GENERAL ELECTRIC
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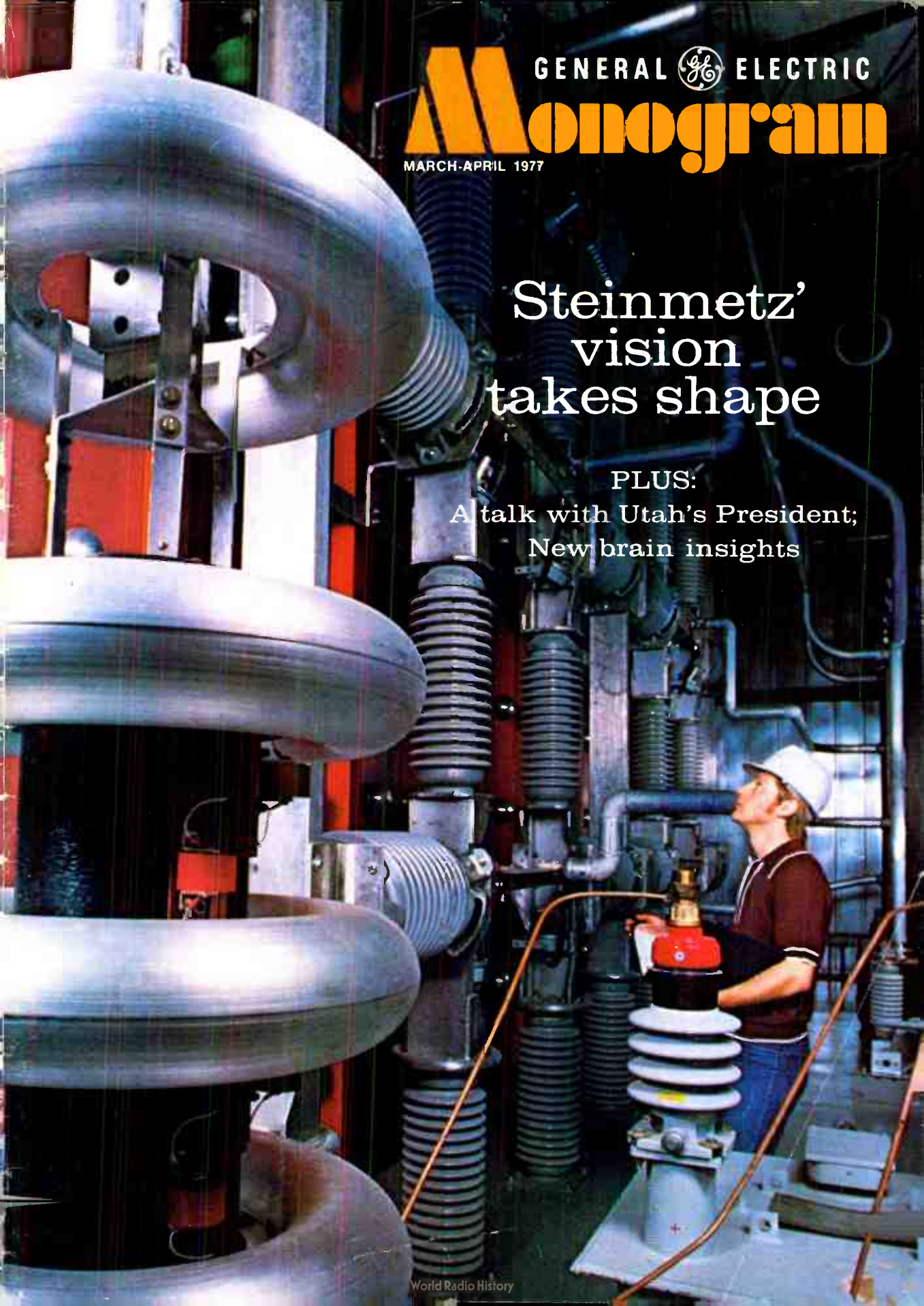
MARCH-APRIL 1977



Steinmetz' vision takes shape

PLUS:
A talk with Utah's President;
New brain insights

*Brrr*siness as usual

GE's 'energy preparedness' programs— stressing fuel austerity and back-up sources— kept plants working during 'worst winter'.

It's official. January 1977 in the eastern two-thirds of the country was the coldest month in 177 years. But sub-zero blasts and paralyzing snowdrifts posed only part of the problem. A dire shortage of natural gas—long predicted but largely ignored—forced hundreds of U.S. businesses and factories to close. Millions of workers were laid off and millions of dollars in lost production resulted.

How did General Electric make out? Much

GENERAL ELECTRIC Monogram

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On the cover: interior of "valve hall" near Stegall, Nebraska, site of the newest GE HVDC installation and of electricity's symbolic "Golden Spike" connecting Eastern and Western U.S. power grids in fulfillment of a Steinmetz vision. Story on page 6.

Contents

The Monogram's purpose is to keep its readers informed on General Electric activities so that they may more effectively represent the Company in its relationships with the public. It is published bimonthly by Corporate Public Relations Operation—Douglas S. Moore, Vice President. Editorial supervision is by David W. Burke, Manager, Corporate Communications, and J. Hervie Haufler, Manager, Corporate Editorial Programs.

During January's record icy grip, GE's Hank Heddesheimer directed efforts of 39 Division energy coordinators who helped keep nearly all GE plants operating despite natural gas shortage.

better than average, thanks mainly to GE's foresight in setting up its Energy Management Program in November 1973. During 1977's "worst winter," only 3,165 GE employees—a miniscule 1.5% of all GEers nationwide—were affected in any significant way by the gas crunch. Despite the fact that GE has key plants in states which declared a natural gas shortage, only seven of GE's 208 plants curtailed operations during January, and most plant cutbacks were for just a few hours.

How was GE's enviable record accomplished? With alternative fuel back-up and an in-place energy management program. Rather than scrambling for replacement fuels during the bone-chilling cold, virtually every GE facility was equipped with back-up energy supplies, either oil or propane. According to Henry E. (Hank) Heddesheimer, manager of Plant Engineering Consulting for the Real Estate and Construction Operation, "the overriding reason for GE's successful weather bout was 'energy preparedness.' GEers were not stymied by recent energy shortages. When problems pyramided, we had a staff and program in place to cope with the difficulties."

A *Monogram* survey of GE's ice-gripped facilities turned up several intriguing present and future GE approaches to thwarting the gas crunch. Four examples follow:

Drill your own gas wells. Anticipating natural gas curtailments, the Lamp Business Division's Energy Council in 1974 began studying auxiliary fuel systems for Lamp's 13 Midwestern plants. One of its major recommendations? Drill natural gas wells at several Ohio facility sites. H. J. (Jack) Killmeyer, Jr., manager of Energy Development and Conservation, states: "Ohio's geological formations are such that the chance of striking gas is two out of three if you analyze and drill carefully."

That's exactly what Lamp did. Drilling at Ravenna, Ohio's lamp plant started in February 1975 and on the tenth day, in the first hole, the drill bit met natural gas at 4400 feet (*Monogram*, May/June 1975). Buoyed by success, Lamp drilled a second well in May 1976, and the two wells now supply 100% of both Ravenna's manufacturing-process and space-heat requirements.

"These gas wells are a godsend," remarks Killmeyer. "Since Ravenna is now self-sufficient, its gas allotment—through an agreement with the gas company—can be passed along to other GE facilities served by the same company. Ravenna's wells cost roughly $100,000 each, should produce for ten to fifteen years and, if used at full capacity for only three years, will pay for themselves."

Ravenna's attractive economics have not been

(continued next page)

lost on Lamp management. Last year seven more wells were drilled—near the Division's Logan, Ohio facility—and an eighth well is underway. Logan, with two huge glass-melting furnaces, needs ten times as much energy as Ravenna and therefore requires more gas-well capacity. Comments Killmeyer: "Lamp's drilling operations are by no means over. Ohio enjoys numerous low-volume, low-risk pockets of natural gas which lie relatively near the surface. We will keep drilling, and this year's goal is nine more wells, with two being in a new area near our Bucyrus, Ohio facility."

Install your own propane systems. An ominous January phone call from Northern Indiana Public Service Co. (NIPSCO) to Ft. Wayne GE notified local GE plants that their natural gas supplies were being curtailed as of January 27. Catastrophe? Not for Ft. Wayne's Appliance Components Business Division and Specialty Transformer Products Section. Their plant facilities personnel simply switched to back-up propane and a reserve mixture of natural gas and fuel oil. Almost no manhours were lost because of the crisis.

Headquartered in Ft. Wayne, Appliance Components has 16 plant locations—all in the Midwest and *all* with propane back-up. "We were ready for the natural gas shortage," says Donald W. Mohrman, the Division's manager of Environmental, OSHA, Energy Resources Operation. "Last year we added 1.2 million gallons of propane capacity worth $2 million to our reserves, and our total propane capacity now equals 1.8 million gallons. Needless to say, NIPSCO was delighted with our effective response to the immobilizing weather."

Mohrman, however, stresses that propane will not be Ft. Wayne's long-term panacea. "Some propane deliveries cost us four times as much as natural gas. Although it's worth it—it enables us to keep running—for us the final answer is yet another energy conversion, probably an eventual changeover to electricity for much of our needs." The Division's long-term goal? To reduce dependence on its natural gas usage 60% by 1981.

Rely on weather-free nuclear fuel. It's a little known fact that on the morning of January 17 the eastern half of the country narrowly averted a major power blackout. How was it prevented? In part by GE-supplied nuclear power plants. The east central states are 90% dependent on coal-fired generation plants, and much of that coal was incapacitated—locked under mountains of snow, waterlogged, or trapped aboard coal barges paralyzed in Ohio River ice. Explains George J. Stathakis, GE VP and general manager of the Nuclear Energy Programs Division: "Nuclear plants require refueling only about once a year, and therefore were generally unaffected by the frozen waterways that denied coal barges access to coal-fired plants."

In such states as Illinois and Connecticut, GE's nuclear performance was instrumental in keeping local GE facilities' electrical systems operational. Commonwealth Edison's seven nuclear units produced a record 48% of the utility's total electrical output during the severe January freeze. Five units are GE. Nuclear units on the Northeast Utilities system furnished better than 50% of system output during the same period, and also provided timely emergency electricity supplies to regions in the Midwest. The GE-supplied Millstone 1 and Vermont Yankee plants contributed to that achievement.

