Meeting -- Tuesday, April 22, 1969

Don Rodgers, Manager, Missile and Space Field Operation
General Electric Company
Don Atkinson, Manager, Aerospace Market Development

CHALLENGE

GENERAL ELECTRIC COMPANY

SUMMER 1970

CHALLENGE

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Summer 1970 Vol. 9, No. 2

CHALLENGE is issued quarterly by Urban and Public Affairs of General Electric Company's Aerospace Group, and serves the employees of the Aerospace Group's Re-entry and Environmental Systems Division and Space Division. It highlights the people and events that make this the most exciting business in or out of this world.

Issued By
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Philadelphia, Pennsylvania 19101

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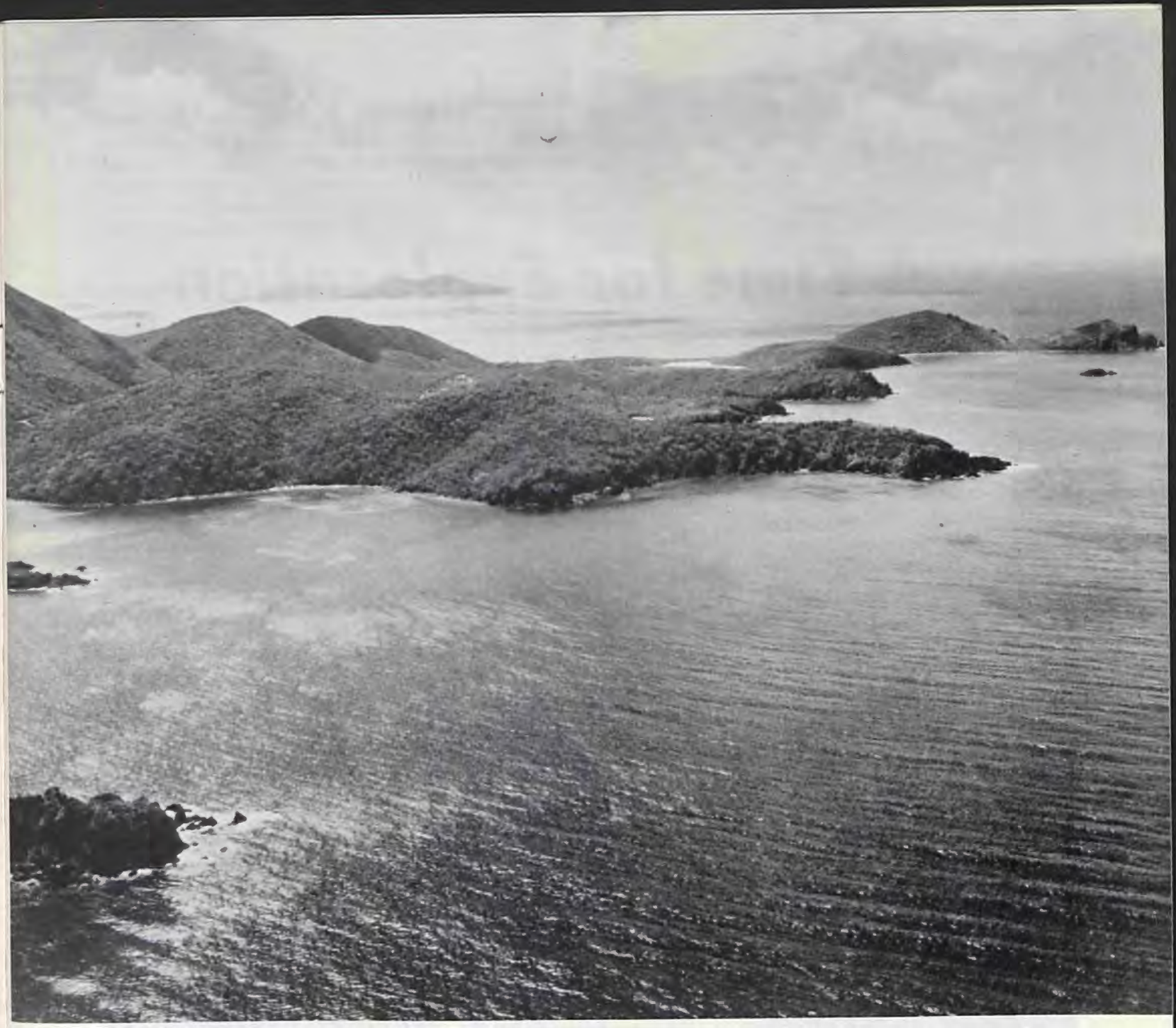
Photographs on pages 21 to 28 provided by U. S. Atomic Energy Commission



From the beginning, the seas — in their beauty and mystery — have held incurable fascination for man. Peaceful friend at times, vicious enemy at others, the oceans — with their bounty of undiscovered wealth — have defied exploration. Man's adventuresome spirit responded to the challenge and he went to the seas; but he lacked equipment to go deep into them and safely remain there for periods of time.

Today the same technology, initiative and dedication which have spurred man to travel in the alien environment of outer space are enabling him to go into the depths of the sea and bring back valuable information on Neptune's domain. In the pages ahead, CHALLENGE highlights some of the explorers, the new technologies and sophisticated equipment which are aiding man in his quest for exploration and exploitation of the oceans—the newest frontier.

A Time for Exploration

Last year, four intrepid scientists lived beneath the sun-splashed waters off the coast of the Virgin Islands for a record-breaking 60 days, conducting research programs while isolated on the ocean floor. They were part of the first "scientist in the sea" program —Tektite I—which gave man a never-before-achieved look into the oceans and their mysteries.

Deputy Program Manager and Scientific Coordinator for Tektite I was Dr. James Miller, who now heads up the Tektite II Program. He said of the inaugural program, "It had a dual objective. To conduct extensive marine science experiments; and study behavior and physical conditions of the four-man crew engaged in a long-duration mission, while they were confined to a relatively hazardous environment." Its results were lauded by marine scientists and oceanographers throughout the country.

Heading up the multi-agency project is the Department of the Interior's Dr. James W. Miller.

Dr. Miller adds, "Tektite I successfully demonstrated that saturation diving using a breathing mixture of nitrogen and oxygen was completely feasible. While the men conducted their experiments, we studied them. There were no serious medical problems. The crew brought back information which would have been impossible to gather if we had just made several dives from the surface as is usually done. And although there was no big event, no great discovery, we consider the mission a complete success—and one whose results whet our appetites for more experiments under the sea."

The success of that program brought the following message to the team from a strong supporter of the program, Secretary of the Interior Walter Hickel: ". . . The potential of the ocean and of such projects are almost beyond the imagination. We may soon have buildings instead of habitats beneath the surface and perhaps in the not-too-distant future, whole new cities, resort areas or recreational facilities. The application of the result of such missions to our way of life can be of far-reaching importance when we realize that these are times of almost unbelievable achievements in space." Secretary Hickel has been an extremely interested witness to the proceedings of the second Tektite, which was initiated in April. Tektite II will last seven months and involves more than 60 scientists, engineers and doctors as crewmen and a large supporting team.

The overriding purpose of the program, emphasizes Dr. Miller, is to further develop marine resources. "There are other functions also—a very significant one being the study of human behavior. Also, we are establishing medically that we can go deeper into the seas without resorting to more exotic gases such as helium."

He adds, "One of the greatest pluses is that marine scientists have the opportunity to live on the ocean floor and study life there. In the past, studies have been conducted from the surface, which is very restrictive." Results from Tektite I—and from the first mission of the second program have brought reactions of "excited, especially from the scientists primarily responsible for that mission." The Tektite Program Manager is optimistic that similar reactions will be recorded for succeeding missions.

It's natural that Dr. Jim Miller was named to head up this extensive under-sea program. He was one of those, several years ago, responsible for formulating such a program. "It was not the brain child of one person, but rather the result of many ideas."

The spark was ignited in December 1966 at a NASA-sponsored symposium concerning man in isolation and confinement. Dr. Miller, then with the Office of Naval Research, reported some results from work he had conducted on Sealab 2. "At the conclusion of my presentation, I suggested the possibility of using underwater habitats as a means of studying crew behavior for later space missions.

"More discussions and idea ex-

In the Great Lameshur Bay in the Virgin Islands, an underwater program hailed as "one of the most ambitious" is now being conducted. Designed to further marine sciences, Tektite II is made up of pioneering men and women working toward solving some of the mysteries the seas have held since the beginning of time.

Experiments completed, the aquanauts enter the habitat.

Ocean floor holds a wealth of material for geologic studies.

Monitoring of crew members is handled by Dr. Miller (rt.) and GE's Charles Meigs.

changes were held—each one, I believe—bringing us closer to an underwater program. NASA sponsored two study contracts — to determine whether information—regarding crew behavior — from an ocean program could be extrapolated into the space program. In its proposal, the General Electric Company indicated that it would provide a habitat.

"Several meetings later, it was agreed that, in order to do a comprehensive study of crew behavior, the aquanauts would need to perform meaningful missions. The Interior's Rick Waller, excited with the entire approach, set about to interest his Department's people in providing scientists for Tektite. The Department did; Rick served as the crew chief on the first program; now serves as Tektite II Deputy Program Manager; and is slated to dive in one of the later missions at 100 feet." Seventeen missions comprise the Tektite II program: ten (with five aquanauts each) at 50 feet; and at 100 feet, seven crews of two men.

While the inaugural program was the responsibility of four agencies — U.S. Navy, Department of the Interior, NASA and General Electric — its successor involves nine prime agencies, plus some 30 other organizations with the Department of the Interior serving as the lead agency.

"While a multi-agency project has its own special problems, it enables you to draw on the tremendous amount of talent housed in each organization. I think we have the best.

"When we announced we were receptive to proposals for the program, the response was gratifying. Proposals were carefully studied and reviewed by a panel composed of marine scientists. Decisions were based on experiments thought to be the most beneficial to the entire program. Of course, diving experience was reviewed. The entire process was extremely competitive.

"The result, therefore, is a crew of highly trained, talented, dedicated and determined individuals — which provides for a stimulating environment. The program has attracted pioneering people; and pioneers normally have strong personalities, which at times causes some conflict, which makes my job a bit more difficult."

GE aquanaut Ed Batutis is observed by an outsider as he performs routine habitat maintenance on Tektite II.

He adds, "Because of today's budgetary constraints, if we didn't have a conglomerate of agencies, we couldn't have a successful program.

"The talent and strength are tops, but the one thing which cannot be emphasized enough is the personal dedication of each one of the team—aquanauts, scientists, base camp people, administrators, everyone.

"It's not strange to see a PH.D. pushing a wheelbarrow or hammering some nails or mending something. Another example of dedication is the group of psychologists we have at the camp to study crew behavior. Each is a trained diver and between missions, they volunteer to dive to the habitat and help in the refurbishing procedures.

"Almost everyone associated with the program is a diver. Tektite has naturally attracted those who like to dive and consider it fun—and for us, they are performing useful jobs. Many are volunteers. Most feel, also that in order to get the job done, they must put extra effort into it. The 'extra effort' means that they often work a 14-17-hour day."

In the "hard work" department, Dr. Miller scores with the rest of the team. The adjectives, "dedicated, talented, helpful," that he uses to describe his fellow workers are used to portray him.

In the last five years, he's received as many awards for "outstanding and superior performance." Last year, his work on Tektite I earned him—from the Department of the Navy—the Distinguished Civilian Service Award. The year before, he was voted one of ten outstanding young men in the Federal Government and received the Arthur S. Flemming Award (given in honor of the former Secretary of Health, Education and Welfare) for "outstanding and top caliber work." The Navy previously had given several awards to Dr. Miller.

Prior to his Department of Interior post, Dr. Miller was with the Office of Naval Research—primarily in the Navy's man-in-the-sea programs. He finds the "undersea business very stimulating." So much so that he shifted full time to it—and from work that wasn't in the least dull.

With the Kresge Eye Institute, under the auspices of a contract with ONR, Dr. Miller spent eight years at the Aviation School of Medicine—planning and conducting basic research in optics and optical equipment. Some of his experiments and studies took him out of the laboratory

A team of aquanauts checks out way station prior to heading back to the primary habitat.

and into the skies with the Navy's famed Blue Angels Flight Demonstration team, "as a passenger conducting studies on visibility. I quickly acquired the greatest respect for those pilots."

Visibility studies took him on other test flights, "again as a passenger, I took part in some exciting maneuvers, where we flew as low as 25 feet and at speeds of 200 knots. To pass over high trees, we had to gain altitude, quickly. These test pilots deserve the highest praise for their flying tactics."

Along with his work in the laboratory and in the skies, Dr. Miller has written and has had more than 50 papers published—dealing with aviation medicine, psychology, visual physiology and more recently with undersea technology.

While Director of ONR's Engineering Psychology Program and becoming more involved in the exciting arena of undersea work, Dr. Miller enrolled in the Navy's Diving School in Washington. "By participating in dives, you can much better understand the men who are engaged in this work and establish a better rapport with them which is essential when you're studying underwater performance."

Tektite II boasts many firsts — in personnel and in equipment, as well as in scientific studies and experiments. Some are:

Minitat—A two-man habitat designed and built for the program by the Worldwide Development Corporation. "The Minitat will take seven of our crews down to 100 feet. A great deal of interest throughout the world is being shown in this, which among other things is being used to study the effects of nitrogen/oxygen saturation diving at greater depths."

Underwater Breathing System — The GE-designed and built closed-cycle underwater breathing system is being used by the scientific community for the first time. It will be used at both the 50- and 100-foot levels. "This system is considered a breakthrough in marine research; a trained diver can operate effectively for up to six hours." There are no bubbles, since exhaled gas is returned to the diver with the unused oxygen after it is passed through a scrubber which removes the carbon dioxide. "The elimination of bubbles makes the unit quite attractive for observation of marine life."

Female Crew—"There have been many comments and questions on the female crew which is scheduled for one of the missions. We expect no problems; and think it's great the women are participating. These women were selected on their scientific capabilities and also their diving experience—the same criteria as for the men. They're top professionals." When asked frequently why a female team is included, Dr. Miller answers, "Why not?"

Engineer/Aquanaut — Primary habitat crews include an engineer in addition to the four scientists. "This we consider to be a big plus; the scientists are free to carry out more studies and experiments. And, in all cases, the engineer is a diver, who can go out into the water and help in investigations and experiments."

Experts call Tektite "ambitious," and its Program Manager agrees. "We set out with goals; we believe we're going to reach them. We've demonstrated to the marine scientific community that certain kinds of research can be accomplished much better when the scientist lives at the bottom of the ocean—rather than staying on the surface and diving occasionally.

"And while these scientists are conducting their experiments, we are studying them — and we've gained valuable information on man in confinement and isolation."

Tektite II provides a considerable step forward in ocean exploration and exploitation. The pioneering men and women engaged in this work are dedicated to their task of exploration. They see not only the immediate results, but the benefits which can be accrued in 10, 20 or more years.

The Tektite Program Manager notes that "most of what we have accomplished and ever hope to accomplish has been the result of talented individuals working as a team. There are frustrations of course; there will be more; these are mostly the irritations of working under sometimes adverse conditions. And the person who can get results under any conditions is the person we want and I think we have. That's when professionalism stands out."

And professionalism is the area in which Dr. Jim Miller and his team excel. ○

pioneering the oceans

For centuries, the alien environment of the seas, as well as a lack of sophisticated equipment, has prohibited man from exploring as much as his intrepid nature would like. The tremendous advances made in technology have enabled man to go deeper into the seas and to operate more effectively and more productively. And the U.S. Navy's Director of Salvage, Diving and Ocean Engineering, Captain Eugene Mitchell, and his crew of experts, are leaders.

"The past decade has brought spectacular advances in the seas as well as in space. The field of diving, particularly, has advanced more than in any other period. And during the '70s, we'll see growth that will startle even the most far-reaching and optimistic mind of today."

