital transmission is quite another story. It has been mathematically proven that all of the information in a voice signal can be extracted by measuring, or "sampling," the amplitude of the signal at a rate that is at least twice its frequency. What's more, that portion of the signal between samples can be discarded, leaving room to insert samples of other voice signals.

In Bell System digital transmission, the sampling rate is 8,000 times a second. Each of these samples, or measures of amplitude, is encoded into a short sequence of *ones* and *zeros,* which is the binary number system as well as the language of computers. A *one* can be electronically represented by a pulse and a *zero* can be represented by the absence of a pulse. A sequence of eight pulses can represent any one of 256 individual amplitudes. An amplitude of 100, for example, is represented by the sequence 01100100.

These eight-bit samples are interleaved with samples of other signals and transmitted as a continuous pulse stream at extremely high speeds. One advantage is that it doesn't make any difference to the transmission equipment whether the pulses are representing voices, TV pictures, or data. To digital transmission equipment, a pulse is a pulse is a pulse. They all look exactly alike, varying only in their combinations. That's why it's so easy to mix voice, data and picture signals when they are transmitted digitally.

Another advantage is that, because all the pulses are alike, they can be exactly recreated, or "regenerated" along the way as they weaken over long distances. The pulses can be pretty feeble by the time they reach a regenerator, but, as long as they can be detected in the proper sequence, there is no problem. The regenerator simply recreates brand new ones for the next leg of the trip. The ultimate received signal may have been regenerated dozens—even hundreds—of times, but it will still be an exact replica of the original.

Analog signals can, of course, be amplified as they weaken en route across the country. But they tend to pick up noise and interference along the way, and this gets amplified, too. Over the years, Bell Labs has developed all kinds of ways to minimize such noise and interference, but digital transmission virtually eliminates these problems altogether.

My Time Is Flexible

Something new is happening at the Network Software Center, and, so far, everybody seems to like it

On April 1, 1982, the first contingent of people who occupied the Network Software Center (NSC) in Lisle, Illinois were given a choice of starting time—anywhere from 7:00 a.m. to 8:45 a.m. That day marked the beginning of Western Electric's first formal trial of Flexible Work Hours.

The trial at the Network Software Center includes three independent alternatives: Flextime, Staggered Hours and Flexitour. While the majority of NSC's employees are on Flextime, the Staggered Hours and Flexitour approaches provide for unique business situations. A description of each alternative is as follows:

Flextime—This is the most flexible and applicable of the three approaches. Employees on Flextime would be expected to work the core hours between 8:45 a.m. and 3:45 p.m. The start time could vary on a daily basis, but each employee would be required to submit a weekly schedule to the immediate supervisor by the preceding Wednesday.

Staggered Hours—In order to provide adequate coverage to meet the needs of the business, there may be some individuals, groups, or organizations (e.g., word processing, data centers, etc.) where a less flexible work schedule would be required. Staggered Hours, like Flextime, has a set number of core hours (8:45 a.m. to 3:45 p.m.). These schedules would be approved on a quarterly basis.

Flexitour—Unique business situations (e.g., Diagnostic Centers, Scheduled Test Lab Time) may require supervisors and individuals to establish special work schedules. These schedules would be established on a monthly basis. There would be no core hours for these employees since they may be required to work unusual shifts such as midnight to 8 a.m., noon to 8 p.m., etc., to meet current business needs.

WE spoke with several of the individuals who were involved with the development and implementation of the Flexible Work Hours Trial to get a flavor for the behind-the-scenes effort as well as the impetus for Flexible Work Hours at NSC.

Ron Tevonian, Director of Network Engineering and Software Development at the Center, who spearheaded the program says, "The program was instituted, largely because of employee requests. No single set of hours is ideally suited for all people. By accommodating the work hours to an individual's situation, we can avoid conflicts which would otherwise lead to lost time or reduced effectiveness.

"In moving to this new building, there was a convergence of factors that seemed to cry out for a more flexible approach. First and foremost were the desires of employees coupled with the needs of business which require many of our people to be at work at odd times. Much of our work involves the use of computers. When you have everyone starting at different times, there are opportunities to access a lightly loaded computer and improve interactive response time. Other aspects of our work require access to a test laboratory to integrate software and hardware into a system.

"Another factor is highway traffic in this area. There has been a tremendous amount of office construction and road construction has not kept pace. Anything we can do to adjust the flow of cars coming in here helps, since we are among the larger employers in the area."

George Hlava, Department Chief, Technical Professional Relations, provided some of the nuts and bolts on implementation. "We made the first announcement in a Technical Professional Relations Newsletter that came out February 15," George said. "About the same time, we started to develop informational material for everyone involved. These materials included employee and supervisory brochures as well as training curriculum from Lee Kopp's Training, Public Relations and Graphic Arts Departments."

Beth Eddy, Assistant Manager, Human Resources, described the introduction of the Flexible Work Hours at NSC. "A great deal of emphasis was placed on implementation planning. A key factor in our implementation was a series of training sessions with the supervisors which provided the necessary information to implement and to train their employees, as well as a forum for discussion of concerns. As a result of these meetings, we made some modifications in the original proposal.

"We have been working very closely with Human Resources people from the Guilford Center, in particular, Bob Kempen and Judith Stokes."

"Since this is a formal corporate trial," Judith said, "we have attempted to identify pertinent measures to evaluate the effect of Flexible Work Hours. These measures will include data on employee perceptions and business operations. Trends of these data were tracked prior to the start of Flexible Work Hours and will continue to be monitored until the conclusion of the trial, which is scheduled to be six months after the last organization moves into NSC. At the end of the trial, these data will be analyzed to evaluate the overall impact."

Casey Encher—Information Systems Staff Member (ISSM) (Flextime)—"I like it, mostly because of the long drive—25 miles. I get here at 7:30 which makes a big difference in traffic patterns although with daylight savings time there have been some other delays. I've already exercised my flexibility. One day I had to have some work done on the car. We can do things like that on fairly short notice—as long as we keep accurate records."

Linda Paule—Information Systems Staff Member (Flextime)—"There are some things I'd like to see done differently, but I think it shows that the company is looking out for the people. My husband is a supervisor at Indian Hill—just across the road—and I normally come in with him and work 8 to 5. If there's some special work situation, we can adjust our schedules. I think it's going to take a while for everyone to adjust, including management."

Lois Wolf—Coordinator, Word Processing (Staggered Hours)—"I'm not a morning person at all—so the later I can start the better. I'm on 8:45 to 5:45 which is fine. Here in word processing we're on staggered hours where our services must be available from 7 to 5:45. We gave everyone in here their choice on when they wanted to start and coverage worked out amazingly well. Everyone got her prime choice. Commuting is not normally a problem. I live 11 miles west in Aurora. Unfortunately, at the moment the tollway is all torn up so it's slower going. From where I sit I can see one of the parking lots. It is interesting that three quarters of the lot empties at four. It's difficult to contact our clients after that hour."

