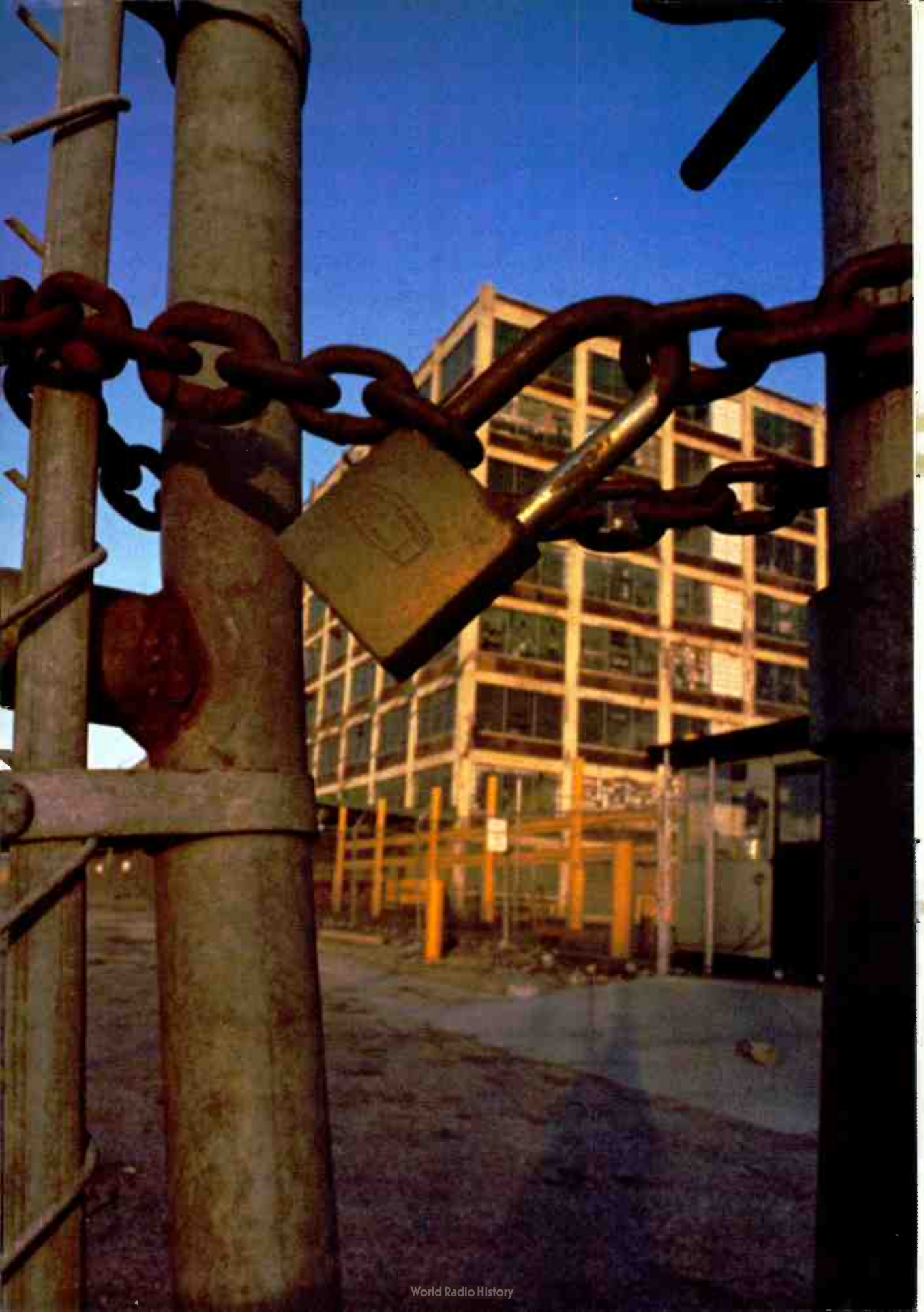
GENERAL ELECTRIC

Monogram

September-October 1982

James A. Baker and the factory with a future



Making America competitive again

In this Monogram *interview, Executive Vice President James A. Baker, Sector Executive for the Technical Systems Sector, explains why General Electric is championing factory automation.*

Interview by William K. Lane

Q: You've outlined three choices American businesses face in the '80s: to automate, emigrate or evaporate. The first choice seems expensive in these tough times; the second means job loss through overseas sourcing; and the third is simply disaster. Are our choices so starkly and unpleasantly defined?

BAKER: I'm afraid so. The recession tends to provide a crutch, and an excuse, for large sectors of American manufacturing that are no longer world-competitive in quality or price—even in good times. A lot of them will go either offshore or out of business unless they improve their productivity. And that goes for GE businesses as well.

Q: How did American industry get itself into this mess?

BAKER: Well, you probably know what happens to wild animals that live in zoos or game parks. The tigers still have their teeth, and the deer can still run, but after a few years of the easy life, they lose a lot of the survival skills that their cousins in the wild must use every day. Some of them, when they are released back into the wild, actually have to be taught to hunt again or they don't make it. A lot of industries, including a few of our own, simply spent too many years fat, dumb and happy in domestic markets without significant foreign competition. When the Japanese and Europeans, who started out hungry and export-oriented, finally made their moves into the U.S., we Americans were out of shape. Many American factories are barrier reefs—one old, tired technology piled upon another. Even when new factories were built, instead of automating, Americans tended to use the

A Midwestern auto factory

photo by Andrew Sacks, Black Star

same old machines—ship them from the old plant to the new plant. And we'd use the same old methods, too, the same old manufacturing processes. Now these plants are having trouble competing with the efficient, modern factories—or the cheap labor—of their foreign competitors. You can strip away much of what's been written about why we're getting beaten in so many areas. It boils down largely to a question of market aggressiveness—technology and innovation—and production efficiency.

"The alternative to automation is closed factories, no jobs and a dying America."

Q: How does GE fit into that picture?

BAKER: We're a lot better off than most, because we've been competing in world markets for most of our history. But we've taken a few licks, too. Without throwing any bombs around the Company—I might get hit with one or two myself—we've been hurt quite badly in several old businesses where we've let our costs climb and our quality decline.

Q: Then why does GE, and your Sector, claim it can lead the nation's industries back on the right path—teach them, as you put it, to hunt again?

BAKER: Several reasons. First, we're probably the world's largest diversified manufacturer. We make everything from large steam turbines to toasters, and we've got a manufacturing skill pool second to none. We're not dilettantes or kibitzers. I don't think there's any doubt among American manufacturers—our customers—that we know what we're talking about. Look, we've got a chest full of ribbons, including a few Purple Hearts from decades of skirmishing in world markets.

Q: But you've said yourself that some of our *own* plants, and I quote, "make Santa's workshop look like the factory of the future." In other words, they're obsolete and inefficient. What does that do for our credibility?

BAKER: I don't think it hurts. We're just being honest. We have a long way to go in automating our own plants, but we are well ahead of the industrial average in many of them. Drive Systems, Aircraft Engine, Large Steam Turbine and several other plants are very advanced from an automation standpoint. But the more important point is that General Electric is putting its money where its mouth is, and doing some truly innovative productivity work in our own factories—even the old ones. We're spending almost a third of a billion dollars at our 70-year-old locomotive plant in Erie,

"The automation market could well hit $30 billion by 1991."

$38 million on the Louisville dishwasher plant, and millions more at other locations. We're not only getting our own act together, but we're taking it on the road, too.

Q: Just how is that act doing on the road? Are you selling anything?

BAKER: We're selling quite a bit, and I think we're getting the message across. But it's going to take a little while. You have to remember that less than a year-and-a-half ago we offered only a few components of this automated factory as product lines. Numerical controls for machine tools, programmable controls and the like. Since that time, we've spent over $500 million in broadening and linking our offerings: computer-aided design, the world's widest line of industrial robots, Intersil, the automated inspection business and much, much more. And we're still not finished. Don Grierson in Charlottesville has been putting this all together, and I've been referring to him as the Evel Knievel of industrial automation because of the huge gap in capability he's leaped in such a short time. Perhaps a more flattering comparison would be to General Eisenhower putting all his forces and equipment in place for D-Day.

Q: When's D-Day?

BAKER: That's classified—meaning I don't know. But keep an eye on interest rates, and you can probably figure it out. In any case, we're ready right now.

Q: From a business standpoint, what's in it for GE?

BAKER: Potentially, a very significant share of a market that could well hit $30 billion a year by 1991.

Q: That will be great for the businesses and the share owners, but what's in it for the worker who shows up some Monday morning and finds himself replaced by a robot?

