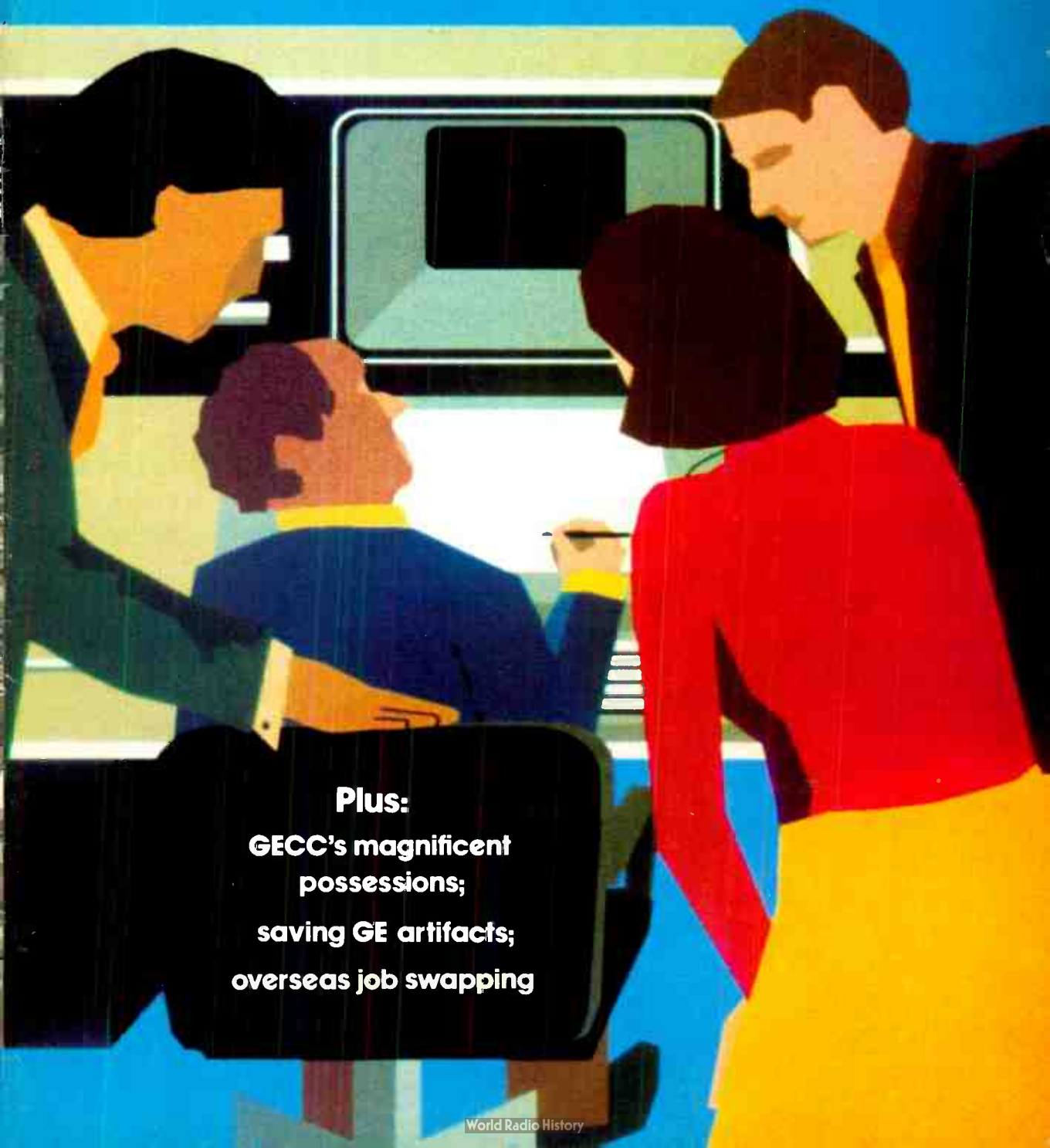
GENERAL ELECTRIC
Monogram
MARCH-APRIL 1978

Now: the era of 'Interactive Graphics'



Plus:

GECC's magnificent possessions;

saving GE artifacts;

overseas job swapping

'Progress for People'

Recent newsbreaks show that at General Electric it's not just a slogan.

As it has for the past century, concern for people continues to be a hallmark of General Electric's activities. If fresh documentation is needed, it's provided by three events of recent weeks: a prestigious White House conference, a Presidential citation for a GE employee, and a record-breaking performance in the interest of minority businessmen.

The White House conference brought together some 500 government, labor, community and business leaders for a five-day examination of "Balanced National Growth and Economic Development." General Electric's participation was led by the Company's Board Chairman, Reginald H. Jones.

In his address, the GE Chairman brought a note of sensitivity and reality to the problems under review:

• On the importance of jobs—"For most Americans, a job is not only a way to keep food on the table. A job is a passport to self-reliance and self-respect. And men and women who are unable to find work, who are frustrated in their efforts to realize the pride and dignity of

GENERAL ELECTRIC Monogram

March/April 1978 Volume 55, Number 2

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

On the cover: Genigraphics® computer slide artwork produced by artist Gregg M. Thomas (above) and Candace D. Ahmed represents one example of General Electric's burgeoning involvement with computerized interactive graphics, as highlighted on pages 6-10.

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.

At the White House conference: GE Chairman Reg Jones greets U.S. Rep. Barbara Mikulski of Maryland. Jones shared the podium with National Urban League president Vernon Jordan, Jr. (left). The Rev. Leon Sullivan (right), board chairman of OICs of America (Opportunities Industrialization Centers), officiated.

making their own particular contribution to the economic well-being of themselves, their families and their communities, are in a very real sense being denied the opportunity for self-fulfillment. That is why we must approach the subject of unemployment not merely as an economic problem but as a social problem—a problem that affects *all* of us, at the local, state and regional level, whether we are employed or not. Unless we recognize that each of us is in some way diminished and hurt by the agony of wasted lives, by the painful struggle of our young people (particularly among minorities) to find their working place in our society, we will not find in ourselves the compassion and the persistence that are required to change a potentially threatening situation."

• On the business stake in solving unemployment problems—"Business leaders, in particular, have a special obligation to understand the true nature of the problem, and to address themselves in cooperation with government at all levels to helping find its solution. This is not merely a matter of corporate citizenship and social responsibility. It is a matter of survival. . . . How long, realistically, could we expect this system to continue, if it were being questioned and challenged, particularly by young people unable to find jobs, who were unconvinced, even turned off, by its performance?"

• On interdependence in finding solutions—"We are beginning to see that we can no longer just push the problem onto the Federal government and mandate full employment. In a nation where four out of five jobs are in the private sector, we are beginning to recognize that we *all* have a role to play. Business, labor, education, state and local governments, community organizations must recognize that, without their creative cooperation, the problem will never be solved."

• On the U.S. economy as a provider of jobs—"The most reassuring fact is that we have a nation of people who want to work and an economy that is providing good jobs in record numbers. Today we have nearly 93 million people employed, 7 million more than just two years ago. . . . Objectively considered, our

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economy is now providing more jobs, at higher real pay, for a greater proportion of our population, than ever before."

• On the reasons for high unemployment—"In recent years there has been an extraordinary influx of women and teenagers (especially minorities) into the work force. Since 1967, for instance, our population has increased only 19%, but the number of teenagers in the work force went up 42%, and the number of women went up 40%. With so many additional people looking for jobs, and with the economy not growing fast enough, somebody was going to be left out. And the people left out are principally the young, the minorities, and the people in cities and rural areas whose economies are in trouble. Unemployment among teenagers is 15.4%; among blacks, 12.5%; and among black teenagers, 37.3%—social dynamite!"

• On the most hopeful solution—"The overall aim of our economic policies in this area should be balanced long-term economic growth combined with targeted programs to solve the stubborn problems of structural unemployment."

Calling for tax reductions to stimulate the economy and to overcome the present lag in business investment in plants and equipment, Reg Jones emphasized that "a combination of reasonable fiscal stimulus, accommodative monetary policy and regulatory restraint should help to assure balanced growth. It should improve our productivity, which helps to control inflation, provide an expanded tax base for sorely needed public services and public works, and increase the number of jobs available all around. As President Kennedy said, 'A rising tide lifts all boats.'

"This is the most important first step we can take to reduce both cyclical and structural unemployment. If we do not take it, we run the risk of turning today's cyclical unemployment into tomorrow's structural problem."

A commendation for HIRE: On the specific front of jobs for veterans, General Electric's efforts recently received special recognition.

Honored at the White House for his initial HIRE (Help through Industrial Retraining and Employment) work with President Carter's voluntary national program was Corporate Employee Relations Operation's (CERO's) Donald B. Powers, Program Manager—Compliance Practices and Programs. Powers was one of 40 business managers to receive a Presidential commendation for helping secure 60,000 job commitments during the first six months of the 15-month employment drive.

As the Company's HIRE program manager, Powers has issued hiring guidelines for GE management, and reports that response has been very good. "Based on operating component reports already submitted, we expect to meet our commitment by September."

HIRE's aim is to provide U.S. jobs and training for some 100,000 veterans. Calling for GE support of the program, Reg Jones observed that while GE components already had plans for hiring veterans, with reports being made quarterly to the government, "HIRE has required a refocus of our efforts in order to increase the number of hires among unemployed Vietnam veterans who are young, minority and disabled."

Remarks Jones: "The challenge has been to initiate this specialized employment effort while keeping it in balance with our other priority programs of affirmative action for women, the handicapped and minorities."

Named a Presidential commendation recipient for his work with the HIRE program, GE's Don Powers (second from left) receives award from Labor Secretary F. Ray Marshall. G. William Miller (left), Federal Reserve Board Chairman, and Presidential assistant Jack Watson flank the two men.

Statistics show that total unemployment among veterans of 7.5% is not significantly higher than the overall unemployment rate. However, for the 20-24 age group it is 13.6%, for young minority veterans it is 25.6%, and for disabled veterans, unemployment is close to 50%.

Assisting minority businesses: Yet another example of how the Company has sought to create jobs and maintain a steady pace of U.S. economic expansion is its minority business enterprise program. Last year, projected GE purchases of goods and services from minority businesses totaled more than $25 million, up 54% from 1976. In 1976, GE minority vendor purchases equaled $16.2 million, up 95% from 1975.

Observes CERO's Fred H. Black, Manager—Minority Business Project: "Results of the Company's minority vendor program have consistently exceeded annual goals, and when all 1977 numbers are in we again expect to exceed our annual target. Purchases under the GE program have increased more than sixfold since 1973. For 1978, our goal is $40 million and we expect to exceed our yearly goal once again."

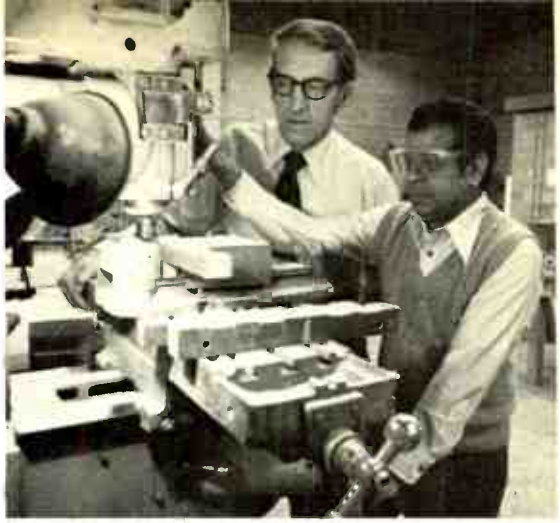
Presently, General Electric components are employing about 800 vendors in such fields as metal fabrication and assembly, electrical and electronic components, lumber and plastics products, food processing and other services.

Notes Black: "GE's aim is to help minority vendors in the best possible way. We're not simply placing a share of the Company's business with minority suppliers, but are mindful of a longer-range consideration—to assist these suppliers in earning even more of our business. By strengthening minority vendors' capabilities, we broaden the spectrum of competitors from among whom GE Purchasing can choose."

To assist minority business enterprise, Black works closely with such groups as the Interracial Council for Business Opportunity (ICBO), the National Association of Black Manufacturers (NABM) and the National Business League (NBL), as well as with the Company's Pooled Purchasing Councils. GE Minority Business Opportunity Fairs are held periodically throughout the country to exchange ideas on new ways GE components can allow minority vendors a greater share of their business.

For service to minority businesses, GE in 1977 received the NABM's annual Industry Leadership Award, and in 1976 received the NBL's Booker T. Washington Symbol of Service Award.

Several years ago, the Company instituted "Extra Step" Awards to recognize GE people who have significantly furthered the Company's affirmative action goals with minority vendors. Sixteen GE employees have been recognized to date, including Erie's Robert T. Ostryniec (above) and Cincinnati's E. P. "Rose" Lockhart (below).



Erie's Amatac Corporation president Nevin Mathur (right) discusses machine work with Transportation Systems Business Division's Bob Ostryniec, manager of Purchasing for Control Manufacturing. Amatac fabricates non-metallic materials for GE locomotives and transit equipment, and provides materials for electrical and environmental system products.

Cincinnati's Bob Boyd (left) and Eluster Fields of Bob Boyd & Associates review GE interior painting project with Aircraft Engine Business Group's Rose Lockhart, a construction buyer. Boyd's company offers painting, remodeling and decorating services.

The mindboggling world of
Interactive graphics

Enter the burgeoning new world of IAG, CAD and CAM. It's not only providing dramatic new tools to engineers and draftsmen, but is also the source of fast-growing GE businesses.