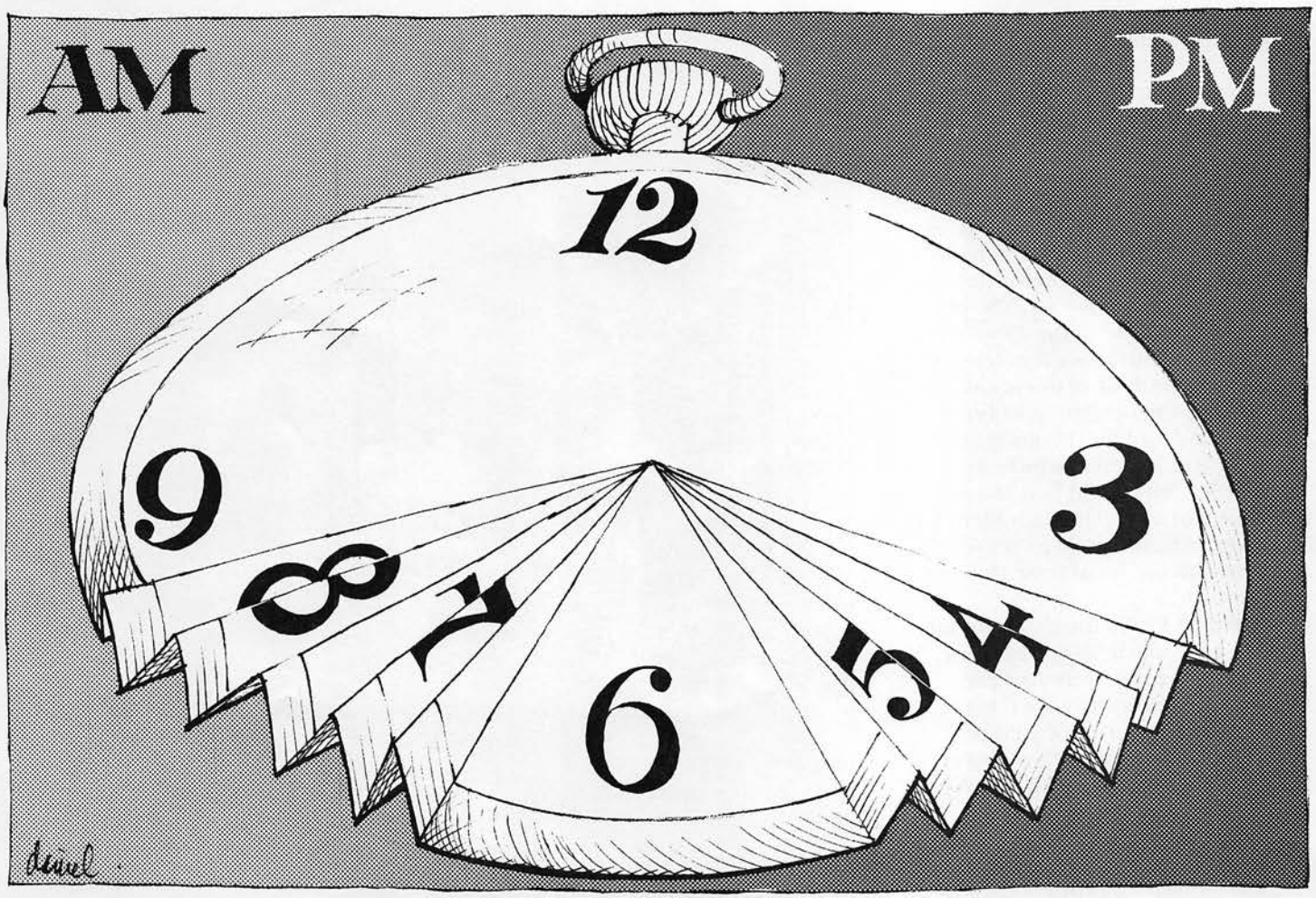
Pat Crawford—Computer Service Clerk—Systems Support Group (Flextime)—"I used to come in early anyway. Now I come in early and have the advantage of quitting earlier. I live about 15 minutes away in Naperville, but I do notice that by coming a little earlier I beat the traffic. In the evening I've been using the extra time studying."

Jerry Zamirowski—Information Systems Associate (Flextime)—"The last couple of days I've been flexing. My car's in the shop and I've been riding to work with a friend. I've been able to adjust my schedule at no loss to the company.

"The approach towards flex hours shows a more professional attitude toward people on the part of the company—and a more professional attitude toward work on the part of the people."

Don Oberholz—Senior ISSM (Flextime)—"I like it, but my wife doesn't. We're getting up an hour earlier, which is great for me, but it's harder for her to adjust. She works at the Geneva Community Hospital. I come by carpool with another Senior ISSM. We've worked out an arrangement where we come in three days at 7 and the other two at 7:30. It's entirely a matter of personal preference. I can get a tremendous amount of work done when I first get in. The meetings and the the phone calls and interruptions usually don't come before 'core' time. It varies, I'm sure, but in this row there are only two of us who arrive with the earliest group."

Bob Mele—Department Chief-Software Production (Flextime)—"I was a member of the original task force on flexible working hours and we will continue to meet monthly to discuss progress and problem situations. It is still very early to draw any conclusions. At the end of the trial, which will run about a year, we will summarize the results and publish our recommendations. I think people have been very receptive to the trial. They seem to be trending toward early in, early out. And there's very little flexing during the week. They set patterns a week in advance and hold to them. Some supervisors have noticed an improvement in some people who had problems getting to work on time. If the trial proves successful, a program even more flexible than we now have may be recommended."



In Recognition of Long Service

Despite all those old jokes about gold watches at retirement parties, the fact of the matter is that Western Electric did not provide such mementos until relatively recent times—the mid 1960s.

Additional vacation days have always been the principal way the Company recognized long service. And since 1915, the Company has given out service emblems on notable anniversaries. Awarding the emblems provides an opportunity for the honoree to spend some time with the boss or upper levels of management (depending upon length of service) to talk about job satisfaction. The emblems have changed in design seven times over the years—largely reflecting the looks of the telephone set. The emblems are available in the form of tie tacks and various other jewelry items, which is what most of us choose rather than the original lapel button.

Company-paid luncheons for up to 12 friends of a retiree, which are sometimes selected in lieu of a gift, date back to 1944, although there had been sporadic attempts to get such a program started for at least 15 years before that.

Gifts paid for by the company, initially a gold watch, a sterling silver bowl or silver tray, were first presented on a company-wide basis in 1966. When the price of gold skyrocketed in the early 1970s, however, 14-carat gold watches were discontinued. It was at that time that a variety of gifts was first offered. The items offered are all top quality. Average cost to the Company is about $170. List prices run considerably higher.

Effective Sept. 1, there will be 41 choices, if you add in all the different styles of watches and patterns of silverware available. In addition to the types of products shown here, Design Line®

Curtis Campbell, Department Chief, Corporate Staff, Pioneer Activities and Special Studies, examines a man's pocket watch, one of the new items. She administers the anniversary gifts and retirement gifts programs.

decorator telephones are also available as gifts, except the Americana Edition wall telephone, which is a limited edition model.

Purchasing has recently negotiated a contract with a new supplier, for the items shown in the large photo, Michael C. Fina Co. of New York City. L. G. Balfour Co. of Attleboro, Mass., continues as the supplier of jewelry items which include the WE emblem. Items are not stocked by Western Electric. They are ordered from the supplier on an individual basis by the local anniversary coordinator at the time the employee makes the selection.

Gifts awarded at retirement or on the 25th service anniversary and every five years thereafter, include old standbys plus some new items such as luggage, silverplated flatware, a new camera, and a 5-inch TV set and cassette player in one.

Zap!

Electrostatic discharge "zaps" millions of dollars worth of integrated circuits every year—but we're fighting back

By Saul Fingerman

Photos by Jack Sauchelli

If you walk across a nylon carpet, or stroke a cat, or comb your hair, you will pick up (or lose) a few billion electrons. Whether you know it or not, you have acquired a charge of static electricity. If you're home, or out shopping, or visiting a friend—or just about anyplace where you're not handling integrated circuits, the most damage you can do is give yourself or your friend a slight electrical shock. But, if you *are* around integrated circuits, you have become a potential killer. With just a touch of your finger, you can blast the life out of these tiny silicon chips. You won't see or hear the explosion, because it happens on a microscopic scale—but it does happen. In fact, the chips get "zapped" so often, it costs the Bell System millions of dollars every year.

And that's what brought a lot of men and women from all over the Bell System to the Denver Works auditorium last April. They came to hear experts from Western Electric, Bell Labs and AT&T tell them how to fight this insidious and costly problem.

It was the Bell System's first symposium on ESD—electrostatic discharge, and it took the missionary zeal of two men to make it happen. The men are Burt Unger of Bell Labs and Western's "Mac" McFarland. The year before, both had presented papers on ESD at a non-Bell System technical symposium in Las Vegas.

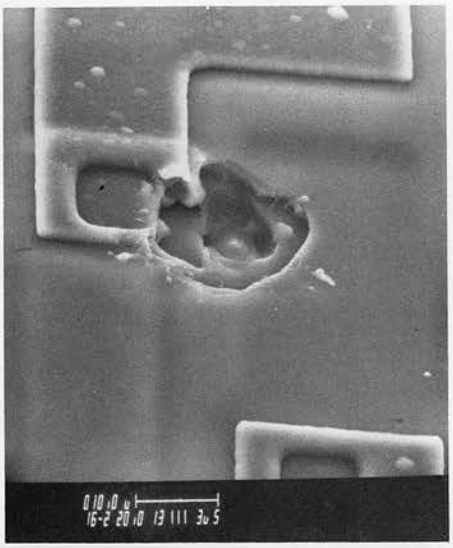
"Afterwards," says McFarland, "Burt and I and a couple of other Western and Bell Labs engineers got together to talk about the ESD situation in the Bell System. We agreed that something should be done, and Burt said, 'How about a Bell System symposium?' When I came back to Denver, I asked for permission to hold one, and got it."

Unger handled the technical end of the program—who would talk about what—while McFarland did the organizational work. This included mailing

A stalwart Captain Denver gives nasty old Static Man a taste of his own medicine. The cartoon first appeared on the cover of the Denver Works' employee magazine.

out about 600 invitations to Bell System people they thought should be interested. "I thought, maybe, we'd get 80 people to come," he says.

He wasn't even close. The response was overwhelming, and it very nearly became a "standing-room-only" affair.

