OCTOBER 31, 1960

missiles and rockets

THE MISSILE/SPACE WEEKLY

Launching of Army's Courier 1B

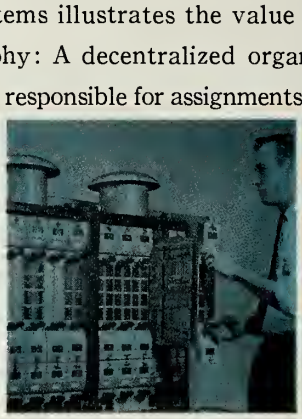
ANSWER TO M/R OPEN LETTER

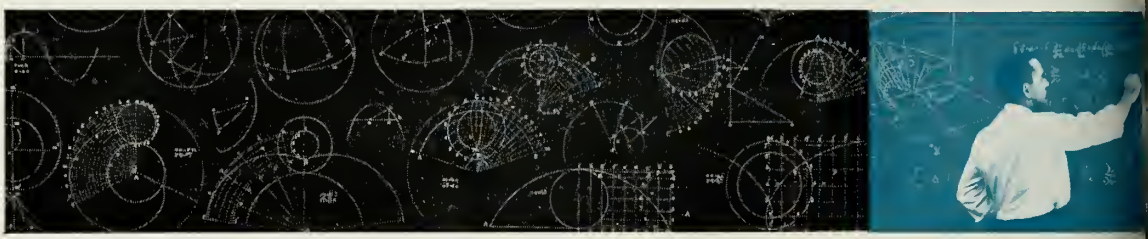
Nixon Takes Defense/Space Stand . . . 10

AN AMERICAN AVIATION PUBLICATION

LIBRASCOPE COMPUTER FACILITIES

Shown below is a composite view of Librascope's facilities wher a variety of computer systems are currently in different stage of design and production. Some are strategically involved witl national defense...others deal with business and industrial proces control. Each is uniquely designed to answer a particular need. Th success of these systems illustrates the value of Librascope' engineering philosophy: A decentralized organization of spe cialized project teams responsible for assignments from concept t delivery...and backed up by excellent research, service, and production facil ities. For your computer requirements, call on the company whose breadt of diversification in computer technology is unsurpassed. ■ Librascop Division, General Precision, Inc., 808 Western Avenue, Glendale, Calif For career opportunities write to John Schmidt, Engineering Employment. ■





computers that pace man's expanding mind

GP

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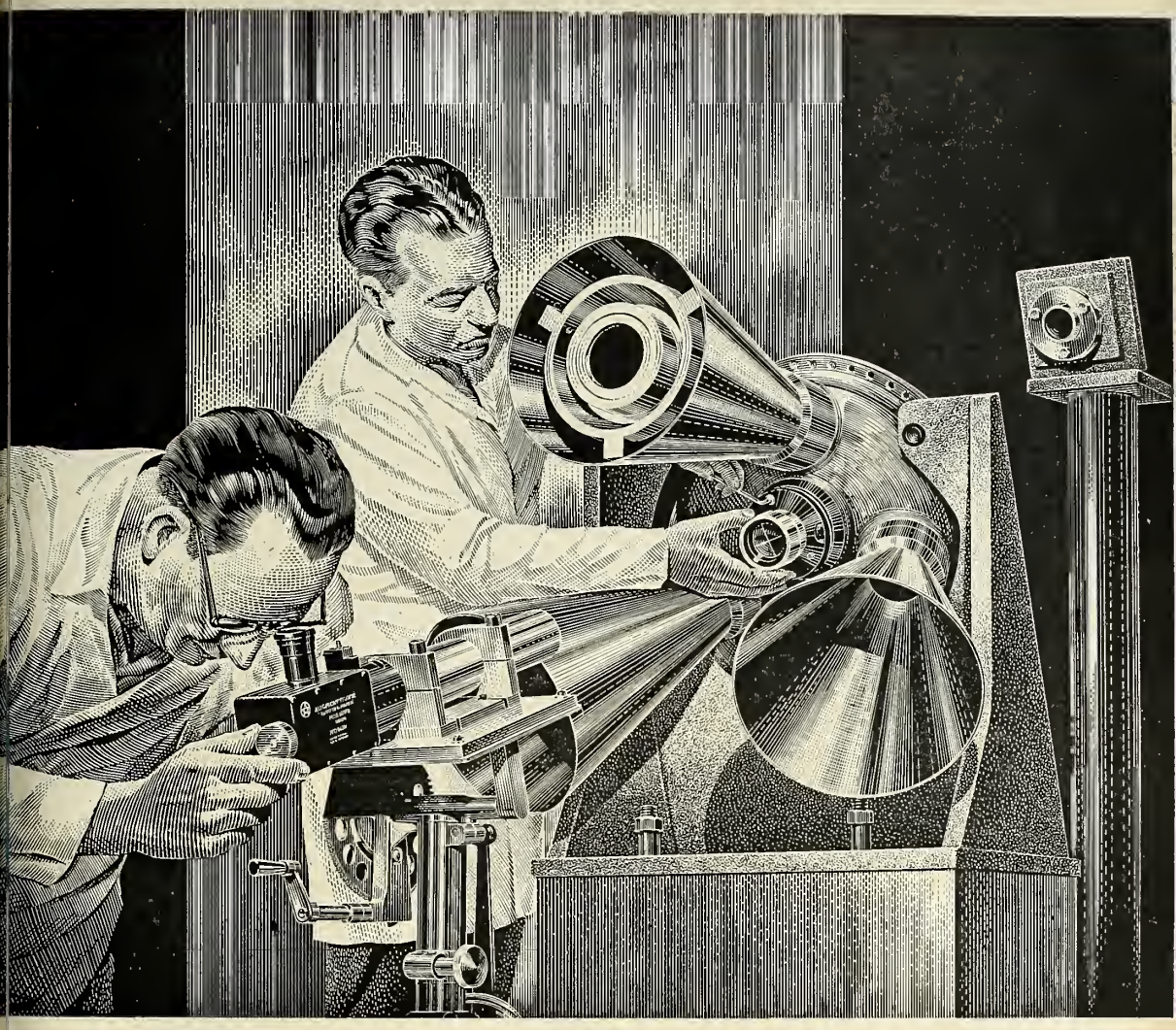

The optically precise calibration of nozzle alignment on a Mercury "Man-in-Space" Rocket Motor is typical of the personal approach applied to a customer's requirements which goes "beyond the specifications." Mercury Motors as developed by GCR achieve a reliability of 99.9%.

rand Central Rocket:

The Personal Approach That Saves Project Time

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Developers of solid propellant motors for Mercury "Man-in-Space," Mauler, Nike Zeus, NASA Space Booster, lunar landing and space probes as well as the Wolf motor, M-motor and hybrid motors. Producers, with "on the shelf" availability, of Javelin, Lance, Viper, Meteor, Jato, Fang, Sword and Saber motors. Positions open for chemists, engineers and solid rocket production specialists.

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AN INDEPENDENT AFFILIATE OF LOCKHEED AIRCRAFT CORPORATION and PETRO-TEX CHEMICAL CORPORATION—P.O. BOX 111—REDLANDS, CALIFORNIA—TELEPHONE PYramid 3-2211.

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HOW SAC'S HOUND DOG CONFUSES ITS QUARRY

When the GAM-77 HOUND DOG strategic missile leaps into action from a B-52G intercontinental bomber, its pre-set controls can veer it off in a direction *away* from the target. It can change course and altitude. Then, with enemy defenses confused, it can turn suddenly and bear down on the target at supersonic speeds. Its guidance system can't be jammed... can't be decoyed. It can reach out hundreds of miles to destroy its quarry.

Outstanding capabilities such as this make the GAM-77 HOUND DOG missile an extremely valuable weapon for SAC. The HOUND DOG has already been tested and proved in flight conditions. It is operational hardware *in being*. And in addition, it has growth potential in range, speed, and payload stretching through many years to come.

THE MISSILE DIVISION OF NORTH AMERICAN AVIATION, INC.

Downey, California

THE MISSILE / SPACE WEEKLY

missiles and rockets

October 31, 1960 Volume 7, No. 18

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THE COVER

The highly successful launching of Army's Courier 1B from Cape Canaveral on Oct. 4. The communications satellite went into orbit on an AF Thor-AbleStar vehicle.

OCTOBER 31 HEADLINES

SPACE MEDICINE

ELECTRONICS

ADVANCED MATERIALS

ASW ENGINEERING

PROPULSION ENGINEERING

DEPARTMENTS

32,747 copies this issue

VIGILANCE

in three dimensions

Eyes can see in three dimensions . . . instantly. Westinghouse has perfected this vital ability in radar to meet defense needs for instantaneous target information.

This Westinghouse technique combines search and height finding in *one* radar. Unlike other systems, the Westinghouse technique offers true 3-D capability. As each target paints on the PPI, its height is immediately available in *real time.*

Developed for the U.S. Air Force, this technique has been successfully employed in both tactical and air defense radars currently in production at the Electronics Division.

One example is the new, truly 3-dimensional AN/TPS–27 tactical radar. This Westinghouse radar requires little or no site preparation, and successfully combines high data rate and mobility with fixed station performance. Here is another demonstration of capabilities for defense.
You can be sure . . . if it's Westinghouse.

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The Countdown

WASHINGTON

Fear New Soviet A-Weapons

Top U.S. officials are deeply worried that Russia secretly may be developing "entirely new" nuclear weapons. The Soviets, these officials point out, could be testing the warheads for the weapons far underground—where they can't be detected. The new weapons may be tied to Russia's expanding space technology.

Kennedy Oversight

Senator Kennedy's advisors are now advising that his failure to include the B-70 in his response to M/R's open letter Oct. 10 was an oversight. He's in favor of building it; so's Nixon (see p. 10).

Advancing Polaris

R&D schedule for the Navy's 1500-mile and 2500-mile *Polaris* now looks like this: The 1500-mile A-2 *(Polaris II)* is expected to be operational by early 1962 or late 1961. The 2500-mile A-3 *(Super Polaris)* is expected to be combat ready by late 1964 or early 1965. All FBM submarines now under construction or in the engineering phase are being designed to handle both advanced models of the missile.

Advancing Asroc

With the *Advanced Asroc* now under development, the Navy expects to be able to strike enemy submarines at ranges well over eight miles. The key is GE's Mark 44 Mod 1 torpedo which will be the *AA's* payload. The standard *Asroc,* which went operational recently, packs GE's Mark 44.

Best the Enemy See

New argument being pushed by the Navy to go ahead with seaborne satellite launch facilities: it would permit secret launchings and keep the U.S. from tipping its hand on the status of military hardware programs.

INDUSTRY

Where the Missile Money Goes

The Air Force these days estimates that 80% of the total cost of its ICBM's is being spent on site activation. At the height of activation of a single launch site, costs can run to $100,000 to $200,000 per day—a particularly expensive item when there are slippage-causing work stoppages.

PERT Expands

Success of PERT (Program Evaluation Review Technique)—computerized management of *Polaris* R&D—is prompting the Navy to adopt it for all major new weapon programs.

Procurement Guidelines

The Air Force is currently beefing up its procurement regulations with a series of broad general guidelines for contractors. It also is warning AF personnel to avoid "imprudent social relationships" with contractors—including acceptance of gifts, entertainment or favors.

Flight Model Ion Engine

Look for NASA to award an R&D contract late in 1961 for a flight-model ion device with a 0.1 lb. thrust, using the SNAP-8 30-kw nuclear powerplant. Program will be based on Hughes' 0.01-lb.-thrust laboratory ion engine, which may be scaled up or clustered. First flight tests are to begin early in 1963, starting with battery-power aboard sounding rockets. First orbital flight with SNAP-8 power is programmed for 1965. This also may be the first flight of a ½-lb.-thrust plasma engine being developed for NASA under competing studies by GE and Avco.

Bigger 'Scope'

Kitt National Observatory, Tuscon, Ariz., is designing a 50-in. telescope for an advanced NASA orbiting Astronomical Observatory. It will be launched into a 24-hr. orbit, probably in 1966 by a *Saturn* vehicle. Prototype already has been built of the 10-ft.-diameter, 30-ft.-long telescope and is being groundtested for remote control, data reduction and telemetry techniques.

Nimbus Contract Slips

NASA's unexplained delay in awarding a prime contract for *Nimbus* is raising questions whether the advanced weather satellite will be launched as planned in early 1962. Some bids on subsystems (PCM telemetry and the tape recorder) already are in.

Apollo Speed-Up

COUNTDOWN hears pressures on Vice President Nixon's campaign may account for the timetable speed-up in the *Apollo* three-man spaceship. NASA was three weeks ahead of its self-imposed Nov. 14 deadline in awarding six-month, $250,000 feasibility study contracts. They went to Convair, Martin and GE last week, and cover system requirements, program plan, funding for a FY '62 R&D program.