The words belong to Captain Eugene Mitchell, U.S.N. Captain Mitchell is Director of Salvage, Diving and Ocean Engineering for the Naval Ship Systems Command, an expert diver and an active participant in the Navy's diving activities for more than two decades — which is an enviable record, since the Navy has been involved with diving for only six decades. He has under his command a cadre of the most talented and dedicated divers and recovery forces in the world.

"They have added many fine accomplishments to the Navy's record," says Captain Mitchell. "Two of the most notable—of which I am very proud—are the recent recovery of a package containing some very valuable NASA film, and also the recovery of the Deep Research Vehicle *Alvin* last fall."

The recovery of the NASA package was particularly impressive. Captain Mitchell notes that "there were some of us who wouldn't have given its retrieval a one-in-a-million chance." The package containing valuable film of the solar eclipse was lost in some 5,800 feet of water in the Atlantic. It had to be found and recovered in a short period of time because of the deteriorative effects of salt water. Added to this problem was the size of the package—15 inches in diameter and three and a half feet long. There was great skepticism concerning its recovery.

"A shrewd interpretation of NASA's radar tracking data, coupled with effective handling of the recovery ship and a special unmanned vehicle, enabled our forces to bring back the package."

Deep Research Vehicle *Alvin* was lost in more than 5,000 feet of water off Cape Cod. *Alvin* gained international fame several years ago when she located and helped retrieve a hydrogen weapon lost off the coast of Spain.

"Although the recovery operation was conceivably within the state of the art, it was particularly significant because recovery of an object of *Alvin's* size (15 tons, 23 feet) from such a great depth had never before been achieved. The operation emphasized that no task in which work in the deep ocean is performed should be considered routine."

For this success, Captain Mitchell cites "the technical know-how and initiative shown by the recovery force personnel, made up of representatives from the Supervisor of Salvage, Naval Research Laboratory, Office of Naval Research and the crew of the *Aluminaut,* a commercial deep submersible.

"The overall task was directed by Bill Milwee (Lt. Commander William Milwee, Jr. — on Captain Mitchell's staff) who did an outstanding job. The recovery represents a major step forward in the Navy's ability to conduct deep ocean engineering operations.

"Each advancement enables us to go deeper and more safely into the sea. There is always the requirement to do deeper salvage work, and with some of the technical problems solved by new equipment and better techniques, we can go deeper into the ocean depths. There are, of course, disappointments. We can't do as much as we would like, primarily because of low funding levels.

"This malady, suffered by almost everyone, has helped us be more judicious in our work. No crash programs are carried out—just carefully thought out and carefully worked out projects. I believe we've accomplished a fair amount, and hope and plan that we will do much more in the future."

An expert authority on the diving and salvage fields, Captain Mitchell notes that, in the past, the U.S. Navy had fallen back considerably in diving, with its equipment lagging behind that of commercial divers, who were coming up with many advanced methods and gear. "Of course, commercial diving had some powerful and profitable incentives—deep sea oil production and the like.

"But in the last few years, the Navy has moved forward rapidly. Today, we have some of the world's most sophisticated equipment and some of the world's top talent."

He considers the Mark I Deep Dive System "the Navy's pride and joy. It's fully portable and can be disassembled and flown in small packages to wherever it might be needed. We can operate it off the deck of a number of different ships; it gives us the capability of diving in a saturated or non-saturated mode. The Mark I system can support three people in the personnel transfer capsule—a sort of diving bell.

"After they have completed a work period in the sea, divers return to deck chamber to decompress, or they can remain in the chambers at depth pressure and go back down."

Another "plus" for divers, according to Captain Mitchell, is General Electric's Closed Cycle Underwater Breathing Apparatus. "It's a remarkable example of what a company like GE can do, using its own funds and

developing equipment for the Navy's use. We would like to encourage other companies to use the same initiative and do the same thing."

The underwater breathing device, developed by Oceans Systems Programs of Re-entry and Environmental Systems Division, will allow a trained diver to operate effectively at depths up to 1,200 feet for up to six hours. "In addition to giving us the capability to dive to these very great depths, the unit provides for reduced logistics support requirements. It also provides more efficient use of helium.

"The unit extends the duration of the diver and, since it has no umbilical, gives him a greater amount of freedom for maneuvering than tethered systems."

Captain Mitchell adds that the Navy has production models of the unit "now being produced for technical and operational evaluation. Based on test results thus far, we have high hopes for this closed circuit breathing apparatus."

The unit is being used by the scientific community for the first time on the ambitious seven-month Tektite II program. Captain Mitchell and his organization support scientific programs such as Tektite. "The first Tektite offered a great deal to us, as does the second—such as the introduction of deep saturation air diving."

Captain Mitchell cites Tektite as just one example of how various governmental agencies and industry can cooperate on a program to the benefit of all participants. "The Navy is aware of the tremendous need for cooperation in working in the deep ocean. We alone cannot support concurrent approaches to any one problem, as is possible in some large programs. In addition to being carefully selective and judicious in our approach to a problem, we have to rely on other agencies and industry for their own contributions and related work. I believe that this method ensures that we receive the greatest amount of talent for our dollars."

In marine circles, it's said that when the Navy wants to get something up off "the bottom," the first man who comes to mind is Captain Mitchell. With a Navy career beginning in 1943 and taking him around the world—on and under the water —he's well qualified for the task.

He earned a B.S. degree in Naval Science from the University of South Carolina, and the advanced degree of Naval Engineer from MIT before attending the U.S. Naval School of Diving and Salvage. While Fleet and Force Salvage Officer on the Staff of the Commander Service Force, U.S. Pacific Fleet— a tour of duty which lasted from July 1964 through June 1967—Captain Mitchell was involved in the conduct of 57 salvage operations, primarily in support of the Vietnam conflict. He was awarded the Legion of Merit with Combat "v" for extraordinary performance.

Captain Mitchell's next job was Officer-in-Charge of the Experimental Diving Unit and Deputy Super-

Recovery of Deep Research Vehicle Alvin, according to Captain Mitchell, was particularly significant because an object of this size "from such a great depth had never before been retrieved."

visor of Salvage. Established 45 years ago, the Experimental Diving Unit is recognized as the Navy's foremost center for deep diving research. Its staff of engineers, medical personnel and highly trained divers develops and tests new and more compact divers' breathing apparatus, improved diver equipment such as communications and heating systems, new life-support systems, and advanced salvage and ocean exploration devices and techniques. Captain Mitchell calls the Unit "the organization which has been at the forefront of Navy diving during the past several years."

Captain Mitchell was designated the first Supervisor of Diving for the Navy in October 1969.

He discusses diving—its problems and promise—from the vantage point of his entire career. "We've extended the depths to which we can go. There are some unmanned submersibles which are capable of going extremely deep. We believe that it is better to go down unmanned; but we need to improve the capability of our remotely operated submersibles before we can replace the diver as a working instrument. At the present, we need a man aboard—to think, to feel and to act. Eventually, I believe we will develop the technology to enable us to be fully effective without man in the vehicle."

Even with the tremendous strides forward made in the diving business, there are many problems to face, tackle and solve. Captain Mitchell sees some of these as "diver heating, communications, physiology. Some of the answers will be a long time in coming; they are not simple to solve. Diver heating, for example, is a critical problem. Fire protection in recompression chambers is another area of concern.

"And of course, advancing technology leads to greater capability, which, in turn, exposes new problems to be solved.

"We've made many inroads to finding answers to these problems and I'm convinced that the talent we have in-house and within industry will continue to solve them."

The U.S. Navy also carries on information exchange programs with several foreign countries and a personnel exchange with Great Britain. "The French are very advanced as are, of course, the British. We're fortunate to have with us Lt. Commander James Majendie from the Royal Navy. The exchanges — information and personnel — have always proved to be fruitful."

Of the future and the accelerating amount of interest being shown by able people in the sea, Captain Mitchell is optimistic. He says, "The technology is there—waiting to be used. And the talent is there—waiting to tackle the problems and ready to use the technology."

He then adds, "The sea is there, also—waiting to be explored." o

Alvin's recovery represents a major step forward in the Navy's ability to conduct deep ocean engineering operations.

Member of Experimental Diving Unit prepares for dive. This Unit is recognized as the Navy's foremost center for deep diving research.

minority report--

The Lady

The question is obvious: "What's a nice girl like you doing in a dive like this?" The nice girl is talented biologist, Dr. Sylvia Mead. The dive is to the Tektite chamber. Together they'll make a little history at the bottom of the ocean this summer.

Some women get exhausted just going to the hairdresser. Others feel it's an adventure to jump bid their partner in four spades.

Sylvia Mead is a housewife. She can cook, sew, iron and scuba dive 150 feet into the ocean to study the feeding habits of fish, and this summer the living habits of five people spending two uninterrupted weeks below the surface of the ocean.

Dr. Mead is an aquanette, or an aquanautess, or an aquanautrix—anyway, she will accompany four other women on a two-week scientific expedition in Tektite 2. The habitat, designed and built by General Electric, is located about 50 feet below the surface of the Caribbean off St. John in the Virgin Islands.

For most of the two weeks the girls will swim away from Tektite to the limit of their scuba tanks and observe sea plants and animals, and they will also study how fish communicate with each other.

"I couldn't be more pleased at being selected," says Dr. Mead. "This opportunity to spend extended periods of time doing these kinds of observations is an excellent one. I want to study the characteristics of marine plants at this depth and make observations of the fish feeding on plants. This is a long-awaited opportunity for all of us."

"All of us" includes her four companions: Dr. Renate True of the Tulane University faculty; engineer Margaret Ann Lucas, a Villanova graduate who will keep house in Tektite 2, providing air and water supplies; Mrs. Ann Hartline, graduate student at the Scripps Institute of Oceanography in California; and Alina Szmant, also from Scripps.

"I've known of my selection since January," Dr. Mead commented. "When the word first went out to the scientific community about the Tektite 2 tests, we were asked to submit papers on work that could be achieved. There were no restrictions on women participating so I turned in a paper and was accepted."

The aquanauts will get two weeks of training to familiarize them with the diving equipment they'll be using. With the kinds of air devices they'll have, they will be able to continue explorations for about six hours at a time. "Since all of us got into this project because of our interest in undersea research, we find this ability to lengthen our expeditions to be most attractive."

One of the problems of the early diving days was the curfew. Divers were, of course, limited by the amount of oxygen they could carry, and this made it impossible to conduct lengthy research. On this mission, when time runs out they can simply return to Tektite 2. Dr. Mead's special interest is algae, or aquatic plants and "we will be keenly interested in observing how the fish in that area live, what they eat, and what they avoid," she says.

Though this particular trip will be for sorority sisters only, Dr. Mead sees no problem in having both male and female divers living in the habitat at the same time. By the time

Takes a Dive

the experiments on Tektite 2 are completed, 17 missions will have been carried out and 16 of these are men only.

"I'm not making this expedition as a woman, but as a scientist," Dr. Mead said. "There is a great deal to be learned about our waters and, as scientists, I think we would be far too concerned about the mission to worry much about the sexual identity of our associates. I've been on an expedition in the Indian Ocean as the only woman in a crew of 60 men. We had no difficulties and I'm confident the day will come when mixed groups of divers will be assigned to programs such as Tektite.

"On our particular mission coming up, no one has briefed us any differently than the male crews. As the date gets closer I'm sure we'll take some kidding, and get some more attention in the press, but our trip is no different from those being made by male crews. We will live in the same habitat. There is a rumor that the only concession is that a curtain may be placed over the shower.

"I look at this (Tektite) mission as an opportunity to supplement observations I've already made on underwater plant life. It will be great to study on an around-the-clock basis."

"I look at this mission as an opportunity to supplement observations I've already made on underwater plant life. It will be great to study on an around-the-clock basis. We will be taking a good many photographs, and though I won't win any awards for my undersea photography, we should be able to bring back a great many useful shots."

In case you worry about things like that, Sylvia Mead knows how to swim. And dive. More than a thousand hours worth. She learned to do all this while she was still Sylvia Earle, farm girl from Gibbstown, New Jersey and later in Florida. Her early interest was biology and it has never left her. On a parallel pattern, she began to dive at age 12.

She belongs to a dozen professional societies and uses words like ichthyology and herpetology the way other women talk about peanut butter and jelly. She went to Florida State (B.S. degree), to Duke (Masters) and more Duke (for PH.D.). She was a fisheries biologist for the U.S. Fish and Wildlife Service, a biology instructor at St. Petersburg College and at Tulane, and most recently a Research Fellow at Farlow Herbarium at Harvard. That's only a partial list of her professional participation. Dr. Mead's real story begins with her expeditions.

Let's try chronology:

—In 1952-53, at the age of 17 she first used a helmet with air compressor on several dives to 15 meters in the Gulf of Mexico.

—In 1953 she first used scuba and hooka-style apparatus while a student at Florida State University.

—For the next 10 years, through 1963, she reached depths of 35 meters off the east coast of the United States and in the Gulf, and published a highly regarded study of green algae.

—In 1964-1966 she continued dives in the Gulf, in the Florida Keys and near Panama City. She went on the International Indian Ocean Expedition aboard the *Anton Bruun* in 1964 making dives down to 50 meters. Also, Dr. Mead dived off Puerto Rico, Bimini, Peru and Chile.

—In 1967 she was certified for diving to 50 meters by the International Association of Professional Diving Scientists. (That's better than half a football field.)

—Since 1967 she has dived off Chile, New England, California and the Bahamas.

Currently, she's a research associate in Botany at the University of California and an Associate in Botany at the Los Angeles County Museum of Natural History where her husband has just taken over as Director of the Museum.

A scientist himself, her husband encourages her in her Tektite adven-

"We will be keenly interested in observing how the fish in the area live, what they eat and what they avoid."

ture. She also gets ample boost, and some envy, from her children: Elizabeth, 9, Richie, 8, and Gale, nearly 2. In the midst of preparations for the Tektite mission, the family has just moved to their new California home ("our final move").

"Yes, pursuing both a scientific career and running a household makes for a full life," Dr. Mead said. "But I believe you can be successful at both. It has nothing to do with being a woman. How far you progress in your profession has to do with how hard you're willing to work and what sacrifices you're ready to make. I do think a woman has to have a little thicker skin in trying to get into some fields, but once you reach a certain point of achievement, the stares and jokes stop, and you are recognized for the merits of your contributions.

"Naturally, I've been asked often what my feelings are regarding the so-called women's liberation movement. I look at this with an equanimity that approaches indifference. There are already plenty of opportunities for women to do what they want. In fact, sometimes our advantages are much greater. Look at the Tektite experiments. Seventeen teams will take part, but the one that'll get the publicity is ours."

Being cooped up with four other women in so confined a habitat holds no problem. She recognizes that part of the experiment is to see how well people get along in such quarters, but looking at their work agenda, Dr. Mead foresees little time for psychological wars.

"The potential of the oceans is overwhelming," she says. "Aquaculture is a most promising pursuit. Agriculture as we now know it was really just getting started a couple of hundred years ago. We are now at the beginnings of aquaculture. And that's only one of the promises of the ocean."

She emphasizes that one of the things everyone must learn to do is put the brakes on pollution practices. "Too many of our waters are becoming biologically dead. We now hear a good deal about our total environment. Lots of latecomers just learned how to pronounce ecology and not much else. What we have to do is for man to learn to live in harmony with his resources."

Tektite will help a great deal. Actually living in the sea is a far superior study method than just dropping instruments over the side. Tektite 1 proved the feasibility of breathing a nitrogen-oxygen mixture, a big step forward. The Tektite aquanaut says, "There is an enormous amount to be learned about the sea. Some fear it because it is a wilderness, but like most wildernesses, it has unlimited potential."