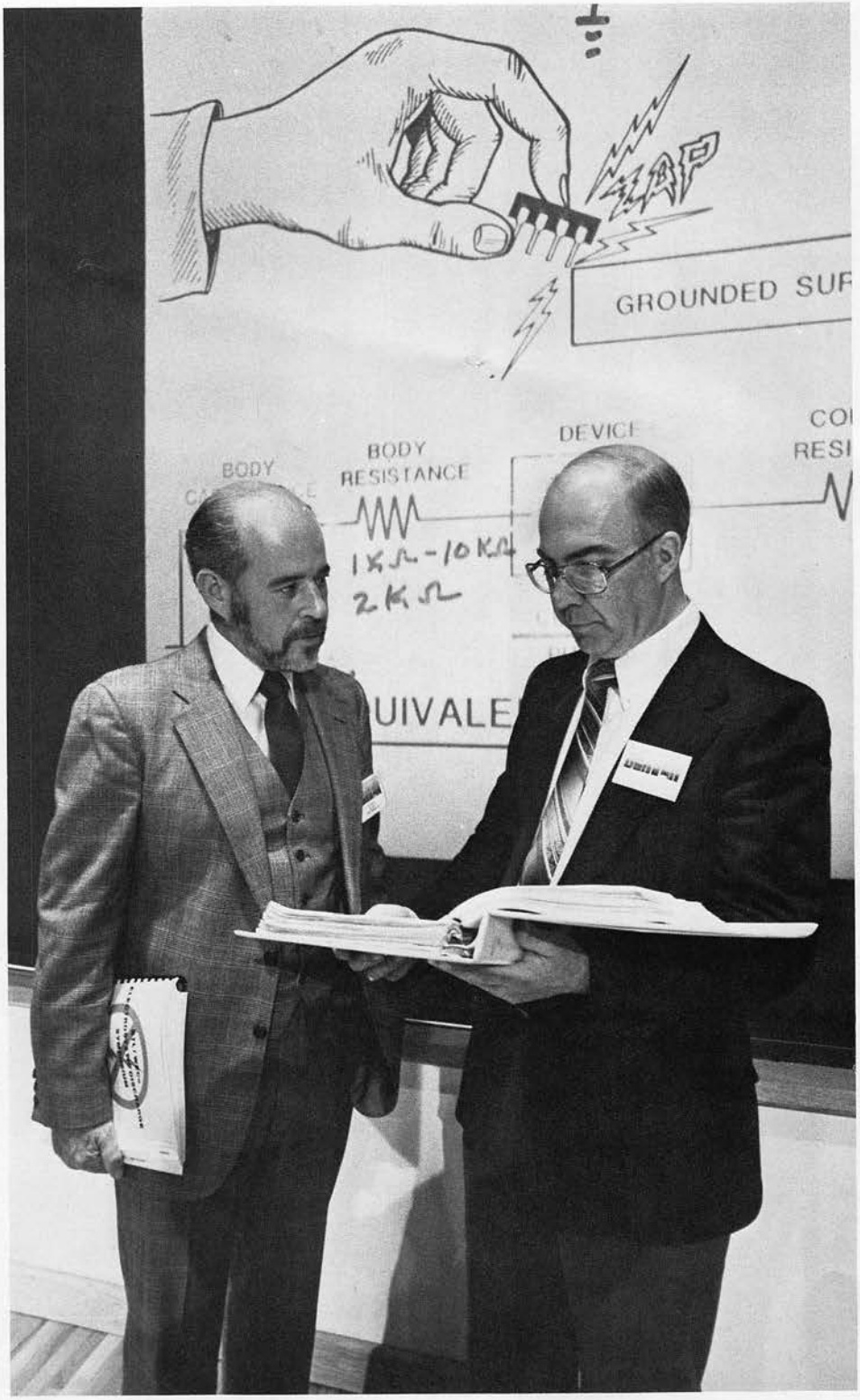


This crater isn't on the moon. It's on a tiny integrated circuit chip and was caused by a bad case of electrostatic discharge.

Chairs had to be added to the Denver Works' auditorium all the way up to the back wall. Nearly 250 people came, including 111 from Western, 95 from Bell Labs, 16 from AT&T, and 24 from the Bell operating companies.

"The Bell companies had to be included," says McFarland, "because ESD problems begin from the day of integrated circuit manufacture and continue all the way to operation in the field. We can do everything possible to get our products to them in good condition, but, if they don't know how to cope with ESD, they can still damage them."

The fact is that any time solid-state devices or circuit packs containing them are touched, they are in jeopardy. This is particularly true in areas with low humidity, such as Denver, where dry air and dry skin make it difficult for an electrostatic charge to bleed off and dissipate. As Unger observed in his opening remarks, "Denver is a great place for an ESD



On the stage of the Denver Works auditorium, Burt Unger of Bell Laboratories and Western Electric's "Mac" McFarland talk over some details before the opening of their symposium on the problems of electrostatic discharge.

symposium. Every time I touched a doorknob at the hotel last night, I drew a spark about a quarter of an inch long." Mercifully, he didn't add that it had been a shocking experience.

And, yet, it can be. The potential your body builds up during a short walk across a carpet can reach 30,000 volts. An amble across a vinyl tile floor can charge you to 13,000 volts. Just sitting on a workbench stool and doing a normal amount of squirming around can get you up to 3,000 volts. Incidentally, you can't feel anything until you get up over about 4,000

volts. But 25,000 volts in the vicinity of your scalp is literally enough to make your hair stand on end and give you that "bride-of-Frankenstein" look so popular in 1930s horror movies.

The reason that none of this is harmful to humans, let alone lethal, is that ESD shocks are essentially all bark-and-no-bite, which is to say they are virtually all voltage and no current. And, for a shock to injure you, it has to push a fair amount of current through your body. Even your fingertip arcing over to a doorknob at 30,000 volts won't suffer any physical harm, because the high resistance and capacitance of your body slows that discharge down so that it occurs over a relatively long interval.

On the other hand, ESD is devastating to integrated circuit chips because all the charge is released very quickly into a very, very small volume. The ESD power being dissipated through a pinpoint-sized transistor junction can easily reach a staggering 2.5 million watts per square centimeter in the first millionth of a second. "And that," as one of the symposium speakers noted in wry understatement, "is an awful lot of power to be dumping into a tiny piece of silicon."

It is, in fact, enough power to bring the silicon up to its 1,400° Centigrade melting point and beyond. True, it very quickly re-freezes, but only after its operating characteristics have been drastically altered, or totally destroyed. Microphotographs of zapped chips often look like pictures of craters on the moon. Not surprisingly, as integrated circuit components get smaller and more and more of them are crowded onto chips, the effects of ESD become even more deadly.

With all of this, one wonders why an ESD symposium wasn't held long before now.

"That's easy," says McFarland. "The reason is that, even though lots of people knew there was a problem, they weren't sure what was causing it. ESDs of only 100 volts or less can damage integrated circuits, but you can't see it, or hear it, or feel it, so people weren't able to recognize it."

He could have added that, even today, it is extremely difficult to detect static electricity damage without sophisticated equipment. In addition there's a problem called "latency." This is where a zapped integrated circuit will often only be wounded, rather than killed outright. Such a device often passes all tests and continues working for weeks or months, or even a year—but, eventually, it will succumb to its wound and die. The longer this process takes, the more expensive it becomes. That's because the cost of finding and replacing a defective integrated circuit increases by about a factor of 10 at each stage of its progress into the Bell System. For example, if it costs 30 cents to find a defective integrated circuit in the manufacturing stage, it will cost $3.00 at the printed wiring board stage; $30.00 at the final system test stage; and $300 in the field or customer premises stage.

Sometimes, integrated circuits are only "wounded," rather than killed outright

At this point, the question becomes, "What are we doing about all this?" The answer is, "Quite a lot."

Starting with the chips, themselves, we are building protective networks right into them. Connected to every lead, the networks consist of diodes and/or resistors and capacitors. The only problem here is that "real estate" on the already crowded chips is at a premium, and the value of such space has to be balanced against the potential cost of ESD damage. In any case, the networks offer limited help. As McFarland says, "There's only so much we can do inside the chip, so very careful handling is required."

As for people working around the chips, they now are grounded by wrist straps with built in safety resistors. These straps are connected to long cords with clips on the end that snap on to conductive plastic counter tops on their work benches. Because the counter tops are grounded, they dissipate electrostatic charges before they have a chance to build up in an operator's body.

Static electricity is created when two materials rub against each other. If you make them conductive, you eliminate the problem. If your socks were made of conductive material, they wouldn't go snap, crackle and pop and cling together so tenaciously when you pull them out of the clothes dryer. In fact, the fabric softener you probably use to cure this pesky problem is really a mild conductive agent.

Where operators have to move around a lot, they use shoe straps and conductive grounding mats. The straps, tucked into their shoes, conduct electricity from perspiration-moistened socks to the mats.

Ionized air blowers that dissipate static electricity over workbenches are also in use, as are anti-static shipping bags and bubble packs and conductive cleaning solutions in wave-soldering machines. In the latter case, Denver Works engineers discovered that the brushes used to clean circuit packs after they passed through wave-soldering machines were building up terrific voltages on the underside of the packs and doing a lot of them in. A conductive cleaning solution solved the problem and is saving Western Electric millions of dollars every year.

