GENERAL ELECTRIC
Monogram
SEPTEMBER-OCTOBER 1978

Toward the Centennial peak: A flurry of activities marks employees' creative response

About the cover

Roller coastermania with GE100 enthusiasm

What better way to impress the Centennial celebration on kids than to tie GE's 100th in with rides on the world's fastest double-track racing roller coaster? It happened at Kings Dominion amusement center in Virginia, aided by GE Centennial discount tickets enjoyed by some 1000 GE people of the Television Business Department in nearby Portsmouth.

Raft-splashing fun to mark the Centennial

Fort Wayne's annual Three Rivers Festival Raft Race draws throngs of amusement-seekers, and this year GE people made sure that GE100 was represented. Afloat on a Centennial barge designed to release hundreds of colorful "GE prize" balloons, an exuberant Fort Wayne crew of 16 General Purpose Motor Department employees pitched in to make the day enjoyable by tossing mini-frisbees to waving crowds on shore.

Syracuse relives a 100-year-old picnic

According to GE legend, the first version of a Company "clambake" was held on July 8, 1878, when the Thomas A. Edison Laboratory staff at Menlo Park, N.J., picnicked along a bank of the Passaic River. One hundred years later, the tradition remains. And, maintain Syracuse's 1100 Electronic Systems Division people who attended, their Centennial outing should make history as the "best yet."

Commemorating GE100 in Steuben glass

A symbol of General Electric's growth into a multifaceted, worldwide company will be perpetuated in a distinctive Centennial sculpture designed by Steuben Glass. Permanently on display at Fairfield headquarters, the classic art is made of crystal and set on a mirrored base to reflect an image of a globe. One hundred Steuben-designed partial replicas of the sculpture are being awarded to employees for exemplary job performance during the Centennial year.

THE COMPANY

Toward the Centennial peak

Imaginative responses by GE people make the anniversary observance 'a many-splendored thing.'

As the General Electric Centennial celebration crescendos toward its October 15 climax, the forms of observance imagined by GE people are shaping it into a rich and memorable event, covering a spectrum from serious art to fun-filled picnics. And there's more beyond the examples pictured on these first six pages:

- GE's Centennial year has been recognized in Congress. A commemorative resolution has been passed in the Senate at the behest of Sen. Abraham R. Ribicoff, while Rep. Stewart B. McKinney has introduced a similar resolution in the House.

- A Centennial grant of $150,000 to the American Assembly of Collegiate Schools of Business has been made by GE to foster international business education.

- A GE-sponsored two-day symposium on "Science, Inven-

"Up With People" performers arrive at Fairfield headquarters as GE100 spirit goes "on the road."

tion and Social Change" was being convened in Schenectady as this *Monogram* went to press. Attracting some 150 education, government and business leaders from around the world, the symposium will "celebrate the revolutionary extension of human capabilities made possible by science and invention over the past 100 years" and will "project further extensions and their consequences into the next 100 years." Read on!

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Linn A. Weiss, *Editor;* Richard J. Knoph, *Associate Editor;*
Donna R. Carpenter, *Editorial Assistant;* Ron V. Taylor Associates, *Design.*

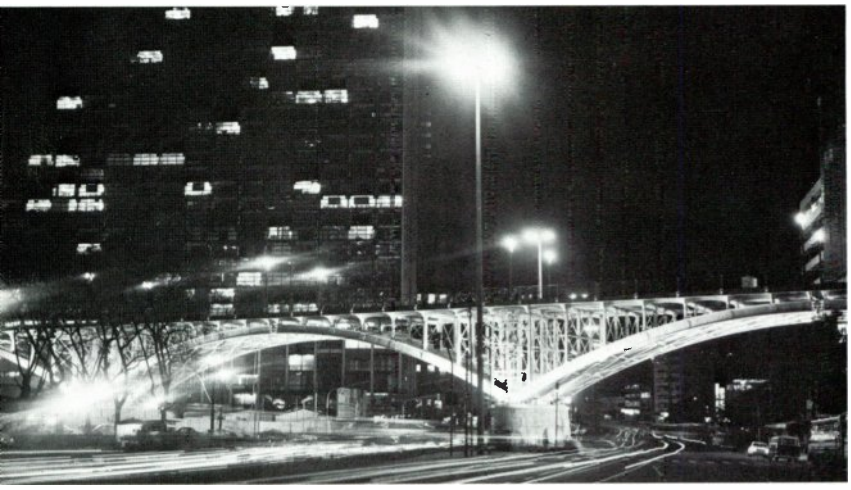
Contents

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. Request permission to reprint articles from the Monogram Editor, Fairfield, Connecticut 06431.

Speaking of the Centennial, R&D-2 captivates audiences

A new maxim may be added to the fundamentals of successful speechmaking: when a robot talks, people listen. Thousands of GE employees and their families around the U.S. have been hearing of the Schenectady Research & Development Center's role in GE science and engineering technology from R&D-2—an animated, mechanical "spokesperson" currently on tour at Company locations. The robot is the featured attraction of a special R&D Center display van accompanying "The Progress," the 100-foot-high balloon launched in June as a tribute to the GE Centennial (see *Monogram*, July/August 1978).

Checking their new friend's "voice box" are Schenectady employees' children Laurie Russell (center) and Joey and Kathy Vacca.



A GE lighting tribute for a Brazilian landmark

First opened in 1913, the Santa Ifigênia Viaduct is one of São Paulo's most cherished architectural monuments. In honor of the Company's Centennial anniversary, GE-Brazil donated and engineered an entire Lucalox® lighting system to flood the landmark's 738-foot expanse with golden color. The viaduct crosses the city's principal avenue and now is open exclusively to pedestrian traffic of approximately 400,000 people daily. In an elaborate ceremony, Santa Ifigênia's "second" inauguration was held on July 26.

Adopt a gorilla? Evendale did it

Bypassing such exotic choices as siamangs, dik-diks and elands, Evendale's Aircraft Engine Business Group "adopted" Hatari, a quarter-ton gorilla, by paying his meal ticket for 100 days. Here, Cincinnati Zoo director Edward Maruska (left) and GE100 program chairman C. M. "Sonny" Pierce discuss the ape's 30-pound daily repast. Employees and their families had the opportunity to watch their Centennial pet consume his gift during GE reduced admission days this summer.

DEMS gives a hand to Philly's celebration
A Centennial kickoff, complete with local media coverage, made Philadelphia's Re-entry and Environmental Systems Division the talk of the town during July. Highlighting a product exhibit was the Diver Equivalent Manipulator System (DEMS), which attracted employees, reporters and community leaders anxious to take turns operating the control arm of the deep-water diving apparatus. DEMS performs virtually all manual tasks required of a diver during difficult undersea operations. Just after this on-camera report by WCAU-TV's Joanne Lee (left), DEMS even lent a "hand" by graciously holding the newscaster's microphone.

For a Centennial Ball, fashions of the past 100
Dressing up a Centennial Ball in Washington, D.C., Rockville's Information Services Business Division employees and GE guests donned imaginative 1878-to-1945 costumes on September 5 for a parade of "people progress." More than 2000 attended the festivities, which featured the GE100 "Up With People" and multimedia shows, awarding of the Steuben Glass Centennial sculpture replicas, a dance band, buffet and "birthday cake of the century." Among the party-goers in foreground (l to r) : Sally Smith, Toni Coates, Per Saether, Clare Aukofer and Ray Marshall.

For GE100, Ravenna employees become part of the show
Awaiting the tops to their "Ralph the Giant" costumes, Ravenna Lamp Plant's Alice Butler (l) and Chris Chmelar were determined to put their best feet forward for more than 1000 co-workers and family members attending a June Centennial picnic at nearby Seaworld of Ohio. Amid the splashes of playful dolphins, and show-biz "kisses" from killer whales featured at the aquatic amusements center, these and other GE performers found time to get into the day's acts themselves. Here, they plan strategy with other employees prior to a kingsize soccer game.

(continued next page)

GE's 100th: Schenectady says it with ballet

For Schenectady GE employees, the Centennial observance turned into an occasion to go backstage at the ballet. Nearly 1000 GE people attended a special New York City Ballet performance of Vienna waltzes this summer at the Saratoga Performing Arts Center and enjoyed the champagne reception that followed. Relaxing after the show to chat with theater patrons and sign souvenir autographs, Ballet members Catherine Morris (left) and Linda Homek join GE engineer Kenneth E. Newman.

Spreading the celebration 27 miles in Milwaukee

What could be more appropriate than some healthy exercise for people who make medical products? Split into five teams, 125 Medical Systems Business Division employees sporting bright GE100 tee shirts carried Centennial flags in a 27-mile "Walka Joga Thon" relay race on June 24. Contestants walked/jogged/ran from the GE training institute and past most of the division's facilities to its headquarters in Waukesha. Completing the course in just under three hours, the winning team represented the division's Cardio and Dental sections.

'Electrical Worker' for Schenectady Museum

What began early this spring as a three-quarter-ton block of rough Vermont marble has taken shape as a permanent commemorative tribute to the Company's Centennial anniversary. Artist Alice Manzi selected her subject—a welder—after visiting Schenectady's GE plants. Entitled "The Electrical Worker," the life-size sculpture will be on display in the Schenectady Museum. The statue has so impressed GE100 program planners that a limited number of small bronze replicas has been cast and will be awarded for job performance excellence to deserving Schenectady employees.

Anniversary clambake with 'down-home' sound

Syracuse and Auburn operations made the Centennial celebration a time for a neighborly GE get-together. Some 1300 Semiconductor Products Department employees enjoyed a spirited summer clambake featuring good-time music from washtub basses, jugs, jew's-harps, spoons, tambourines, drums and a player piano. Part of the "GE100 Blue Grass Jug Band" (l to r): Dorothy Poole, Jim Meyer and Rich Sheffey.

Red Sox and GE families team up for a big day

Pack 10,500 fans into Fenway Park to cheer their favorite team to a come-from-behind victory, add the excitement of a GE100 salute, top it off with a handshake from one of baseball's pitching aces, and you've got what it takes to make a 13-year-old boy happy. It was that kind of memorable afternoon for Bobby Sullo—and his dad, Bob, a Lynn project craftsman—when Boston's Mike Torrez extended a personal welcome at GE Family Day on June 17.

Fun in the sun for 5000 at Burlington's outing

A brilliant August sun provided perfect anniversary celebration weather for Burlington GE people at a big all-day Centennial Family Outing. How big? The "field day" event drew a ready-for-action crowd of 5000 merrymakers. Taking time out during a busy afternoon of play is 18-month-old Jennifer Bushey.

THE GE FOUNDATION
It's different – it takes initiatives

This independent trust continues to launch programs that are later duplicated by other firms and foundations.

"It's one thing simply to award financial grants to worthy educational programs," remarks William A. Orme, the General Electric Foundation's secretary. "It's quite another thing to become a creative force for constructive change. We've been able to study areas of need, devise new programs and later see our Foundation-initiated projects endorsed by other companies."

He continues: "Our newest funding program is directed toward key public issues. We are seeking to identify future economic and social problems, learn the weak areas in the present research, and develop a timetable for examining the concerns in depth."

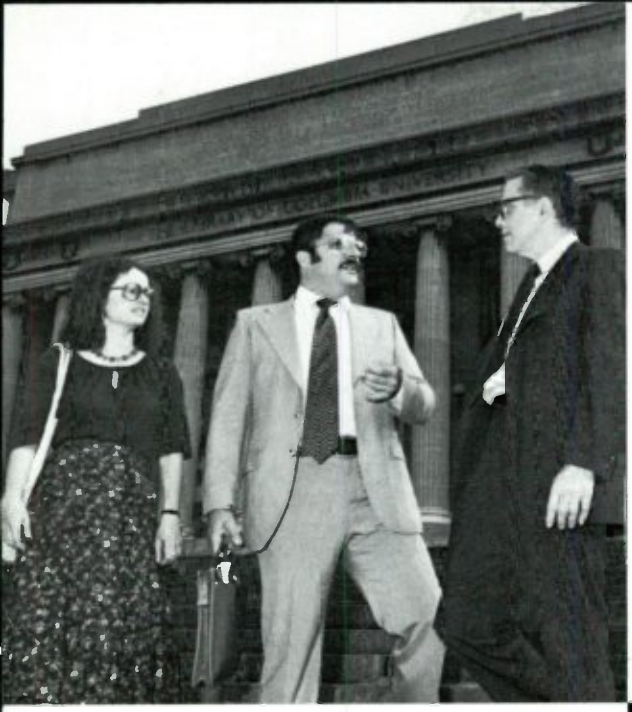
As a separate entity from General Electric, the GE Foundation has its resources completely detached from those of the Company. Observes GE Senior VP-Finance Alva O. Way, chairman of the Foundation Trustees: "The Foundation's primary mission is to play a leading role in supporting educational and research activities which will meet the priority needs of both busi-

(continued on page 10)

Gaining U.S. expertise

"My fellowship is helping me acquire a master's degree in electrical engineering," observes Turkey's Güner Tuğrul, who expects to graduate from Stanford University next June. She is one of six foreign students now in the U.S. on fellowships funded by GE Foundation grants administered by the Institute for International Education (IIE).