The Atomic Industrial Forum reported that nuclear power in January kept 257,000 persons

Ravenna drilled its own gas.

San Jose helped keep nation warm.

Ft. Wayne (l) had propane ready.

on their jobs, prevented the loss of nearly $230 million in monthly wages, and saved the economy some $3.8 billion in goods and services. Concludes Stathakis: "In previous years electrical-load peaks have usually occurred during the air conditioning months. Thanks to their nuclear units, many utilities were able to withstand this winter's unexpected energy demands."

Let computers regulate your plant heat. Even though Binghamton, New York's Aircraft Equipment Products Division facility last year turned in a record 35% energy savings compared to 1973, GE management still wasn't happy. Still more energy should be saved—but how to do it? Enter Honeywell's Automated Energy Management System—computer-based equipment that automatically regulates the plant's heating and air conditioning units. Installed in March, the system promises to save an additional one million kilowatt-hours of electricity annually, while reducing the use of purchased steam by six million pounds.

"We're elated with the equipment's prospects," exclaims Robert D. Meyer, manager of Advanced Manufacturing Engineering. "The system cost less than $100,000 and should pay for itself within two-and-a-half years. It not only reduces the energy we consume, but also reduces our utility's 'monthly electrical demand fee rate' by anticipating and preventing unnecessary peak periods."

The system automatically turns equipment off and on based on various conditions—time of day, day of week, and outside temperature and humidity. It's also programmed to select the best heating, ventilating and air conditioning modes, and it turns power off (on a priority basis) when approaching preset demand limits. Notes Meyer: "The computer will wake up on a cold morning, check the temperature outside, and start heating the plant 15 minutes earlier than usual. It knows when it's Saturday and Sunday, and is a strict observer of all Company holidays."

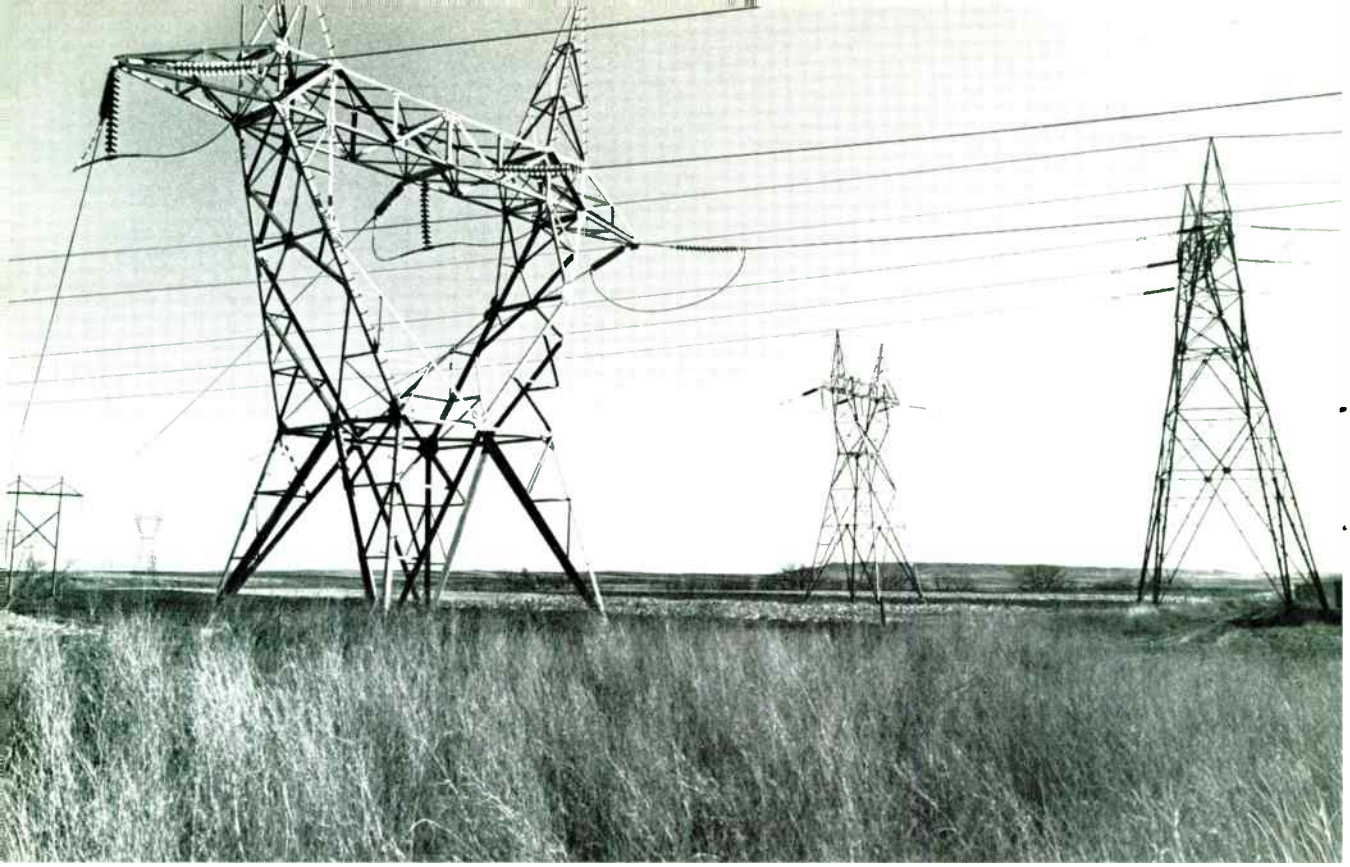
Binghamton relies on computers.

The man responsible for coordinating GE's day-by-day energy conservation efforts is Schenectady's Hank Heddesheimer, Real Estate and Construction Operation. Since the inception of GE's expanded energy austerity program in November 1973, Heddesheimer has directed the efforts of 39 Division energy coordinators who advise Company components on ways to conserve plant energy (*Monogram*, Nov./Dec. 1974). GE's energy conservation efforts since 1973 have produced substantial savings both in fuels and energy resources required to manufacture products.

"This winter's natural gas shortage is a taste of things to come," warns Heddesheimer. "By so heavily emphasizing conservation in his first budget's energy proposals, President Carter indicated the extent to which the nation's power sources are dwindling. Energy conservation research got the biggest single proposed increase in the Carter energy budget and nearly doubled [to $318 million] the amount proposed by President Ford. The Administration is now asking everyone for energy-saving ideas."

As the Company's official energy-conservation contact with such agencies as the Federal Energy Administration and the Federal Power Commission, Heddesheimer already has given the government hundreds of GE-implemented energy-saving approaches. He emphasizes that GE's conservation efforts date back to 1962—"we were one of the first companies to take such action"—and notes that in 1976 both the Department of Commerce and FEA cited GE for its "excellent energy conservation program." Dozens of other organizations—including Procter & Gamble, Colgate-Palmolive, the Virginia Public Affairs Council and Schenectady's Ellis General Hospital—have received GE counsel regarding their own fuel-saving programs.

"Energy conservation programs are with us to stay," maintains Heddesheimer. "President Carter's energy plan, promised to Congress by April 20, will doubtless seek to reduce America's energy demand through conservation and other incentives." He concludes: "General Electric can be proud that it has an energy austerity program already in place and geared to stopping waste. With our employees' diligent help, we'll find even more energy-saving opportunities."



A Steinmetz prophecy nears reality as East-West power grids join at Nebraska site.

Stegall: electricity's 'Golden Spike'

Charles Proteus Steinmetz (1865-1923) was a visionary. Working in the rosy dawn of the electrical era, this GE pioneer in electrical theory (see pages 9-11) foresaw with great clarity the all-electric home, the environmental benefits of electricity, sound movies and the shorter work week that industrial electrification would permit.

He also predicted, as early as 1921, the inevitability of a national power grid—"a network of interconnected generating and conducting systems" which would do "for the distribution of energy what the railroads in the last seventy-five years have done for the distribution of materials."

But efforts to fulfill that prophecy encountered roadblocks that might have stumped even a Steinmetz. The main problem: synchronization. Unless alternating-current power systems are perfectly synchronized, they will "fight each other," causing cascading blackouts.

Now, however, Steinmetz' vision is approaching reality—thanks to General Electric technology. Near the crossroads of Stegall, located in the wheat and sugar-beet country of Nebraska's western panhandle, the nation's first "tie" between the Eastern and Western *a*synchronous power grids has been achieved. A $13 million GE all solid-state High-Voltage DC (HVDC) intertie—engineered by Philadelphia's Switchgear and Distribution Transformer Division—is allowing power to flow between this country's Eastern and Western grid systems, unaffected by synchronization problems.

Why at Stegall? Because this is the service area of Tri-State Generation and Transmission Association, Inc.—an electricity wholesaler for 25 rural electric systems in Colorado, Nebraska and Wyoming. Tri-State's territory straddles the two grid systems, and at Stegall the two systems are closest together.

Observes Philly's Dr. Frederick J. Ellert,

Manager—HVDC Control and Advanced Engineering Operation: "The Stegall project marks an historic first step toward a unified, sophisticated power network for the U.S. Although it's now the lone East-West intertie, it can be viewed as the first achievement toward developing a high-capacity East-West grid capable of nationwide power exchanges between utilities."

Does the Stegall tie deserve such acclamatory mention? Absolutely.