A draftsman without a drafting board, compass, templates, erasers, scratch pads, pencils or masking tape? It's happening, as the whole area of product design and manufacturing planning moves into the computer age.

Across General Electric today, more and more engineers and draftsmen are visualizing their thoughts electronically, using a computer-aided graphics console.

Typical is the work of an Aircraft Engine Business Group draftsman in Lynn who, working at a computer graphics console, can draw a machine part. This "drawing" is then transferred electronically to manufacturing without an actual drawing being made. Once there, a manufacturing specialist working at another computer graphics console can draw a desired "tool path"—the path to be traveled by the cutting tool while machining the part. This "drawing," transposed by computer into machine tool instructions on a tape, goes to one of Lynn's manufacturing shops where a numerical control (NC) machine makes the part automatically.

Some 35 GE components now employ computerized interactive graphics (IAG) systems, which comprise 200 terminals and 85 minicomputers. GE operations plan to add more terminals later this year.

Dialogue with a computer is now a common occurrence for many GE engineers and draftsmen in developing machine parts. Using interactive graphics, Fitchburg's Mechanical Drive Turbine employees (above) design turbine parts.

"Until recently, industry relied exclusively on hand-drawn engineering drawings to provide exact information about every detail of each machine part that was built," observes Schenectady's Dr. Jules A. Mirabal, Manager—Engineering and Manufacturing Engineering with Corporate Consulting Services. "But now this method is giving way to minicomputer-based graphics systems that are faster, more versatile and less error-prone."

The IAG-equipped draftsman simply defines machine parts electronically in terms of a programmed geometric graphics data base. IAG enables the engineer/draftsman to carry on a dialogue with a computer—to assemble parts in simulation, check for clearances and tolerances, and ultimately use the same data base to create parts programs needed to make the components.

States Dr. Mirabal: "GE operations now use IAG for design engineering and drafting, as well as for machining control and tool design. We believe that IAG will be an important part of the link between computer-aided design (CAD) and computer-aided manufacturing (CAM)."

IAG's breakthrough in the CAD/CAM area signals its importance in the new era of microcomputerization. IAG integrates the best of man and machine, alleviates countless manual "reiterations" and increases work output.

Dr. Mirabal's Schenectady colleague, Dr. Kenneth W. Jenkins, Manager—Advanced Manufacturing Technology Development, remarks that "since 1973, American industry has been learning the capabilities of IAG in design, but now real growth is starting in manufacturing. For example, 16 GE components are starting to apply IAG systems to both CAD and CAM activities, and several components—Aircraft Engine Business Group's Lynn Manufacturing Division, Armament Systems Products Department, Ordnance Systems Products Department and Space Systems Department, among others—have established defi-

nite IAG links to manufacturing."

How does an IAG system work? Briefly, the system consists of terminals, a central processing facility and output devices. As drawings are developed, either a two- or three-dimensional geometric data base is built—a precise, computerized graphic definition that is the common data base for design, production of NC tapes, derivation of tool paths and tool design.

Comments Dr. Jenkins: "In the design area, we're doing things we couldn't possibly do before. We're developing the geometric data base for stress calculations, structural dynamics, aerodynamics and heat transfer. Drawings can be automatically scaled up or down for minute study. If dimensions overlap or fall short when drawings are placed one atop the other on the screen, errors are obvious."

GE's newest involvement in IAG's far-reaching technology came in December when Corporate Research and Development's Automation and Control Laboratory in Schenectady purchased development rights to a solid-modeling software package called SynthaVision®, a new method of generating three-dimensional, mathematical models developed by Mathematical Applications Group Inc. (MAGI), Elmsford, N.Y.

Stuart G. Miller, Laboratory Manager, says: "For the first time, we can generate a 3-D, mathematical model of a non-existent part and display it on a video screen with all the realism of a photograph. Solid modeling gives us the ability to create 3-D models of solid objects—not just line drawings and surface descriptions—which can yield all the information needed for structural analysis, component design, and fabrication and assembly."

The SynthaVision version of solid modeling includes the mathematical formulas for 12 solid "primitives"—box, sphere, cone, and so forth. A finished model can be sliced through at any point from any angle, rotated in space, "exploded," and used to create line or shaded drawings. Because the model is a "solid" representation, it can be used to calculate the part's weight, volume, moments of inertia and other mass properties.

Naturally, as with any pioneering technology, there are challenges that must be painstakingly addressed. Can solid modeling capabilities be developed for practical use? Can they be made economical? Faster? More user-oriented?

"We think they can," replies Miller's colleague, David E. Godfrey, Manager—Advanced Computer Aided Technology Program. "We've already identified parts that are so complex, both externally and internally, that we cannot readily calculate their mass properties using present-day graphics systems. We're now working with GE operations on an entirely different approach that uses solid modeling."

Another IAG development project underway in the Company is in Engineering and Manufacturing Engineering, where, under Dr. Jenkins' leadership development engineers are linking IAG systems with remote devices which can handle "hostile environment" tasks in manufacturing. These programmable manipulators may eventually work in hot

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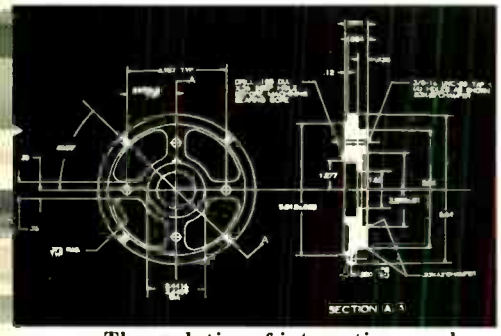
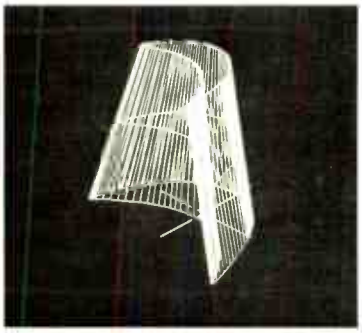
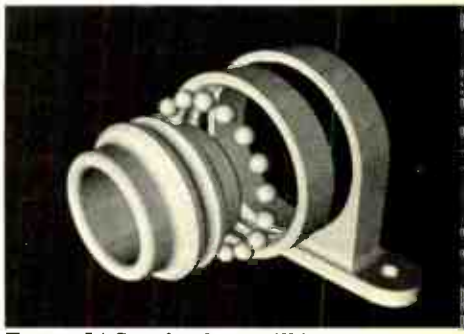




The evolution of interactive graphics technology is visibly evident. Two-dimensional line drawings (above) are giving way to more technically precise three-dimensional drawings (right).

Photo courtesy of MAGI



Future IAG technology will include three-dimensional solid models. The drawing above is backed up by data—not only on its surface description but all data needed for structural analysis and tool design.

Genigraphics artwork: wide range of creativity

areas to unload die casts and plastic molds as well as to spray-paint in highly toxic atmospheres.

The world's largest computer slide art service—marketed by Syracuse's Electronic Systems Products Division and using its Genigraphics® image generation system—illustrates a direct GE commercial stake in IAG technology, and provides another example of IAG's useful versatility.

Basically consisting of an operator's console, a minicomputer and a film recorder, the Genigraphics system creates, manipulates, records and stores slide artwork in minutes.

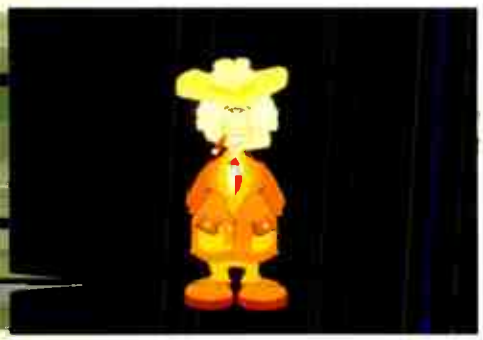
Since 1974, 23 of these $300,000-plus machines have been sold outright, and hundreds of other companies are keeping the Division's five Genigraphics® service centers busy.

"Slide presentations produced in most companies today cost twice as much as they should and take far too long to prepare," states the Division's Walter E. VonSeggern, Manager—Computed Image Systems and Services Operation. "The Genigraphics system combines the speed and accuracy of a computer with the imagination and talents of an artist."

Working at a Genigraphics console, an artist can create, compose and photograph up to 10 visuals an hour, store them in the computer, and retrieve them at any time for corrections or updating. A graphics library of more than 800 symbols, logos, formats and type fonts is available—as are a palette of more than eight million color variations and six basic compositional elements (circles, sectors, ellipses, rectangles, squares and lines).

Using this IAG technology enables GE to be very competitive both in delivery time and price. Observes von Seggern: "Turnaround time for artwork handled by our Genigraphics service centers is typically three days, whether the customer is buying three pieces of work or 200. While conventional art shops may be able to match our delivery performance on small jobs, our ability to call on our other centers around the country gives us a real competitive advantage

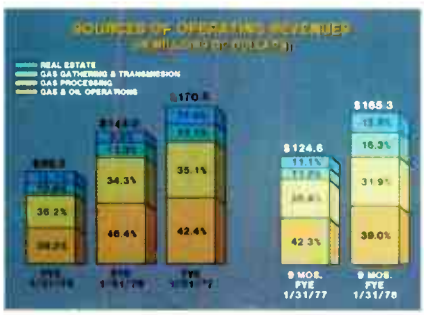
Genigraphics art contests held the past two years demonstrate IAG technology's versatility. The 1977 Most Complex art winner was "Rose Window" (far upper left), by Houston's Mike Melnick, Genigraphics Center 7. "Fighter Plane" (far lower left), by Chicago's Terry Traxler, Chartmasters, Inc., won in 1977 for Most Photographic.



Artistic slides

Magical as the Midas touch, the Genigraphics system offers companies crisp, clean business charts and maps unvarying in quality. An almost unlimited spectrum of colors, tints, shades and hues exist at the touch of a button. GE offers formal training programs for customers' operators and machine maintenance personnel.

Business slides



in handling the larger orders."

In November, GE introduced the advanced Genigraphics 100B unit, a second-generation system (see *Monogram*, Jan./Feb. 1978). Also recently offered is a miniterminal, useful in remote locations with smaller graphics needs. A newly-developed accessory for this miniterminal is an electromagnetic tracing tablet which permits free-form tablet tracings to be

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automatically entered in a Genigraphics machine.

A second GE commercial use of IAG technology exists with Ground Systems Department's computer-generated-image flight simulators, now used for military and commercial flight training. The Company's first IAG work began in 1958 at GE-Syracuse, where the first computer-generated imagery system ever built produced a repeating ground plane pattern ultimately adapted for a flight simulator's instrumentation system.

Today, the Company's Compu-Scene® flight simulators offer the only FAA-approved computer-generated-image (CGI) system in commercial operation for both day/night pilot training.

"Rising fuel costs and the spectre of threatened fuel shortages have confronted the military and commercial flying community with the need to reduce aircraft fuel consumption," says Daytona Beach's Phillip W. Farmer, Manager—Simulation and Data Systems Programs. "The Department of Defense is committed to a 25% reduction in flying hours by 1981. As a result, CGI flight simulators are in increasing demand for use in flight crew training."

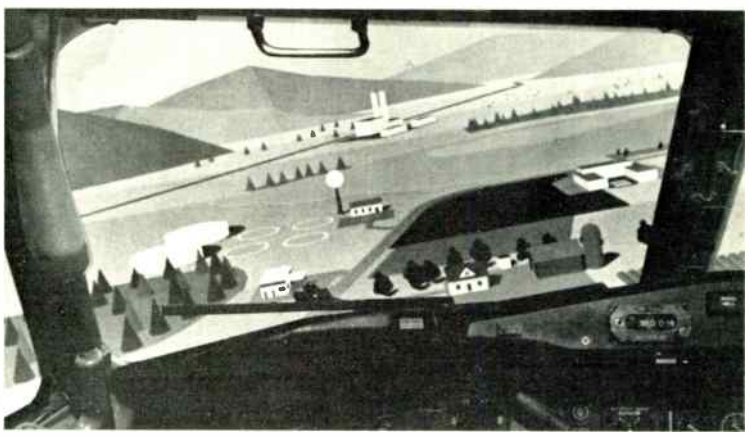
The Compu-Scene minicomputer stores a digital representation of facsimile "gaming areas" outside the "aircraft." The pilot/operator sees a two-dimensional color perspective view of a chosen gaming area on television displays mounted outside his simulator "cockpit"—the view based on aircraft position and attitude data obtained from the computer. Because the viewer's line of sight on the display scene is focused at infinity, the system produces a realistic impression of depth and hence the outside world.

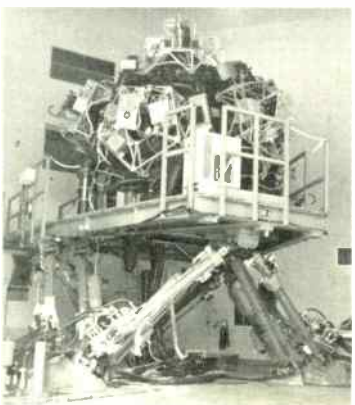
Moving models permit extremely realistic interactive training. Inside the cockpit, pilots "fly." They bank, climb, dive, accelerate, take off and land. The computer helps create recognizable scenes of mountains, rivers and buildings. Weather is portrayed by controlling the height of cloud tops and bottoms, and visibility on top of and below the clouds. Special effects provide scud, rain and lightning.