These fellowships, which represent IIE's oldest corporate program, since 1961 have enabled 94 students from 17 countries to earn master's degrees in engineering through a GE Foundation investment of more than $700,000.



◂ New 'key issues' research

Key public issues of potentially significant impact on the American enterprise system and economy are now under study at the University of Pennsylvania, Wayne State University and Columbia University—with the GE Foundation's help. Shown at Columbia: GE's Dr. Nicholas Perna (center), Corporate Planning and Development, discussing a Work/Leisure Tradeoffs Project with Drs. Susan Gray (left) and Dean Morse.

Funded by a $70,000 GE Foundation grant, the Columbia research focuses on such issues as early retirement and new legislation concerning mandatory retirement.

Experiencing 'world of work' ▸

Building industry occupational awareness among school guidance counselors, teachers and administrators has been a prime objective of the GE Foundation since 1959. More than 2000 educators have now attended the Summer Career Education and Guidance Institutes conducted by Boston University, Indiana University, University of Louisville, Ohio State University, University of South Carolina, and Syracuse University.

Participating in a "lab experience" in South Carolina is Charleston teacher Martha Stowe (left), shown "shadowing" an employee at the Columbia-Pacific Mills Textile Company. The GE Foundation's 1978 contribution for these summer institutes was $100,000. Forty-seven educators completed the course this summer.

◂ Help for her career

University of Texas senior Bernadette A. Auzenne of Baytown is pursuing a bachelor's degree in chemical engineering. "I'd recommend engineering to other women with an aptitude for math and science," she remarks.

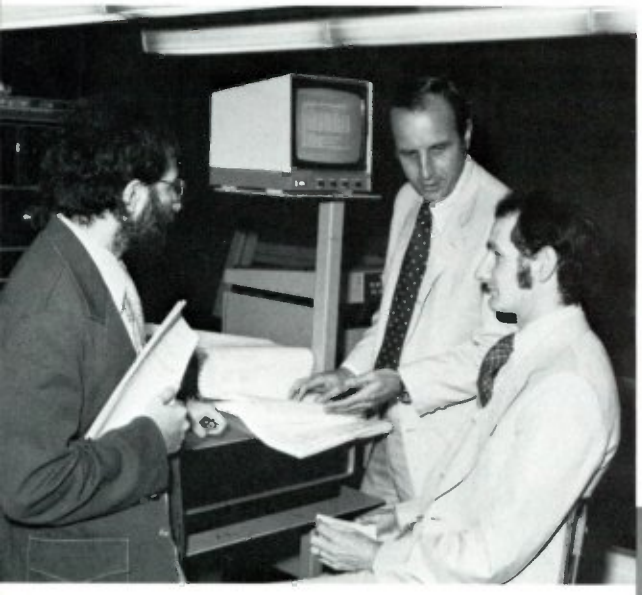
Auzenne's studies are being assisted as part of a 1978 GE Foundation grant of $210,000, which fully funds the Engineering Scholarship Program for Minority Community College Graduates administered by the College Board. This year, some 60 minority engineering students received similar scholarships.

ness and society. The idea is to underwrite a broad range of activities and maintain a steady level of support—independent of trends in the Company's annual earnings."

The Foundation's 1978 grants will approximate $4.4 million—the 11th straight year in which a record will be set. Presently, some 110 schools and 49 supporting organizations are receiving Foundation contributions.

Various examples of GE Foundation-initiated activities appear on these and the preceding pages. Since its founding in 1952, the Foundation has pioneered numbers of now well-established programs—many later copied or adapted by others. Examples include the Corporate Alumnus Program of gift-matching (1955); summer programs for high school and college faculty (1959); and programs to increase the supply of qualified minority professionals through grants to universities and educational organizations, principally in the fields of engineering and business administration (1972).

Bill Orme remarks: "Our new program to research key public issues is only the latest of the GE Foundation's 'uniques.' The Foundation is a living and growing entity that continues to change in anticipation of the evolving needs of education, society and business."



◄ Examining business in society

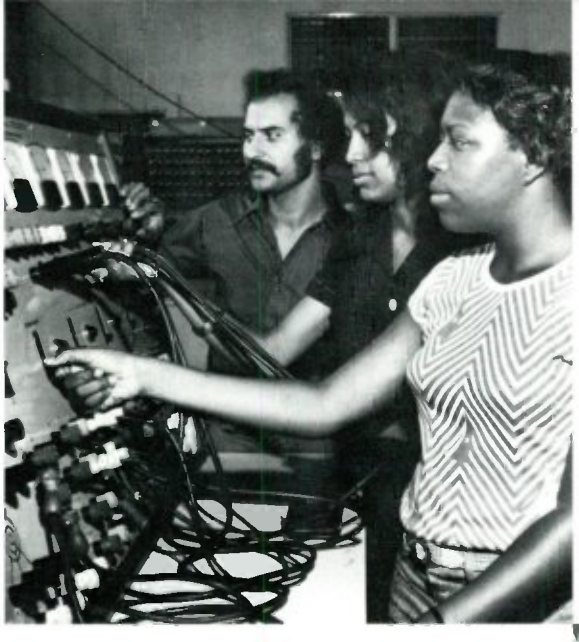
The University of Pittsburgh's Drs. Alfred Marcus (left) and David Blake (center) and doctoral student Liam Fahey discuss their present research—which seeks to develop alternatives to retirement. Since 1972, the GE Foundation has annually supported research and publication activities at this school, and the Foundation's 1978-79 grant totals $10,000.

In 1976, Pittsburgh published a Foundation-funded book on the role of corporations in society, *Social Auditing: Evaluating the Impact of Corporate Programs*, co-authored by Dr. Blake and two other Pittsburgh professors. Notes Dr. Blake: "This pioneering work has become a much-quoted reference document, and has been published both in hard cover and paperback."

Science and math exposure ►

Wanamaker Junior High students in Philadelphia are taught the principles of logic circuit board use by Philadelphia Electric mechanical engineer James Cornish. Sponsored by PRIME —Philadelphia Regional Introduction for Minorities to Engineering—this summer program was one of the first such projects designed to attract minorities to the engineering professions, and was begun in 1974 with a GE Foundation grant. The 1978 grant totaled $25,000.

This summer, the PRIME University Program enrolled 375 secondary school students on five university campuses. The program's premise: minority students must be sought out much sooner to prepare and motivate them for engineering careers.



◂ More minority engineers

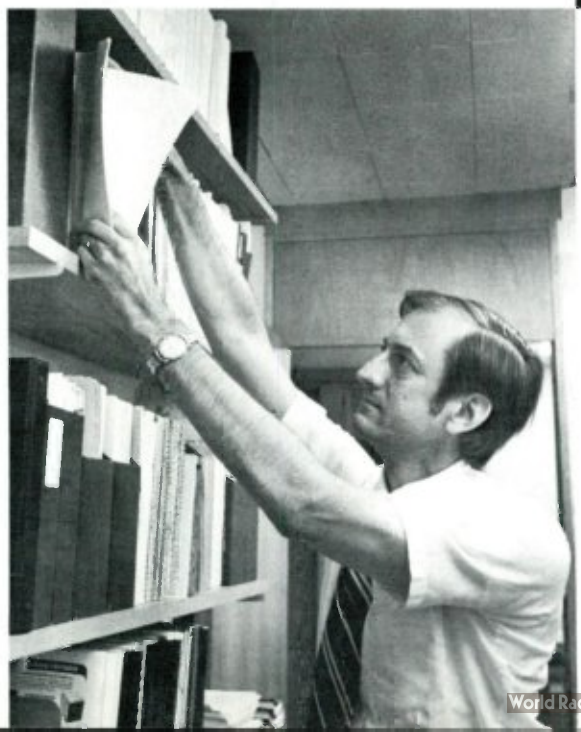
The GE Foundation's latest "Mainstream Awards in Engineering"—these awards total $900,000 for the 1978-82 time period—will go to six predominantly black engineering schools including Prairie View A&M University (left).

Established in 1972 to help overcome the national shortage of minority engineers, the grants are designed to increase enrollments and improve the quality of academic curricula. States Prairie View's engineering dean, A. E. Greaux: "Like General Electric, our university is celebrating its 100th anniversary this year. Our school is making notable strides in both engineering and business."

Upgrading school curricula ▸

GE co-op student Lydia York (top right) worked this summer at Schenectady's Large Steam Turbine-Generator Division. Her alma mater, Florida A&M University, is receiving a GE Foundation grant to help gain accreditation for its business school's curricula. Florida A&M is one of two black colleges—North Carolina A&T State University is the other—now receiving help for accreditation from 1976-78 GE Foundation grants of $146,000.

At bottom right, North Carolina A&T students Tyrone Massey and Paula Jeffries return for the fall semester. Comments their business dean, Dr. Quiester Craig: "In the past, business and finance were not considered important courses at black schools. We're making great headway in remedying this situation."

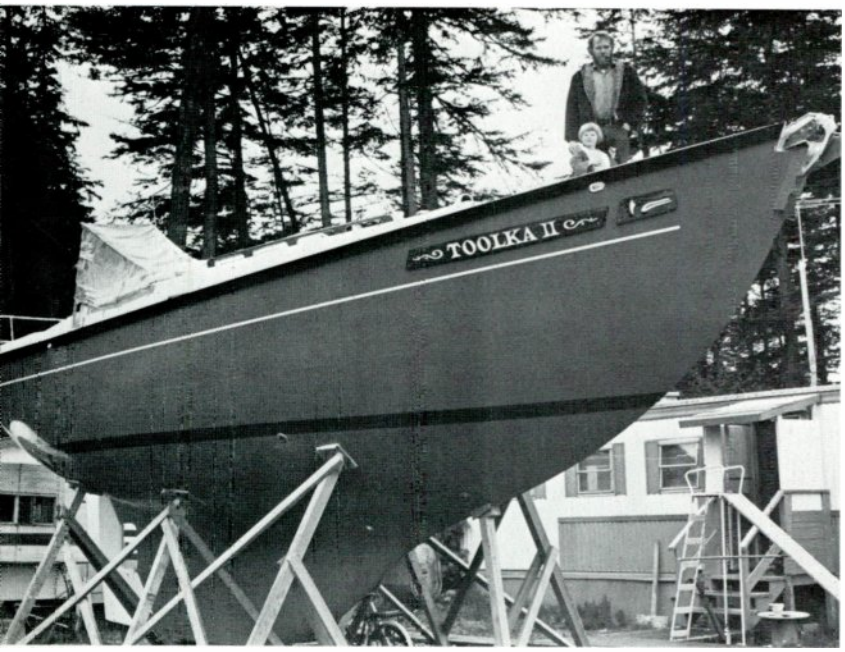


◂ Scenarios on energy

Dr. Henry Jacoby of the Massachusetts Institute of Technology is studying energy policy at MIT's Center for Energy Policy Research—the work partially supported by a 1978 GE Foundation grant to MIT of $20,000. Dr. Jacoby, the Center director, notes that the grant provides MIT with the freedom to explore new research areas, initiate new programs and provide support to promising young scientists and economists.

Stanford University, Rensselaer Polytechnic Institute and Princeton University are receiving GE Foundation grants for other energy-related research projects.

Monographs



Home for sail. As his third excursion into boat building, Utah Mines Limited's Karel Doruyter recently built *Toolka II*—and, with wife Tanya and daughter Nicola, has said goodbye to "landlubber" life. The Doruyters have taken up permanent residence aboard the sailboat, which is berthed near Karel's work at Utah's Island Copper Mine on Vancouver Island, B.C.

Remarks Doruyter, the Mine personnel supervisor: "The vessel is self-contained. We can sail away on weekends—without hours of planning and packing. We enjoy the outdoors and still sleep in our own beds." Starting with the hull, Doruyter fitted *Toolka II's* entire interior.

No bloodmobile bottlenecks. When long lines of GE blood donors formed at Burlington's Aircraft Equipment Division plant, safety administrator Timothy Davis turned to the Mark III® computer network for a speedy solution to the delays.

