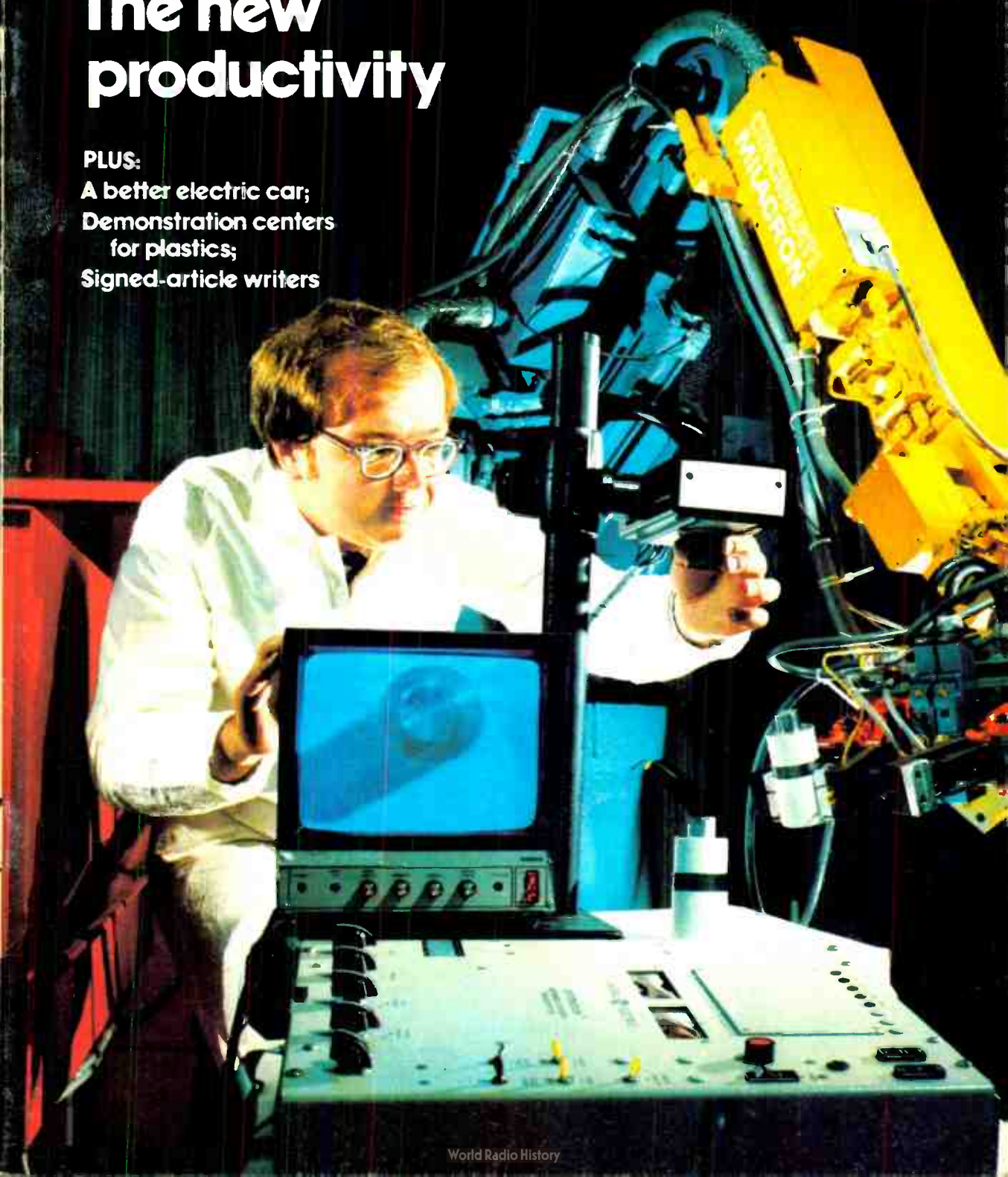
GENERAL ELECTRIC

Monogram

JULY-AUGUST 1979

The new productivity

PLUS:
A better electric car;
Demonstration centers for plastics;
Signed-article writers



Flexible automation represents one way GE is scoring productivity gains. In Schenectady, GE's Bruce D. Newell conducts welding experiment.

The

Can GE make a major step-up in

"A lot of new things are happening on the productivity front. One is a greater awareness of what the term really means—'productivity' is how successfully a business can bring together technology, capital, environment, materials and people into an optimized mix of output. Productivity increases when people develop new products and technology, have more efficient machinery and equipment to work with, manage more effectively, are better trained, educated and motivated, and have better working environments."

The speaker is Robert B. Kurtz, Senior VP-Corporate Production and Operating Services.

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Contents

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new productivity

its rate of productivity improvement? The Company's experts tell why and how it will be done.

As head of CPOS, Kurtz has the responsibility to help improve the Company's productivity wherever possible. Improved productivity is a top-priority goal for GE.

"For the 1979-83 period, a major step-up in the rate of productivity improvement is required to meet the challenges of multinational competition and continued inflation," Kurtz observes. "GE must be particularly concerned with productivity improvements because multinational electrical firms in Japan and Germany have been supporting their competitive thrusts with impressive gains of 5% to 6% per year."

He notes that "there's a new and more favorable attitude in the U.S. today regarding productivity—induced by the awareness that people, dollars, technologies, raw materials and energy must be utilized more efficiently. Americans are increasingly aware of how poorly the U.S. is faring in relation to other industrialized nations."

Something else that's happening in the area of productivity, Kurtz points out, is a host of new developments and techniques—such as robotics, interactive graphics and low-cost microprocessor-based controls. "Industries which have been the most successful in applying electronic technology have generally shown the highest productivity gains," he observes.

CPOS is now leading a Company-wide effort towards optimum use of computer technology through its Bridgeport-based Computer Management Operation, which includes the Computer Aided Engineering and Manufacturing Council, Special Purpose Computer Center and two Computer Application Centers.

In Bridgeport, a Production Systems Application Center set up by CPOS is charged to find the best production systems currently used in industry worldwide. Also, an Electronics Manufacturing Practices Center has been established as a focal point for the application and introduction of electronics manufacturing processes.

"*GE must be a leader* in productivity improvement to obtain continued growth in sales and net income, and earn the right to serve customers," states Kurtz. "For the U.S. as well as GE, improved productive efficiency means better control of inflation, preservation of jobs, higher living standards, and a better quality of life. Real income cannot grow without commensurate growth in productivity."

He concludes: "General Electric management has always been concerned with productivity, but when we look at our competition, it's clear we need to do better. Ways to increase GE productivity have been identified across the Company, and it's the role of CPOS to help GE components acquire state-of-the-art practices."

Senior VP Bob Kurtz: "Our current national concern with productivity reflects a healthy shift in interest toward how we're using our resources to get the job done."

The following stories illustrate how the Company is scoring impressive productivity gains. Every Sector is doing many of the same things to increase productivity, so with limited space, we can focus on only one distinctive type of development per Sector:

Robotics

Industrial robots are not so winsomely human as those in "Star Wars"; most of them in use today are more like single arms that, following electronic instructions, can perform various repetitive functions.

Japanese industry has taken the lead in putting robotics to work—in 1978, their use in Japan increased by one-third to 40,000. The U.S. robot population reached 7,500.

One GE Sector that is pushing hard to build its competitive strengths by increasing its use of robots, or flexible automation, is Industrial Products and Components. States Jack C. Acton, staff executive—Industrial Products and Components Technology Operation: "With more than 50% of Sector sales motor-related, the application of robotics to motor manufac-

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During Sector Technical Council meeting in Springfield, Mo., plant manager Louis Brunner (above, second from right) asks employee Etta Duelen to discuss her work with Council members Jack Acton, Robert Carlson and Clovis Linkous. Left: Springfield's Bill Essick operates robot in die-casting.

ture offers great opportunities for productivity gains. The Sector began to apply robots in 1977. Today, these flexible automation programs are operational at all five domestic Specialty Motor Department plants and in other Sector plants that produce both motor and control products."

Observes Acton: "We're now using robots for jobs that involve repeated lifting and in environments containing smoke, fumes or unusually high temperatures—such as in die-casting work in Specialty Motor's Springfield, Mo., motor plant (shown above). Robots are helping reduce workplace hazards. They also have been programmed to perform monotonous material-handling jobs."

Acton also points out that GE is striving to be more than a recipient of productivity technology; the Company is looking for ways to develop new business in automation.

One example: the Optomation™ Instrument System developed by Electronic Systems Division. By applying this GE technology, robots can now acquire "vision." At Schenectady, Corporate Consulting Services is using a prototype of this system to experiment with robot sight (see front cover). One robot manufacturer is selling robot units with an Optomation Instrument System. Developments such as this could give GE an increasing share of an industrial robotics business that now totals more than $60 million a year.

The industrial Sector is now "transferring" the knowledge gained by its components' pioneering with robots, and other manufacturing technology, via its new Technical Council.

Interactive graphics

The recent breakthrough of interactive graphics (IAG) in the area of computer-aided design and manufacturing (CAD/CAM) signals a new era of productivity improvements. Large investments in IAG, CAD/CAM and numerical control equipment have been a major thrust of Power Systems Sector in its push for heightened productivity.

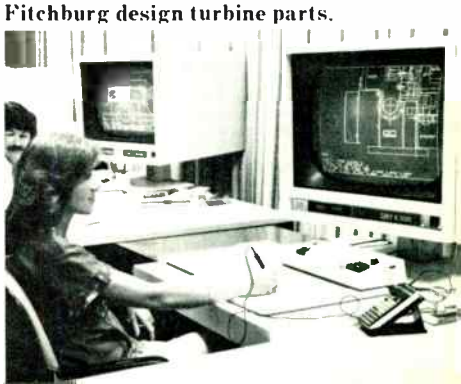
A specific example of a total systems approach is in Fitchburg's Mechanical Drive Turbine Department. The Department's concept provides a link between engineering, drafting and manufacturing, producing a totally integrated system.

Fitchburg's IAG-equipped engineers and draftsmen, seated at computer graphics consoles, can define machine parts electronically by using a programmed geometric graphics data base. The operators produce multidimensional drawings—precise graphics definitions that can be used for design, derivation of tool paths and production of numerical control tapes. IAG alleviates countless manual "reiterations" and reduces work time.

"For each of our turbine designs, we've established goals for reducing the time spent on repeatable engineering and drafting tasks," notes the Department general manager, George W. Sarney. "In 1974, we implemented our first CAD program. By 1981, we're seeking to reduce the time required on repeatable tasks by a factor of four."

Declares Sarney: "In the design area, with IAG, we're accomplishing things we couldn't possibly do before. Besides reducing design cycle time, we are facilitating standardization and improving quality—not only from a drawing legibility standpoint, but also from the standpoint of accuracy of the information transmitted to

Using computer graphics consoles, GE engineers and draftsmen at Fitchburg design turbine parts.



manufacturing."

As for Fitchburg's CAM activity—which involves the use of numerical control machine tools for manufacturing—IAG is the newest method for generating computer tapes which "talk" to the numerical control machines.