When most people take two weeks in the Virgin Islands they come back with a suntan. Dr. Sylvia Mead expects to return with a great deal more. o

Earlier this year, General Electric in Huntsville, Alabama, won a $22 million contract for Launch Vehicle Ground Support Equipment. "We've written our future," says General Manager Jim Keister, "now we have to live up to it."

Huntsville Shows the Way

There is no question that Huntsville will continue to play an important part in both space and defense programs despite recent major budget and manpower adjustments which have impacted all of the locally based government agencies and installations, namely NASA's Marshall Space Flight Center, the U. S. Army Missile Command and the Safeguard Systems Commands.

Yet is was only a few months ago that predictors with gloom in their voices were saying that the Huntsville era was over. With the space budget reduced, with the Apollo Program successful, the town that became a city would fold, they said.

What many people failed to recognize was the real significance of Huntsville to the nation. Huntsville is the location of a very important *national asset* for both space and defense which will be required to address the challenging programs of the future. The successful moon landing established Huntsville as a permanent future contributor rather than ending its role in space.

Obviously, continued government belt-tightening will affect Huntsville employment levels. However, this was expected and the Huntsville Industrial Expansion Committee had the foresight to diversify the business base through aggressive pursuit of new local, non-aerospace businesses. In addition, a hard-core business base, which supports the space and DOD installations at Redstone Arsenal, is well established and dedicated to continued participation in future advanced programs.

A significant part of this hard-core base is General Electric in Huntsville. Officially called Huntsville Programs of Apollo Systems, General Electric is presently staffed at approximately 800 after reaching a low of 750 earlier this year.

"No question about it, our winning of the Launch Vehicle Ground Support Equipment job added greatly to our stability," says General Manager Jim Keister. "In today's limited budget situation you're successful if you can just stay even and, as a result of LVGSE, we hope to show some modest growth. The LVGSE is a most demanding job, one that will require the same kind of dedication and energy that we put into the proposal effort. Fortunately, the people who did that proposal job are right here ready to follow through on the contract.

"We felt we were a strong contender right from the start of the competition. I believe we won because we had a dedicated team of people who simply left nothing undone. We tried to be completely responsive in every area. Quite importantly, we concentrated on every realistic means of reducing costs."

For as long as business people can remember, they've been talking about the three keys to success—delivering on time, building a product that works, and staying within costs. Like most, Keister figures the order of importance for these three shifts with the times. The priorities vary.

"These keys aren't always equal. Usually, one dominates, depending upon the national situation. In the 60's it was delivery and performance as we worked to achieve the national goal of a lunar landing. In the 70's with the many demands for funding being placed on the nation, never before has cost effectiveness been so important. Certainly, you must have the other two elements—it's got to be on time, and it's got to work, but in a restricted budget environment like this year, the pressure is on maximizing the use of the dollar. So we have concentrated a good deal on this factor."

The LVGSE is, of course, a NASA program, but Huntsville General Electric also has contracts with the Army Missile Command and in support of the Army Safeguard System.

Marketing Manager Fred Glick-

man outlines the Huntsville capability: "We've got a proven record in systems analysis and definition skills from past and present test and checkout and simulation work. Beyond that, we have broad design and fabrication capabilities for electronics equipment. A third major area of contribution to our present and potential customers is in providing management systems and analytical skills. Examples are our data, configuration and logistics management competences, and computer systems and programming capabilities," he said.

"Our strong points are obviously based on these competences plus the fact that we don't dismiss any requirement lightly and can be depended upon to commit the best we have to any task undertaken, and perform reliably and at low cost," adds General Manager Jim Keister.

"The LVGSE proposal was truly the best proposal with which I've ever been associated. It got that way because people understood the program and how we could handle it.

"The reason we were successful in winning the LVGSE, which in the second round of proposals pitted us against the fifth and eighteenth largest American corporations—and who are also the twelfth and third largest NASA contractors — was the recognition on the part of every one of our employees, every business function, and by our management, that we absolutely had to win to survive as a meaningful business entity. Virtually every one of our people knew that 50 to 60 percent of our existing employment pivoted on the outcome of that competition. There were really three additional factors we credit with why we won. First and foremost, was our prior establishment of the customer's confidence that we would perform precisely as we had set forth in our proposal: technically, within the costs quoted and with the managerial commitment stated. Second, the clarity and the precision in the way we stated how we intended to do this job. Third, the competitiveness of the costs quoted.

"From the first time the requirement was identified, the LVGSE represented an important turning point for GE/Huntsville. It was a vital paving stone in providing the retention of resources we would require during the period newer, longer range program requirements were firming at NASA and with our other customers. It would open new doors and new challenges to us with NASA, in technical working relationships in the equipment areas where we had not previously been assigned design cognizance or operating responsibility. Additionally, it provided the opportunity to demonstrate our competitive capabilities. Finally, it helped fulfill a long term marketing goal here in

Huntsville's General Manager, Jim Keister, meets with some of the team responsible for landing the LVGSE contract. Seated, l-r: Fred Glickman, Marketing Manager; Chuck Crossen, Manager, SDF Facility Operation and Maintenance; GM Jim Keister; Larry Sullivan, LVGSE Program Manager; and Darrel Pilgrim, who heads up Sustaining Engineering, Fabrication and Logistics for the program. Standing, l-r: Plant Accountant Ernie Schempp, Bill French, Larry Petters, Al Lane, Bill Rawson, Stan Friscic, Bill Shaffer, Lynn Pepper and Chalmers Riley.

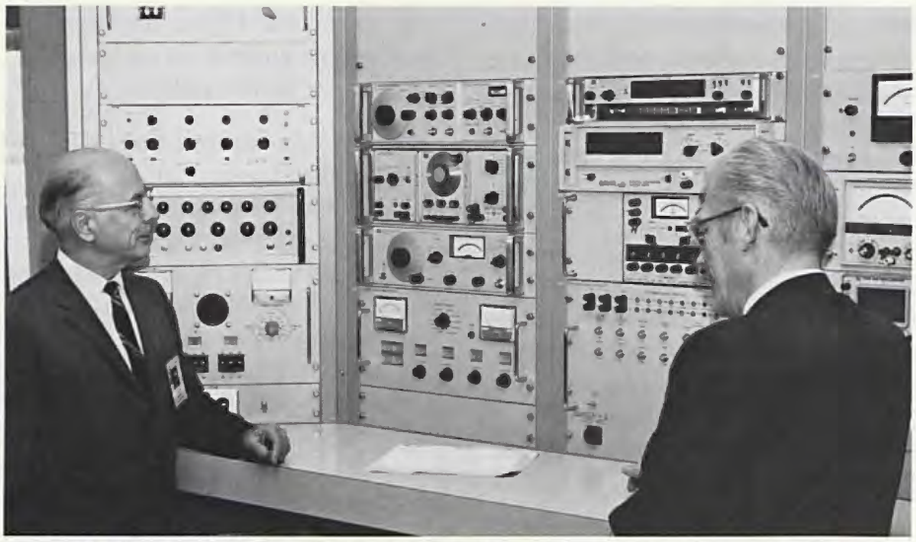
Huntsville to achieve a significant programs diversification of our total business. This diversification really takes many forms. In 1971 for example, an estimated one-third of our projected business will be in the challenging areas of incentive and award fee contracting.

"While the LVGSE does all the many good things for us earlier described and as we move on to absorbing and digesting its responsibilities, there is one signpost all of our people recognize and observe. That is, the long working hours in preparing the LVGSE proposal, setting forth our directly related experience, past innovations and selected approach to fulfilling the job and, in addition, the challenges to generate superior technical approaches and cost-efficiencies, are required in equal degree in every proposal we will be making over the next few years. This period will see a significantly reduced market in which an increasing number of contracts will be competitively let.

"Just to maintain present levels will take lower costs, more innovativeness, better proposals and a higher win ratio in this competitive marketplace. Only a clear superiority in creativity, lowest cost and clarity of approach will make the difference. And, as on the LVGSE proposal, all functions and all levels—from individual contributor to upper management—will have to put forth their best and unreserved ideas, energies and commitment."

General Manager Keister adds, "In the 70's the customer is faced with the problem of having to get more for less. He must make that dollar work like it never has before. And the aerospace outfit that's going to stay in this game has to recognize this kind of emphasis on value per dollar."

At a time when some felt General Electric might be phasing out of the area that houses the Marshall Space Flight Center and the Army Missile and Safeguard Commands, Keister finds the GE story getting stronger.



General Manager Keister (l) meets with Dr. Fred Schultz, Manager of General Purpose Test Set Programs.

He and his staff anticipate a reasonable period of stability and the base for a more promising future several years hence, because of the experience, versatility and competence of the Huntsville Programs people.

In addition to LVGSE, Huntsville aspires to work for NASA on the Space Shuttle, on advance projects and to provide support in management systems, on-board and Ground Data Systems, reliability, quality control and other key areas. With the Army, Huntsville is aiming for the development of systems to evaluate performance, accomplish training and weapon system management and others.

Delivery in April to the Marshall Space Flight Center of the first group of Skylab ESE was typical of the GE Huntsville story. All equipment — racked equipment, cables, logistic spares — was delivered on schedule and within contract costs. The hardware, plus computer software requirements, were furnished for use in testing the Apollo Telescope Mount Thermal Systems Unit at the Manned Spaceflight Center in Houston.

Confidence that they can continue to perform for all three principal customers—NASA, MICOM and Safeguard—is evident when Keister points to the kind of requirements they face in carrying out the LVGSE effort. General Electric will be responsible for launch-to-launch engineering and logistics services for all Saturn Launch Vehicle Ground Support Equipment (LVGSE), both electrical and mechanical, and operation of the System Development Facilities.

The major elements of work include:

—program management
—phase-over into new hardware areas
—sustaining engineering
—fabrication of mod kits and spares
—logistics services
—maintenance and operation of System Development Facilities
—reliability and quality assurance
—configuration and data management

"This is a big job," Keister commented. "It combines work of six contractors. To win it took a good deal of effort. But we had much to offer. Our depth of resources within the Company was enormous. Our engineering and fabrication team had a well-established record of cost credibility built up over years of demonstrated performance. We were able to show the kind of computer equipment and the skills inventory this job takes.

"On the management side we were able to offer an experienced program

management team that had never impacted nor delayed a launch for lack of the necessary hardware or software deliveries or performance. In addition, we had a great deal of related experience in digital equipment, computers and displays."

GE's Huntsville facilities are ample to meet these tasks and more—with two office buildings and warehouses: a combined area of 124,000 square feet. It has a model shop, metal parts and cable fabrication, printed circuit board fabrication and wiring assembly. The facilities also include two GE 415 computers, a terminal to a GE 635 computer, an engineering development laboratory, reproduction and photography and publications and graphic arts.

"Our real plus is people," Keister says. "We've got people here who have been through the whole space program. They are experienced, confident, and all exhibit this confidence in the future of space technology and its applications to DOD programs. The caliber of our people is the reason I'm confident that we can continue to move ahead."

Jim Keister has been moving ahead since he left birthplace Coburg, Iowa. An engineering graduate from Cornell University (one son now at Cornell, another who has already graduated and a daughter graduate from the University of Rochester), Keister has really had a series of careers.

He jumped quickly into the television business in the 1930's before most people knew it was going on. There were early problems of establishing national standards and pulling the industry together technically. ("We could see the potential of television then as a communication media, but we could not foresee how people would be able to afford it.")

World War II brought another career, this time in radar. Then he spent most of the 50's working with semi-conductors in Syracuse, helping to develop General Electric's position in that field. He moved to Schenectady in 1960 and then to Daytona Beach in 1962 when people were beginning to talk about Apollo. It was at Daytona that his latest career — this one in the space field — began.

"The contrast of working in space was pronounced," he recalls. "Here we were in a highly concentrated single goal business. We were necessarily integrating a total industry effort, developing and building a single massive system. Compare that with the semi-conductor business where we were turning out identical items in the millions.

"I think the relationship to the customer is a dramatic one. He's a guy we can not only see, but he lives right alongside of us. His success depends upon ours. Apollo 11 was everyone's thrill and Apollo 13 was everyone's concern. We live these missions from beginning to end. I think Apollo 13 reminded us of what we already knew—that we are charting new seas, and the possibility of catastrophe is always with us."

Jim Keister is encouraged by what he sees in the operation he heads. He's impressed mostly by the people, and the potential business opportunities that are available if one provides a better or cheaper means of fulfillment. He's also impressed by the community spirit that brings new industry in with relish, praises local industry when it succeeds, and sympathizes when things don't go well. The *Huntsville Times* editorially commented on the LVGSE award:

"Our congratulations to General Electric Co. here, the winner in a difficult competition for a long-term, $22 million contract consolidating work on Saturn rocket ground support equipment for Marshall Space Flight Center. The company, which expects a modest rise in its Huntsville employment under the 45-month contract, has long been a productive member of this community's missile-space family. In fact, the first contractor group to arrive here in 1950 with the Wernher von Braun missile team was a contingent of GE employees. A fruitful association has followed.

"Selection of the winning bidder from an initial field of four competitors was undoubtedly no easy matter for the space agency. . . . The losers, all of whom have existing operations here, will unfortunately suffer possible further losses in employment. . . ."

As for the future, Keister continues to look at NASA, MICOM and the Safeguard Program. He sees new programs in the Space Shuttle and Space Station areas and he forecasts a solid need for Huntsville's hard and software efforts, and for the management systems experience which has been highly acclaimed.

"I want to see us grow, and become a solid long-term business, diversified so that fluctuations in the economy won't bring about serious setbacks," says Keister.

He was speaking about General Electric in Huntsville, but he could just as well have been talking about the whole community. It's a city that grew through great contributions from Wernher von Braun and defensive Army Missile Systems to protect our installations and personnel. Man has reached the moon, Dr. von Braun has moved to Washington, but Huntsville continues to keep the pace.

So, the message is: the lights have not gone out on Memorial Parkway. The hotels continue to be busy. The restaurants continue to be crowded. The go-go girls continue energetic. The nearby Brown's Ferry's nuclear power plant approaching completion will be the second largest nuclear power plant in the world and the splendid new Huntsville airport is a showplace among those of the Southeast with everything but the runways carpeted. And, four major non-aerospace industries have come to Huntsville. They're all here and reflect the confidence that Huntsville, its government installations and supporting industries will continue as a viable force in the nation's inventory of productive skills applied to tomorrow's needs. o

USAF Lt. Colonel Roy Smith
Chief — Minuteman III Branch
Re-entry Vehicle Division
Space and Missile Systems Organization

SPOTLIGHT ON THE PROGRAM MANAGER

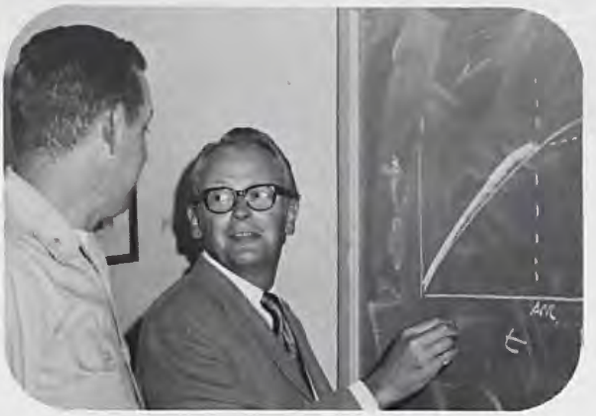
The program is Minuteman III—part of the nation's foremost land-based defense system. The man in the spotlight is Program Manager Roy Smith—experienced engineer, dedicated Air Force officer, and competent professional. "My job is to insure that the program meets all the cost, schedule and technical requirements," Smith says, "and to make trade-offs among those three parameters. The main task is one of making sure we have all the resources—men, money and facilities—to execute the program."

Last year the emphasis was on managing resources to carry out both an on-going operational program and a research and development effort. This year it's on meeting some very stringent delivery schedules. And Smith confidently relies on an experienced staff of technical people (civilians and Air Force officers; more than 70 percent have advanced degrees) to get the job done.