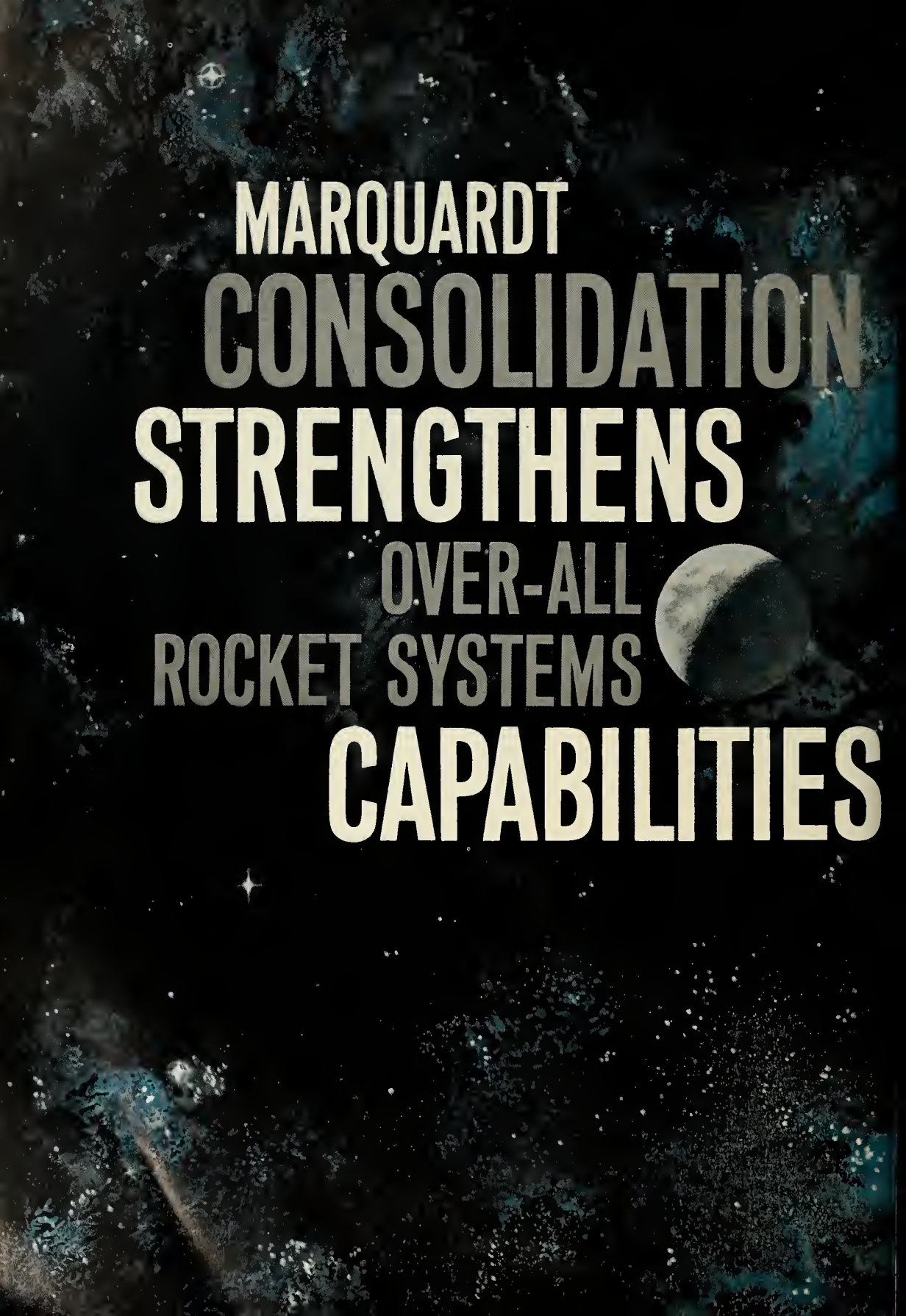
INTERNATIONAL

France's 5-year Defense Plan

De Gaulle's five-year defense program which squeezed through Parliament includes only $1.2 billion for nuclear "deterrent" weapons, which many French congressmen feel is insufficient. The total five-year defense "equipment" budget of $5.2 billion also includes: $154 million for missile R&D; $45 million for propulsion R&D; $45 million for test ranges; $10 million toward civilian space projects. No money was appropriated for a tactical ballistic missile. Estimated 10-year development cost of a strategic ballistic missile is $800 million, with tests beginning in 1963 and the first ones operational in 1968. Nuclear warhead development will proceed at $40 million to $60 million per year, bringing A-bombs into quantity production in 1968—and H-bombs not until 1970.

Overseas Pipeline

Russia is eyeing an astronomical observatory satellite . . . Key to Britain's space program may be the communications satellite package now being proposed by NASA for U.S. industry . . . Decision on an MRBM for Europe is not expected now until the mid-December NATO ministers conference.


MARQUARDT
CONSOLIDATION
STRENGTHENS
OVER-ALL
ROCKET SYSTEMS
CAPABILITIES

Cooper Development Division to Centralize Operations in Van Nuys

In the next few months the entire Cooper Development Division will move to the Van Nuys headquarters of The Marquardt Corporation. By concentrating aero/space operations in one centralized, fully equipped facility, the full capabilities of Cooper can be better focused on the technological problems facing government, industry, and private research groups.

Cooper Development Division will be in direct contact with extensive testing facilities and the combined experience and knowledge of the Power Systems Group and the ASTRO Division. Power Systems Group maintains an outstanding reputation in advanced rocket engine concepts, fuels and propellant research, high temperature materials development and experimentation, and advanced manufacturing techniques. A close working relation with the ASTRO Division will provide a nationally recognized source of basic and applied research information as it pertains to CDD's operations.

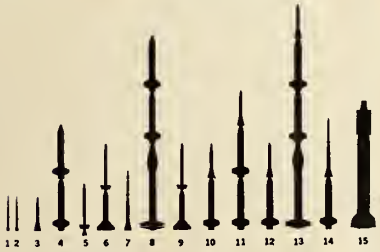
CDD, located in Monrovia, California when acquired by Marquardt in 1958, provides complete and proven high altitude rocket research services. These high altitude or space probe systems are designed for wind measurement; meteorological, radiation and biological information; and similar military and scientific high altitude aero/space programs.

CDD supplies a complete project service—from design, development, and production to field testing and data evaluation—for rocket research systems. Now with immediate access to larger testing and manufacturing facilities and directly supported by Marquardt's more than fifteen years of comprehensive experience in the propulsion field, CDD can offer their customers broader, faster problem solutions on an even more competitive cost basis.

Detailed information covering Cooper's experience, capabilities, products and services may be obtained by writing A. B. Metsger, Vice President-General Manager, Cooper Development Division, The Marquardt Corporation, 16555 Saticoy Street, Van Nuys, California.

Engineers and scientists experienced in aero/space activities are invited to acquaint themselves with the outstanding career opportunities in the field of rocketry at The Marquardt Corporation.

The Cooper Family of Rockets



1. ROKSONDE 100
2. ROKSONDE 200
3. ASP I
4. PYTHON
5. ASP IV
6. TERRIER—ASP 150
7. ASCAMP
8. BOA
9. TERRIER—ASP 300
10. ASPAN 150
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Nixon: Military Has Mission

Vice President breaks silence in defense/space debate— replying to M/R's open letter, he contends Administration 'long ago' recognized strategic space race with Russia; sees 1970-71 lunar landing; opposes DOD reorganization

MISSILES AND ROCKETS submitted an open letter Sept. 27 to Vice President Nixon containing a nine-point proposal on defense and space. Following are Mr. Nixon's comments (M/R's proposals are in italics).

by Vice President Richard M. Nixon

1. Recognize as national policy that we are in a strategic space race with Russia.

If the Eisenhower Administration had not long ago recognized that we were in a strategic space race with Russia, our space record would not be as creditable as it is today.

Twenty-six earth satellites and 2 space probes have been launched successfully by the United States.

Six satellites and 2 space probes have been launched successfully by the Soviet Union.

Today 13 United States satellites are in orbit; only 1 Russian satellite remains in orbit.

Eight United States satellites in orbit are still transmitting; the sole Russian satellite in orbit is not transmitting.

The United States has recovered 2 satellite payloads from orbit while the USSR claims to have recovered one.

Despite the greater weight of USSR space vehicles, the United States has gathered far more scientific information from space. In instrumentation, communications, electronics, reliability, and guidance, United States space vehicles have made gigantic strides.

In short, the United States is not losing the space race or any other race with the Soviet Union. Today we are ahead of the USSR. From a standing start in 1953, we have forged ahead to overcome an 8-year Russian lead. And we will continue to maintain a clear cut lead in the race for space.

2. Expedite present space projects to provide a new and bold program with the following goals; Manned space platform—1965; A U.S. citizen on the moon—1967-68; Nuclear power for space exploration—1968-69; A space craft which can take off from earth, travel to and in space, return and land under its own power—1968-69.

The ability to exploit space is a first priority national objective of the United States. Inspiring goals have always been the choice of the American people. In the exploration of space our goals will be moved forward as rapidly as possible, taking immediate advantage of every technological breakthrough. We have a ten-year program, officially approved by the space agency and the President, targeted on realistic goals that can be achieved. It is bold and imaginative and as compatible with proposal no. 2 as informed technological projections will permit. Briefly, it provides for actual testing of a nuclear-fueled space engin Project *Rover*, by 1965. The program calls for launcl ing and operation of a permanent manned space st tion to which our astronauts will go and come ar stage flights deeper into space in the period 1966-196 It provides for the first manned circumlunar fligh around the moon in the period 1967-68.

Because of the need to perfect the nuclear dee space engines and insure adequate power for retur and safe landing on earth, the moon landings ar presently scheduled for the period 1970-71. It entirely possible that this target date will be advance

3. Recognize that "space for peaceful purposes" possible only if "freedom of space" is ensured; henc that the U.S. military must be given a predominar role in developing and carrying out the projec necessary to guarantee freedom of space.

"Freedom of space," like "freedom of the seas," essential to the progress of mankind. The United State will promote the concept of "space for peaceful pu poses," and be its champion. Our efforts will b directed to ensure that we are fully supported b international agreement and law. As with our othe ideals and principles, our military forces must hav the mission, and the necessary strength, to defen "freedom of space."

4. Establish pre-eminent strategic, tactical and de fensive forces with representation from all service.

President Eisenhower's 1958 reorganization of th Defense Department tightened civilian control over ou Armed Forces, firmed the authority of the Secretar of Defense, strengthened the staff serving the Joi Chiefs of Staff, cleared the command channels to ou fighting forces, and opened the way for expediting th decision-making process.

The execution of this plan has completely justifie and demonstrated the effectiveness of civilian contr and our present concept of organization.

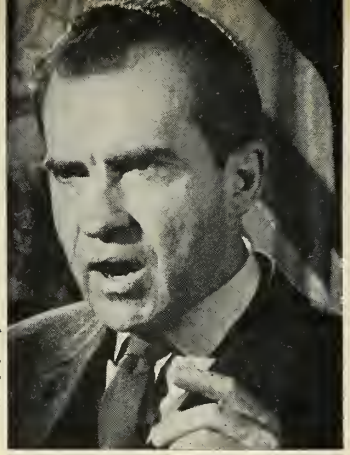
I oppose the establishment of pre-eminent strategi tactical, and defensive forces with representation fro all services. My reasons, in part, are as follows:

1. Precise advantages of functional organizatio have not been identified and presented to the Congres and to the American people.

2. Today we have a proven defense system whic we are asked to abandon in favor of one havin obvious defects and no publicly known advantages.

3. The principles of functional organization an of the unified command are not new in any respec In fact, in our present defense organization, suc principles are used whenever they can be employe effectively.

Defend' Space



"I oppose establishment of pre-eminent strategic, tactical and defensive forces with representation from all services."

4. The proposal could lead to as many separate forces as there are military functions to be performed. Instead of an Army, Navy, and Air Force a multiplication of services could result accompanied by duplication, confusion, and increased costs without increased military capability.

I reject a "cannonball" approach and I reject the principle that just a little bit of reorganization will produce perfection in our defense organization. Improvements have been made over the years and will continue to be made after careful analysis, and with the approval of the Congress.

I believe that our present defense organization established by President Eisenhower should be retained for the present. Today our Armed Forces, subject to civilian control, are fully capable of an immediate and flexible response operating under an umbrella of invulnerable and diversified deterrent forces.

. Recognize the necessity of greater defense fund-ng to accomplish this, including a supplemental udget in January, 1961, to make it possible to: Speed p to a maximum degree the construction of ICBM aunching bases, Polaris submarines and the Mach 3 issile-carrying B-70. Provide the Army with funds o begin the immediate procurement of already-eveloped modern missiles, other weapons and airlift.

With respect to future defense budgets, the amount required must be determined on the basis of forces and programs and in context with the total national strategy. Military technology is moving at a very rapid pace and changes are occurring almost daily in the international situation. Clearly, under these circumstances, the defense program must be kept under virtually continuous review and changes made promptly wherever necessary. I have said many times I favor acceleration of the *Polaris* and *Minuteman* programs and I favor the speedy development of the B-70. Whether a supplemental appropriation will be necessary in January is a decision to be made at the time. If it usefully would serve our missile program, accelerated as recently as August and September by the President, I would favor it.

There cannot be and will not be a price ceiling on our security. The United States must, and I for one am resolved, to pay what is necessary in money and effort to provide for our common defense.

This is my position and I state it positively—we can afford and we will provide the defense America needs. There can never be a price ceiling on security, nor will we flinch from the demands our security requires.

Establish further-on defense spending by need and ot by budget ceiling.

In answer to this question I should like to quote from the Republican Party Platform of 1960:

The United States can and must provide whatever is necessary to insure its own security and that of the free world and to provide any necessary increased expenditures to meet new situations, to guarantee the opportunity to fulfill the hopes of men of good will everywhere. To provide more would be wasteful. To provide less would be catastrophic. Our defense posture must remain steadfast, confident, and superior to all potential foes.

7. Streamline defense regulations and procedures to make industry's role in the U.S. defense and space effort more effective.

Defense regulations and procedures have improved steadily throughout the years of the Eisenhower Administration.

Of America's annual 40-plus-billion-dollar defense budget, approximately 25 billion dollars is spent each year in contracts for equipment, material and services including research and development of weapons systems.

Now, the 25 billion defense dollars spent in industry contracts is three times the combined purchasing volume of General Electric, General Motors, and United States Steel.

Obviously, in a business as large as that conducted by the Defense Department, improvements can be made. And improvements have been made and will continue to be made. As an example, the Single Manager System installed in 1956 to eliminate duplication among the military services in the procurement of common-use supplies has produced almost 400 million dollars in factual savings over the last four years.

8. Take what steps may be necessary to establish and promote national scientific objectives.

National scientific objectives have been established and are being pursued vigorously. Technological breakthroughs are exploited to the maximum advantage. From a standing start in 1953, the United States has had to telescope time in our scientific efforts. Our scientists and engineers have worked wonders, and are highly deserving of the deep gratitude of this nation. I can assure my fellow Americans that we will all continue to press forward to attain and even surpass our national scientific objectives.