"The IAG method of generating tapes is much faster and less error-prone," reports Sarney. "While the system takes time to implement, we expect a substantial productivity payoff. By 1980, we hope to cut cycle time for producing computer input by a factor of three."

Advanced electronics

Microprocessor-based innovations are a key to Consumer Products and Services Sector's ability to meet the life-style needs of today's consumers, while scoring impressive productivity gains and manufacturing products more efficiently.

State-of-the-art microprocessor technology has been incorporated into General Electric appliances ranging from microwave ovens to television sets. New applications are taking place monthly. One case history: GE electronic digital clock radios, which employ advanced microprocessor technology, have unique clock radio capabilities and can be manufactured so as to permit a significant productivity gain.

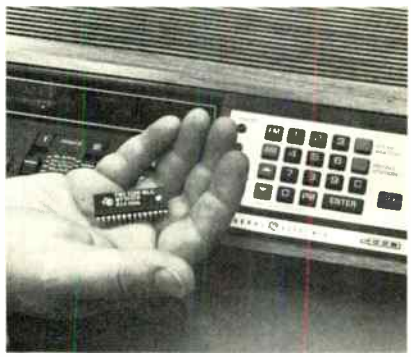
The Great Awakening® clock radio introduced in June by Syracuse's Audio Electronics Products Department is the first FM AM clock radio with a keyboard instead of a tuning knob. The many programmable wake-up and radio functions are made possible through low-cost microprocessors and productivity breakthroughs in innovative test methods.

"Using previous methods to test all of the features of The Great Awakening clock radio would take almost 20 minutes per radio," comments Audio Electronics' general manager, Walter W. Williams. "On a high-volume assembly line, such a time is prohibitive. But by incorporating a self-test system in the microprocessor circuit, and designing the product so it can be electronically tested with minicomputer-controlled test equipment, *the time is reduced to one minute!*"

Electronics redesign also has been the method by which the Home Sentry® smoke alarm has been continually improved in cost—while also improving the product's producibility and reliability. The E. I. Company Limited of Shannon, Ireland—a GE affiliate—manufactures all of the Company's smoke detectors.

"The first GE smoke alarm was produced in 1975 and included a dual ionization chamber and discrete electronic signal processing circuits," notes E. I.'s Frank A. McCabe, president and managing director. "Our first redesign, in 1977, comprised a new low-cost, single ionization chamber and custom integrated circuits. This April, we began producing our second redesign, which includes lower-cost microelectronics and a smaller nine-volt battery."

The result? The new Home Sentry smoke alarm costs only one-third as much to manufacture as the one introduced in 1975. Thanks to savings in materials, it is only two-thirds the size and meets competition by selling for only one-fourth as much.



Audio Electronics' The Great Awakening® clock radio employs microprocessor technology in both its manufacture and testing.

Powdered metallurgy

Produce the superalloy in powdered form; under high pressure, shape the powder to approximate the part desired; then machine—this innovative method of making engine parts, called "powdered metallurgy," has proved to be a major productivity gain for Technical Systems and Materials Sector, which employs a large number of raw materials in manufacturing its products.

Case in point: Aircraft Engine Business Group, which must use such expensive materials as nickel, cobalt, chrome, molybdenum, tungsten and tantalum in order to manufacture GE aircraft engines. Recently, prices of these materials have gone almost straight up. Cobalt, as an example, has increased in price from about

(continued next page)

$5 a pound two years ago to $25 a pound today. Other materials have gone the same way—escalating at a rate more than twice that of the consumer price index. Combinations of these materials make up the superalloys from which most engine parts are made.

In the early 1970s, Aircraft Engine Business Group embarked upon an ambitious productivity-improvement program to reduce materials use and machining time. "It's not uncommon for a forging to be ten times the weight of the finished part," says Raymond F. Letts, VP and general manager of Aircraft Engine Manufacturing Division. "To reduce that ratio, we have to get nearer to the shape of the final product with the input material. A good way to do this is through powdered metallurgy. The alloy is produced in powdered form, then squeezed under high pressure into what we call a 'near net shape,' then machined—obviously with far fewer chips needing to be cut than with a forging."

Faced with increases in material costs, Evendale GE is using powdered-metallurgy process to produce many of its aircraft engines.

A good example of this approach has been in the production of engine parts made from General Electric René 95, a nickel-base superalloy rich in expensive, hard-to-get, hard-to-cut metals. Now in use on the T700, F404, and CFM56 jet engine programs, near-net-shape powdered-metallurgy approaches have reduced René 95 input by 45% and machine time by 32%.

"By using the powdered-metallurgy method, we expect to save an average of 260,000 pounds of René 95 a year on the engines over the next decade," says Letts. "This amounts to an $80 million cost savings over that period."

'Locotrol' trains

"Locotrol"—which stands for "locomotive control"—is a unique method which GE's natural resources affiliate, Utah International Inc., is benefiting from in its drive to increase productivity at its Australian mining operations.

In Central Queensland's Bowen Basin, located northwest of Brisbane, Utah is the lead joint-venture partner of Central Queensland Coal Associates (CQCA), which operates three open-cut mines and will soon start a fourth. Metallurgical coal from the Goonyella, Peak Downs and Saraji mines is railed on a Queensland Government Railways track (financed by CQCA) to the coal export terminal of Hay Point, which is owned and operated by CQCA.

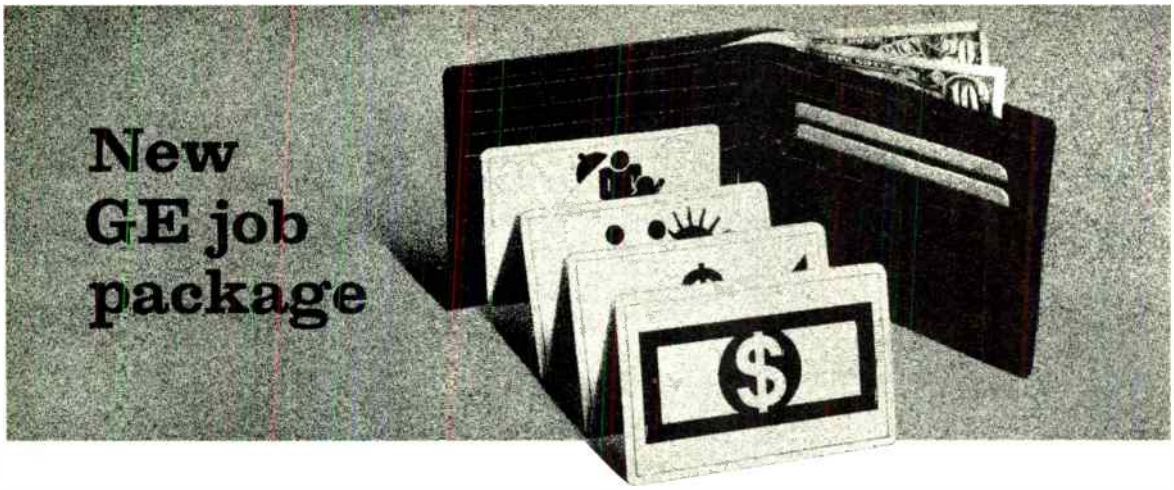
"Until Saraji mine came 'on stream' in 1975, coal from the Goonyella and Peak Downs mines was railed to Hay Point in trains, each of which comprised three locomotives and 74 'wagons',"observes Utah's Robert J. Brock, CQCA operations manager for the four mines. "With the addition of Saraji—and looking ahead to the new Norwich Park mine—Utah and its partners saw that they had a rail congestion problem. The single railroad track would be hopelessly ensnarled."

The solution? A unique "locotrol" train, which in essence is a train twice the length of those formerly in use. Each train comprises three locomotives and 74 coal wagons—followed by three more locomotives, a radio-control wagon and 74 more coal wagons. A single train crew, riding in the front locomotives, radios instructions back to the unmanned locomotives.

Observes Brock: "There are now five 'locotrol' trains running, which together make five or six trips a day, seven days a week. Each train is two kilometers long (1.2 miles). This has solved our congestion problem, lowered labor costs and developed an orderly way to transport our coal."

Shown arriving at Australia's Hay Point coal terminal, this "locotrol" train can deliver twice the coal of conventional train.

New GE job package



A substantially enriched cost-of-living formula and a new GE Dental Plan are but two of the new employee benefits.

"The new three-year employment package that has been negotiated between General Electric and the International Union of Electrical Workers and the United Electrical Workers provides more than 20 new values in GE pay and benefit plans, which are designed to meet the needs of employees in these unpredictable times."

So observes VP Frank P. Doyle, Corporate Employee Relations, regarding the labor settlements. Noting that the agreements represent "nine weeks of tough and constructive bargaining," he says the contracts "provide equity and better income protection for employees while meeting the Company's need to remain competitive."

In past years, Doyle notes, the Company has leaned toward larger general pay increases and smaller cost-of-living adjustments, because the business usually can be managed more effectively when labor costs are predictable. "This year, in response to concerns about inflation, the new job package is oriented more toward cost-of-living protection."

Under the three-year agreement, General Electric hourly and nonexempt-salaried employees already have received an immediate pay increase of 50 cents per hour, or $20 per week, effective July 2. There also will be two other fixed increases totaling 32.5 cents an hour, plus five more cost-of-living adjustments.

To help employees during this period of high inflation, the labor pact includes an improved cost-of-living escalator—an increase of 1 cent per hour for each 0.2% increase in the consumer price index—which is a 50% improvement over the former 0.3% formula. In addition, previous restrictions on payouts are removed, and payments will be made every six months instead of yearly.

Over the next three years, the total increase in wages—including the c-o-l escalator—is estimated at about $2 an hour, or $80 a week, based on anticipated rates of inflation.

Other benefits include a new dental plan, early retirement at age 60 and higher pensions.

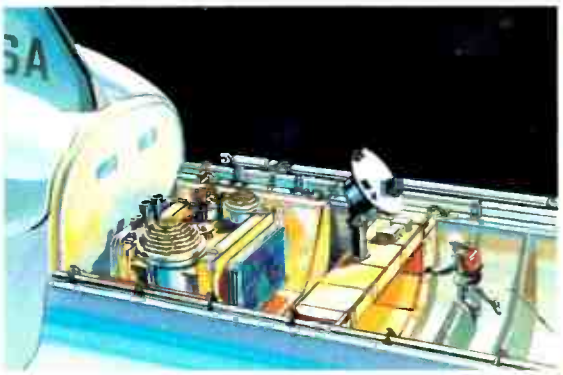
"Better dental coverage was a high priority item," remarks Doyle. "Beginning July 1, 1980, GE will have a new dental plan that emphasizes preventive dental care and helps pay for restorative procedures. The plan will cover all employees who have at least one year of continuous service, and their eligible dependents. This coverage requires no employee contributions."