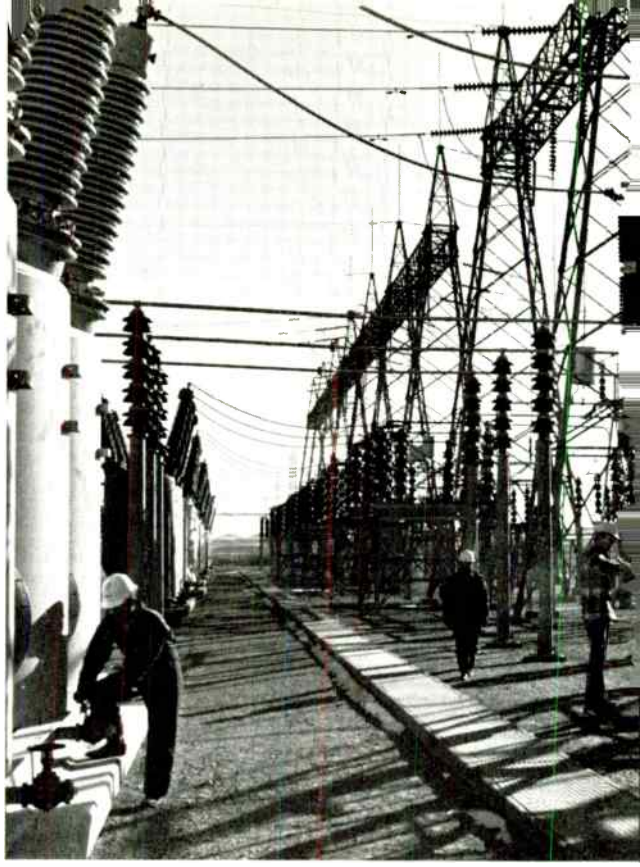
At its December 7 dedication, GE and Tri-State properly compared Stegall with the 1869 linking of the Union Pacific and Central Pacific railroads at Promontory Point, Utah, which signaled completion of the nation's first transcontinental railroad (an apt analogy, recalling Steinmetz' reference to a railroad network). Stegall is nothing less than the electrical industry's "golden spike." Many more interties of adjacent power systems such as Stegall's are now possible.

A visit to the Stegall converter substation is revealing. Steinmetz' pioneering vision can be appreciated here in Nebraska first-hand, as one looks at the two grids' towers separated by only a few hundred yards of wheatfields and a lightly traveled road. Steinmetz' pioneering vitality is also symbolized here, as Stegall sits almost squarely on the Oregon Trail, the American pioneer's arduous western pathway.

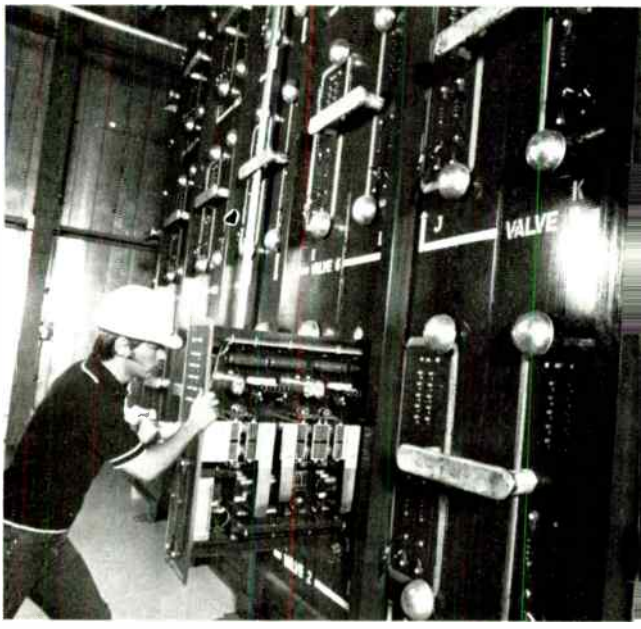
Just east of Stegall looms massive castellated Scotts Bluff—the prairie schooner's "Gibraltar of the Plains," and to the northeast flows the French fur trappers' cranky North Platte ("a mile wide and an inch deep"). To the southeast rises famous Mitchell Pass—conduit for the Oregon Trail, Pony Express, Overland Stage, and first transcontinental telegraph, and passageway for countless homesteaders, gold-seekers, ranchers and farmers on their way west.

Nebraska's pioneer spirit is still alive here and kicking. The buffalo may be gone, but antelope and other bighorn thrive. Coyotes still howl from the wintry wastes, and harsh early spring snowstorms demand an iron resolve from budding larkspur and hoarhound. This is Oglala Sioux country, and some of the area's farmers are now on the warpath over the state capital's alleged lack of attention to their western counties. Arguments quickly recede, however, before patriotic boasts about the University of Nebraska's "Big Red" football team.

The heart of Stegall's pioneering technology is the wafer-shaped, half-dollar-sized GE thyristor



In the switchyard where East meets West, the two overhead beams (upper right) represent the respective grids. Stegall can convert 110 megawatts of AC power to DC and back to AC.



Housed in air-cooled valve structures in Stegall's "valve hall," hundreds of high-powered semiconductors called thyristors operate as the core of GE's solid-state HVDC East-West intertie.

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—a high-power semiconductor that represents electricity's "golden spike." Housed in air-cooled thyristor valve structures in a "valve hall," hundreds of these thyristors operate as the core of the installation which consists of two 110-megawatt solid-state converters, each including two 25-kilovolt, 2200-ampere bridges that convert 110 megawatts of AC power to DC and then back to AC.

The Stegall system has a design availability goal greater than 99%; its solid-state HVDC equipment occupies an area one-third that required for a comparable conventional mercury-arc installation; and the equipment is cheaper and easier to install and maintain.

"The Stegall tie revolutionizes our service capability," states William E. (Bill) Mickey, Tri-State's general manager. "It bonds our member utilities together on a planned and systematic power basis and makes power exchanges routine." Using Stegall, Tri-State plans to purchase power from Basin Electric Power Cooperative, a Midwest power co-op, and then transfer that power to Tri-State's Western customers.

To be sure, the Stegall DC tie is small (110 megawatts) and doesn't signify that Steinmetz' national power network is already in place. Nor can Stegall claim to be the world's first or even largest all solid-state HVDC installation in operation. That laurel must go to the GE-equipped Eel River HVDC facility in Canada's New Brunswick province (320 megawatts), where Eastern Canada since 1972 has been linked to Labrador's plentiful hydro power, using the new HVDC technology.

For that matter, the Stegall tie also cannot claim to be this nation's most sophisticated HVDC facility. Two intraconnected Square Butte HVDC installations in Minnesota and North Dakota (*Monogram*, September/October 1975) will shortly begin a unique "mine-mouth" or "coal-by-wire" power project. Electric power generated near North Dakota lignite fields will be converted to DC and sent 456 miles via DC transmission lines to Duluth, Minn., where it will be reconverted to AC.

Nevertheless, GE's Dr. Ellert asserts that "the Stegall project represents the Continental Divide of AC transmission systems. It's the hurdle into the new land. With HVDC apparatus, utilities can now meet their emergency power needs and strengthen their reliability, while minimizing the chances of such catastrophes as the 1965 New York blackout."

Adds Dr. Ellert: "GE HVDC thyristor technology will help evolve a national power grid, whether or not a deliberate effort is made to accelerate it. Increased emphasis on utility interconnections is inevitable. Stegall is just the first step—albeit a crucial one—toward developing a large and unified national power network."

Historic crossroads

One of the first prominent landmarks glimpsed by pioneers on their way to Oregon and California, Scotts Bluff (right) looms over the North Platte Valley near Stegall, Nebraska. After weeks of monotonous sameness on the Great Plains, this martial sentinel produced inspired log book entries from westernbound travelers—some comparing the bluff to European bastions, towers, battlements, embrasures, minarets, parapets and amphitheatres. America's Bicentennial last year saw the reenactment of the pioneers' arduous western journey, as a Conestoga caravan moved through Mitchell Pass (right) and on past Stegall—site of the electrical industry's newest pioneering landmark.

Photos courtesy of Downey's Midwest Studio

Charles P. Steinmetz

Induction into Inventors Hall of Fame recalls his own estimate of his work.

When Charles Proteus Steinmetz was inducted into the U.S. Patent Office's National Inventors Hall of Fame February 6 in Washington, D.C., the ceremony provided an occasion to look back on the career of this GE "electrical wizard" and assess what he actually accomplished.

The assessment is not as simple as that of Edison, who invented the incandescent lamp, the phonograph and other objects in everyday use. Even though Steinmetz garnered some 200 patents before his death in 1923, he is remembered not so much for his tangible inventions as for his successful forays into electrical theory.

He never took the time to write his memoirs. But after his death a brief evaluation of his life's work was found among his papers. Here is Steinmetz' own estimate of his "three most important works":

• **Law of Hysteresis.** As he wrote, "When the magnetism [in an electrical motor] alternates, it consumes power. Such power consumption means loss of efficiency and heating, and it therefore is of importance to the builder of electrical apparatus to make the designs so that this loss of power by alternating magnetism (called "hysteresis") is as small as possible. However, the laws of this power loss were entirely unknown, and many engineers even doubted its existence. . . .

"I had to calculate and design an alternating-current commutator motor. I knew there would be a loss of power in the alternating magnetism of the motor, and I wished to calculate this hysteresis loss to get the efficiency of the motor.

"I therefore looked through the literature and found two tables of hysteresis loss given, one by Ewing in his book on magnetism, and one by Kapp in his little book on alternating currents. Unfortunately, the two tables very much disagreed with each other, and the curves given by the tables differed in shape from each other.

"I then studied both tables and found that Kapp's table must contain a typographical error. From Ewing's table of hysteresis losses, however, I

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At the ceremony, Steinmetz' adopted great-grandson Joseph S. Hayden, Jr. (left) accepted the Inventors Hall of Fame plaque.

derived mathematically a law, the 'Law of Hysteresis', showing how the hysteresis loss increases with the increase of magnetization; roughly, it is that every time the magnetization doubles, the hysteresis loss trebles."

The result of Steinmetz' discovery? Engineers for the first time could calculate how much magnetizing current machines could carry, so they could be designed to produce as much power as possible. This revolutionary finding helped to open the floodgates for AC machinery, as evidenced by the countless AC apparatus and appliances used today.

• **Formula for AC.** Steinmetz' law also led the inventor toward his second achievement – developing a way to compute numerical solutions for AC problems.

Recalled Steinmetz: "There was no difficulty in making calculations with the direct current; it had a direction and a value, which could be measured by an ammeter, and calculations made with it. But the alternating current had no value and no direction, its value continuously changed, and so the direction; and in all calculations with alternating current, instead of a simple mechanical value of the direct current theory, the investigator had to use a complicated function of time. . . .

"The idea therefore suggested itself to represent the alternating current by a single complex number or 'general number,' as it is better called. This proved the solution of the problem of alternating current calculation."

By applying complex numbers to AC, engineers at last could predict the exact behavior of AC circuits. Steinmetz made AC calculations almost as simple as DC calculations, thus speeding machinery designs.