As his Management Problems Analysis (MPA) GE course project, Davis used system simulation to work out the bottlenecks and achieved a triple payback. First, each employee cut a half-hour from the blood donation process. Second, GE-Burlington saves $3,200 a year in employee waiting time. Third, the National Red Cross asked GE to make the computer program results available to chapters across the U.S.

Shown at the computer are Davis, and Ruth Bogorad, director of donor resources development for the Vermont/New Hampshire Red Cross Blood Service.

Subtropical Wyoming? With 90-degree summers and a semi-arid climate where the average annual precipitation is only 12 inches, it is hard to envision Shirley Basin, Wyo., as the past home of lush forests that grew in wet, boggy ground. But at Utah International Inc.'s Pathfinder Mines Corporation near Casper, a square-mile patch of land peppered with petrified wood proves that the quagmire existed.

According to Pathfinder mine geologist Edward C. Rafuse, the 35- to 50-million-year-old petrified wood at Shirley Basin indicates that today's sagebrush and prickly-pear cactus are the successors of thick, subtropical vegetation.

Examining some of the petrified wood are Pathfinder's maintenance superintendent Mack Tilley and his grandsons.

Viewers get the message. Introduced on ABC's September 29 GE All-Star Anniversary Special, a series of new TV commercials is launching the Company's *second* hundred years of commitment to technology and product leadership.

Television audiences receive a GE "Progress Report" in each 60-second message. In the line-up of commercials: energy-saving plastics, demonstrated as an auto industry application

by mime players Shields and Yarnell (above).

Among others: the R&D Center's creative engineering with magnets to build a permanent new jaw for an auto-accident victim, Geniponics® tomatoes, the Widescreen 1000 Home Television Theater, solar energy and the Weathertron® heat pump, sports lighting, the computed tomography (CT) scanner, and more. The "Progress Report" theme will be continued in supporting General Electric print advertising through 1979.

Governors' Conference. "The U.S. will face an electric power shortage with serious loss of jobs and heavy economic impact if nuclear power and coal production suffer shortfalls in the 1980s," Dr. Thomas A. Vanderslice, Senior VP—Power Systems Sector, told the National Governors' Conference on Aug. 28.

Pointing to an independent study commissioned by GE with Data Resources, Inc., Vanderslice said: "If nuclear plants scheduled for operation between 1981-85 are prevented from doing so, and if growth in coal production is only half that projected, the energy shortfall will result in two million fewer jobs and raise electricity prices an average 15%."

Shown at conference (l to r): Vanderslice; South Carolina Gov. James Edwards; Idaho

Gov. John Evans; Washington Gov. Dixie Lee Ray; U.S. Department of Energy's John Deutch; and New Hampshire Gov. Meldrim Thomson, Jr.

More than meets the eye. Boosting word skills of the deaf with cameras and a computer is making WRGB-TV a commercial programming pioneer. The GE station in Schenectady airs "Signs of Silence" each Sunday morning with a learning twist added to sign language communication.

Program host, the Rev. Robert A. Jordan (right), says: "Average reading skill of hearing-impaired adults is at grade school level. Our unique format includes a computer-controlled word display on the screen as I speak and 'sign' the news, with words above grade-school level shown in reversed color and then displayed again as a vocabulary list."

Honors. Once again, GE was the top winner in the annual "I-R 100" competition sponsored by *Industrial Research/ Development* magazine. Awards for seven of the "100 most significant new technical products or processes of the year" were presented to GE developers at the "I-R 100" banquet Sept. 21 in Chicago.

- Named one of the nation's 10 outstanding engineering achievements for 1977 by the National Society of Professional Engineers is the GE-built Square Butte Project—the nation's first "coal-by-wire" project—which supplies Minnesota Power & Light Company with electricity from a North Dakota mine-mouth power plant.
- Plastic Business Division's Mt. Vernon, Ind., plant on the Ohio River has received the "Clean Water Award" from the Izaak Walton League of America, Inc., a conservation group. Nominated by the Indiana State Stream Pollution Control Board and the Environmental Protection Agency, the GE plant was one of only 12 U.S. plants recognized for "exemplary water quality improvement."

GE diesels put to sea

Erie's Locomotive Operations has found a major new market for GE diesel engines aboard harbor tugs, ferryboats and Navy cable ships—to name a few.

Marine applications for General Electric diesel engines? For persons accustomed to thinking of GE diesels mainly in terms of railroad locomotives, a surprise awaits. A closer look at GE's diesel business reveals that the Company has been supplying marine-adapted diesels to ship owners since 1970. To date, GE-Erie has sold 49 marine diesel engines and diesel-electric power modules which, by fall 1979, will be operating on 24 commercial ships.

These seagoing diesels are not being used simply for emergency starts and auxiliary power. Indeed, many provide primary propulsion, electric power for ship's service and drill rig power aboard drill ships. States Erie's Ben H. Elliott, manager—Diesel Power Products: "The world beyond the railroad transportation industry is going to see more of the General Electric diesel engine. The excellent fuel economy of the GE diesel, combined with its ease of maintenance and the engine's compactness, makes the diesel a favorable alternative for prospective purchasers."

Evidently, growing numbers of ship owners think so, too. GE diesel engines and diesel-electric power modules are being placed aboard harbor tugs, ferryboats, tuna boats, towboats and drill ships and drill tenders.

Marketed with eight, 12 and 16 cylinders, the GE diesel engine comes in ratings up to 3500 hp —which precludes its use as a propulsion system aboard larger-sized ships. But it finds other uses on these large vessels. Case-in-point: Erie is supplying two 16-cylinder diesel engines to Farrell Lines, to provide ship's service for two containerships now being constructed in Baltimore.

Observes Ben Elliott: "An exciting new General Electric business has come of age in Erie, and it represents a significant marketing inroad. This country's diesel-engine market is rapidly diversifying, and GE is parlaying its years of experience with the diesel into numerous new marine and industrial applications."

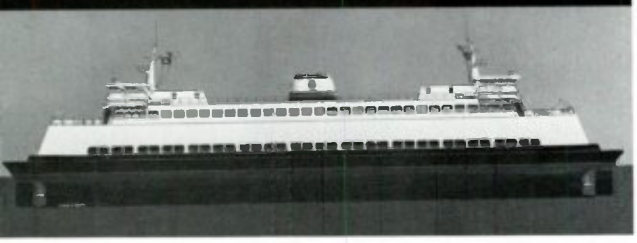
GE diesel experience dates back to 1924 when Dr. Hermann Lemp designed the first commercially successful GE diesel engine at the Erie Works. Experience with the present F series diesel dates back to the mid-1950s, with today's production representing a fourth generation of improvements that have lowered operating costs, improved maintenance and reliability, and further reduced fuel consumption.

Currently, for Washington State's Department of Transportation, Erie is supplying a

(continued on page 16)

Production test cell technician Kenneth Monti checks GE marine diesel engines on their way to numerous new applications.

Recent GE marine diesel applications include three diesel-electric power modules aboard Shell's drilling tender *Tenaga* (top); engines for two Farrell Lines containerships similar to vessel at right; and 12 diesel engines for six new Washington State ferryboats.



Drawing courtesy of Washington State Department of Transportation

General Electric's marine diesel business began eight years ago. Among early GE projects: fishing vessel *Enterprise* (top), originally purchased for Del Monte tuna fleet, propelled by one diesel engine; Crescent Towing and Salvage's tugboat *Port Hudson* (below), also powered by one diesel engine; and Reading & Bates' drill ship *Douglas Carver*, with three diesel-electric power modules.

dozen 12-cylinder diesel engines to be used for propulsion in six new Puget Sound ferryboats. All are scheduled for service by next fall.

For the Navy, Erie is furnishing six 12-cylinder diesel-electric modules for use aboard two new Military Sealift Command cable-laying ships, the *USNS Myer* and *USNS Neptune*. Now under construction in Baltimore, both ships are scheduled for service by next year and will use the GE diesels for propulsion as well as auxiliary power.

Earlier this year, Shell's operation in Brunei, Borneo, launched its offshore-drilling-platform tender *Tenaga*. This drill barge contains three GE 12-cylinder diesel-electric modules.

As the *Monogram* went to press, the *Glomar Atlantic*, a new drill ship built by Global Marine, was entering service. Aboard are four GE 16-cylinder diesel-electric modules and a plethora of other GE products virtually identical to the GE modules and other products aboard the Exxon-leased *Glomar Pacific*, also a Global Marine ship (see *Monogram*, July/August 1978).

"The decision to intensify our marine-diesel marketing effort was made in May 1976," notes William Speicher, manager—Diesel Engine Systems. "We had just completed five years of marine operation, and we saw major new opportunities unfolding. These applications included marine sales as well as stationary power uses."

One example of Erie's successful new foray into the stationary power market is in Jeddah, Saudi Arabia, where the Saudi National Company Ltd. for Electric Power recently ordered a 16-cylinder GE diesel engine as start-up power for the Jeddah II gas turbine plant. The engine was delivered earlier this year. The 11 gas turbines at the Jeddah I and Jeddah II plants are all GE units, and International Projects Department supervised their installation.

"In undertaking our new marine and industrial sales strategy, we first had to set up a marketing network," remarks Ben Elliott. "We've built this marketing infrastructure, and 1978 sales have more than doubled last year's—both in the value and number of orders. Our marine and industrial business is growing at a rate that should see it increase fivefold by 1983."

He concludes: "We're one of GE's faster-growing businesses, and because of our diversifying market and the high caliber of our employees, we expect to realize record sales in the years ahead."

Some 5000 General Electric diesel engines are now in operation. In Erie's main assembly area, grinder Randy Strickenberger grinds an engine's main connecting rod, while assembler Rick Pheasant lowers unitized cylinder into place.

New Businesses From Research

CHAPTER 6

In the fall of 1900, the young General Electric Company entertained a revolutionary idea: to establish its own laboratory devoted to scientific research. No other American company had one. After all, research was done at universities, not factories.

As unusual as the idea was, it didn't bother GE Vice President E. W. Rice, Jr. As technical director, he knew that scientific knowledge was the most important raw material for engineering development, and that the source of that knowledge was research. Also, the legacy of Edison's Menlo Park laboratory had provided the Company with a deep respect for the value of inventions.

First GE research lab

The decision to establish a research laboratory was shared by Rice, GE co-founder Elihu Thomson, consulting engineer Charles P. Steinmetz and patent lawyer Albert G. Davis. For the laboratory's first director, they selected a young assistant professor at the Massachusetts Institute of Technology, Dr. Willis R. Whitney. The first home of GE research was a simple barn behind the home of Steinmetz, but after a fire destroyed it early in 1901, facilities were found at the Schenectady Works.

Under the guidance of Whitney, the new concept of industrial research and development took root and grew. A staff of talented scientists developed over the years, with the genius of Steinmetz augmented by Dr. William D. Coolidge, Dr. Irving Langmuir and others. The new knowledge that Rice had sought was soon emerging, to be applied to new and better products.

Improved lamps were the first notable result of the new laboratory's investigations. Whitney's GEM metallized filament of 1904 boosted lamp life, and Coolidge's ductile tungsten revolutionized both metallurgy and lighting in 1914. Out of Langmuir's research into electron flow in a vacuum and Coolidge's knowledge of tungsten came, in 1913, the first high-vacuum, hot-cathode x-ray tube. It was known as the "Coolidge tube," and its combination of tungsten target, heated tungsten filament and high vacuum became the basis for nearly all x-ray tubes from 1913 to the present.

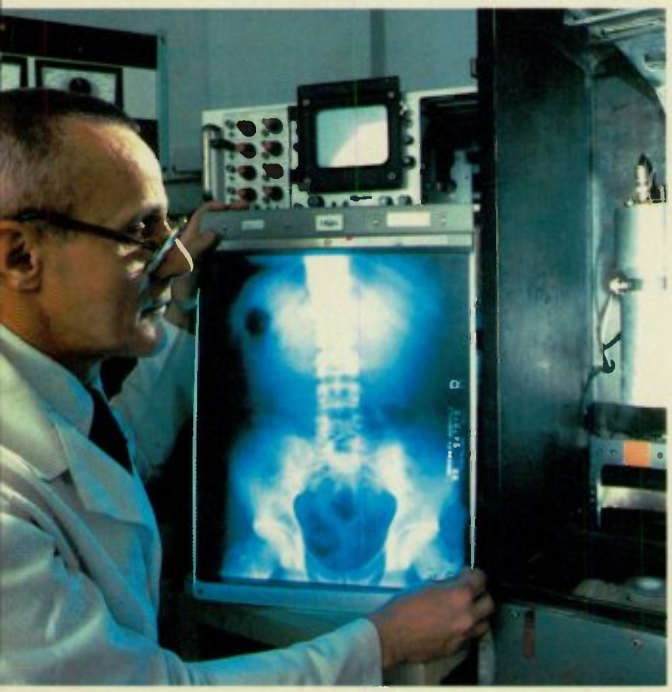
The Coolidge tube formed a significant technological base for the Company's medical business that, over the years, continued its innovation. Between 1930 and 1960, GE introduced one- and two-million-volt tubes, remotely controlled x-ray systems, industrial x-ray units, and electronic patient monitoring equipment. In the 1970s, the Company entered the nuclear diagnostic market with a full line of gamma cameras, and computed tomography with the first sub-five-second CT scanner. In 1977, GE introduced a mobile nuclear camera with built-in computer for real-time examinations, especially important in heart studies, and made improvements in CT technology including higher resolution image capability.