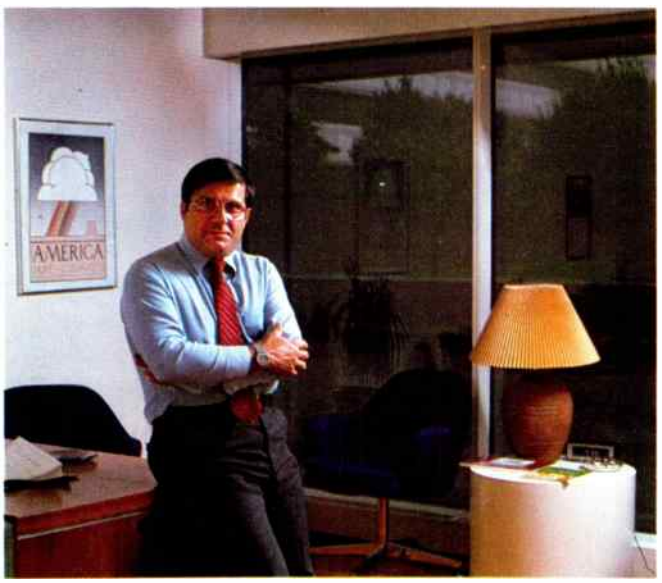
BAKER: That's the most common question I get hit with. And it's a good one. There are major industries in this country—steel, autos and a hundred others—that will simply die if they do not improve their productivity. Automation is the *only* way they can save themselves. The employment levels in those industries will probably never again reach the levels they hit a decade ago, but we *can* help them get competitive and we *can* help them stay in this country if we automate them. The alternative is closed factories, no jobs and a dying America.

A second point is that employment has historically been *highest* in times of high productivity gain and *lowest* in times such as these when productivity is stagnant or declining. Healthy businesses that are beating

foreign competition expand, and the truly crummy jobs that no one really wants to do are generally replaced by better, more challenging, more rewarding ones.

Now, anyone who stands up and says that no worker will ever wind up out of a job—period—because of automation may be indulging in wishful thinking. It's like a general rallying his forces for a major battle and promising there will be no casualties. We haven't done that, and we never will. But there is no question in my mind that the biggest winner in

What's so big about



GE Economist Nick Perna

AMERICANS usually doze off or change the subject when economists or businessmen or government officials talk about our country's need for greater productivity. They simply dismiss the subject as a devious scheme to get people to work harder or longer for the same amount of pay. This is the "ho-hum" attitude that's brought us the highest unemployment and deepest recession since the late 1930s.

By now it's painfully obvious that more taxes and more government spending won't fix the problem—and won't stop other countries from nibbling away at American markets and American jobs.

What's urgently needed before other industries go the way of automobiles, steel and textiles is a clear recognition by the American people that higher U.S. productivity is the best way out of the problem America faces, and the basic key to a more productive, more competitive economy.

According to General Electric economist Nicholas S. Perna, productivity is what can get this

an automated, more productive industrial base will be the American worker.

And I can tell you one other thing for sure. If General Electric succeeds in this massive and risky venture we've undertaken—helping to save American industry—we will have made possibly the biggest contribution in GE's history to the quality of life in this country.

Q: And if we don't succeed?

BAKER: Then some Monday morning I may find a robot at my desk.

a few productivity points?

country out of the doldrums and back on the track toward strong economic growth and a rising standard of living.

A recent study by Perna, manager of Long-Term Economic Research and Forecasting, shows what the state of the economy might have been today if the annual productivity improvement had averaged three percent, as in the '50s and '60s, rather than one percent or less in recent years. It would have eased inflation and unemployment and raised the real income of the American worker.

Inflation. "At minimum," Perna points out, "each percentage point of productivity growth reduces inflation by one point. Some research indicates that one additional point of productivity growth ultimately reduces inflation by two or more points as improved efficiency percolates through the economic system. This extra productivity could have cut today's inflation in half."

Unemployment. "Historically," Perna continues, "faster productivity growth has meant lower unemployment. Higher productivity increases our competitive position and sales volume in international markets. Much of the U.S. unemployment problem today stems from too *little* productivity. More productivity with lower inflation might have made it possible to avoid the back-to-back recessions of the past couple of years, which have pushed unemployment close to 10 percent. Instead, we could have had an unemployment rate more like five-to-six percent—if not lower."

Income. "It is no accident that productivity growth and real income gains for Americans move in lock step," Perna notes. "Economic theory predicts—and the facts confirm—that productivity is the single most important determinant of lasting improvements in real income per worker. Thus, with higher productivity, real income for all Americans could have been much higher today than it actually is. There would have been enough additional real income, real goods and services to balance the federal budget, increase the spendable income of all American families by about 25 percent, and increase the earnings of U.S. corporations by a like amount.

"In other words, with higher productivity, the average annual income per American family today could be almost $7,000 more than it is. That's real—not inflated—income and real purchasing power that could have paid for a lot of new cars, homes, appliances, furniture, vacations and college tuitions."

By Robert H. Thomas

The highlight of the Tool Show, the GE exhibit drew some of the largest crowds.

We're betting this country's industrial base is going to stop feeling sorry for itself long enough to do what must be done to turn its aging factories into the world-class competitors they once were. And when it does, we'll be ready."

With this statement, delivered in early September by Senior Vice President Donald K. Grierson, Group Executive of the Industrial Electronics Business Group, to chief executives of machine tool companies, General Electric unveiled its many products and services for the Factory With a Future.

The location was Chicago's McCormick Place. The event was the 1982 International Machine Tool Show—the largest industrial trade show in the Western Hemisphere.

And McCormick Place was humming—nearly 100,000 visitors, $250 million in the latest equipment and technology, 16,000 tons of whirring machinery, and 1,200 exhibiting companies from all over the world. They came to Chicago to show off their new products, despite the bleak news that U.S. manufacturing output had just dropped to its lowest level since

photos by Joseph Kugielsky

THE 1982 INTERNATIONAL MACHINE TOOL SHOW

Selling the factory with a future

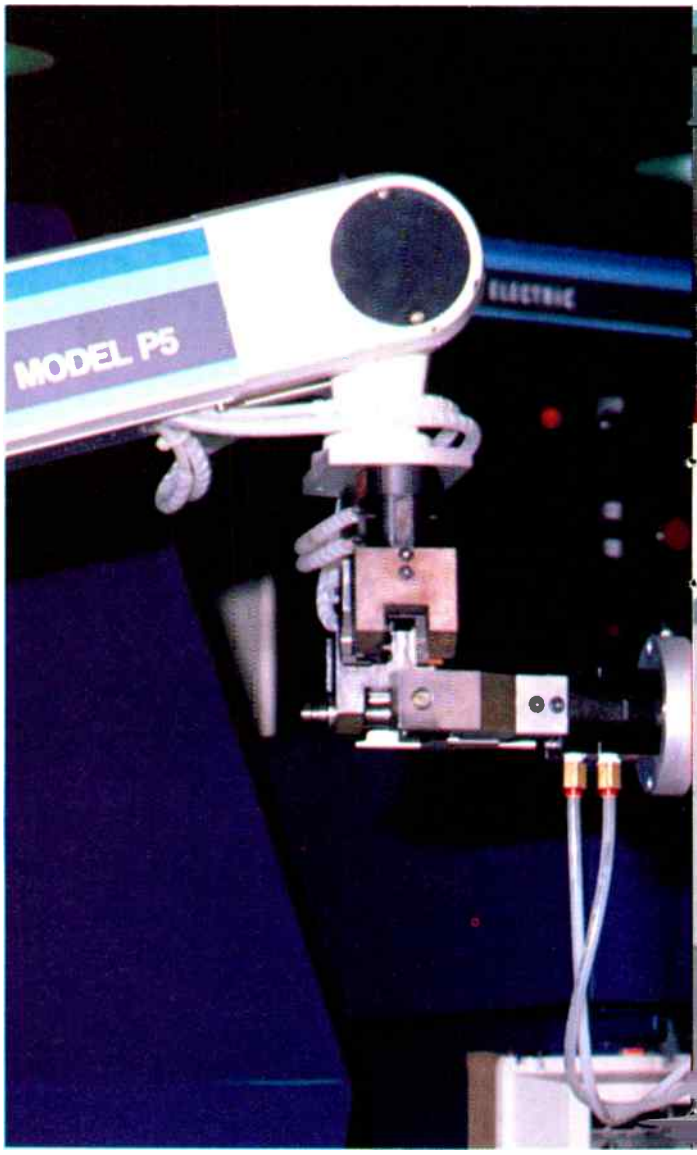
the 1974 recession. These companies had one message they wanted to get across; it was for American industry to quit waiting to be saved by an upturn in the economy and get on with the business of automation—a message GE has been stating for some time.

In fact, it was the GE exhibit that drew some of the largest crowds and heaviest press coverage because it offered a completely automated design and manufacturing cell—an actual working factory that turned out a product. In this case, a robot "gripper."

"We made a very conscious and fiscally painful decision not to hunker down—not to sit back and wait for volume, but to move ahead in technology and positioning," Grierson said to the machine tool executives.

"When the pent-up demand breaks," he continued, "your customers, and ours, are going to want the best, most capable and most cost-competitive industrial equipment they can get their hands on—and they're going to want it immediately. I certainly would have preferred to wait for volume and cash flow to improve before spending the $20 million that the new Mark Century® 2000 numerical control cost to develop. But I want to sell numerical controls—not promises—when the sun comes out again."

The GE exhibit consisted of 17 components—each displaying



The hand-off (center) by two robots highlighted the GE exhibit. Top: Don Grierson (left) and Charles Lamb. Center: Carl Schurenberg on the right. Bottom: Unveiling the MC 2000. Managers like Dave Miller (upper right) were kept busy while other Company representatives showed off a variety of automated products and entertained members of the press.

products or services for the automated factory. Apparatus and Engineering Services Operation, Automation Systems Department, General Electric CAE International, Inc., Calma Company, Carboloy Systems Department, GE Credit Corporation, Factory Automation Planning Services Operation, General Purpose Control Department, Industrial Control Department, GE Information Services Company, Intersil Systems, Optoelectronics Systems Operation, Imaging, Processing and Recognition Systems Operation, Manufacturing Automation Systems Engineering, Small AC Motor Department, Speed Variator Products Operation and the General Electric Trading Company.