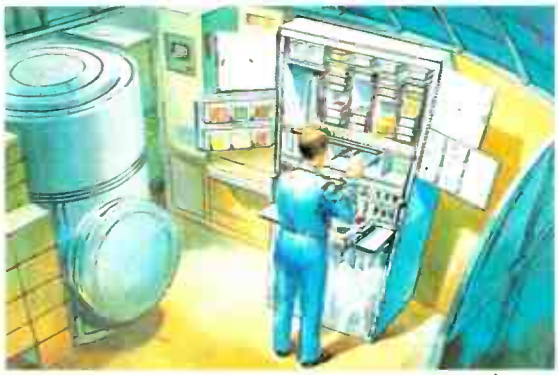
The dental plan will cover check-ups, cleaning, diagnostic services, fillings, bridges and crowns on a fixed-fee basis. This will result in 100% coverage of a region's prevailing rates for diagnostic and preventive care, and about 50% on restorative work.

States Doyle: "The GE job package also responds to employees' needs for retirement security. Major benefit increases include early retirement at age 60 with full earned pension, and a 25% increase in the range of guaranteed pension levels. In addition, employee contributions to the Pension Plan will begin at $9,000 of annual earnings instead of $6,600, resulting in another pay increase of about 3.5 cents per hour in take-home pay."

A number of other benefit improvements include three weeks of vacation after seven years, an increase in the lifetime maximum medical insurance to $350,000 per person, and an increase in minimum life insurance to $20,000.

Now being built by GE, the Landsat D earth resources satellite is designed to be retrieved by Orbiter for maintenance and replenishment.





Supplying support services, GE-built Standard Test Racks (left) will mount and interconnect experiment packages in the Orbiter's large cargo bay. Orbiter's new GE-built galley (right) is designed for fast meal preparation and cleanup in a near zero-g environment.

Exclusive drawings for *Monogram* by P. A. Bertolino

Here comes the Space Shuttle!

General Electric has a lot riding on mankind's next giant step into space.

When NASA's Space Shuttle Orbiter, the nation's first reuseable spacecraft, lifts off in 1980, space exploration will become an even more active and diverse field of endeavor. General Electric will be in the midst of it, as revealed by the large number of Company projects scheduled to be aboard the spacecraft.

To date, Space Division's responsibilities in the Space Shuttle program have included 40 contracts. Fourteen of these are major hardware and management projects in support of upcoming flights, with many more NASA and military projects due for contract bids. NASA already has a Shuttle Orbiter "traffic schedule" covering 12 years and totaling about 500 flights. Peak activity is to be reached in 1988 when more than 60 flights are scheduled from Kennedy Space Center, Florida, and Vandenberg Air Force Base, California.

Among the Company's contributions to date:

- The Orbiter's crew quarters will house the GE-built galley, waste-collection system and oxygen-level monitor. GE has designed food packages that make the food more appetizing and easier to hold and serve.
- Inside the Orbiter's Spacelab, where seven crew members and scientists can work at one time, a GE-built Atmospheric Cloud Physics Laboratory will help atmospheric scientists study the earth's weather mechanisms.
- Also for the Spacelab, GE is building a latex spheres reactor for development of materials to assist medical, biological and industrial research.
- GE has designed and built Standard Test Racks to support, interconnect and service a variety of experiment packages which will be carried in the Shuttle's open cargo bay.
- The new Landsat D and Defense Satellite Communications System (DSCS III) satellites—being built at the GE Valley Forge Space Center—are Shuttle-compatible. DSCS III is designed for launch from Orbiter; Landsat D is designed to be retrieved by it and returned to earth for refurbishment and replenishment.
- Also tentatively slated for the cargo bay is a LIDAR (Light Direction and Ranging) system, which GE designed to conduct atmospheric measurements by laser radar.

Still other projects include the University of Chicago's Cosmic Ray Nuclei Experiment, in which General Electric-designed hardware will support the measurement of cosmic rays in space. The Company also is sponsoring a series of small Orbiter payload experiments, to be allotted to universities as research projects in a variety of disciplines.

As part of the Company's ongoing service efforts for the Orbiter, GE built and operates the spacecraft's factory checkout station and the facilities used to support the approach-and-landing testing. Once Space Shuttle flights begin, GE will monitor the spacecraft's avionic instruments during flights via an Orbiter-to-ground data link.

GE also will integrate the Orbiter's life sciences experiments, supplying essential engineering and management services. These Company-provided services will be used in medical, biological and botanical experiments in the near-zero gravity, high-vacuum, vibration-free space environment.

Why does a certain cloud produce a torrent of raindrops, while others precipitate only a drizzle? Why does one cloud produce lightning and thunder, while other outwardly similar clouds do not? Why, out of a field of hundreds of thunderstorm-producing clouds, does one develop into a tornado? The GE-built Atmospheric Cloud Physics Lab will tackle these questions.

The versatile Shuttle will serve many missions as a launch and retrieval vehicle, a platform for scientific experiments, and a test bed for instruments and equipment. In space, Orbiter will go into a low earth orbit of up to 500 miles, where it can serve as an earth-orbiting lab for 7-to-30 days. The cargo bay can carry loads weighing as much as 65,000 pounds.

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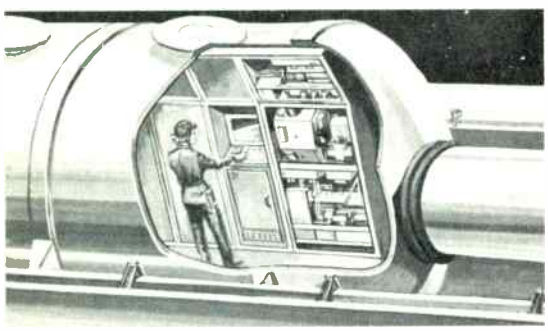
After the mission, Orbiter is slowed, begins a re-entry trajectory under intense thermal stress, descends into the atmosphere and lands like a conventional airplane at its launch site. Within two weeks, it can be serviced, loaded with a new cargo and readied for a new mission.

The first Space Shuttle Orbiter to be launched, named *Columbia,* is at Kennedy Space Center for final integration and test sequences. Its first orbital flight is scheduled for mid-1980.

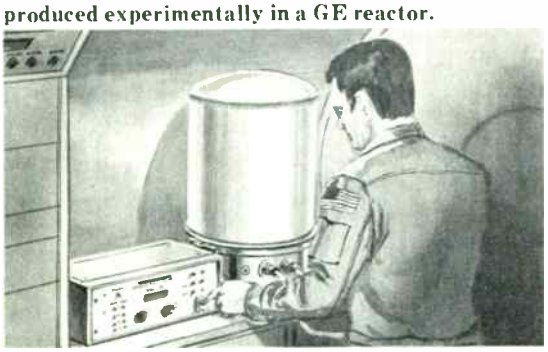
Observes Lee L. Farnham, VP and general manager of Space Division: "The earth-orbiting Shuttle now joins other General Electric 'down-to-earth' space projects, such as the Nimbus and Landsat earth observation systems and the Japanese Broadcast Satellite, to enlarge the Company's role in reducing the cost and increasing the effectiveness of using space to meet commercial, scientific and defense needs."

He concludes: "Our Shuttle work adds another chapter in our recent space history, which, since 1976, has included two Viking spacecraft, equipped with GE control and guidance systems, which are still orbiting Mars—and Voyagers 1 and 2, now exploring the Jovian system and beyond, with GE-built electrical power systems aboard. It's a record of which we can be proud."



Scientists will conduct weather research in the Atmospheric Cloud Physics Laboratory, unhampered by gravity which often prevents accurate assessments.

Possibly the first commercial product made in space will be precisely sized latex spheres in solution—produced experimentally in a GE reactor.



High-technology breakthroughs

Computerized load control for the home

Fuel supplies are plummeting. Utilities' operating costs are rising. What to do? "Load management" may be the answer.

Introducing a product to help make this energy concept possible: the HC-1® Home Comfort and Load Management Control, a joint effort by the Industrial Control Department and the R&D Center's Solid State Applications Operation.

'The next great GE plastic'

Lexan®, Noryl®, Valox®, Genal®—they're registered trademarks for General Electric plastics that have achieved high-visibility successes. Now it's time for them to move over and make room for another big GE entry: Arnox® resin, a major new engineering plastic material.

Shown holding test-molded Arnox® auto distributor cap: Dr. Gene Banucci (l) and Bob Rager (r). Dr. George Niznik is at center.

GE research labs are making headlines with a new energy-saving group of 'high-tech' products.

A GE light bulb with 'smart electronics'

Exactly a century after Edison's invention of the common incandescent light bulb, a new contender has appeared on the scene—thanks to General Electric's Lighting Business Group in Cleveland and Syracuse's Electronics Laboratory.

A radically new GE bulb—the Electronic Halarc®—is the first of a new, energy-efficient family of lighting products which use less electricity and deliver longer bulb life. The "Electronic Halarc" bulb will last five times longer than the typical 750-1,000-hour life of ordinary incandescent bulbs and use only one-third as much electricity to generate the same amount of light.

Field tests in homes will begin later this year, and the new bulb will be available to the public in early 1981.

"The technology of this lamp represents the most important development in lighting since the Company introduced the fluorescent lamp in 1938," states James A. Baker, VP and group executive of Lighting Business Group. "The lamp includes a metal-halide arc tube—the kind incorporated in GE's industrial and commercial Multi-Vapor® lamps, but reduced in size—combined with sophisticated electronic circuitry contained in the base."

"The development of a new, miniature arc lamp appropriate for home use was the challenge posed for the Lighting Business Group," notes E-Lab Manager Richard A. Kashnow. "However, before home use could be practical, 'smart electronics' had to be invented to start and run the new arc lamp, provide standby illumination during start-up, and provide the immunity—which arc lamps normally lack—to line voltage fluctuations. Designing electronics to perform these complex functions within practical size and cost constraints was the challenge posed for our Electronics Applications Center."

The two-way bulb is expected to retail for about $10, compared to $1.50 suggested retail for the 50/100/150-watt three-way incandescent. But, because it is designed to last up to five times longer, and is three times as efficient, the new bulb can actually *save consumers about $20 over its lifetime.*

Replacing the conventional thermostat, the HC-1 control facilitates energy storage *prior* to peak periods of power consumption, thereby reducing usage *during* the peak—while retaining home comfort level. Wide use of the HC-1 control would allow utilities to reduce investments needed for peak electricity demands. Result? Potentially lower customer rates.

In a June 1979 report on a test in 112 homes, the Potomac Edison Company announced good results with the HC-1. GE estimates that, based on installations in 40,000 homes, the utility could save $50 million in capital expenditures after the initial cost of installing this control on customers' walls.

Discussing energy-saving capability of HC-1® home comfort center (on wall): Hagerstown, Md., homeowner Sandra Lorshbaugh, and Potomac Edison's Joseph Staley.

Hailed as "The processable epoxide," Arnox resin is a family of materials providing the long-recognized superior properties of epoxy resins without traditional epoxy processing problems.

The familiar procedure of having to mix two materials to produce an epoxy is done away with by the new GE development. Arnox resins feature a single-component technology which requires no component mixing to initiate the curing process. Rather, cure is thermally triggered at a specific temperature (around 300°F, depending on the process). At temperatures below that point, Arnox resin is highly stable and requires no refrigeration or special handling. And once curing begins, it is exceptionally fast.

Arnox resin—in the GE plastics pantheon, it's a newcomer that seems destined to begin showing up in everything from transformer bushings to automotive engine components and oil field pipes. It is, in short, what Glen H. Hiner, VP and general manager of Plastics Business Division, has called "the next great GE plastic."