As far as McFarland is concerned, the really heavy artillery against ESD damage consists of Static-Awareness Programs, one of which he instituted in Denver in 1981. Now an integral part of the Dimension® PBX and Horizon® communications system circuit pack manufacturing lines, the program has already resulted in cost reduction savings of $3.8 million. It is clearly the way to go.

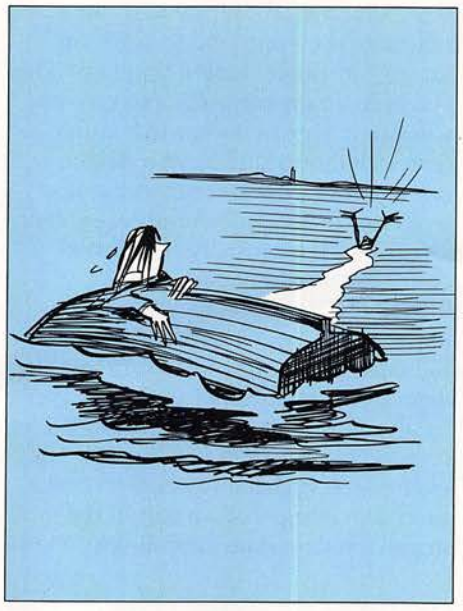
"I'm optimistic," he said after the ESD symposium came to a highly successful conclusion. "People who used to be just voices crying in the wilderness have now been heard system-wide. The word is getting out, and now that people have become conscious of ESD, they'll start to do something about it."

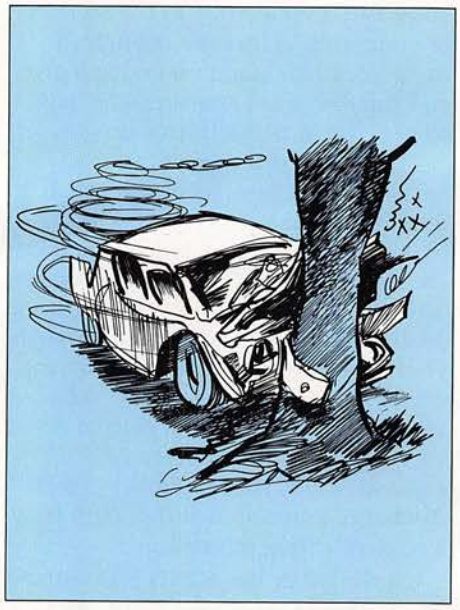
To prevent static electricity from building up in her body, Ruth Reagan clips her wrist strap to the conductive counter top of her work bench.

Don't Panic! It Could Kill You

There is no simple way of avoiding panic. But there are things you can do

By Paul Chance





It is a December afternoon in 1903. The famous comedian, Eddie Foy, is performing before a large audience at the Iroquois Theater in Chicago. Suddenly someone shouts, "Fire!" and people jump to their feet. Foy comes to the front of the stage. "Don't get excited," he shouts, "there's no danger." The orchestra plays a number. The rigging above the stage is ablaze, and as Foy leaves the stage the entire loft comes crashing down in flames. The lights go out, and the crowd goes mad.

The melee is worst in the balcony, where the flames lick at the crowd. One swarm of people surges for the fire escape ladders. Those who can't get onto the ladders spill out of the windows and fall to their deaths. Others stream down the stairs. Some fall, and are washed over by the wave of people behind them. In some places the bodies pile up seven or eight feet deep; those who are not crushed, suffocate.

The fire is quickly extinguished; there is little damage. The crisis is over in ten minutes, yet over 500 people already lay dead, and another 100 will soon die from their injuries. Most are victims not of fire, or smoke, or falling debris, but of panic.

Panic may be defined as an inappropriate response to danger, but that is something of an understatement. Often, as in the Iroquois Theater fire, it proves to be a life-threatening response to danger. A burning building is one kind of danger that is likely to produce panic. There are, of course, many others. Soldiers who panic in battle may throw down their weapons and run into the fire of an advancing enemy. When a household explosion is imminent, people sometimes rush past a nearby exit in order to get to the back door they are accustomed to using. A swimmer being carried out to sea by a riptide may struggle uselessly against the current when all he needs to do is swim parallel to the shore to escape danger. A motorist driving on an icy road should pump his brakes to avoid a collision, but he may panic and slam the pedal to the floor instead.

All sorts of situations, then, can induce panic. What they all have in common, however, is the possibility of avoiding injury if one acts quickly. Both danger and the possibility of avoiding injury appear to be essential to produce panic.

The greater the danger, of course, the more likely we are to panic. Thus, a person who awakens and sees a curl of smoke emanating from a wastepaper basket is less likely to panic than is a person who awakens and finds the bedroom engulfed in flames.

The slimmer the chances of avoiding injury, the greater the chances of panic. If escaping injury is virtually certain, there usually is little panic. Hence, people do not ordinarily panic when a flood threatens to inundate their homes because there usually is plenty of time to get to high ground. Had all thirty exits in the Iroquois Theater been clearly marked and functioning properly, there might have been far less panic and many more survivors. Ironically, if there is *no* chance of avoiding injury, if there is nothing a person can do except hope for rescue, there is ordinarily little

Dr. Chance is a consulting psychologist who has written for us previously on the subject of safety.

panic. For instance, when divers are trapped beneath the sea, they seldom panic. People rarely panic unless there is some chance of avoiding injury by speedy action.

Panic often has disastrous consequences, so it would be nice if there were some simple way of preventing it. There isn't. There are, however, two things you can do to lessen your chances of becoming a victim of panic.

The most obvious thing you can do is avoid situations that are likely to be dangerous. You can, for instance, avoid driving when the roads are slippery. When driving on icy roads, you can reduce your speed so that you will have more time to react to hazards. You can avoid attending events in theaters and auditoriums that are overcrowded. And so on.

Of course, you can't always avoid situations in which danger may arise. You are least likely to be trapped in a hotel fire if your room is on the ground floor, but you may not be able to get a room on that floor. The best way to avoid the dangers of the highways is to stay off them, but then how would you get to work? It is impossible to lead a normal life and avoid all situations where danger may arise. The next best thing to avoiding danger entirely is to learn how to cope with it.

The person who is least likely to panic in a crisis is the person who knows what to do when it occurs. In World War I, the Germans introduced two new weapons, poisoned gas and the flame thrower. When Allied soldiers faced these weapons for the first time, they often panicked, sometimes with fatal consequences. But once the soldiers had learned what they were up against and how to cope with it, they usually kept their heads. Similarly, police officers, fire fighters, pilots and flight attendants seldom panic when faced with the hazards of their work because they have learned what to do when those dangers arise.

Merely knowing what to do in the event of danger does not, however, guarantee that you will *do* it. Most people know that they should pump their brakes when stopping on slippery roads, that they should avoid elevators when escaping from burning buildings, that if their boat capsizes they should stay with the craft rather than attempt to swim ashore. Yet when faced with such dangers many people do not do what they know they should do. Ideally, then, learning to cope with a hazard means *practicing* the appropriate response. It is for this reason that the training of professionals who may face danger in their work includes practice at dealing with simulated hazards. Fire fighters do not merely read about what to do to avoid suffocation from smoke inhalation, they practice crawling on their hands and knees through burning buildings. Police officers undergo training in which they are attacked by armed 'criminals.' Pilots spend hours at a flight simulator that throws their 'plane' into a spin. Soldiers practice advancing on an enemy while 'bombs' explode around them.

It would be impractical for most of us to undergo the sort of training taken by police officers and others. But you and the rest of your family can have periodic fire drills in which you actually do what you should do in the event of a home fire. Similarly, after checking into a hotel, take a few minutes to look over possible escape routes. You can take driving instruction (perhaps involving simulation training) that will give you valuable practice in coping with dangers you might encounter on the road. You can take a first aid course that will give you practice in treating make-believe injuries. You can take a course in water safety that includes practice in dealing with boating hazards, such as fires, collisions and capsized boats. Remember that while reading or hearing about what you are supposed to do is helpful, you are most likely to avoid panic if your training includes *performing* the necessary skills under an expert's supervision.

If you are well-prepared for a crisis, you should be able to cope with it when it arises. If not, you may panic. And that could kill you.

Processor for the Information Age

New times call for new products, and here is one of the newest. It is versatile and fast—and it is stirring up a lot of interest

Photos by Joseph Gazdak

Last March, Jim Brewington, Manager, Account Management (Network), and several of his colleagues went to Detroit to tell a group of Michigan Bell executives about one of Western Electric's newest and most exciting products. The Michigan Bell people listened with rapt attention because they knew they were hearing about new technology in a new field.

The product they heard about is the 3B20S processor—our initial offering in a line of minicomputers for Bell System applications.