"We're proud of the talented GE people from all these different businesses who helped create a standard of excellence in the industrial world," Grierson told the *Monogram*.

The center of attraction, set on a raised platform in the middle of all the component booths, was the GE automated factory—the result of many months' work by an engineering team from Charlottesville, Va., headed by Charles E. Lamb, manager—Manufacturing Automation

Systems Engineering.

"Our manufacturing cell showed that we are unique in the field of automation. We have proven products for factory automation, and we demonstrated how these products can be integrated to work together. And we can offer a system — not just one product or one service," Lamb said.

"The reason for automation," he went on, "is simple — to improve quality and productivity. Better quality, better productivity making us more competitive will mean jobs coming back into this country. It will mean, too, a more pleasant work environment. No more dangerous, dirty, dull and hot work — and we can operate our factories continuously."

Here's how the GE automated factory worked: On the platform in front of an audience of about 100, a Company representative began the scenario with an explosion — a videotape of an old factory being blown away. As the roar of dynamite spread over the audience, the tape was reversed, and the bricks and mortar came flying back into place, and the narrator stated:

"We're not suggesting that you blow up your present plant and start from scratch. What we are saying is that you can work with the facility you have — using GE products — and GE can help you create your own 'Factory With a Future,' one step at a time. We know how to put it together because at our own plants that's exactly what we're doing. We're modernizing our plants because we've seen the

GE representative Bob Drew hands out a souvenir: a robot gripper.

writing on the factory wall. We intend to be in business well into the next century and beyond, and we want you to be there with us."

The narrator then explained each part of the GE automated factory — from the Calma® CAD/CAM system designing the robot "gripper," to the Mark Century 2000, and then on to the GE controls®, drives, motors and tooling in the lathe.

Next were two GE P5 robots — programmable five-axis robots. One of them fed the "gripper" into the lathe and then handed the finished product to its twin which passed it in front of the GE Optomation® II camera for quality inspection. Finally, the second robot loaded the "gripper" into a shipping box and gently nudged it onto a conveyor belt, sending the product on its way to the customer.

"People are recognizing that factory automation is an idea whose time has come," commented Carl J. Schurenberg, GE's industrial sales manager for machine tools. "The key to selling automation is getting the customer to realize that the Factory With a Future is not a long and painful conversion. It's a simple, step-by-step, planned procedure. You start with individual products, intelligently plan how they will integrate into the operation, and then eventually link them all together."

Schurenberg said: "Robotics, automated material-handling systems, flexible manufacturing cells — all these are separate elements of automation that can be tried and then linked together to form a cohesive and very productive system."

"This GE exhibit not only shows that factory automation works," Grierson concluded, "but it puts GE out in front — it gives us world leadership."

GE runners "lean and agile" at Corporate Cup Relays

But wait 'til next year when they'll be #1 or #2

1. Bell Systems
2. Texas Instruments
3. General Electric
4. Delta Airlines
5. IBM

If that looks like the start of an article on America's FORTUNE 500 companies, you're right. But this is about corporate America *at play*.

Even at play, businessmen and women are planning strategy, sizing up the competition, thinking carefully about positioning.

This is the story of the fourth annual Corporate Cup Relays, where GE finished a highly respectable third out of more than 50 corporations which had passed the rigors of regional competition to make it to the nationals in Palo Alto, Calif., July 24 and 25.

Sponsored by *Runner's World* magazine, the Corporate Cup started out in 1979 as a strictly

by Steven M. Schwartz

photos by Runner's World

Greg Tucker of Louisville (left) and Mark Smith of Charlottesville, Va.

GE's Marie Kastrup of Evendale

Rich Minutti of Philadelphia (above).

"fun run," with lots of informality, and in the 1981 event, one runner even wore her resume on the back of her uniform. By 1982, however, the event had become more serious, and had been renamed The Chariot Cup, paying homage, with theme music and attendant regalia, to the Academy-Award-winning movie, *Chariots of Fire*.

Most significant this year, however, were the phenomenal times. Nine out of 10 national records were rewritten, including the Masters (age 40-and-over) 10K Road Race, won by General Electric. GE's team, led by Nuclear's Bill Meinhardt and Schenectady R&D's Andy Urquhart, improved its time by more than 45 seconds over last year. The quality of the competition here was telling, in that nearly half the runners averaged better than a six-minute-mile pace.

Because of the increasing toughness of the competition, runners who expect to do well at the Corporate Cup have to train rigorously. Meinhardt, who's manager of Nuclear Services Business Planning and Analysis in San Jose, runs 70 miles a week—20 miles on Sunday. "It takes a very strong commitment and several years of work to reach your potential. Once you start giving yourself options, you're through," he says.

Dick Sim, general manager of Medical Systems' Special Health Programs Department in Milwaukee, is another example of the personal commitment required to excel in this meet. Dick helped pace GE to second place in the President's Relay—not without considerable resourcefulness in sticking to his training regimen.

The month before The Chariot Cup, Dick had to hit the road to visit several Medical Systems plants—travel that meant running at dawn at places like the Imperial Palace in Tokyo, Tivoli Gardens in Copenhagen, the back roads of Britain's St. Albans, and the banks of the Charles River in Boston.

Of the nearly 40 General Electric runners who competed in California, perhaps the greatest heros were the women. Because the Company has fewer female runners than some other tough competitors, GE is forced to run its women harder—and more often. In fact, several of our women had to run races back-to-back.

Pam Ketcham, a professional relations placement clerk with Armament and Electrical Systems Department in Burlington, helped GE finish third in the Pyramid Relay. She ran the first quarter-mile leg in that event, only to run another full sprint in the Women's Relay less than a half-hour later. "The quarter mile is tough to do twice in a row. My nerves really took over," she said.

Marie Kastrup, a design engineer with Aircraft Engine in Evendale, and Donna Anderson,

Sherri Moore (right) of Bloomington, Ind.

a trainee in Erie's Financial Management Program, ran in the Women's 5K Road Race. As an example of the determination of General Electric's women runners, Donna ran with a stress fracture of her ankle, and only after running her last event, the Women's 800, checked herself into Stanford University Hospital.

Even with a dozen events and qualifiers, our runners managed to fit in two parties—a victory party *before* the first race, and a pizza party after the last race to celebrate GE's distinction of being the only company to have finished in the top three every year since the event began.

The GE team captains, Chet Bieganski (East Coast) and Kevin Holtzclaw (West Coast), both insist that GE, in Holtzclaw's words, "is just a runner or two short of winning the Corporate Cup." According to Holtzclaw, there are still miles to go to reach all the good runners at General Electric.

"Play so that you may be serious."
—ancient Greek saying

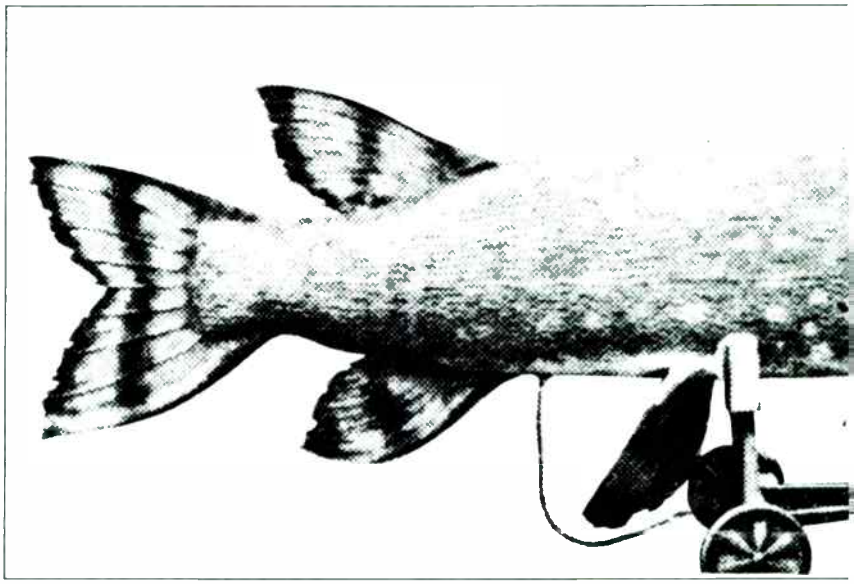
A fish story

First there was "The Creature from the Black Lagoon." Then there was "Jaws." And now there's "The Pike."

It's a multimillion-dollar English horror film, starring the most sophisticated mechanical movie monster since the great white shark in "Jaws." Produced by City Major Studios of Manchester, it is now being filmed in England.

The star is this 12-foot-long pike which can cut through the water at six knots and bare its 300 backward-facing teeth in a menacing, man-eating grin. And those teeth actually exert pressure equaling 900 pounds.