Able to travel 100 miles on a single charge is the sleek ETV-1, the latest GE-developed electric car.

New electric car goes to Washington

To steaming Washington, D.C., motorists experiencing frustrating gas lines, the sight of a sparkling new car that can be "fueled" by simply plugging it into an electrical outlet was a welcome sight, indeed.

The object of such rapt attention was a sleek four-passenger subcompact electric car, the ETV-1—for Experimental Test Vehicle-One—developed by General Electric for the U.S. Department of Energy (DOE) and introduced June 22.

With reporters and curious onlookers pressing for a good view, the official unveiling was handled by DOE's John M. Deutch, assistant secretary for energy technology, and Omi G. Walden, assistant secretary for conservation and solar applications.

Representing GE was Dr. James M. Lafferty, manager of the Power Electronics Laboratory at the Company's R&D Center, Schenectady. He called the ETV-1 "the most advanced experimental electric car on the road today and an important milestone on the road to overcoming the barriers to a practical electric car."

In contrast to the GE Centennial Electric car that utilized off-the-shelf commercial components and batteries, the new DOE car incorporates new technological developments that clearly advance the state of the electric car art.

Dr. Lafferty, obviously pleased with the car's enthusiastic reception, told the *Monogram* that the ETV-1 was designed systematically from the ground up to meet specific objectives. These include acceleration from zero to 30 miles per hour in just nine seconds, the ability to maintain 50 mph up a mile-long 5% grade, a passing speed of 60 and a range of at least 100 miles at a constant speed of 45 mph. Even in stop-and-go urban driving, the auto travels 75 miles between battery charges.

Among the technological developments applied to the ETV-1 is a special 20-horsepower GE DC traction motor that powers the car. At cruising speed, the motor is over 90% efficient, yet is made 30 pounds lighter by the judicious use of aluminum and the machining away of excess metal.

"We've also equipped the vehicle with a novel regenerative braking system," notes Lafferty. "When brakes are applied, or the car travels downhill, the electric motor functions as a generator, helping to recharge the batteries."

New lead-acid batteries with 25% higher energy than current models were developed by subcontractor Globe-Union, Inc. Eighteen six-volt batteries make up a 108-volt energy pack for the car. A built-in battery charger can recharge the cells, when 80% discharged, in 10 hours using a 30-amp, 115-volt wall outlet.

Another major innovation is the power-conditioning unit that allows the speed, torque and acceleration of the DC motor to be controlled smoothly and efficiently. The key is a new GE high-power transistor that can switch hefty currents up to 400 amperes in under a millionth of a second. Also employed is a microprocessor that manages energy flow to prevent jack-rabbit starts and other driver abuses that waste energy or damage batteries.

The sporty look of the ETV-1 results from an aerodynamic body design by subcontractor Chrysler Corp. that reduces air resistance to 60% that of current subcompacts. Chassis features include front-wheel drive, rack and pinion steering and independent suspension. Instead of a gear shift, the car is controlled by three dash-mounted pushbuttons: neutral, reverse and forward. Vehicle weight was reduced by using Lexan® polycarbonate, other plastics, high-strength steel and aluminum.

If the test vehicle was mass-produced in quantities of 100,000, says DOE, the consumer price would be $6,400. The life-cycle cost of the car over 10 years would be about 18 cents a mile, of which two cents would pay for scheduled maintenance. This is comparable to present gasoline engine cars.

The ultimate objective of DOE's electric car program is to stimulate commercial manufacture, helping to reduce oil consumption. The range of the ETV-1 is closer to what the U.S. driving public will accept, says DOE, being equivalent to leaving home with a half tank of gas.

While GE is an active manufacturer of electric vehicle components, Dr. Lafferty reiterated that the Company presently has no plans to manufacture or market such vehicles.

Involved in development of the DOE car in addition to the R&D Center: DC Motor and Generator Department, Ordnance Systems Department, Drive Systems Department, Plastics Sales Department, and Semiconductor Products Department.

Meanwhile, GE research continues on design of a new "hybrid" vehicle that would combine an electrical drive system with either a diesel- or gasoline-fueled engine for extended range. The research is being done under a DOE-Jet Propulsion Laboratory contract.

Only one thing about the ETV-1 surprised a *Monogram* reporter: discovery of a small gas tank. Why? This electric car has a *gasoline*-fueled heater.

How the GE-100 electric car compares with the new DOE ETV-1:

	GE-100	ETV-1
Capacity	4 adults	4 adults
Minimum urban range (stop-and-go)	45 miles	75 miles
Range—constant 40 miles per hour	75 miles	100 miles
Wheel base	92 inches	98 inches
Curb weight	3,250 lbs	3,320 lbs
Battery system	18 lead-acid	18 lead-acid
Battery weight	1,225 lbs	1,080 lbs
Maximum recharge time	13-15 hours @ 110 volts	8-10 hours @ 110 volts
Horsepower	24 (DC series motor)	20 (separately excited DC motor)

All that's needed to shift the ETV-1 is a flick of the finger. Three push-buttons, mounted on the dashboard, control the gears.

Monographs

'Room at the Top.' How does a young woman start up the ladder to executive management positions in fields that have traditionally been held by men? In Bloomington, Ill., Illinois Wesleyan University and General Electric's General Purpose Control Department have teamed up to help young women answer that question through a "Room at the Top" program, which began in 1976.

This program combines rigorous academic study with work experience in fields traditionally not open to women. So far, the Company has sponsored 12 GE Scholars.

Participants currently enrolled at Illinois Wesleyan and working on a part-time basis at GE-Bloomington are (front row, l to r): Sharon Young, Martha Peoples and Kathy Gilbert; (back row) Anne Lorang, Angie Vincent, Joy Schaefer and Debbie Kratovil.

HONORS

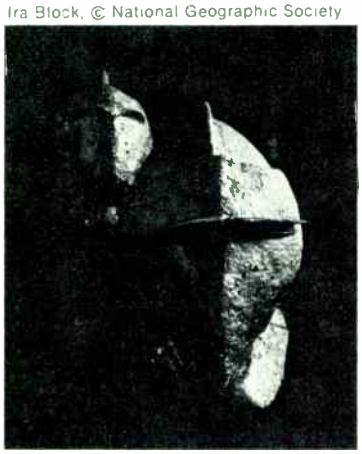
Presidential appointment. Board Chairman Reginald H. Jones was sworn in on May 24 at a White House ceremony as chairman of the President's Export Council, a 40-person advisory panel that will channel recommendations to the Government on export expansion. Council members include seven persons from the executive branch, six from Congress, and 27 private-sector members representing business, labor, agriculture and consumers.

Export expansion is seen as a major factor in fighting inflation, holding down unemployment and offsetting the big increases in the cost of imported oil.

New World 'first.' A complete close helmet, the kind worn by European officers and cavalrymen in the 16th and early 17th centuries, has been recovered along the banks of Virginia's James River. It's the first such visored helmet to be discovered in the Western hemisphere—and General Electric silicones helped with the recovery.

As reported in *National Geographic's* June issue, the helmet was found at Wolstenholme Towne, a new archaeo-

Ira Block, © National Geographic Society



logical site near historic Jamestown. When spotted, the helmet had been reduced to little more than a layer of rust, and could not be removed from the clay in which it was embedded.

The salvage technique required carefully removing earth from the top half of the helmet. A steel frame was built around the helmet and the clay in which it rested. The helmet's top portion was then stabilized by coating it with a layer of RTV silicone rubber mold compound. A layer of plaster was applied, the 200-lb. load was lifted from the excavation and turned upside-down, and the process successfully repeated.

Mettle for a medal. Schenectady's Joseph M. Zelezniak has a dream. He wants to represent the U.S. in Moscow at the 1980 Olympics in the shot put. If his performance keeps improving as fast as have his track meet results, he may make it!

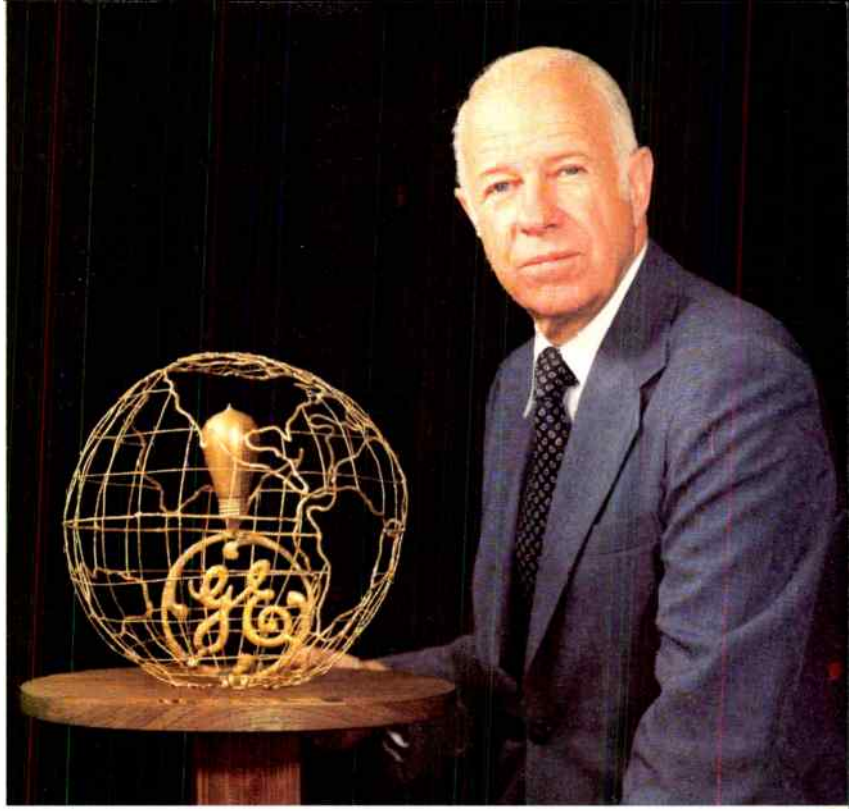
The maintenance worker for

Large Steam Turbine-Generator Division is now ranked second among East Coast shotputters by the AAU. A typical week for the 6′ 3″, 255-lb. shotputter includes a full GE work schedule—then daily two- or four-hour training sessions at Union College. Notes Zelezniak: "My goal is to reach a 64-foot toss by August, to get a good shot at the Olympic team."

• "Sustained, successful marketing leadership on a worldwide basis" was the criterion for the American Marketing Association's recent decision to honor GE with its 1979 Achievement Award, which was accepted by Vice Chairman W. David Dance.

• For its recent Centennial program, GE has won the 1979 Silver Anvil Award (special business events category) of the Public Relations Society of America. David W. Burke (below), manager of Corporate Communications, accepted the award.

• Named to the Market Research Council's Research Hall of Fame is, below right, Dr. Herbert E. Krugman, manager—Corporate Public Opinion Research.



W. David Dance

David W. Burke

Dr. Herbert E. Krugman

• General Electric has received a "Business in the Arts" award from Business Committee for the Arts, Inc. and *Forbes* magazine, for "support, growth and vitality of the arts" in Louisville. VP Robert E. Fowler, Jr., general manager—Major Appliance Manufacturing Division, accepted the award.