9. Re-establish decision-making in the U.S. defense and space organizations.

It may be that further improvement in the decision-making process will be found necessary in the future. I will not hesitate to recommend to the Congress any additional improvements required in the national interest. At the same time, I can not condone any changes incompatible with our fundamental principles of government. ⁂

Turn page for comparison of Nixon's stand with Sen. Kennedy's answer in M/R Oct. 10.

Candidates' Views Compared:

Senator Kennedy

1. We are in a strategic space race with the Russians and we have been losing.

2. Target dates for a manned space platform, man on the moon, nuclear power for space exploration and a true manned space ship should be elastic. All should be accomplished as swiftly as possible.

3. Freedom of space must be assured, preferably by mandate of the United Nations. The United States must have pre-eminence in security as an umbrella under which we can explore and develop space for the benefit of all mankind.

4. We must reorganize the "cumbersome, antique and creaking machinery of the Department of Defense. The Democratic Platform calls for reorganization according to functions and missions. We will study the feasibility and efficiency of a (combined) Strategic Command, Tactical Command, Continental Defense Command, Material Command and Development Command."

5. "In January I will send to the Congress specific requests to: accelerate *Polaris, Minuteman* and other strategic missile programs; expand and modernize our conventional forces; harden and disperse bases; use an air alert; do more on antisubmarine warfare; speed up development of space warning systems and an anti-missile weapons system."

6. "Defense spending must be based on the security needs of the nation and not the predetermined confines of a budget. Basic research must be encouraged and expanded on a long-range budget plan. Research cannot be started and stopped according to the whims of the budgeteer."

7. "Certainly defense regulations and procedures must be simplified and the proliferation (in the Department of Defense) of secretaries, assistant secretaries, under-secretaries, special assistants and deputy assistants to secretaries, boards, commissions, councils and committees must be rolled back."

8. "National scientific goals will be our first objectives, continuously emphasized."

9. (On decision-making) "The Democratic Party has strength in depth among dedicated men familiar with defense problems. They will have a mandate to speed the decision-making process, and authority to make affirmative decisions very quickly."

Vice President Nixon

1. The Eisenhower Administration long ago recognized we were in a strategic space race with Russia. Today we are ahead.

2. The ability to exploit space is the first priority national objective. The Administration's 10-year program calls for testing a nuclear-fueled space engine by 1965; a permanently manned space station by 1966-67; circumlunar flights in 1967-68; moon landings 1970-71.

3. "Freedom of space," like "freedom of the seas," is essential to the progress of mankind. Our military forces must have the mission and the necessary strength to defend "freedom of space."

4. "I oppose the establishment of pre-eminent strategic, tactical, and defensive forces with representation from all services." Among the reasons: It could lead to as many separate forces as there are military functions to be performed . . . "I believe that our present defense organization established by President Eisenhower should be retained for the present."

5. "I favor acceleration of the *Polaris* and *Minuteman* programs and the speedy development of the B-70. Whether a supplemental appropriation will be necessary in January is a decision to be made at the time. If it would usefully serve our missile program, I would favor it."

6. The United States can and must provide whatever is necessary to insure its own security. To provide more would be wasteful. To provide less would be catastrophic. There should never be a price ceiling on security.

7. "Defense regulations and procedures have improved steadily throughout the years of the Eisenhower Administration. Obviously, in a business as large as that conducted by the Defense Department, improvements can and will continue to be made."

8. "National scientific objectives have been established and are being pursued vigorously. Technological breakthroughs are exploited to the maximum advantage. I can assure my fellow Americans that we will all continue to press forward to attain and even surpass our national scientific objectives."

9. "It may be that further improvement in the decision-making process will be found necessary in the future. I will not hesitate to recommend to the Congress any additional improvements required in the national interest. At the same time, I cannot condone any changes incompatible with our fundamental principles of government."

Countdown for Survival

M/R readers continue to debate th defense/space issues raised in the Oct. . edition. A few of their comments:

Define 'Space Race'

Isn't it time we defined tbe term "Spac Race?" Before readers can have educate views on "winning the strategic space rac with Russia" they should have a clear-cu understanding as to the objectives of th race.

In actuality, it would require actio at the top levels of our government an State Department to properly define th "Space Race." And I believe it is tim that this should be done.

Why not set forth—for the world t know—(a) Just what we consider to b productive efforts in this field and, there fore, ones in which we will be very active and (b) Efforts we consider to be a wast

'Most Powerful'—Ike

President Eisenhower struck out at critics of the U.S. strength during a nationwide "non-political" speaking tour.

"If we look out today at ourselves in true perspective we see a great nation," the President said in his concluding address at Houston. "The most powerful the world has seen . . ."

He said the United States has no need for "giant new arms programs." He said the nation already is "pursuing defense policies and programs which provide us with real security now, and if our nation remains alert and flexible in meeting changes in the world situation will do so into the future."

Defense Secretary Thomas Gates said in a speech in Miami the following day that U.S. military strength is "the greatest the world has ever known."

"I would resign my position as Secretary of Defense this moment if I had any reason to believe that our national policies were building a second rate defense," Gates said.

of time, money, men and materials, an therefore efforts in which we will d nothing. For example, in category (a) w could include all space programs whic promise concrete advantages, such as sa ellites for navigation, surveillance, weathe observations, communication and tel vision relays, "man in space" effor related only to space adjacent to our ow planet, rockets for mail and other tran portation and the like. In category (b let's publish as official that we do n intend to put a man on the moon—(any other planet. What purpose is the in such devastatingly expensive efforts?

(Continued on page 46)

A-Test Ban Hurts Missile Warheads

AEC's Wilson leads in warning that Reds may be testing; Polaris, Minuteman are affected

by James Baar

FAILURE of the United States to sume nuclear testing and its possibly oding effect on U.S. missile power is using increasing alarm in military rcles.

The reason is the growing belief nong top government officials that e Russians are conducting secret nderground nuclear tests.

AEC and military officials warn that this is so, and the United States does ot follow suit, the Russians can gain a emendous advantage in developing im-oved nuclear warheads for both ctical and strategic missiles.

Particularly at stake is the chance develop much more powerful war-ads for *Polaris* and *Minuteman*.

Today all nuclear-tipped U.S. ssiles carry warheads tested prior to ov. 1, 1958—the beginning of the f-imposed U.S. suspension of nuclear ting that matched a moratorium de-red by Russia. In effect, the U.S. oratorium froze the payloads for ich missiles are designed.

New tests, all of which would be derground to prevent fallout, could begun very quickly. The AEC has rked throughout the moratorium iod on the improvement and ex-nsion of elaborate facilities for under-und testing at its Nevada Test Site.

The first underground test—*Rainier* ook place there in 1957. Other tests owed under the Nevada mesa.

• **Soviet cheating?**—Both presiden-i candidates in their fourth TV de-e underlined the possible danger of tinuing indefinitely the so far fruit-e negotiations with the Russians for uclear test ban based on a satis-ory system of policing it.

Sen. John F. Kennedy said whoever elected President should make one effort to reach an agreement with sia on a test ban. But he said if the rt fails "we'll have to meet our onsibilities to the security of the ted States."

Vice President Richard M. Nixon believes the Soviets are "actually filibustering" the test ban negotiations and that "it's time for them to fish or cut bait." He said a last effort at agreement should be made immediately after the presidential election.

"I don't think we can wait until the next President is inaugurated," he said, and added omniously that based on reports he has concluded the Russians already "may be cheating."

Dr. Robert E. Wilson, an AEC commissioner, was more specific. In an Oct. 20 address in Chicago, Wilson said:

"There have been recent indications of some explosions in Russia which they have tried to explain as unusually large shots of conventional high explosives.

"No explanation has been offered," he added pointedly, "with regard to their claim last winter of having just developed an amazing new weapon. If that was a nuclear weapon, as seems probable, how could they know it was amazing unless they had tested it? Or, if they are turning out missiles like sausages, as Mr. Khrushchev told the United Nations, dare we assume that these are either of old or of untested designs?"

• **Key to power**—Wilson, a former board chairman of Standard Oil of Indiana and a noted engineer, also put in some of the plainest terms so far the military gains to be achieved by resuming nuclear testing:

—"New and really revolutionary types of nuclear weapons might be developed by the underground testing of relatively small weapons. This is especially true in the small 'battlefield' devices designed to put troops out of action quickly and effectively with a minimum of people at a distance. In addition, however, valuable information regarding much larger weapons can also be obtained by small underground weapons tests which would be free from any possibility of fallout.

—"Designs of nuclear weapons really tailored to recent and prospective new defense systems could be developed and their dependability and safety, which must necessarily be demanded of all nuclear weapons stockpiled, could be reliably checked.

—"It would be possible to increase substantially the yield-weight ratio of a considerable number of our older bombs and warheads using this advantage either to increase the yield for a given weight, or decrease the weight for a given yield, both of which would have great military value, especially in long-range missiles such as the *Minuteman* and *Polaris*.

—"It would be possible to make further progress on getting greater cleanliness—less radiation hazard—in weapons of various sizes and it might even be possible to produce thermonuclear weapons without any fissionable products, as some of our scientists have envisioned."

Wilson said that these foreseeable improvements are of such importance that "any country which decides to proceed with further testing . . . while we continue to observe a moratorium is likely in a few years to take our place as the foremost nuclear power in the world."

Moreover, Wilson clearly indicated he thought this was exactly the course on which the Russians have already embarked.

"We know of no practical way at present to detect and identify underground tests inside Russia up to 20 kilotons of TNT equivalent or well over 100 kilotons if they are muffled," he said.

"In view of the Soviets' record of open breaches of solemn agreements and promises during the past 15 years . . . it is beyond my comprehension why so many well-meaning people urge blind reliance on their record in this area where incentives for breaking it are so large and there is virtually no chance for detection."

It is understood that other members of the AEC saw Wilson's statements and generally concurred. ⁂

The Missile/Space Week

Bambi, Saint and Spad—Satellites Beware

The Air Force is expected to award a contract by mid-November on *Saint*—A system for inspecting and intercepting enemy military satellites.

Some two dozen companies are understood to be involved in the bidding that closed at the end of October. The Air Force is reported to be planning the first test launching within a year.

Meantime, ARPA is moving ahead with its *Bambi* studies for a satellite capable of launching anti-missile missiles against ICBM's seconds after they are launched. A competition for more studies is possible soon.

Convair's *Spad* is a principal entrant in the field. *Spad* is a study aimed at development of a satellite that would provide early warning of a launching and either alert ground-based anti-missile missiles or launch one itself.

Red Rocket Sub Raises Few Eyebrows

Informed Navy sources are attaching nothing new to Soviet premier Nikita Khrushchev's recent boast that Russia has submarines "equipped with atomic engines and armed with rockets."

The Navy has said for some time that the Russians were apparently building several nuclear-powered submarines. It also has said that Soviet diesel-powered "Z" Class submarines carried missiles with a range of several hundred miles. These missiles are launched from the surface.

Navy sources said Soviet missiles carried by a nuclear-powered submarine apparently are of the same type.

IUE Chief Carey Undercut by GE Settlement

Settlement of the nationwide IUE strike against 54 General Electric plants appeared this last week to have weakened the authority of IUE President James Carey.

More than 50,000 IUE members returned to their jobs after the three-week strike concluded in the signing of a contract almost identical to the original proposal offered by GE. The contract provided an initial 3% pay boost.

The settlement came after IUE negotiators and Westinghouse signed a generally similar agreement.

The strike against GE suffered from unpopularity among powerful elements of the IUE—particularly Schenectady Local 301, the union's largest. Carey blamed the strike's lack of gains on Local 301's "desertion."

Top Red General Takes Command of Soviet Missiles

The Russians have again reminded the world of the importance of the all-inclusive Soviet Rocket Command.

The reminder came with the announcement that Marshal Mitrofan I. Nedelin, chief of the Soviet Rocket Command and Deputy Defense Minister, had been killed in a plane crash Oct. 24. Moscow radio said Nedelin has been succeeded in both posts by Marshal Kirill Moskalenko.

Marshal Moskalenko is the former commander of the vital Moscow Garrison and a member of the Central Committee of the Communist Party.

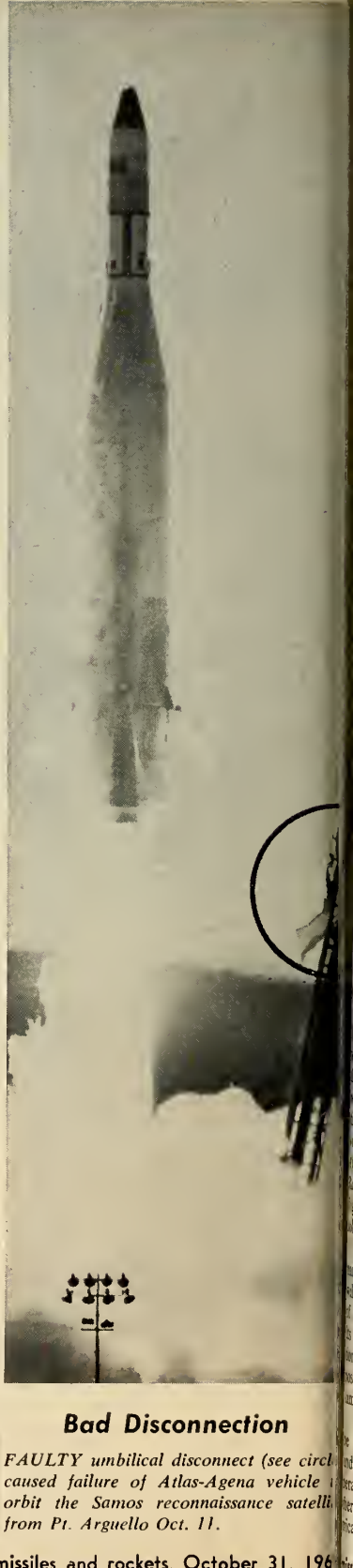
Space Guidance for the Confused

The Defense Department's Office of Public Service is seeking to perform the laudable public service of unconfusing the public about space—now that election time has come again.

In a clearly non-partisan memorandum to all "Department of Defense speakers," Public Services Director James Dunton said "some Americans have the false idea that we are behind the Soviets" in space.