Remarks Farmer, "Because the cockpit is mounted on a motion system, the flight simulator can create flying conditions right down to various somatic sensations experienced by a pilot during high-flight maneuvers. The system incorporates aircraft motion, gravity forces and simulated air turbulence. We can even record a pilot's first flight on computer tape and replay it for him."

Of course, IAG technology was the essential link that produced the flight simulator's present success. Farmer emphasizes that "computer flying" provides less expensive and, in many areas, better pilot training. The fact that the U.S. Air Force plans to purchase more than 200 flight simulators over the next 10 years, at a cost of more than $2 billion, provides solid evidence of the shift to simulators for training.

To date, GE has supplied 11 flight simulator systems—to Boeing for its 707, 727, 737 and 747 aircraft; the Air Force for its T37 and T38; the Navy for its TA-4J; the West German government for NATO's Tornado; and NASA for Apollo's lunar-lander development. In addition, the Company is presently building Air Force flight simulator visual systems and radar simulators for the B52 and KC135, and a visual system for the Navy's Research and Development flight simulator in Orlando, Fla.





"Cockpit window" scene (above) produced by GE's Compu-Scene flight simulator illustrates level of interactive graphics realism available for computer-generated-image flight training. To simulate actual flying conditions, simulator cockpits are mounted atop two-story structures (left) which create aircraft motion, gravity forces and air turbulence.

The first of 11 diesel-fueled generators arrives in Ft. Wayne to help provide electricity during power cutbacks. Evendale's Louise Leist (right) uses a lamp from home to temporarily replace office lighting.

Another energy-short winter

From BRINGALAMP strategy to do-it-yourself techniques, GE plants survived the crunch.

First there was the oil embargo. Then the winter of 1976-77 brought record low temperatures and a natural gas shortage. This year it was the combination of electricity curtailments imposed by striking coal miners and another unusually chilly season that furrowed the brows of industrial energy chiefs. There were anxious moments. But General Electric plants had forecast problems for the winter of 1977-78, and again came through with minimal dislocations.

"Terrific energy achievements were reported from across the Company," observes Henry E. (Hank) Heddesheimer, Manager-Plant Engineering Consulting for the Real Estate and Construction Operation. "Aggressive energy management programs helped prepare GE to survive severe cutbacks by several electric power companies and, in some locations, a repeat crunch on natural gas supplies." (See *Monogram*, March/April 1977).

From his Schenectady office, Heddesheimer tracks daily changes in energy situations affecting GE nationwide. He adds: "Typical of the exceptional efforts made to minimize the impact of curtailments were actions taken in Fort Wayne, Evendale and Louisville."

• Indiana and Ohio utilities were among the hardest hit by fading coal supplies. On February 24, Indiana & Michigan Electric Co. chopped a mandatory 25% off industrial power allocations. Fort Wayne's Appliance Components Business Division plants and Specialty Transformer Business Department were ready. They had decided in mid-February to furnish vital electricity through 11 diesel-fueled generators. The $706,000 equipment investment helped keep production going and people working.

• For wartime security, much of Evendale's Aircraft Engine Business Group plant was built without windows. Result: 33% of its electrical consumption is spent on lighting. When Cincinnati Gas & Electric Co. asked its industrial customers to voluntarily trim electricity usage by 25%, Evendale's emergency "BRINGALAMP" program began. Office employees came to work carrying bedroom or desk lamps with 100-watt bulbs to light their darkened work areas. Offices closed at 5 p.m. sharp and custodial staffs worked only during first shifts. Combined with other conservation measures, the 80% cut in office lighting met the power reduction plea.

• Entrenched in snow and stung by biting cold, Kentuckians made exhausting demands on heating supplies. On a few occasions, Louisville's Major Appliance Business Group plants faced 40% curtailments of natural gas from their supplier. Crises? None, thanks to energy preparedness that began as far back as April 1976, when GE negotiated an option to buy an in-ground natural gas reserve at Blue Buck Point, La. Three wells on the site now produce 0.5 to 1.5 million cu. ft. of gas per day, which is piped into GE facilities at Louisville; Columbia, Md.; and Bloomington, Ind. Also, the contract with the seller requires the drilling of another three wells. Supply life: eight to ten years under current shortfall projections.

Plan a GE Centennial stop in your summer vacation

Wherever you travel this year—
from the rugged beauty of Pikes Peak to Disney World's fantasyland—
an attraction of GE interest can be included.

Illustrated at right:

1. **Edison National Historic Site,** W. Orange, N.J. A 1½-hour tour covers the house and grounds of Glenmont, Edison's beautiful Victorian home. Buildings include a machine shop, chemical lab and a replica of "Black Maria," the first motion picture studio.

2. **Walt Disney World** near Orlando, Fla. Located in one of the world's finest amusement parks, the GE Carousel of Progress features 36 audio-animatronic figures, which act out four stages in the life of an American family from the pre-electric age to a contemporary all-electric one.

3. **San Francisco cable cars** in San Francisco, Calif. A GE motor installed in 1912 is one of two motors still providing power for all three of the city's cable car lines. It can be seen at the Cable Car Barn at Mason and Clay Streets, along with examples of cable cars used in San Francisco over the years.

4. **General Electric Lighting Institute,** Nela Park, Cleveland, Ohio. Known as "The University of Light," the Institute has hosted over one million people interested in learning the principles of modern illumination. The Lamp gallery is of particular visitor interest. An appointment is needed.

5. **Smithsonian Institution,** Washington, D.C. The many GE items on display include consumer goods and power and lighting products in the History and Technology Building and the CF6 jet engine in the National Air and Space Museum.

6. **Branford Trolley Museum,** East Haven, Conn. Preserving a former major mode of transportation, the museum has amassed a collection of 93 trolleys dating from the 1890s. A three-mile trolley ride goes over trestles and past woods, marshes and a quarry. Two other trolley museums of note: the Seashore Trolley Museum, Kennebunkport, Me., and the Orange Empire Trolley Museum, Perris, Calif., both of which feature trolley rides.

7. **Henry Ford Museum** and Greenfield Village, Dearborn, Mich. This 14-acre museum of history, art, industry and science covers 300 years of Americana. One of the largest repositories of Edison memorabilia, the museum includes Edison's New Jersey and Florida labs.

Other stops not illustrated:

National Museum of Transport, St Louis, Mo. The museum's massive exhibits include rare and one-of-a-kind locomotives and railway cars. Collection includes an 1892 Thomson-Houston Electric Company rail car and GE-Erie's B&O car 50, the first high-speed mainline diesel locomotive placed in regular service.

Edison Birthplace Museum, Milan, Ohio. Historic house built in 1840 by Edison's father, Samuel, the museum contains photographs, personal family mementos and examples of Edison's inventions.

Edison Winter Home, Ft. Myers, Fla. The nation's first pre-fabricated home—built in Maine and shipped to Florida for construction—this unusual house has gardens containing some of the world's most intriguing trees and plants, which Edison used as "experimental" material for several of his inventions.

The Exploratorium, San Francisco, Calif. Housed in the Palace of Fine Arts, the Exploratorium's "hands-on" science exhibits enable visitors to learn while enjoying themselves. GE has donated a collection of neutron radiographs from the Irradiation Processing Operation and a "heat" camera.

Pikes Peak near Cascade, Colo. A plaque atop this mountain commemorates the first time a turbo-supercharger was installed in a Liberty engine, enabling engine power to be maintained in high altitudes. The date, September 1918. The man responsible? Dr. Sanford A. Moss of GE-Lynn.

Lamplighter Hall, Hendersonville, N.C. This unique GE display facility features operating high intensity discharge (HID) luminaires. The Crossroads of Light, in use during the summer, provides a nighttime dramatization of outdoor lighting techniques. An appointment is needed.

Mt. Vernon Museum of Incandescent Lighting, Baltimore, Md. The world's only museum devoted entirely to the history and development of the incandescent lamp, its collection contains over 30,000 lamps, one-fifth of which are always on display.

Schenectady Museum, Schenectady, N.Y. The Elfun's GE Centennial exhibit will open in May.

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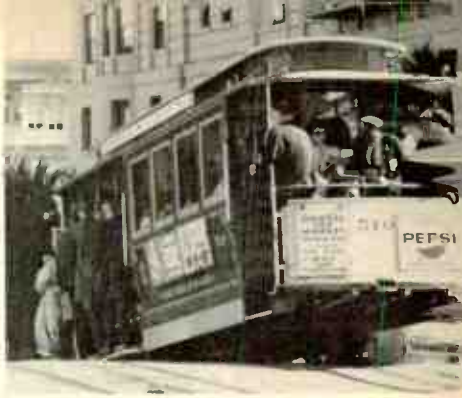

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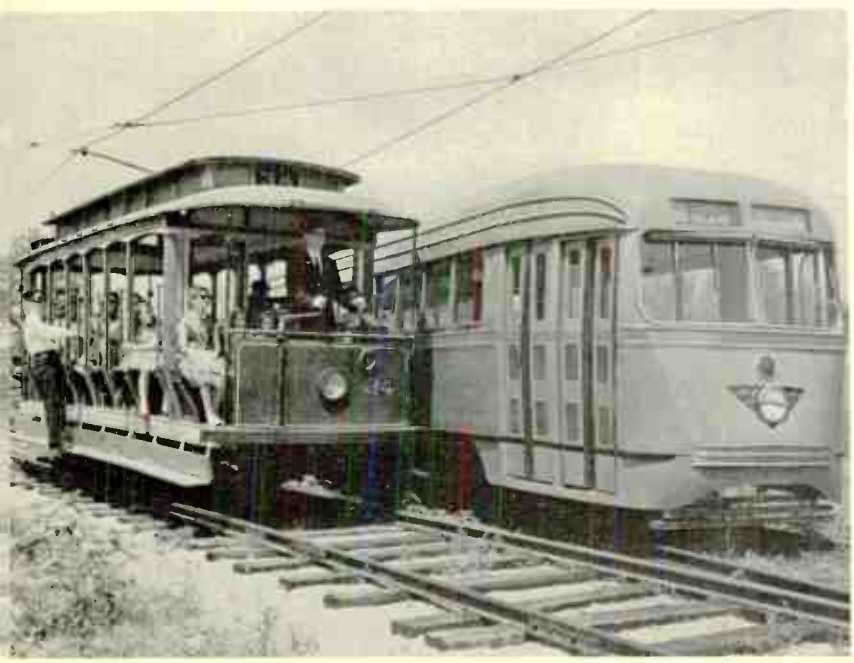

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Monographs

U.S. Bicentennial continues. Any American who fights against his country in a foreign army can be charged with treason, but Kenneth J. Tischler's forays against America's finest won't get him in trouble. On weekends as an 18th century British infantryman fighting "the colonists," Lighting Business Group's Tischler is a member of the Brigade of the American Revolution, a national organization chartered to reenact Revolutionary battles for the Bicentennial.

A Quartz & Chemical Products project engineer, Tischler made the red coats that he and his son Ken wear into battle, and the weapons—replicas of the Brown Bess muzzle loaders. On maneuvers, father and son are subjected to the same discipline and regimentation as their 18th century counterparts, and fight the same battles at the same locations.

For the Tischlers, the Bicentennial has barely begun. Battles are reenacted on their 200th anniversaries, and since the fighting did not end until the surrender of Cornwallis at Yorktown in 1781, more than three years of battles remain.

An African début. When Nigeria recently hosted the largest trade fair in African history in its capital city of Lagos, GE was among 112 companies from 56 countries to participate, marking the first time the Company has attended a trade fair on that continent.

Nigeria's National Development Program through 1980 calls for public sector expenditures of $69 billion. The Lagos fair's purpose? To enable exhibitors such as GE to help Nigeria import products and services for its oil-fueled economy.

Since the show, Export Sales and Services Division (ESSD) has booked a $16 million order for three frame-5 gas turbines for the Nigerian National Electric Power Authority. GE participation was sponsored through ESSD and the Africa/Middle East Area Division. Pictured: Nigeria Federal Commissioner of Trade (Brigadier General) M. Shuna, being shown Company exhibit by GE-Lagos manager John Maddox as GE distributor M. A. Omisade looks on.

Honors. Awarded Presidential citations for "exceptional service to others in the finest American tradition" at a recent National Alliance of Business conference were Evendale Aircraft Equipment Products Division's William J. Kuehl and Francis L. Kattell.

• Charles H. Holley, general manager of Schenectady's Electric Utility Systems Engineering Department, has earned IEEE's 1978 Nikola Tesla Award for contributions to power generation and utilization.

• Bernard B. (Bill) Ballance, Manager—Louisville Relations Operation, has received the International Association for Personnel in Employment Security's 1977 Human Services Award, presented to a Kentuck-

Indian campsite. When Lighting Business Group's Ruth Kruse looks out her back window in Ohio, it's not unusual for her to see dozens of guests camped out. Years ago in the New Mexico desert, an Indian saved her husband Ed's life after a rattlesnake bite. In return, Ed Kruse asked the Indian to spread the word that his people would always be welcome at the Kruse farm in the Midwest.

The Indians took him at his word. Notes Ruth Kruse, a Ravenna Lamp utility operator: "The first large Indian group arrived in 1970. About 400 people came from as far away as Florida, Alaska and Mexico. Forty-three tribes were represented and they camped by our farm pond."

Because of the Kruse act of friendship, the Indians have long held them in esteem. "When Ed died last year," Ruth said, "the Indians came to the funeral home and draped a blanket over the casket—the *same* ceremonial blanket used for the burial of Cochise."