Metallurgical products and diamonds

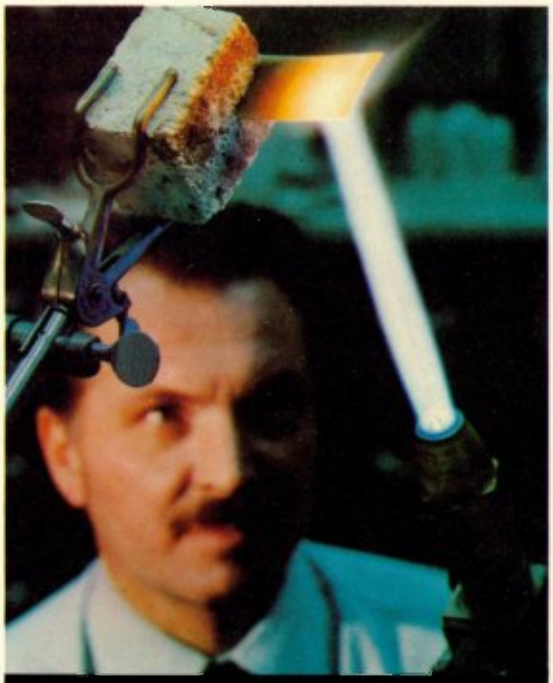
What was billed as "the hardest metal produced by man," cemented tungsten carbide, was the amazing product of the Carboloy Company formed by General Electric in 1928. It gave cutting tools qualities far surpassing the best steels, and also gave a big boost to American industrial productivity. The Carboloy Company grew during the war years, playing an important metalworking role in war production and then expanding applications of Carboloy® cemented carbides to tools for coal mining, oil and gas well drilling and blast hole drilling. The Company merged with GE in 1950.

Another startling development made headlines around the world in 1955 when a team of GE scientists achieved a centuries-old dream by producing Man-Made® diamonds in the laboratory. While appropriately dazzling in themselves, they also created a new GE business: providing industrial diamond grit for applications ranging from metal cutting to glass grinding, stone and concrete sawing, and dentistry. In 1969, another new superabrasive material, Borazon® cubic boron nitride, expanded the Company's product applications to include hardened

Today's GE R&D Center, above, is one of the largest, most diversified organizations of its kind in the world. X-ray research by Coolidge—at right below with Irving Langmuir and physicist J. J. Thomson in 1923—began today's GE Medical Systems business, left.



Man-Made® diamonds (1955) and synthesized gem diamonds (1970—above) by GE researchers (below) ended a centuries-long quest to duplicate nature's hardest substance.



Scientists study fabrication of silicon carbide heat-resistant materials (above); large family of GE silicone products grew from 1940 research on a direct process (below).

steels and superalloys. In 1973, polycrystalline diamond Compax® blanks for machining metals were announced, followed by a BZN® Compact product line in 1974.

Silicone materials

Kids would later know silicones as "silly putty," but to GE researchers intrigued with them in the 1930s, their properties were no laughing matter. From the commonest of substances—sand—came a versatile substance that could be changed, chameleon-like, into rubbers, adhesives, fluids, greases or resins. Another fascinating characteristic: regardless of heat or cold, silicone rubber remained elastic. Silicones are a unique family of materials, bridging a gap between organic and inorganic substances and combining the inherent benefits of both types while virtually eliminating the limitations.

Silicone research had flowed naturally from the Company's quest for better insulating materials. A significant step was taken in 1940 by GE chemist Dr. Eugene Rochow, who invented a simplified procedure for the preparation of silicone chemicals. His "direct process" involved a chemical reaction combining silicon with a compound of carbon, hydrogen and chlorine.

From test-tube quantities, silicones grew to commercial scale with the opening of the Company's Waterford, New York, plant in 1947 under the direction of Dr. Charles E. Reed. Since General Electric is one of only two major companies in the country manufacturing the material, the Waterford plant comes close to being one of a kind. It was one of the most ambitious projects to be undertaken in the Company's post-war expansion program and incorporated advanced principles of modern chemical engineering in its design. It took more than two years' time to design and build.

For over 30 years, a steady stream of new products—now numbering over 2000—has reflected robust world demand. The stable, heat-resistant polymers are used as adhesive sealants, encapsulating compounds, formed-in-place gaskets, sealants for building construction, additives, lubricants, and a host of other products applied to industrial, construction and consumer needs. Their esoteric uses include the boots worn by astronaut Neil Armstrong as he took his historic first step on the moon.

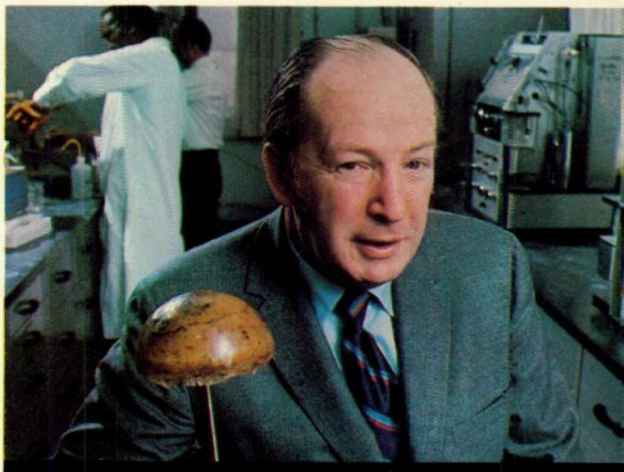
New plastics

Charles Steinmetz can be credited with launching GE's plastics business. In 1912 he recommended expansion of the staff conducting research in artificial resin chemistry. An early product of this effort was Glyptal® alkyd resin paint used in electrical coatings and varnishes. By 1928, a large phenolic compounding plant was established at Pittsfield, Mass., and soon produced such products as vacuum tube bases to replace fragile ceramics. Numerous wire coatings and insulation were developed by GE beginning with PVC polymers that supplanted brittle rubber in 1934, followed by flame-resistant Flamenol® insulation, Formex wire enamel and tough Alkanex® polyester insulation.

The modern era of engineering plastics began in 1953 with the discovery of Lexan® polycarbonate resin—one of the world's toughest and most famous plastic materials. Dr. Daniel W. Fox was working on new wire insulations at the Research Laboratory and "brewing" a batch of polymers using diphenyl carbonate when his stirrer motor stalled.

"When the mass cooled down," he recalls, "I broke off the glass and ended up with a 'mallet' made up of a semi-circular replica of the bottom of the flask with the stainless steel stirring rod sticking out of it. We kept it around the laboratory and occasionally used it to drive nails. It was tough."

GE's family of plastics grew with the 1956 discovery by Dr. Allen Hay of an entirely new polymer material, PPO® resin, with excellent strength at high temperatures. The commercial outgrowth of his discovery: Noryl® resin. Soon to follow were Genal®,

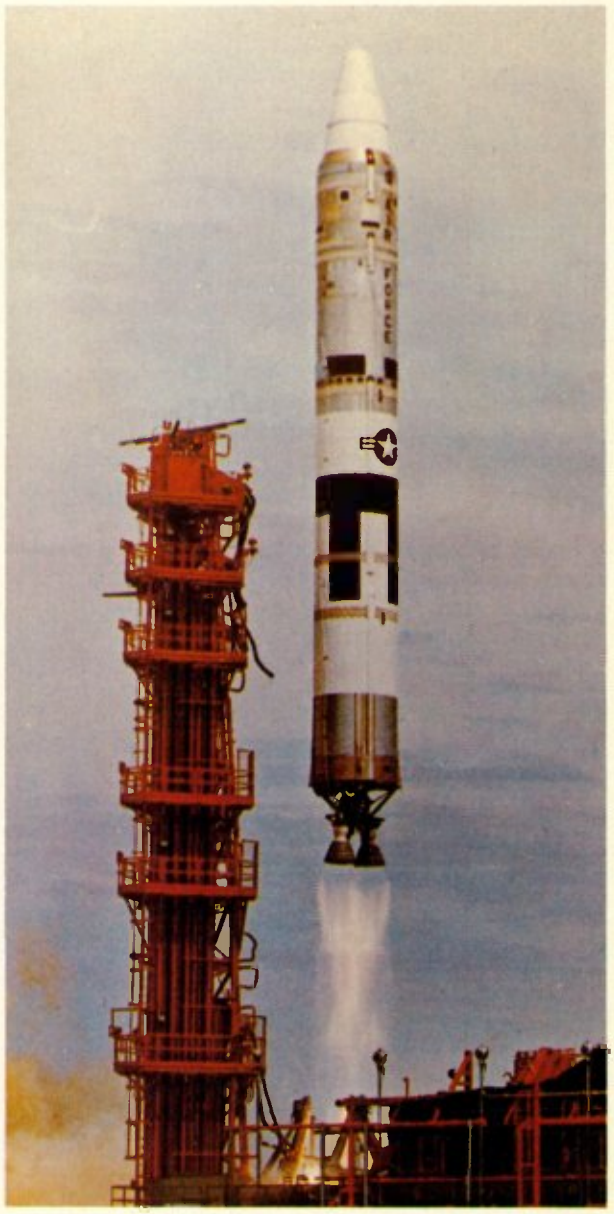


Dr. Daniel Fox (above), inventor of supertough Lexan® polycarbonate resin. Today, Lexan Structural Foam reduces jeep weight by substituting for its heavier metal top (below).

the modern injection-moldable version of the original phenolic, in 1968, Valox® thermoplastic polyester resin in 1971, and Engineering Structural Foam in 1972. Today, GE produces over 500 million pounds of engineering plastics a year and is the world leader in the field.

GE in space

At White Sands, New Mexico, in the late 1940s, GE and German scientists combined their talents to give America its first boost into space. It was dubbed the Hermes Project after the Greek messenger of the gods, and it began with captured V-2 rockets. But



GE aerospace technology includes satellite microwave communications (above), sophisticated re-entry systems for space vehicles (right), and ocean systems for undersea research (below).

over its decade of existence, the project tested 103 rockets and missiles and developed the world's first multistage liquid-propellant rocket that was a precursor of the Atlas and Titan rockets later built by the U.S.

In 1955, GE was given the challenge of developing a heat protection system to house and protect space payloads during re-entry into the earth's atmosphere when temperatures of 12,000°F are encountered. The result was the extremely successful Mark 2 re-entry system. Operational on both the USAF Thor IRBM and the Atlas ICBM, the Mark 2 provided the nation with a strategic deterrent weapon system which helped maintain the world's balance of power. Today, GE provides the re-entry systems for the USAF's Minuteman III and the U.S. Navy's Trident ballistic missiles.

From this weapon systems work evolved a series of early technological achievements which served as stepping stones for advanced aerospace programs: the first payload recovery from space, in 1958; the first vehicle recovery after flying the full ICBM range (1959); first photos taken from space (1959); the first satellite recovery from orbit (1960); the first transmission during re-entry blackout period (1961); and the Biosatellite space laboratory (1969).

By 1961, GE had opened its Space Technology Center on a 128-acre wooded site at Valley Forge, Pa., where a complex of nine buildings rose to become the largest, most advanced space facility built by private industry. Here, GE's support of the nation's all-out manned space effort spanning the Mercury, Gemini, Apollo and Skylab programs was concentrated. For Project Apollo, GE supplied overall quality control, systems engineering, checkout equipment, facilities for Saturn launch vehicle tests, first live color TV pictures of splashdown, and the SNAP-27 lunar power source. When man landed on the moon, it was with the help of 37 GE components and some 6000 employees.

Post-Apollo assignments have included development of the Nimbus and Landsat satellites, Japan's experimental broadcast satellite, the Space Shuttle's checkout station, and interplanetary probes such as Viking, Pioneer and Jupiter. Among many spin-offs of GE space technology are thermal insulation for the Alaskan pipeline, manned underwater habitats, modular housing, environmental protection systems, experimental solar energy systems, and industrial and underwater manipulators.