• Dr. Arthur M. Bueche, Senior VP for Corporate Technology, has received the Industrial Research Institute Medal Award.

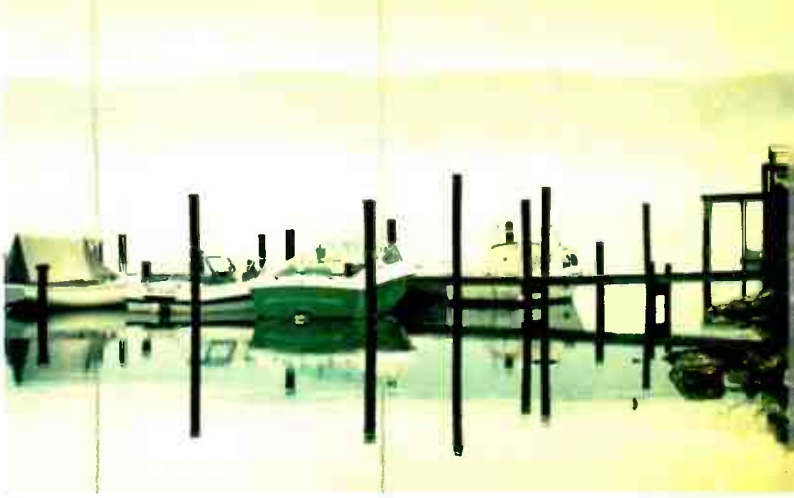
• The R&D Center's Dr. James M. Lafferty, manager—Power Electronics Laboratory, has been awarded the IEEE's Lamme Medal.

• Also at the Center: Dr. Charles P. Bean was elected to the American Academy of Arts and Sciences, and Dr. Robert H. Wentorf, Jr., to the National Academy of Engineering.

• Retired GE engineer Richard H. Kaufmann has received the Marston Medal from his alma mater, Iowa State University.

GE shutterbugs

Displayed on this and the following three pages are photos taken by a number of the General Electric world's skilled amateur photographers. Some regard themselves as "photo-journalists." Others are interested in special effects. Among camera buffs featured: Evendale's Robert L. Meyers, who has won $5,500 in three separate Eastman Kodak photo contests; and Burlington, Vt.'s Michael H. Slack, a camera *aficionado* who owns some 65 working models—including an American Optical Company wetplate model, circa 1862.



"Serenity," James Ardery

"My Glamorous Wife," Carl May

"Sunseed," Bernard Geyer, Jr.

"Horned Puffins," James Carr

"Horned Puffins"
Sea birds (left) of the Pribilof Islands—located off the Alaskan Coast in the Bering Sea—were discovered by Binghamton's James E. Carr during his visit to this bird and seal haven.

"A Fire in Baltimore City"
On his way to a night class at the Community College of Baltimore, Columbia, Md.'s Thomas J. Schaeffer snapped this picture of a warehouse fire (right), by hand-holding a five-second exposure.

Untitled
A rainbow without clouds and rain? Fairfield's Charles M. Howard caught the pine tree-framed scene at far right in Connecticut's Norwalk Valley during a "thermal inversion," when sunlight was refracted off summer haze.

(continued on page 18)

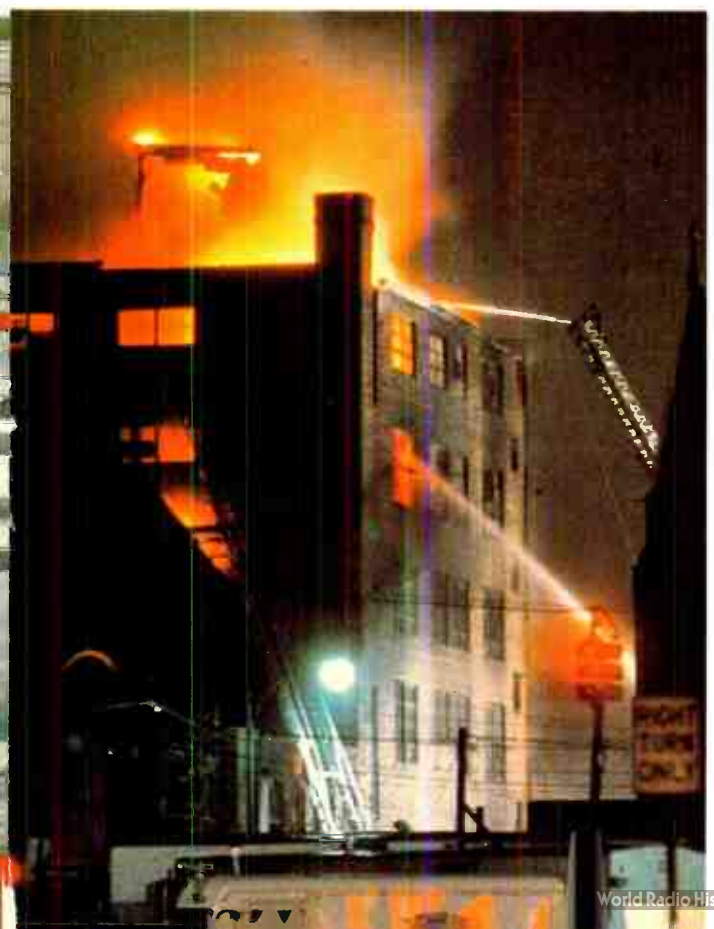
"Serenity"
Captured in the early morning before the haze had lifted from Virginia's Smith Mountain Lake, the scene at left was photographed by GE-Lynchburg's James E. Ardery as he stood on a floating platform 50 feet from shore.

"My Glamorous Wife, Rosetta"
Their friends couldn't afford a professional model and photographer in producing an advertising booklet, so Milwaukee's Carl E. May and his wife (far left) teamed up to help out.

"Sunseed"
Silhouetted against a setting sun, the dandelion (left) had been taped onto the back of a chair before being photographed by Syracuse's Bernard H. Geyer, Jr.

"Easter Vigil in Candlelight"
St. John the Baptist Catholic Church in Schenectady was the setting for this time-exposure Easter photo (right), taken by Syracuse's Richard J. Connery.

"Easter Vigil in Candlelight," Richard Connery



Untitled, Charles Howard

"A Fire in Baltimore City," Thomas Schaeffer

Untitled, Michael Slack

"Taj Mahal—Jewel of India," Dr. Miles Martin

"Taj Mahal—Jewel of India"
On an 80-day trip around the world, Schenectady retiree Dr. Miles J. Martin spent 12 days in India, where he shot Agra's world-famous mausoleum.

"The Snob"
Grand Prize Winner in an Eastman Kodak International Newspaper Snapshot Awards contest, the snooty sea lion (right) was captured on film by Evendale's Robert L. Meyers.

"Doña Rosa"
Now residing in Syracuse's Everson Museum, the photo "Doña Rosa" (upper right) was taken by retiree William Masin in Mexico. His subject, an artisan, produces black earthenware.

"Skipper's Ready"
Touring a farm where bird dogs are trained, Evendale's A. John Kasak spotted Skipper (lower right) locked in an enclosure. "He was so unlike the other dogs—just dying to get out and romp with kids—that I had to snap him!"

"Eva," Stephen King

"My Team Won Again," John Galloway

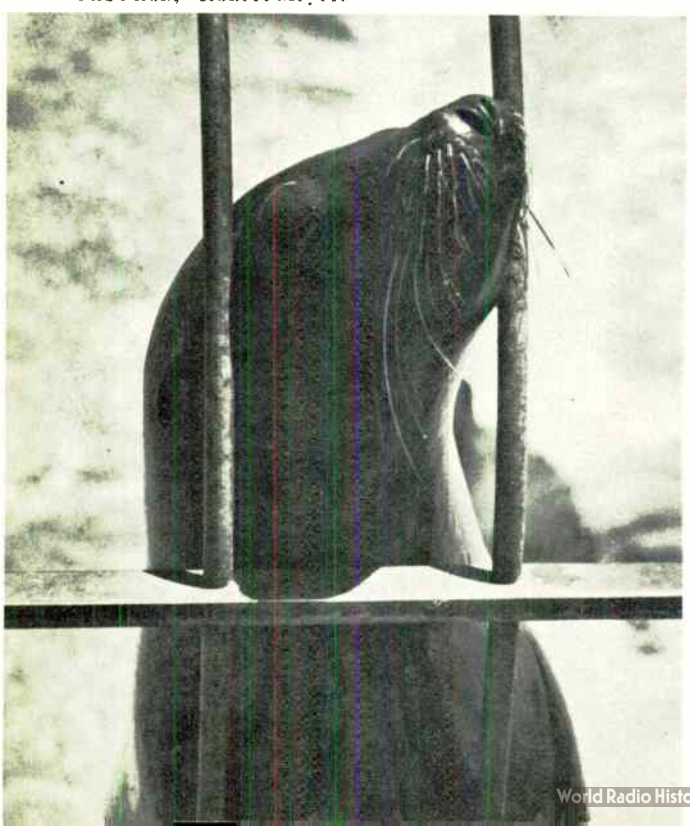
Untitled
For his covered bridge photo (far left) in Vermont, Burlington's Michael H. Slack used an 1890s model Telephoto Cyclepoco camera —and did his printing on Unicolor paper, using mostly yellow filters to create an "antique" print.

"Eva"
Stepping off the elevator of a graduate students' dorm at New York University, Philadelphia's Stephen E. King noticed a little girl waiting in the lobby.

"My Team Won Again"
At the University of South Carolina, after a football game, Columbia's John C. Galloway saw a couple reading a newspaper. Their baby was with them. Galloway asked if he could snap a picture with the baby holding the newspaper.

"Doña Rosa," William Masin

"The Snob," Robert Meyers



"Skipper's Ready," John Kasak

Signed articles

Employee viewpoints, abounding in magazines from *House Beautiful* to *Metalworking News*, do more than gratify the writers; they help strengthen the image of GE as a leader in diverse technologies.

John Rocchio responds to nuclear customers' needs
"Customers in many of the countries I call on don't just want to buy our *hardware*," observes San

Roger Kambour writes on research in plastics
On an average of 100 times a year —for the past eight years—Schenectady's Dr. Roger P. Kambour, a 1979 GE Coolidge Fellowship Award recipient, has been quoted or had his work referenced in many professional journals. The R&D Center physical chemist has published 44 research papers on polymer crazing—a precursor to cracks in plastics—and on other properties of polymers. He's also author of four broader reviews and a book chapter on his research.

"Two articles each took me nearly a year to complete, and one review was 140 journal-pages long. A future article will come from my current work at General Electric—predicting polymer weaknesses before plastic compounds are actually produced, thus eliminating some costly mistakes."

Jean Mattingly's kitchen design tips 'came home'
"For years, I wrote magazine articles on showplace kitchen designs —while in my own humble kitchen the most striking design focal point was a bare light bulb over the sink. I felt I was living the story of the shoemaker's children who had no shoes," recalls Certified Kitchen Designer C. Jean Mattingly, manager—Home Modernization for Louisville's Major Appliance Contract Support Operation. "So I remodeled my kitchen in 1970, then wrote a bylined article about that project, too."