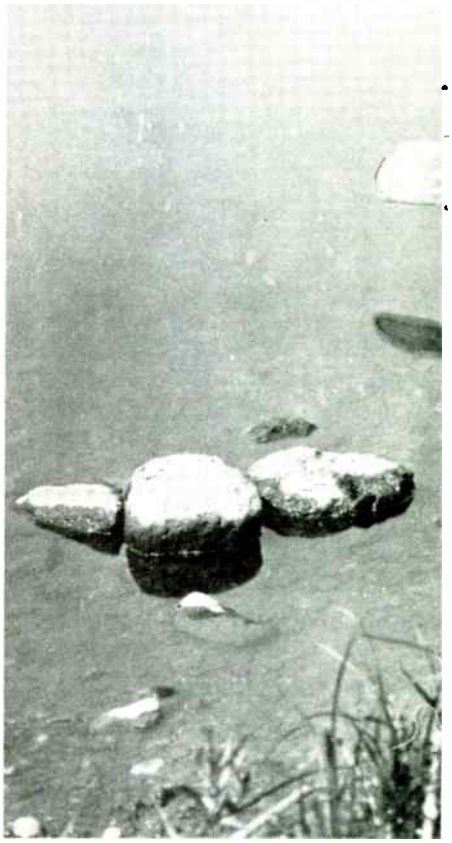
• **Theory of Transients.** With the advent of high-voltage AC transmission, Steinmetz foresaw lightning problems as AC transmission lines crisscrossed the country. He noted: "For many years the great problem, which delayed the further successful development of electrical engineering, was that of the protection from lightning. . . .

"This led to the investigation on transient phenomena [abnormal electrical discharges]. . . . It was very soon found that while lightning may have been the criminal which started the trouble in the electric system, the damage and destruction was not done by lightning, but by the electric machine power back of the circuit, which was let loose and got out of control."

Steinmetz' famous "lightning" generator reproduced these electrical transient effects and helped him simulate the electric circuit's general behavior—thus allowing further development of high-powered transmission systems.

In his 1923 *Monogram* eulogy to Steinmetz, former GE President E. W. Rice, Jr. credited Steinmetz' mathematics with bringing "order out of chaos" and assuring GE's success as the U.S.'s leading AC electrical-apparatus supplier.

Wrote Rice: "He was a prolific inventor, a skilled mathematician, a trained engineer and an inspiring teacher. . . . During his short life, he rendered services of the most conspicuous character and inestimable value." GE



Steinmetz was one of the few who understood Einstein's $E = mc^2$.

At his Viele's Creek camp near Schenectady, Steinmetz spent many hours working in his canoe.

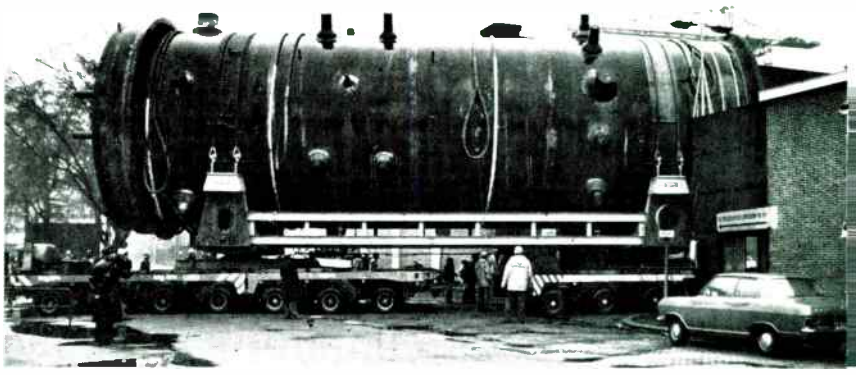
Steinmetz and his cigar were inseparable, and he repeatedly ignored anti-smoking decrees.

Not quite 20 years his senior, Edison enjoyed meeting with Steinmetz to discuss electrical wizardry.

Monographs

Tight fit. When Spain's Cofrentes nuclear power plant enters service about 1980, it will be the largest GE nuclear plant in Europe (nearly one million kilowatts), and also will be Europe's first BWR/6.

But moving the mountainous 700-ton pressure vessel recently from the Netherlands to Spain required extra-special handling. At Spain's port of Alicante, for instance, the vessel had to be offloaded two inches at a time, so the ship's ballast could be shifted to prevent the stern from rising like a cork.



Transporting the vessel overland to Cofrentes 90 miles away was not simple either. Parts of the road were precipitous, winding and narrow. The vessel had to be pulled by two 700-hp diesel tractors while being pushed by a third. Maximum speed: 10 mph.

Photo courtesy of Hayward Daily Review

She's a sarge. Not only is a policewoman not a handicap on a police force, she's a definite asset, maintains Sgt. Edwina Parsons of the Hayward (Calif.) Police Department. Her husband is Fred W. Parsons, Jr., a metallurgist for Fast Breeder Reactor Products Department in San Jose.

States Sgt. Parsons: "In my 20 years of police work, I've had to learn to talk my way out of potential violence. I once arrested a big cowboy for drunkenness who 'yes ma'amed' me all the way to the station. Another big guy said 'Just don't tickle me' when I started searching him."

What's been the effect of Mrs. Parsons' career on the couple's family life? Observes husband Fred: "I'll admit I worry about her. She's occasionally involved in riots and brawls, and she's now on the street supervising 15 other patrol officers on the midnight shift." But ask her to stop? No. "She wants to develop her own career, and she's entitled."

Emergency! CB radio does a lot more than keep track of police cars. When Indiana's January blizzard struck, Ft. Wayne GE's Paul High and Mark Polloni manned their CB stations and answered numerous calls for help.

Recalls High: "Our emergency radio teams stayed on call 24 hours a day. We rescued motorists with four-wheelers; rushed a kidney patient to the hospital; delivered needed insulin by snowmobile; and made several pregnancy runs. Needy people were supplied food. People who ran out of fuel were evacuated."

The team's quick reaction to the paralyzing snow was not lost on a local Indiana sheriff. He's now providing the CBers with a permanent base station.

To the rescue. When the Explorers Club of Pittsburgh arrived in Peru last July to climb the Andes' 20,900-foot Nevado Huandoy, club members learned of several recent climbing accidents. Two American climbers had already been killed, and two others were missing. Would the club assist in a rescue mission?

Armed with the Mobile Radio Products Department's two-way radios, club members

quickly mounted a grueling five-day expedition that rescued the fatigued Americans. Commented the club's Jay M. Hellman: "GE's radios helped make important logistical decisions affecting movement of personnel, food and necessary climbing gear. Our climbers talked to one another in a straight line for up to 15 miles."

Did the club finally conquer its Andean summit? Yes—but only after losing more than $3500 worth of its alpine gear to Peru's version of Bonnie and Clyde.

Honors: In a salute to GE as Kentucky's largest employer, the Louisville Area Chamber of Commerce at its annual meeting in January displayed 20 exhibits depicting GE's worldwide technology. Keynote speaker for the meeting was

Stanley C. Gault, VP and Sector Executive of Consumer Products and Services Sector.

• Employees of GE's Miniature Lamp Products Department were presented with Sears, Roebuck and Co.'s "Symbol of Excellence" award during recent ceremonies at Nela Park. The award is based on quality of merchandise, new product development and delivery performance.

• San Jose's Irradiation Processing Product Operation received the National Safety Council's Award of Honor February 2 in recognition of five million man-hours worked without a lost-time accident (a nine-year achievement).

• For the fifth consecutive year, the General Electric Credit Corporation has been honored with the mobile home industry's top financial awards. On hand to receive the 1976 "Lending Institution of the Year" award and "Leader of the Year" award were GECC's Augie A. Strandberg and William J. Ehlers. John M. Martin, Manufactured Housing Institute president, presented the plaques at the recent MHI-sponsored National Mobile Home Show in Louisville.

• John E. Corr, a consulting engineer in the Nuclear Energy Systems Division, has been elected a Fellow of the American Society of Mechanical Engineers. Elevation to this prestigious position came January 13 during an ASME section meeting in San Jose.

• Donald D. Scarff, VP—Atlantic Regional Relations, has been elected to his second term as Chairman of the Board of the Pennsylvania Chamber of Commerce. Scarff has been a director of the state Chamber since 1971.

Truly a winner. What do you do if you win the Illinois State Lottery? For Wheaton, Ill.'s Mrs. Faith Monson, the answer was elementary. She'd already decided that if her fantasy came true, it was off to Fantasyland itself with two children "who need to see the world is pretty."

The kids selected? Patty and Joanie Riley, both afflicted with Frederick's ataxia, a crippling disease. Making the Walt Disney World trip a little more special was GE's Carousel of Progress, which arranged for tickets, lunch, a VIP tour, and photos with several Disney characters.

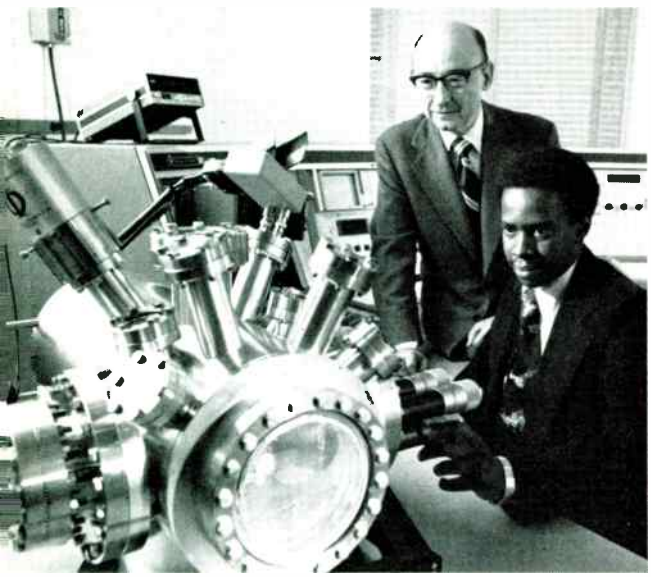
A billion in R&D

GE is not only spending more on technology; it also has programs to spend each dollar smarter.

Among the plenitude of figures disclosed by the GE 1976 Annual Report, one that merits underscoring is this: in 1976, for the first time in GE history, the Company's investment in research and development topped $1 billion.

The published total: $1075 million, including $412 million that was Company-funded and $663 million performed under contract, primarily for U.S. government agencies. All three figures were up significantly from the comparable totals for 1975, with the increase in GE-funded research up by $55 million.