Therefore, Dunton provided a "Score Sheet" on space listing all successful U.S. and Soviet space launchings in small type. In big type, the sheet noted that the "Total Achievements—U.S. vs. U.S.S.R. were 25 U.S. satellites to Russia's six and two space probes each.

Dunton recommended that speakers use the "Score Sheet" to "correct misconceptions." He neglected to suggest any discussion of the relative significance of U.S. and Soviet launchings.



Bad Disconnection

FAULTY umbilical disconnect (see circl caused failure of Atlas-Agena vehicle orbit the Samos reconnaissance satelli from Pt. Arguello Oct. 11.

JPL Space Probing Hits $50 Million

1961 industry share of 65% apt to be hiked next year; planetary fly-bys with Mariner and Voyager vehicle due in 1962-3

by William J. Coughlin

PASADENA, CALIF.—The surface of cloud-shrouded Venus is to be mapped by radar from an orbiting vehicle within five years as part of NASA's interplanetary exploration program. Mars will be mapped photographically at about the same time.

These were among details of NASA lunar and planetary programs outlined here last week by Jet Propulsion Laboratories for some 600 industry representatives. It was the last of three briefings held at NASA centers following the first NASA-Industry Program Plans Conference in Washington (M/R, Aug. 8, p. 17). Earlier briefings were held at Goddard Space Flight Center (M/R, Sept. 5, p. 13), and George C. Marshall Space Flight Center (M/R, Oct. 3, p. 13).

Dr. William H. Pickering, director of JPL, said the laboratory will spend approximately $50 million this fiscal year on the NASA programs. Of this, 65% will go to industry, with that proportion probably increasing next year.

"As a matter of fact, it is our plan that the lunar program in particular, which represents about 50% of our total fiscal year 1961 budget, will be carried out predominantly through industrial effort," Pickering said.

• **One-ton Surveyor**—There were new details of space vehicles and their experiments.

The *Surveyor* spacecraft which will follow the *Ranger* lunar impact vehicle will weigh approximately one ton, including guidance and retro systems, and be able to soft-land 100 pounds of instruments on the moon. Launch vehicle will be an *Atlas Centaur* similar to the *Atlas Agena B* combination used in the *Ranger* program—which calls for five flights, including three lunar impacts, a solar satellite and an earth satellite.

The *Saturn*-boosted *Prospector* lunar craft which will follow surveyor will be capable of accelerating payloads of several tons to lunar transfer speeds. Its missions will include roving exploration of the moon's surface and the possible return of lunar material samples to earth.

Physical properties of the moon to be measured include surface texture and hardness; thermal properties (temperature, temperature gradients, and thermal conductivity); density; electrical parameters such as conductivity and permeability; the nature and magnitude of the moon's magnetic field, if any; a determination of the level of seismic activities. Geophysical methods, such as seismometry and gravimetry, will be employed to determine the internal structure of the moon.

Whatever lunar atmosphere exists also will be analyzed. Organic molecules will be isolated and analyzed in the search for pre-life and sub-life forms.

• **Search for life**—Fundamental scientific knowledge sought in NASA's space exploration program is aimed at answering three questions:

–Is there extraterrestrial life?

–What can be learned of the origin and evolution of the solar system and its component bodies?

–What must be learned to assure the success of the more difficult missions of the future?

NASA now hopes by 1970 to have spacecraft capable of landing on the surfaces of Venus and Mars, as well as probing out to Jupiter and Mercury. JPL interplanetary craft using the *Centaur* launch vehicle will be called *Mariner* and those using the *Saturn* booster will be called *Voyager*. These plans for interplanetary explorations were outlined:

–First *Mariner* mission will be a fly-by of Venus in 1962 to provide scientific measurements of the planet and developmental test of the spacecraft and its instruments. After a second *Mariner* mission as a deep space in 1962, the *Mariner* will be used with some refinements and instrument changes for Venus probes in 1964 and possibly 1965.

Developmental missions to Venus using *Voyager* will begin in 1965. The first *Voyager* will be an extension of the *Mariner*, with the additional injected weight available being used primarily for a retro-propulsion and terminal guidance system to put the spacecraft in orbit around the target planet. It is planned to include an active radar in the Venus orbiter for mapping the surface.

• **Planet exploration**—First launching of the *Mariner* Mars spacecraft is scheduled for 1963 as a developmental mission and will be a prototype for the 1964 Mars mission. Trajectory will be chosen to provide the best overall test of the spacecraft involving some form of earth return orbit. First flight of a Mars orbiter *(Voyager)* will place emphasis on surface photography.

Direct observation and identification of life forms now living on the surface of Mars is regarded as a most important experiment, requiring a landing. This spacecraft will carry TV reading microscopes working in the ultraviolet and near ultraviolet regions, as well as systems for culturing mirco-organisms and measuring the changes in the culture medium. Dates for Mars surface exploration were not given.

Increased capability of the *Saturn* C-2 vehicle is expected to permit a Mercury fly-by in 1970. Early shots aimed toward this planet probably will be devoted to photographing the planet's surface and permitting, by observation of the spacecraft trajectory, better determination of the planet mass and mass distribution. Experiments will be designed on the basis that Mercury probably is very much like the moon.

Initial effort at probing Jupiter is to be made by 1970, again utilizing *Saturn* C-2 and possibly a nuclear upper stage. Jupiter is assumed to have a large and intense Van Allen radiation belt, and therefore, a strong magnetic field. Measurements of the detailed nature of these features will be made by the first Jupiter spacecraft with a complete spectrum of field and particle measuring devices.

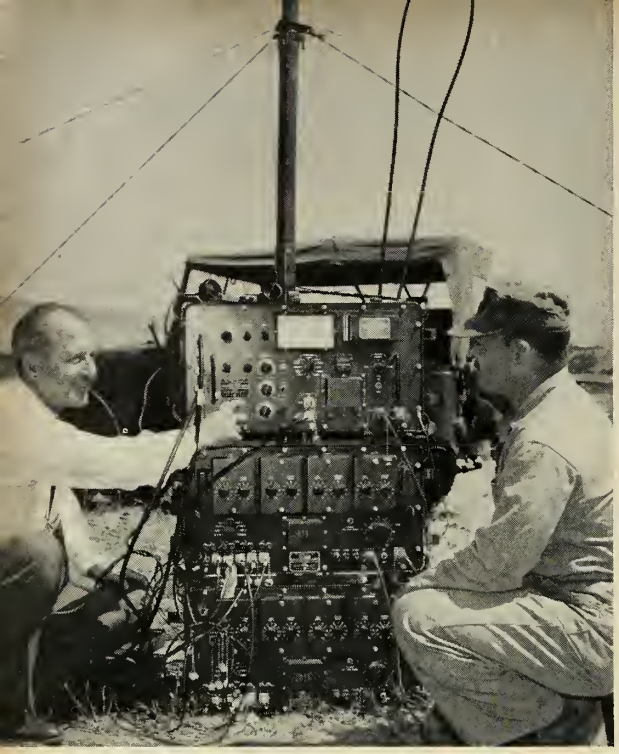
An attempt to probe interplanetary space out of the plane of the ecliptic is planned in 1968, again using *Saturn* C-2.

JPL Contracting Schedule

The *Surveyor* moon vehicle hardware contract will be let probably in February. Present holders of vehicle design study contracts include Hughes, North American, STL and McDonnell.

About 25 firms are being invited to bid on *Prospector* study contracts —with four awards of $250,000 each due to be made next spring. A hardware contract will be let in FY '62.

Awards are due before the end of 1960 on $100,000 study contracts for 250-ft. antennas to upgrade JPL's Goldstone facility in support of the space exploration program. Several lesser contracts are scheduled to be let by JPL in the remainder of FY '61.



Instructing Marine Corps personnel in portable microwave communications equipment, AN/TRC-27.

In Germany, checking a proposed radar site for masking objects, preparatory to installation.

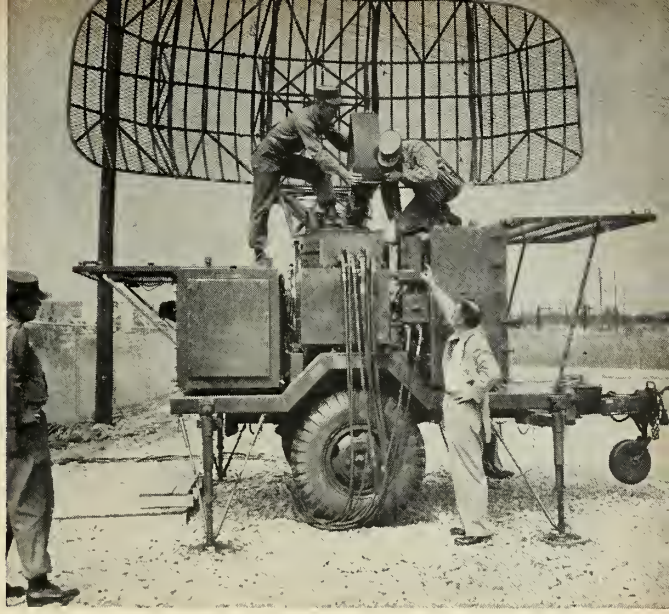
Delivering AN/CPS-9 weather radar parts for the Department of Meteorology, New Delhi, India.

Now in their 18th year of technical assistance

Raytheon field engineers, in over

work on installation, instruction and maintenance

On-the-spot training in the field on part of the Hawk missile system.



About to board a B-47, this Raytheon field engineer provides technical assistance on electronic countermeasures equipment.

(U.S. Navy photo)

On Midway, Navy technicians receive instructions on adjustment of airborne navigational equipment.

With its third consecutive satellite success, RCA Astro-Electronics Division has made "reliability" meaningful in space systems engineering and development. Read the "Reliability Record" for yourself.

December, 1958: Project SCORE. AED developed the communications and control systems for the U.S. Army Signal Corps' "Talking Atlas", part of a program under ARPA, Dept. of Defense. Transmitters, receivers and control units in the satellite and at the ground stations all operated perfectly as the "Talking Atlas" broadcast the President's Christmas message and proved the feasibility of active communications satellites.

April, 1960: TIROS I. The sophisticated satellite, including its structural design as well as the electronic systems, and its ground stations were developed and built for NASA by AED under the technical direction of the U.S. Army Signal Corps. It accomplished its mission in meteorological observation, sending down over 20,000 TV pictures of earth and its cloud cover.

August, 1960: Project ECHO. The only electronic equipment on this 100-foot balloon, launched by NASA to prove the feasibility of passive communications satellites, are two "dinner plate" beacon transmitters 10 inches across by ⅜ inch thick, including storage batteries and solar cells. These units, designed to permit beacon tracking of the satellite, weigh only 11 ounces apiece and were developed and built by AED.

As more and more sophisticated space systems are developed, AED will continue to design for reliability in this most demanding of all environments. To find out how you can draw on this dependable R&D capability, contact the Manager, Marketing, RCA Astro-Electronics Division. If you are interested in participating in this challenging team effort, contact the Employment Manager, Astro-Electronics Division, Defense Electronics Products, at RCA's "Space Center" in Princeton, N. J.

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ELECTRONICS

Radiation Effects Lessened

New high-frequency, thin-base transistors are less susceptible to radiation damage than older types, says IBM in a report on its recent study. Next most seriously affected components are capacitors.

More on Escalator Cooling

Rocketdyne has designed a moving belt radiator for cooling nuclear-powered space vehicles. Running the belt at different rates makes it possible to control the rate of heat loss. The belt runs through the engine, picking up heat at the surface of the reactor core and carrying it outside.

Project Sherwood Spawns Ion Gage

A photomultiplier ion gage, linear with pressure from 10^{-3} to 10^{-10} mm Hg, has been perfected by Westinghouse engineers as part of a long-range AEC-sponsored research program aimed at controlled nuclear fusion. The gage does away with the usual heated filament and employs a beam of ultraviolet light.

Liquid Flywheel For Satellite Stabilization

General Electric is reported to be making progress on the concept of a "liquid flywheel" for satellite attitude control. Liquid metal (such as mercury or sodium) is magnetically pumped around a closed loop at high speed to provide the same stabilization effect as a conventional hard-metal flywheel.

ASW ENGINEERING

Advanced Sonar Tests Start in Spring

If progress continues at its present rate the Navy will test its new 70-mile-range sonar next spring. Only a few weeks ago the Navy ordered production to start on its 12-mile-range sonar system. Both accomplishments have been achieved during the past year following a step-up in ASW R&D.

ADVANCED MATERIALS

Treaty of the Meter Superseded

It was hardly noticed but the world officially replaced the standard meter bar resting in Paris with the orange-red line of krypton 86 as the new standard of length. The U.S. inch must now be equal to 41,929.399 wavelengths of the krypton light.

Inflated Re-entry Gliders Feasible

NASA has concluded that inflatable re-entry vehicles are possible and offer some advantages such as foldability and low landing speeds. One typical configuration would have a wing load of 1.5 lbs./sq. ft. and could operate within a angle-of-attack range from 11° to 66° and at initial re-entry angles from 0° to –2.5°.

Radiation-Resistant Rubbers Developed

Researchers at B. F. Goodrich have created 14 new rubber-like materials which are now being evaluated for radiation resistance. The study expects to show how the addition of an aromatic group in a polymer affects the degree of radiation protection.

GROUND SUPPORT EQUIPMENT

"Measurement Pinch" Tightens

Several instances of just how far the state of the art of precise measurement is being pushed have been revealed at recent Bureau of Standards measurement research meetings. Manufacturers accept jobs with "impossible" tolerances, reluctant to admit that equipment and techniques for the necessary measurements do not exist—and then search frantically for some way to do the job. One company, it was learned, built some ultra-precise equipment but was unable to check it against the specifications. When the units were accepted by the buying service, the manufacturer tried to find out how they were inspected for tolerance and learned that the buyer couldn't check them either.

Solar Test Facility Started

General Electric has begun construction of a facility to test large solar-powered static generating systems for space. The facility, located near Phoenix, Ariz., will be able to handle solar collectors as large as 21 feet in diameter on a movable sun-oriented mount.