GE Centennial keepsake. A commemorative booklet of the Company's 100th birthday—comprising the six chapters of GE historical highlights now appearing in the *Monogram*—will eventually be bound under special cover and made available at cost to GE components.

The booklet will be printed in mid-August. While the exact price depends upon the total number printed, they are expected to cost about 35 cents each. Ordering information will be mailed to GE operations in April so that an adequate supply can be printed and shipped well before the peak of the Centennial celebration in October.

Shown preparing the book for publication: Corporate Editorial Programs' Devere "Dee" Logan (left), the booklet's author, and *Monogram* designer Ron V. Taylor.

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ian who makes an outstanding human services contribution.

• A retired GE engineer, James K. Newell, Jr., has received the 1977 Distinguished Auburn (University) Engineer Award, presented annually to one of the college's graduates who has excelled in his profession.

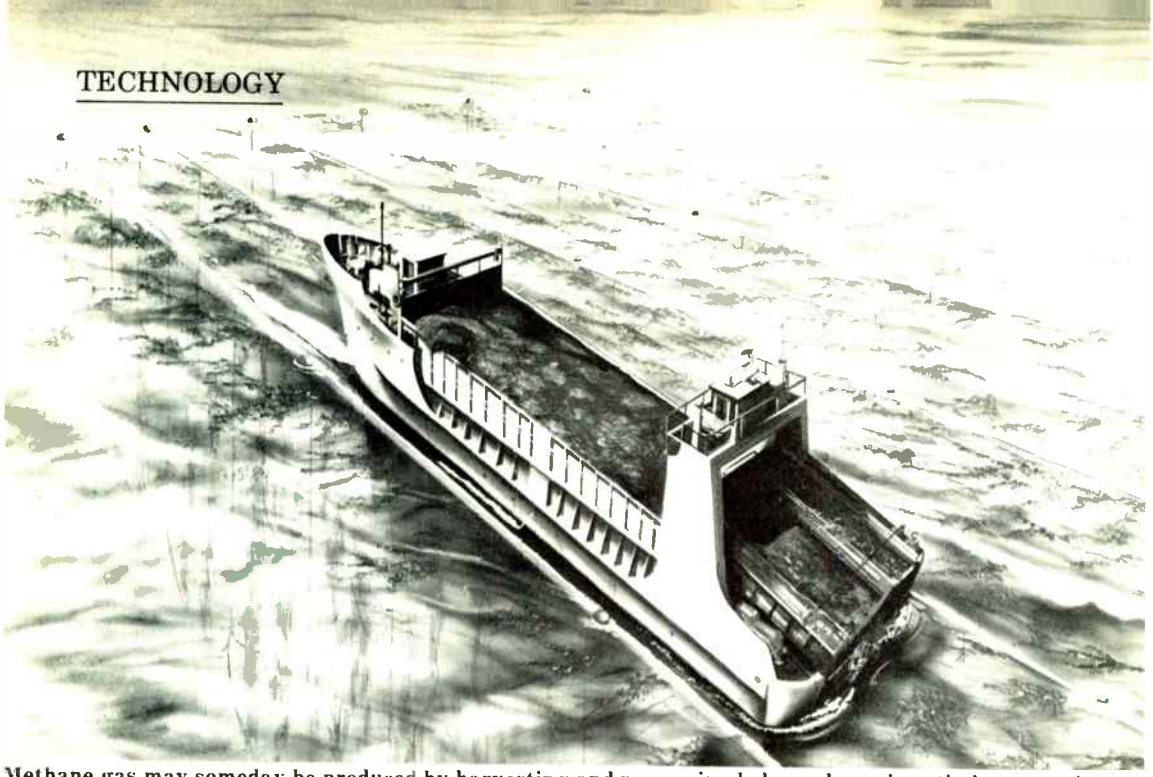
• The Center for Marketing Communications has elected Albany's Robert E. Ingmire, manager of Advertising and Sales Promotion's Industrial Operation, chairman of its Board of Trustees.

• For his role in increasing performance of aircraft gas turbine engines, Evendale's Martin C. Hemsworth, manager of Design Technology, has been elected a Fellow of the Society of Automotive Engineers.

Crossing the sound barrier. When 13-year-old Scott Clemons (center) approached his assistant scoutmaster, H. D. "Dave" Evans (left), an Ordnance Systems engineer in Pittsfield, for help with his Boy Scout "Citizenship" skill award, Evans discovered he had more of a task than he thought.

Deaf since birth, Scott had no understanding of the word "citizen." Recalls Evans: "We spent that first evening writing notes to each other, and before we were through we were both tired and frustrated." The upshot? Evans decided he would have to learn sign language, if progress were to be made.

Today, Evans is proficient enough in sign language to teach a noontime course to his Pittsfield coworkers, and to tutor other Scouts including "R. J." Howe (right) who have become interested by watching Evans communicate with Scott. Evans has also taught scientific concepts to deaf elementary students, and is producing a visual reference book on scientific experiments for use by teachers of the hearing-impaired.



Methane gas may someday be produced by harvesting and processing kelp as shown in artist's conception.

Energy: can kelp help?

GE experts see it as a long-range hope—and will begin farming it this summer.

For millions of years, giant brown algae have been flourishing, growing to the surface from the dark muck of the ocean's floor. Left to thrive, each of these kelp plants can grow at a rate of two feet a day, reach a length of 200 feet and weigh 400 pounds.

Philadelphia's Re-entry & Environmental Systems Products Division is planning to turn tons of this astonishing, naturally regenerating plant into an inexhaustible, nonpolluting, versatile energy source by farming it off the southern California coast. Primary use for the crop: methane gas.

One promising alternative for dwindling natural gas supplies should be the result of the Energy from Marine Biomass Program, sponsored by the Gas Research Institute and managed by General Electric. Initially, the study is taking shape as an underwater structure for use as an experimental quarter-acre kelp farm. The first of its kind in the world, the farm will be moored in roughly 2,000 feet of water about five miles off Laguna Beach and is scheduled for deployment this summer.

It is the relocation of these giant kelp plants —from their natural beds close to shore to the open sea where there is no competition for use of available space—that makes this program unique. The adult kelp plants will be attached to floats 60 to 80 feet beneath the surface and fertilized by artificial upwelling of nutrient-rich water from deep below the test farm.

At harvest time, the experimental facility should produce an annual yield equivalent to more than 25 tons of dry kelp per acre, which will be fed into a bacteria-laden processor for anaerobic digestion. From this, methane gas as the primary product, and animal feed supplements and fertilizer as process byproducts, can be retrieved.

Concludes Re-entry & Environmental Systems' Thomas E. Shaw, General Manager—Research and Engineering: "If the nation can be successful in demonstrating the use of marine-growth biomass, then through emplacement of large-scale farms the U.S. may become virtually independent of foreign gas sources. But we must expect to commit 10 to 20 years of steady, well-planned effort over a wide spectrum of technology to ensure a solid foundation for the economic exploitation of this potentially major energy source."

Technology for Transportation

CHAPTER 3

"All aboard!" Thomas Edison, inventor-turned-railroad-conductor, raised his voice to herald the trial run of America's first full-sized electric locomotive. It was May 13, 1880. The "Wizard of Menlo Park" had constructed a narrow-gauge railway winding a third of a mile near his New Jersey laboratory. It included a small, six-foot-long locomotive powered by an 11-horsepower Edison dynamo and pulled a small, open-air passenger car.

"Fire her up!" commanded Edison to "engineer" Charles Batchelor at the throttle. The passengers shouted their approval and waved their handkerchiefs as the tiny train slowly gathered speed and bumped along the track on its way to the terminal. History records that the return trip was less exhilarating, since attempts to reverse the engine resulted in a burst friction wheel, and passengers had to push the train back to its starting point.

Edison's 1880 electric loco.

But the application of electricity to transportation needs had begun. Many railroad executives would later visit Menlo Park and discover a reliable, well-controlled locomotive achieving speeds of 40 miles per hour. Yet many regarded it as a toy, and certainly no replacement for either horsecars or steam locomotives. One exception was Henry Villard, president of the Northern Pacific and a director of Edison's company. Villard encouraged Edison to build a 50-mile electric railway in the wheatlands of the Midwest. But the press of other projects drew Edison from the project, and the bankruptcy of the Northern Pacific ended Villard's dream.

Edison did employ one of the most innovative minds in electric traction, however. In 1883, Frank Julian Sprague was working primarily on the construction of new Edison central stations, but in his spare time was also experimenting with electric motors. His fascination with them led to his resignation in the fall of 1884 to form the Sprague Electric Railway and Motor Company. He continued his experiments, testing a clean, quiet and economical new electric traction system that could replace the smoke-spewing steam locos of the day.

Meanwhile, in East Cleveland, Ohio, E. H. Bentley and Walter Knight constructed the first public street railway in the nation to openly compete with the ruling horsecar. It opened in the summer of 1884. Another pioneer, Charles J. Van Depoele, ambitiously introduced experimental electric trolley lines in Toronto, Detroit, South Bend and Minneapolis, with a unique trolley pole equipped with a grooved wheel running along an overhead wire. By 1889, both companies would elect to merge with Thomson-Houston.

In the spring of 1887, Sprague was given a contract to develop a new street railway in Richmond, Virginia. It would become the nation's first large-scale electric streetcar system. The order was for 40 cars, 12 miles of track and a 375-horsepower electric plant. It was to be finished in 90 days. The route included steep grades, sharp curves and unpaved streets that clearly eliminated animal power.

Technical challenges had to be overcome, and typhoid fever made Sprague miss his deadline, but by the fall of 1888, reliable and economical operation had been achieved. New trolley poles were developed, lightning arresters were installed, and carbon brushes for the motors eliminated the source of numerous motor failures. The success at Richmond was an expensive one, costing Sprague nearly twice what he was paid, but the investment would be repaid by the additional business generated when word of his accomplishment spread. By 1890, Sprague and Thomson-Houston would be dominant in the field.

Sprague's company eventually became part of General Electric by virtue of its purchase in 1889 by the predecessor Edison General Electric Company. With the merger of the Thomson-Houston companies, the new GE had in place a strong Railway Department that quickly demonstrated its expertise in 1893 by building an elevated railway encircling the grounds of the Chicago World's Fair.

Electricity had performed satisfactorily on numerous trolley systems, so it next entered the domain of the steam-wheezing "iron horse." The first main-line electrification was accomplished by the Balti-

Amtrak passenger trains zip along the busy Northeast rail corridor pulled by husky GE E60CP electric locomotives, fast becoming the reliable workhorse of the system.

A 1904 GE-powered electric parlor car operated ▶ by the Branford Trolley Museum, East Haven, Connecticut, whisks riders along a scenic three-mile round trip.

New GE diesel-electric locomotives are gradually replacing wood and coal-fired units in Nigeria, which is upgrading its rail transportation system.

more & Ohio Railroad. In 1895, the B&O began using three 96-ton, 360-horsepower General Electric locomotives to pull trains through its new mile-long Baltimore tunnel. In 1907, New York's Grand Central Station banished steam locos in favor of 35 GE electrics, whose 1,700 clean and quiet horsepower equalled that of the steam monster they replaced. All GE locomotives operated over 50 years.

Over the years, additional technological developments from GE have made rail history. Among them: the first V-8 gasoline rail passenger car (1908), the first commercially successful diesel-electric loco (1924), first American gas turbine-electric loco (1948), first U.S. rectifier-type AC electric locos for passenger service (1955), the GE E50—the first thyristor-controlled, commercial-frequency, automatically-controlled, AC electric loco in the U.S. (1968) and the world's first 50,000-volt, 6,000-horsepower thyristor-controlled locos for the Black Mesa and Lake Powell Railroad (1973).

Electricity on the sea

As early as 1909, the idea of applying electricity to ship propulsion had intrigued GE consulting engineer William Emmet. Turbine-electric drives would be feasible, economical, and practical on large vessels, he told the Navy. But officials remained unconvinced, preferring to stay with traditional steam propulsion. Emmet persisted, emphasizing that GE electric motors should be given a fair trial. At last, the Navy agreed to a test, and in 1913, the collier *Jupiter* was commissioned. It soon demonstrated the value of turbine-electric drives for maritime use, and was followed in 1915 by the all-electric ship *New Mexico*, which firmly established electric drives as economical and reliable at sea. The success of the *Jupiter* and *New Mexico* resulted in the Navy's adoption of electric drives for all its capital ships.

Civilian maritime applications also began in 1915 with the commissioning of the *SS Pacific*. The first large cargo steamer of moderate speed built in the U.S., she was equipped with a GE steam propulsion system that included a five-stage Curtis turbine developing 2,400 shaft horsepower and a speed of 11.5 knots. Continued development of marine turbines through the '20s and '30s positioned the Company as a leader in the maritime field. In World War II, GE marine systems powered some 1,700 U.S. Navy and Merchant Marine ships.

Today, diverse GE technologies are being applied to ship propulsion, including geared steam turbines for giant supertankers, containerships and liquefied natural gas transports. Gas turbines, derived from both aircraft and heavy-duty land types, have also gone to sea. A program begun in 1959 produced the GE LM1500, a derivative of the J79 aircraft engine, that powered hydrofoils and patrol boats. In 1970, the LM2500 marine gas turbine was selected to power 30 U.S. Navy Spruance-class destroyers—the Navy's first gas turbine-powered combat ships. Later, the gas turbine was used on Navy and NATO patrol hydrofoils and guided missile frigates. The world's first commercial ship powered by a heavy-duty gas turbine—a GE MS-5002R—was the "Iron Monarch," a 15,000-ton Australian cargo vessel that began service in 1973 and set an endurance record in 1977 of over 10,000 hours of operation.