According to Brewington, "The 3B20S is a vehicle that will help us realize many new opportunities. We are offering the 3B20S as a package of hardware, software, and support services for a variety of applications that include computer-aided design and manufacturing, business data processing, engineering problem solving, and office automation. It's a sophisticated machine with Western Electric's reputation for excellent service behind it."

The Bell operating companies are not yet familiar with this new line of Western Electric product. To change that, the account teams, the Product Line Planning and Management (PLPM) organization and the Corporate Account Management (CAM) organization have teamed up to launch an orientation program for representatives of the operating companies. These demonstrations include an overview of what the 3B20S is and can do, as well as a presentation using a fully operational 3B20S processor. In March, PLPM, several account teams, and CAM were in Detroit. It was the fifth such meeting and at least five more are planned for this year.

The 3B20S shows are composed of audio/visual presentations about the processor, the UNIX* operating system, and the support services and training available to 3B20S purchasers. These presentations are followed by several demonstrations using an on-site working 3B20S to show potential customers the versatility of the processor and its uses in the office of today and the future.

Bob Merna of PLPM, who is responsible for processor sales, spoke about its capacity and features. "This minicomputer," he said, "is built in the Western tradition of reliability. It offers the best uptime of any system in its class and it has performance to match."

The 3B20S evolved from the 3B20D model processor, which was designed for switching systems where reliability is critical. In fact, the 3B20D is the central processor for the new No. 5 ESS local digital switch. The 3B20S offers all the same components as the duplex model and goes through all the factory system tests to insure reliability. It is a processor built with the customer in mind. It has a wide operating temperature range (from 32°F to 122°F), it is quieter than other minicomputers, it has a 15-minute backup power supply for insurance against a power failure, it consumes less power, and it is easy to install.

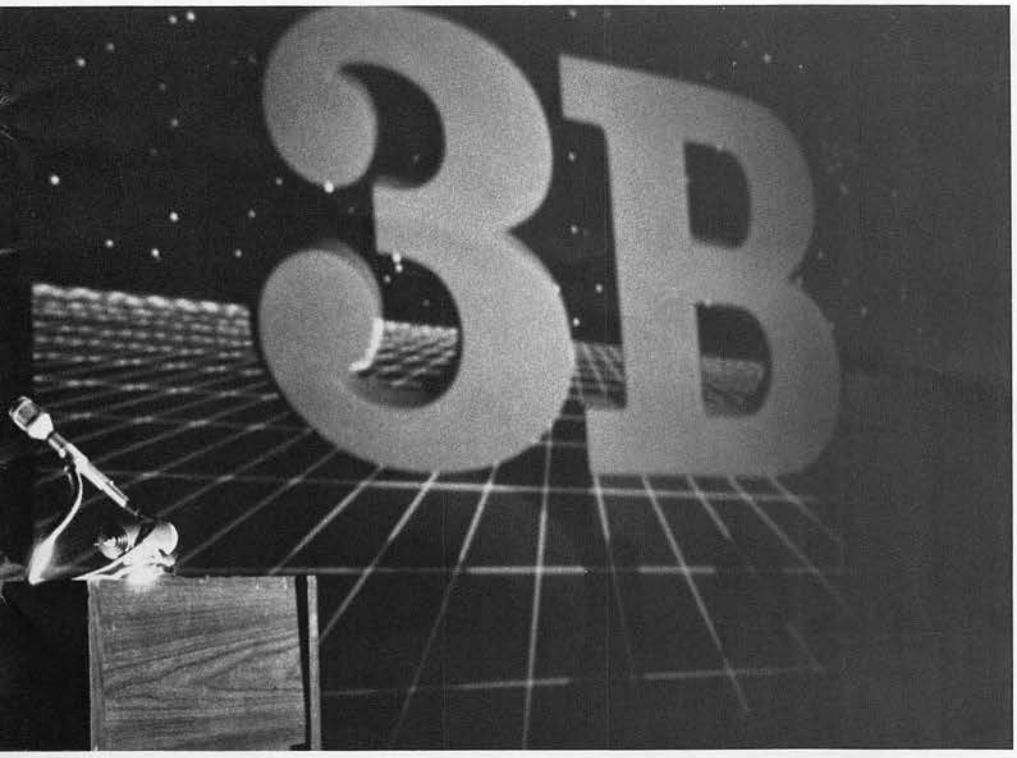
"We received this machine here in Detroit as a finished product," said Merna. "It was manufactured at our Oklahoma City Works. It took only four hours to get it from the crates to working order.

"Most important, however, the machine is built for performance. It uses the latest circuit technology, high-speed memory, and advanced architecture. It can execute almost one million instructions per second. That's fast enough to balance every Western employee's checking account for a month—in *five* seconds. I think it's a solid system with excellent design."

*Trademark of Bell Laboratories

Bold graphics add emphasis to Jim Brewington's talk on the 3B20S.

Kathy Zitny outlines the role of the 3B20S in the office of the future.



Bob Merna (third from left) *talks about the 3B20S.*

It's the software that gives computers their versatility and flexibility and the 3B20S was designed to make maximum use of the UNIX operating system. Designed by Bell Labs, UNIX software has earned a fine reputation among programmers and software designers both in and out of the Bell System. Don Jester, also of PLPM, demonstrated briefly some of the commands available on this system and allayed concerns that software and computer terminals are only usable by information systems engineers and computer programmers.

"The UNIX operating system," he said, "promotes user efficiency because its command language emphasizes brevity." We like to say you get a lot (of work done) for a little (command typing). There are over three hundred commands in the version of the UNIX system that is furnished with our 3B processor. However, a user can learn the fifty or so often-used commands in a relatively brief period, and, thereby, become much more productive.

"Many of the UNIX software commands are grouped into packages for convenience and easy use. For example, there is a package, the Programmer's Workbench, that aids in the development of software for large, mainframe computers. Another package provides complete text processing and phototypesetting facilities for production of memoranda, brochures, handbooks and other large documents. Still another package provides tools for circuit designers. Taken all together, I hope you can understand why I'm very enthusiastic about the 3B processor and the UNIX system."

Following Don's lead, Kathy Zitny, a product planner and a member of the PLPM group, gave a presentation about the UNIX system application package known as the Office Automation System (OAS).

"This application," she explained, "combines data and information processing to make the Information Age a reality. The Office Automation System attempts to replace paper shuffling with electronic transmission. You can send and receive messages instantaneously via video display terminals rather than waiting days for a letter to get from one person to another. In essence, OAS improves office productivity with features that are being developed to provide word processing, electronic messaging, a dictionary and spelling checker (with the capacity to add specialized words or acronyms), and an electronic calendar. The Office Automation System has been used on a trial basis at four Bell System locations. One of the first full-service site applications is being installed at WE's Southgate facility in Morristown, N. J., where I'm told it is anxiously awaited as a real time-saver."

Mario Padilla, Director of Product Planning for Processors, has his office at Southgate. He confirms that the 3B20S, the Office Automation System, and other applications that will make office workers more productive are the "way of the future." He asserted, "Part of our future is in this 3B20S processor. We have high quality equipment and software, but as important, we have the Western Electric tradition of service. We back this system from cradle to grave. This might be our first minicomputer, but we're not new to the business of installing and maintaining our equipment. We're respected for our service commitments, and we intend to continue to observe that good reputation—in this new field for the Bell System."