The tall Texan won a BS degree in engineering from the U.S. Naval Academy in 1952, entered the Air Force and was commissioned that same year. He was first stationed at Sandia Air Force Base, New Mexico, assigned to the Armed Forces Special Weapons Project. He then began a series of assignments as nuclear weapons maintenance officer with the Aviation Depot Group at Caribou AFS, Maine; the 3d Aviation Depot Squadron at Andersen AFB, Guam; the 42nd Munitions Squadron, Dyess AFB, Texas; and Hq. 15th Air Force at March AFB, California. Colonel Smith then went to Wright Patterson AFB, Ohio, to attend the Air Force Institute of Technology, and in 1963 received his MS degree in astronautics. He was development engineer with the General Electric Contract Management Office in Philadelphia from 1963 to 1965, and then transferred to Norton AFB, San Bernardino, California, for his present assignment. CHALLENGE recently visited Colonel Smith at Norton and captured with camera some of the elements of the program manager's task.

Discussions of program status are held on a daily basis with Smith's immediate superior, Colonel Robin Hansen, Chief, Re-entry Vehicles Division, Minuteman Systems Program Office.

Colonel Smith reviews future business opportunities with GE/RESD's Jack Bohuslaw (center), manager of Strategic Systems - Planning and Market Development, and Chris Raber. Contractor advanced engineering personnel often provide ideas for needed weapon system improvements.



Chris Raber, General Manager, Strategic Systems Programs, RESD and Smith update program financial condition. Cost control has been one of key elements of program success over past years. Continuing emphasis is placed on best possible product at minimum cost.

Negotiating team: (l-r) Don Montgomery, contracting officer; Smith; Major Tony Azure, chief, Production Section under Smith; Lawrence Dowdy, contract negotiator; and Robert Morse, price analyst. Fact finding and negotiation of fiscal 1970 Production Buy and fiscal 1969 Block I changes have been in progress since March. Fact finding and negotiation of follow-on RDT&E contract is scheduled to start in late June. Project Office provides technical evaluation of all contractor proposals, forms a key element in Air Force negotiating team.

In a typical hallway conversation of technical problems encountered on program, Smith chats with Arthur Burgess, Minuteman III Re-entry Systems manager for TRW Systems. Burgess heads team that provides system engineering and technical direction for Mark 12 program.

Assembly and checkout status is the subject as Smith meets with Captain Fred Strawn, Mark 12 Re-entry System Support Systems Project Officer.

Smith checks in with Major David Griffin, Chief, Engineering Section, Minuteman III Re-entry Systems Branch, for daily review of test programs and results, discussions of Engineering Change Proposals. Review and approval of ECP's has been one of major tasks for project officers recently.

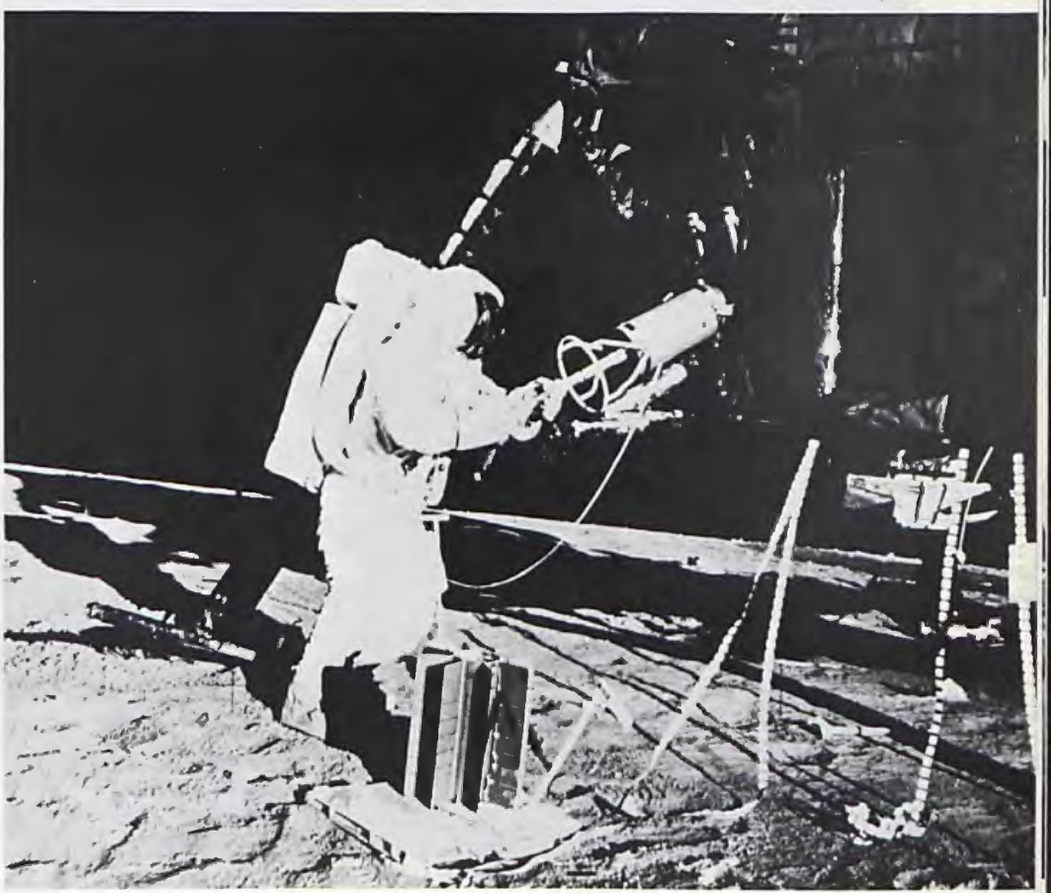
Colonel Smith congratulates Captain James Hallows, Mark 12 Re-entry Vehicle project officer, on recently submitted cost reduction. Value engineering and cost reduction program play vital part in keeping costs to a minimum—assuring availability of funds for hard-core of program.

from manhattan to the moon

On a sizzling July morning, 25 years ago scientists of the super-secret Manhattan Project found the key to the enormous amount of energy locked into the atom. The fiery test on that day at Alamogordo, and the subsequent devastation of Hiroshima and Nagasaki jolted the world into the Atomic Age.

In the years that followed, man has realized immense resources of electric power from the atom. He has learned to apply radioactivity to healing and research. He has devised schemes for harnessing nuclear explosives to peaceful engineering projects. He has sent tiny, long-life nuclear-powered instruments far into space. And, as a prelude to the 25th anniversary of the Atomic Age, man placed a nuclear generator on the surface of the moon.

All the way from Manhattan to the moon, atomic energy has truly brought man into a new relationship with his environment . . . and with humanity.



THE PEACEFUL ATOM A SERVANT OF MANKIND

"Silence reigned over the desert. From the east came the first faint signs of dawn. And just at that instant there rose, as if from the bowels of the earth, a light not of this world, the light of many suns in one. It was a sunrise such as the world had never seen, a great, green supersun, climbing in a fraction of a second to a height of more than eight thousand feet, rising ever high until it touched the clouds, lighting up earth and sky all around with a dazzling luminosity.

"Up it went, a great ball of fire about a mile in diameter, changing colors as it kept shooting upward, from deep purple to orange, expanding, growing bigger, rising as it expanded, an elemental force freed from its bonds after being chained for billions of years. . . . It was as though the earth had opened and the skies had split.

"A huge cloud rose from the ground and followed the trail of the great sun. At first it was a giant column, which soon took the shape of a supramundane mushroom. Up it went, higher and higher, quivering convulsively, a giant mountain born in a few seconds instead of millions of years. It touched the multicolored clouds, pushed its summit through them, and kept rising until it reached a height of 41,000 feet—12,000 feet higher than the highest mountain.

". . . Then out of the great silence came a mighty thunder. For a brief interval the phenomena we had seen as light repeated themselves in terms of sound. It was the blast from thousands of blockbusters going off simultaneously in one spot.

". . . The big boom came about a hundred seconds after the great flash —the first cry of a newborn world."

An eyewitness to the epochal event, William Laurence, *New York Times* science writer and Pulitzer Prize winner, thus described the birth of the Atomic Age.

"The Atomic Age began at exactly 5:30 mountain time, on the morning of July 16, 1945, on a stretch of semi-desert land about 50 airline miles from Alamogordo, New Mexico," he

Aerial view of atomic production plant at Oak Ridge, Tennessee.

wrote. "At that great moment in history, ranking with that moment when man first put fire to work for him, the vast energy locked within the heart of the atoms of matter was released for the first time in a burst of flame such as had never before been seen on this planet, illuminating earth and sky, for a brief span that seemed eternal, with the light of many supersuns. The elemental flame, first fire ever made on earth that did not have its origin in the sun, came from the explosion of the first atomic bomb. It marked the climax of one of the greatest dramas in our history and the history of civilized man. . . ."

It was several weeks later when a war-torn world learned that one of the scientific landmarks of the 20th Century had been reached in a baptism of fire in the New Mexico desert. On the morning of August 7, 1945, President Harry Truman announced that on the day before, a similar bomb, with an explosive force equal to 20,000 tons of TNT, had been dropped on Hiroshima, the hoped-for catalyst to the surrender of the Japanese and the end of World War II. In solemn tones, the President declared: "The age of atomic energy, which can be a tremendous force for the advancement of civilization as well as for destruction, is at hand."

Follow-on details disclosed that experiments to harness the power of the atom had been conducted by the U.S. Army under the code name "Manhattan Project." Included in the Manhattan Engineer District were three "secret cities" — Oak Ridge, Tennessee; Richland, Washington; and Los Alamos, New Mexico. The installation near Knoxville, Tennessee sprang up within months, had a peak population of nearly 75,000 and was the fifth largest city in the state. In Hanford, Washington, giant nuclear reactors were built in a semi-desert area covering 600 square miles. Inside, scientists were producing plutonium for use in atomic bombs. Los Alamos, the brain center of the Manhattan Engineer District, was under the direction of Princeton's Dr. J. Robert Oppenheimer.

"The greatest marvel," President Truman said, "is not the size of the Manhattan enterprise, its secrecy or its costs, but the achievement of scientific brains in putting together infinitely complex pieces of knowledge held by many men in different fields of science, into a workable plan. And hardly less marvelous has been the capacity of industry to design, and of labor to operate, the machines and methods to do things never done before, so that the brain child of many minds came forth in physical shape and performed as it was supposed to do. . . . What has been done is the greatest achievement of organized science in history."

Theories and concepts of atomic energy—infinitely complex pieces of knowledge—were accumulated over many, many years. The Manhattan scientists expanded on the research efforts of technical titans of the past —Sir Isaac Newton, Antoine Henri Becquerel, the Curies — Marie and Pierre, Kalproth, Dalton and Mendeleef. In 1905 Einstein stated that mass and energy were equivalent. Neils Bohr explained the internal structure of the atom in 1913. Enrico Fermi's experiments with uranium in the 1930's opened great fields of investigation. Atomic physics reached a critical stage in 1939 when Hahn and Strassmann bombarded uranium with neutrons.

Fermi and Bohr were among the prominent scientists who worked on Manhattan, along with Dr. Vannevar Bush, James Bryant Conant, Ernest O. Lawrence, J. Robert Oppenheimer, Harold Urey and many others. With Army General Leslie Groves as project head, the supersecret research program eventually employed tens of thousands of engineers, scientists, production workers, soldiers and scores of others.

(Text continued on p. 26)

'Atoms for Peace'

By Dan Huebner, General Manager — Nuclear Systems Programs, Space Systems Organization

It has been 25 years since technology and industry teamed up to unlock the secrets of the atom and thrust the world headlong into the Atomic Age. This new technology burdened us with awesome new responsibilities. It asked many probing and painful questions. The Atomic Age asked us to choose between new alternatives and to accept new risks. It filled many minds with many doubts about the human race, about our powers and our limitations.

Upon learning about the Manhattan Project, many of us recalled the words of Sir Oliver Lodge, who earlier had written: "If ever the human race gets hold of a means of tapping even a small fraction of the energy contained in the atoms of their own planet, the consequences will be beneficent or destructive, according to the state of civilization."

We in the Space Division are privileged to have shared in the task of producing beneficial applications of nuclear energy. The most outstanding example of this is the SNAP-27 generator placed on the moon during the Apollo 12 mission. Developed by the Isotope Power Systems Operation, a component of our Nuclear Systems Programs, this device supplies electric power for the instruments and the radio transmitting data from the lunar surface to earth. And we are currently involved in continuing efforts to develop other nuclear power sources for future space projects.

In the years ahead, we look forward to increased opportunities to apply nuclear energy to peaceful and productive purposes.

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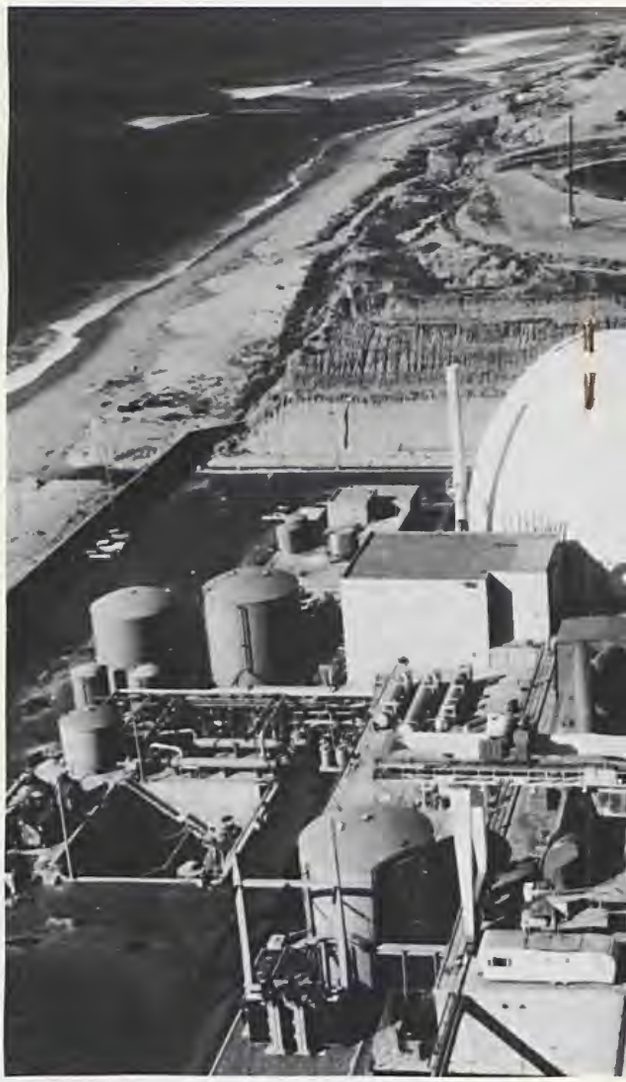

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1 Apprentice training at Oak Ridge National Laboratory includes classroom study in addition to direct instruction in craft work.

2 Work is conducted on the Engine Installation Vehicle of the NERVA Technology Program at AEC's Nuclear Rocket Development Station, Jackass Flats, Nevada.

3 Like a giant beach ball, the nuclear containment sphere forms a distinctive centerpiece for the San Onofre (Calif.) Generating Station.

4 Highly automated Control Room of the San Onofre Station houses an elaborate system of dials, gauges and lights to notify operators instantaneously of any deviation from normal conditions.

5 Nuclear-powered cardiac pacemaker —developed by AEC—weighs three and a half ounces and is designed to operate for at least 10 years.

6 Radiosurgery Facility — built by the Hanford Environmental Health Foundation — permits medical treatment of persons injured in accidents in which radioactive particles might become imbedded.