Mattingly's designs appear in *House Beautiful*, *1001 Decorating Ideas*, *Home Improvement Contractor* and *Qualified Remodeling*. "I just finished a 'remodeled kitchen of the year' in Florida. Look for the kitchen in *House Beautiful* next February!"

Bill McAdams: a voice for international standards
"Worldwide, GE participates in more standardization activities than any other company."

So says GE's spokesman on standards, William A. McAdams, manager—Industry Standards Staff. From Fairfield's Corporate Technology Staff offices, he has written some 50 articles and edited several booklets on standards activities.

As immediate past president of the American Society for Testing and Materials, and the National Fire Protection Association, McAdams also is asked to advise U.S. lawmakers on standards development and regulations, and frequently is quoted in professional and trade publications. "Many of my current writings are advocacy pieces on greater use and unification of standards on an international scale."

Jose's John P. Rocchio, international sales manager for the Nuclear Energy Marketing Department. "They want to train their own people for high-technology careers on their own soil, and prevent 'brain drains' from occurring by maximizing their resources. GE's ability to respond resulted in my co-authoring an article entitled 'International Nuclear Technology Transfer'."

Rocchio's sales savvy, and additional business perspective from Peter Cartwright, former manager—Nuclear Energy International Business Development Operation, were combined to prepare the article for the August 1978 issue of *Power Engineering* magazine.

Bob Rieker's money advice for industrial contractors

Stamford's Robert V. Rieker (r) admits that the content of his financing and leasing articles in *Excavating Contractor* and *Metalworking News* won't rivet his family's attention at dinner conversations. "But to the guy who has his life savings invested in a construction business, money is a fascinating topic," says the marketing relations manager of GE Credit Corporation's Industrial Equipment Financing Department. Above, he discusses a construction project with Connecticut contractor, Jack Brennan.

"One article I wrote for *Construction Equipment Distribution* described what every distributor salesman should know about financing. Reader response was so great, the editor asked permission to print the story a second time."

Organization Changes

CORPORATE

Lowell W. Steele, Staff Executive—Corporate Technology Planning

CONSUMER PRODUCTS AND SERVICES SECTOR

Norman P. Blake, Staff Executive—Consumer Products and Services Broadcasting and Business Development Operation

Nicholas J. Covatta, Jr., Staff Executive—Consumer Products and Services Strategic Planning Operation

Geoffrey A. Thompson, VP and General Manager—Family Financial Services Department, GECC

James R. Britt, General Manager—Home Laundry Engineering Department

Thomas E. Dunham, General Manager—Dishwasher & Disposal Engineering Department

John B. Hagerty, General Manager—Refrigerator Marketing Department

Alan K. Hegedus, General Manager—Lamp Glass Products Department

William C. Maines, General Manager—Home Laundry Marketing Department

J. Michael McDavitt, General Manager—Range Marketing Department

Glen S. Olinger, General Manager—Overseas Appliance Department

Thomas L. Williams, General Manager—Lighting Systems Department

INTERNATIONAL SECTOR

Gerald T. Smiley, Chairman of the Board and Chief Executive Officer—General Electric do Brasil S.A.

Jose Bonifacio de Abreu Amorim, President and Director—General Electric do Brasil S.A.

Thomas Romanach, Vice Chairman and Corporate Consultant—General Electric do Brasil S.A.

Richard E. Ferst, VP—Corporate Finance Operation, General Electric do Brasil S.A.

TECHNICAL SYSTEMS AND MATERIALS SECTOR

Glen H. Hiner elected a Vice President

D. Rex Blanchard, Managing Director—General Electric Plastics B.V.

Sheldon R. Erikson, General Manager—Mining Products Department

Joseph F. Ponzillo, General Manager—U.S. Mobile Radio Department

The miners who wouldn't

This story is *not* about an iron ore mine that produces record quantities of ore. Rather, it's about an old iron ore mine owned by Utah International, General Electric's natural resources affiliate, that has operated for years on a low-grade ore that many other miners considered unprofitable.

The story begins with the Mormon settlers in 1847, includes a footnote on Japan's attack on Pearl Harbor, and leads to an odd-looking "dry land dredge" which has helped keep Utah's oldest mine operating profitably *years longer than many thought possible*. "Ingenuity" and "stick-to-itiveness" are recurring themes.

Since Utah is now successfully involved with such huge iron ore properties as Mt. Goldsworthy mine in Australia, the Samarco operation in Brazil and the Waipipi operation in New Zealand, it's safe to conclude that the insights gained at the Iron Springs mine near Cedar City, Utah, have been exceptionally valuable.

To hear the unusual story of Utah International's Iron Springs mine, the *Monogram* turned to the mine's resident historian, Mine Manager York F. Jones. The action is in southwestern Utah, 190 miles northwest of Grand Canyon National Park. "Iron ore deposits were discovered near Cedar City in 1847 by Mormon pioneers," begins Jones. "In 1852, the town's Mormon colonists began erecting their first blast furnace, and at daybreak on Sept. 30, 1852, they tapped the furnace that produced the first iron manufactured west of the Missouri River."

Subsequent attempts to commercialize the iron deposits in this Pinto-Iron Springs mining district usually failed, he continues. "It required World War II—and the fear of Japanese bombers attacking West Coast steel mills—to bring a boom to the area." In 1942, the Government contracted for the construction of a steel mill at Provo, to be operated by U.S. Steel.

Also motivated by war requirements, CF&I Steel retained Utah International to develop and operate one of its open-pit iron ore mines in the area.

Notes Jones: "Up until then, Utah International had only been involved in natural resources on a limited contract basis. We were railroad and dam builders. We *did* possess earth-moving skills, though, and decided we could handle this mining assignment."

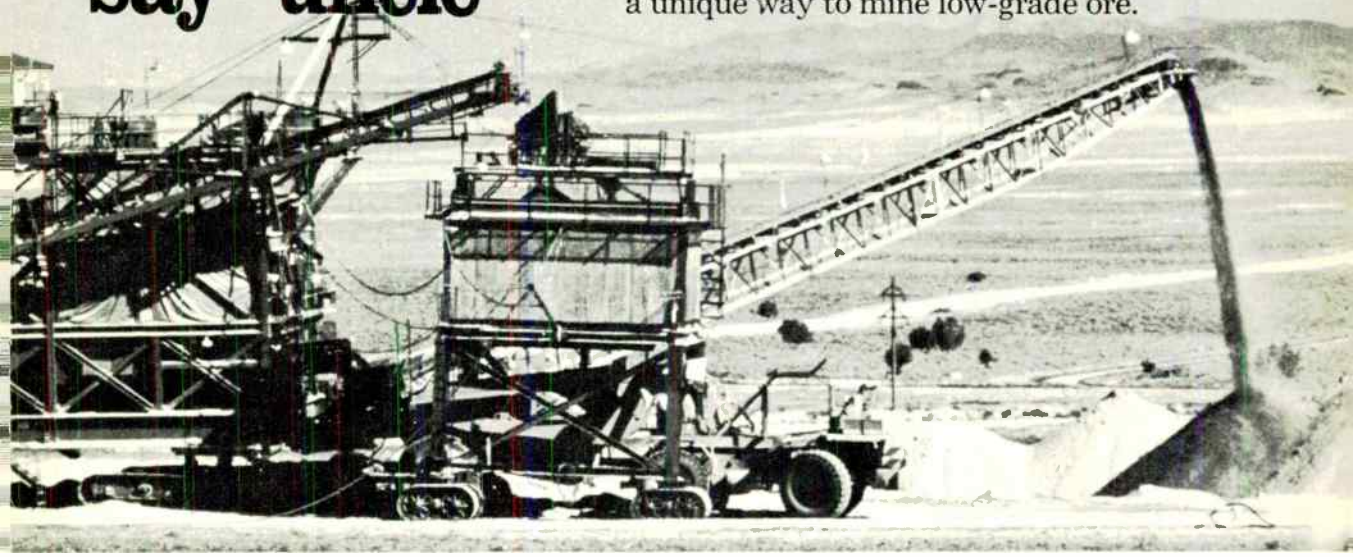
In 1946, Utah acquired its own mine at Iron Springs, some 15 miles west of Cedar City. For the next 15 years, Utah profitably owned and operated five open iron ore pits in the area—plus the one pit for CF&I Steel, located ten miles away.

However, by 1961, the majority of the remaining iron ore reserves controlled by Utah were of such low grade that Utah's customers could no longer use this ore to make steel.

Utah's iron pits had to close.

say 'uncle'

Many said the Iron Springs mine was exhausted—but Utah found a unique way to mine low-grade ore.



Near Cedar City, Utah, this one-of-a-kind mobile plant helps Utah International mine low-grade iron deposits.

Or did they? A resounding "Wait!" was heard from Utah's miners, who engineered and built a "beneficiation" plant at Iron Springs to upgrade their ore deliveries—by scrubbing and magnetically separating some 2,500 tons of ore a day. Three years later, a revised customer contract was signed, calling for an even higher grade product. As a result, the plant was expanded to handle 4,000 tons per day. Quality ore shipments continued; sales were brisk.

But many still thought the final act in this successful business saga was near at hand. Diminishing reserves of acceptable ore forecast an end to mining. All that eventually would be left would be low-grade alluvial deposits. The area's alluvial deposits average only 9% iron content. By comparison, Minnesota's Mesabi Range low-grade iron ore averages 28% iron content, and Utah's Mt. Goldsworthy mine in Australia, 63½%!

What Utah's miners came up with next *made world mining history*. With the help of Utah's Mining Technical Services operation, the miners developed and installed a *mobile* beneficiation plant, a 550-ton unit that moves under its own power on tracks and follows the dragline along each cut.

"The best way to describe it is that it's like a 'dry land dredge'," remarks C. Ray Juvelin, Iron Springs mill superintendent. "Since it was unprofitable to truck tons of low-grade alluvium to Utah's beneficiation mill miles away, we 'brought the mountain to Mohammed.' This mobile plant recovers the small amounts of iron ore, raising the grade from 9% to approximately 50% iron content."

This low-grade ore is subsequently further processed at the Iron Springs mill, upgrading it to a 58% iron content. It is blended with concentrates from other deposits, and—depending on the iron concentration—is sold as open-hearth or blast-furnace ore.

"Thanks to our dry land dredge, I've been able to complete my entire mining career at Utah's Iron Springs mine!" proudly observes retiring Mine Superintendent Hyrum Humpherys—a Utah employee who joined the company in 1941 and moved to Cedar City shortly after the company received its first mining contract in 1942. He retired June 29 after 38 years. He is one of numerous senior Utah employees who received at least a portion of their mining "education" at Cedar City.

Notes Humpherys: "We miners at Iron Springs could have called it quits years ago. But in 1964, we took a new-fangled idea, applied some elbow grease and put it to work. With the help of our mobile plant, Iron Springs has shipped an average of 500,000 short tons of iron ore each year for the past 15 years—ever since this portable beneficiation unit went on line!"

The power of demonstration

Convincing metal-trained customers to 'think plastics' takes more than hard sell. At GE Plastics' Technical Centers, customers themselves prove how plastics can solve their problems.