GE technology: international

Since 1882, when Edison installed a 3000-lamp electric lighting system at London's Holborn Viaduct, GE technology has known no national boundaries. By 1893, GE proudly proclaimed that its incandescent and arc lamps "extend in an unbroken line around the earth; they shine in the palace of the Mikado as well as in the Opera House in Paris."

"International demand for GE technology has grown steadily over the history of the Company," points out Senior Vice President and International Sector Executive John F. Burlingame. "For example, back in 1914, GE contributed significantly to the electrification of the Panama Canal. Today, General Electric technology and know-how are at work in more than 140 countries of the world. Examples range from power generation in Japan and d-c transmission in Zaire to locomotives for Latin America and jet engines for the A300 European Airbus.

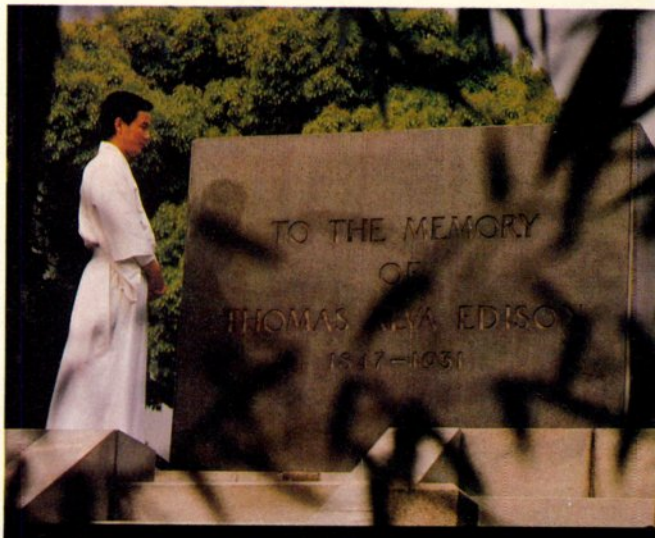
"High-technology products and systems accounted for a major share of GE's $4.7 billion in sales to markets outside the U.S. in 1977. Of particular importance were power, transportation, communications and medical systems, as well as industrial production equipment and materials such as engineering plastics and Man-Made® diamonds.

"In the future, GE's success as an international company will continue to depend in large part on how well we match our technical capabilities to the needs of countries in every stage of growth and development. As a result, maintaining technological leadership will continue to be a priority objective in the years ahead."

General Electric technology builds the world's economic infrastructure, including Speedtronic® solid-state control system for GE gas turbines in the Mid-East (above), and power transformers at Aguirre, Puerto Rico (below).

GE's research thrusts

Dr. Arthur M. Bueche, vice president for research and development, summarizes the Company's present technical thrusts: "In 1977, for the second year in a row, GE's R&D expenditures topped $1 billion. Around the world, the Company has some 15,000 technical-degree holders engaged in research, development and engineering. In terms of the breadth and depth of their technical training, and the vari-



Symbols of the worldwide spread of electrical technology since young Tom Edison launched his lamp experiments are located only miles apart in Japan. At Osaka, near the research laboratories of the Matsushita Electric Company, is a full-length statue of Edison (left), surrounded by other electrical pioneers. It was commissioned by the firm's founder, Konosuke Matsushita, in order that "our employees would be reminded of Edison's example and be inventive like him." Nearby, at Kyoto, a memorial stands on the grounds of a Shinto shrine, source of bamboo for Edison's lamp filaments.

ety of programs in which they are engaged, these men and women constitute the strongest and most diversified technical team to be found anywhere. One evidence of this is the Company's patent record; GE has led the list of companies receiving U.S. patents every year since records have been kept. Over recent years, GE engineers and scientists have been producing patentable new inventions at the rate of nearly four every working day. Our people have won countless other awards, too . . . Nobel medals, the top honors of professional societies, and industrial prizes. But the most important contributions of our engineers and scientists are not patents and awards; rather they are the contributions made to new and improved products which General Electric can offer: to industry for greater productivity; to utilities for efficient and environmentally-sound ways to generate and deliver power; to government for stronger defense; and to consumers for new convenience, safety, reliability, and greater value. Recently, an in-depth Company-wide study—throughout Operations and at the Corporate level—confirmed our traditional strength in technology, but it also came up with many challenges. What it all means is that the Company's second century is going to be a very exciting time for all of us."

Excitement ran high as a GE-sponsored Junior Achievement enterprise was named "Company of the Year."

Top JA company is GE-sponsored

First among 7500 competitors—the top Junior Achievement manufacturing company in the nation—that's the distinction won by a JA minicorporation run by a group of Fort Wayne high school students.

X-10-TION, a Junior Achievement company sponsored by GE-Fort Wayne's Specialty Motor Department, was recognized at JA's 1978 national conference as the "Company of the Year." The "catch" name of the top company denotes its primary student-made product, electrical extension cords.

The awards competition was strenuous. To become Number One, the 18 Fort Wayne achievers had to start from a field of more than 7500 high-school firms operated by 200,000-plus enterprising students. Specialty Motor Department's help was continuous and vital. A band of employee advisers volunteered countless hours to guide the young executives in effective business management.

GE people have contributed their time and talents to nearly 2000 student-run companies since the national JA organization was formed in 1942.

Helping Fort Wayne students (center) run the nation's top JA company were GE business counselors (clockwise from left): Henry Reidenbach, Doug Lohse, Wynn Hazen, Dan Beckman and coordinating adviser Gene Andert.

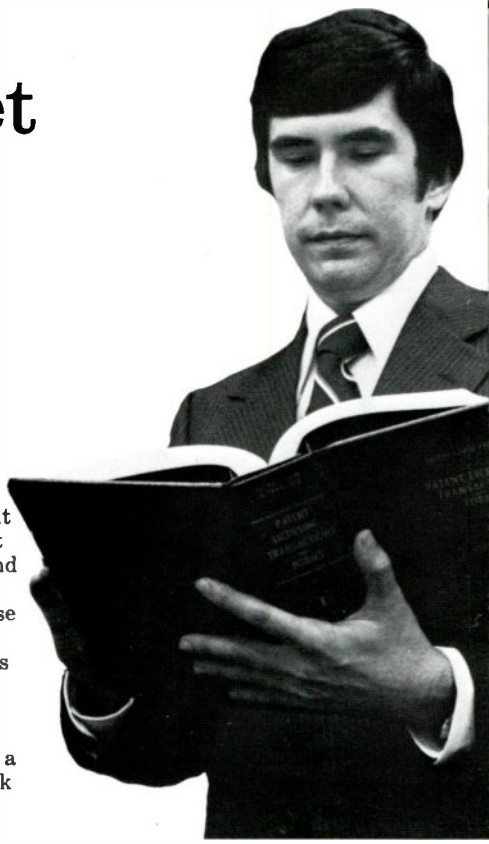
Dr. Timothy Prince: latest in line of family 'doctors'

A member of one of GE's notable families, Evendale engineer Dr. Timothy C. Prince (standing) is the grandson of both Dr. David C. Prince, a retired GE vice president, and Dr. Philip L. Alger, formerly with Schenectady's Large Motor & Generator Department. His father, Evendale's Dr. David C. Prince, Jr. (seated), a consulting engineer, works with his son in the Advanced Engineering and Technology Programs Department.

"My father earned his Ph.D. in 1951 at MIT while working for GE-Lynn," notes Timothy. "My grandfathers' Ph.D. degrees were both 'honorary,' earned for their many engineering accomplishments." Using the Tuition Refund Program, Timothy earned his M.S. and Ph.D. degrees in mechanical engineering from the University of Cincinnati, in 1970 and 1976. "Luckily, my dissertation was work-related—on the aerodynamics of turbines and compressors—so I finished my Ph.D. work somewhat faster."

Employees who get the 'Third Degree'

One's formal education need not end when joining GE. The Tuition Refund Program is helping many GE employees earn their doctorates.



For Ralph Savage, degrees in engineering, business and law

When Utica's Ralph M. Savage fills out forms that call for his educational background, it takes a little time: 1968, B.S. in electrical engineering; 1970, M.S. in electrical engineering; 1972, GE Advanced Engineering Course; 1974, M.B.A., including an American Marketing Association special award for maintaining a perfect 4.0 average during his studies; 1977, Juris Doctor.

"I always wanted to attend law school, but couldn't swing it financially by myself," notes the patent attorney for Aircraft Equipment Division departments in Utica and Binghamton. His latter two degrees were obtained at Syracuse University with the help of Tuition Refund. Savage describes the 100-mile round trip between Utica and Syracuse as "tiring," and adds: "I was the only one in my class who worked eight hours a day and, during the evenings, took the exhaustive review course to prepare for the bar exam."

In 1980, they'll be Dr. and Dr. Morris Morgan

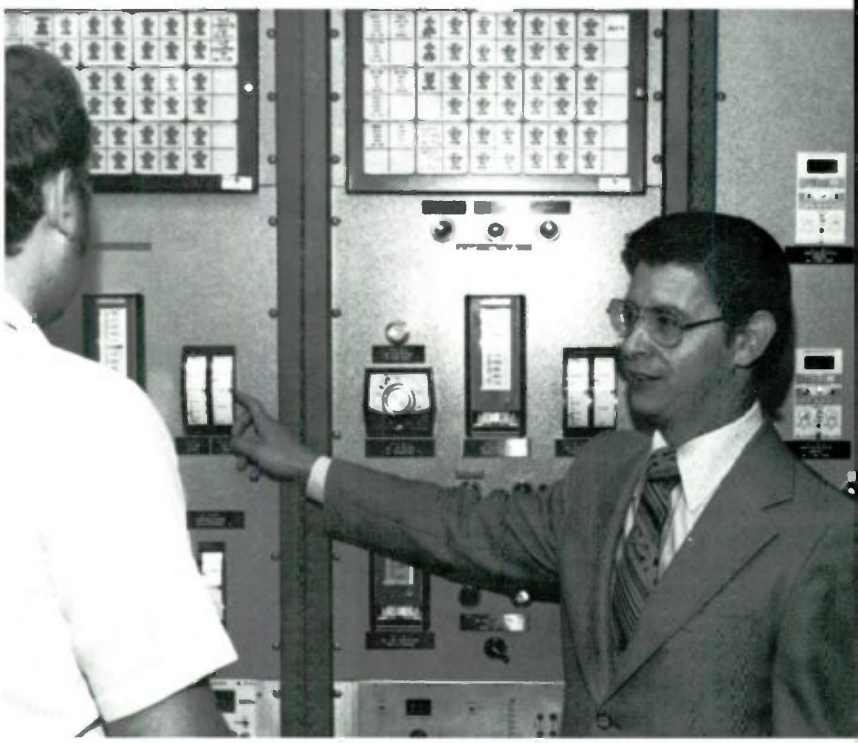
This May, the Research and Development Center's Dr. Morris H. Morgan received his chemical engineering doctorate from Rensselaer Polytechnic Institute. His wife Carolyn, also with Schenectady's R&D Center, is now completing her Ph.D. in statistics at Union College. Both joined the Company in 1973.

"Since we both went back to graduate school, we felt less guilty about studying instead of washing the dishes," comments Dr. Morgan, a staff chemical engineer. Adds Mrs. Morgan, a computations statistician: "Our son Eric was born last October. Considering our heavy study loads, we were lucky that he began sleeping through the night after two weeks!" Husband and wife agree that the Tuition Refund Program has been beneficial. "Educational costs have soared," Morris observes. "It's great not to have to face a heavy financial burden. Continuing education works to the advantage of both the Company *and* the individual."

Dr. Sam Armijo: academic motivation from GE experience

Looking back at the 1960s, San Jose's Dr. J. S. "Sam" Armijo recalls: "It was an important time of high-technology changes. I wanted to work. And I wanted to go to school." He ended up doing both. "It made for an interesting experience. The business world and the academic community operate at different paces. But a lot can be accomplished in a short time when you're committed to it. I was able to finish my doctoral dissertation work in only 18 months."

Armijo is manager of core materials engineering for the Nuclear Technology Department. He considers his GE association valuable for more than the educational benefits which helped him earn a Ph.D. in materials science from Stanford University in 1969. "Many years of GE lab disciplines taught me what projects to start, and probably more important, *how* to finish them. Bringing any kind of research to a timely completion is standard operating procedure."