GE's Key Dates in History

1938—GE announces development of the fluorescent lamp. Katherine Blodgett develops "glareless" glass. 1940—GE's Kingdon and Pollock isolate a quantity of U-235. Charles E. Wilson becomes president and Philip D. Reed chairman of General Electric. 1942—Charles E. Wilson joins War Production Board; Gerard Swope returns as president. Philip D. Reed resigns to serve Harriman Mission in London; Owen D. Young returns as chairman. 1943—GE Credit Corporation is announced.

The evolution of GE ship propulsion technology is dramatized by the modern *Adrian Maersk* and the *SS Pacific* (inset), which was commissioned in 1915 and was the first large cargo steamer of moderate speed built in the U.S. to be equipped with geared steam turbine propulsion.

Aircraft engines

Climbing 14,109 feet up Pikes Peak, Dr. Sanford Moss and his GE colleagues tinkered with a new device attached to a 350-horsepower Liberty reciprocating aircraft engine. It was June 19, 1918, and the device was the turbosupercharger—a means of boosting piston engine power by compressing air into the intake. Moss's tests were successful. The new GE turbosupercharger allowed reciprocating aircraft engines to operate efficiently at higher altitudes than ever before, setting altitude records in the '20s and '30s.

Bell XP-59 jet of 1942.

World War II brought the jet age. America's entry began with a jet engine design conceived by Englishman Frank Whittle. General Electric was invited by the U.S. Army Air Corps to develop a production engine. Work began in October, 1941.

Only six months later, the GE I-A engine was assembled and successfully tested. On October 2, 1942, a small, glider-like aircraft—the Bell XP-59—equipped with two GE I-A engines made a secret and highly successful test flight of ten minutes above a dry lake bed in California.

Several variations of the I-A were developed, and by 1943 GE would mass produce the J33 to power the famous Lockheed P-80 "Shooting Star." The axial-flow compressor was incorporated into the J35 in 1944, followed by the J47, powerplant for the F-86 and the B-47. Later, GE developed the variable-stator compressor in response to the need for a new reliable, high-thrust, fuel-efficient engine that could perform well at twice the speed of sound. The engine was the GE J79, used for such famous aircraft as the B-58, F-104 and F-4. J79-powered aircraft set 44 world speed, altitude and time-to-climb records.

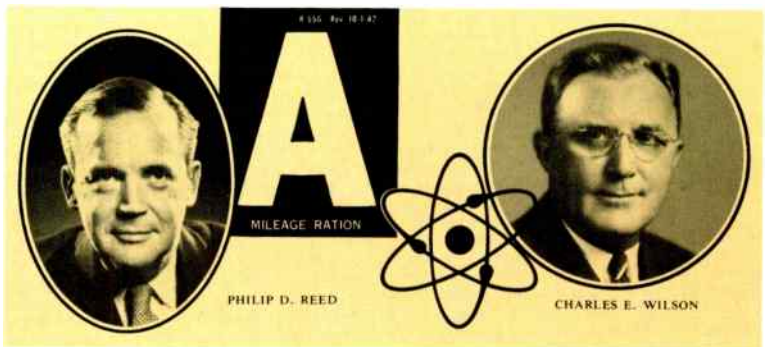
Commercial derivatives of the J79 were introduced in 1956, with the CJ805 engine with turbojet or turbofan versions selected for the Convair 880 and 990 jetliners. A geared turboshaft engine, the T58, was GE's contribution to the 1957 flight of the first U.S. turbine-powered helicopter.

In 1958, a new high-performance, supersonic powerplant, the J85, was developed for the U.S. Air Force. It powered the Northrop F-5 "Freedom Fighter" and other aircraft. The J85 successes also resulted in another major commercial engine development: the CJ610 derivative that brought jet power to business aircraft. The CJ610 and its turbofan version, the CF700, are presently powering over 1,000 business jets.

The day of the supersized transport dawned in 1965. GE received a contract to develop engines for the world's largest aircraft, the Lockheed C-5 Galaxy. The resulting engine, the TF39, ushered in the era of the high bypass turbofan offering higher fuel economy for subsonic aircraft.

GE returned to the role of an airline engine manufacturer in 1967 with receipt of a long-term contract to develop engines for the proposed U.S. SST. In 1969, the GE4 established itself as the world's most powerful engine with maximum thrust of 69,900 pounds. Although the SST program was canceled, GE successfully built upon its TF39 technology to market the CF6 and firmly establish the Company as a supplier of commercial jetliner engines by 1968. The CF6 was soon setting records on DC-10, A300 and 747 wide-bodied jetliners. By the end of 1977, the undisputed popularity of the CF6 was evident in its selection by 53 airlines to power 350 wide-bodied jets.

1944—Charles E. Wilson is again elected president. **1945**—Philip D. Reed again elected board chairman. Ground is broken for new research laboratory. **1946**—Irving Langmuir and V. J. Schaefer announce "cloud seeding" weather modification. GE begins study of power generation by nuclear energy. **1947**—Construction begins on the Knolls Atomic Power Laboratory. **1949**—New high voltage laboratory opens in Pittsfield, Mass. **1950**—Ralph J. Cordiner becomes GE's chief executive officer.



GE's CF6 turbofan engine has accumulated nearly 9 million hours of airline service on over 270 wide-bodied jetliners. Gas turbine pioneer Dr. Sanford Moss (inset, right) discusses his turbo-supercharger with U.S.A.F. General Jimmy Doolittle.

Future of transportation technology

Factors that hardly mattered during the first 35 years of the jet age—noise level, life cycle cost and exhaust emissions—will play a key role in the design of future power plants according to Fred O. MacFee, vice president, Group Strategic Planning Operation, Aircraft Engine Business Group.

"The future calls for new ways to control the spiraling cost of engine development and production, such as through international groups of companies," he says. A new generation engine, the CFM56, is currently under such joint development by GE and SNECMA of France. Growing population, more leisure time and income should result in a tremendous demand for "people" air transport. "Five years from now, a new breed of airliner with greater efficiency and lower noise and emission levels will begin to appear in service," MacFee predicts.

New jet engine technology: CFM56

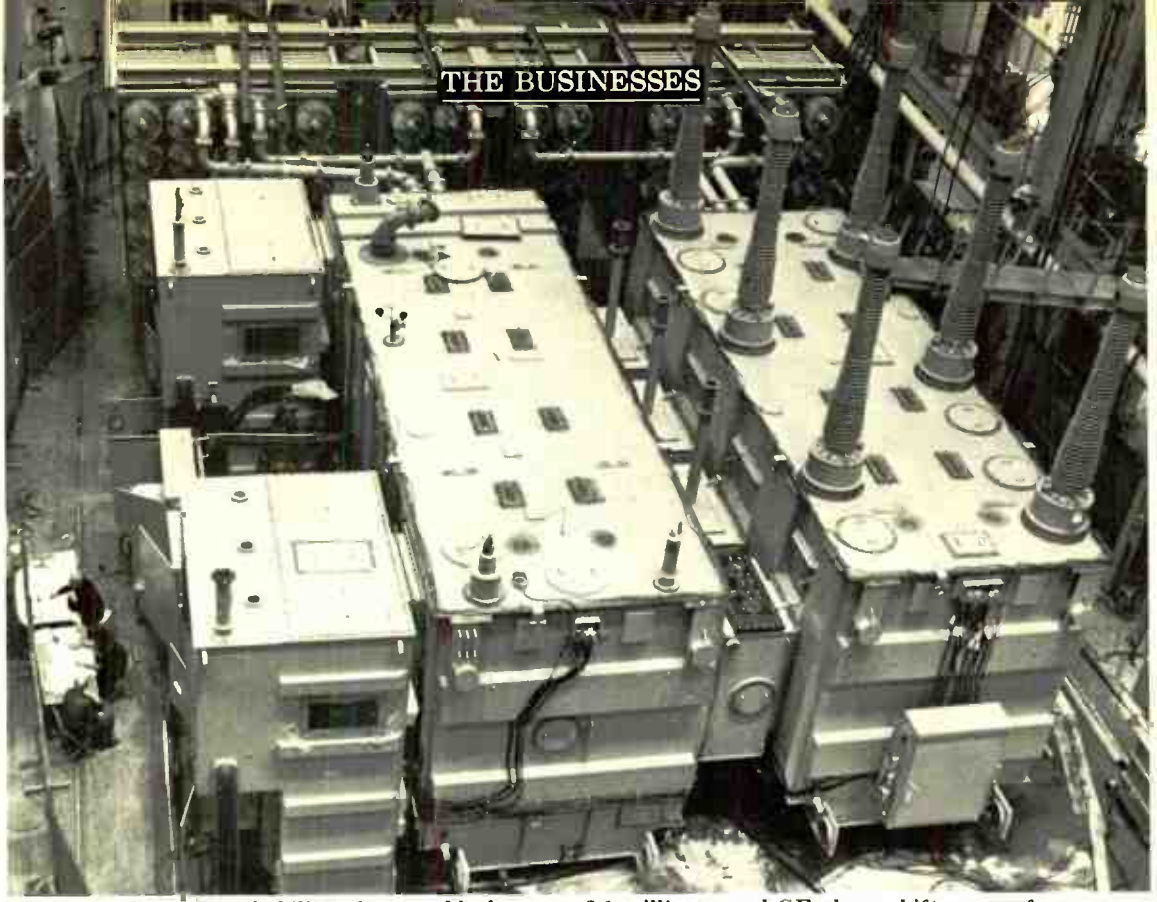
GE aircraft engine research includes such projects as an experimental variable-cycle engine combining the best characteristics of a turbofan with the strong points of a turbojet. Other projects involve energy-efficient designs and techniques for reducing exhaust emissions and engine-generated noise, plus a quiet, shorthaul experimental jet engine for NASA.

GE technologies for marine and rail transportation, meanwhile, are also expected to play significant roles in expanding markets such as energy and raw materials. Growing international shipping of liquefied natural gas, for example, will require a buildup of the LNG fleet.

"Railroad electrification and the advent of new offshore markets also offer increased prospects for the locomotive business worldwide," says Carl J. Schlemmer, vice president and general manager of the Transportation Systems Business Division. "GE is also responding to the desire of rapid transit operators for reduced power consumption and improved reliability by developing new solid-state propulsion controls for both DC and AC motors," he reports. "In addition, microprocessors and unique on-board diagnostic equipment are being developed." Electric drives for giant off-highway trucks, developed by General Electric in response to mining industry needs for vehicles with the power of locomotives and the flexibility of trucks, will also benefit from greater mining of such materials as coal and uranium.

General Electric begins its second century with diverse technological strengths for transportation needs, be they surface, sea or air.

Research on new transportation technology includes development of better jet engine blades (above), and modern GE motorized wheels in which part of the motor also serves as the axle to reduce vehicle weight.



To help reduce the probability of power blackouts: a 2.1-million-pound GE phase shifter transformer.

'Colossus'

Pittsfield's mighty phase shifter transformer is a giant step toward greater systems reliability.

The job required a giant. To provide an important link between two big utility systems that have different phase angles, Pittsfield's Power Transformer Department had to come up with the largest phase shifter transformer it had ever built—a true "Colossus" weighing 2.1 million pounds.

The mammoth General Electric unit will help control the critical flow of electric power between Consolidated Edison of New York and Public Service Electric & Gas of New Jersey. Among the reasons for its massive existence: to help reduce the probability of future blackouts.