Expanded Standing Still

Newly acquired data published by ARDC effectively increased the maximum altitude rating of Republic Aviation's new space simulation chamber from about 800,000 to more than 1,000,000 feet. The chamber's pressure capability of 10^{-8} mm Hg remained the same, however.

Electronic Pump Produces Ultra-High Vacuums

Vacuums well past 10^{-9} mm Hg are said to be obtainable with Varian's new VacIon electronic pumps. The pump, with no moving parts, operates by electronically removing gas molecules and atoms from circulation by the formation of chemically stable compounds and by "ion burial."

OPTICS

Super-Precise Camera Developed

A resolution capability of 50,000 lines per inch has been achieved by a research camera developed by the National Bureau of Standards. The camera will be used in efforts to set up standard methods for determining the resolving power of photographic materials. No such standard exists at present.

Bigger Telescope for OAO

A 50-in. telescope is planned for later versions of the NASA Orbiting Astronomical Observatory, replacing the 36-inch unit programed for the first two satellite observatories. The bigger telescope would enable researches to measure the red shift of Lyman-alpha emissions from galaxies farther than the two-billion-light-year range of the 200-inch Palomar optical telescope.

PROPULSION

Polaris Propellant I_{sp} 245-250 seconds

It's now declassified: I_{sp} of the present 1200-mile *Polaris* propellant (ammonium perchlorate-aluminum polyurethane combination) is 92-94% of the theoretical limit of 266 seconds.

Astronauts Get 'Final' Space Suits

Latest version incorporating 120 modifications of original design gives much greater freedom of movement, safer instrumentation

STRAPPED, VISORED AND ZIPPERED Astronaut "Deke" Slayton emerges from centrifuge chamber after a rigorous test of the new suit. In case of a cabin decompression, the orbiting astronaut could not live more than 10 seconds without the suit.

by Heather M. David

THE FINAL DESIGN of the *Mercury* pressure suit has been streamlined to allow the astronaut greater movement—from bending his knees to gulping his Adam's apple.

The new suit incorporates some 120 modifications of the original model designed by the National Aeronautics and Space Administration's Space Task Group and manufactured by B. F. Goodrich. It was pronounced flight-ready after weightlessness tests in a KC-135 transport at Wright-Patterson AFB, Dayton. The astronauts got the new suits from Akron last month.

Barring further drastic complications, this suit will go on the first manned *Redstone* flight—scheduled for early 1961—through the orbital mission. All seven astronauts rigorously tested the new suits in the *Redstone* mission profile on the Navy's Aviation Medical Acceleration Laboratory centrifuge at Johnsville, Pa.

• **Design lampooned**—Throughout the program much criticism had been leveled at the suit design, which under full pressure permitted little maneuverability by the pilot. The addition of reinforcing strips at the knees, shoulder and small of the back has helped by creating extra bending points.

The astronauts are satisfied. Navy Lt. Comm. Walter Shirra, who specialized on the suit part of the program, maintains "The suit is adequate for what we want it to do."

"It's not designed to walk around the moon or change vehicles in space or put patches on rocket ships . . . The requirements of the *Mercury* capsule are such that we are in a couch or use part of the couch to protect us."

Five "ribs," or convolutions, at the shoulders, elbows and knees allow bending movement of almost 90°. NASA spokesmen admitted that bearings at the joints would allow easier movement but the danger of pressure leakage would be greater.

The hands, a trouble-spot since de-
gn first began, have shaped up with
but one finger curved with ribbed
aterial to follow the natural con-
uration.

After much experimentation, the
ace Task Force found that the astro-
ut needed one finger he could
aighten without too much effort to
sh control buttons. The left middle
ger has been designed to remain
aight under pressurization for this
rpose.

• **Medical instrumentation moved**
In testing one of the older suits the
ace Task Force found that there was
great danger of disconnecting the
edical telemetering system attached
the astronaut's waist.

The biopatch was moved to a less
lnerable spot on the right thigh, where
e wiring does not interfere with body
ovement or the oxygen connection.
addition, the telemetering system was
anged from a 16-connection maze of
ring to a single, round cannon-plug
nnection with 20 possible inputs.

Through this one attachment, tem-
rature, respiration and four EKG's
ectrocardiograms) will be transmitted.
e EKG's will be sensed by two elec-
des strapped on the chest and one
der each arm.

Other monitors have not yet been
nounced. No answer to the problem
taking blood pressure has yet been
nd, according to NASA officials.
ce a pressure cuff must be used to
se blood pressure, it becomes a diffi-
lt and cumbersome task in flight.

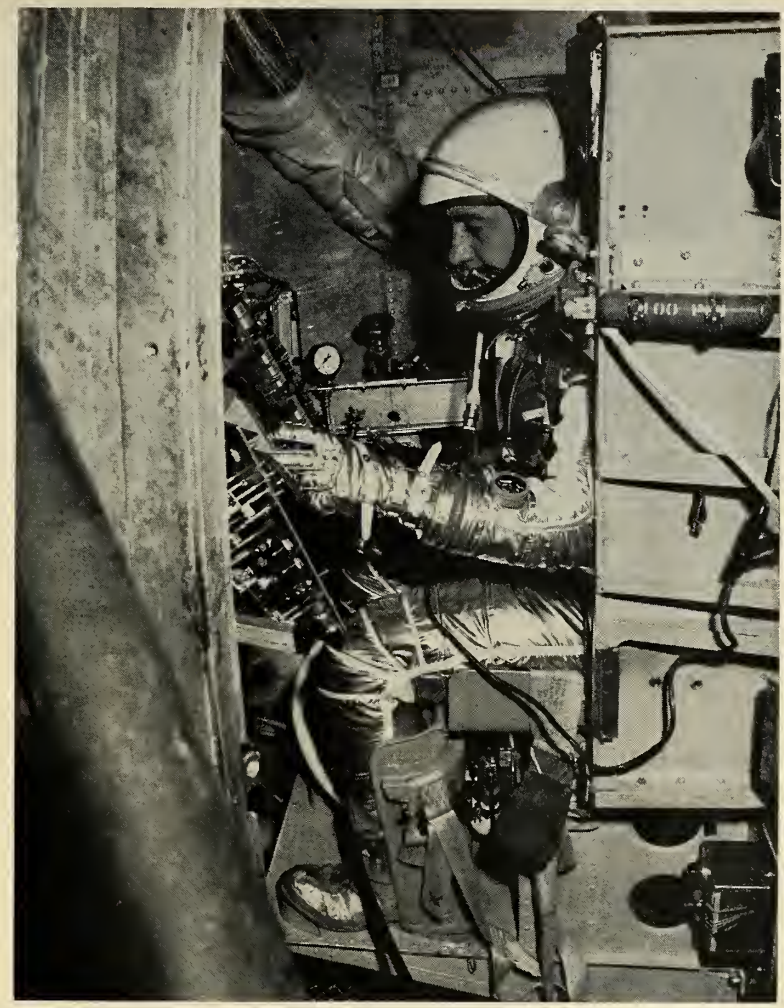
The oxygen umbilical cord remains
the waist where it disseminates 100%
throughout the suit to cool it be-
re circulating into the helmet. A con-
ction at the helmet purges the system
exhaled CO_2.

Odors removed from the suit are
ssed over an activated charcoal bed.
vo beds of lithium hydroxide remove
CO_2. The oxygen supply will last
hours, but the lithium hydroxide
ll be expended in 36 hours.

• **Air-conditioned**—Although air
nperatures may reach 125° or more
ring re-entry, the suit can be easily
ntrolled to a comfortable 80°. In a
cent *Big Joe* booster shot the *Mercury*
psule went to 150° air temperature
d 225° wall temperature—still no
ad on the heat exchanger system. A
onge rubber inner layer which had
en designed to insulate against heat
s discarded at this time.

Water condensed from the air is
ught in a vinyl sponge and squeezed
o a container. The water is a coolant
r both suit and cabin and can be
ed as an emergency drinking supply
ile the astronaut is waiting to be
cked up.

During normal flight cabin pressure



ASTRONAUT Virgil I. Grissom takes simulated flight in new pressure suit on centrifuge at Johnsville. Note straps at wrist and knees to prevent suit from dangerous "ballooning." New pressure gauge on arm provides backup for cabin equipment.

will range from 5.1 psi to 5.5 psi. The suit will always contain a little under a pound pressure because of the oxygen-cooling and respiratory system.

• **Emergency**—The astronaut will have two pressure gauges to warn of cabin decompression. Besides the cabin instrumentation a small pressure gauge has been added to the forearm of the suit to provide backup.

If either gauge shows too much pressure loss, the reading will trigger pressurization of the suit. The *Mercury* suit will go to about 4.6—but it can withstand four times this much pressure before bursting.

Weighing a total of 20 lbs. with helmet and shoes, the suit actually has two separate layers. The exterior layer is covered by an aluminized nylon coating provided by Minnesota Mining and Manufacturing, which is plied to the Goodrich rubber suit layer.

The suit has a total of nine zippers —two at each ankle, two attaching the gloves, three on the torso and two "Slayton" zippers on the neck. The neck zippers got this distinctive appellation when astronaut "Deke" Slayton's Adam's apple tangled with the original single center zipper.

• **Noise protection**—the 4½-pound helmet, which will be closed during launch, re-entry and most of the trip, also serves as protection against the noise of the *Atlas* booster. Outside the capsule the noise has been measured at 145 decibels inside, 115. The helmet eliminates an additional 15-20 db.

The helmet, made of hard fiberglass, has a 1½-inch-thick layer of pyrofoam material called Lockfoam, manufactured by NOPCO. The shock-absorbent material gives slowly to prevent the astronaut's head from bouncing around in his own helmet. ⌘

Thermoelectric Modules Have Arrived

Developments at Diamond Ordnance have brought the devices to readiness for work in missiles and space

by William Beller

THERMOELECTRIC MODULES for electronic cooling and heating are finally here. They are ready to be designed directly into equipment.

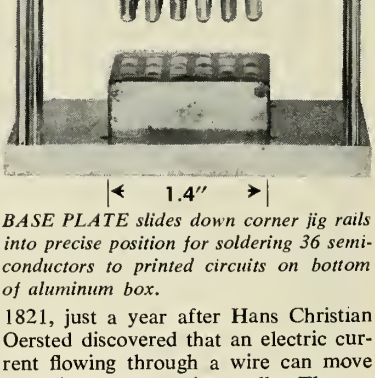
The applications are impressive. Temperature-sensitive components can be held at a constant temperature. Circuits operating under laboratory conditions can be used without re-design to meet military temperature specifications. Reliability can be increased because the number of components needed is cut down appreciably when the operating temperature range is reduced.

Recent developments at the Army's Diamond Ordnance Fuze Laboratories in Washington, D.C., have made the thermoelectric device ready for use in missile and space electronics. By printed circuit technology, the device is built cheaply, reliably and with highly predictable characteristics. By ingenious jigging, it can be made in production by untrained help.

Significantly, it can be powered by an ordinary dry cell because the necessary cascaded circuitry is printed.

DOFL physicist Irving Sochard worked out the module concept and hardware under the general direction of physicist Harold Gibson.

• **A forgotten theory** — Back in 1821, just a year after Hans Christian Oersted discovered that an electric current flowing through a wire can move an adjacent magnetic needle, Thomas Johann Seebeck made a discovery: a magnetic needle is also deflected if part of a circuit made up of two different conductors is heated. He erroneously concluded that magnetism—not current—could come from a temperature difference. This was a blunder that scientists are still bemoaning. It discouraged an early start on the thermoelectric devices.



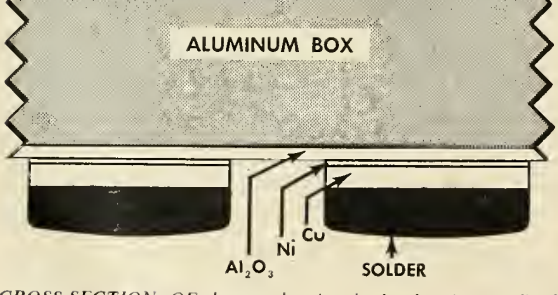
BASE PLATE slides down corner jig rails into precise position for soldering 36 semiconductors to printed circuits on bottom of aluminum box.

A flurry of thermoelectric activity was seen in 1834 when French watchmaker Jean Charles Peltier noted thermal effect associated with a curre passing through a circuit of dissimil. conductors. Several years later a Ru sian demonstrated to the St. Petersbu Academy how he could use the "Peltie effect" to freeze a drop of water. Eve this demonstration led to no applicatio until the present century and the adve of the semiconductor.

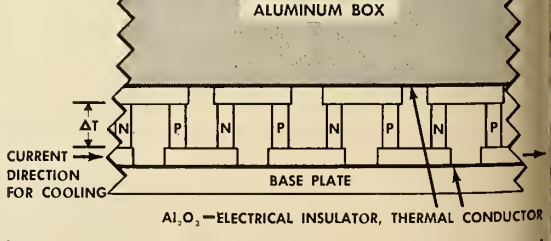
• **Active cooling**—The Army phy icists made two important contribu tions. First, they were able to cascad 18 pairs of semiconductors in serie thus the module's voltage is built up t practical values of 1 and 2 volt amenable to single electrochemical ce operation. Next, they were able to mak modules of solid circuitry do th thermoelectric job.

Currently, the module is 1 cubi inch. This volume can satisfy mos electronics needs.

Larger and smaller packages can b made. Still, there are practical limits particularly for electronics uses. Fo instance, in the near future it is doubt ful that anybody will have enoug electronics to fill a module anywher near a cubic foot. On the other hand, there is a lower limit, possibly aroun 1/8-cu.-in. Here, the large radiatin surface of the insulation would over ride the effects of cooling and heating



CROSS-SECTION OF box and printed circuit. An anodized layer of aluminum oxide about 1 mil thick is first deposited, followed by about 0.1 mil of electroless nickel and 2 mils of copper. A Kodak photo-etching technique then brings out circuit pattern in the copper. The final step is the solder dip.