It's not surprising that these increases receive an approving nod from the Company's VP for Research and Development, Dr. Arthur M. Bueche. Concerned about trends that show the U.S. spending proportionately less on R&D while other industrial nations are spending more, Bueche has been one of the strongest advocates for increased R&D support by the U.S. as a whole as well as by General Electric.



VP Bueche watches Dr. Frederick Bacon, physical chemist at the R&D Center, operate an electron spectrometer.

"Our advocacy," Bueche says, "isn't just a case of R&D empire-building; it's based on the fundamental fact that economic success and growth for the U.S. depend on technological leadership. If we don't offer customers the best, they'll buy from somebody else. And the world is now full of 'somebody elses' just waiting for the chance to take over."

Art Bueche and his associates aren't content, however, with merely seeking more support for R&D. They're also developing programs whose purpose is, in effect, to spend each GE R&D dollar smarter.

For the Research and Development Center, these efforts begin at home. Says Bueche: "One of the steps we've taken is to define more clearly for ourselves and the rest of the Company just what it is we do at the R&D Center. We've developed a set of four words as quickly understandable descriptions of the spectrum of our activities":

Search—looking for new ideas and information as exemplified by GE work in the new field of amorphous metals, new approaches to solar energy, and unique ideas for sophisticated diagnosis of cancer and heart disease.

Focus—turning special research attention on those areas that seem to have greatest potential for GE business. Examples include new ideas for more efficient combustion processes, improved display systems, new plastics and new mathematics for improved computer software.

Demonstrate—showing that new ideas can really be made to work. The Center expects to demonstrate, as an instance, that turbine buckets and engine blades *can* be made from

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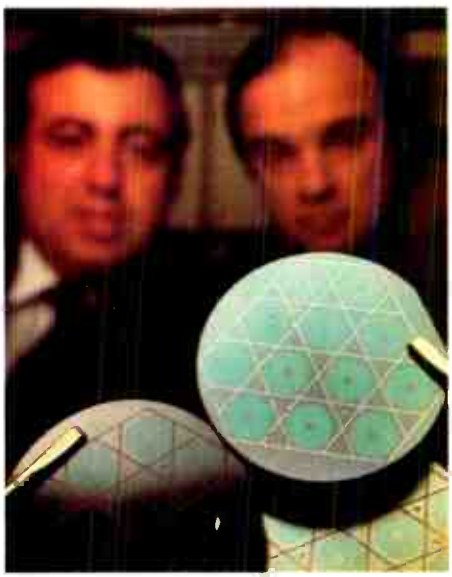
Three facets of Corporate R&D



Principal ways in which the General Electric Research and Development Center seeks to do the longer-range, farther-out research that is GE's "insurance policy for the future" are illustrated here. Left: research funded by General Electric, exemplified by work on thermomigration, a technique that reduces the time required to fabricate a semiconductor device by as much as a thousandfold. Above: research performed partially under contract for government and industrial customers—work on the ultra-high-temperature gas turbine that can operate at higher temperatures, and hence at higher efficiencies. Right: prototype development of advanced electronic circuits at the Integrated Circuits Center in Syracuse, one of six Corporate-level Technology Applications Operations in the U.S. which Corporate R&D sponsors and helps support.

exotic new materials such as eutectics, composites and special ceramics.

Business—the actual job of technology transfer, working hand-in-glove with operations to make the transition from laboratory to product and profit, as in the use of more sophisticated electronics in GE appliances and the actual building of the first GE computerized tomography units.

In another important step, the R&D Center has supplemented its work by sponsoring specialized centers, called Technology Applications Operations, for meeting specific development needs. Typical is the Integrated Circuits Center in Syracuse, N.Y., which produces wholly new circuits needed in GE product designs. Specialized aid is provided by the Solid State Power, Computer Aided Design, Plastics Applications and Electronics Applications Centers, as well as by the Special Purpose Computer Center, which is under the aegis of the Industrial and Power Delivery Group.

Some 90% of GE's total R&D, however, is being done by operating components. Corporate R&D sees it as critically important to make the most of the work done in the 100-plus laboratories and many engineering organizations associated with product operations.

"Again, we have a program," Bueche says. "We identify and designate 'Centers of Research' in GE operations. These centers are groups with special skills and facilities which have been judged to be highly useful not only to their own operations but also to other parts of the Company."

Corporate R&D has identified 34 Centers of Research. At Louisville, for example, the Major Appliance Applied Research and Engineering Division includes five Centers, covering a span of special expertise from coatings, finishes and adhesives to structural plastics and elastomer applications. Says Bueche: "These research teams support appliance operations directly, but indirectly they have proved extremely helpful to other parts of the Company."

The ultimate objective, Bueche sums up, is synergism—to make the whole greater than the sum of the component parts. "If we're to make the most of that billion in R&D, we all have to be aware of our strengths and use them, wherever they may be located. The results of how well we do this will play a big part in determining what kind of a future GE will have."

Louisville's Structural Plastics and Elastomer Applications Center has active projects with many GE departments, helping them develop new plastics tailored to their needs.

Schenectady's Materials and Processes Laboratory includes three Centers of Research, including work on high-voltage insulation systems such as this developmental strand insulation.

Pittsfield's High-Voltage and Dielectric Material Systems Center has been investigating electrical phenomena at AC transmission voltages up to 1½-million volts.

'Centers of Research'

To make broader use of the great technical strengths in GE operations, Corporate R&D has designated 34 "Centers of Research" offering special skills and facilities to other components. Pictured here are six examples.

Gainesville, Florida's Battery Business Department's Advanced Engineering Laboratory offers applied research expertise in working with chemical reactions inside porous metal structures.

Valley Forge's Microwave Communications Center offers special abilities in high-frequency communications systems. Shown: big wave-guide antenna used in receiving satellite transmissions.

Auburn, N.Y.: work on experimental medium-current thyristor wafers is indicative of special skills in electronics technology offered by Semiconductor Products' technical staff.

An office building in the Amsterdam suburb of Amstelveen, above, is a nerve center full of computers, below, intricately hooked by satellite and cable to similar rooms in the U.S. The site is Information Services Business Division's first European Supercenter.

The GE connection

Information Services' computer network broadens reach with new European Supercenter

A businessman sits at a computer terminal in Cleveland preparing a financial report. If he were asked, he would probably surmise that the computer power he was using was coming from one of the units located in GE's Supercenter in nearby Brook Park. At that precise moment, however, he might well be wrong, because the central processor handling his work might not even be in the U.S.—it could well be in the Netherlands.

This example is just one indicator of the earth-girdling computer service system that has been put in place by General Electric's Information Services Business Division.

No one else has put together anything like GE's network. Using it, ISBD customers can gain almost instant access to their data files from almost 450 U.S. cities and more than 90 international cities in 20 countries.

The new Supercenter just opening in the suburbs of Amsterdam was installed primarily to meet Europe's increasingly sophisticated service needs. But it blends into ISBD's MARK III® service network as though it were located next door to Brook Park or ISBD's other Supercenter in Rockville, Md.

"Now that the Amsterdam center is up and running," says Information Services' International Department General Manager Paul R. Leadley, "not only might a London user be using computer power from the States when he dials GE's number in London, but a San Francisco user could well be using computer power from Amsterdam to plot his sales chart."

The new, better "load-balanced" network remains totally integrated because of a piece of electronic architecture ISBD calls Cluster System technology, another ISBD quantum jump in sophistication.

The Cluster System allows multiple central processors—the big computers—to access multiple file systems simultaneously. The effect: a truly impressive homogeneity in which physical location of the giant machines makes no real difference to the user. To him, it's all one big system dispensing computer power.

The continuing drive for a technologically mature global network, says Vice President and Division General Manager Dr. George J. Feeney, is a reflection of the needs of ISBD's more than 5000 worldwide customers—they're doing increasingly sophisticated things on the network and they're increasingly international. About 1000 of them are already making multi-country use of the network. The Rockville classrooms in ISBD's International Training Center include many international faces as overseas customers with unusual applications upgrade their use of the network.

Some big customers put together their own hybrid computer network, letting their central computers "talk to" the MARK III system. The Coca-Cola Company of Atlanta, Georgia, for instance, has harnessed its own computers and GE's service together to give management the global reach they need to do specialized inventory reports, financial consolidation and reporting on demand and scheduling.

Dr. Thomas A. Vanderslice, Vice President and Group

(continued next page)

Executive, Special Systems and Products Group, sums up ISBD's accomplishments so far: "Less than 12 years after remote computing was commercially introduced by General Electric, it is now an industry approaching one billion dollars in sales and still growing faster than the computer market itself. Our own Information Services Business continues to be the leader in that industry and a good example, we think, of GE foresight, innovation and assertiveness in the mushrooming services industry."

The network at work

Some of the fastest growing types of applications on the network are represented in the following update on what several good ISBD customers are doing with GE's increasingly sophisticated service these days:

Business from GE components, a vital backbone during ISBD's formative years, today continues to be representative of the greatly expanded MARK III service customer base. GE Information Services has helped

move the Components Sales Department, for instance, from the manual era of order-taking, in which it was facing an avalanche of paper, to a position of fast-service superiority over any other multi-line component manufacturer.

CSD is GE's pooled sales organization selling 86,000 different electrical and electronic components from 30 GE departments to thousands of OEMs and distributors. Since ISBD and CSD initiated this order service system in 1973, more than 85% of CSD's order volume has been converted from the paperwork mode to simple computer-terminal entries. The entries are made from 42 CSD locations in the U.S., including the Ft. Wayne, Ind. headquarters site, left, manned by CSD's General Manager Donald D. Barlow, Joseph L. McAleavey and Rodney L. Everhart. That means that the equivalent of 260,000 documents, such as sales orders, are entered yearly into CSD's network file, where they are instantly retrievable for order filling by CSD's product department clients. The average transit time before MARK III service: three days.

Marine Midland Bank has been using the MARK III network to keep pace with the volatile fluctuations in international currency rates. Since 1971, these have caused many international institutions to lose millions of dollars in a

single day. The International Treasury Management Division of Marine Midland Bank has developed a program they call MARINFO, based in London. The bank's offices in both New York and London update a constantly accurate MARINFO file of the latest figures in the European money markets.

ISBD government accounts include the U.S. Maritime Administration, whose sampling

ships gather vast amounts of data each winter on the encroaching ice conditions in the Great Lakes.