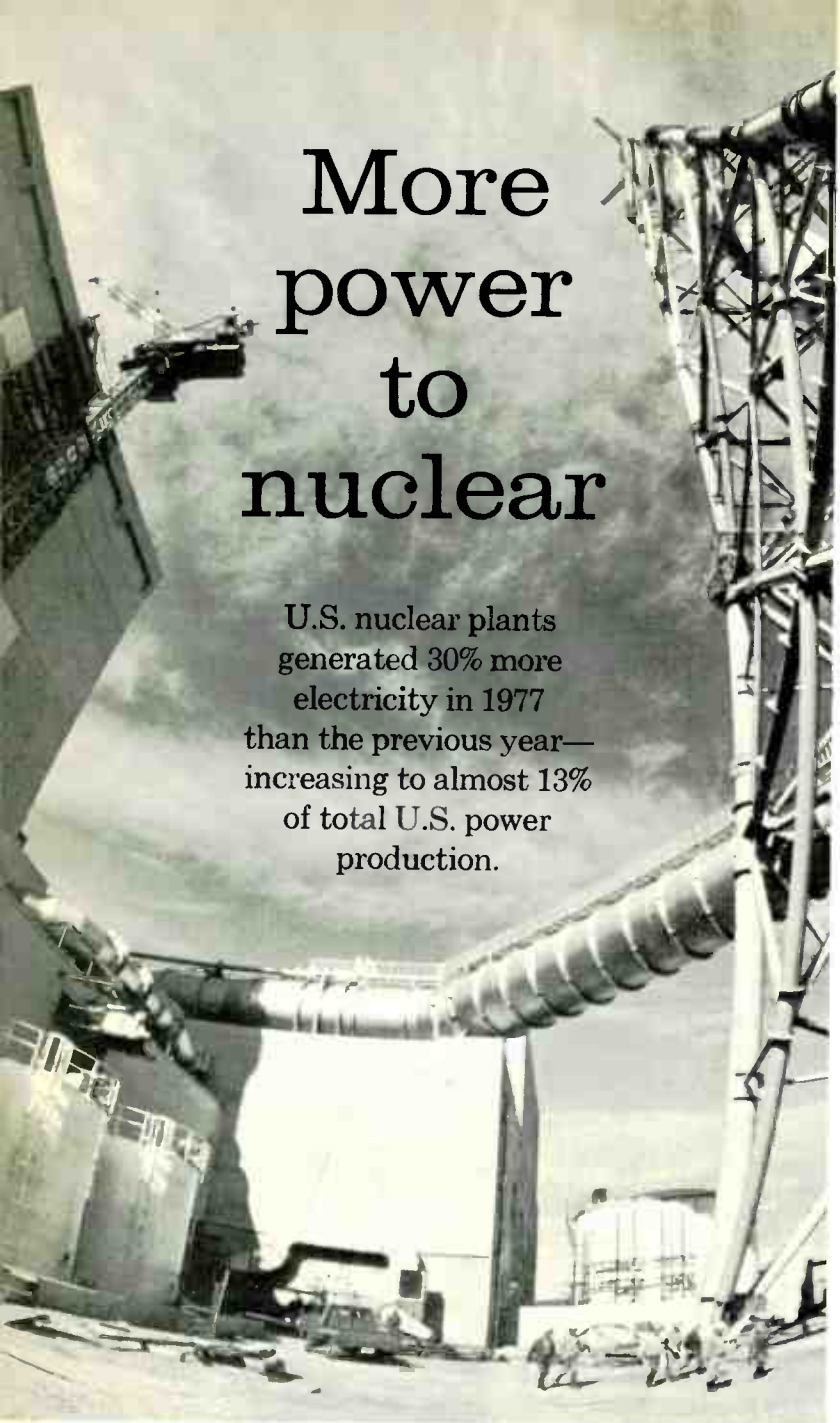
Measuring an impressive 62 feet long and 42 feet wide, Colossus dwarfs the dimensions of an average-size home. And the complex engineering design feat was equaled by the manufacturing response time of the employees who built it. At Con Edison's request, GE was able to move up the delivery of the phase shifter to December 1977. Originally-scheduled delivery date: March 1978.

The effort hasn't ended. Explains Nicholas Boraski, general manager of the Power Transformer Department: "While Colossus is being installed now at Con Edison's Farragut Station, it soon will be joined at this Brooklyn site by a partner jumbo phase shifter from us."

To further improve reliability, Con Edison is installing a second tie with Public Service, prompting the order for a second phase shifter. Notes Boraski: "Again, the request is labeled 'rush,' and the target date for completion is the second quarter of this year. The second unit will serve as a spare until completion of the utility's new tie. Combined, the two phase shifters represent more than $6 million in Con Edison business for GE."

More power to nuclear

U.S. nuclear plants generated 30% more electricity in 1977 than the previous year—increasing to almost 13% of total U.S. power production.



For Japan, nuclear energy is a 'must.' Shown: Japan Atomic Power Company's Tokai 2, a new 1,100-megawatt General Electric nuclear power plant now undergoing start-up testing.

Despite the gnashing of gears over the future shape of this country's commercial nuclear power program, utilities' nuclear plants are quietly assuming more of the U.S. electrical generation load. Newly available statistics for 1977 show that nuclear energy generated about 260 million megawatt-hours of electricity, a 30% increase over 1976 and close to 13% of America's total electric power production.

For the past two winters in the Northeast, nuclear capacity spelled the difference between adequate power and blackouts, as harsh weather immobilized a large portion of the fossil fuel supply and generating equipment. 1977 was also the year when nuclear power nudged out hydro-electric generation as a power plant fuel, and the Atomic Industrial Forum (AIF) calculates that by the early 1980s nuclear energy will overtake both oil and gas to become second only to coal as an electricity producer.

Despite recent U.S. utility plant deferrals now impacting on both fossil and nuclear suppliers, construction in *both* areas is moving steadily forward. Some $5.2 billion was spent on nuclear construction in 1977, and the AIF trade group reports that this will climb to $5.8 billion in 1978.

Utilities continue to grapple with uncertain regional load-growth and financing conditions but, according to the Edison Electric Institute, more than half of the electric utility industry's expansion program —in terms of capacity—is still based on nuclear power.

Neither snow, rain, cold nor strike has impeded U.S. nuclear power plants from generating electricity this winter, according to a survey of the country's nuclear utilities. In many cases, utilities actually sold some of their nuclear power to non-nuclear utilities whose capacities were being threatened by wet, frozen or depleted coal supplies.

New York's Consolidated Edison produced enough nuclear electricity in January to sell 465 million kilowatt-hours (kwh) from its fossil fuel plants to needier utilities. In the same month, Niagara

Mohawk transferred 125 million kwh of oil-generated power to the hard-hit Midwest, South and West, reserving nuclear electricity for its own Upstate New York customers.

Chicago's Commonwealth Edison, which operates seven nuclear units in Illinois, reports that since the coal miners' strike first began it provided electricity that would have required 4 million tons of coal to generate (as of March 10).

Nuclear power presently accounts for 9% of this nation's installed electrical capacity, yet last year accounted for about 13% of total electrical production. This dramatizes the proportionally heavier use that nuclear plants are receiving, particularly during recent winter cold spells when coal piles froze and oil barges were icebound.

Imported oil last year cost the U.S. $45 billion, compared to $5 billion in 1972. Our 1977 trade deficit was $26.6 billion—*almost three times the highest ever previously experienced.* Considering the fact that the U.S. Department of Energy predicts electrical generating capacity must more than double by the year 2000, coal and nuclear power *together* must play an increasingly important energy role.

Present GE start-ups of three more nuclear stations around the world—in Japan, Italy and Taiwan—will shortly add more than 2.5 million electrical kilowatts to the mounting world supply of electricity from nuclear energy.

Japan's Tokai 2, Italy's Caorso and Taiwan's Chinshan 1—all employing GE boiling water reactors (BWRs) and ancillary systems—will bring to 15 the Company's total number of units operating in eight countries outside the U.S.

When the Chinshan station enters commercial operation this spring, Taiwan will become the 21st country to generate commercial nuclear electricity. Installed nuclear plant capacity outside the U.S. recently soared 33% in one year's time, and non-U.S. nuclear capacity now surpasses U.S. nuclear power generation.

Including those nuclear units built by GE licensees and the overseas units now in start-up testing, a total of 45 GE-type units are now operational in the U.S. and abroad. Their combined generating capacity of more than 26 million kilowatts is enough electricity for 26 cities the size of San Francisco.

Spanish engineers Juan Carlos Mampaso (left) and Ignacio Oyarzabal receive nuclear fuel training in San Jose as part of Company's effort to help Spain manufacture nuclear fuel.

General Electric's backlog of unfilled orders for nuclear systems and nuclear fuel totals more than $5 billion, including 38 U.S. units and 17 outside the U.S.

Remarks Power Systems Sector's Dr. Thomas A. Vanderslice, Senior VP and Sector Executive: "A review of this nation's future energy alternatives leads to one inescapable conclusion—that *all* of our energy supply options must be pushed to the limit. By the year 2000, coal and nuclear must supply at least half of the U.S. energy needs, with most of this being used in the form of electricity."

Dr. Vanderslice continues: "The proliferation of laws and regulations regarding *all* modes of power generation must be streamlined. We cannot afford the delays and uncertainties of the present decision-making process. I am encouraged about some of the advanced energy technologies down the road—the trouble is, they are still quite far down the road. Based on our population already born and growing up in America, the alternative to *not* being able 'to get there from here' is to develop all our present energy supply options to the greatest extent possible."

The first U.S. nuclear operator control system to use cathode-ray tubes as the primary data-display method—the GE Advanced Control Room—has just been shipped to Pennsylvania Power & Light for use in its 2.2 million-kilowatt Susquehanna GE nuclear station.

Powered by GE marine turbines, the oil tanker *Atigun Pass* is one of ten GECC vessels. The GE affiliate also owns an offshore oil drilling rig.

Those magnificent

What U.S. financial services firm owns a fleet of 69 commercial airliners, 8 sea-going tankers, 589 locomotives and 18,000-plus railcars? Hint? This firm also possesses a Gulf offshore oil drilling rig, an anhydrous ammonia plant, 223 computer central processors, several walking draglines and a chemical plant.

Name of the firm: General Electric Credit Corporation, presently America's fourth-largest independent/affiliated finance company, which last year celebrated its 45th anniversary by turning in earnings of 18% over 1976 and accounting for 6% of General Electric's total profits.

"Today, when you board an American, United, Western, Trans World, Eastern, Piedmont, Texas International or Allegheny jetliner, chances are good that you are flying on a GECC-owned aircraft," remarks GECC's Larry A. Bossidy, VP and general manager of the Commercial and Industrial Financing Division.

Through GECC, General Electric has become a prime mover of people and goods on land, sea and in the air. With the purchase last fall of the oil tankers *T. T. Stuyvesant* and *Atigun Pass*, the GECC fleet has grown to 10 vessels representing more than a million tons of shipping. Plans call for five more GECC tankers to be in service by year end.

GECC also owns helicopters, towboats and barges, cabooses and hopper cars, and large trucks and heavy-duty mining equipment. Last fall, this GE wholly-owned affiliate began providing customer lease financing on new Gates Learjets. Under a unique financing program, GECC buys new Learjets and leases them to major corporations.

"Even if GECC stopped lending money right now, it could still anticipate future revenues of as much as one billion dollars, based on the present portfolio," notes John W. Stanger, GECC's president. "With 34 main market areas and 2,800 different products, GECC has become a nationally recognized leader in consumer, commercial and industrial financing and a growing factor in the insurance industry."

The "Credit Corp" is this nation's leading lender in the equipment financing and leasing field, and is also one of the larger lenders in home products and *the* leader in mobile home financing. GECC helped pioneer leveraged leasing, and today is the world leader in that

GECC recently began leasing a new fleet of Learjet business aircraft, and today is this country's leading mobile home financial lender.

GECC possessions

business with more than $3.4 billion of industrial and transportation equipment (at original cost) in its portfolio.

President Stanger observes that GECC is a GE service business wholly unlike any other—"money and creative people are our *only* two resources." The credit firm employs 7,700 people and has a fund-raising capability that runs into the billons of dollars.

"The money resource is a basically simple concept," Stanger states. "We borrow at wholesale—many of our notes in the millions of dollars come due every day—and then retail these funds with creative salesmanship and superior service."

Equally important to GECC's success is the people resource which, he stresses, has produced the organization's aggressive growth. "Our philosophy is to develop market experts, motivate them highly and extend the incentives of the profit motive deep within GECC ranks." Currently, 850 GECC employees have P&L (profit-and-loss) responsibilities.

GECC started by financing GE appliances, and today still finances GE products from appliances to locomotives. However, the GE products represent only about 4% of GECC's present business.

The GE affiliate's commercial and industrial portfolio has grown about 20% a year for the past five years and is now the firm's strongest growth area. "Our employees have earned for GECC a national reputation as a credit organization that thoroughly understands industrial leasing," comments Larry Bossidy. "Our people are experts on everything from Florida fishing trawlers to High Sierra mountain-climbing trucks."

Recently, GECC formed a wholly-owned subsidiary, Full Service Leasing Corporation, to help the nation's banks better serve their commercial customers by enabling them to offer a variety of leasing programs without setting up their own leasing departments.

Extremely active in consumer financing also, GECC is now one of the largest U.S. credit sources for home products. VP Ray F. Pettit, general manager of the Consumer Financing Division, notes that GECC presently serves some 18,000 furniture and appliance retailers who together represent a $1.1 billion investment. As the leader in the mobile home field, the Consumer Division is also helping lead

(continued next page)

a recovery in the mobile home industry through "Project Upturn," a program which so far has made available $500 million for dealer inventory. As a result, one in nine mobile homes purchased by U.S. dealers is now financed by GECC.

The firm's Family Financial Services business is presently active in direct consumer loans. With 180 offices in 27 states, this component provides funds for home improvements, education and medical expenses and a variety of other consumer purposes. Home equity lending, utilizing residential real estate as security, is providing strong growth impetus to this enterprise.

GECC has also developed and is testing in New Jersey and New York its own revolving charge card—called MPC for Major Purchase Card—which is positioned to provide creditworthy individuals with purchasing power for large ticket home products.

GECC's entry into the insurance business came in 1971 when it acquired The Manhattan Fire and Marine Insurance Company—now renamed Puritan Insurance Company. Its profits have increased at an average rate of more than 50% per year since joining GECC.

In 1973, GECC purchased the now 70-year-old Puritan Life Insurance Company of Providence, R.I. Revitalized under new management, Puritan Life has doubled its insurance in force in the past four years, and Art O. King, manager of Insurance Operations, ranks Puritan in the top 5% of the nation's life insurance companies in terms of 1977 business written. Puritan Life has more than $4 billion of insurance in force, and some 8,000 agents are writing insurance at a rate of more than $1 billion a year.

Among GECC's numerous activities in the commercial and industrial field: financing of truck fleets, small aircraft and machine tools—and cooperative programs with OEMs (original equipment manufacturers) whereby customers can lease data processing equipment, supermarket fixtures, medical x-ray equipment, and printing and food processing machinery.

In a unique GECC industrial deal last year, the Farrell shipping line's containership *Austral Entente* was "jumboized" from 669 feet to 813 feet. The new midsection doubled the refrigerated cargo-carrying capacity of the ship, which was originally leased by GECC to Farrell in 1973.