7 The Sedan Crater at the Nevada Test Site, larger than three football fields and deeper than one, was produced by a 100-kiloton thermonuclear detonation. Experiment was part of the AEC Plowshare Program to develop peaceful uses for nuclear explosives.

Under the aegis of the Manhattan Project, atomic energy theories and facts were synthesized and reconciled. A host of independent observations was placed in correct order. The missing keystone was cemented into the arch at Alamogordo.

Scientists had split the atom. They had broken up particles of matter so small they could not be seen, and obtained an enormous amount of the universe's basic force—energy.

Research into atomic energy had begun as an attempt to discover how the universe is put together. Unfortunately, as Hiroshima proved, the research efforts of 25 years ago had led to the development of a weapon that could blow the world apart.

Because the destructive potential of atomic energy was immediately apparent, people everywhere urged that steps be taken to restrict its use for peaceful purposes. And, following the Japanese surrender, the President recommended, and Congress passed, laws for control of atomic energy. "The scientific and industrial knowledge on which this discovery rests does not relate merely to another weapon," Mr. Truman said in October, 1945. "It may someday prove to be more revolutionary in the development of human society than the invention of the wheel, the use of metals or the steam or internal combustion engine. Never in history has society been confronted with a power so full of potential danger and at the same time so full of promise for the future of man and for the peace of the world."

It was to fulfill the promise for the future that the Atomic Energy Commission was established in 1946. An independent government agency, the AEC inherited the assets of the Manhattan Engineer District, and today has research laboratories, testing stations and other major facilities throughout the nation. The Commission's stated objective: "The development, use and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise."

Developed by the AEC's Argonne National Laboratory, this instrument is designed to reproduce symbols in the Braille alphabet that have been recorded on ordinary magnetic tape — thereby increasing the volume and reducing the cost of Braille literature.

Leukemia patient undergoes treatment by extracorporal irradiation of his blood. Purpose of this form of treatment is to destroy leukemic white cells without injuring other cells or organs in body.

The AEC immediately initiated a sweeping program to attain those objectives. Just ten years after Alamogordo, the first International Conference on the Peaceful Use of Atomic Energy opened at Geneva, Switzerland. Atomic scientists from many nations were invited to the first public exhibit of a U.S. nuclear reactor. Over the years, the AEC's international cooperative program to promote the development of the peaceful uses of atomic energy has expanded manifold. The results of this program are well known.

Today, 25 years after Manhattan, an assessment of the peaceful atom reveals substantial progress in the ways science and industry have combined to turn the atom into a servant of mankind. Some examples:

Medical Research and Treatment: Through the use of radioisotopes, many illnesses are diagnosed and treated. For diagnostic purposes, radioactive material is inserted into the body, and is followed and mea-

sured as it searches out ailing organs. Great progress has been made in diagnosing brain, heart, kidney, thyroid and liver ailments. Additionally, a plutonium-fueled cardiac pacemaker is being developed for malfunctioning hearts. Californium, a laboratory-created element, exhibits properties which may permit its use to kill cancerous growths without harming normal body tissue.

Food: Techniques to preserve food through irradiation are claiming the attention of nuclear scientists. Studies are underway to determine what food products can be pasteurized and sterilized after packaging to insure longer storage life.

In agriculture, the peaceful atom has made possible advances in control and elimination of insects, weeds and some plant diseases. Radiation techniques to rid grain of insects have also been perfected.

Water Purification: Aware that population growth is placing heavy demands on the supply of fresh water, the AEC plans nuclear plants for desalting seawater. Discussions on nuclear energy for electric power and desalination have been held with atomic scientists from India, Israel, Pakistan and other countries.

Nuclear Defense: To insure this nation's continuing strong defense posture, the AEC, coordinating with the Department of Defense, conducts basic and applied research on nuclear arms development. Nuclear-powered ships include the *Polaris* missile-launching submarines, deep submergence research vehicles, the nuclear-fueled aircraft carrier *Enterprise* and the frigate *Bainbridge,* which were deployed in the Vietnam conflict.

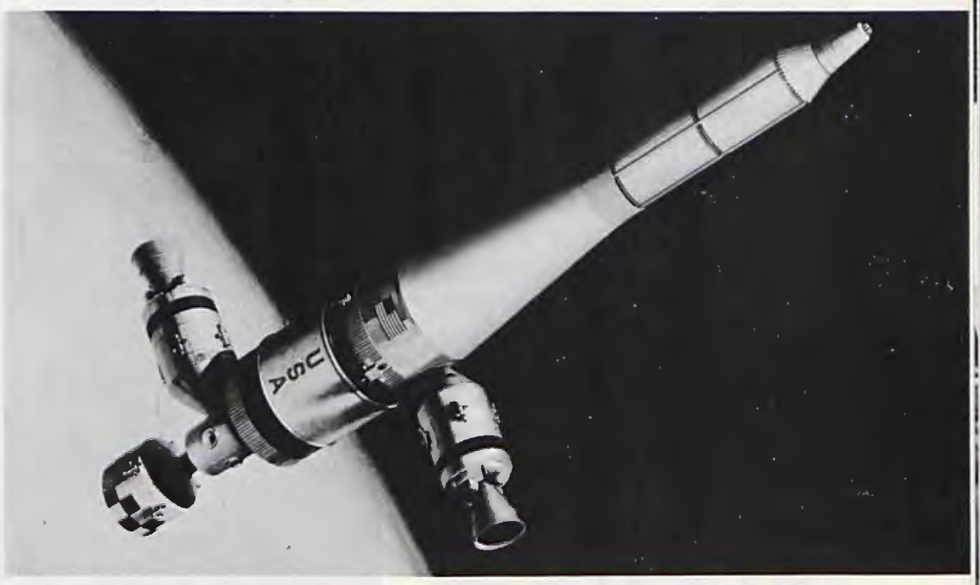
Plowshare Program: Designed to develop peaceful applications for nuclear explosives, Plowshare takes its name from the Biblical injunction to turn weapons into implements of peace. The Plowshare Program promises peaceful atomic explosions to move earth, create harbors and open mines. Once peaceful atomic blasts are exempted from the nuclear test ban, Plowshare could excavate a canal across Central America at a fraction of the cost of conventional methods. Nuclear blasts could create underground reservoirs for gas and other natural resources, cut a highway or railway pass through a mountain, or shift the landscape to improve water and soil conservation.

Electrical Power: Millions of Americans already heat and light their homes with electricity supplied by nuclear power plants. AEC spokesmen predict that atomic reactors will turn out 61,000 megawatts of electricity by 1975; four times that much by 1985. General Electric, the leading reactor manufacturer, expects nuclear fission to fill half of the nation's power needs by 1980.

Space Power and Propulsion: In a joint program with the National Aeronautics and Space Administration, AEC is developing nuclear rockets for propulsion and a series of electric generators. One SNAP (Systems for Nuclear Auxiliary Power) generator aboard a navigational satellite was placed in orbit seven years ago, and powers the satellite's tiny radio transmitters. Other isotope power sources have been built to power weather satellites and lunar probes, and to heat astronauts' suits.

Notable among the SNAP series is the nuclear generator developed by General Electric's Space Division. SNAP-27, placed upon the surface of the moon by Apollo 12 astronauts, supplies electric power for the lunar surface experiments package.

The peaceful atom is also serving as a social force to counteract years



Nuclear power in the seas and in space. Nuclear reactor could furnish the electrical power for an orbiting manned space station (as depicted in this early artist's concept). Nuclear power was first used on the N.S. Savannah, cargo-passenger ship.

Dr. Glenn Seaborg, chairman of the Atomic Energy Commission, looks forward to the establishment of large nuclear-powered agro-industrial complexes. The "nuplex" could produce up to one billion gallons of fresh water from the sea per day and more than 2,000 megawatts of electricity. Powered by twin 1,100-megawatt nuclear reactors, the complex could feed six million persons from a scientifically managed food factory.

of deprivation. The National Accelerator Laboratory is recruiting and training workers from the Chicago ghettos for construction and operation of a 200-billion-volt atom smasher. Part of the Oak Ridge facility is being used as a vocational school, where atomic experts teach technical know-how to disadvantaged people in East Tennessee and prepare them for well-paying jobs in private industry.

AEC Chairman Dr. Glenn Seaborg envisions the day when the atom can be used on a gigantic scale in the fight against hunger and poverty. "We're working on a bold concept, the nuclear complex or 'nuplex.' This is a giant agricultural-industrial complex built around nuclear reactors which will use advanced agricultural and industrial technologies. The atom can be used to generate electricity and fresh water for residents of the 'nuplex' and produce fertilizer from air, water and chemicals. It can be used for industrial applications, too —to fuel metal refineries or chemical factories for the production of steel, magnesium alloys, plastics, solvents —and all at reduced costs.

"For an investment of $1 billion, a 'nuplex' could be built to sustain 100,000 farmers, laborers and their families. The same 'nuplex' would feed five million others, and export fertilizer to grow food for another 50 million people."

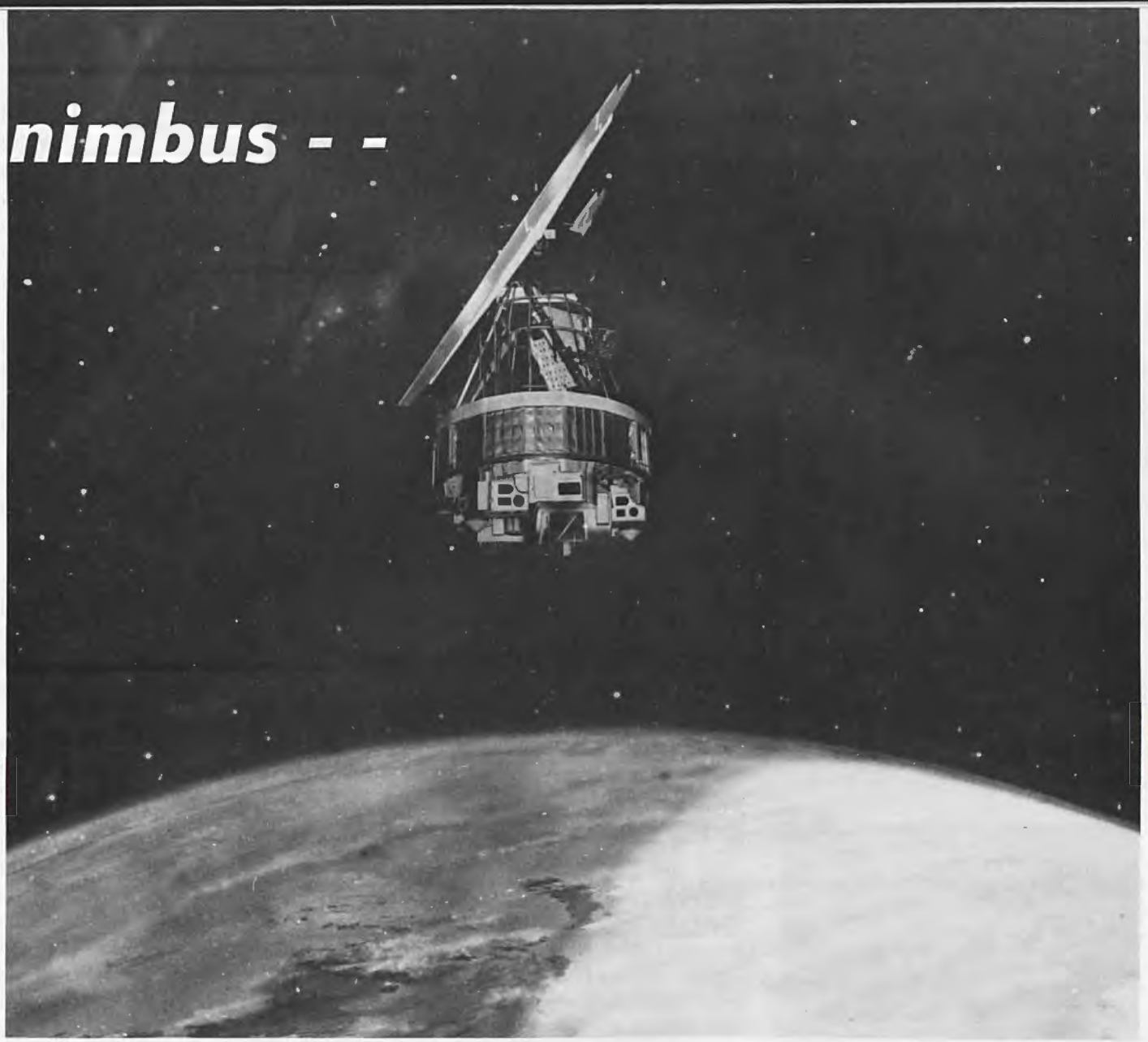
The "nuplex" is just one of the atomic marvels promised for tomorrow. The massive energy that nuclear reactors produce can be harnessed for completely new tasks, among them ridding rivers and air of pollutants, reclaiming human and commercial wastes, and mining previously uneconomical ores.

On this, the 25th anniversary of the birth of the Atomic Age, we see that the amazing atom has propelled us from Manhattan to the moon. Looking ahead we can see no limit to the future role of atomic energy in producing cheap electricity, in making advances in medicine, industry, space, commercial applications, research—in a host of fields.

The Atomic Age was born in war. Through growing international cooperation, the way is being paved for nuclear energy to become a productive force for the good of all mankind.

Atoms for peace. o

The Hanford Science Center at Richland, Washington, is a showplace for atomic energy and products of AEC's Hanford Plant.



a continuation of success

This year marks the 100th anniversary of the U.S. Weather Bureau. It marks also the 10th anniversary of the Nimbus Program—which has provided to the Bureau a new and exciting dimension in its quest for precise and long-range weather forecasting.

At 12:17 on Wednesday morning, April 8, 1970, the countdown reached zero and the latest Nimbus weather satellite slowly left its launch pad on the Western Test Range and with gathering momentum rose skyward.

At Goddard Space Flight Center, it was just after three a.m. This National Aeronautics and Space Administration Center in the quiet Maryland countryside is headquarters for the Nimbus Program. It is also site of the sophisticated Operations Control Center, hub of activity for tracking operations.

In addition to those engaged in tracking the spacecraft as it was launched and went into its polar orbit, several hundred more gathered to witness countdown procedures and also to discover when the spacecraft would start functioning. They—engineers, technicians, scientists from NASA *and* GE*, and their families—could hear conversations between tracking stations—such as Johannesberg, South Africa and Winkfeld, England—and Goddard. These spectators learned when the spacecraft separated from its booster vehicle, a Thorad/Agena D booster. They also heard confirmation of the solar paddles unfolding.*

About an hour after launch, Nimbus, one of the world's most sophisticated satellites, was ready to start its duties. From its 690-mile-high orbit, it now observes worldwide weather developments twice a day. It joins its sister, Nimbus 3, which on April 14, celebrated one year of successful operation.

After announcement was made that all was well with Nimbus, congratulations were extended to fellow workers. One of the most jubilant was NASA*'s Harry Press, who for a great deal of his career, has been engaged in helping this country advance its meteorological field.* CHALLENGE *talked to the Nimbus Project Manager shortly after the successful launch of Nimbus 4.*

Nimbus Project Manager Harry Press calls Nimbus 3 and 4 the beginning of a "revolution in meteorology."

"NASA and GE are naturally elated by this spacecraft's success. We've lived through every moment of its design, building, testing, launch. Many more share our feelings. ESSA and the entire meteorological community are delighted with its results—as they have been with its predecessors.

"The Nimbus 3 and 4 missions, I think, have begun a new revolution in meteorology. One which will continue for a long time—to the benefit of everyone. With new sensors, we can accomplish what was unthought of at the beginning of the program —a short ten years ago."

He continued: "People throughout the globe receive data transmitted from Nimbus. There are some areas today in Australia, New Zealand and Africa who enjoy modern, very sophisticated weather information. Prior to 1964 (when the first Nimbus was launched) these and many more areas received no data whatsoever."