World of Communications

It was hard to tell who was having more fun—the parents or the children

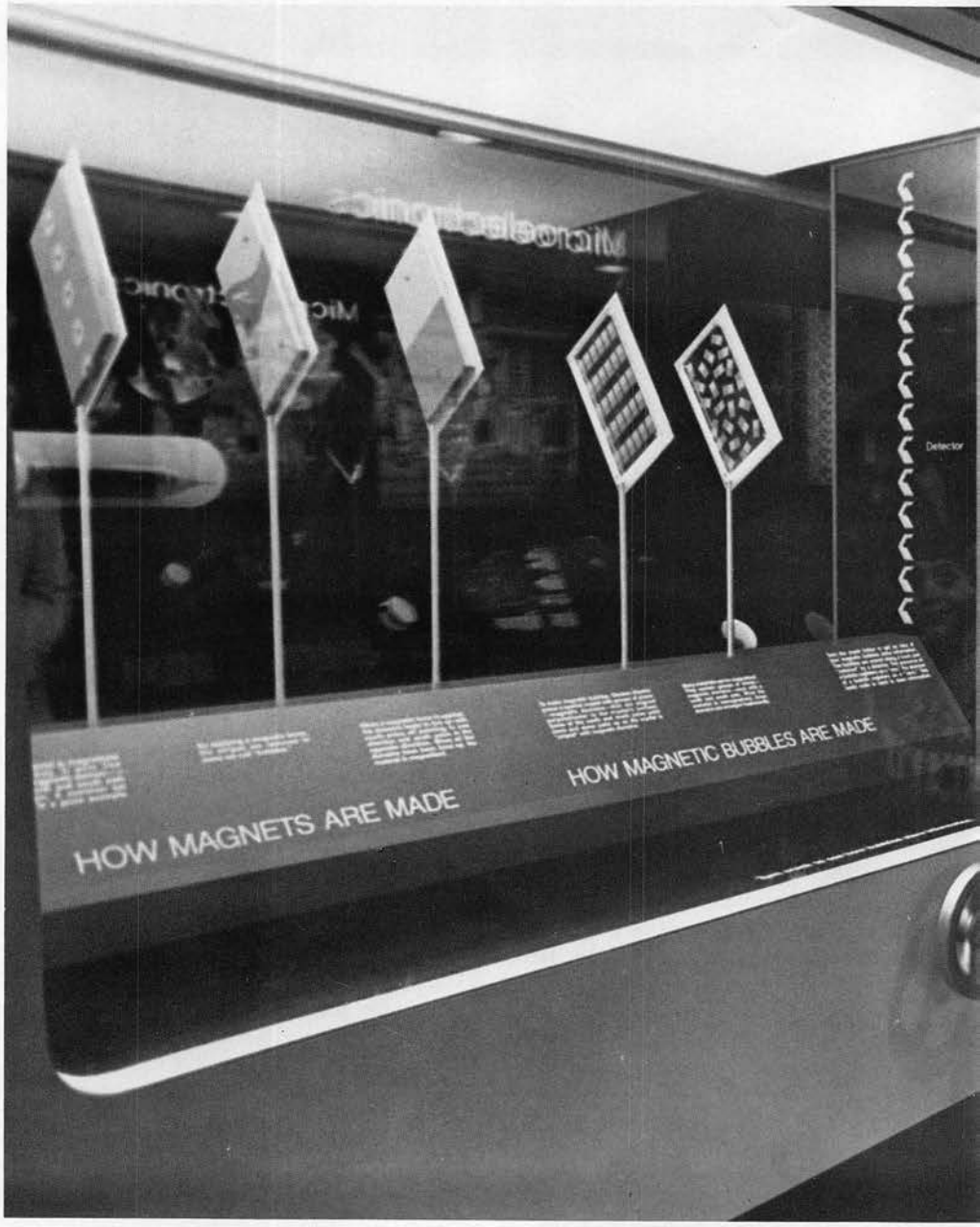
Photos by Warren Schild

Thanks to a telephone, Gregory Bridgewater can find out more about frequencies, vibrations, and the "shape" of sound.

This year, Western Electric employees in the Chicago area wrapped up Engineers' Week in a big way. On Saturday night, February 27th, Chicago's grand Museum of Science and Industry, where a new Bell System exhibit about telephony and communications called "OMNICOM" was recently installed, opened its doors exclusively for WE employees and their guests. The whole museum was accessible that evening—the famous coal mine, the new Viking exhibit, the World War II submarine, and of course, OMNICOM—to everyone connected with the Hawthorne Works, Montgomery Works, Northern Illinois Works, and the Central Region Headquarters.

OMNICOM, which means, "world of communications," is a joint effort of Illinois Bell, AT&T Long Lines, and Western Electric with counsel from Bell Labs. There are 36 modules in the exhibit, many of which include hands-on interactive machinery—voices can be recorded and played back, cranks activate lights and bells, buttons activate recorded information. One exhibit explains Sir Isaac Newton's discovery that sound waves travel at different speeds. Another describes the difference between analog and digital information. There's one that describes how a microwave radio system works and one that explains how the Bell network makes use of microwave radio, coaxial cable, satellite paths, and lightwave systems for telecommunications.

At Western Electric's exhibit about magnetic bubbles, you can record your own voice and hear it played back using this technology. At our



Fay Bass gives her son Billy a boost so that he can get a better look at one of the displays at OMNICOM in Chicago's Museum of Science and Industry.

Tony Cossa's children, Danny and Cathy, got an idea of how magnetic bubbles store information by turning the crank to move "bubbles" along a track. This movement caused lights to flash—in the children's eyes.

photonics exhibit there is a demonstration of lightwave communications and lasers. If you are interested in learning more about silicon integrated circuits and microprocessors, the exhibit about microprocessors has a full and detailed description and a hands-on portion.

There's an exhibit that pits a tic-tac-toe player against a computer and dares the player to "beat the brain." It's not easy, and this game was drawing a big crowd that evening. Many of the exhibits include telephone receivers, and instructions to listen in, to find out the point of the exhibit and a little more about the subject. Little children as well as adults pick up these telephone receivers just as naturally as if they were at home speaking on their own telephones. One thing was clear throughout OMNICOM—Western Electric people are comfortable around phones.

Fay Bass from the Warrenville Data Center and her son Billy were there that evening. She spoke enthusiastically about this kind of event for Billy. "Touring this museum," she said, "is an educational experience. I always learn something new here—but it's usually so crowded. It's a world-famous institution. Tonight, the few thousand people who are here hardly make a dent in crowding the exhibits, so I feel really good about this idea of opening it to the employees and their families."

Danny and Cathy Cossa got caught by the magnetic bubbles and spent a good deal of time learning more about magnets and what they mean to the telephone network. Danny, in particular, seemed to be captivated by the lights that flashed on and off as a result of a magnetic field generated when he spun the crank attached to the exhibit. Their dad, Tony Cossa, now at Northern Illinois Works in #1A ESS customer support, spent a good deal of his career at Hawthorne. He said he was very pleased to see his children so interested in the exhibit. "I'm glad these exhibits are written so well—in layman's terms," he said. "The technology really does need to be explained, because the Information Age is really upon us and my kids will be full beneficiaries of today's technology—if they understand it and can take advantage of it. We're engineering a new information processing and transmission era in the Bell System. This exhibit, with its historical as well as futuristic segments, is one way to prepare these children for the different world that's around the corner."

It was the first visit to the Museum of Science and Industry for Gregory Bridgewater. He had a look of wonder at the size and scope of the museum. His father, George, works at the Indian Hill facility. "This WE open house," George said, "was a great idea—especially for the children. They don't always know or understand what we do for a living. It's a good way to describe the telephone network, how it operates, and what our role in it is. After we finish here, Gregory wants to see the coal mine exhibit and the story of the Vikings. I'm sure we'll be back here again. This isn't the kind of place you can cover in one evening—there's just too much information to absorb in one trip."

Judging from the crowds in the museum and in OMNICOM that evening, a great many WE employees and their families entered the world of communications and found it fascinating. With the help of OMNICOM, a great many more people will share the vision of the new world of telephony and the technology that is transporting us into the Information Age.

Phones, Phones, Phones

Jack Holtman has over 100 of them

By Dale Shores

Have you ever seen a McKinley phone? How about a Strowger? If you haven't, then you might want to visit Jack Holtman's telephone "museum."

An installation supervisor in the Southern California Installation Area, Holtman started collecting antique telephones and phone-related memorabilia four or five years ago.

As he tells it, "It all started during a trip to Oregon. I ran across a man who had two antique wall phones for sale and, working for Western, I was interested, so I bought them. But it wasn't until a year later that I actually got around to refurbishing them. Now I've got 50 phones inside and probably 50 more in my workshop. The problem is I'm running out of walls to display them on!"

Holtman belongs to the Antique Telephone Collectors Association which publishes a monthly newsletter listing phones for trade or sale. This is just one of many sources Jack uses to obtain phones and phone parts for his collection.

Surrounded by a battery of antique wall telephones, Jack Holtman proudly displays one of his attractive acquisitions. He refurbished most of them, himself.

"I've picked up quite a few of these phones at swap meets and antique shops," he relates. "Half of the fun of this type of hobby is bargaining for the telephone you want."

The Holtman 'collection' contains everything from an 1898 American Electric tandem phone to one of the first, circa 1900, intercom office candlestick models. The latter was licensed for use only in the state of California. The gleaming oakwood and brass fittings bear testimony to Holtman's fastidious refurbishing process.

In addition to the phones, directories from days gone by grace the collection. One such directory bearing the date 1924 reveals the first system of number assignments. "Back then," Holtman explains, "if you were the first person in town to have a phone, you were assigned the number one; if you were the twelfth, then that was your number, and so on."