"Creative entrepreneurship is General Electric Credit Corporation's ticket to long-term stability and growth," maintains John Stanger. "In this business, getting rid of chestnuts is just as important as making sound investments. Sometimes even the most promising enterprises go sour, and in recognition of this, we have provided reserves of $178 million."

The GECC president is confident of his organization's future, noting that its 1977 total receivables were up 12% over 1976. "We're aggressively tackling new investment areas—for example, a taconite ore dock facility on Lake Superior and the nation's first fully electronic retailing system for Goodyear—and we're carefully coupling market growth with our market expertise." He observes: "Unlike most businesses, GECC can try out new ideas on a limited scale without excessive costs."

Among GECC investments: motor homes and a fleet of 18,000-plus boxcars, hopper cars, gondola cars, flat cars, tank cars and cabooses.

1. Cress Fuentes ◦

2. Vernon J. Harris

3. James A. Stamper and Ralph F. Boyd, Sr.

4. Margaret L. Spieker

5. Gordon W. Van Citters

The community problem-solvers

Five Phillippe Awards for public service go to six employees who followed up on concern.

1. Problem: a rural Indiana town was threatened with no tax dollars to continue disbanded ambulance service and emergency first aid. **Answer:** an accredited volunteer "Life Squad" —with a 34-month record of more than 400 calls to date. A man who made it work: Cress Fuentes, Evendale Manufacturing Operation.

2. Problem: Utica students, counselors and community leaders needed a heightened awareness of minorities' opportunities in technical careers. **Answer:** Program to Increase Minority Engineering Graduates (PIMEG). The man who voluntarily pioneered the area effort: Vernon J. Harris, Aerospace Electronic Systems Products Department.

3. Problem: Schenectady-area residents sought voices to express their many needs. **Answer:** constructive community action groups. Two men whose concern each spans three decades: Turbine Business Group's Ralph F. Boyd, Sr., board chairman of Schenectady Community Action Programs, board chairman of Baptist Retirement Center Corp., and charter member and past president of Schenectady NAACP; and James A. Stamper, chairman of Schenectady's Human Rights Commission, past president of Carver Community Center, and charter member and past president of Schenectady NAACP.

4. Problem: ex-offenders of the law, alcoholics and teenagers in Cincinnati needed a friend to whom they could turn. **Answer:** regular counseling and special chats. Overcoming her own hearing impediment, the woman who took the time to listen: Evendale's Margaret L. (Meg) Spieker, Aircraft Engine Business Group.

5. Problem: severely mentally and physically impaired children in the Philadelphia area lacked intensive care and training. **Answer:** a new facility hailed by the Federal and state governments and the mental health community as a "landmark" effort. The man behind it: Gordon W. Van Citters, Space Division.

GE memorabilia collectors

The GE Centennial throws a spotlight on people who make a hobby of preserving the elements of Company history.

Vince R. Cracchiolo's flotilla of flatirons

Vince Cracchiolo's great-grandparents contributed the first flatirons to his collection. Now with 50 to 60 old irons—"about 85% of them still work"—this Export Sales and Services Division employee with New York's export customer service has a virtual "flatiron museum" in his home.

"During this century, irons have been one of the most promising housewares items on the market. I began collecting both GE and Hotpoint irons over 25 years ago, using housewares catalogs dating back to 1919 to learn their selling characteristics and see their evolution." His oldest flatiron: dated 1908.

Cracchiolo has periodically offered his collection for display, and it is now on exhibit at the Schenectady Museum. "I continue to purchase old irons, and have to 'warehouse' my burgeoning collection when it's not being shown."

Millie S. Boutall: collector of light

For Lighting Business Group's Millie Boutall, happiness is an old light bulb—the older the happier. Boutall's incandescent lamp collection numbers in the thousands, she's accumulated these electrical-age artifacts for more than a decade, and her oldest bulbs date to the 1880s.

A Euclid Lamp payroll production clerk, Boutall is a member of The Incandescent Lamp Collectors Association. She traces her serious bulb-collecting interest to 1968 when a Lamp foreman gave her what may be her oldest single lamp—a "Swan bulb." Swan, a contemporary of Edison, later incorporated his company into General Electric.

Boutall has become an expert on the history of light, and she's often invited to lecture at historical society meetings. She notes that "the most I've ever paid for a single lamp is $18.50. The rest have been given to me or cost only three or four dollars."

Charles S. Kupinski saves old GE movies

During 48 years with GE, Schenectady retiree Charlie Kupinski helped produce some 650 Company films. As a GE film apprentice in 1929, he set up the movie lights when GE President E. W. Rice interviewed Elihu Thompson, then age 90, concerning his early childhood.

Chief motion picture editor for Advertising and Sales Promotion

Operations when he retired in 1971, Kupinski remembers producing a Coolidge film on x-rays and a Langmuir film on seeding clouds with crystals. His film collection includes such titles as "The Panama Canal," "Land of Cotton" and "Queen of the Waves."

"Even in the earliest years, GE filmmakers were innovative. They achieved animation as early as 1915 and dubbed sound on the film 'The Wings' in 1928. The 1923 film 'The Benefactor' pleased Edison because of the professionalism of Jack Weire, now a retired GE artist, who played him in the biographical film."

Ralph O. Williams: antique wireless buff

Owner of some 400 radios of the 1920s, Philadelphia's Ralph Williams ranks as one of this country's largest collectors of antique wireless equipment. He is presently vice president of the Antique Radio Club of America and also belongs to the Antique Wireless Association.

A Re-entry and Environmental Systems chief engineer, Williams has been a serious *aficionado* for 18 years. "I'm a product of the 1920s when one of the big things was radio. My hobby specialty is Atwater Kent sets, though my collection includes all the early Radiola radios built by GE and sold through RCA."

Two hundred of Williams' best radios, all 1921-27 vintage, are displayed in Williams' "basement museum," which is periodically stampeded by other radio buffs when radio conferences are held in Philadelphia.

Robertson, Dehn and the Elfun Hall of History

Elfuns Rudy A. Dehn (left) and George M. Robertson are among a group of Schenectady Elfuns now establishing a local General Electric Hall of History—a permanent home for collecting, safeguarding and using GE's exciting heritage. They are shown arranging GE artifacts for a recent Schenectady Museum exhibit.

This "Exhibition of Progress" highlighted TV receivers from Alexanderson's 1927 scanning disk set. Coolidge x-ray tubes and Edison bipolar dynamos—including an unusual "inside out" motor.

Following up on *The Edison Era* and *The Steinmetz Era* photo history series, the Hall of History publications committee is now staging a Company-wide "Giants" hunt, to collect stories on GE "Giants" who, though less publicized than Edison or Steinmetz, played vital roles in GE's growth from 1923 to 1946. Nominees' names should be forwarded to Robertson, Hall of History, GE R&D Center, K-1, P.O. Box 8, Schenectady, N.Y. 12301.

The 119-motor home of Lisle D. Hodell

Fort Wayne's Lisle Hodell insists that easy suburban living requires electric motors. That's why, since 1960, this now retired General Purpose Motor Department general manager has incorporated 119 fractional horsepower motors—all but 28 of them GE—into his nine-room home.

Hodell has motors to lower bunk beds from the walls, remove ashes from his fireplace, open and close drapes and power a patio waterfall. His office includes a vibrator desk chair, beneath the kitchen

sink a ventilator keeps towels dry, and on the patio a suction fan pulls insects into a plastic bag.

"Before retiring in 1962, I began designing my home and obtained motors from as far away as Europe, Mexico and Canada." His collection includes a ball-shaped 1903 Ft. Wayne Electric Co. motor, but his pride-and-joy is a more recent model: the 100 millionth Form G Motor produced by DeKalb's Appliance Motor Products Department.

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Bryce A. Denton: authority on GE-Ontario

General Electric's West Coast appliance history provides a fascinating topic for Ontario retiree Bryce Denton, former product evaluation manager for Housewares and Audio Business Division. Recognized as an authority on local electrical history, Denton is a frequent guest lecturer at the Ontario Historical Landmarks Society.

"I began collecting old GE-Ontario flatirons in 1970, and as far back as 1940 was saving old GE product catalogs. I've got several of the earliest GE spray, steam and travel irons ever built."

In 1976, Denton began writing a book on GE-Ontario. He notes that the Company's Ontario lineage traces back to E. H. Richardson who, in 1904, began marketing irons through his Pacific Electric Heating Company. Renamed the Hotpoint Electric Heating Company in 1912, the firm later merged with GE and the Hughes Electric Heating Company in 1918.

The TV artifacts of Gerald E. Segner

Portsmouth's Television Business Department owns the original home TV receiver demonstrated in 1928 by GE's Dr. Ernst Alexanderson, and marketing communications manager Gerry Segner—shown with the set—was instrumental in having it refurbished.

"I began collecting TV memorabilia for the Department seven years ago, when developing a new communications plan that explained GE's contributions to the TV industry. I've since dug up old photos, speeches and technical specs—plus several antique sets that have since been refinished."

Among Segner's archives: a rough pencil sketch and engineering drawing on buff-colored paper, believed to be Alexanderson's sketch of a total television system. "After many years in this business, I'm still fascinated. By the mid-1980s, a family room may include large-screen TV projections, video-tape recordings, video-display games and computers."

William F. Edwards' showcase of electric gear

Pittsfield's Bill Edwards began restoring antique steam engines eight years ago, and became interested in the types of apparatus these engines powered. Result? "I also began accumulating old GE and Stanley motors, generators, ammeters, fans and voltmeters to demonstrate what these steam engines could do."

An Ordnance Systems Products Department quality assurance specialist, Edwards owns 24 steam engines and belongs to the area's Early Engine Club and The Berkshire Gas and Steam Engine Association. He's one of only two members of either club who demonstrate steam engine operation.

Included in his GE electrical cornucopia: a DC motor (circa 1892); an Edison bipolar motor (circa 1895); and a revolving armature alternator (circa 1900). Most electrical equipment he finds rummaging through old buildings or by talking to other antique collectors.

Emil J. Remscheid: his father said 'save Dr. Steinmetz' things'

Almost every summer from 1912 until Charles P. Steinmetz' death in 1923, secondary-school student Emil Remscheid accompanied the famous GE pioneer to his Viele's Creek camp near Schenectady where he assisted with experiments and recorded test data. Among his Steinmetz artifacts: the diary Steinmetz kept at his "Camp Mohawk."

Remarks Remscheid: "My dad was a GE machinist who told me to save everything I could relating to Steinmetz: 'Someday, he's going to be a famous man.' " Remscheid's collection includes the slide rule that Steinmetz brought from Germany, two scrapbooks of notes regarding work to be done, and eight textbooks on electrical engineering.

Remscheid's most memorable project with Steinmetz: "Camp Mohawk was once struck by lightning and Steinmetz was quite happy about it, using the opportunity to study the effects—splintered trees and shattered windows but no fire. This incident played the largest role in his building a lightning generator to duplicate the effects."

Henderson and Wheeler preserve GE jet history

America's successful entry into the Jet Age came Oct. 2, 1942 at Muroc, Calif., when the Bell XP-59 Aircomet powered by twin GE 1300-pound-thrust Type I-A turbojet engines made its first flight. Aircraft Engine Business Group-Lynn's Ralph E. Wheeler (left) and Gerry V. Henderson—shown with this first engine in Lynn—are now collecting and displaying GE jet engine artifacts.

Remarks Henderson, who worked on GE's first two jet engines and is a Jet Pioneers' Association past president: "The Company's Jet Age contributions go back even before 1942. GE's Dr. Sanford Moss operated the first U.S. gas-driven turbine wheel—an experiment that led to the first flight, in 1919, of an airplane with a turbine-powered supercharger."

In 1973, with the backing of AEG's Gerhard Neumann, VP and Group Executive, Wheeler helped establish Evendale's Jet Propulsion Museum. "I'd been 'squirreling away' old GE jet engines for 20 years, so it was easy to obtain the 30 engines now in the museum."

Nina M. Alvey's antique GE coffee pot works fine

Date of origin of Nina Alvey's sterling silver GE electric coffee pot is not known, but a New York antique catalog reveals it is at least 75 years old. The remarkable thing is—it still perks its four cups of coffee, and is designed to filter coffee twice before yielding its servings.

A Louisville Appliance Park product tester, Alvey (center) acquired the coffee pot 20 years ago for $5 when her daughter purchased it from an antique peddler. "Not till years later did I learn that the pot actually worked. A man interested in the pot said he had a plug to fit it, eventually produced one, and it has been brewing coffee ever since."

In 1944, Alvey opened a country store in rural Kentucky—the B&N Market and Antique Store—and during 30 years as a storekeeper became an antiques expert. Her extensive collection—in her home, two log barns and two other houses—includes other coffee pots, dolls, glassware, china and 1880s furniture.