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Dr. Leo Sheporaitis: 'research teaches you how to learn'

"Independent work makes you creative—it's the 'proving ground' where you learn how to discover the unknown," states Burlington, Vt.'s Dr. Leo P. Sheporaitis, an advance design engineer with Armament Systems Department, pictured (right) with associate Carol J. Mowinski. Sheporaitis joined GE in Lynn in 1960 and transferred to Philadelphia a year later. There, he earned an M.A. in mathematics from Villanova University in 1965 and a Ph.D. in applied mathematics from the University of Pennsylvania in 1969. His work-related dissertation concerned the random effects of aerodynamic disturbances on GE satellites and re-entry vehicles.

"During one's Ph.D. studies, the 'payoff' often seems uncertain. Many hurdles have to be faced: preliminary exams, comprehensives, the dissertation, orals. My wife and I had two children during my graduate-school years, and all these events made for some lively times." Was all the study worth it? "In my case, the Ph.D. degree opened new doors for me in research. I'm thoroughly enjoying the camaraderie of scholarship that has come with the endeavor."

Dr. Ron Mann earned all three degrees with GE help

Syracuse's Dr. Ron L. Mann joined GE in 1956—still 60 credits short of his bachelor's degree. Using GE educational benefits, he enrolled part-time at Syracuse University a year later, and earned his B.S. degree in mechanical engineering in 1961. The next six years saw him return to SU to obtain his M.S. in mechanical engineering also, and this May he received his Ph.D. in mechanical engineering as well.

A firm believer in self-improvement, this Heavy Military Equipment Department consulting engineer has developed and taught four GE engineering courses in the past five years. He urges: "At least once every two years, take a Company or university course related to your field, so you can stay up-to-date. In my case, although I'm 20 years older than people just getting out of school, I have 20 years of industry experience in addition to being as up-to-date academically as they are!"

Mary Ann Peters: her doctorate's 'around the corner'

Now writing her Ph.D. dissertation and also working full-time for the Company, San Jose's Mary Ann Peters takes a no-nonsense attitude toward her appointments calendar and wristwatch: "Don't let anyone waste your time—if you want to waste it, waste it yourself." A veteran of long work days that end in the library at 11 p.m., Peters, a senior product planner with Nuclear Energy Programs Division, will receive her Ph.D. in business from Golden Gate University in 1979.

Her dissertation concerns leasing capital equipment to the government—"a subject of potential value to GE," she submits. "GE employees' support for my research has been wonderful, and I've received a multitude of leads in the banking world, Congress, Office of Management and the Budget, and throughout the Company." Peters began her Ph.D. work in 1974, before joining GE in 1976: "The Tuition Refund Program has given me the financial 'stick-to-itiveness' I needed."

Dr. Bud Konrad's degrees 'occurred' from updating skills

For the engineer, a simple fact of life: if you want to keep your skills sharpened, continue your education. Salem's Dr. C. E. "Bud" Konrad, senior development engineer, had no trouble following that philosophy. For years, classes at Virginia Polytechnic Institute were a natural extension of his work at the Industrial Control Department. "After all, GE's Tuition Refund Program was paying my way," he explains. "The funny thing about it all was that I never gave much thought to advanced degrees. But before I really realized it, I had completed about 80% of the course requirements for a master's in electrical engineering. So I got one in 1967, then went on to earn a Ph.D. in 1971."

Until last year, Konrad also was an adjunct professor of graduate electrical engineering at VPI. "I owe a lot to the school—and to GE. The Company paid for everything except my diploma fee and cap and gown. You just can't argue with that!"

Organization Changes

CORPORATE

Arthur M. Bueche elected Senior VP—Corporate Technology

R. Howard Annin, Jr. elected VP—Regional Relations

Roland W. Schmitt elected VP—Corporate Research and Development

CONSUMER PRODUCTS AND SERVICES SECTOR

Paul L. Dawson elected a Vice President

Richard T. Gralton elected VP and general manager—Major Appliance Sales and Distribution Operations

Irving L. Griffin, VP—Special Studies, Major Appliance Business Group

Norman E. Gertz, general manager—Refrigerator Components Department

Stanley A. Gorski, general manager—Central Air Conditioning Department

Thomas J. Shideler, general manager—Home Laundry Manufacturing Department

INDUSTRIAL PRODUCTS AND COMPONENTS SECTOR

Eugene J. Kovarik elected a Vice President
William Longstreet, elected VP and general manager—Contractor Equipment Business Division
James M. McDonald, general manager—Apparatus Distribution Sales Division
William H. Broach, general manager—Western Apparatus Service Department
Donald G. Cochran, general manager—Hermetic Motor Department

INTERNATIONAL SECTOR

Frank D. Kittredge elected a Vice President

POWER SYSTEMS SECTOR

Edward C. Clark elected VP—Special Projects
George B. Cox elected a Vice President
George H. Schofield, general manager—Industrial and Marine Steam Turbine Division
George W. Sarney, general manager—Mechanical Drive Turbine Department

TECHNICAL SYSTEMS AND MATERIALS SECTOR

Lee L. Farnham elected a Vice President
Donald K. Grierson elected a Vice President

Women in hard hats

GE people continue to prove traditional job viewpoints were too narrow.

Old-line ideas of where women are "supposed" to work—or not work—keep on being shattered by GE employees.

Take construction sites. Once the individuals under those hard hats were invariably male. But no more. In GE's Real Estate and Construction Operation, three more GE women have become members of the team:

- Allison Donenfeld, a Union College engineering graduate, is a resident manager in RECO's Projects Operation. "My job as resident manager," she says, "affords me plenty of opportunities to use my engineering skills, plus the fact that I get a lot more contact with people in the field. RECO is the kind of operation where you take on as much responsibility as you can and learn from every situation."
- Kathy Flood, a graduate of Russell Sage College in Troy, N.Y., joined GE's Financial Management Program this past January. Her assignment with RECO's financial section involves on-site audits at construction sites. "I was assistant controller for a wholesale construction firm before joining GE," comments Flood. "But there are better opportunities with GE and I feel like I have more of a future here."
- Karen Mason, who has worked as an engineering intern with RECO, feels that the experience has "added direction" to her work toward a degree in design engineering at Union College. The on-site inspections she has conducted with Donenfeld have, in her view, brought a new perspective to her design interests. "I've enjoyed my internship with GE," she says. "They encourage you to take responsibility and learn, and I like that."

Out in Morris, Ill., another GE employee is breaking new ground as GE's first woman licensed to operate a commercial nuclear plant. She's Andrea Hotham and her job is as a senior instructor at GE's Boiling Water Reactor Training Center in Morris—a job requiring a senior operating license from the Nuclear Regulatory Commission.

Hotham graduated from Northwestern University with a liberal arts degree and planned to be an English teacher. Now, instead, she's teaching nuclear plant operation. Her experience has made her an advocate for nuclear power. "If we're going to have enough electricity to meet our needs in the 1980s and 1990s," she says, "we've got to build nuclear plants now."

Kathy Flood, an auditor for RECO's financial section, checks out a shipment of steel for one of her customer's accounts.

At GE construction site, RECO resident manager Allison Donenfeld, left, and engineering internist Karen Mason pore over blueprints. "People accept you for what you can do," Donenfeld says, "not what you are."

At home before a nuclear plant control console, GE's Andrea Hotham works as a senior instructor at the GE Boiling Water Reactor Training Center.

Windows on the world's research

Liaison staffers help GE keep current on the 60% of technology that's non-U.S.

Writing in the influential *Washington Post* recently, commentator Daniel S. Greenberg made the point that while other nations are vigilant in observing U.S. technology, the U.S. fares poorly at keeping in touch with leading scientific centers abroad. It's an imbalance, he wrote, that American industry is aware of, "but with the Government indifferent to the problem and pooled monitoring efforts barred by antitrust regulations, few companies do anything about it."

Then he added: "One major exception is General Electric, perhaps the most shrewdly and tightly managed of our big high-technology corporations. Monitoring of foreign science and technology is handled by two GE representatives in Zurich, two in London and one in Tokyo."

Greenberg ended by quoting Dr. Charles M. Huggins, manager—International Programs Operation at GE's Research and Development Center. GE keeps watch on overseas R&D, Huggins told him, because "60 percent of all new science and technology is developed outside the United States."

Dr. Charles Huggins

Dr. Charles M. Huggins has headed the R&D Center's international liaison program for three years, following eight years spent in maintaining liaison between the R&D Center and domestic operations. "The job was and is a challenge and we've made a lot of progress. In establishing liaison with a ministry abroad, we find that the problems aren't so much in the areas of geography, social customs or language as in getting agreement on goals and objectives and in understanding the different ways in which people are motivated."

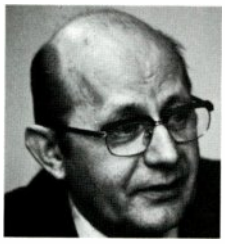
The *Post* article thus gave recognition to a little-known but vital part of GE's research program. For a broader view, the *Monogram* talked with Huggins and with representative members of his liaison staff.

"With so much of today's advanced technology being generated abroad," Huggins said, "we felt we had no option other than to establish scientific liaison with at least the three main centers of technology offshore—the Far East, Western Europe and Eastern Europe."

To maintain exchanges with these centers, GE's Interna-

(continued next page)

tional Programs Operation has for several years had liaison posts in Zurich and London in Western Europe, and in Tokyo in the Far East. As for Eastern Europe, Huggins handles most of this liaison himself. "It doesn't seem appropriate or productive to put an office there. We cover Moscow and Warsaw by traveling." Huggins has been to Russia 20 times in the past four years.



Rudolf Koehler

Rudolf A. Koehler, GE's Tokyo-based scientific representative for Asia, is an electrical engineer who started on GE's Engineering "Test" Course in 1942. "I've been here in Japan three years. Before that, my assignment was to maintain liaison between the R&D Center and GE's power delivery operations. The work here becomes steadily more challenging, because, whereas Japan was formerly a follower in technology, it's now often an equal, and sometimes a leader, in many key areas."

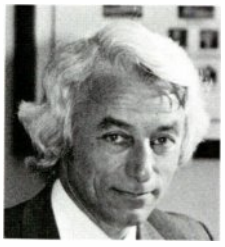
While those three geographical regions account for a large proportion of new science and technology, other areas are also important to General Electric. A long-established interchange with Canadian General Electric, for instance, is maintained through an assigned liaison scientist. Also, a new liaison scientist post has just been created in Schenectady to establish liaison with other areas—the first area of emphasis being Latin America.

In addition, Huggins' component includes a Materials Applications Center in Singapore, serving the laboratory needs of GE's Singapore operations, and a study is underway to provide a similar service in Brazil.

All in all, the liaison staff includes some 22 people, including eight Ph.D.s, a professional engineer, six engineering technicians in Singapore, and a secretarial staff that is at least bilingual and in some cases trilingual.

Huggins sees the objectives as being very clear: "Our operation assists and complements the entire staff of CRD to identify, access and transmit to the Company the technological developments interesting to GE." He adds that "this is all done in a perfectly legal way, through public information or contractual agreement."

In carrying out this program, the liaison operation provides a resource for technology-based special missions—studies and analyses, as well as evaluation of people, institutions and technologies. "We also implement and manage cooperative R&D programs with other institutions, as a way of acquiring technology not otherwise available to us. And, of course, we provide a variety of technically oriented services to the Company's commercial operations. We will participate in delegations to foreign governments for science discussions, for example, or put together R&D exhibits as part of a big trade show."



Dr. Eric Ash

Dr. Eric A. Ash, a Fellow of the Royal Society, is one of two GE liaison scientists located in London. "I concentrate mostly in the area of physical electronics, while my associate, Peter Kirstein, follows the computer sciences. For both Peter and me, the GE work is part-time —I'm also a professor in the Department of Electronics Engineering at the University College of London. I find it a help to the GE job to be actively engaged in research myself—people in other organizations can be sure that we on our side can bring something useful to any mutual discussion."

Areas of mutual interest to GE and to other institutions are sought out by GE's liaison people. "We probe to see if there is a possibility of sharing experiences in areas that can be discussed publicly. If interest is indicated, our staff members will arrange for an exchange of technical specialists to delve further into the matter. Relationships must be built on mutual respect—without that, nothing can be accomplished."

Dr. George Szasz

Dr. George J. Szasz is one of two GE scientific representatives for continental Europe, with offices in Zurich. "Our main objective in establishing CRD's Liaison Office in early 1956 was to strengthen our ties with the scientific and technical community in Europe. I focus on materials science and engineering while my associate, Dr. Hans Eichenberger, specializes in electrical and mechanical engineering—with emphasis on energy-related technology. We also provide modest financial support to outstanding young scientists who are involved in projects of interest to General Electric."