When ports are closed and the shipping season is shortened, millions of dollars in commerce are lost. MARAD can't control the ice but, by putting all the fresh data on the MARK III system, this government agency has made analyses available to hundreds of designers, financial planners and shippers, who use the network to evaluate alternatives, foresee delays accurately and plan for crew and cargo.

1. Charles D. Riley

2. William N. Aswad

3. Dr. Elmore M. Kennedy, Jr.

4. Richard W. Richardson

5. Carlos P. Vasquez

1977's Phillippe Award winners:

Five who made a difference

1. Counseling troubled teenagers in New Hampshire has been a major project for process control analyst Charles D. Riley, Aircraft Engine Business Group, who has established a nonprofit coffeehouse, the Doorway Inn. Drawing on his own prison experience as a youth, Riley also counsels inmates at Concord State Prison, to help them return to society.

2. Lobbying for a handicapped children's pediatric convalescent unit in Vermont, Armament Systems Products Department's William N. Aswad, manager of Manufacturing Engineering, successfully appealed to two committees of the state legislature. As president of the Vermont Achievement Center, Aswad has won support for other education and therapy programs throughout the state.

3. Assisting the peaceful integration of Detroit's schools, Carboloy Systems Business Department's Dr. Elmore M. Kennedy, Jr., manager of Product Engineering, served as vice president of the Coalition for Peaceful Integration. Kennedy also started and managed the GE-cosponsored Expo-Tech/Michigan project which promoted technical careers for minority students.

4. Seeking foster homes for Boston's disadvantaged children led aircraft parts manager Richard W. Richardson, Aircraft Engine Business Group, to become president of the United Homes for Children, Inc. Richardson also has set up a job-training program for the city's hard-core unemployed, and created an inner-city rehabilitation program which has improved housing and produced new minority businesses.

5. Improving educational opportunities for San Jose's Spanish-speaking people, project analyst Carlos P. Vasquez, Boiling Water Reactor Projects Department, helped form the San Jose Area Bilingual Consortium, which has received a $1 million federal grant covering ten school districts. Vasquez also has chaired a parent advisory committee to promote a school bilingual program.

'Open staffing' takes hold

GE's exempt employees are experiencing a new approach to career promotions. Termed "open staffing" in most locations, the new system of identifying job candidates has been spreading for several years, and is already familiar to GE's hourly and most non-exempts.

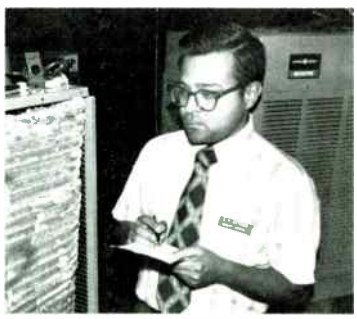
Define open staffing? Briefly, when there's a job opening, its description is advertised on bulletin boards or in plant publications for all to see. Then interested employees nominate themselves; professional relations personnel screen out candidates who lack qualifications; and the hiring manager conducts interviews using a wider slate

Samuel M. Byrd
Foreman - Inspection
Lynn Quality Operations
Lynn, Massachusetts

I came to GE in 1972 as a non-exempt employee. I liked my last job—I was an industrial x-ray technician for Aircraft Engine Business Group—but my friends have recently been finding jobs through open posting, and last fall I began to ask myself, "Why not me, too?" So I self-nominated for two exempt supervisory jobs at the same time—and got a dual offer!

Needless to say, the program has worked for me. I've now got more of a stake in things—I'm a foreman responsible for 18 people who inspect jet engines during manufacture—and I feel compelled to broaden my education. For instance, I'm planning to enter Northeastern University shortly to begin work on a B.S. in business administration.

About self-nomination—at worst, you won't get the job and nothing's changed. But perhaps you'll be just what a manager's looking for—in which case, you're both winners. My own advice to anyone who has been hesitant is not to be afraid to take a chance. You never know what might develop.



Shreedhara V. Ramarathnam
Manager - Quality Control Engineering
Central Air Conditioning Business Department
Tyler, Texas

I've been with GE 10 years, always as a quality control engineer. GE's professional relations people always advised me to go where my strengths are, so last November I self-nominated for my present job. It was a lateral move—I had the same title with Home Laundry Products Division in Chicago.

I'm happy. Getting used to Texas' vast expanses was a little difficult—my wife and I are both from Madras, India, and are used to big cities—but I'm enjoying my new involvement with GE's Weathertron® heat pump. I can't help but like open staffing—I wouldn't have heard about my new position without it.

The best thing about self-nomination is—it makes you career-conscious and not just job-conscious. You have more say-so over your career timing—you're a free agent. It's more democratic—I'm sure its popularity will rise as managers learn they can uncover unsuspected, qualified candidates.

Elaine A. Clark
Specialist - Computer Data Control
Aerospace Electronic Systems Products Department
Utica, New York

I'd been an 8th grade English teacher ten years when I joined GE in 1975 as a computer support clerk. "Stymied" is a good word to describe how I felt teaching, so when the computer field opened up, I jumped. I'm probably one of the few employees to use open staffing three times—I came in under the program; after just three weeks on night shift, successfully nominated myself for computer production support planner; and last April self-nominated for my first exempt position.

Choosing a job instead of always being chosen—I like it. It adds a touch of adventure, and offers the possibility of job diversity and advancement. Gail Sheehy's recent book *Passages* says lots of people have mid-life crises where they wish to change careers.

Maybe the best thing about the program is—it opens doors to you. You can speak out. It gives you a running start on jobs and weeds out job-description misunderstandings.

than otherwise probable. Constructive feedback to unsuccessful applicants is heavily stressed. (Some components use a modified version in which employees self-nominate in advance of an actual opening.)

What's been employees' reaction to the new system? Here are four "case histories."

John P. DeMarchi
Mining Tools Sales Representative
Carboloy Systems Business Department
Mt. Pleasant, Pennsylvania

I'd been with GE 13 years—six years as a Carboloy production foreman—when I successfully nominated myself last year for a sales job. This meant not only a new job—but new everything. We moved from a city to country environment; I had to start creating sales opportunities for myself; and I no longer was a boss.

To be perfectly frank, my family was wary of the move, though no longer. Open staffing accomplished what my CMMD-2 form had been hinting at for several years—a desire to sell. My new job has opened up a whole new field of opportunity for me—it's challenging and fun. We've got a four-acre farm now; have switched from two cars to two palomino horses and one car; and have built a barn and are raising chickens. Our children love it.

My advice to other GEers is know your desires and capabilities and then act on them. Self-nomination places the primary responsibility for your career on yourself.

Organization Changes

CORPORATE

Richard W. Roberts, Staff Executive—newly established Corporate Technology Studies

COMPONENTS AND MATERIALS GROUP

Edwin F. Phelps, Jr., General Manager—Laminated and Insulating Materials Business Department

CONSUMER PRODUCTS AND SERVICES SECTOR

Van W. Williams, VP and General Manager—Major Appliance Product Management Division

James W. Cherol, General Manager—Home Laundry Product Management

Robert E. Fowler, Jr., General Manager—Major Appliance Manufacturing Division

Richard T. Gralton, General Manager—newly established Major Appliance Marketing Operations

Walter W. Williams, General Manager—Audio Electronics Products Department

William R. Webber, Manager—Consumer Products and Services Strategic Planning and Review Operation

INDUSTRIAL AND POWER DELIVERY GROUP

Andrew Glassanos, Manager—Large Transformer Strategic Planning Operation

INTERNATIONAL AND CANADIAN GROUP

James R. Birle, General Manager—Far East Business Division

Robert F. Smith, Manager—International Strategic Planning and Review Operation

POWER GENERATION BUSINESS GROUP

William A. Northrop, General Manager—Machinery Apparatus Operation

Aguirre power station on Puerto Rico's south shore, above, is representative of the opportunities for GE combined-cycle gas turbine and steam turbine generation plants offshore. Built under GE project management, the system first provided quick power through eight "Frame 7" gas turbines powered by distillate oil. The rest of the system now being completed, left, adds high fuel efficiency through eight exhaust-heat recovery steam generators connected to two steam turbine-generators. The project's final contribution: an almost 15% boost to Puerto Rico's power generation capacity.

Project Manager Champion, far right, and James M. O'Gara, Site Project Manager, meet on the site of the project they coordinate for International Projects Department on this Caribbean island.

STAG power overseas

The variables are lined up in favor of GE's hybrid power plants in developing countries

In such diverse corners of the world as Puerto Rico and the Republic of Korea, GE combined steam and gas turbine power plants—STAG plants, in GE parlance—are finding a ready market these days. The $146 million contract won from Korea Electric Company early this year is just the latest example of the unique confluence of needs and product suitability which is now spurring international demand for this innovative GE product. The Korea order also happens to be the largest order ever for GE STAG plants and includes two entire power plants plus complete project management.

One reason for the demand: countries with fast-growing infrastructures need extra electric power on a faster timetable than the average "stateside" utility. Several of the MS-7000 gas turbines in the two 320-megawatt South Korean plants will be producing power in 1977, within a year after they were ordered.

Another benefit: these same countries, with limited energy resources, want a plant which uses fuel efficiently. GE STAG plants take the waste heat energy in the 1000-degree F. exhaust stream of the gas turbines—which produce about two-thirds of a STAG plant's power—and use the waste heat to generate steam. The steam is piped to steam turbine-generators to make the other one-third of the power. In Korea, construction of steam turbine-generators at the two sites—Kunsan and Yongwol—will follow by a year the initial fast completion of the gas turbines and raise the thermal efficiency of the plants to high levels, by power generation industry standards. And the Greenville-produced heavy-duty gas turbines can be run on a variety of petroleum fuels.

But marketing these large systems to developing countries requires more than a contract signature and a shipping date. Months of work with the utility customer and potential local partners precede any signing. And then many of the plants are GE-built from the ground up under the supervision of International Projects Department. The essentially-completed 600-megawatt STAG project at Aguirre, Puerto Rico, illustrates the necessity and challenge of doing it this way. "We took the full responsibility for this multi-million-dollar project ourselves simply because the customer wanted us to," says project manager Malcolm L. Champion, Jr. "They wanted more than the equipment—they wanted our management and technical expertise too. Yet, at the same time we have been able to use Puerto Rican suppliers."