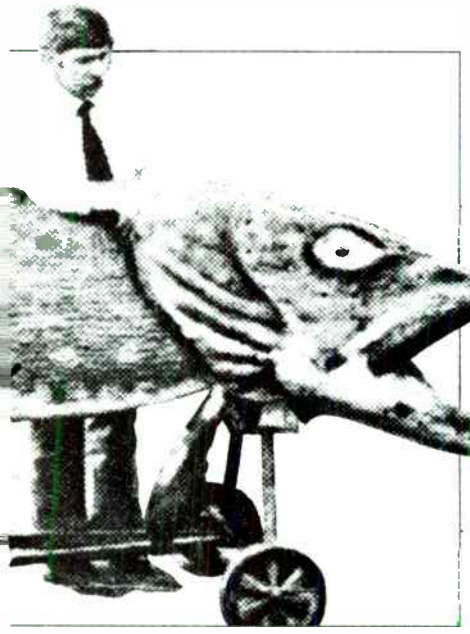
The most ticklish problem facing the pike's designer, Ted Carter of Ulvatech, Ltd., of England, was finding a suitable outer skin for his monster—one that was non-toxic and resisted corrosion. Carter's problem was solved when he used RTV 700, a GE silicone substance.



In war-torn Beirut, GE aid to a beleaguered hospital

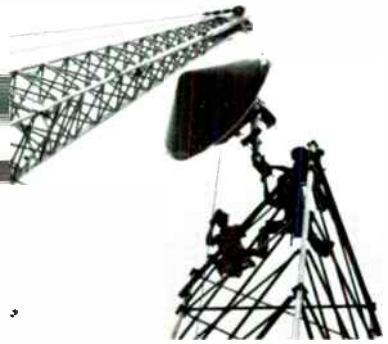
As in any hostilities, the fighting in Lebanon has produced great suffering, but has also spurred great compassion. As casualties mounted this summer, the American University of Beirut Hospital responded to the urgent needs of Israelis, Lebanese, Syrians and Palestinians, regardless of personal danger. Noting this, officials of the General Electric Foundation and the Company's International Sector decided to make a gift to the hospital to aid in its work.

The hospital, founded in 1867



by Presbyterian missionaries and considered to be one of the finest in the Middle East, has been particularly hard-pressed because of the damage to other medical facilities in the area (see photo). During the months of June, July and August, more than 4,000 wounded were treated there by a staff hailing from more than 30 countries—"almost a small United Nations," according to Nimr Ibrahim, the University's director of development.

In August, Edward C. Bavaria, VP and General Manager—Middle East/Africa Business Development Division, presented a $10,000 check to the hospital, citing "the humanitarian effort [which] required great sacrifices by the staff of the hospital."



Something So Right

The GE Theater continues this season with the airing of "Something So Right" on Tuesday, Nov. 30. Starring Ricky Schroder, James Farentino and Patty Duke Astin, the show is about the relationship of three lonely people—a trouble-prone boy, a middle-aged nightclub owner and the boy's mother, a young divorcee. The production will be shown on CBS. Recently "Bill," a GE Theater production won two Emmys.

Sky-high

Atop a 165-foot antenna, workers are shown finishing a microwave radio system linking 14 General Electric facilities in the Syracuse area in a telecommunication network that is expected to save the Company nearly $2 million in the first year of operation and, over a 12-year period, $43.6 million in equipment and outside-line usage.

Operated by Northern Telecomm System, the network is GE's largest privately owned communications system, providing a full range of electronic telephone features. It has the capability for simultaneous transmission of voice and data communication.

GE inducts jet pioneer into its Aircraft Hall of Fame

It was 40 years ago that General Electric built America's first jet engine. Based on the Whittle W.1 engine that had been developed a year earlier by airplane pioneer Sir Frank Whittle, the GE engine was the forerunner of today's advanced turbojet and turbofan engines.

In September, at the opening ceremonies of the 1982 Farnborough Air Show in England, Whittle (left) was inducted into the GE Aircraft Hall of Fame by Senior Vice President Brian H. Rowe, Group Executive of the Aircraft Engine Business Group.

"By pioneering successful jet flight, Frank Whittle has helped change the face of the earth," Rowe said, noting that gas turbines today power every major airliner, military aircraft and ships, and even serve marine and industrial applications worldwide. "If you look at the chronology of GE jet engine development," he continued, "the initial entry is a small block that says *Whittle*. That's his hallmark—the tribute to this giant of aviation."

In search of El Dorado

IN THE BUSH COUNTRY of central Brazil, a convoy of four-wheel-drive Toyota land cruisers kicks thick clouds of red dust across a dirt road. It is June, the dry season, and the temperature sizzles past 100 degrees.

Inside the lead Toyota, Carlos Andrade of Utah International, one of Brazil's foremost geologists, downshifts, and the land cruiser slows before splashing across a shallow river. His eyes take in the mountains peppered with little trees, stunted and twisted by the cruel climate.

"This was *bandeirante* country," he tells the Utah foreign exploration managers accompanying him on a field trip to scout this remote region for minerals. "The *bandeirantes* came up here in the 1600s to mine gold," he continues, "and by the 1900s, most of the mines were played out. Today their descendants raise soybeans and cattle. That's all anybody thinks this land is good for anymore. But I think different." ➳

photos by Alvaro Benetti and Stephen L. Harris

BY STEPHEN L. HARRIS

Os bandeirantes

IN THE 16th, 17th and 18th centuries, the boundaries that today mark Brazil were shaped by roving Portuguese fortune hunters known as *bandeirantes* because of the flags—or *bandeiras*—they carried. Driven by the quest for gold and diamonds, these rough and nomadic bands slashed into the wild interior of a vast land, ignoring a demarcation line fixed by papal decree in 1494. They expelled Spanish settlers and pushed the Brazilian frontier to the banks of the Paraguay River. They brought slaves with them and, as they cut into the interior, the *bandeirantes* would stop along the way for a year or more to replenish supplies by planting and harvesting crops, grazing their cattle and subduing Indians for slavery. Small villages sprang up, peopled by *mamelucos*—a mixed race of Indians, Negroes and Europeans. But it was in gold and diamonds that the *bandeirantes* gained their fame. They discovered rich deposits of gold in what are now the states of Minas Gerais, Mato Grosso and Goiás. Like their American pioneer counterparts, they had helped to forge a nation out of a raw land.

The Toyota bounces out of the riverbed, shedding water like a steel duck. Andrade is convinced that hidden somewhere in the surrounding countryside is one of the world's major deposits of gold.

And he bets he knows where it is.

Finding it, though, is like finding a golden needle in a jumbo haystack. Brazil is a giant of a country—3.3 million square miles. Its interior is among the least-known—remote, inhospitable, a land of savannas and dense jungle. Only in recent years has Brazil been geologically mapped. Thus, uncovering minerals such as gold, silver, copper, uranium and coal will not be done overnight.

How then can Andrade, who began Utah's operations in Brazil in the mid-'70s when Utah formed Mineração Colorado, Ltda., have the boldness to take a team of top geologists to sites that he believes will yield gold in such grand quantities that mining it will be worthwhile? What brought him, and his colleagues, to the conclusion that, indeed, there is gold in these Brazilian hills?

"Systematics," he says, steering the Toyota along the dirt road.

Andrade doesn't believe in luck. You systematically dissect the land with every tool available—radar, Landsat imaging and personal reconnaissance. That means slugging your way through miles and miles of bush, probing the earth with holes drilled by machines called "winkies." You find out what the land is like, what it is made up of, and you compare it to other parts of the world already explored, and if the geology is similar, then the minerals should be the same, too. The similarity between Brazil and Canada is remarkable even though the climate and topography are vastly different. There is gold in Canada. There must be gold in Brazil.

The golden needle in Andrade's haystack

lies somewhere in the state of Goiás, between Rio Araguaia and Rio das Almas (River of Souls). Exploratory drilling has been encouraging, and now Andrade wants to pick the brains of fellow Utah geologists, to call upon the experience of men who have searched the four corners of the earth for gold and coal and copper and who found mines such as Australia's Bowen Basin and Chile's Escondida—legendary discoveries in the history of Utah International.

The Toyota thumps across a wooden bridge spanning Rio das Almas, once the scene of a bloody battle between *bandeirantes* and Indians. The river still harbors anacondas, piranha and stingrays. Jaguars still prowl the hills, but are rarely seen. Andrade, who once mapped an unknown tributary of the Amazon, is as much at home here in Brazil's bush as he is in his offices in teeming Rio de Janeiro.

For some of the Utah geologists with Andrade, it is their first visit to Brazil. But they take to the bush as if it was their home, too.

There's Gordon Taylor from South Africa's Southern Sphere Mining and Development Company; Colin Greathead, also South African, from Utah's headquarters in San Francisco; Alastair Grant from P.T. Utah Exploration, Inc., in Indonesia; Canadian Maurice "Mo" Young, Utah's North American exploration manager; and Francisco "Pancho" Ortiz from Minera Utah de Chile, Inc.

The convoy rolls into Pilar de Goiás, a little village of *bandeirante* descendants, where Andrade has a field office. It was near this village in 1705 that the *bandeirantes,* using slaves, struck gold. The dates carved on three bells outside a church confirm the year of the strike. Unfortunately, village records—meticulously kept for 200 years—were destroyed in the early 1900s when an enter-

With "Mo" Young (far left) and Andrade looking over his shoulder, South African Gordon Taylor discusses Brazil's geology with fellow explorers.

prising clerk used them to make fireworks.