Nimbus 1, the trailblazer, had a one-month lifetime. Its brief span was due to a failure of the solar array drive system. "It returned excellent photographs, whetting the appetites of meteorologists for more information. It not only gave us a more complete and sophisticated look at the earth's weather; it revealed significant differences in the topography of Antarctica."

Nimbus 2 is a legendary hero for its longevity. During its 32 months of active life, the spacecraft transmitted more than 132,000 photographs. It provided fulltime cloud cover pictures; it traced major storms and hurricanes; it detected copper deposits in Norway; it mapped the Gulf Stream.

Of the first two, Mr. Press notes: "They started in the direction of what was considered operational metsats—with the focus on advancing mapping capabilities — using TV cameras and infrared radiometers. The first two flights successfully did this. We developed high resolution

TV systems and also real time TV systems. Especially well recognized is the Automatic Picture Transmission. We have received hundreds of plaudits from APT users, some who are 'do-it-yourself' experts who inexpensively built receiving stations, thereby providing for man a new look at the earth.

"But," he continues, "the spacecraft didn't become operational. They were over-ambitious and also expensive and ESSA couldn't afford this. We restructured the program and its objectives. From this exercise came the decision to build bigger spacecraft and observatories which could fly more experiments. New objectives were specified such as quantitatively measuring the structure and the properties of the atmosphere — vertical distribution of humidity, wind velocity, distribution of ozone."

Instruments — an entirely new series — were developed for Nimbus 3 as well as 4. Also scheduled was a 50-watt nuclear power supply to prove the feasibility of this type power source and to develop techniques for its integration, test and operation. The first attempt to launch Nimbus 3 — in May 1968 — ended disastrously with an abort of the launch vehicle — which led to destruction shortly after lift-off.

"The manner in which everyone responded to that disaster was overwhelming. The challenge of the loss led to an immediate turn-around mission—blessed by NASA Headquarters' approval, AEC support and enthusiastic cooperation of GE and the other contributing contractors. In less than nine months, we were ready to go. Nimbus 3, providing data daily, has been a resounding scientific and technological success."

And according to David Johnson, Director of ESSA's National Environmental Satellite Center, the vertical temperature soundings made by Nimbus 3 "open up the opportunity of obtaining the global observations which the scientists believe are required if they are to produce forecasts as much as two weeks in advance."

"Nimbus 3, providing data daily, has been a resounding scientific and technological success."

These successes led to the latest in the series. Nimbus 4 carries significantly more sophisticated sensing devices than its predecessors. "There was a complete upgrading of the satellite. It provides much improved observatory services; better control and data systems; and also a much better ground system. Here at Goddard our ground system has been updated substantially with more utilization of computers," Press said.

Nimbus 4 carries the largest number of experiments ever flown—including one provided by Great Britain, a selective chopper radiometer. The others are an image dissector camera; a backscatter ultraviolet spectrometer; an interrogation, recording and location system; an ultraviolet solar energy monitor; a satellite infrared spectrometer; infrared interferometer; a filter wedge spectrometer; and a temperature, humidity infrared radiometer. "Full coverage of the earth is had, as well as a much higher spatial resolution than before.

"The Nimbus program is celebrating its tenth anniversary this year—and I believe we've accomplished a great deal. Four spacecraft launched — each one more sophisticated and capable of doing more than the one before. And the adage, about a program being as good as the people responsible for it, holds true. The Nimbus people—here at Goddard, at GE and all other support—have continually worked at advancing the state of the art in technology and subsequently in meteorology. And they've succeeded."

The Nimbus Project Manager continues: "It's been said many times that there are no NASA or GE people on this program—only Nimbus people. I think it's so. The second Nimbus 3 mission was a good example of the quality of people on the project — competent, knowledgeable and completely dedicated. I think I can boast and say we have some of the best. People like Stanley Weiland, who leads the technical engineering effort . . . and Gerry Burdett and Dick Devlin, technical officers on Nimbus 3 and 4 respectively. Responsibility on the intricate controls system for the last mission rests with Helen Newman, while Gene Delio serves as systems designer and experiment engineer. These are just a few. But these, coupled with the others here at Goddard and the talent of the industry team, made for success."

Managing a program such as Nimbus, according to Mr. Press, involves "breaking down jobs into clear pieces that are separable and identifiable and then matching people to each of

these elements. Of course, at the outset, you have to find good people; and to keep them, you have to challenge them and put them in a position of responsibility. I think given responsibility and some challenge, we all tend to work harder." This philosophy must work; there are many active charter members of the program—both at NASA and GE.

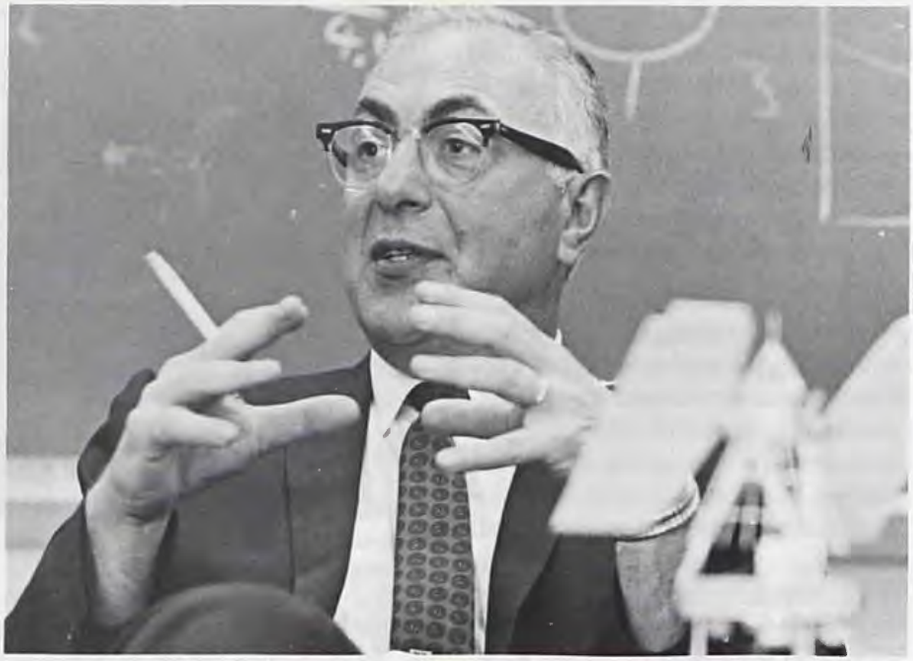
He continues. "You also have to learn early in the game who your best 'hound' is—the guy who can quickly locate problems which may arise. If you're really lucky, you may be fortunate to find a couple of 'hounds.' After a problem is identified, matching a man to the problem for a quick and satisfying solution is another hurdle. But here again, the talent and support from the entire team make for a quick solution."

Regarding government-contractor relationships, the Nimbus Project Manager says, "Again, I think we have the best. NASA tries to complement the contractor's capability and we all work together. Sure, we've had problems — technical and personal; every project does. I think we've overcome them—in a manner advantageous to the program."

He calls the solar array drive on Nimbus 1 "as delicate and irritating a technical problem as I have ever seen." Mr. Press cites GE's prompt solution. "Those people did a great job in determining what was wrong, where it was and then in solving it.

"Most people in this business identify deeply and emotionally with their jobs—almost to the extent of foregoing other pleasures of life. They feel that accomplishments are made by people who are willing to put the extra effort into doing a job. Their self-discipline is amazing. It seems that people involved in this arena practice very efficiently the art of self-discipline."

Harry Press is no exception. For his outstanding dedicated service to the program which he heads, he received NASA's Exceptional Service Medal. The award, presented by NASA Administrator Dr. Thomas Paine, cites Press for outstanding contribution in successfully completing Nimbus 3. It adds that the data received "provides the basis for more precise, long-range weather forecasting."



"Most people in this business identify deeply and emotionally with their jobs, almost to the extent of foregoing other pleasures of life."

His entire career has been involved in some way with the quest for precise long-range forecasting of weather. With a degree in mathematics from Brooklyn College, he did graduate work in mathematical statistics and meteorology at Columbia and at New York University. At the latter, he served as Air Force Weather Officer and Instructor of Meteorology. From there, he joined the then National Advisory Committee for Aeronautics —forerunner of today's NASA — at Langley Research Center. He was engaged in aeronautical research on problems of gust loads on airplanes and space vehicles.

"We designed structures for rough weather flights so that the planes could withstand the rigors of bad weather and thunderstorms. The optimum design was a plane strong enough but not too heavy. It's not too unlike designing spacecraft where weight and strength are important."

Joining the Nimbus team in 1961 has enabled Press to continue his involvement in structural design as well as advancing technology in the meteorological field. And the involvement will continue. Nimbus E and F missions are now under study to determine final configuration; they are planned for launch in 1972 and in 1973 respectively.

"They, too, will be greeted enthusiastically by the meteorological community," says Press. "Payloads on E and F will be entirely different from those on other Nimbus craft. New and exciting sensors are planned. Now, we work almost exclusively in the infrared range. On the next two, we'll be working in the microwave region, which will enable us to see through clouds and provide a picture of most of the earth's area."

The Nimbus Program was initiated some ten years ago to give the world a better look at itself from observatories hundreds of miles away in space. With the successes to date and with the continuation of the program —led by Harry Press and staffed with a competent crew—the picture becomes clearer. ○

Resort-like setting houses a multi-disciplined team of professionals whose talents are tackling problems which face our society and the entire world.

TEMPO—figuring the future

From Nostradamus to Jeanne Dixon, predicting the future has always fascinated man. Just ask any handicapper. With the other kinds of problems now facing us, charting the coming years may still be just as fascinating—but today it's taken on a new sense of urgency and importance. Thinking about that tomorrow is the articulate, concerned and competent crew who form the backbone of TEMPO—General Electric's Center for Advanced Studies.

By Robert L. Simons

Leading TEMPO's efforts for the last six years is Saadia Schorr.

John McKee is one of some 200 experts who make up TEMPO's technical staff.

Maybe Cicero in 50 B.C. had a great idea for an organization and just didn't realize it when he stated, "Tomorrow will give us something to think about." That's just the charter and exact business area for TEMPO —where a multi-disciplined team of professionals blends its considerable skills and insights with a lot of hard work to produce the ingredients for what we all hope will be a better tomorrow. At TEMPO, the question about tomorrow is not whether there will be one, but what can we do now to assure that it will be better.

One of the big (and it's getting bigger all the time) contributions of TEMPO has been to translate the latest techniques developed in the management of the nation's defense and to utilize and apply these methods to the host of other problems facing our society and the entire world.

Located in Santa Barbara, California about 100 miles northwest of Los Angeles, TEMPO has a deceptively low pressure appearance that's considerably at variance with the problems they consider and solve every day. An employee remarked, "With all the brainpower around here, it's like being on a college campus—without the exams." Looking at a technical staff of more than 200 real experts, half of whom have masters degrees with over half of those with PH.D.'s, one gets the impact of that remark and the considerable people resource TEMPO brings to its work. The average age of the professional staff is the late 30's. In addition to this kind of expertise being internally available, TEMPO can call on consultants for their specific know-how and its applicability to the problem at hand.

Originally established in 1956 by Dr. Dick Raymond and Dr. George Haller as a component of the then Defense Electronics Division, TEMPO was conceived on the premise that GE's Defense business could benefit from a RAND-type organization. Today's TEMPO is just as brisk, but with a somewhat different emphasis. Although more than 50 percent of its business is still in the national security sector, the recent thrust has been toward increased involvement in other areas.

Whether you call it a think tank or a brain bank, TEMPO's basic approach is sound and it works: When asking questions about the organization and functioning of society, the best approach is to take a broad systems look to problem solving based on the techniques evolving in the general field of management sciences and operations research.

A typical task team assembled to address a specific problem includes members of TEMPO's professional staff versed in the disciplines of economics, engineering, mathematics, physics and a social science. The project team gets deeply involved in

With TEMPO ten years, Gene Harris manages Defense Service Programs for the Air Force, Army and Navy. He also served on the Los Angeles Little Hoover Commission.

Senior Programmer Analyst Edith Feniger says of TEMPO's environment: "An atmosphere where it's your ability and competence that pay off."

trying to discover exactly what the problem is, sometimes to the point of restating the question.

For example, on an internal study for GE, TEMPO was asked, "Should GE invest in nuclear ship propulsion?" After pre-contract discussions it was agreed that question really was, "What is the business potential for nuclear propulsion of merchant ships?" The team then began a twelve-month study effort involving a myriad of questions and considerations.

They estimated the demand for various cargoes and potential trade routes; then derived a mix of potential carriers to satisfy demand over projected routes. TEMPO modeled alternate configurations of propulsion systems such as large diesel gas turbines, nuclear steam and nuclear gas turbines—all contenders for the ship propulsion job of the future.

Next they made a cost-effectiveness analysis over varying assumptions including some related to potential technological breakthroughs. For example, suppose a reliable gas turbine can be made to run on cheap Bunker c fuel oil. The analysis was made taking into consideration competition from other carriers such as pipelines, air, rail, etc. The results provided General Electric with some additional insights on the wisdom of entry into this field by pointing out the number of long-voyage, high-speed, large-bulk carriers with vast turn-around time needed to satisfy the main market of the future.

The final TEMPO output is ideas and the medium is a paper report, but the work and planning that go into that report may return the buyer 100 or 1,000 times its cost.

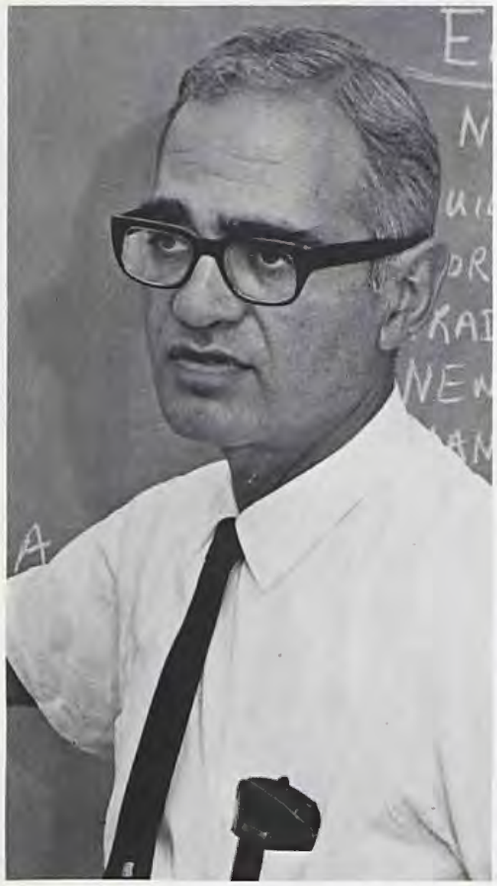
From its initial purpose of supporting the company's efforts in the defense business, TEMPO has gradually evolved so that today it has branched into working in three other areas—(1) private sector (for other industrial firms); (2) public sector (local, state and federal agencies); and (3) international economic development area. These three areas reflect the trend toward a balance of defense and non-defense work in the United States and overseas.

The growing awareness of U.S. and foreign businessmen for the necessity of this kind of service is evidenced by the fact that right now there are about 400 different firms engaged in TEMPO-like activity. Ranging from two-man shops to RAND, Hudson Institute and organizations affiliated with universities and colleges, it's a tough business where your competitive edge is as fine as your next idea.

Tom Paine, who led the group in Santa Barbara for five years, once commented, "Where once it was necessary for man to react to change only when he felt its effects, it is now necessary for man to anticipate change and to either prepare appropriate responses or set in motion

Dr. Jack Berberet, currently working in the area of ABM defense, says that "Science has a bigger effect on our life and society than we realize."