With 27 GE STAG systems in place or on order in the U.S. and around the world, will the demand for these compact power generation systems overseas continue to build? "I think so," says Frank D. Kittredge, manager of Electric Utility Sales Operation for International Sales Division. "In many high-growth lesser-developed countries, power generation requirements are growing by 10-20% per year. There's a continuing need for rapidly installed yet efficient power plants so necessary to sustain their industrial growth rates."

Progress, Utah style

The President of GE's new subsidiary discusses new growth ventures in three different corners of the world.

Utah International's President Alexander M. ("Bud") Wilson has been involved in the development of every major mining project for Utah since 1954, when he joined the Company. At that time Utah owned three small mines. Now there are 16 major facilities which have achieved an orders backlog of more than $5.8 billion. More than any other part of his work, Wilson told his visitor, he has enjoyed seeing desolate and unusable tracts of land transformed into economic contributors.

GEers are familiar with the growth ventures of General Electric—in new directions of medical technology, information services, engineering plastics and the like. But what about growth ventures for the new member of the GE family, Utah International Inc? For answers, the *Monogram* interviewed Utah President Alexander M. Wilson in his office in San Francisco's financial district.

MONOGRAM: First, how important are new ventures to Utah?

WILSON: Right away, in answering that question, you notice the difference between the manufacturing business and the natural resources business. At Utah, we're constantly depleting our mineral assets. So new ventures are essential, not optional. They represent all of tomorrow's business.

MONOGRAM: What new ventures would you single out as most essential?

WILSON: While we're constantly engaged in mineral exploration and in analyzing new possibilities, I could single out three ventures right now as being especially important to our long-term growth—one each in iron ore, steam coal and coking coal.

MONOGRAM: What's the venture in iron ore?

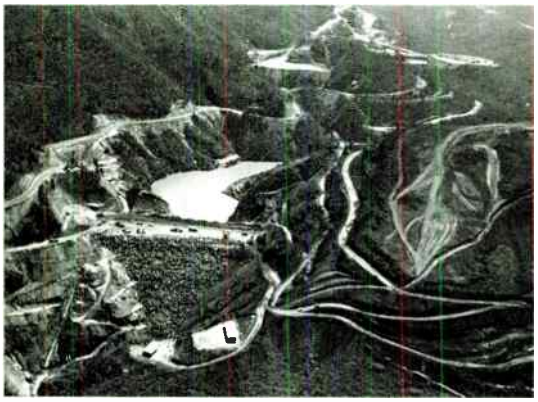
WILSON: It's the Brazilian project called Samarco Mineração, which has become what a technical journal has called "one of the most innovative and imaginative mining projects in the world."

It involves mining large amounts of iron ore near Belo Horizonte, Brazil, transporting it through a unique 246-mile slurry pipeline to the Brazilian coast, into a pelletizing plant and onto ships at a deepwater port called Point Ubu.

The significance of this project lies in its access to very large amounts of iron ore. The scope is difficult to understand until you see the size of the project, carved out of the brush from scratch, but here's some perspective. Samarco's concessions and reserves amount to more than 300 million tons of this iron ore, which looks like consolidated gray-blue sand. We will ship about seven million tons a year to customers in Europe, the United States and Japan, and the pipeline is sized for future expansion.

There has been considerable interest in the pipeline, which is the longest iron slurry pipeline in the world. One of the business advantages of this pipeline during the estimated 25-year life of this project will be the relatively stable transportation costs.

I should note for the record—Utah International owns 49% of Samarco and we furnish them technical guidance and management expertise. Samarco has its own strong and independent management. Our 51% partner is S.A. Mineração da Trinidade (Samitri).



Utah's Samarco project: iron ore this year.

MONOGRAM: How about the newest domestic steam coal project?

WILSON: That's our Craig mine project in the mountains of Colorado—a project that illustrates the importance of timing in the mining business. We've held the coal rights to the Craig mine area for some 20 years—just as we are now holding the coal rights to other areas where coal and water for power generation are available together. But it wasn't until recently that the right factors came together to make it profitable to start operations at Craig. Plans for two new generating units operated by the Colorado-Ute REA made the development of the coal attractive.

This will be 'mine-mouth generating,' a familiar concept to many GE people, I'm sure, and a concept we helped pioneer in the West. The Craig project will supply the utilities with 2.1 million tons of coal per year. Our biggest mine-mouth generating supply contract, of course, is on the Navajo Indian Reservation in New Mexico, where we supply about seven million tons per year to five generating units.

As always, our environmental quality department did a lot of preliminary surveying and planning before we settled on a final mine plan. One of our challenges is to create an environment that will attract the elk away from the mining area until the restoration is complete—with the hope that the elk will stay in the neighborhood. We will regrade and restore the land after the resources are removed, of course.

MONOGRAM: Could you describe the large coking coal project?

WILSON: Large as it is, Norwich Park is simply the latest—the fifth—in a series of mines we've opened in an area of Queensland, Australia that has become very important to us. This 170-mile-long string of coal deposits we delineated and pioneered in 1969 has turned out to be the largest new metallurgical coal field opened in this century. The State of Queensland has already given us permission to export up to 650 million tons of coal from the area. There is still a lot more there.

When we first visited this area, called the Bowen Basin, we found one town—Blackwater—which consisted of twelve houses, a school and a pub, as I recall. Now there are 175 miles of new railroad to get the coal to the coast, four mines, a sophisticated deepwater port, a greatly expanded town of Blackwater and two entirely new towns containing 2600 Utah families. Putting it another way—in just ten years Utah has become one of the largest independent coking coal producers in the world.

Our Australian subsidiary, Utah Development Company, owns a large majority interest in Norwich Park and the other mines. Minority interests are held by Mitsubishi Development Pty., Ltd., and by Australian interests.

Perhaps two years from now we'll see the first coal from the Norwich Park mine.

MONOGRAM: What do you think the GE-Utah merger can contribute to all this?

WILSON: The blending of GE and Utah skills is going to have many benefits for us. Here's one, for instance: we expect to enhance the performance and reliability of our heavy equipment using GE technical skills. Informal coordination has already started in that direction.

The exchange illustrates the complementary nature of our businesses. GE's success depends heavily on its technology, whereas Utah can adapt that same technology for maximum efficiency in its businesses.

Utah's primary success, on the other hand, continues to depend on finding and controlling natural resources in projects like Samarco, Craig and Norwich Park. I think GE can be proud to be engaged in the natural resources business which contributes the raw material without which we couldn't enjoy the kind of life we have today.

What's new

40-channel CB

Seventeen additional channels are included on Housewares and Audio Business Division's seven new CB rigs, introduced January 1 following FCC okay of 40-channel use. Sportscaster Howard Cosell is GE's spokesman for the new CB line.

Smoke detector–another save

Thanks to HABD's Home Sentry® smoke alarm, Hickory, N.C.'s Mr. and Mrs. Robert A. Branflick still have a home. Employed by Distribution Transformer Business Department, Bob Branflick awakened last December 17 to a telling squawk, and raced to his kitchen where he smothered a table-top fire ignited by a Christmas candle.

When the power fails

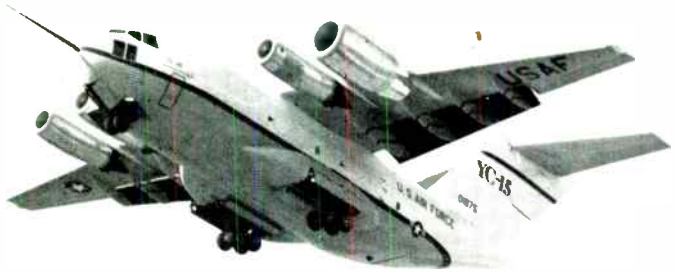
No one's left in the dark if his home is equipped with HABD's new Home Sentry® security light, which automatically comes on when power failures occur. With the switch set at "auto," the light charges from household current, and it may also be used as a portable flashlight.

Weather radio

National Weather Service broadcasts can be received on several of HABD's new radios, and even some of its cassette recorders have this feature. GE's "Super 7" multi-band radio above is pretuned to the VHF Public Service (hi) band frequency and receives local weather forecasts.

Coffee when you want it

Coffee that's ready when you are is now possible with HABD's new Coffeematic® Brew Starter automatic drip coffeemaker. The Brew Starter, including a clock and 12-hour timer, can brew two-to-ten cups of coffee automatically, eliminating the wait for that first cup in the morning.



Take-off for a new jet

The result of more than five years of development, the 22,000-pound thrust class CFM56 jet engine flew for the first time February 16 on the left outboard position of a military transport prototype plane. The engine was developed jointly by Aircraft Engine Business Group and France's largest engine manufacturer, SNECMA.

Roof-bolting resin capsule

Making underground mine ceilings safer is being accomplished with the Carboloy Systems Business Department's new resin capsule. By resin-bonding a mine's roof bolts to overhead rock strata (instead of merely bolting mechanically), mines are made much safer—and this process also saves the time and money required to recheck mechanical bolts.

Portable fluorescent

Ready to plug in and light, the Lamp Business Division's new Bright Stik™ 33-watt fluorescent light eliminates the need for separate fixtures and special wiring. The self-contained unit produces as much light as a 50-watt bulb and lasts five times as long.

Sealed battery

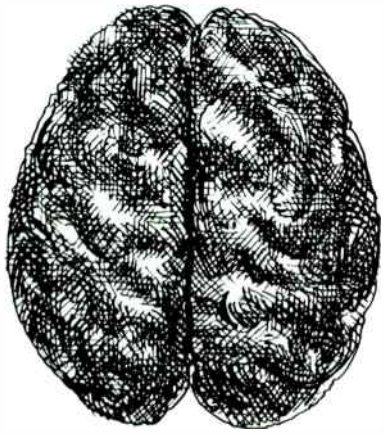
Not just another rechargeable battery, the Battery Business Department's new sealed lead-acid "D" cell offers a high discharge rate, and costs substantially less than traditional rechargeable batteries. Six and 12-volt models are available.

Fast data transfer

The newest companion to the Data Communication Products Department's successful TermiNet® teleprinter line provides quick data retrieval-and-storage capability. The free-standing TermiNet® Magnetic Tape Terminal also features editing flexibility and a 350-character-per-second search capability.