CROSS-SECTION OF thermoelectric module, showing semiconductor circuit. The temperature difference exists between the aluminum box and the base plate, which are joined by N and P semiconductors. Note that these are electrically in series, but thermally in parallel. Current module volume is 1 cubic inch.

Design Charts

UPPER: *Current required for various loads.*

MIDDLE: *Power required for zero load.*

LOWER: *Current required for zero load kept at constant temperature.*

Thermoelectric devices are designed o control the temperature of micro-ircuitry in solid-state electronics. The ooling and heating is done actively. A passive system would call for fins or or running a stud to a container or adiator.

• **A misconception**—If there is a roblem of simply reducing an item's emperature to ambient, a thermoelec-ric device is not recommended. A ood heat conductor is better than a ump. Only if it is necessary to get elow ambient is the Peltier effect seful.

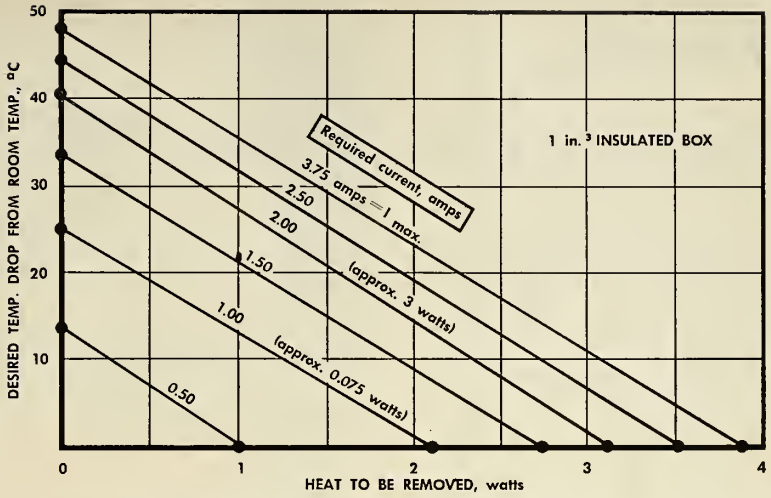
The exception is, of course, when recise temperature control of a small egion is needed while the ambient aries. An intriguing instance involves he crystal oscillator when used for ime control. Usual practice is to put he crystal in an oven, which is high bove ambient temperature in order to eep the temperature constant. Draw-acks include a need for uninterrupted ower for the oven so that the crystal oes not cool, and a shortened crystal fe because of its elevated temperature peration.

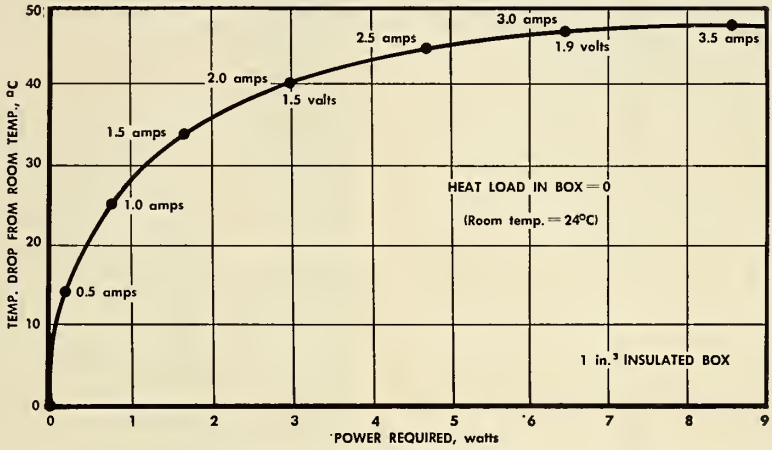
A thermoelectric module could be evised to keep the crystal at a temper-ture that would be appropriately set a constant approximately equal to e average ambient. A sensor would onitor the module's temperature, and eat or cold would be added as a func-n of current flow and direction. wer failure would be only a minor sturbance.

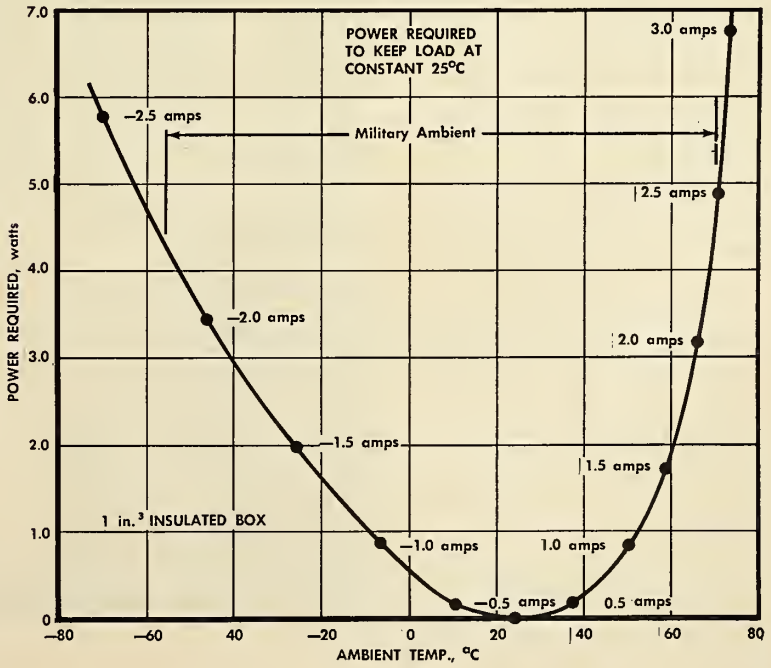
A common error is to attempt to e the Peltier effect to cool a heat nerator—for instance, a power tran-stor. Analogously, if an enclosure is eated by a blast furnace, a fan will a much better cooling job than an r-conditioner.

Several hundred companies are orking on thermoelectric theory, in-uding research on practical devices d material. Prominent among these e CBS Laboratories, General Electric, eneral Instrument, National Carbon, CA, Texas Instruments, Westinghouse d Whirlpool.

So far there have been no general plications of the modules. Yet the sign charts are ready, predictability of rformance is very high, and there rtainly is a need. Sochard observes at "It's up to applications groups to ake the next move." ⌗







Army Takes Wraps Off Its EETF Worl

FORT HUACHUCA, ARIZ.—The Army Signal Corps' EEIF (Electro-magnetic Environmental Test Facility) program now under way here may cost nearly $90 million before it runs its five-year course.

The present phase of the program, instigated to solve the difficult problems of radio interference within a field army command, is directed by Pan American World Airways under an $18.8-million, two-year contract. Major subcontractor is Bell Aerosystems Co.

At present, the Army says, the contract is "right on schedule," in terms of both time and money.

Contract award was made last March and work to establish the facility was started almost immediately. The initial project (phase I) is to study spurious radio emissions by duplicating a typical electromagnetic environment associated with a tactical unit of company size within a battle group, a battle group within a division and a division within a corps. Later, a corps within an Army will be studied in a 3-year phase II study.

A review of the program to date was included during a large-scale, three-day conference to acquaint the press and high ranking officials of the military with latest Army electronic equipment developments and techniques at this installation.

Twenty contractors who are working with the Army at the Electronic Proving Group in testing major prototype systems participated in the broad indoctrination.

This is the first time the gates of Fort Huachuca have been opened to newsmen for such a demonstration. The Signal Corps had much to show and say.

• **Need for EETF shown**—It has been estimated that today's field army will average 75,000 electromagnetic radiators in a 100-mile square area, said Lt. Col. Redheffer, deputy director of the EETF program. And he said the situation will worsen. Increasing power levels and greater improvements in radio receiver sensitivities can only magnify the existing interference which degrades and even interrupts communications.

The task of EETF is multiple: 1) to reveal existing incompatibilities with operational communications equipment; 2) to recommend corrective modifications; 3) to obtain data that will provide a firm basis for the design of new equipment; 4) to test new frequency assignment plans; and 5) to test new equipment and systems.

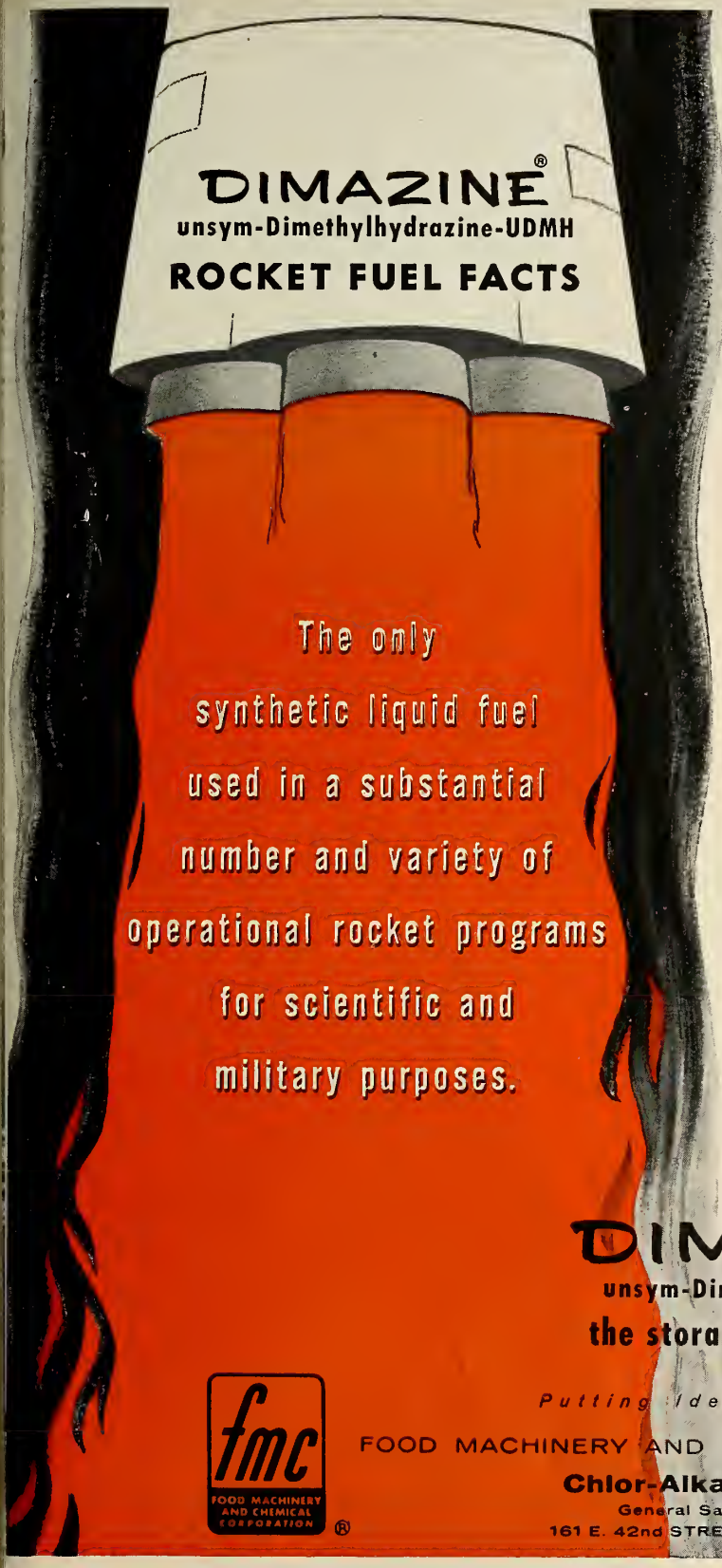
In short, the Army wants to know the degree, sources, and solution to the interference problem. It also feels that with its approach, realism is assured by including all the normal sources of unintentional radiation (vehicles, generators, etc.).

To implement its investigation Pan Am will use the Army's new IBM-709 complex at the Post's research center for analysis of test data. Mathemati models will be developed which w include propagational phenomena a equipment characteristics.

Also, standard electronic field va are being modified to simulate fi radiators. Other EETF instrumentati will permit interference detection a provide for collection of data needed develop or validate the mathemati model.

The whole program has been coo dinated with the Department of D fense and Federal Communicatio

AIR-TRANSPORTABLE TROPOSCATTER. Communications systems such as th being tested at Electronics Proving Ground, can be put into operation in 7 minut



and here are some of the many reasons why:

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276	IRFNA

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Pilâtre de Rozier and Marquis d'Arlandes (November 21, 1783), using a Montgolfier balloon, were the first to leave the earth to test man's physiologic reactions. This experiment was the forerunner of intensive Space Medicine studies of today.

SPACE MEDICINE

There is a relatively narrow zone above the surface of the earth in which man's physiologic mechanism can function. Hence the unrelenting search by Lockheed scientists into many aspects of Space Medicine.

Engineers already have equipped man with the vehicle for space travel. Medical researchers now are investigating many factors incident to the maintenance of space life—to make possible man's flight into the depths of space. Placing man in a wholly new environment requires knowledge far beyond our current grasp of human biology. Here are some of the problems under investigation: The determination of man's reactions; the necessity of operating in a completely closed system compatible with man's physiological requirements (oxygen and carbon dioxide content, food, barometric pressure, humidity and temperature control); explosive decompression; psycho-physiological difficulties of spatial disorientation as a result of weightlessness; toxicology of metabolites and propellants; effects of cosmic, solar and nuclear ionizing radiation and protective shielding and treatment; effects on man's circulatory system from accelerative and decelerative G forces; the establishment of a thermoneutral range for man to exist through preflight, flight and reentry; regeneration of water and food.

Exploration into unknown areas such as Space Medicine, provides endless stimulation to imaginative scientists and creative engineers. Research at Lockheed's Missiles and Space Division covers the entire spectrum—from pure basic research to development work, in support of current projects. Space Medicine is but one phase of Lockheed's complete systems capability in missiles and satellites. To maintain this position of leadership calls for an extensive research and development program—ranging from electrical propulsion research to advanced computer research, design and development. Typical current projects are: Man in space; oceanography; fuel cells; space station; space navigation; solid state electronics.