Harold Asher heads up TEMPO's Public Sector Programs — headquartered in Washington, D.C.



those forces which will modify the environment; thus reduce, alter or eliminate effects of the change."

When Dr. Paine left for his job as Administrator of NASA, he was succeeded by Saadia M. Schorr whose most recent six years experience has been part of a period of growth and accomplishment that is the proud record of TEMPO.

Commenting about the thrust of TEMPO activity, Mr. Schorr states, "We are working on the problems of society at a point of impact where technology, economics and management intersect. This is the area which may be tomorrow's real battleground between cultures for international pre-eminence."

Visitors representing many foreign countries come to TEMPO each year. Included among those countries have been Algeria, Austria, Brazil, Canada, Chile, France, West Germany, Great Britain, India, Indonesia, Ireland, Italy, Japan, Mexico, the Netherlands, Sweden, Trinidad and Turkey. The annual Christmas display of some of their flags on TEMPO's galleries has become a tradition in Santa Barbara.

While there is increased emphasis placed on other than defense work within the TEMPO community, several notable contributions to the nation's security have been made and are being currently developed, like:

1. MARIS - Material Readiness Index System, for the Polaris Program

2. FADAP - Fleet ASW Data Analysis Program

3. DIAC - Defense Information and Analysis Centers

4. Studies on the effects of nuclear bursts on communications systems

5. Data and Systems Analysis for Tactical and Strategic Force deployment.

Some of the outstanding contributors at TEMPO who are committed to improving the fabric and quality of life tomorrow by thinking about it today include:

Dr. Jack Berberet - currently working in the area of ABM defense, he's recently done some research into what he calls, "The Science of Science." He is convinced that, "Science has a bigger effect on our life and society than we realize and people just don't realize the tremendous source of information this country has been to the world. However, the science of trying to measure science is primitive. We've got to learn to use this body of knowledge more fully."

Incidentally, back in 1959, Dr. Berberet predicted the Chinese would explode a nuclear device, "no sooner than 1963, no later than 1965." They did it in 1964.

Dr. Dave Fields - a member of the Professional Staff working in Public Sector Programs together with a staff of 20 technical people under the direction of Dr. Harold Asher, is ad-

TEMPO draws many visitors from foreign nations each year. The annual Christmas display of some of their flags on TEMPO's galleries has become a tradition in Santa Barbara.

dressing problems like optimizing urban renewal programs, improving planning methodology, determining what the vital factors are in urban planning, etc. Customers for this activity include the city of Santa Maria, California, the state of Hawaii, and our own Aerospace Group.

A comic strip character once noted, "It's not the work that tires you out so much, as it is the planning." Dr. Fields bears this out when he says, "The answers we come up with are the result of a lot of digging, some very detailed fact gathering, and a little imagination and analysis."

Edith Feniger is one of the eight women on the Professional Staff. A native of Vienna, Austria, she's been with TEMPO for 10 years and has progressed from a computer technician to a Senior Programmer Analyst. She characterizes TEMPO's unique environment as, "An atmosphere where it's your ability and competence that pay off." While working in Santa Barbara, Edith was able to complete her studies for a B.A. in Math from the University of California at Santa Barbara, a school her 22-year-old son now attends.

Then, there's *Gene Harris* whose section at TEMPO is the largest and deals with Defense Services Programs for the Air Force, Army and Navy. Leading a team of 80 specialists in the very complex area of systems analysis for the military, he observes, "Systems analysis is not a panacea; but it's a viable approach to answering a problem when properly applied." A 10-year veteran of GE, all of it with TEMPO in Santa Barbara, Gene was also part of the Los Angeles Little Hoover Commission.

With locations in Los Angeles, Washington, D.C., Honolulu and Geneva, Switzerland, TEMPO is well on its way toward becoming a worldwide missionary for the benefits of American technology and planning.

Mr. Schorr voiced it well when he said, "The nuclear bomb with its implications of instant mass destruction might be considered one extreme of a broad spectrum of our work. At the other extreme, we are concerned with another explosion of at least equal destructive potential. This one we believe may be more certain, is certainly more insidious, and is equally, if not more destructive. I refer to the population explosion.

"Between these two extremes and including them, TEMPO is deeply concerned with the vast range of possible life styles. Our work involves selection of alternatives that will best enable mankind to take advantage of all that an advanced civilization has to offer. In a very real sense, the ultimate customer is the world's young people."

TEMPO—an organization geared to the goal of taking an objective look at tomorrow and planning to help make it a better tomorrow — for everyone. o

SPACE DIVISION'S INTERNATIONAL OPERATIONS

At a time when cooperation among all nations is so essential to the peace and progress of the world, the space program provides a focal point for scientific, administrative and diplomatic cooperation.

General Electric's Space Division, involved in virtually every mission in the United States space program, is also an active participant in international cooperative efforts for the exploration and exploitation of space.

An outstanding example of this participation is the Division's role as consultant to the Messerschmitt-Boelkow-Blohm Company (MBB) on the Helios solar probe project. The West German government awarded the prime contract to build the spacecraft to MBB's Space Division at Ottobrunn, Germany. MBB in turn contracted with GE's Space Division at Valley Forge to act as its United States consultant. Under the Helios program—the largest international cooperative space program ever undertaken by the National Aeronautics and Space Administration and a foreign government—two spacecraft will be launched toward the sun in 1974 and 1975. They will carry experiments designed to measure solar particles and fields. As consultant on Helios, General Electric provides outstanding, experienced personnel for specific technical and management tasks.

In addition to its contractual obligations overseas, General Electric is a leader in fostering international understanding of the utilization of space through such organizations as Eurospace and the International Astronautical Federation. "International cooperation in space will grow very rapidly in this decade," predicts Daniel J. Fink, Vice President and Space Division General Manager, who maintains a direct, active interest in international space activities. He was United States delegate to the IAF meeting in Argentina in 1969, is now a member of the new international committee of the American Institute for Aeronautics and Astronautics. "As a leading contributor to the U.S. space programs," he continues, "we support the concept, consistent with national policy that technological developments of domestic space efforts are fully utilized throughout the world for the common good of all men."

Fink pointed out that the Division's overseas effort is extensive, and includes active participation with governments as well as industrial firms and supranational space organizations. Thus GE not only has arrangements for the reciprocal exchange of space technology in developed countries, but is in a strong position to assist developing nations in the application of space technology to their national needs.

Dan Fink: "The application of space technology . . . can be so useful to mankind."

Space Division entered the international market place nearly eight years ago with Al Carter spearheading an investigation of the potentials of multi-nation cooperation in space. Involvement is now worldwide and includes Europe, the Far East, the mid-East and South America. As manager of International Market Development, Carter has marketing responsibility for all Space Division activities and business interests outside the United States. "Frankly," he says "our goals are principally commercial—we're looking for a financial return, new technologies and sound partners for international bidding arrangements. These can only be accomplished with an organization which knows how to operate in an international environment."

Such operational know-how resulted in the award of consultant contracts on Project Helios and ANS earlier this year. "The ANS (Astronomical Netherlands Satellite) is another European space venture in which we are pleased to act as consultant," comments George Hellhake, a member of the Division's International Market Development team. "We're collaborating on the development of this satellite which is designed to investigate stellar ultraviolet and x-ray emissions." The ANS payload will consist of three experiments, and it will be launched by a Scout vehicle in the summer of 1974 into a near-circular sun-synchronous twilight orbit.

"Among our other business opportunities," Carter told CHALLENGE, "is a licensing agreement we're working on with Japan, in support of its national space program. Our contribution would include a technology transfer and consultation service designed to provide capabilities not adequately represented there."

Perhaps Space Division's greatest contribution to international space cooperation will be in the area of broadcast satellites which promise to become the chief means of wiping out illiteracy in the world. Addressing the 20th International Astronautical Congress in Argentina last fall, Dan Fink pointed up the progress that has been made in television broadcasting from space, in terms of the technologies and systems, and discussed some of the work Space Division is doing with Brazil and India. "At this very moment, NASA and the American space industry are pursuing all of the technologies, both in space and on the ground, pertinent to broadcast satellites. This technology work, together with associated applications and systems studies, clearly shows that space broadcasting is not only feasible but highly practical as well. Brazil and India are now leading the way and others are not far behind, in performing extensive systems studies to define how space broadcasting can satisfy important needs of their countries. Experiments are also being planned to use the capabilities of NASA's new Applications Technology Satellites (ATS-F/G) for practical evaluation of space broadcasting to both community centers and schools in the early 1970's."

Fink underscored the need to take advantage of the technologies and systems understanding being developed and "to assure ourselves that this application of space technology, which can be so useful to mankind, becomes a reality in the seventies in as many nations as possible. This is one of the most significant space applications that will benefit mankind all over the world."

George Hellhake (left) and Al Carter: Space Division's International Market Development teammates.

In September 1969, India formally signed an agreement with NASA for experimental use of the ATS-F satellite to broadcast to 5,000 villages, with some 20 million inhabitants. Educational television programs will concentrate on modern farming techniques and will be beamed to community receivers in four rural regions of India. On this side of the world, Brazil has proposed an experiment to transmit television and multi-audio instruction programs to several hundred schools in Rio Grande del Norte. The Space Division conducted studies with members of the Brazilian National Commission for Space Activities, under the direction of Dr. Fernando de Mendonca, scientific director, and the Indian Committee for Space Research, whose chairman is Dr. Vikram Sarabhi. The studies involved the total system, from analyzing requirements to defining the technical cost and planning aspects for system implementation.

Another international cooperative effort to which Space Division can contribute is that of managing available earth resources and devising better ways to find new resources to meet the demands of an ever-expanding world population. In this regard, work being done on NASA's Earth Resources Survey Program should lead to the development of long-life satellites with cameras and sensors capable of observing the earth and transmitting pertinent data to people who can do something about developing and managing earth resources. Such information will help lead the way toward assuring the world's food supply and improving the quality of life.

Already, the signs of the gain and the good evolving from a variety of international cooperative ventures are abundant. And history may well record that such international cooperation in the exploration and exploitation of space may be the catalyst to better unite men on earth in peace. ○

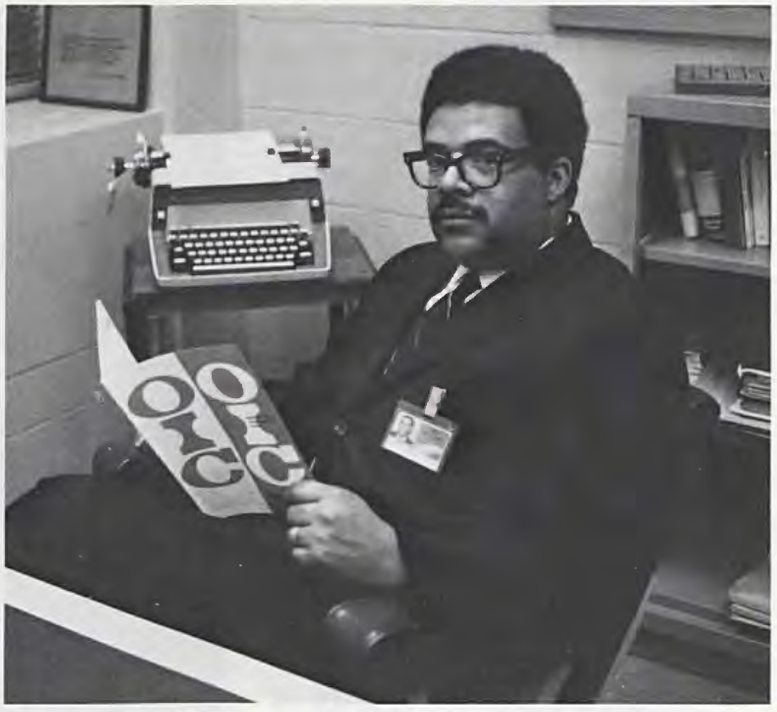
'One Man Can Make a Difference . . . And All Men Should Try.'

. . . John F. Kennedy

Most of us are concerned about our nation's social problems — urban and suburban crises, racial polarization, crime and traffic control, environmental pollution, and the generation/credibility gap. And with good reason. This concern is reflected by the large number of General Electric employees who are motivated to try to change the things that need changing.

Thus a man in Mississippi moonlights as a deputy sheriff — at a salary of one dollar per year. And four busy Philadelphia women donate two evenings a week helping others improve their clerical skills and land secretarial jobs. While in California a man-and-wife team organizes and equips a school for deaf toddlers.

These people, and others like them, are the hyphen in a powerful new force — the Industrial-Community complex. They accept the philosophy that industry, as a microcosm of society, must reflect all of that society's shared values — social, moral, political and legal, as well as economic. In many ways these volunteers seek to translate their considerable talents and energies into a positive force for progress. CHALLENGE salutes these GE men and women — some of whom are pictured here—who try to make a difference. They work hard toward making America what they think it ought to be.



Matt Coleman of SSO Research and Engineering's Laboratory Administration has been named to the Montgomery County Opportunities Industrialization Center advisory board. Comments Matt: "Getting personally involved is satisfying and a very effective way of helping."

Donald E. Johnson has volunteered to serve as a commissioned auxiliary deputy sheriff for the St. Tammany Parish in Louisiana. He's manager of Property Management Unit 284 at the Management and Technical Services Department, Bay St. Louis, Miss.

Mickey Lipsker (right) repro-typist at Re-entry and Environmental Systems in Philadelphia, is a volunteer nurse with the Wynne-Brook Ambulance Corps. Every Saturday morning (she's also on call during the rest of the week) Mrs. Lipsker is ready to ride in an ambulance and administer life-saving first aid to her neighbors.

Don Delk, systems evaluation engineer at Apollo Systems Department, designed and built an electronic baseball game for children at the School for the Blind, Daytona Beach, Florida.

Dick Banziger, specialist, Program Integration, Apollo Systems/Houston, is chairman of the International Institute for Education. He is responsible for coordinating activities for visiting foreign dignitaries and students.

Don Potter and his wife Juanita helped form the Peninsula Oral School for the Deaf to prepare handicapped children to attend public school by first grade. Recently elected to the school's board of directors, Don is system manager, Advanced Projects for SSO in Sunnyvale, California.

Four RESD volunteers who spend two evenings weekly as instructors in the Secretarial Improvement Program, from left, Chet Johnson, Barbara Taylor, Ruth Jones and Yvonne Jones. Under the program, typing, business communications and grammar are taught to residents of the Mantua and Powelton Village sections of West Philadelphia. Says Chet, "The SIP students have to sharpen their skills so they can apply for better paying secretarial positions. It's great to be part of this program." The other young women share her enthusiasm for social involvement.

Sixty five years ago the Pennsylvania State Police was created, the first uniformed police organization of its kind in the U. S. Today with more than 3,000 personnel to provide essential services to the Commonwealth's citizens, the force serves as a model for other state police agencies throughout the nation.

A new and proud tradition was established on May 2, 1905 when Governor Samuel W. Pennypacker signed into law the creation of the Pennsylvania State Police. As he took office, the Governor remarked, "I looked about to see what instruments I possessed to accomplish my boundless obligation . . . what instruments on whose loyalty and obedience I could truly rely. I perceived three such instruments: my private secretary, a very small man; my woman stenographer; and the janitor. So, I made the State Police."

From that less than auspicious start, the State Police was quick to establish a reputation for competence, impartiality and effectiveness that today is nationally recognized. Expanding to meet its growing responsibilities, the State Police is a modern and efficient organization geared toward maintaining the peace and well-being of the Commonwealth and its citizens.

While about 80 percent of the force's efforts involve patrolling the Commonwealth's highways, the organization is a full and participating partner with municipal and federal agencies across the total spectrum of combating criminal elements wher-

SERVING THE

Present and past Pennsylvania Governors and State Police Commissioners: Gov. Raymond P. Shafer and Col. Frank McKetta (top); former Gov. Samuel W. Pennypacker, who established the force in 1905, and the first State Police Commissioner, John C. Groome, who served until 1920.