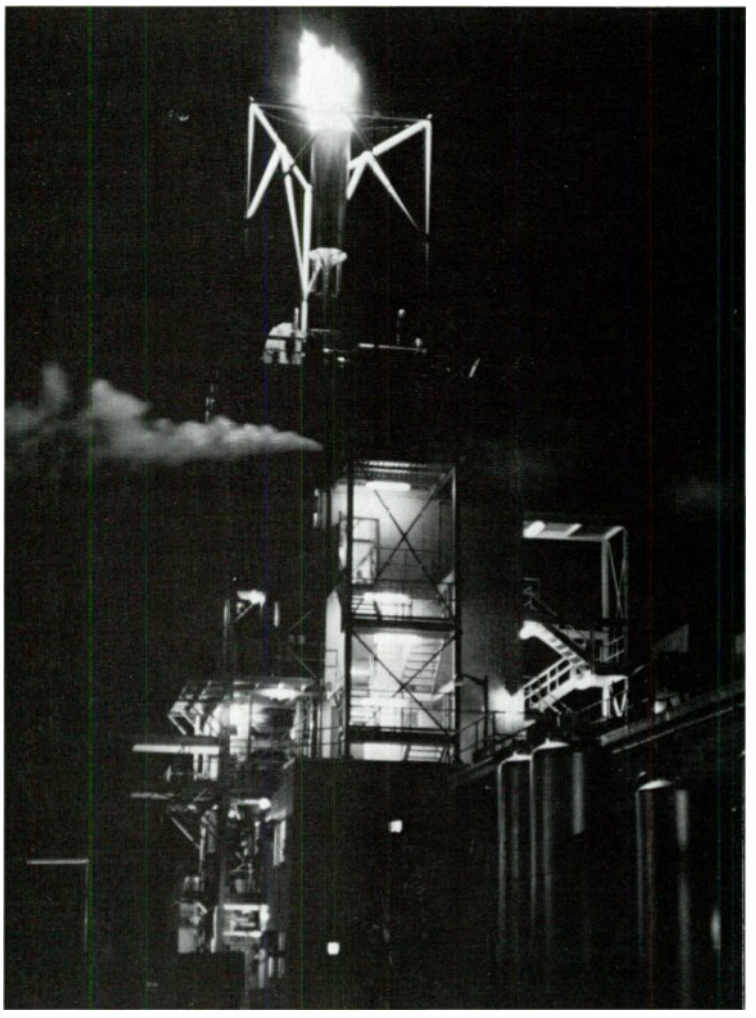
What's an example of a cooperative R&D program? "One I could cite," Huggins said, "is our agreement with the National

Coal Board of the United Kingdom to establish a continuing exchange of technical information related to the future of coal in supplying energy needs. This technical collaboration started last year through the cooperative efforts of Sir Derek Ezra, chairman of the National Coal Board, General Electric Chairman Reginald H. Jones, and GE Vice President for Corporate Research and Development Roland W. Schmitt.

"Thus far, we have initiated an exchange of engineers, are looking at the technology of coal mining and handling equipment, and are involved in joint studies of energy scenarios, including coal gasification."

Huggins notes that another example "involves a project CRD has underway for the Electric Power Research Institute to develop a sodium-sulfur battery—a super-battery that could be used by the nation's electric utilities for bulk energy storage. We have worked out a subcontractor relationship with the Marcoussis Laboratories of Compagnie Générale d'Electricité of France to acquire their unique expertise in the technology of making seals that secure the battery system."

By maintaining these "windows on the world's research," the R&D Center keeps a steady output of relevant technological information flowing to GE operations. The written reports are supplemented by personal contacts. "It's standard procedure for liaison representatives to spend part of each year in the U.S.," Huggins says. "They revisit the R&D Center and also travel to their 'clients' in GE operations. It's a necessary step in keeping our information-gathering network in tune with the needs of GE businesses."



Two examples of cooperative international projects developed with the aid of R&D liaison reps: (above) coal gasification research at the R&D Center, shared with the U.K.'s National Coal Board; and (left) work on sodium-sulfur batteries, utilizing technology from France's Compagnie Générale d'Electricité.

Other new technical areas of mutual interest to GE and various institutions are now being explored by GE's liaison people—to maintain a steady flow of useful information to the Company's components.

Cogeneration

It's a new buzzword for an old energy idea. Since the 1950s, GE has supplied more than 400 'cogenerating' turbine-generators.

A look at this nation's future energy alternatives leads to one inescapable conclusion—that *all* of our energy supply options must be pushed. In his April 20, 1977, energy message to the nation, President Carter mentioned "cogeneration" as one of the options to be encouraged, and his subsequent National Energy Plan embraced this concept as a means of conserving energy and reducing the nation's dependence on foreign oil.

Is cogeneration something new? It might be for those unfamiliar with power generation, but for General Electric, other industries and many utilities, it's just a newly coined word for a concept that has been applied successfully by many facilities for years. In the past, it has been called "in-plant generation," "on-site generation" and "the byproduct power concept."

Briefly stated, cogeneration is the simultaneous production of electric power and a useful form of thermal energy, such as steam. The "co" in cogeneration refers to the electricity and steam produced—not the teaming up of an electric utility with another industry.

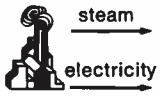
A cogeneration installation can be either an in-plant facility or a so-called "over-the-fence" arrangement, where steam and electricity are moved across property lines. The co-location forms of cogeneration fall into numerous arrangements (see accompanying chart).

Why the increased attention to cogeneration? Observes Lynn's George H. Schofield, general manager of Industrial and Marine Steam Turbine Division: "Rising fuel costs, uncertain energy supplies and conservation efforts have made cogeneration a subject of added importance to facilities with substantial energy requirements. The energy-saving potential of cogeneration cannot be denied. Invariably, electric power and process or heating steam can be produced simultaneously with greater energy efficiency than in two unrelated facilities."

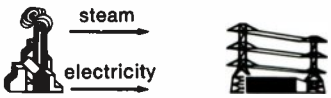
Because of General Electric's various turbine businesses, the Company is heavily involved in cogeneration applications. Cogeneration is a steam turbine and combustion gas turbine technology, and a combination of the two can be the most efficient arrangement in a number of cases. The Company began supplying steam turbine-generator units for cogeneration in the early 1900s, and the first cogenerating gas turbine units were sold in 1956.

Since the 1950s, GE has supplied more than

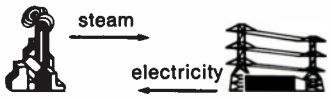
Examples of cogeneration



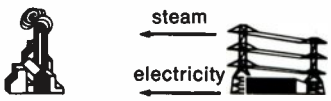
The industry owns its own equipment and produces its own electricity and steam.



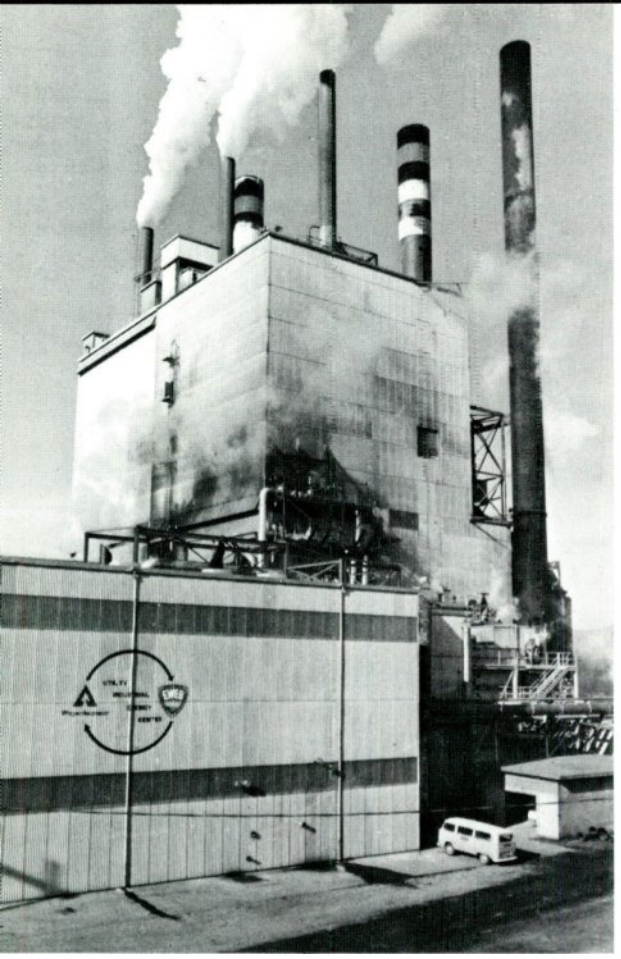
The industry owns its own equipment, produces its own electricity and steam, and sends the excess to a utility.



The industry owns only the boiler and sends its excess steam to a utility; the utility, which owns the turbine-generator, sends electricity to the industrial plant.



The utility furnishes steam as well as electricity to the industrial plant.



This cogeneration facility is jointly owned by Weyerhaeuser Paper Company and the City of Eugene (Ore.) Water and Electric Board (EWEB), and includes a 50,000-kilowatt GE steam turbine-generator. Electrical output is sold by EWEB to the cities of Pasadena, Burbank and Glendale, Calif.

400 cogenerating units, with ratings of from 2500 to 120,000 kilowatts, for such industries as pulp and paper, chemicals, steel and petroleum. Also, GE has supplied more than 100 mechanical drive gas turbine units to cogenerating industries where heat recovery boilers are used to provide process steam or heat.

Why does the cogeneration concept succeed? Explains Schofield: "With cogeneration, waste heat is converted to process steam, thus utilizing a much higher percentage of a fuel's energy potential. The additional fuel required to produce both electricity and process steam can be as low as one-half of that required for large plants generating electric power only."

Schofield continues: "A plant's steam requirements, rather than its electricity requirements, usually determine the feasibility of cogeneration. If a plant has large steam requirements and is planning a large, low pressure steam boiler, the increased efficiency of a cogeneration cycle can readily justify the additional investment of a somewhat larger high pressure boiler."

Energy savings from cogeneration are well-documented. Nevertheless, *energy* efficiency and *economic* efficiency are not necessarily the same. If utilities and industry are to voluntarily embrace cogeneration on a large scale, there must be some economic incentive for doing so. Acknowledging this fact, President Carter has included incentives in his National Energy Plan now before Congress.

"Federal legislation, more than anything else, will affect cogeneration's growth," submits Schofield. "Both electric utilities and industry insist that cogeneration's full potential will require changes in present rules." They include:

- Increased tax incentives.
- Federal guarantees or allowances to promote new energy processes.
- New environmental standards that consider benefits of efficient energy production.
- Regulatory changes, to promote profitable cooperation between utilities and industry.

The provisions of the National Energy Bill requiring joint utility/industrial cooperation in certain cogeneration projects create concerns on both sides. Utilities are concerned with the problems of arriving at "fair" rates and the allocation of priorities.

By the same token, many industries are reluctant to consider external sales of electric power because they do not want to get involved in utility licensing regulations, or to be forced to guarantee the time of day and amount of power to be delivered to the utilities.

Another question concerns the future availability and price of fuel. Some plant managers are reluctant to add cogeneration facilities because of doubts concerning both these subjects.

Despite these concerns, cogeneration undoubtedly will receive further impetus as industrial plants seek protection against possible shortages of electric power. In the 1980s, the possibility exists for serious electricity shortages in many parts of the U.S.

Observes George Schofield: "In the right situations, cogeneration extends an opportunity to supply all the plant's process heat requirements and all or most of the plant's electricity needs, at much lower cost than if each were developed in separate processes."

Bright ideas

Superior 'flashability'

Shutterbugs are taking snappier snapshots with Photo Lamp Department's new FlipFlash® II array. The bulbs generate 50% more light than those of the original FlipFlash units, and built-in lenses and a special reflector distribute light more evenly than other multiflash models.

Lights cut school bills

Classroom subject: energy. As part of a national education group's "Saving Schoolhouse Energy" project, Fluorescent Lamp Department's Maxi-Miser® lamp/ballast system is providing low-cost light and high system efficiency to a Washington State elementary school (above).

Halogen headlamps twice as bright

Helping motorists keep their eyes on more of the road, Miniature Lamp Department's halogen headlamps (left) can double a car's present allowable high-beam headlamp candlepower. The new sealed-beam units' whiter, brighter light increases visibility on the highway.