It is Sunday, and the *vaqueiros*—the cowboys who tend the herds of Brahman cattle—sip drinks in the shade of the verandas. Their children share the dirt street with chickens and pigs. An ox cart hauling firewood rumbles past, its wooden wheels screeching out a complaint. The hills close to Pilar are pockmarked with played-out mines—shafts gouged into granite, dank with the smell and sound of dripping water. But in the rivers and streams nearby, villagers still pan for gold.

The convoy stops in front of the field office, a small, whitewashed building on a side street. It's one of several Spartan-like offices in Brazil's bush country. Ore samples gathered from the surrounding hills are brought here, analyzed, tagged and sent on to Mineração Colorado's laboratory in Rio. The inside of the field office is lined with rocks.

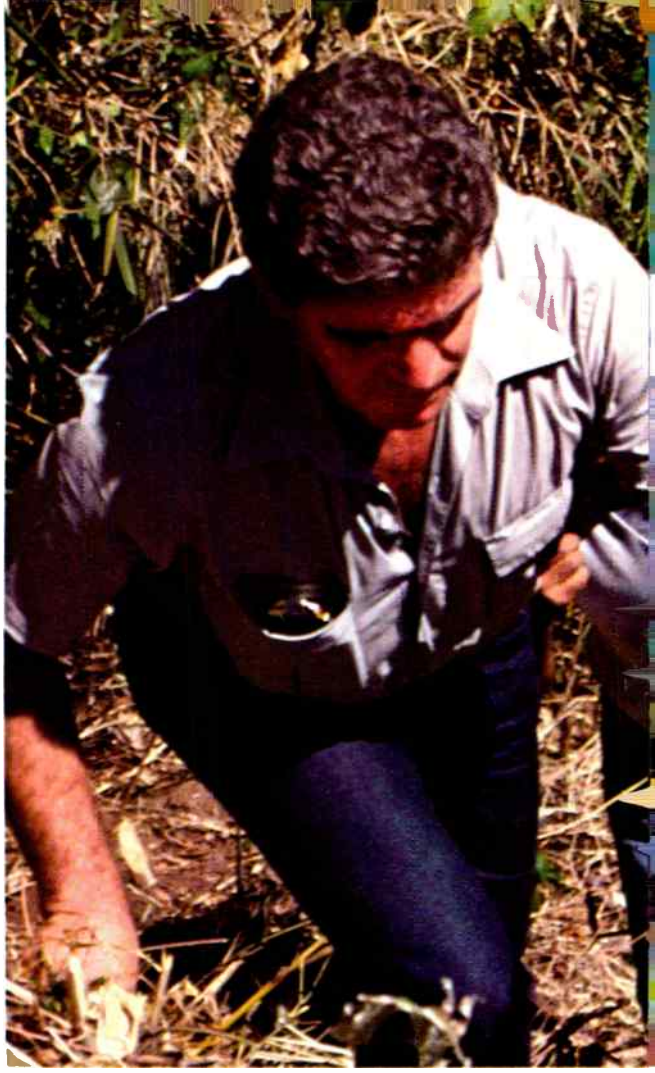
Picking up a rock, Andrade holds it in front of the only non-geologist on the team.

"This may look like something you'd throw at a mangy dog," he tells him. "But to us it's a clue to what's out there, to what minerals are in these hills. This rock, and others like it, and the ore samples we drill, help us understand the land. What was this place like two billion years ago? Was it an ocean? If we know what the conditions were like then, if we can reconstruct the environment, we have a better idea of what's out there today."

He puts the rock back on the table. "We can't leave any questions unanswered because there are no case histories in Brazil. There are no comparisons."

There's always merriment in Andrade's eyes—deep-set under a thick, furrowed brow. But there's a look of seriousness, too, a sense of his, and of Mineração Colorado's, responsibility for opening up Brazil's interior.

Educated at a Connecticut prep school and then the University of California at Berkeley, Andrade—his full name is Carlos A. Cezar de Andrade—joined the oil giant, Petrobras, in the 1950s as one of Brazil's first geologists. It was with Petrobras that he mapped the unexplored Amazon tributary. He later worked for private Brazilian groups and, because of his close dealings with foreign businesses, was sought by Utah International's Robert O. Wheaton, Vice President and manager of Exploration and Business Development, to start an operation in Brazil.



Wheaton told Andrade that the new venture was his to run. Andrade hired a staff and selected the name Colorado because in Portuguese the word is easier to pronounce than Utah.

"Carlos heads a team of tough professionals who know how difficult mines are to find, but are tackling with intelligence, resourcefulness and energy the special problems posed by exploration in an area that until a few years ago was geologically unknown," says his present boss, Oliver Warin, Utah's manager of mineral exploration.

Today, from its offices in Rio's Rua Barão de Lucena, Mineração Colorado runs exploration endeavors throughout most of Brazil,

The Utah team, led by Andrade, hikes into the mountains — where they believe gold will be found.

including Bahia and the Grande Carajás Project in the Amazon. The staff in Rio keeps in daily touch with the field via shortwave radio—even with geologist José Nakashima, a Brazilian of Japanese descent who has, for the past two years, lived 2,000 miles away on the banks of the Itacaiúnas River in the Amazonian rain forest.

"We explorers," laughs Andrade, "believe it's more fun to find minerals than to get them out of the ground. Let the engineers do that."

The stop at the field office in Pilar is short. The convoy is restocked with water and food and starts out again—this time to venture into the nearby hills to check exploratory holes, rock outcroppings and the general make-up of the land.

The convoy rattles along the dirt road that leads from the village. The road takes them into the hills, past sprawling ranches and grazing herds of Brahman cattle. Now and then a small house appears—a crude brick outpost against the Brazilian frontier. Vegetables and fruits grow in a yard scratched from the forbidding land. A short distance away, wooden crosses mark shallow graves. Children in bare feet play by the roadside.

The lead land cruiser pulls off the road and follows a trail that is just a rut in the red soil. The rut follows the roll of the land, dipping and rising, and the land cruisers slant and sway precariously. Wheels spin. Gears grind. Another river is forded. The convoy stops under the shade of a tree. Beyond is a small mountain, perhaps 2,000 feet high.

It is this mountain where Andrade believes he will find his golden needle. He has already

staked claims to the land.

On foot now, he and Helmut Brockes, district geologist for Mineração Colorado and a *bandeirante* descendant, guide the others up the mountain's side. Brockes' grandfather lived in Pilar in the early 1900s, at the time of the great fireworks display. Brockes knows the people; he knows the land.

It takes about half-an-hour to reach a trickle of a waterfall. The vegetation is thicker here. A week earlier, one of Andrade's men, poking into the ledges with a rock hammer, disturbed a rattlesnake. In an instant, he lopped off its head with a machete.

"This place reminds me of Africa," Gordon Taylor of South Africa says. Standing in the shade, he mops his face with a handkerchief.

Taylor and Andrade have been conferring a lot about the land—its similarity to parts of Africa, particularly areas where gold has been abundant—and the potential for a major gold deposit. Taylor chips away a piece of ledge with his rock hammer and examines it with a lupe—a tiny magnifying glass attached to a leather thong around his neck. The rest of the team also studies outcroppings—Brockes, consulting with "Mo" Young of Canada, points to other tracts of the mountain where similar rocks have been uncovered.

Later, at another site away from the mountainside, in a field overlooking a river, the geologists examine ore samples hauled out of the earth by a "winkie" drill. Easy to move around and inexpensive to use, the "winkie" is crucial in any exploration venture. It allows more than surface investigation of the land.

"Every time we put in a 'winkie' hole," Andrade tells Taylor and the other geologists, "we get some encouragement."

But the drilling is tough—not because the earth is hard, but because it is soft. One hole took 15 days to penetrate 105 feet of soil. The samples are spread on the ground in wooden cases—telltale clues to geologic formations.

For three days, the exploration continues. Rocks are scrutinized—even those found along dirt roads. Freshly dug trenches are looked at and outcroppings, rare in this part of Brazil, are examined. You can almost sense the nearness of what Andrade is searching for. He has eliminated much of the giant haystack and is now closing in on his golden needle. But there is still much to be done.

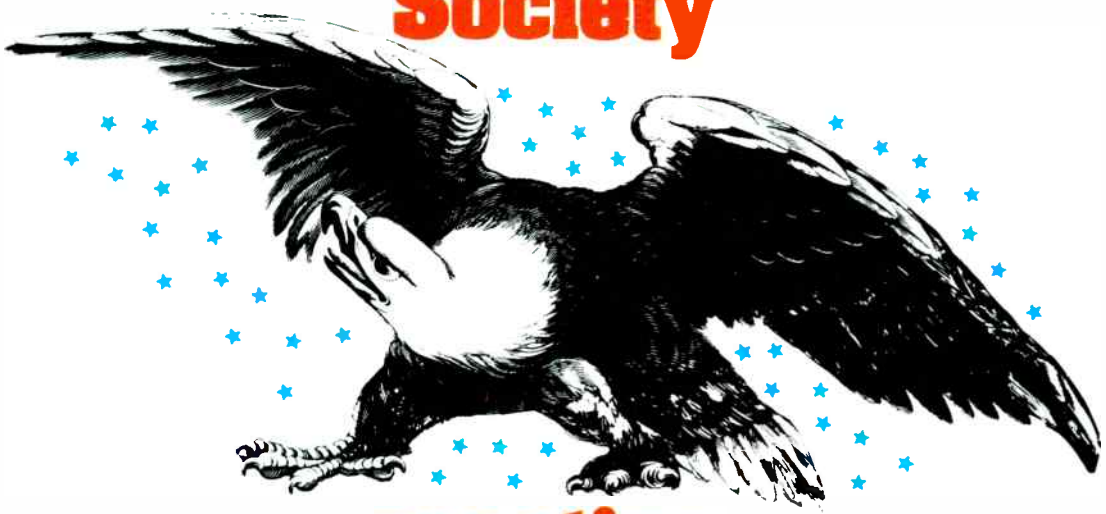
Taylor sums up the team's feeling. "I'd like to be in on this project. It looks promising."