Keeping up with the flood of information requested and received by the State Police requires the use of this sophisticated and dependable computer equipment.

ever they appear. More than a million criminal records are on file and are accessible to police departments throughout the country. Applying the latest scientific advances and techniques is another part of keeping up with the Joneses on the other side of the law. A modern training academy located in Hershey (where municipal officers may receive initial and refresher instruction) insures that a steady flow of fully qualified and trained men are regularly infused into the force and complement the experienced officers.

A mobile, flexible cadre of officers equally at home on foot, behind the wheel of a car, at the controls of a helicopter, or wearing scuba gear, the State Police is also active in the less visible, but just as important, areas of youth aid, driver and safety education, as well as protection of the Governor and his family.

The State Police also forms an important link in the protective chain of the vast rural sections of the Commonwealth where there are no local police agencies, in addition to helping thousands of small communities where two or three officers are appointed by local authorities, primarily for traffic duty.

Colonel Frank McKetta, the current State Police Commissioner and a native of Yukon, Pa., has served in virtually every capacity and level of command in a career that spans more than three decades of service to Pennsylvania. An active proponent of taking "new and constructive approaches to the new problems facing us," the Commissioner said, "It has been amply demonstrated through our experience in the field and at departmental headquarters that improvement and innovation to meet new demands are necessary." Pennsylvania's finest — an organization steeped in the tradition of success— is prepared to do just that.

COMMONWEALTH

Driver testing and education are part of Police program designed to reduce tremendous toll in human life and property damage caused by auto accidents.

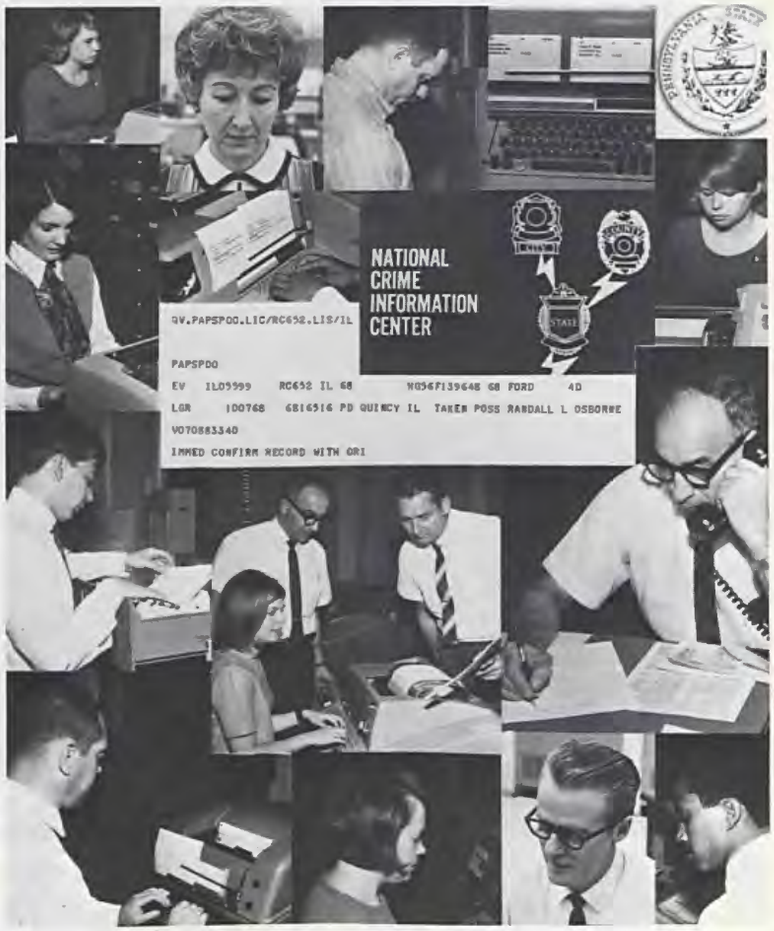
The Pennsylvania State Police is a model of efficiency, a model of honesty, a model of absolute freedom from political contamination. One of the great difficulties in our large States has been to secure an efficient policing of the rural sections. In communities where there are still frontier conditions, such as Texas and Arizona, the need has been partially met by establishing bodies of rangers; but there is no other body so emphatically efficient for modern needs as the Pennsylvania State Police. I have seen them at work. I know personally numbers of the men in the ranks. I know some of the officers. I feel so strongly about them that the mere fact that a man is honorably discharged from this Force would make me at once, and without hesitation, employ him for any purpose needing courage, prowess, good judgment, loyalty, and entire trustworthiness. This is a good deal to say of any organization, and I say it without qualification of the Pennsylvania Police.

Theodore Roosevelt

THEODORE ROOSEVELT

Sagamore Hill
November 10, 1916

An endorsement from an early admirer . . . and it's just as true today.



The people behind the "hits": A tightly knit and smoothly functioning system of information exchange among the law enforcement agencies results in increased protection for the public.

Law enforcement during the Roaring Twenties.

The Pennsylvania State Police Aviation Division, formed two years ago, in some of its varied activities.

Another aspect of State Police work. Here the fire marshal investigates a possible arson case.

Inspection in ranks: Col. McKetta views a top-notch team, with pride in its professionalism and appearance.

Each year, thousands of Pennsylvanians are thrilled and impressed with the horsemanship exhibitions put on by Pennsylvania State Police.

people on the move

Dr. Marv Bunker

RESEARCH A JOY

"When you discover the practical application of a system of pure logic, you've found the true beauty and joy of mathematics." This is Marv Bunker speaking (PH.D., Electrical Engineering, University of Florida, 1969).

Marv, a consultant in Apollo Systems' Advanced Technologies Engineering Laboratory, is one of those fortunate people who is doing exactly what he's always wanted to do. "I get phenomenal pleasure from research and technical problems, and I also find teaching tremendously satisfying. I'm an Adjunct Professor at GENESYS" (University of Florida's Graduate Engineering Education System—his was the first PH.D. granted by GENESYS).

When he was in undergraduate school, Marv chose a math course every time he had a free elective. "Engineering is really applied mathematics, after all. I think today's engineers need practical orientation, too, and some don't have it until they get out on the job. This is why, in my teaching, I try to cover not just theorems and proofs, but also their application to the problem."

Most of Marv's research work at Apollo Systems deals with electronics. He devotes a lot of time to working with Computer Generated Images and, in his own areas of knowledge, he helps others solve their problems. "My goal is to become as effective as possible as a contributor in the technical end of the business. I've been in management, too, but I know I'm better off if I stick to the research and consulting. Good management, of course, is extremely important. I'm happy there are those who get satisfaction from performing this function, so I can concentrate on the technical area. Right now there are many challenging problems in the Department's push to diversify its business, and problems to be solved are what make work interesting."

INNOVATIVE SYSTEM

"The great thing about this system is that not only does it tell us where we stand, it also shows in what direction we are moving." The speaker is Ed McManus, manager of Business Data Management in RESD Research and Engineering. The system is C/SPCS—Cost/Schedule Planning and Control System — a method of monitoring and evaluating performance on the Air Force Minuteman Program. "With C/SPCS," Ed says, "we're up-to-date with schedule and cost information, and are able to spot potential problems and suggest solutions."

Ed took over the job of implementing C/SPCS at RESD about a year ago, and has been instrumental in getting the new system accepted throughout the Division. "My role is one of marrying the requirements of C/SPCS with the managers' needs."

One of Ed's innovations is adopting the work breakdown structure on proposals so he can summarize, by shop order number, the lower elements of work involved to the significant program requirement levels. Information on manpower, funding and other data is also ascertained.

It's a job he's spent years getting ready for. Since joining GE in 1961 ("I was about on the first rung of the corporate ladder in those days"), Ed has been developing his administrative abilities. After spending his evenings at La Salle College, and dividing the weekends between studies and a growing family, he won a bachelor's degree in business administration in 1968. Along the way he moved up the corporate ladder into progressively responsible administrative positions, and has done a fine job of helping subordinates develop their administrative skills.

"I look for the conscientious person," he says. "The men and women in my organization are self-starters and hard drivers. They have good ideas, a positive attitude and constantly seek to know 'why.' Those are the keys to success in business."

Well said by a man who not only knows where he stands, but has a pretty good idea of where he's going.

COURAGE BRINGS SUCCESS

Man in motion Len Edelstein paused briefly to discuss the essentials of success: "Hard work and know-how are important, sure. But, if you want to make things happen, to get programs and people moving,

Ed McManus

Len Edelstein

Bob Tharpe

courage is what it takes. Courage to rock the boat." Len is Manager of Manufacturing Engineering in Operations and Evaluation at RESD. He heads a group of some 200 people whose primary task is to develop new standards and innovative manufacturing methods and techniques which meet design specifications for the production of quality hardware in the most cost-effective manner. They come up with good ideas, because, in Len's words: "We are willing to take a chance and try out new concepts. After all, there's always a better way if you look for it."

That philosophy has been Len's mainstay throughout his engineering career—since his two hitches in the Navy during WW II and the Korean conflict, when he worked on steam and diesel engines, through his five years with Radioplane, and on to Martin Marietta where he was operations chief on one of the Titan static firing test stands. During a decade at Martin, he switched from test operations to management of interplanetary program study projects. But proposal work lost some of its appeal ("I wanted to be where the action is"), so he came aboard RESD in 1968 as a consultant.

Of his present job, he says, "There's plenty of work here and we put in long hours each day getting it done." His subsection supports all RESD business areas.

Operating with a free hand, Len believes in letting his people make their own way. "I want them to be aware — to get involved with the problems. I don't expect my men to be constantly at their desks, because our types of problems occur on the factory floor. I rotate my people and give them more and more responsibility and freedom to grow as they demonstrate their capability." Len likes to avoid getting too comfortable in a job. "It's easy to follow the same routine, to go on doing the same things in the same way. No company can survive if it's staffed entirely by men comfortable in their jobs. And when I feel too comfortable, I know it's time to start rocking the boat."

NUCLEAR POWER GROWTH

Technologists had just begun to tap the commercial potential of atomic energy in the early 1950's. To Bob Tharpe, who was then deciding on a career, the nuclear power field looked like a good one to pursue. Obviously, he made an excellent choice. Power is one of America's greatest needs; nuclear power has been pinpointed as the key to growth.

Bob studied chemical engineering at Clemson, earned a master's in nuclear engineering at the University of Florida and then went to work for Oak Ridge National Labs in Tennessee, for three and one-half years. He was then tapped to attend the Oak Ridge School of Reactor Technology. He joined General Electric in 1961 at the Company's Atomic Power Equipment Department in San Jose, where he was ultimately lead engineer for a 150-megawatt reactor power plant constructed in southern Italy. After preliminary work on a plant for Tarapur, India, Bob joined Advanced Nuclear Systems Engineering Operation in the former Missile and Space Division in 1963.

Today, he's manager of Systems Engineering in the Nuclear Systems Power Section of Space Systems Organization, riding herd on applications of the Division's nuclear business operations: isotopes, or low power systems; reactors, or multi-kilowatt power sources; and power conversion system components of ten kilowatts and above. Included in the current crop of contracts are a thermionic reactor to power an unmanned spacecraft, a magnetohydrodynamic propelled space vehicle and evaluation studies of the safety of an Isotope/Brayton cycle system.

"There's no question," Bob comments, "the nuclear power business has matured. And the seventies will see substantially increased use of nuclear power devices, particularly on spacecraft. The Space Division, with proven aerospace and nuclear power capabilities is in a unique position. With our procedures, capability and technical knowhow, we've got an edge on the competition." Looking ahead, Bob hopes to see multi-kilowatt nuclear-powered spacecraft in flight, whether the mission is earth orbital, lunar landing or a tour of the outer planets. "That's my professional goal for 1980—for a big nuclear power space system to fly—and for GE to get the job of building it." ○

Rewards of Space Research

By Senator Clinton Anderson, Chairman — Aeronautics and Space Sciences Committee.

The space program, spearheaded and motivated by the Apollo goal, has come to maturity. It is now an integral part of the national scene,

not because space exploration is spectacular but because it is a valuable, necessary part of our country's life.

We have heard that Apollo has produced no "tangible" values. Is national pride not tangible? Is international respect not tangible? Is proof of our country's ability to set a goal of enormous difficulty and then to stick to it and accomplish what we set out to do not tangible? I believe they are. In 1960, a worldwide poll showed the majority of the world believing that the dominant force in international affairs would be the Soviet Union. In 1970, the same survey now indicates the majority of the world believes that the United States is—and will continue to be—without peer in power and influence. Can we say that this change of view came about because of the war in Vietnam? Can we say it was caused by our diminishing foreign aid budgets? Can we say it resulted from the image of internal strife, violence and dissension we have grown to accept as normal? Can we say it was the outcome of our senseless environmental destruction? We cannot. We can say, however—as does every informed observer of the international scene to whom I have spoken — that the policy of peaceful use of outer space, the wholly open civilian space program, the tremendous strides in space sciences and the continuing application thereof to human problems here on earth, and above all, the Apollo lunar landing—the victory of man over his terrestrial domain — these are the events and achievements that have moved the minds of men.

These are not inconsiderable values. Are you also aware that it was an astronaut's pressure suit that saved a young woman's life in California last year? That artificial limbs are now using Apollo transducers? That a whole new set of fireproof materials and flammability standards are now available? That Hurricane Camille was spotted and tracked by satellite, and that authorities were therefore able to warn and evacuate Gulf Coast residents? That a NASA centrifuge was used to dislodge a bullet in a man's brain? These, too, are values—the kind we have called spinoff or applications. But is not the greatest value we can identify that of knowledge, of understanding the phenomena that created our world, our solar system, our universe? It is that kind of knowledge we are gaining, and it is only with that kind of knowledge that we can hope to do something about our own future on our own planet. Sixty pounds of lunar rocks are giving up the secrets of their past to the analysis of our scientists; they may hold the first hard answers to the formation of the earth, and therefore to some of the forces with which we must contend successfully if we are to manage and improve our environment.

We learn, too, about man in the laboratory of space: How much is he a creature of the unique surface conditions of earth; how adaptable is he to wholly foreign conditions; what are the limits of his capabilities.

We have created, by dint of stubborn will, dedication and farsighted policy, a space capability for the United States. We have proven to the world our own confidence in that capability by sending men to the moon and back; we have exercised that capability for new communications systems and new levels of accuracy in weather forecasting. We have been using it for science, probing deeper into the nature of the world. We have just begun. The values already accrued outstrip the costs to date; the values to be harvested from now on are measureless —because they are limited, not by technology, not by science, but by our lack of imagination.

We are in a new world because space exploration has made it possible. We must recognize the change, seize the opportunities, and learn to live with a future that, in reality, is the present. o

CHALLENGE

MEMORANDUM

THE WHITE HOUSE

WASHINGTON

GE

→ user
→ toyed w/ comm carrier sat, pre-comsat intl + dom -
pilot useful for econ not tech learning
but real econ learning only w/ ownership -
need new orgl mngmnt to realize unique
advantages of space

EXECUTIVE 3-3600

D. R. RODGERS

MANAGER

MISSILE & SPACE FIELD OPERATION

GENERAL ELECTRIC COMPANY

DEFENSE PROGRAMS DIVISION

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SPACE DIVISION

GENERAL ELECTRIC

VALLEY FORGE SPACE CENTER
P.O. BOX 8555
PHILADELPHIA, PENNSYLVANIA 19101

Summertime...and one's thoughts turn to the cooling waters of the oceans...so did CHALLENGE. In this issue, we turn the spotlight on this newest frontier.

CHALLENGE also spotlights the Air Force's Lt. Colonel Roy Smith, cool and competent Chief of SAMSO's Re-entry Vehicle Division Minuteman III Branch.

I hope you find this an informative issue.

Sincerely,

R. C. Sharp, Manager
Product Information