In his Columbus, Ohio, office, Vice President Charles R. Carson, group executive of the Engineered Materials Group, lets a handful of what looks like heavy confetti trickle through his fingers. "This is mainly what our Plastics Business Division sells—pellets of engineering plastic resin. Can you imagine how far we would have gotten by trying to convince metal-trained customers to give these pellets a try? We'd still be trying to get to first base. It's essential that we help customers bridge the gap from this rather undramatic product to the many exciting applications they can make of it. It's the same with other products of the Group—silicones, Man-Made® industrial diamonds, tungsten-carbide metal-cutting and mining materials, laminates and insulating materials, and rechargeable batteries: to make sales, we have to demonstrate what the product can do, where it can save money, how it can improve productivity."

What it comes down to, Carson says, is that for the businesses of his Group, the venerable mousetrap theory just won't do. Having invented better products, the Group has no intention of sitting back and waiting for customers to beat paths to its door. Instead, it reaches out with convincing show-and-tell techniques that promise customers bottom-line benefits through solving problems for them.

For the Group's Plastics Business Division, these promises take tangible form in GE Technical Centers, facilities in place specifically for the purpose of giving customers firsthand experience with GE plastics.

For close-ups of Plastics' tech centers, a *Monogram* reporter toured the centers at Bergen op Zoom in the Netherlands, at Evry in France, and in Detroit, Michigan—three of the seven centers that carry GE plastics technology to customers in Europe, Japan, Australia and the U.S.

The visit to the Dutch center coincided with General Electric's first Information Meeting for European Investors, held at the headquarters facilities of General Electric Plastics B.V. (GEP) in Bergen op Zoom. At this meeting, VP Glen H. Hiner, the Plastics Division's general manager, explained the essential role of the Technical Centers.

The high-performance features of GE plastics explain part of the remarkable growth of this business, Hiner said. But "being responsive to our customers is what makes us different from many other engineering plastics companies, and has been a major key to our success."

Describing how, in each European country served by GEP, the aim is to make GE a local partner to that country's customers, Hiner added: "In each of these areas, the focal point of our operations is our Technical Center, where we have gathered together molding equipment, testing laboratories and product specialists. These centers serve as a local resource for our customers, where they can work with our technical and design specialists to solve their prob-

(continued on page 26)

How to 'sell' a prospect on using a GE plastic taillight: let him mold his own in one of seven GE Plastics Technical Centers. Three representative centers shown: (top) Detroit's Auto Polymers Center; (right) GE Plastics Holland facility; and (below) French center near Paris.

lems or explore new ideas."

How successful has this concept been? Hiner offered examples of new business won with aid of center demonstrations:

- In Europe-made TV sets, 80% of all deflection yokes are molded from Noryl® resin.
- Impact-resistant Lexan® polycarbonate is found in many lighting applications, such as in globes which light approaches to the Vatican.
- A dashboard molded from Noryl resin in the VW Rabbit replaced over 70 separate parts with one molded part, saving VW about 20% in manufacturing costs per dashboard. "Today, eight European car models have Noryl resin dashboards, with more on the way."
- Lexan polycarbonate was chosen over other plastics for use in bumpers on Fiat's racing model 131, an application that is "capturing the attention of other European automobile manufacturers as well."

A tour of the Bergen op Zoom Technical Center showed what Hiner meant. Here, customers participate in formulating plastics, mixing them, molding them. Test devices include one that enables customers to test the strength of their own prototype products and prove to their own satisfaction what these GE materials can withstand.

A fresh example of how well this procedure works was offered by D. Rex Blanchard, managing director of GEP: "Architects for a new central stadium in Split, Yugoslavia, came here specifically to find out whether they could plan on using Lexan sheet for the auditorium's roof. We proved to them the application was feasible and could halve the weight, in comparison with glass. This had an extra excitement for them: they could design less massive support structures. Demonstration was a key factor in our winning the largest polycarbonate sheet roofing project in the world."

Plastics' French center is strategically located at the "new town" of Evry near Paris. "We're near Orly airport—the terminal that serves French domestic flights—and just off the main highway to the south," explains Daniel Burnand, general manager of General Electric Plastics France S.A.R.L. "And because we're in a new town being developed to help decentralize the urban population of Paris, we enjoy the latest in French telephone service, roadways, etc."

Ease in reaching the center is vital to the French company's strategy. "We rely heavily on customer seminars, many of which we hold here. Since our first seminar, in June 1976, we've averaged about a seminar a month. Each seminar brings some 40 customer representatives together with our technical experts, and the whole emphasis is on solving *their* problems through correct use of *our* plastics. The word is getting around that these seminars are good, they're worthwhile, and no other French supplier offers anything like them."

On visit to French tech center, GE Chairman Reginald H. Jones (right) hears from Plastics' VP Glen H. Hiner about Fiat auto bumpers made of Lexan® resin.

What's the result of the French company's demonstration program? Stories such as that of winning the housing of a window motor for Peugeot autos: "The housing was made of aluminum alloy. We thought Lexan resin could do the job, with a saving in weight and in costs. The customer gave us an old tool for making the housing and said 'Prove it.' We modified the tool for plastic injection molding, turned out Lexan polycarbonate housings that stood up to road tests—and got the order."

The automobile of the future inevitably comes up for discussion when a reporter visits Eugene J. Thomas, manager—Automotive Sales Section and head of the Auto Polymers Center in Southfield, Mich. This tech center is located specifically to serve U.S. auto manufacturers, most of whom are less than 30 minutes away. But today it is also drawing an increasing flow of visitors from Europe and Japan.

The reason for this worldwide interest, Thomas says, is that "the trends in auto design favor our types of tough, high-performance plastics:

- "To conserve gasoline, designers must lighten the weight —for example, a headlamp of Lexan resin weighs one-third as much as a glass lamp.
- "Today's smaller cars make people want to counter the closed-in feeling by opening up the roof areas—you'll see an increasing use of transparent

materials, more 'moon roofs.'

• "Smaller cars also make chrome and brightwork less desirable than color harmonies —you'll see colorful plastic bumpers coming to U.S. cars, for example, as they are already in place on European cars.

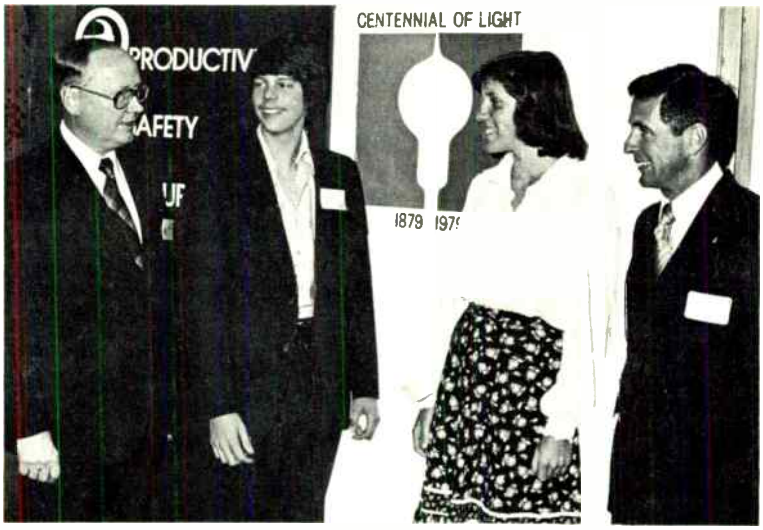
• "Greater design freedom is made possible by plastics because plastics can be fabricated into more complex shapes than is possible with, say, sheet aluminum.

• "With the arrival of Arnox® resin (see page 10) on the scene, providing a material that's very tough and also resistant to heat and chemicals, you'll see plastics taking on structural functions in the car —leaf springs, for example, that do the job while cutting the weight by a half or more."

As an indicator of what's happening, Thomas cites the 1980 Ford Thunderbird: "Each of these cars utilizes 30 pounds of GE plastics—everything from plated Noryl resin wheel covers and Lexan polycarbonate roof sections to Valox® resin ignition systems and distributor caps."

The final word on the Detroit center comes from Group Executive Chuck Carson. "So successful has this center been in stimulating the use of GE plastics and silicones throughout the automotive industry, that the scope of the center has been expanded to include application development work and service for all of the Group's chemical and metallurgical-based businesses." He adds, "Through combining the products and services of the Group in the new GE Automotive Materials Center, we not only can serve the automotive industry more effectively, but can more strongly position ourselves for further penetration of this $250-million opportunity."

Centennial of Light



General Electric celebrated its Centennial anniversary *last* year, marking a century since the first GE predecessor company was formed to *finance* Thomas Edison's development of the incandescent lamp. But the actual *invention* of the lamp came on October 21, 1879—and that date makes *this* year, 1979, the root year for GE's Lighting Business Group.

The Group is now leading the Company in celebrating the "Centennial of Light." GE's lighting business has made enormous strides since Edison's historic invention (see page 10).

This spring, in honor of the occasion, 102 Edison Scholars attended a symposium at Cleveland's General Electric Lighting Institute. The students—a male and female from each of the 50 states and the District of Columbia—were chosen by their respective states and District for being outstanding science students. Each student received a $1,000 Edison Centennial of Light Scholarship, sponsored by the Thomas Alva Edison Foundation.

The two-day program featured talks by prominent guest scholars, scientists and industrialists, including Nobel Prize winner Dr. Ivar Giaever, an R&D Center biophysicist, and Apollo 8 astronaut William A. Anders, VP and general manager of Nuclear Energy Products Division.

Shown here: Edison Scholars Steven Rushkowski of Wolcott, Conn., and Maura Mitchell of Goleta, Calif., with VP and Group Executive James A. Baker (left), of Lighting Business Group, and Anders.

To be sure, the symposium has been just part of Nela Park's centennial effort. More recently, a "Centennial of Light Day" was held at Cleveland Stadium. At the ballpark, 13,189 GE fans, almost half of the game's crowd, watched the Cleveland Indians beat the world-champion New York Yankees, 8-4.

On October 21, General Electric will participate in a re-enactment of the "miracle of light" at Greenfield Village near Detroit, where, among the more than 85 historic buildings on display, are Edison's Menlo Park and Fort Myers laboratories.

Warehouse hustle

If you've been impressed by how quickly your need for an appliance part is filled, the answer begins in New Concord, Ohio.

Step 1. Appliance parts orders, plus "pack" and "pick" directions for warehouse use, come to New Concord's Bill Coulter and Alice Ross at computer speed.

Despite the tremendous influx of requests for replacement parts that results from 80 million GE and Hotpoint major appliances now in service, Major Appliance Product Service Department's Parts Distribution Operation makes sure items are in stock when customers call. Each day, the operation's main distribution center in New Concord, Ohio, ships 92,000 parts—from dishwasher dials to dryer drums—totaling 24 million parts per year!