The end of the field trip is near. Andrade steps down to the banks of a shallow stream where one of his panners squats in the cold water, sifting through the red mud. The silver pan glistens in the bright sunlight. The water washes away the soil. Heavy stones are lifted out. Soon all that's left are the glittering specks of gold dust.

"We must search until we find it," Andrade says, his eyes going from panner to mountain. "We must search until we're convinced nature didn't put it here. We can't sit back, because then somebody else will find it."

Below: Symbols of a raw, beautiful frontier. Right: Mineração Colorado gold panner, Irani Lima Dios.

The Elfun Society



meeting the challenge of the new federalism

From Schenectady to San Jose, from Pittsfield to Pittsburgh, from all over the United States and Canada, a volunteer army of 25,200 General Electric people is now on the march. It's the Elfun Society, and its key objective is to help bridge the gap in federal support to states, cities and towns.

"Problems of our communities are endless — health care, drug abuse and crime control," points out Elfun President Lawrence G. Ostermann. "The Elfuns and GE working together, using their combined professional expertise, can be a significant catalyst in solving these problems, in getting the job done. This is the task of the Elfun Society."

For the Elfuns, a 55-year-old organization, this was not always its main task.

For years it promoted the interests of GE, a record that caused former Company Chairman Reginald Jones to say: "You are the keepers of the General Electric spirit — the one shining thread that holds past and future together."

But as the Elfun Society moved deeper into the turbulent decade of the '80s, promotion was not enough.

In a message to Elfuns last year, GE Chairman Jack Welch challenged them to make "a searching and fundamental evaluation of what the Elfun role should be."

The Elfuns took up that challenge under the leadership of its immediate past president, Calvin D. Neithamer. And this March they took their response to Fairfield, seeking support from the Corporate Executive Office.

That response is built around the concept of voluntarism.

Comments Ostermann: "We find ourselves in a new world, a new social world. There's a new philosophy throughout the land — a new federalism evolving from Washington that says Uncle Sam must step back from doling out public funds to solve all our problems. Instead, it's suggested that we should let the people solve the problems of their own communities. That means the private sector must pick up the slack as the federal government backs off. You and I are that private sector. The Elfun Society is that private sector, and so is General Electric."

"Throughout its history, the Elfun Society has responded to the changing needs of the times. In the 1950s, for example, it emphasized programs of communications, fellowship and public affairs. But at no time did Elfun alter its basic purpose of serving the interests of GE — by acting as a good neighbor and a concerned corporate citizen," Ostermann remarks.

With this philosophy, the Elfuns got CEO support. Chairman Welch reiterated that support in a speech to Elfuns on September 13.

"We are in tough times," Welch said. "Many of the communities we serve are being racked not only by a weakened economy, but by cutbacks in federal spending. General Electric has increased its contribution level, but the total is just a drop in the bucket compared to what is needed to make up for these cutbacks. Rallying Elfun around the concept of voluntarism, and taking advantage of that tremendous retirement community we have, we can

Lawrence G. Ostermann

Calvin D. Neithamer

truly make a difference to the communities in which we live and work."

Then, in answer to a question, Welch stated: "I really believe that if Elfun is to be a volunteer organization, it should be manned by men and women who are absolutely committed to that concept—on their own. I think of Elfuns as acting from the heart, from the soul—doing what they want to do, and General Electric being proud of what they're doing because they're GE people."

The Elfun Society was formed in 1928 by Gerard Swope, GE's third chief executive, as a volunteer organization of company professionals. Elfun had as its original purpose to "encourage a spirit of cooperation, fraternity and good fellowship and provide an open forum for discussion of topics relating to the welfare of its members and the interest of the Company."

It began with 12 chapters, mostly concentrated in the Northeast. Today it has more than 70 chapters.

And it's unique in American business. No other company has a similar organization.

"We are convinced Elfun is a dynamic General Electric force," says Cal Neithamer, who guided the refocusing of the group's mission before stepping down as president this year.

"It was good for Elfuns to have Jack Welch challenge us," he continues. "Today I feel we are in an excellent position. We are in tune with the times, and we are certainly a key element in our Company's new voluntarism thrust. Elfun has always been in the forefront of volunteer activity, but now the Elfun Society will build on this—with full management encouragement."

The evening Welch spoke to the Elfun Society, Neithamer's successor, Larry Ostermann, told fellow members that "chapters are the heart and soul of the Elfun Society. Your chapter performance in this coming year will determine whether or not we have truly met the Welch challenge...the challenge to really do something—not just for your Elfun chapter, but for your community, your neighbors, your fellow workers."

Already this move into the forefront of voluntarism by Elfuns is being felt in communities across the United States and Canada.

In Pittsburgh, for example, Walt Doherty, a GE sales representative, heard the story of a woman, paralyzed from the chest down, who was trapped in her car last winter when it stalled on an ice-slick highway. For almost two panic-stricken hours, no one came to help.

This was a story Doherty could quickly relate to—his son is also a paraplegic. Doherty, an Elfun, contacted his chapter chairman with an idea. Why not provide GE CB radios to Pittsburgh's handicapped drivers?

The chapter adopted the idea, and Doherty took it upon himself to coordinate the project, to obtain and install the radios.

Said one recipient, "I sure could have used one of these CBs a couple of winters ago when I, too, was stranded on an icy road. Fortunately, some people found me, or I might have frozen to death."

Organization Changes

International Sector
John A. Urquhart, Executive Vice President and Sector Executive

Corporate
Roland W. Schmitt, a Senior Vice President
Joyce Hergenhan, VP—Corporate Public Relations
Bruce O. Roberts, VP—Corporate Services
Leonard Vickers, VP—Corporate Marketing

Consumer Products Sector
Richard L. Burke, VP and General Manager—Major Appliance Production Division
Richard T. Gralton, VP—Consumer Distribution
Eugene F. Apple, VP and General Manager—Lamp Components Division
Jacques A. Robinson, VP and General Manager—Television Business Division
Gary L. Rogers, VP and General Manager—Lamp Products Division
Thomas L. Williams, VP and General Manager—Lighting Systems Products Division
William S. Frago, General Manager—Lamp Consumer Marketing and Sales Department
Stephen J. O'Brien, General Manager—Major Appliance Satellite Production Department
Edward J. Russell, General Manager—International Lighting Department
Francis M. Scricco, General Manager—Room Air Conditioner Department
Charles P. Pieper, Staff Executive—Consumer Products Strategic Planning and Development Operation

Industrial Products Sector
Jesse M. Lawrence, General Manager—General Purpose Control Department
David E. Momot, General Manager—General Purpose Motor Department
John J. O'Connor, General Manager—Large Motor and Generator Department

Power Systems Sector
James R. Birle, Senior VP and Group Executive—Construction and Engineering Services Group
Robert T. Bruce, VP and General Manager—Domestic Apparatus and Engineering Service Operations
George R. Brown, General Manager—International Apparatus and Engineering Service Operations
Arnold R. Adler, General Manager—Gas Turbine Projects and Customer Services Department
Charles E. Bedford, General Manager—Engineering Services and Projects Department
Peter W. Camp, General Manager—Nuclear Fuel Projects Department
Frank D. Judge, General Manager—Nuclear Control and Instrumentation Department
Hugh J. Murphy, General Manager—Medium Steam Turbine Department
John R. Patterson, General Manager—Gas Turbine Engineering and Manufacturing Department
John E. Van Hoomissen, President—General Electric Uranium Management Corporation

Services and Materials Sector
D. Rex Blanchard, VP and General Manager—Lexan Products Division
Philip M. Gross elected a Vice President
John D. Opie, VP and General Manager—Specialty Plastics Division
Michael E. Echols, General Manager—RTV Products Department
John B. Lidstone, General Manager—Plastics International Ventures Department
Donald W. Shirey, General Manager—Sheet Products Department
Paul L. Dawson, Chairman of the Board and Chief Executive Officer—General Electric Plastics B.V.

Technical Systems Sector
Henry J. Singer, VP and General Manager—Industrial Sales Division
Walter E. Weyler elected a Vice President
James A. Meehan, General Manager—Automation Systems Department
Curtis W. Powell, General Manager—Data Communication Products Business Department

Aircraft Engine Business Group
Neil Burgess, VP—Customer Relations
James N. Krebs, VP and General Manager—Military and Small Commercial Engine Operations
Harry C. Stonecipher, VP and General Manager—Commercial and Military Transport Engine Operations
Robert C. Hawkins, General Manager—Aircraft Engine Advanced Technology Operations

Educational twosome...

Traders-in-training

TEN TRADERS-IN-TRAINING, they came from Indonesia, Hong Kong, Singapore, Colombia, the Philippines, India and Thailand.

All were college graduates with engineering degrees when they were recruited by General Electric in their native countries almost a year ago.