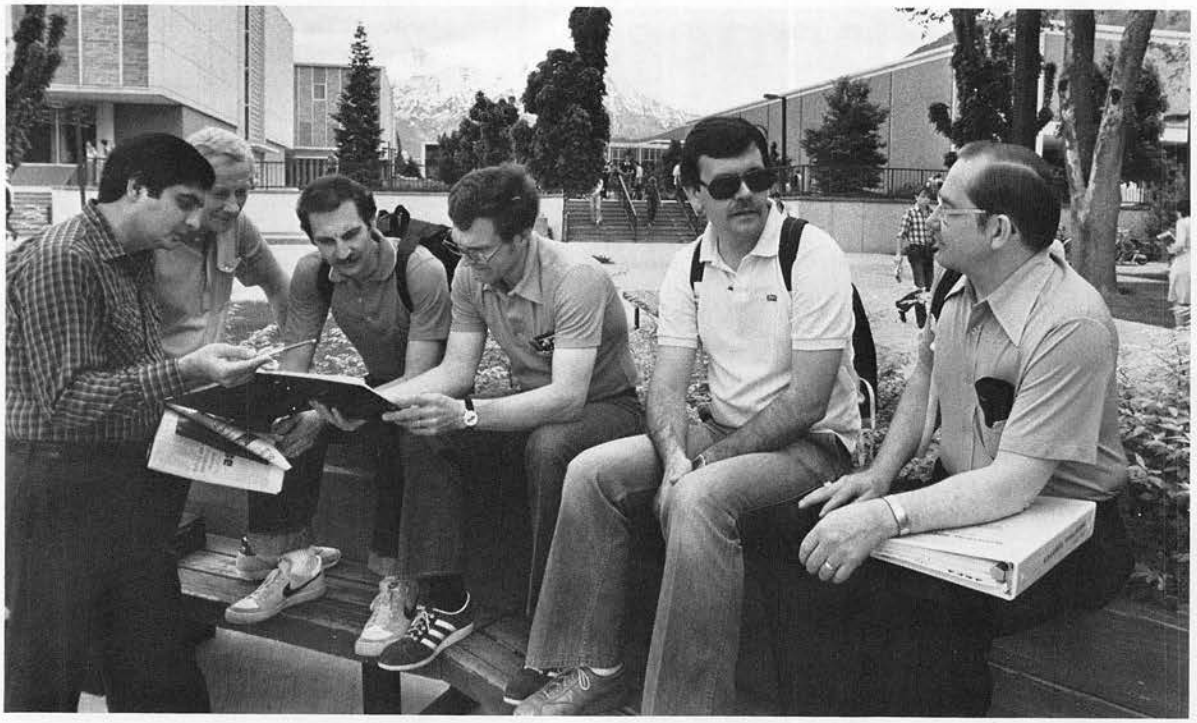
Mrs. Holtman has gotten caught up in the telephone collecting spirit as well. She recently traced a phone that appeared in a Christmas catalogue for May Company department store to its owner in Hollywood. This took patience, perseverance and quite a bit of time on the phone. Holtman admits, "She's really been a lot of help."

Although still enthusiastic about his hobby, Holtman states that costs have skyrocketed and the rare models he seeks are harder to find. "I had to go to Salome, Arizona for the McKinley set," he admits. But cost and scarcity of the antique sets do not deter him from continuing his search for rare telephones and phone-related memorabilia. "As long as I'm working for Western, my hobby will interest me because it ties in with my job. I really can't foresee getting bored with it."

Summer on Campus

For a few weeks each year, these employees leave their jobs to become full-time college students

By Elizabeth M. Perlman



Rakesh Khetarpal of Montgomery, Bill Foster of Columbus, Gary Kahler and Aaron Faltin of Omaha, Paul Bendig of Atlanta, and Bob Attebery of Omaha.

Lasers, robotics, microelectronics, software, and photonics are just a few of the dynamic technologies that Western Electric recognizes as vital to our future and our growth. Advances in these fields are proliferating so quickly that technical professionals find they must continually update their education to stay current with their fields. Our position on the leading edge of technology is in large part a result of employees who stay in touch with state-of-the-art developments and constantly renew the sophisticated knowledge they use on their jobs and in their careers.

Many technical professionals combat "obsolescence" by continuing their education either at courses sponsored by the Corporate Education Center or through advanced-degree work at local universities. Finding the best way to keep up to date varies. For some, night school under tuition refund is the right answer, but that is a long haul involving a major commitment and the personal time to fit classes and homework into already busy lives.

Moreover, for graduate work in state-of-the-art technology, the right courses are not always available locally. The CEC offers intensive courses in the technologies of Western Electric processes and products that satisfy the needs of many people. But, to ensure the quality and technical leadership which is fostered by more technical professionals completing advanced degree programs, the company offers two other programs that go beyond tuition refund and courses taught at the CEC. This is why the CEC administers these programs: the Engineering and Science Fellowship Program and the Summer On-Campus Program. Each year, ten or more technical professionals are awarded fellowships to pursue graduate degrees in technical subjects which meet company needs and provide individual development for the recipients of these fellowships.

The Summer On-Campus Program operates on a larger scale. At selected universities, master's degree programs are planned by the CEC and the university faculty in technical subjects when the company needs employees with advanced academic training. Several participating universities have agreed to waive their normal admissions tests giving the candidates the company selects the chance to sink or swim based on the tests at the end of each course.

Steve Dupor, a technical writer at Reynolda Road in Winston-Salem, is one of the participants in Western Electric's Summer On-Campus Program. Like the others interviewed for this article, he is studying at Brigham Young University in Provo, Utah toward a degree in computer aided manufacturing. "I applied for these courses in order to maintain a current level of knowledge about our products and technology," he said. "Technology is moving so quickly, I really have a sense of urgency about maintaining an understanding about the state of the art. I feel we can accomplish more by being on campus, with labs, and time set aside for nothing in our lives but studying. The whole environment is more conducive to learning than night

courses would be."

To minimize time away from family and job, the courses are concentrated in a four- or five-week period during the summer, so the work is intensive. Employees who are accepted to the Summer On-Campus Program leave their briefcases at home along with their jobs, their families, and their day-to-day routines to become full-time students.

Bill McCormick, a process engineer at the Atlanta Works, concedes, "I decided to join this Summer On-Campus Program because it poses fewer problems than I would have had going to night school. There's less negative impact on my job when I take a solid five weeks off. Also, I think we can learn better in this environment. This is my third summer in the program and each summer I've brought 'back-burner' problems from work to the attention of the professors. We've come up with some creative and viable solutions."

Hal Pierce of the Oklahoma City Works visits with his daughter Jennifer, who is also taking summer courses at Brigham Young University.

Hal Pierce, a product engineer at the Oklahoma City Works agreed with Bill's assessment and added, "The only way I could consider going back to school was to do it this way. Night school takes too much of a toll on my family and my job. It's a funny coincidence, but I have two daughters that are in school here at Brigham Young, and one that just graduated. It's awfully nice to see them here—it's a long distance from Oklahoma City. Of course, we've had a laugh about studying together, my children and I in college at the same time."

The Western Electric students live in dormitory-style housing on or near college campuses; they take graduate-level courses offered exclusively for WE employees; and the work they complete in a month is equivalent to a 16-week semester; so they spend most of the time going to class, in a lab, or studying.

This program has been sponsored by the CEC since 1957 when 137 students attended five universities and took courses like "Electron Tubes and Circuits" and "Computer Theory I and II." This year almost 300 students were accepted and courses ranged from "Computer Graphics" to "Integrated Circuit Technology" to "Industrial Robotics."

Rakesh Khetarpal, a planning engineer at the Montgomery Works, explained his decision to pursue a master's degree in computer aided manufacturing: "I have a feeling that robotics and computer aided design are going to evolve very quickly. It's like having a crystal ball here, a clearer insight into what is coming in a few years in the works. We spend about 15 or 16 hours a day here at school. Most of that time is spent in labs working at computer terminals. We have access to fine equipment and it's available all day long—a real plus."

The list of participating schools has changed since 1957 as a result of changing company needs for specific technologies. In 1982, the following universities offered classes for our people: Brigham Young University, Clemson University, Kansas State University, New Mexico State University, Purdue University, Texas Tech University, and the University of Illinois.

Susan Muller, an information systems developer at the Reading Works, describes how this degree fits into her plans. "Although this course work is not directly related to my present assignment, I expect it, and the master's degree, will become more and more vital to my career. That's why I chose Brigham Young's program rather than one in another discipline at another participating school. Right now, it helps me to work better with the engineers I provide programming services for. I understand now what they are up against. I decided that I had to go to school in some sort of full-time program because I work a lot of overtime and school really suffers if you don't give it all of your free time. I get a great sense of accomplishment after finishing these 5-week marathons—we act like workaholics for a month and then we can slow down and go back to our real lives—I suppose knowing that it will end helps to keep us going."

Depending on when they started, the students who went back to school in the summer of '82 are just one-to-four short summers away from master's degrees in one of the following disciplines: electrical engineering, computer science, industrial engineering, or computer aided manufacturing.

Larry Mullins, a senior engineer at the Denver Works, asserted, "I'm enrolled in this program because it's exactly what I was looking for. Automated manufacturing is the direction we should be going. I plan to do a thesis in the area of computer controlled testing. The professors have been really cooperative about helping me tie my ideas into my job and into the 'real world.'"

Brigham Young University is the only participating school that offers a degree in computer aided manufacturing. This is such a new field that there's a lot of give and take between professors and Western Electric professionals.