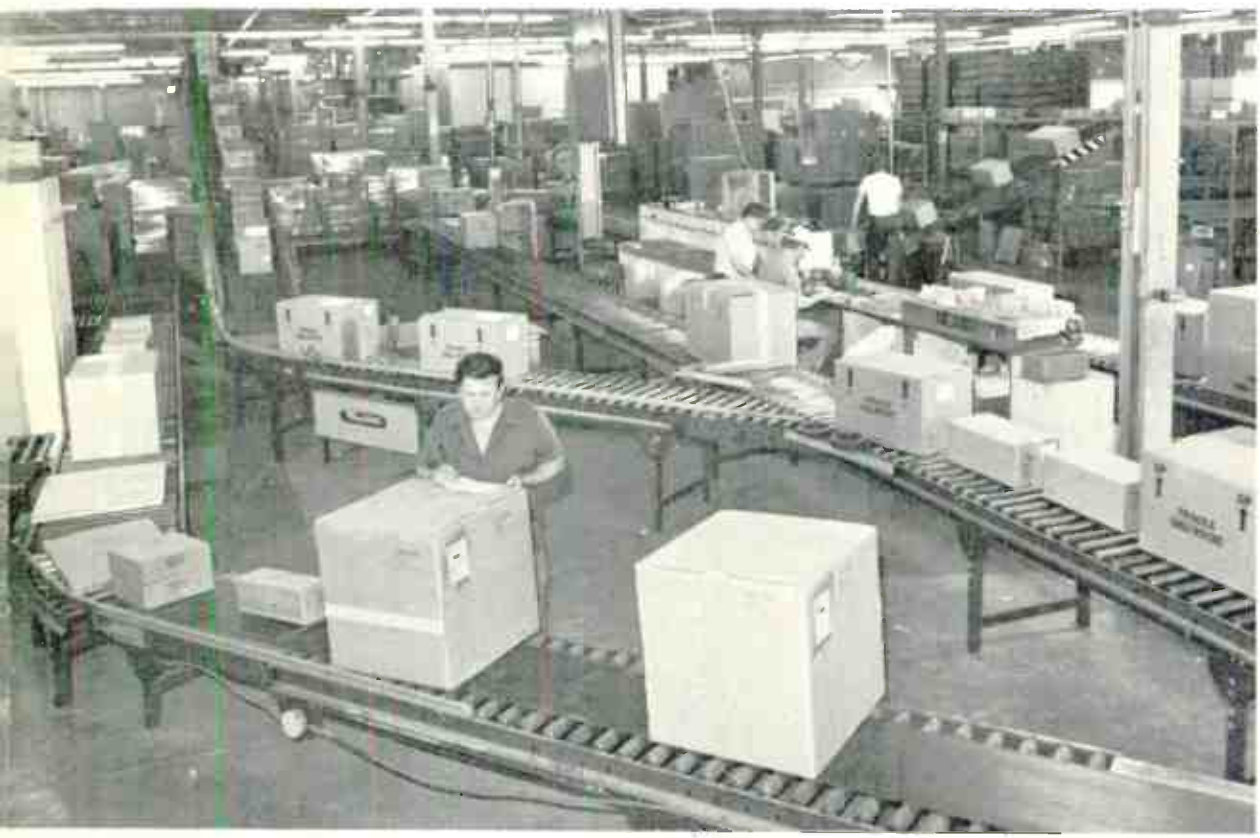
Where do the parts go? New Concord deploys the major portion of its giant inventory to regional Replacement Parts Centers (RPCs), located in key customer-service areas. With computer access to New Concord, RPCs' inventories are perpetually maintained to assure that 90% of all parts are always available to servicers and other local customers. The RPCs' goals: 60% of orders filled the same day they're placed, 90% the next day, and 100% the day after that.

Result: New Concord's quick service means RPCs, plus distributors, "private brand" companies and global transporters, get what they need—fast.

Step 4. "Pack" and "pick" lists to fill orders get a once-over by (l to r) dispatcher Lonnie Stephen, foreman Dale Wright and accumulator Mark Catlett.

Step 2. Before these microwave oven touch-control units become available as replacement parts, Gene Dowell makes a final quality control inspection.

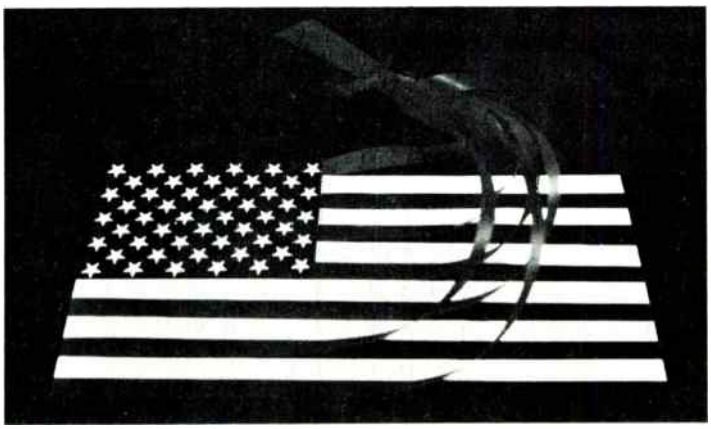
Step 3. Packaging small parts is a big operation. Shown: (at left) Betty Wallace, and (above, l to r) Pam Boetcher, Ted Catlett and Shirley Dillon.



◀**Step 5.** There are 43,000 catalog items in stock at New Concord. Floor-to-ceiling parts-picking keeps Mark Catlett and Jack Dillon on the move.

Step 6. Small parts and bulk items are "married" in a pre-loading area. Dick Cole (foreground) watches 40 tons of parts shipped out each day.

Untying the knot



# of U.S. red tape

Conflicting, contradictory requirements are the inevitable consequence of the quantum increase in the volume of U.S. Government regulations in recent years. GE has helped throw new light on the costs of excessive regulation through 1) participation in a first-time study to establish hard data on compliance costs, and 2) a penetrating analysis by a GE officer.

Compliance with regulations imposed by just six agencies and programs of the Federal Government cost 48 large companies, including General Electric, some $2.6 billion in 1977, or 40% as much as they spent on research and development . . .

This $2.6 billion in incremental costs incurred by these companies to comply with the six sets of regulations—many of the regulations considered by the companies to be wasteful and nonproductive—raised retail prices by more than 1%, increasing the pressures of inflation . . .

The effect on profits generated by these companies is indicated by the fact that the $2.6 billion in direct costs represented 16% of their profits in 1977, the year covered by the study . . .

For manufacturing companies—most heavily affected by these agencies—the add-on costs of compliance represented more than 17% of the participating companies' total capital expenditures . . .

These measurements of the impact of regulation in diverting the resources of industry to nonproductive activities are not just an economist's guess-timates. They come from a recently completed pioneering study conducted for the Business Roundtable by the accounting firm of Arthur Andersen & Co., with General Electric as one of the 48 participants.

In selecting just four dozen companies and six Federal agencies and programs, the Business Roundtable survey obviously refrained from trying to calculate the costs of actions that would have been taken in the absence of regulation, industrywide costs, the effects of state regulations or such substantial secondary costs as loss of productivity and construction delays. Rather, the focus was restricted to those incremental costs that could be clearly documented and verified out of the accounting, engineering and other records maintained by business.

The six Government entities included the Environmental Protection Agency, the Equal Employment Opportunity Commission, the Occupational Safety and Health Administration, the Department of Energy, Employee Retirement Income Security Act, and the Federal

Trade Commission.

The Business Roundtable study's summary opens with the statement that "most governmental regulation originates from genuine concern for the achievements of desirable economic and social costs." The study expresses industry's concern, however, that the cost of meeting regulatory costs may be excessive and out of balance with the benefits gained. It also asks whether alternate, less costly methods could be employed to achieve desired goals.

A larger context for this narrowly focused Business Roundtable study was provided recently by the paper presented at the IEEE Conference on U.S. Technological Policy Issues by GE's James F. Young, VP—Technical Resources on the Corporate Technology Staff.

VP Young's analysis highlights this decade's "incomprehensible proliferation of new regulation" by noting: "The Office of the Federal Registry reports that 61,000 pages of Government regulations were issued in 1978, compared

to 20,000 in 1970. That's more than a 300% increase in just eight years. At the beginning of May, this year, there were already 19,000 pages!"

Proliferation on this scale, Young emphasizes, leads inevitably to anomalies, conflicts and contradictions. Examples:

- "One Washington agency told ship operators to install doorsills so doors will seal tightly when one compartment is flooding, keeping the ship afloat. Another said to remove the sills because sailors might trip on them."
- "One agency told contractors to install backup buzzers on bulldozers to warn construction workers behind the equipment. Another chose, in the same month, to tell contractors to make everyone wear earplugs until quieter bulldozers could be designed."
- "While the Department of Energy was busy regulating for greater use of domestic coal to cut oil imports, the EPA issued new source performance standards that generally prevent siting of new coal power plants."

As to the costs of these massed regulations, Young cites not only the Business Roundtable study but that of Murray L. Weidenbaum, of Washington University, which established the fact that, in all, more than $100 billion was spent during 1978 to comply with Federal regulations. Recent Office of Technology Assessment studies, Young notes, show regulation is adding 1-to-1½% to inflation.

This heavy monetary burden, he believes, "is a further weight on our declining position versus other nations in such basic measures of economic drive as rate of productivity improvement, R&D funding, and investment in new business ventures."

What's to be done? Industry's role, Young says, is not that of "categorically opposing regulation" but rather of "opposing only the unnecessary, the unreasonable and the unworkable."

Jim Young followed up his hardhitting analysis by outlining a sound program for reform of social regulation. Included among his recommendations:

- A reasonable pace that lets the nation "concentrate on the obvious defects in our system first" and worry about the "cosmetic touches" later.
- A balancing of interests by Government agencies rather than "single-mission myopia."
- An end to "the mania for redundant record-keeping and rule-making."
- Procedures that allow regulators to set standards of performance but leave the choice of action to those bearing the costs.
- An effective overview to avoid administrative procedures that go beyond Congressional intent and the laws themselves.
- Elimination of "the adversary approach to problem-solving."
- Avoidance of furthering "the zero syndromes."

Zero-risk and absolute safety, he argues, "are costly illusions. We must weigh costs against benefits and balance national priorities."

GENERAL ELECTRIC

General Electric Company
Fairfield, Connecticut 06431

AIR POWER. The world's largest wind turbine, the result of a commitment by General Electric to help solve energy problems, was dedicated July 11 atop North Carolina's 4,420-foot-high Howard's Knob.

The electrical generating system for the turbine, designed and built by the General Electric Space Division for the Department of Energy and the National Aeronautics and Space Administration, was nearly three years in the making.

The turbine catches winds of between 11-35 miles per hour with two 100-foot-long steel blades. The wind is then harnessed by the computer-controlled generator, which is driven by a high-speed shaft. The result is 2,000 kws of electricity fed into a utility corporation power grid. Start-up of the 350-ton windmill makes the owners of about 500 homes in Boone, a community on the slopes of Howard's Knob, the latest beneficiaries of GE technology.

Rotor shaft, gear train and generator are housed in a boxcar-sized nacelle which sits on a tower 140 feet above the ground. Nearly six acres surrounding the tower have been turned into a recreation area.

Notes VP Lee L. Farnham, general manager of Space Division: "The Howard's Knob turbine brings the wind power industry to an unprecedented stage of sophistication and enables GE to contribute to the solution of today's energy problems."