An eye for quality

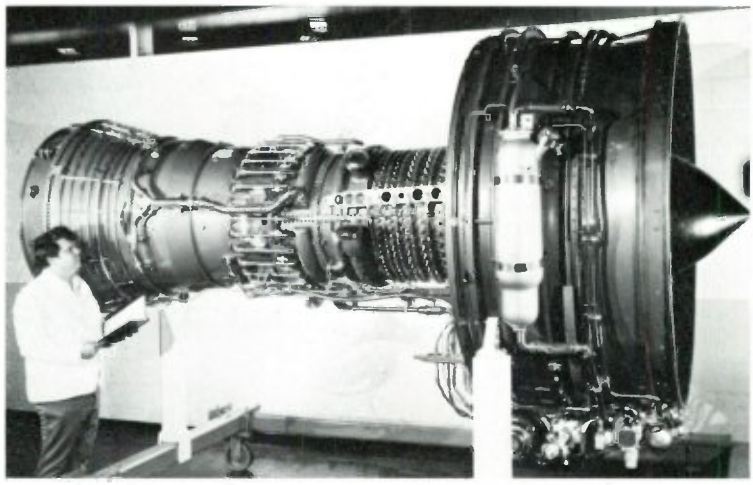
Electronic quality control for industry from the Electronic Systems Division: when the TN2500 Camera feeds visual data into the PN2383 Decision Processor, high-volume manufacturers can inspect, measure and control 300-plus parts a minute.

Just 'charge them'

For the person who uses many batteries around the home or office, Battery Business Department's BC1 charger saves money. Introduced in September, it charges up to two pairs of the same or different size GE rechargeable batteries simultaneously.

'Relax' your hair

Curly hair? Kinky hair? A case of "the frizzys"? Now, hair can be relaxed at home to achieve a variety of soft-looking styles. Housewares and Audio Business Division's Curl Tamer® hair straightener can be used from one shampoo to the next.

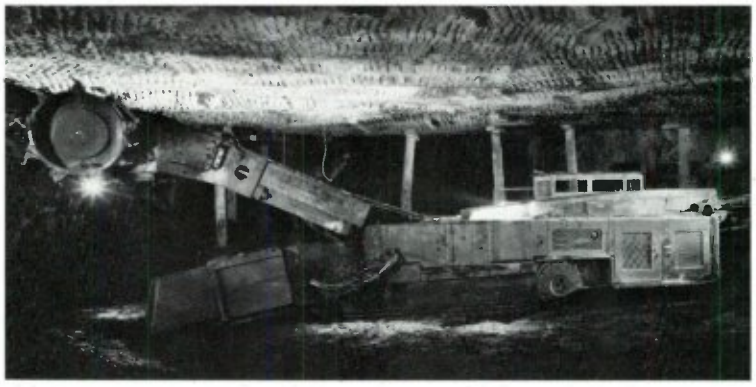


Powerhouse for medium-size aircraft

Aviation experts at September's internationally renowned Aerospace Exhibition and Flying Display in Farnborough, United Kingdom, scrutinized a leading candidate to power new medium-size twin and trijet aircraft. On display: a full-size mockup of the CF6-32 high bypass turbofan engine by the Aircraft Engine Business Group. The new GE powerplant has a thrust rating of 30,000 to 39,000 pounds.

Kitchen energy-saver

The Potscrubber® III dishwasher not only saves energy—it can make your kitchen quieter, too. Heating the water represents 80% of a dishwasher's energy use. With a unique high-performance wash system, this new Major Appliance Business Group product uses 40% less hot water than its GE predecessor. And, a new drying technique eliminates the need for a fan motor, resulting in still more energy savings with less noise.



Motors for miners

Retrieving underground coal is essential to meet U.S. energy needs. San Jose Motor Plant's continuous miner motors can handle the job. Built with detectors to prevent overheating, they power massive cutting heads of low-profile underground miners (above).

Protecting with plastics

This job could be a shocker. But safeguarding high-voltage work on a Pennsylvania railroad's electrified "live" third rail are strong insulating covers (right) of Plastic Business Division's extrudable Noryl® thermoplastic resin.

PERSPECTIVES

'Good' vs. 'bad' stress

As a topic for public discussion, stress has received so much attention as to be confusing. GE's Dr. Lenci helps sort out the basics.

From the amount of space it has been given in press accounts, "stress" may seem like a new plague inflicted on humankind. As a byproduct of organization life, stress is considered by some to be a cause of hypertension, heart disease, colitis, kidney problems, ulcers, headaches, asthma, depression, anxiety and alcoholism.

Is stress worse today than in earlier eras? What are the basic facts to be winnowed from today's welter of information? The *Monogram* sought answers from General Electric's Dr. T. Dexter Lenci, Corporate Medical Operation.

As for the time scale, Dr. Lenci deflates the present-day emphasis on stress. "The truth is that while acute stress *is* responsible for a wide range of physical and psychological disorders, modern man is probably under no greater stress than were his earliest ancestors."

He agrees with the University of Montreal's Dr. Hans Selye, the leading expert in the field: "It is not that people suffer more stress today; it's just that they think they do."

The rush for relief from stress, Dr. Lenci notes, has placed heavy demands on conventional medical methodology in such fields as psychiatry and pharmacology. Many individuals seem to believe that stress is their own problem to solve, because their personal physicians lack the training and the experience to advise on some of the newer types of treatment.

Today's more esoteric solutions range from alpha-wave-training and Transcendental Meditation (TM) to Transactional Analysis (TA), yoga, Zen, est and hypnosis. Among nonbehavioral methods: acupuncture, vigorous massage, seaweed baths and Outward Bound survival courses.

Observes Dr. Lenci: "Scientists continue to study the relative benefits of each method. But it's still too early to say, definitively, that one or another procedure is 'best,' or even advisable in certain cases."

He continues: "There is no magic cure for stress. Because a person's reaction to stress is subjective, it's hard to recommend one universally applicable elixir. What relieves one person's stress may exacerbate another's. At any rate, it's not the stressful components of a person's life that usually cause a stress problem. More often it's how the person *perceives* the stress in his life."

Not all stress is bad. Everybody is under some stress because, as Dr. Selye has pointed out, if one managed to avoid stress completely, one would be dead. There is both "hyperstress," or too much stress, and "hypostress," or not enough. Both situations are relative to the individual.

Dr. Selye feels the word "stress" has been used so overwhelmingly in its pejorative sense that he has coined a word for good stress, "eustress," from the Greek word for good. An example of eustress would be that of Olympic winners at their moments of glory.

Exactly what is stress? In simple terms, Dr. Lenci says, it's a nonspecific response of the body to any demand. Stress is the state you are in, not the agent which produces it.

Whatever their form, agents of stress share one common trait: they stimulate in the body what is known as the primordial "fight-or-flight" response. The instant it receives the stress "alarm," the brain alerts the pituitary gland, and through the pituitary the adrenal glands, to secrete hormones to prepare the body for vigorous exertion.

With stress, the body's fight-or-flight response activates, but may be inappropriate. For the slow pupil whose teacher treats him as stupid, there is no one to fight, and nowhere to run. If one's fight-or-flight mechanism is continually activated, the body's adaptive energy simply runs out and physical or emotional illness may result.

Stress-connected illness contributes to one-third of the working days lost to sickness each year in industrialized nations, according to Sweden's renowned Caroline Institute. Because stress is caused by the individual's inability to adapt to a situation, it is not readily apparent. An unkind word from the boss, a social snub, a feeling of being unappreciated, stunning defeat or even victory—all affect one's well-being.

Personality may have a lot

to do with how well the body takes stress. San Francisco's Drs. Meyer Friedman and Ray Rosenman have defined Type A and B personalities. Type A is an obsessive striver, fights constantly against deadlines and has an extra dose of aggression. Type B is the opposite. The two doctors found that almost twice as many Type As as Bs had coronary artery disease, when other typical risk factors such as smoking or hereditary predisposition had been ruled out.

Dr. Lenci notes that the person who can adapt to complexities, or who knows when to quit if there's no remedy to a problem, is the type who thrives on stress. The "trapped" person who can't find a way out of a bad situation is the one prone to health problems.

"Much of the stress which people have to deal with is *not* job-related," notes GE's Dr. Lenci. "Many doctors say more problems arise from the home situation—e.g., marriage, children, finances—than from work itself." A chart (below) developed by Drs. Thomas Holmes and Richard Rahe at the University of Washington gives numerical weight in "life-crisis units" to life events that cause stress. In it, only 10 out of 43 life events are job-related.

What's to be done when the individual thinks he or she is under too much stress? Dr. Lenci supports the recommendation of the Menninger Foundation's Dr. Elmer E. Green, who states: "The first solution is to break the pattern of tension." That may involve nothing more than getting away for a weekend, or learning to delegate more authority. "Aerobic" exercises—such as walking, jogging, tennis, cycling and swimming—are commonly recommended for cardiovascular fitness. Hobbies are another tension-releaser.

As for Dr. Selye, he believes that the secret to avoiding undue stress "is learning how to live." One must pace oneself, carefully allocate one's time and energy, and be aware of how changes can upset one's equilibrium. He advocates, "Acquire as much good will and as many friends as possible."

Stress-relieving tips have been offered by Dr. Abraham Lurie of Long Island's Jewish-Hillside Medical Center:

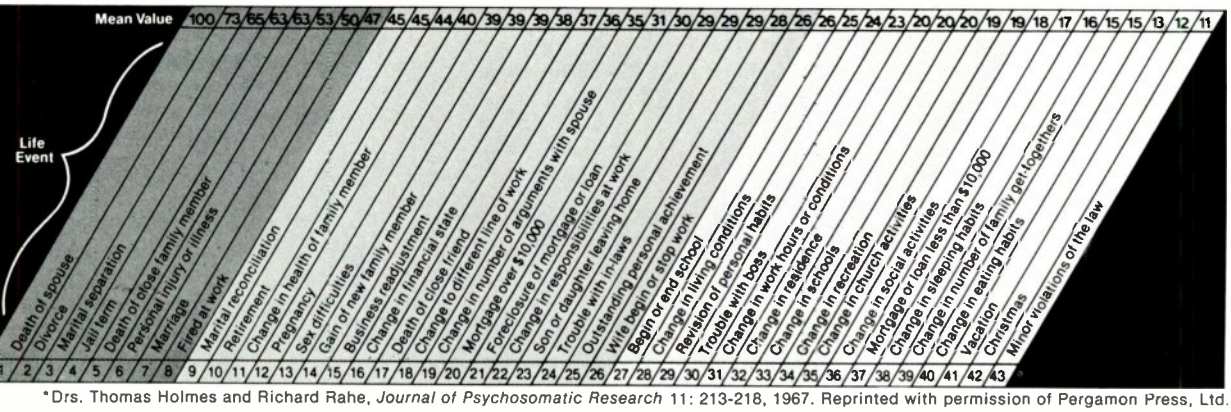
- First, try to identify the cause of stress. Next, decide how important it is. Then try to recall a similar situation, and how you resolved it before.
- If the problem is "external" to you, try breaking it up into its good and bad parts. If this approach fails to ease tension, seriously consider a major permanent change in your life. If change can't be effected, secure professional advice to help you adjust to the problems you must live with.
- If the difficulty is "internal," try to learn what recently has happened to intensify these negative feelings. Then you can work on modifying your reactions. If this doesn't work, consider professional counseling.

In addition, Dr. Lenci emphasizes the point that a good clinical evaluation—physical examination—is the cornerstone of appropriate stress management.

How's your stress score?

This "Social Readjustment Rating Scale" developed by Drs. Thomas Holmes and Richard Rahe at the University of Washington measures stress in terms of 43 "life events." They say a person scoring less than 150 on their scale has only a 37% chance of becoming ill during the next two years. A score of 150 to 300 raises the odds of illness to 51%, and a 300-plus score means you have an 80% chance of becoming seriously ill.

To find your score, check the events applying to you during the past 12 months. Then add up the total values.



*Drs. Thomas Holmes and Richard Rahe, *Journal of Psychosomatic Research* 11: 213-218, 1967. Reprinted with permission of Pergamon Press, Ltd.

GENERAL ELECTRIC
General Electric Company
Fairfield, Connecticut 06431

'LIGHT' HOUSE. Looking for a home that's light, bright, warm and easy on the budget? Built for *Family Circle* magazine, this house in Redmond, Wash., uses GE fluorescent lights, kitchen appliances and the Weathertron® heat pump to achieve economical energy use.

The home's lighting costs were cut 63% by a GE-designed lighting system that relies almost exclusively on soft white home fluorescent tubes instead of incandescent household light bulbs. The nine-room house, with windows located mainly on the south side to gather the Pacific Northwest's solar energy, uses 53 fluorescent tubes, several in custom-designed fixtures.

Undercabinet lighting in the kitchen (right) makes cooking and clean-up chores easy, and provides an attractive setting for the various GE major appliances. Also, the home's GE Weathertron heat pump consumes less than one-half the energy of conventional electric systems and is used for heat on sunless days as well as air conditioning.