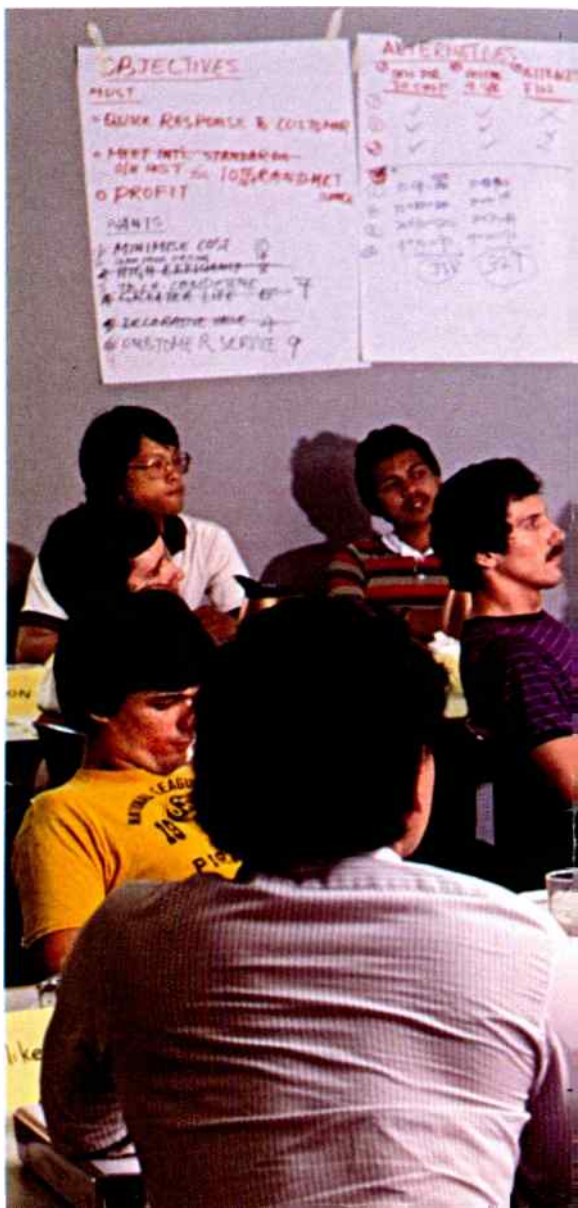
When they joined U.S. trainees in GE's Technical Marketing Program for a two-week Marketing Institute at Fairfield University in Connecticut this summer, they were completing the last phase of a comprehensive International Marketing Program curriculum.

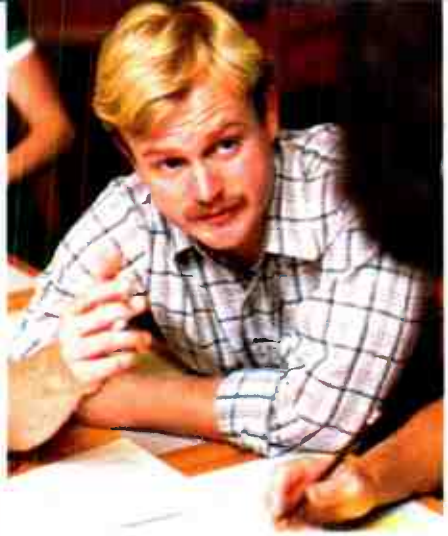
Next Step: a return to their home countries as full-fledged General Electric Trading Company (GETC) sales engineers.

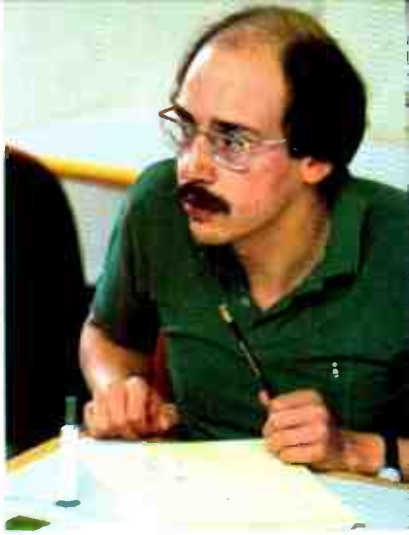
George J. Stathakis, president and chief executive officer of GETC, has pinpointed marketing, promotional and entrepreneurial skills as the qualities most crucial to success as an international trader.

And the International Marketing Program, which marks its fifth anniversary this year—and is now part of GETC, is dedicated to the development and refinement of just such skills in the young people it so carefully recruits and trains, according to Joseph E. Teahan, manager of Sales Personnel Development for GETC.

Once accepted in the program, Joe Teahan says, recruits spend a month or two in the GE sales offices in their home countries —learning local market and customer needs and gaining "hands-on" experience with office procedures







Students (from left) Pradipta Sens of India, Patty Dillon and Mike Ireland of the U.S. and Hernando Jaramillo of Colombia. Below: Instructor Pete Hazelwood, Jr., of Concept Associates, Inc., Racine, Wisc.

while defining their needs for additional training.

Then it's off to the United States for several months of on-the-job experience at GETC's regional support operation in New York City and in operating components of the Company —gaining a broader knowledge of GETC operations and capabilities, identifying sales support sources, participating in selected formal training courses, and working on meaningful projects.

A two-week International Marketing Institute—held this year at Fairfield U.—completes the formal program requirements.

"The Institute," Teahan says, "combines lectures and workshops which are designed to fine-tune negotiating skills, develop talents for promoting sales relationships, increase understanding of the distributor's role in marketing and sales, and further refine communications abilities."

And perhaps most important, there is continued emphasis on the overriding importance of the entrepreneurial approach and spirit—the *sine qua non* of successful trading.

A prime example of General Electric's extensive international sales and distribution network—one of the new General Electric Trading Company's major assets—is the fact that since its inception in 1977, the International Marketing Program has trained 56 young men and women from 29 countries on six continents (all except Antarctica).

Their mission as program graduates? To use the skills they have mastered to produce the overseas sales to prove the truth of Stathakis' statement about GETC and its future: "The General Electric Trading Company is an idea whose time has come."

IN A JUNE ceremony at Mecklenburg Gardens in Cincinnati, 24 young GE engineers received certificates in recognition of their successful completion of the first year of a brand-new Company program—the Advanced Course in Manufacturing (ACM).

Just what is ACM? It's a three-year, graduate-level engineering program leading to a Master of Engineering or Science degree. It utilizes the talents of Company experts in manufacturing as well as the expertise of participating universities to teach the underlying concepts inherent in the pervasive technologies

Above: From Bob Campbell (left), second-year student Dan Warrell, pursuing a master of engineering degree, learns about the P5 robot.

'Turning art into science'

of electronics, computer utilization, materials, and manufacturing processes.

It represents an innovative cooperative industry-university effort aimed at the establishment of manufacturing engineering as a high-technology career path in industry and as a legitimate field of academic study at the university level.

The curriculum for the pilot program in Cincinnati was developed jointly by the Aircraft Engine Business Group and the University of Cincinnati. A second ACM program begins this fall in Louisville—an effort of the Major Appliance Business Group and the University of Louisville; and Medical Systems Business Operations and Marquette University are planning a program in Milwaukee.

Selection of students is based on their undergraduate college grades, the recommendation of their managers, and their willingness to work and study 60 hours a week. They attend classes on Company time, but also have normal job responsibilities. They must study on their own time.

Echoing Chairman Jack Welch's call for GE to be on the leading edge of technology, "both in terms of people and machine efficiency," Vice President W. George Krall, general manager of the Evendale Production Division, congratulated members of the pilot class:

"You are the vanguard, turning our art into a science, moving us away from the 'buggy-whip' mentality. Go out on the factory floor with all this knowledge you're gaining. Identify and solve multidisciplinary production problems. Gain the respect among engineers that manufacturing needs. Advance this business. Think of crisis as opportunity. Enjoy the complexity, the challenge—and stick with ACM." **E.W.V.**

Right: To Catherine McCrea, Dave Rigney describes the inner workings of a prototype T700 combustor lever.

photos by Joseph Kugielsky

University of Minnesota veterinary student Mark Martol prepares bald eagle for ultrasound scan, which may help in determining the bird's sex for breeding purposes.

Modern-day Dr. Doolittles

GE medical equipment is helping vets breed eagles, pinpoint a tortoise tumor and bring relief to a St. Bernard

By Donna R. Carpenter

Minnesota vets Donna Stevens (foreground) and Betty Kranek discuss best course of treatment for a patient.

Dr. Christine Juroslek (l), senior vet at Michigan State's Veterinary Clinical Center, and student Margaret Berry comfort German wire-haired pointer Nikki, who is about to have x-rays taken.

THE WAITING ROOM resembles the queue at Noah's Ark. Lions, lizards, chimps and cows sit hoof by paw and claw with dogs, alligators and eagles.

"On an average day, we get everything from a teacup poodle to a 1,500-pound horse," says Dr. Daniel Feeney, director of the Radiology Division of the University of Minnesota's Veterinary Teaching Hospital. Seeing an average of 60 animals a day—15,000 cases a year—Dr. Feeney and his colleagues not only alleviate animal ills, they also conduct research and attempt to

teach a new generation of veterinarians to care for cattle, deal with dogs, and treat turtles.