Organization Changes

CONSUMER PRODUCTS AND SERVICES SECTOR

William L. Grim, General Manager—Refrigerator Product Management Department

INDUSTRIAL PRODUCTS AND COMPONENTS SECTOR

David M. Engelman, General Manager—Circuit Protective Devices Department
Daniel Lovinger, General Manager—Specialty Transformer Business Department
John D. Opie, General Manager—Lexan Products Department
William R. Vineyard, General Manager—Wiring Device Business Department

POWER SYSTEMS SECTOR

Frank D. Judge, General Manager—BWR Systems Engineering Department
Harold H. Klepfer, General Manager—Nuclear Technology Department
Eugene W. O'Rorke, General Manager—Domestic BWR Projects Department
George A. Roupe, General Manager—Fuel Projects Department
W. Bryan Webster, General Manager—International BWR Projects Department
Jack Williams, Jr., General Manager—Nuclear Energy Marketing Department

TECHNICAL SYSTEMS AND MATERIALS SECTOR

Richard J. Farrelly, General Manager—Development and Production Programs Department, Re-entry & Environmental Systems Products Division
Thomas E. Shaw, General Manager—Research and Engineering Department, Re-entry & Environmental Systems Products Division

Exchange families: from afternoon sightseeing to City of Light soirées, Americans Tracey and Phyllis Homburg with children Kerry, Lynn and Jill (left) enjoy the Parisian lifestyle. At right, avid fans of the Cincinnati Reds baseball team, French citizens Michel and Helene Turpin with children Martial and Nathalie receive an autographed poster and other souvenirs at Riverfront Stadium from right-fielder Ken Griffey.

An American in Paris (and vice versa)

GE-Evendale and SNECMA-Paris employees swap job situations, share talents—and develop worldwide markets.

If CFM International employees work together well—despite the obvious barriers created by living on opposite sides of the Atlantic, in the U.S. Midwest and the heart of France—it's no accident.

A strategic outgrowth of this jointly-owned company of General Electric and Société Nationale d'Etude et de Construction de Moteurs d'Aviation (SNECMA) has been the exchange of approximately 20 American and 20 French families between Evendale and Paris. Swapping work situations and lifestyles has built a solid rapport valuable to both business partners in operating smoothly on a global scale.

The GE Aircraft Engine Business Group and the French aviation engine firm co-funded CFM International in 1974 as a joint venture in the engineering and sale of the CFM56 high bypass turbofan engine for subsonic aircraft in military and commercial markets. Since the project began, more than 4,000 test hours have been accumulated on eight of these 22,000-pound-thrust engines in the U.S. and France.

Are the "exchange families" able to make the adjustments to new countries, communications and customs? American Tracey G. Homburg, browsing around a Paris open-air market, and Frenchman Michel J. Turpin, smiling from behind a hotdog at a Cincinnati Reds baseball game, answer "yes."

For Homburg, product support manager of CFM International, "Paris has lived up to its reputation as one of the world's most exciting cities. There are many things to do every weekend," he notes.

Since he, his wife and three children spoke no French upon arriving in the City of Light, communications—combined with "the normal confusions of any move, whether it's across town or across an ocean"—were an initial concern, Homburg admits. But that was two-and-a-half years ago. Ready to conclude his French assignment at the end of this summer and resume GE responsibilities in Evendale, he adds: "Today the whole family speaks adequate French and recognizes the impact of different approaches to problems of everyday life and business. Living here has been a positive learning experience."

Turpin, SNECMA assembly manager of CFM International in Evendale, echoes that appraisal. He, his wife and two children also learned the language of the area in which they have lived for the past two years. Speaking excellent English now, Turpin comments: "When you arrive in a new country, you can stay at home—or get out and meet the people. We've gone all over the beautiful United States, and everywhere we go, we receive a most wonderful welcome."

And when in America, do as the Americans do. Turpin has become "a great fan" of baseball, he says. "The SNECMA employees working here even organized the 'First National French Baseball Team' to play

against people from GE," he notes. "We lost 40-3, but that's not important. The importance was the spirit of friendship." Still, Turpin plans to arrange a spring GE-SNECMA sports contest in which he feels his team will fare better. The game? Soccer.

Turning their attention to business, Homburg and Turpin agree on the worth of CFM International. The CFM56 engines are to be assembled where they are purchased—those bought in the U.S. will be completely assembled here, and those bought in Europe will be completely assembled in France. CFM International provides a single customer interface for the CFM56. The company can marshal the full resources of GE and SNECMA from either Cincinnati or Paris to offer complete support services to worldwide customers.

Explains Homburg: "GE and SNECMA each share 50% of the effort on this project. It's a unique management approach in that the 50-50 marriage is just that, and not merely an extension arm of a parent company. This sharing gives both participants the opportunity to be in the forefront of future worldwide business."

Concludes Turpin: "It's marvelous to compare work techniques and talents. The most significant benefit, however, is the fine cooperation and understanding of people from different countries working together. It's good business to open the doors of the world."

For AEG's Gerhard Neumann: France's highest tribute

The Republic of France has conferred its highest civilian honor on a member of GE top management. Gerhard Neumann, VP and Group Executive—Aircraft Engine Business Group, was awarded the insignia of Chevalier and appointed Knight of the Legion of Honor in ceremonies held January 31 at Salem, Mass.

Recognizing Neumann as a key figure behind the successful formation of CFM International, French President Valéry Giscard d'Estaing selected the AEG chief operating officer for the distinguished tribute. The honor perhaps best characterizes Neumann's commitment to international business excellence.

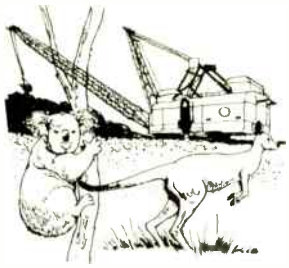
Presenting the award, Rene Ravaud, President and Director General of SNECMA, the partner company of GE in CFM International, applauded Neumann as "a true friend of France" who has worked "to develop cooperation between our two companies and to make this cooperation an example for other joint ventures in the future between our two countries."

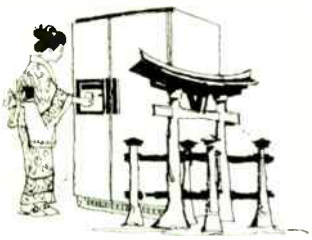
Spanning four decades, Neumann's aeronautic professionalism is as international in scope as the history of the man himself.

Born in Germany during World War I, he developed an early interest in aviation. At the end of the 1930s, Neumann traveled to China to maintain aircraft and equipment for the Chinese Nationalist Air Force. With the outbreak of World War II, he joined Major General Claire Chennault's American Volunteer Group—the legendary "Flying Tigers"—as an engineering specialist, and in 1942, though not a U.S. citizen, enlisted in the U.S. Army Air Corps in China and was assigned to Technical Air Intelligence. That same year he put into flying condition a crashed Japanese Zero fighter aircraft, the first to fall into Allied hands, and so helped to provide invaluable technical intelligence. His engineering feats and intelligence work for the Office of Strategic Services (OSS) culminated in a special Act of Congress that granted him U.S. citizenship in 1946.

Neumann then moved to Santa Monica, Calif. to work for the Douglas Aircraft Company. But at the request of General Chennault, he returned to China in early 1947 to become chief engineer for the General's Civil Air Transport airline in Shanghai. He joined GE in Lynn in 1948, was elected a vice president in 1963 and became group executive in 1968.

Appointed Knight of the Legion of Honor by the French government, VP Gerhard Neumann (third from left) receives France's top civilian tribute, the insignia of Chevalier. With him are his wife Clarice; AEG marketing communicator Leonard A. Dalquest; and CFM International Chairman and Chief Executive Jean-Claude Malroux (right).





A personal belief in multinationals

By
Richard M. Kleinhans
Counsel—
Latin American
Operations

As a General Electric attorney for eight years, International Sector's Richard M. Kleinhans has had close contact with this country's business operations both here and abroad. Since 1975, his work in the international field has led to firm opinions about multinational corporations and the world economic role of the U.S., which he summarizes here.

I have always been a believer in fair, free international trade as beneficial to everyone who participates. Multinational corporations are key contributors to this trade process, and it is distressing to observe how they recently have come under criticism from some quarters in the U.S. Below, I state some of the charges leveled against multinationals, and then refute these critics' accusations with what I believe to be the facts. For example:

Charge. "Multinationals are the means by which the U.S. economically exploits lesser developed countries." **Facts.** Multinationals are not a "U.S. creation." The last decade has seen the phenomenal rise of many foreign-based multinationals, which are not only matching Americans factory-for-factory, office-for-office overseas, but are also setting up operations here in the U.S. The flow of foreign investment into the U.S., in the form of acquisitions and joint ventures, is approaching flood proportions.

Charge. "Multinationals are 'runaway shops' in search of cheap foreign labor." **Facts.** U.S. companies do not place plants overseas primarily to take advantage of low labor rates on products to be shipped back to the U.S. They invest overseas to serve markets not otherwise accessible to them. More than 65% of the total U.S. overseas investment is concentrated in Europe and Canada—scarcely areas of minimal wage rates. Nearly 95% of General Electric's overseas subsidiary output is sold in foreign markets. In the isolated instances where GE does import a product into the U.S., it is a defensive move to remain competitive with foreign imports.

Charge. "Multinationals export U.S. jobs, thereby causing domestic unemployment." **Facts.** International companies do not curtail U.S. jobs. A recent GE study found that 37,000 U.S. employees have jobs as a result of GE product export sales. And those 37,000 GE jobs supported in turn some 45,000 domestic jobs out-

side the Company in supplier and vendor firms. The percentage of GE domestic jobs dependent on exports has grown from 6% in 1970 to nearly 14% in 1977. Operations of GE overseas affiliates, manufacturing products in host countries, generated 13,000 of these GE jobs in the U.S., plus 16,000 of the jobs among vendors and suppliers.

Charge. "Multinationals export both U.S. capital and U.S. knowhow, weakening America's competitive position abroad." **Facts.** This country's multinationals are not "giving away" valuable U.S. technological knowhow, and these companies' foreign investments are not diverting funds from domestic purposes. Foreign licensing is part of a beneficial two-way exchange which leads to the sale of U.S.-manufactured parts and equipment and to identifying added business. And even with their increased foreign activities, U.S. multinationals enjoy a U.S. growth rate far above the national average.

Charge. "Multinationals run roughshod over the rights of other countries." **Facts.** Multinationals do not exert undue influence on, or threaten the sovereignty of, their host countries. The reality is: multinationals are generally welcomed abroad because they offer capital, business, technical skills and market knowledge that benefit the host nations. Indeed, U.S. multinationals are highly dedicated to being good corporate "citizens" in their host countries. Harvard Business School author Raymond Vernon, in his recent *Storm Over the Multinationals*, finds little support for contentions that multinationals stifle local entrepreneurs, engage in exploitative transfer pricing, systematically manipulate subsidiary profits, or suppress all competition.

Today's explosive expansion of science-based industries worldwide prevents the U.S. from being pre-eminent in every field. Western Europe and Japan now export four times as much as the U.S., compared to 2½ times as much in 1960. As a matter of necessity, the U.S. is increasingly dependent on world trade, and cannot afford this erosion of its export position.

According to a recent issue of *Business Week*, the West German firm Siemens plans to build a power-generating equipment factory in Florida, is showing acute interest in the U.S. market and "is certain to bring tough, new competition to a broad spectrum of electrical and electronics markets here." Siemens is one of the world's largest makers of electrical and electronics equipment and is General Electric's single largest world competitor.

When final figures are computed, GE's 1977 international business is projected to contribute in excess of $2 billion to the U.S. balance of trade. By contrast, this country's 1977 trade deficit totaled $26.6 billion. American multinationals play a pivotal role in the health of the U.S. economy, and today more than ever it is vitally necessary that they maintain a strong competitive position worldwide.

Unfortunately, under consideration today is Federal legislation which would eliminate the foreign tax credit, the deferral of taxes on foreign source income until it is remitted, and the tax deferral associated with Domestic International Sales Corporations (known as DISC). These important tax benefits either parallel other nations' tax approaches—or have been previously voted into U.S. law to compensate our multinationals for special advantages given to foreign competitors by their own governments.

The repeal of these provisions would seriously hurt U.S. business interests abroad, reduce this country's export competitiveness, reduce export-related U.S. employment, and further deepen our negative trade balance.

U.S. political leaders must recognize that America does not dominate world economic activity. As the International Sector's John F. Burlingame, Senior VP and Sector Executive, has stated: "The U.S. is no longer a self-sufficient economic island unto itself. To compete successfully, U.S. business needs to be supported by its own government in a way comparable to the treatment of our international competitors by their own governments."

Other nations are actively and enthusiastically promoting their multinationals, while our own government appears lackadaisical toward—and at times even intransigently opposed to—U.S. business operations overseas.

This country can ill afford to turn isolationist—with laws that would impair our international competitive position. We must turn outward with bold new efforts to make U.S. industry more productive and cost-competitive.

Moreover, wholly apart from these vital economic considerations are the diplomatic and political benefits which come to us through foreign trade. Strangers can never be friends—or even allies. Mutual respect is achieved through people learning to value one another. General Electric has thousands of employees traveling and living throughout the world—making new friends for the Company, for fair and free trade and for the U.S.

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ENERGY INNOVATIONS. Two recent breakthroughs by the GE Research and Development Center:

An experimental superconducting electric generator (above)—its rotor spinning at −452°F to take advantage of the low resistance that occurs near absolute zero—should be ready for tests next year. Chilled by liquid helium, this 20-million-volt-ampere AC generator can produce as much electricity as a conventional machine twice its size. Shown: GE engineers Dr. Trifon Laskaris (upper left) and Fred Hajjar.

What looks like icy slush (left) is actually warm Glauber's salt (sodium sulfate decahydrate), the "active" ingredient in a new GE solar-heat-storage device under development. Carlyle Herrick (far left), the device's inventor, and technician Kenneth Zarnoch examine the inexpensive substance, which will be slowly rotated inside a barrel where it will absorb heat above its 90.3°F melting point and later release the heat as it freezes.