New Series locomotive

More than 70 innovations are incorporated in the Locomotive Department's New Series locomotives, resulting in lower maintenance costs and improved availability and reliability. For added safety, GE's new locomotives use Lexan® plastic side windows, and each locomotive contains an annunciator panel that identifies problem areas for servicing.



The brain: new insights

A Crotonville enthusiast is applying brain hemisphere research to business.

The workings of the brain have intrigued us for thousands of years. We wonder why some people are so very bright in some ways, but so dull in others, so capable of mastering certain mental activities but not others. Why do some creative thinkers have difficulty mastering a balance sheet? Why can't some accountants understand business strategy?

Hippocrates supplied a hint of the answer in 400 B.C.: there is a duality to our brain. It is this schism that has stimulated a growing amount of brain research that, since 1970, has amounted to an explosion of new data.

"For me, personally, this new knowledge of the brain is the most significant since $E = mc^2$," says W. E. (Ned) Herrmann, Manager—Management Education Operation at the Company's Professional Development Operation in Crotonville, New York. Herrmann has conducted a series of workshops called "Brain Updates" in which he reviews recent findings on how the brain works, its effect on our behavior and some implications of his research.

Herrmann's interest in the brain grew from his personal involvement as a painter and sculptor. "Last July I was preparing to moderate a distinguished panel of artists on the subject of creativity," he recalls. "The more I read, the more impressed I became with the new information available about the functioning of the brain in this regard." His research is continuing, totaling over 400 hours thus far, and includes extensive reading and the attending of various workshops with leading physicians and psychologists active in the field. He points out that his GE workshop role is that of an application seeker rather than an expert.

Fundamental to an appreciation of the brain is the fact that each of us has two "minds." The cerebral cortex of the brain is divided into two hemispheres, joined by a large bundle of interconnecting fibers called the corpus callosum. The left side of the body is controlled by the right hemisphere of the cortex, while the right side is controlled by the left hemisphere.

Although both sides of the brain share the potential for many functions and both sides participate in most activities, in the normal person the two hemispheres tend to specialize. The left seems to process information sequentially, and is involved with logical, linear thinking, especially in verbal and mathematical functions. The right hemisphere, in contrast, is primarily concerned with our orientation in space, simultaneous comprehension, holistic thinking, ability to synthesize, artistic endeavor, and recognition of faces. If the left hemisphere can be said to be logical, the right is intuitive; if the left is controlled, then the right is emotional, and so on.

Research by neurologists, neurosurgeons and psychologists has confirmed this cerebral specialization. Hundreds of clinical cases show that patients with left-hemisphere damage have impaired language ability. A right-hemisphere injury may not interfere with speech, but does cause severe disruptions in spatial awareness, musical ability, or the recognition of faces.

The corpus callosum linking the two hemispheres, consisting of millions of neuron fiber connections, passes information between them.

Severing this communication link—as occurs after radical neurosurgery on severely-affected epilepsy patients—produces no abnormal, observable symptoms on a day-to-day basis. However, tests show the clearly specialized functions of the two hemispheres. For example, if a patient felt a pencil (hidden from view) in his right hand, he could verbally describe it, as would be normal. But if the pencil was in the left hand, he could not describe it at all. Since the left hand informs the right hemisphere, which lacks speech capability, and since the verbal hemisphere (left) of the split-brain patient is no longer connected to the right hemisphere, the verbal apparatus literally doesn't know what is in the left hand.

The recognition of specialized dual hemispheres helps in understanding the duality of individuals, as Sigmund Freud and others have suggested. It accounts for those moments when, as psychologist Robert Ornstein points out, our verbal intellect suggests one course and our feelings or intuition another.

Herrmann reports that we approach our daily activities with a brain orientation typified by a dominant hemisphere. While a task may require both right and left brain capability, our dominant hemisphere tends to "take over" the whole task, excluding the other hemisphere's contribution. Thus, results would be limited to capabilities of the dominant hemisphere while the best solution may have been in the excluded other hemisphere.

Many occupations involve concentration in one hemisphere of the brain. Science, law or mathematics are heavily involved in linearity and verbal logic—all left-hemisphere dominant. Executive tasks such as decision-making and policy determination, personnel counseling, and artistic activities such as painting and sculpture tend to be more present-oriented, requiring judgment and intuition—right-hemisphere dominant.

"Ours is largely a left-hemisphere society," comments Herrmann. "In fact, an actual enlargement of a portion of the left hemisphere occurs in most of us as the brain aggressively pursues language. The three R's contribute to it, as does our social structure, technology focus and business culture with its emphasis on rewards for logical, rational behavior.

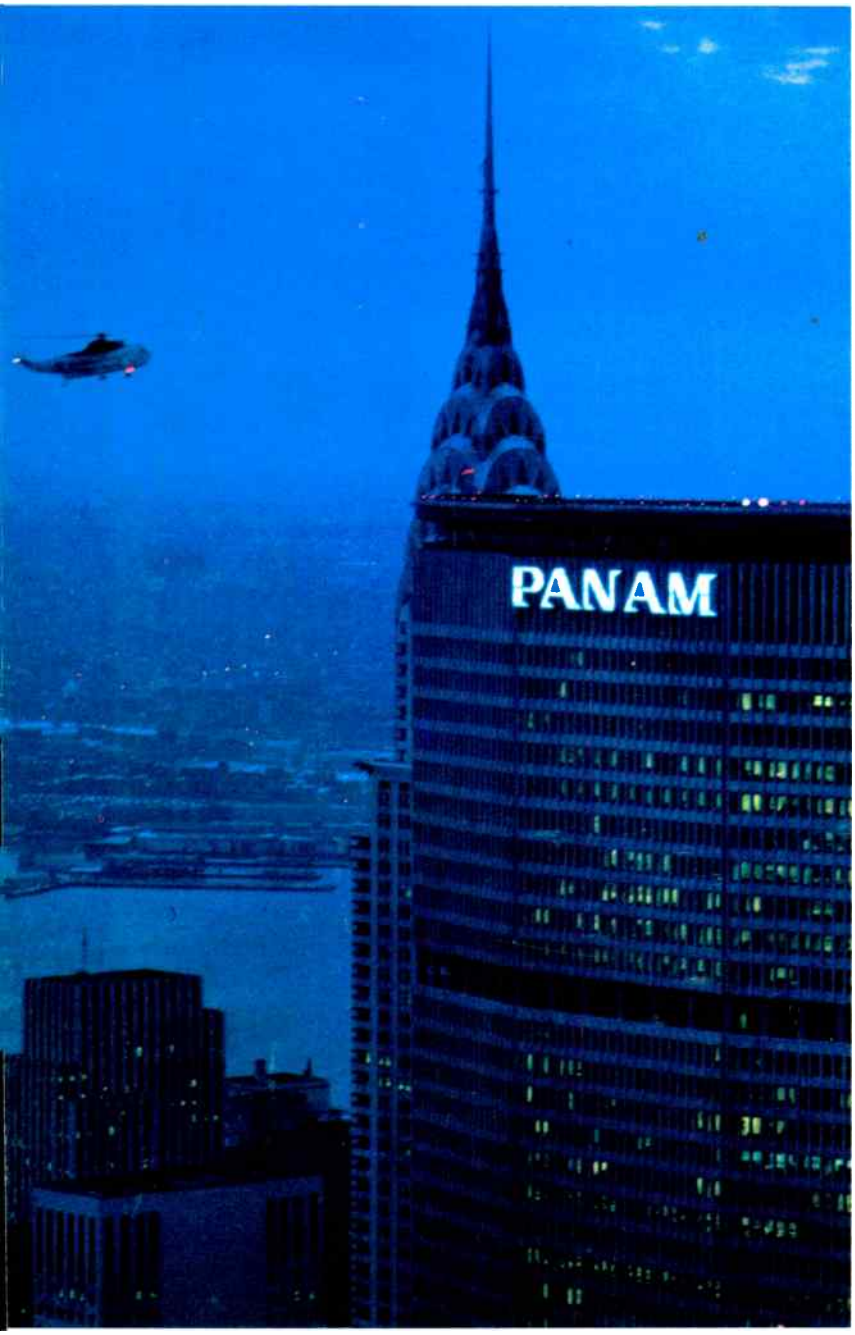
"There are right-brain cultures that provide an interesting contrast to ours. For example, in our Western culture we would define the smallest unit of time in technically-precise, scientific terms, while an Eastern culture might simply refer to the time it takes to boil rice."

Herrmann: Apply two minds to a problem.

Applied creativity is one of the most fascinating aspects of the brain's activities, and one that intrigues Herrmann the artist. "To be creative requires a creative task to do plus a climate in which the whole brain can function," he points out. "For many creative people, the process begins as a left-brain activity involving orientation, preparation and analysis of the task. Then, during the incubation and ideation phase, the emphasis can shift to the right-brain where intuition or a flash of insight can occur. The process ends in the left-brain for capturing and evaluating the creative results."

It is this specialization that allows the hemisphere better suited to a task to do it—if the other hemisphere allows it. The free interplay of both hemispheres is characteristic of "whole-brained people." Herrmann notes that methods of educating both halves of the brain are now evolving, together with ways of integrating both hemispheres. The latter category includes such methods as creating a climate that allows people to be themselves, nurtures motivation, encourages communication and "celebrates the whole person.

"Our brain workshops are building bridges to new knowledge that we feel is significant. These new developments provide 'cutting edge' knowledge that enriches our whole understanding and approach to adult learning. We know that it's eventually going to be applied in many ways to corporate cultures and our daily lives. It has rich potential. What remains is to chart pathways to achieve that potential."



TAKING AN ELEVATOR TO THE AIRPORT

New Yorkers who have been fighting traffic jams to get to all three major area airports since helicopter service from atop the Pan Am building was suspended as uneconomical in 1968 are rejoicing over recent resumption of service.

A prime reason for the good news: the 30-passenger Sikorsky S-61 helicopter (below), powered by twin CT58-140 1500 horsepower GE engines made in Lynn. The more efficient new equipment has helped make it possible for New York Airways to turn the airport service into a going business venture.

To board one of the 96 daily flights from the heliport, Man-

hattan-based travelers simply take an express elevator to the 57th floor terminal 808 feet above busy Park Avenue. The 6 to 10 minute flight saves a full hour of business time for most passengers, often provides a spectacular view of the city, and costs little more than the equivalent taxi ride.