Engineers and Scientists: If you are experienced in work related to any of the above areas, you are invited to write: Research and Development Staff, Dept. J-29, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed / **MISSILES AND SPACE DIVISION**

Systems Manager for the Navy POLARIS FBM; the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA • HAWAII

LING VIBRATION EQUIPMENT HELPS KEARFOTT INERTIAL GUIDANCE SYSTEMS MEET THE TEST

Anything that goes into a missile has to ride out the ultimate in vibration tests. To make sure its products meet that test, the Kearfott Division of General Precision, Inc. chose Ling Vibration equipment for its own testing facility. A leader in the development and manufacture of inertial guidance systems, Kearfott supplies systems and components of various types for many major military projects—including Bomarc B, Subroc, Talos and Atlas. The Kearfott installation, one of the most modern on the eastern seaboard, was designed and engineered by Ling in cooperation with Kearfott. The system includes a 5,000 force pound shaker, power supply control console and all associated electronics for complete sine-random-complex wave testing. For information on Ling Vibration Equipment to help you to greater product reliability, write Dept. MR-7 at our Anaheim address.

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Commission and with cognizant state and local government agencies. Results are being made available to the other services on a continuing basis. (For additional details on the EETF program, see M/R, Feb. 15, 1960, p. 16.)

• **New equipment highlights**—Among the vast array of new equipment shown, in dynamic or static display, were a sizeable number having missile application.

Militarized mobile computers which have been developed and will be tested at the Proving Ground will greatly aid the local field commanders.

Known as the FIELDATA family, the Army's militarized mobile computers will include a small computer for the lower echelons and the BASICPAC for more complex applications. Largest member of the family is the MOBIDIC (Mobile Digital Computer), a general-purpose, completely transistorized computer mounted in one or more 30-foot vans.

It is planned to use this system at the army level and possibly at the corps level. A prototype of the MOBIDIC is now undergoing tests at Fort Monmouth and another is scheduled for use by the Seventh Army in Europe.

Such systems will be invaluable for fire control direction for standard artillery and for unguided missiles (*Little John, Honest John*).

For communications, a whole host of versatile systems has been developed. Two mobile tropospheric scatter communication facilities were revealed—one by Collins Radio and one by Westinghouse—which permit direct multichannel transmission over distances up to 150 miles.

Geographical barriers offer no problem. M/R also learned from some of the military operators of the Collins system that from initial set-up to establishment of communications requires less than 7 minutes.

Finally, for smaller tactical radio systems, the very broadband "Log-Periodic" antenna will be used with a Quick-Erectable mast to replace combersome and heavy equipment previously used. The new antenna requires no replacement or relocation of dipoles to change frequencies; the new mast can be raised by two men (instead of the usual four) in about 1½ minutes.

Other systems offering significant advancements include:

–The PFNS (Position Fixing Navigational System) under development by Bendix-Pacific Div. The system employs four radio transmitting stations which radiate an electronic grid pattern covering the area of field army responsibility. A PFNS receiver anywhere in this grid pattern provides an operator with numerical and pictorial display of present position and past track-made-good. Service is around the clock and is accurate to better than 100 meters, according to Bendix.

–North American's Autonetics Div. displayed its "ABLE-Precise Differential Reference," an extremely accurate gyrocompass for determining True North within 30 secs. of arc. Operating time required is about 15 minutes. Simple to operate, the system permits readout through a standard transit or theodolite. Either could then be rotated through an angle to align rocket launchers, radars, or other angle-calibrated equipment.

–A pulsed-light theodolite (PLT) developed by Motorola Corp. is a recording wind-speed and direction system. Used to measure turbulence in the regions below 3000 feet which are so important for firing unguided missiles and drones, the system is automatic. Every 15 seconds a light pulse is emitted to a meteorological balloon. Reflections are recorded to measure range, azimuth angle, and elevation angle. This data is fed into a computer for conversion into wind components and eventual printout.

–First look at its new air-to-ground photo transmission system for tactical aerial reconnaissance also was permitted by the Army Signal Corp. The system will be used in high-performance drones (*SD-4* and *SD-5*, now under development) at from 1000 to 55,000 feet altitude. Initially, it requires two minutes to complete cycle from observation, photograph, and transmission to photo processing and readout on the ground.

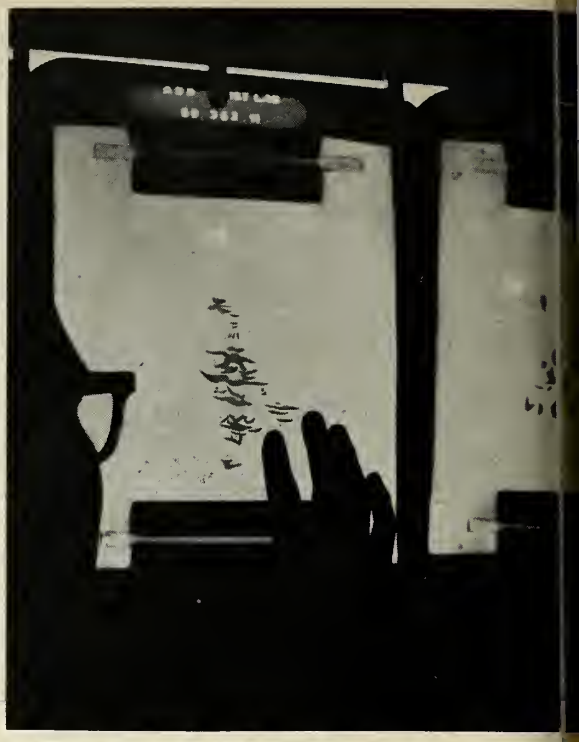
Transmission time is 8 seconds per frame. The 130-lb. aerial subsystem differs from the CBS Laboratories developed Photoscan system demonstrated earlier this year (See M/R, Feb. 15, 1960, p. 18) primarily with its optical scanner.

Resolution in the new system is from 20 to 40 lines per millimeter. Camera used is the new KA-70, 70mm high-speed, high-resolution aerial system. No other details were available on this still highly classified system.

• **Dollars delay production**—Funds have obviously been made available for expanded research and development by the Army. One point to consider, however, when reviewing all these and other advanced systems being tested here at the Proving Grounds is that most of them will not be seen as standard issue for from 2-3 years.

Why? The same old problem the Army has been plagued with following every great war—production money. Today's cold war so far has been too "cool" to provide the impetus needed to get these much needed electronic weapons in the hands of our field soldiers.

FLAWS ARE DESIGNED into the castings by the tiny silver discs which the engineer is here arranging on the pattern board.



CASTING RADIOGRAPHS reveal a given degree of shrinkage More than seven different types of defects will be X-rayed

advanced materials

'Perfect' Defective Castings Formed

by John F. Judge

A SERIES OF defective steel castings will be poured by the American Brake Shoe Co. under a Navy contract.

The problem is that each casting must contain only one defect, and this flaw must be perfect.

The purpose of the contract is to provide the Navy with accurate reference radiographs to be included in a manual covering acceptance standards for air and missileframe castings.

The rigid radiographic standards that have guided both consumer and foundryman for years are available only for sections thicker than 0.75 in. With the recent development of improved casting techniques, light steel sections have been made stronger and more reliable, with coincident increases in missile and aircraft applications.

American Brake Shoe's Research Center will produce defective castings with wall thicknesses ranging from 0.13 to 0.75 in. Each casting will be an 8 in. by 6 in. rectangle.

Alloy compositions will include 4130, 4140, 4330 or 4340, 347, 410 or 430, and 17-4PH. The specific flaws involved are inclusions, cold shuts, shrinkage, cracks, gas holes, hot tears and misruns.

Each radiograph must clearly identify the defect's shape and size. In most cases, radiographs will be made to display the flaw in several degrees of progressively increasing severity.

• **Casting variables**—Plates will be cast with and without taper to produce varying degrees of soundness. Risers will be varied in size and sometimes completely eliminated.

Chills will be used in certain instances and in other cases, an assortment of localized appendages will be attached to produce hot spots which will, in turn, generate changing conditions of internal shrinkage. Mold and metal temperatures will also be varied.

It is anticipated that as many as 240 castings will have to be made in order to achieve the required number of standards. Since the final size of the standard is small, it may be possible in some cases to get more than a single usable X-ray from a plate.

The specifications for the casting procedure were drawn up by the Naval Ordnance Laboratory, White Oak, Silver Spring, Md. These had to parallel the processes used in the production of operational castings.

Heats of steel will be melted in a basic lined induction furnace. FeMn and FeSi will be added following meltdown, and the heats killed with Ca-MnSi added at tap. The metal will be poured at 2900°-3150°F into ceramic molds.

Ceramic molds will be used to minimize surface defects which might be deterimental in the shooting of good radiographs.

When published, the manual will provide industry when its first standard reference for checking the quality of light steel castings. It will also act as a point of departure in the effort to improve their fabrication.

Submarine Has Big Edge over Defense

Most urgent problem is detection of quiet, deep-running subs and development of stand-off weapons for arming surface ships

by Vice Adm. Harry Sanders USN (Ret.)*

THE GREATEST IMPROVEMENT in the submarine during World War II was the invention of the snorkel.

It largely nullified the capabilities of ASW aircraft because it permitted the submarine to cruise submerged at speeds of nearly 18 knots and also to charge its storage batteries while submerged. Aircraft radar of that time could not pick up the relatively small snorkel valve. The snorkel, because it went far to make the submersible into a true submarine, was the forerunner of the nuclear-powered submarine.

Nuclear power in itself has revolutionized naval warfare. No longer can a large modern submarine fleet be defeated by a war of attrition. There are several reasons for this.

First, because radar waves do not penetrate water, deep-running submarines cannot be detected by aircraft radar. Nevertheless, the art of sonobuoys is progressing rapidly and promises to significantly increase airborne detection capabilities.

Second, because the range of shipboard sonar detection devices is short, the chance of a surface ship getting close enough to a submarine to detect it is slight.

Third, nuclear submarines can make more speed submerged than on the surface. This submerged speed can exceed the speed of surface ships.

Lastly, nuclear submarines can remain submerged for months and can cruise in waters where no other vessel can go. The USS Sea Wolf completed a cruise during which it remained submerged for 60 days. Submarines have cruised under the polar ice, across the North Pole to Europe. The USS Triton made a cruise around the world under water in 84 days.

On top of the revolutionary advance of nuclear propulsion is the ability of the modern submarine to fire long-range missiles fitted with atomic warheads.

Another factor that will greatly increase the capabilities of the submarine is deep submergence. When the third dimension of depth is greatly increased, the tactical problem is correspondingly made more difficult. Antisubmarine weapons must be designed that will travel faster and further under water and have enhanced guidance and target seeking capabilities.

• **Surface ships vulnerable**—Modern submarines have torpedoes that are faster and cover greater distances than those of World War II. At some time in the near future, submarines will have long-range missiles such as *SUBROC*, which can be fired submerged and which go through the air for miles.

Today, surface ships do not have stand-off weapons that can compete with these submarine weapons of the future, although *ASROC*, the new antisubmarine rocket, and DASH, the drone helicopter installed in destroyers, are steps in the attainment of this objective. Until there can be developed for surface ships a long-range detection and fire-control system together with a long-range stand-off weapon, the craft will be at an increasing disadvantage against submarines.

The excellent work of Task Force Force ALFA in the Atlantic has demonstrated that no single vehicle and no single weapon can find and kill submarines. A team effort by a task force composed of aircraft carriers, destroyers, carrier aircraft—both fixed wing and helicopters—and hunter-killer submarines is necessary to detect and destroy modern submarines.

Much work is being done to improve the equipment that this team must have. Better communications between aircraft, surface ships, and submerged submarines are necessary. Better airborne detection devices are required and these are under development. Also needed are improved antisubmarine weapons for surface ships, submarines and aircraft. Progress has been made in sonar equipment for surface ships.

The protection of Naval task forces is a problem that is well in hand; the development of advanced sonar for surface ships, sonobuoys for aircraft, and new types of weapons should be able to meet the requirements of this type of local defense.

The protection of merchant convoys is a far more difficult problem because of the large number of ASW aircraft and surface escorts required to protect the large volume of shipping—if, as in the past, local escort is to be provided.

Great interest is shown in the development of hydrofoil boats. The U.S. Navy has let a contract to Boeing Aircraft for a PCH, a hydrofoil boat of 110 tons displacement. Hydrofoil boats were constructed by the Germans during World War II. They built boats as large as 80 tons which made 45 knots. These boats were used as transports in the Mediterranean.

The Russians have one or more such craft operating on their rivers. These craft have the advantage of being smaller, very fast, and much cheaper than the large ASW ships. There are, however, difficult problems to be overcome. Before hydrofoils can be operated in heavy seas, their operating gear and the supporting structure

Second in Series

This is the second in a special series of articles intended to acquaint readers with the nature of the submarine threat, the ASW engineering problems involved, and the means or lack of means for solving them. Written by authorities in the ASW field, future articles will deal with environmental factors, sonar, hydrodynamics, oceanography and ASW weapon systems.

* *Admiral Sanders is Corporate Director, ASW Engineering, Chance Vought Aircraft, Inc., and a member of* Missiles and Rockets *Magazine's Editorial Advisory Board. Part I of this two-part series, a brief history of the development of submarines and ASW warfare, appeared in last week's M/R.*

must be rigorously designed to resi the severe stresses.

• **Basic research needed**—Th scientific problems associated with th development of antisubmarine warfa are perhaps the most difficult in th whole area of defense. Electromagnet microwaves will not travel under wate therefore, radar cannot help us to fin submarines in the vast volume of th world's oceans, the area of which cove 71% of the surface of the world.

Sound, on which we depend s much to detect submarines, trave through the water in strange and som times unpredictable ways; it is reflecte and refracted by the boundaries c layers of water of different tempera ture, salinity, and specific gravity. Thu sonar equipment mounted in the hull of surface ships has difficulty in pene trating the thermocline—the boundar between the surface layer of warr water and the colder water beneath This thermocline varies from 150 t 400 feet below the surface, so that sub marines can hide below it. There ar also problems of cavitation whic cause rapidly moving underwate vehicles to generate so much self-nois that it is difficult to devise sonar equip ment to listen through the noise.