Helping in these tasks is some of the most sophisticated medical equipment available, including CT scanners and ultrasound, fluoroscopy, radiation therapy and x-ray units.

"In some technical fields," says Dr. John Judy, associate dean of Michigan State University's College of Veterinary Medicine, "veterinary medicine has made tremendous strides in the past 10 years. We can detect disease earlier, determine its extent more accurately, and treat it more effectively. And like our colleagues specializing in human medicine, we now emphasize preventive medicine."

Adds Dr. Ulreh Mostosky of the College's Radiology Section: "Indeed, anything done in human medicine can be done on animals. After all, many medical procedures—implanting pacemakers, for example, or using pins to repair fractured bones—were perfected on animals. People are coming to expect more for their animals, but we still have to consider the economics of a situation, whereas human doctors seldom do."

Most vets advocate animal medical insurance as a way to get the best care for the most reasonable cost, but attempts to start such programs have been largely unsuccessful.

Veterinary medicine is, in any case, flourishing. The number of vets in the United States has doubled in the last 25 years—to about 35,000—and there are so many applicants each year to the nation's 27 veterinary schools that fewer than a third are admitted.

One reason veterinary medicine is surging is because Americans own an astonishing 80 million pets (including pleasure horses). This army of animals commands the attention of three times as many veterinarians as 190 million head of livestock. The cost of many of these animals also is rising, as record prices are paid for everything from show dogs and race horses to zoo animals, making adequate veterinary care an economic, as well as emotional, necessity.

As in human medicine, there is a growing trend toward specialization, with many vets opting to care for exotic and wild animals, others specializing in race horses, cattle or house pets, and still others going into areas like dermatology (of the fur, feather and fin variety), pathology, cardiology and radiology. This becomes easy to understand when one considers that veterinarians are licensed to practice on 950,000 species of animals—"all but one," jokes Minnesota's Dr. Feeney.

"Seriously, though," he continues, "you can't be a jack-of-all-trades or you'll be a master of none. Much of what vets learn comes from human medicine, which applies nicely to cats, dogs and other animals, but in reptiles, amphibians and exotics the organs are in different places, and there are wide differences in lung structure, digestive tracts and bronchial distribution. We also may not be aware of what normal behavior *is* in a given animal, or what kind of diet it should be getting. So it's becoming more and more important to have specialists who do."

Dr. Ronald Burk, a radiologist at New York City's Animal Medical Center, concurs: "We handle 65,000-70,000 cases a year, and we've got to have people who can take a wide variety of factors into account. Birds, cats and many wild animals often conceal symptoms to protect themselves from predators. Some catch exotic diseases or are hard to handle because of their size. Examination and improvisation become very important, as does having the right equipment to detect problems.

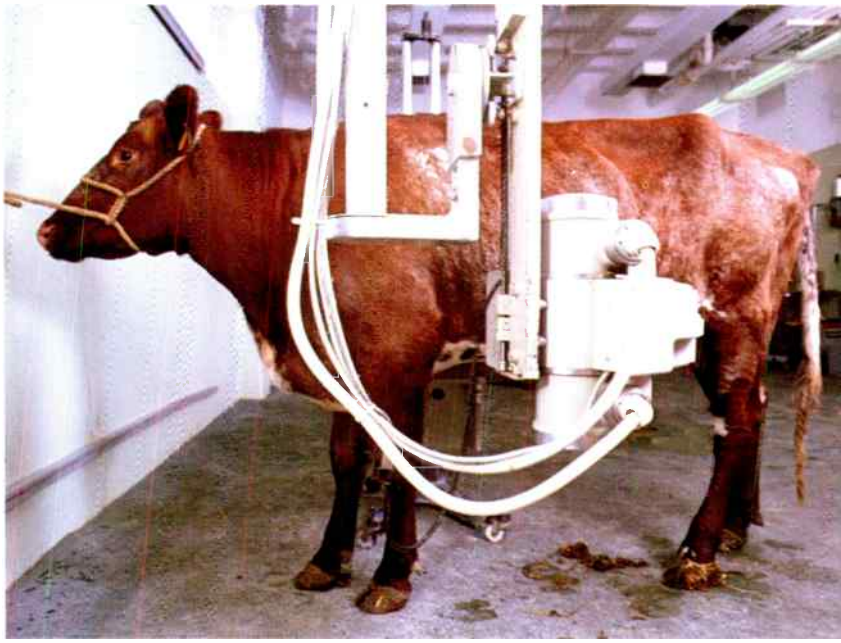
"To give you an idea of the difficulties, let me tell you about the recent surgery we performed on Jalopie, a Galapagos tortoise belonging to the Staten Island Zoo. After 45 years of living at the zoo, Jalopie developed a tumor on his shoulder. It was removed six months ago, but grew back. We were consulted for a second opera-

tion, and used a GE x-ray unit to determine the full extent of the tumor, so we could remove it all. I was concerned that the shell would preclude a clear image, but fortunately, there was enough air between the body and the shell to enable a clear image to be taken.

Jalopie weighed 180 pounds so we had to wheel him down the hall on a skateboard and prop him stomach-up in a tire with his head higher than his tail so that his lungs wouldn't collapse. Tortoises don't have diaphragms so everything tends to crunch together when they aren't right-side-up. Finally, under anesthesia Jalopie's heart rate was only 12 beats per minute, so we kept holding our breaths waiting for the EKG [which monitors heart rate] to blip."

"But you'll be pleased to know that in spite of all this, Jalopie is now convalescing nicely at the Zoo and will be able to receive visitors soon."

Sophisticated monitoring equipment also is used in animal pregnancies. Notes Dr. Gary Johnston, a colleague of Minnesota's Dr. Feeney: "In pregnant animals, particularly those who are past term, we may want to see if the heart rate is normal, if the offspring are active, or if we need to perform a Caesarean. Some animal breeders also like to know how many offspring they can expect in a litter.



X-rays taken of farmer's cow (top) will show if animal has swallowed nails, wire or other hardware or if there is evidence of organic problems. Below, student Margaret Berry examines "Geranium Joe" for bladder deformity using a GE x-ray unit with image intensification. Such units are used in diagnosing heart, urinary, gastro-intestinal and other disorders.

Our GE Datason® ultrasound unit can tell us all these things without danger to the fetuses."

Drs. Feeney and Johnston recently used their Datason as part of a program to explore whether the sex of eagles, hawks and falcons can be determined by ultrasound. This is important because the birds' sex organs are internal, and up to now there has been no totally safe way to do this. Should the ultrasound technique prove to be successful, it will be used by the Raptor Rehabilitation Center, an arm of the University of Minnesota's Veterinary Hospital, where 30 eagles are nursed, studied and encouraged to breed.

The hospital is widely known for its radiology department and cancer board—which draws on surgeons, internists, pathologists and radiotherapists from both the medical and veterinary schools to decide on courses of treatment for animal patients. Oncology (cancer) specialists from a local VA hospital work jointly with the staff as well, and a trial program of radiation therapy and hyperthermia (extreme heat) used on patients has been a valuable source of research data.

Michigan State has similar research projects and joint ventures: a recent grant will enable vets to use rabbits as a model for studying toxic shock syndrome; drug screening is done for the Michigan Department of Health; and the osteopathic and medical schools on campus work closely with the Veterinary Clinical Center on many cases.

Additionally, an experimental drug provided by the National Cancer Institute is being used on the bone tumor of a current patient—a St. Bernard named Fara—combined with radiation therapy administered via a GE x-ray unit

A GE CT scanner is being used by Dr. David Roberts, director of Veterinary Dental Medicine and associate professor of Anatomy at Pennsylvania's School of Dental Medicine, and Dr. Gabor Herman, director of the University's Medical Imaging Group, in a wholly new area of veterinary research. The two are using the scanner to help simulate three-dimensional pictures of a horse's leg joints.

"Last year, we took a scan of a horse's leg," explains Dr. Roberts, "and saw the potential to feed that information —as well as data on the horse's movements—into a computer, which combines the two into a 3D moving picture. This allows us to examine function of the bones in a living animal and, more importantly, it will give us insight into joint abnormalities, including arthritis and enable us to predict performance and potential breakdowns in both animals and humans."

Human medicine often benefits from data generated in animal medicine, and in March of this year, New York's Animal Medical Center received a $500,000 grant to coordinate research on diseases that occur in both humans and animals. And, in an unusual arrangement, the Center works with the Sloan Kettering Memorial Hospital, using the hospital's equipment and experimental cancer drugs in exchange for feedback on interesting cases.

A staff specialist is even studying the results of human-animal bonding, the process by which humans and animals relate to one another, usually with enormous benefits for the human party. "The importance of these cannot be overestimated," says the Center's Dr. Burk. "They include increased survival rates among heart-attack victims who adopt pets; the lowering of high blood pressure; and progress in treating autism, schizophrenia, depression and the criminally insane. And, of course, the ability to 'see' that a Seeing Eye dog gives to a blind person."

"All of which reminds me," concludes Dr. Burk, "of what Dr. Doolittle said when his sister told him that if he went on treating hedge hogs and mice, none of the best people would have him for a doctor. 'But I like the animals better than the best people,' Dr. Doolittle replied and, of course, I agree."

Michigan State veterinary student Jeri McLaughlin uses Maxitron 300 to administer radiation therapy to treat bone tumor in Fara the St. Bernard (l) and above, reassures her that everything will be all right.

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