Donald Meyer, a product engineer at the Columbus Works, stresses the importance of taking courses that are relevant to his job. "This particular master's program—in computer aided manufacturing—is the only one of its kind that I'm aware of. This classwork impacts directly on my job. I'm involved with printed wiring board manufacture. A good portion of that is computer-controlled. The knowledge we are getting here and the skills will have an impact on Western's manufacturing methods in just a few years. I want to be able to take advantage of the changes."

It takes just over five summers at the rate of two courses a session to complete the course work and the thesis, design project, or comprehensive exams required by the participating universities to qualify for a master's degree.

Charlie Cote, a test engineer at the Merrimack Valley Works, is one of many students who is anticipating an end to his Summer On-Campus "career." He, like many of his colleagues, looks forward to completing the course work and the degree. "This is my third year and it has been really productive. I'm half finished with this degree and next summer I'll be starting my thesis. I hope my experience as a contributing editor of the *Valley Voice,* our location publication, helps me when it comes time to start writing about computer aided design and manufacturing."

Pioneers with Insight

Gold Coast Pioneers live up to their "Tradition of Caring"

When Frank Jarrell, Western Electric's voice communications manager for account management in Florida, was president of the Gold Coast Chapter of the Telephone Pioneers in 1980, he was actively searching for a "big" community service project that would simultaneously benefit a lot of people and help bring together his chapter's widely dispersed membership.

The chapter's vice president, Whitley Andrews, and community service chairman, Floyd Neely, proposed a fund-raising campaign for Insight for the Blind, a nonprofit organization in Ft. Lauderdale that records books and magazines for blind and handicapped individuals. Specifically, they proposed raising $200,000 for a new building to replace the cramped storefront the organization currently occupies.

Insight for the Blind is one of five volunteer recording studios in the United States that meets the requirements set by the Library of Congress for "Talking Books." It is housed in a small building and has three recording studios.

Caroline Mansur, founder and president of Insight, recalls, "In 1975, we were seeking contributions of money, recording equipment, and technical expertise to get the organization started and running. I approached the Pioneers who agreed to build our three soundproof recording booths. They provided both the materials and labor. I should add that for many years they've also been repairing the playback machines used by the recipients of Talking Books throughout the country. We are indeed grateful for their help. And, now, they've agreed to raise the money and provide the labor to build the new building where we will have 10 recording booths as well as space for editing and research. We have a waiting list of people who would like to make recordings, but not enough equipment to accommodate them, and there are many thousands of print-handicapped people who depend on Talking Books for information and entertainment."

Talking Books—tape-recorded print materials—are provided free to blind and handicapped individuals by the Library of Congress. The books are composed of cassettes and a tape player. Eligible people can get Talking Books from local libraries and return them by mail free of charge.

In 1981, Insight for the Blind purchased a plot of land for the new building with contributions from private groups and individuals. The Pioneers prepared the blueprints, cleared the land, and solicited gifts-in-kind for architectural designs, construction, landscaping, engineering, and legal expertise. The ground breaking ceremony for the new building took place March 10, 1982. With evident pride, Frank calls this project "the biggest—in terms of dollars—that the Pioneers ever attempted." The 100 or so guests included some of the volunteers who keep Insight operating and a number of Telephone Pioneers for whom this ground breaking was

The Florida Gold Coast Chapter of the Pioneers is helping Insight for the Blind realize a dream of a new building and larger facilities.

Don Allen checks pronunciation and timing as Margaret Hunter reads for Insight for the Blind. They are two of the many volunteers who prepare Talking Books.

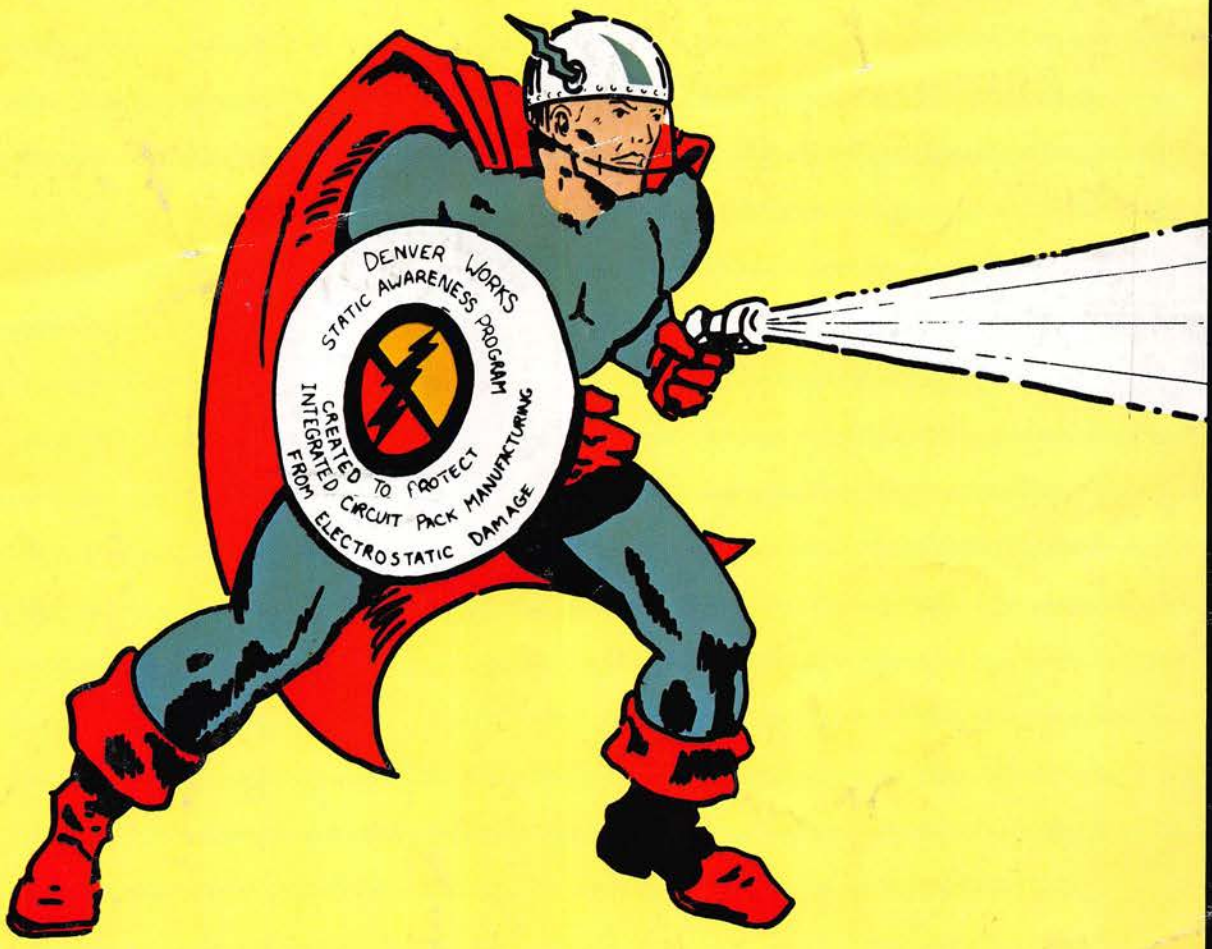
the culmination of a lot of hard work.

As Alice Wilson, Florida Gold Coast Chapter administrator, put it, "This building we've been working toward is finally materializing. We have eaten, slept and lived Insight for the Blind. Soon we'll be able to point to the fruits of our efforts."

Lloyd Sauls, contract administrator at the Miami Service Center, is responsible for documenting the history of the project for the WE Gators Council. He explained, "The greatest benefit of this effort is that it makes literature, textbooks and magazines available to blind and handicapped people. Braille material is expensive and for the most part quite bulky. With a greater number of recording booths, a greater number of people will get material. In the end it helps us all. The fund-raising campaign has gotten off to a big start, and we already have $83,000 for the building."

Doc Horton, an inspector/tester at the Miami Service Center and president of the WE Gators Pioneer Council, had only positive words about the future of the capital campaign. "We're *sure* we can meet our goal. The Pioneers have sponsored a 10-mile walk-a-thon, and other such events are planned. We make planters for living and artificial plants out of unrefurbishable telephone housings. Those planters are selling faster than we can produce them. And there's also the 400-page cookbook produced by the Gold Coast Life Members called 'A Lifetime of Favorite Recipes.' The first printing has all but sold out. We're getting ready to start a second printing."

As Frank Jarrell had hoped, his Pioneers are working as a team, involved in one big project, making fund-raising presentations, making and selling planters and cookbooks, planning events, and seeking private contributions. Bob Kleinert, President of AT&T Long Lines and President of the Telephone Pioneers of America who assisted at the ground-breaking ceremony, summed up the effort to build a new home for Insight for the Blind. He said, "This is a tremendous project. Its size and scope fit well with our theme 'A Tradition of Caring.' It's a challenge in every sense of the word."



Who is the intrepid Captain Denver zapping? To find out, turn to page 18 and read "Zap!"

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