To make matters harder, we ar dealing with an environment abou which we know very little. As some one recently put it, we know mor about the back side of the moon tha we do about the bottom of the ocean We certainly know far more abou outer space than we do about our ow inner space, the ocean.

Congress, the Navy and the scien tific community are all aware of ou lack of knowledge of the ocean en vironment and recent appropriation have given the science of oceanography a push forward. But it will be man years before we accumulate the in formation we need.

• **Future of ASW**—The most ur gent problem is the detection of quiet deep-running submarines. Certainl there will be impressive development in underwater acoustics. Very prob ably there will be progress in device employing electromagnetic wave pheno mena, and infrared.

Advanced types of sonobuoy which will provide early detection an tracking of submarines are probable New types of sonar devices installe on the ocean floor will be develope and they promise to be effective.

ASW weapons, particularly missile launched from surface vessels, sub marines and aircraft will be greatly im proved in range and accuracy. Jet o hydroduct-propelled underwater mis siles of high speed will be developed.

Communications between subma rines in the depths of the ocean an

ircraft will be improved; and, un-
anned underwater vehicles, nuclear-
ropelled and controlled electronically
r programed in advance are a possi-
ility for searching and patrol.

Developments such as these, to-
ether with the continued improve-
ent of what we have, can reduce the
resent formidable advantages of the
uclear-powered, ballistic-missile-firing
ubmarine.

Part 2 of a 2-part series. Part 1 appeared Oct. 24)

First U.S. Measurement nstitute Set up in D.C.

An Institute of Measurement Sci-
nce—the first in this country—will be
stablished at George Washington Uni-
ersity in Washington, D.C.

Dr. Martin Mason, dean of the G.
V. School of Engineering, said that
he Institute will be a major factor in
elping the U.S. overcome Soviet su-
eriority in the science of measurement
hich has contributed greatly to Rus-
ia's missile and space achievements.

In comparing U.S. and Russian
ccomplishments in this field (metrol-
gy) the Bureau of Standards pointed
ut that in 1956 the Soviets claimed
hey could make calibrations of tem-
erature measuring devices up to
000°C; their five-year plan called for
xtending this competence to 12,000°
y 1960. By contrast, in 1956 the U.S.
ureau of Standards had reasonably
atisfactory means for providing tem-
erature calibrations of up to only
800°.

Today, NBS calibrations can be
ade only up to 4200°C—or about
ne-third of Soviet capabilities.

Electronics and space industries,
hich feel the "measurement pinch"
ost acutely, have offered equipment,
oney and their own employes for stu-
ents in support of an academic center
r metrology.

Dr. A. G. McNish, chief of the
BS Metrology Division, said that there
as been nothing like the proposed cen-
r before in the field of scientific meas-
rement. "The very security of our
ation and the future vigor of science,
dustry and commerce in America all
epend on it."

First classes at the Institute will
art next February as part of G. W.'s
gular curriculum.

Founding of the Measurement In-
itute resulted from informal discus-
ons among members of industry, the
ureau of Standards, and George Wash-
gton University, according to Dean
ason. He said that The Martin Co.
rovided an initial fund of $10,000
hich made the center possible.

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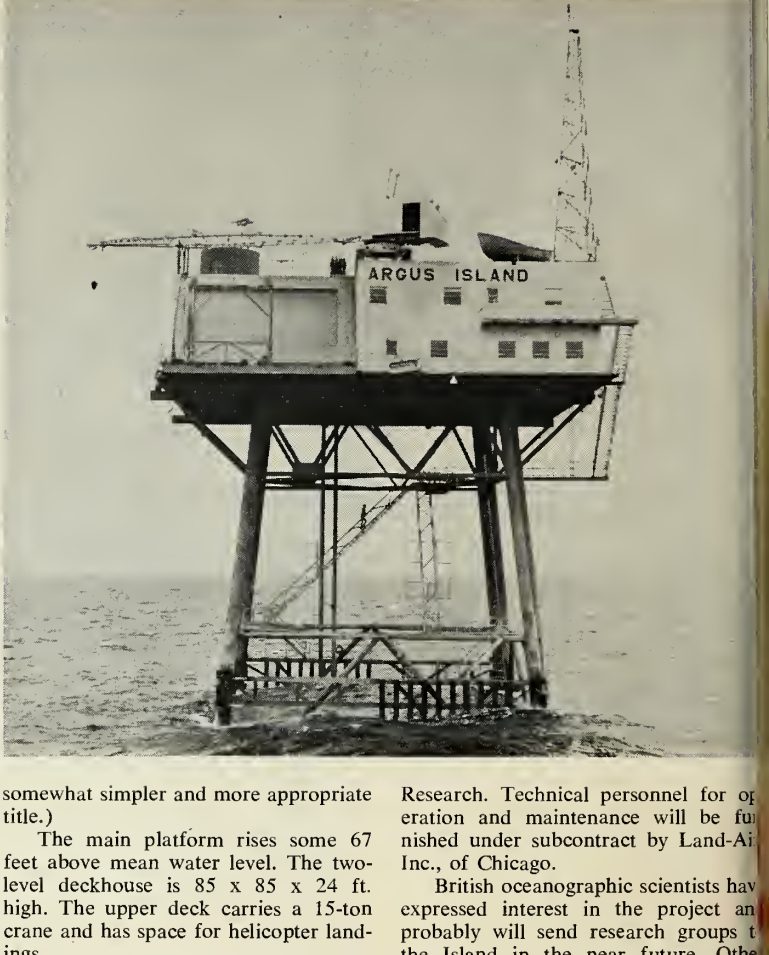
ASW engineering

'Argus Island' Soon to be In Operation



The Navy's "Argus Island" experimental test facility off the coast of Bermuda soon will be in full operation. For the first time it will be possible to make continuous oceanographic measurements which are completely free from coastal effects.

A complete research complex has been installed on the "Texas Tower" type artificial island to study physical and acoustical measurements of the ocean.

Secondary duties for the future will be the testing of underwater detection equipment for the Navy and for marine biology experiments.

The $1.25-million island is secured by four huge columns that spread outward slightly from the tower and extend 260 feet to the ocean floor. The columns are implanted in Plantagenet Bank, 30 miles off the southwest coast of Bermuda. (Because of its nearness to Argus Bank—meaning "watchful guardian"—it was tagged with the somewhat simpler and more appropriate title.)

The main platform rises some 67 feet above mean water level. The two-level deckhouse is 85 x 85 x 24 ft. high. The upper deck carries a 15-ton crane and has space for helicopter landings.

The research program will be carried out by Columbia University's Hudson Laboratories for the Office of Naval Research. Technical personnel for op eration and maintenance will be fu nished under subcontract by Land-Ai Inc., of Chicago.

British oceanographic scientists hav expressed interest in the project an probably will send research groups t the Island in the near future. Othe European scientists have been invite to make use of this particularly valu able facility for studies of their own.

mergers and expansions

LEACH CORP. has bought a two-story, 48,000-sq.-ft. building from the U.S. Relay Co., now liquidated.

BARRY CONTROLS INC. of Watertown, Mass., and The Wright Line of Worcester, Mass., have merged and will be known as Barry Wright Corp. Stock will be exchanged at the rate of one share of Barry Wright stock for each share of either Barry or Wright stock held.

AVCO CORP.'s Research and Advanced Development Division in Wilmington, Mass., has formed a new Industrial Products Subdivision. The subdivision will market products primarily in the areas of high-temperature technology and environmental simulation. Robert A. Hawkins has been appointed Director of Products in addition to his post as Manager of the Quality and Reliability Department.

OLAER PRODUCTS, INC., established earlier this year, has opened a Fluid Power Service Center in Westbury, N.Y.

A. O. SMITH CORP. will build a $2-million advanced research center at Middleton, Wis., near Madison. Advanced research activities are scheduled to begin in the new facility by the middle of 1961.

C-E-I-R of Arlington, Va., and Engleman & Co. of Washington, D.C., have completed contract arrangements for an economic merger. The Engleman facilities in Washington will be moved to Arlington, and Capt. Christian Engleman, USN (Ret.) will join C-E-I-R as vice president. The merger is C-E-I-R's second in the past three months. In July a merger was effected with General Analysis Corp. of Los Angeles.

FILTRONICS CORP. has been formed in Chicago for the purpose of providing filters to designers of modern communications equipment. Evangelos Argoudelis, the firm's vice president and director of engineering, and Theodore Stamatix, project engineer, were both formerly with Motorola's applied research department.

VERTOL DIVISION of Boeing Airplane Company will build a $2-million engineering research and test facility on a 15-acre tract next to its present flight test facilities at Philadelphia.

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Bid Revised

West Coast LH_2 Plant Put off Year by NASA

Target date for beginning operation of NASA's big new liquid hydrogen plant on the West Coast is being postponed a year.

In an amendment to its invitation to bidders, NASA moved the operational date from June 1, 1961, to June 1, 1962. West Coast requirements in the meantime will be supplied by truck and rail transport from Air Force Plant No. 74 at West Palm Beach, Fla., operated by Air Products Inc.

Opening date for bids on the new hydrogen supply was postponed a week, from Nov. 16 to Nov. 23.

Increased requirements for liquid hydrogen on the West Coast result from the award to Rocketdyne Division, North American Aviation, of a contract to develop a 200,000-lb.-thrust liquid hydrogen-LOX engine to power the second and possibly an eventual third stage of later versions of *Saturn*. Also, Douglas Aircraft Co. is developing a smaller second stage, which later will be an upper stage.

• **LOX for Centaur**—NASA's present requirements in the West—for the *Centaur* development work at Convair and for the Project *Rover* nuclear rocket work at Los Alamos—are being met by a medium-sized plant opened by the Linde Co. at Torrance, Calif., last summer.

From July 1961 until May 1962, the contractor will be required to deliver 2,976,000 lbs. of liquid to the West Coast. More than half will go to Los Angeles, with smaller amounts consigned to Sacramento, San Diego and Mercury, Nev.

The revised bid request dropped any requirement for the contractor to concern himself with supply on the East Coast. He is merely to act as a transportation service delivering liquid produced at West Palm Beach wherever NASA desires.

On completion of the West Coast plant, the contractor must supply minimums of 600,000 lbs. a month in June-August, 1962, 800,000 lbs. a month in September-December, 1962, and 1,234,000 lbs. a month and 3,700,000 lbs. a quarter during the calendar years 1963-66.

NASA requires that 1/28 of the total requirement must be delivered daily. Thus, production capacity of the new plant would have to be at least 44,000 lbs. a day, about two-thirds the total of 67,000 lbs. daily capacity of the Papa and Mama Bear installations at West Palm Beach. Linde says its Torrance capacity is 13,000 lbs. a day. ⌗

Modifications Raise Polaris' Range

A-2's second-stage case will be made of Spiralloy and chances are good that the wound glass filament will be used for both stages in future models.

SUNNYVALE, CALIF.—The Navy has let contracts for production of a longer range *Polaris* fleet ballistic missile, with major revisions in the initial A-1 version.

The new model FBM, designated A-2, will have a longer first stage, a slightly shortened second stage, and improved propellants in both stages. Second-stage motor casing will be fabricated of Spiralloy. The overall effect of the changes will be to increase the 1200-nautical-mile range of the A-1 to 1500 nautical miles.

Incorporating improvements based on data gained from the *Minuteman* program, the second stage will be made by Hercules Powder Co. under a $17-million letter contract awarded by Lockheed Missiles and Space Division. LMSD received a Navy contract for $181 million to speed development of the longer range model. Aerojet-General Corp. will build the first stage for the A-2, as it has been doing on the A-1.

Polaris second-stage propellant will be almost identical to the *Minuteman* third-stage propellant, with slight modifications. The case will be of Spiralloy, a continuously wound glass filament impregnated with an epoxy resin, now used in *Minuteman*, and will be fabricated in the same manner. (See M/R, October 17, p. 36.)

Propellant will be a modified double base type, with combustion temperature over 6000°F, and an extremely high specific impulse. Mass ratio is understood to be greatly improved over the previous version; this, combined with the improved propellant and lighter case, is expected to aid performance considerably in the important second-stage phase of powered flight.

• **Labor of Hercules**—The second stage was developed at the Allegany Ballistic Laboratory, operated for the Navy by Hercules. It will be produced at Hercules' Bacchus, Utah, works, which expects to add some 500 employes.

Production of the A-2 second stage will begin within a few weeks. Contract negotiations will probably be completed by Nov. 1. Award of the contract reportedly was greatly influenced by the performance of Hercules' third-stage *Minuteman* motor.

The first stage, now being tested by Aerojet at its Sacramento Solid Rocket Plant, has a steel case, and is powered by an improved propellant. Aerojet points out that it did not have a production contract for an improvement on the second stage, but developed one for potential use in reaching the require 1500-nautical-mile range. The Navy ha not officially designated the Aerojet cas as a backup for the Hercules effort, bu it is expected to do so.

Werner R. Kirchner, Senior Div sion Manager of the *Polaris* project a Aerojet, said the award of the A-2 sec ond-stage contract to Hercules will nc cause a reduction in the work force i the company's *Polaris* program.

• **Setbacks for titanium**—Aerojet i known to have developed a high-per formance titanium case for the third stage *Minuteman* which eventually los out to the Spiralloy case. It is likely tha the firm's second-stage *Polaris* A-2 cas is also titanium.

Titanium's defeat by Spiralloy i two such significant applications, wher extreme performance is required of very lightweight case, may indicate trend that will lead to non-metalli motor cases in a great many rocke motors for future vehicles, especiall since there are no practical limits on th size of the Spiralloy case.

There's also a definite possibilit that the cases for both stages of *Polari* rocket motors may be fabricated of material such as Spiralloy—if the Nav seriously pursues the goal of a 3400 nautical-mile missile, as predicted b some highly placed sources. So fa however, no production contracts hav been let on an A-3 version of th *Polaris*.

• **Much is unchanged**—Overall de sign of the A-2 FBM is essentially th same, with the major changes applie mostly to propulsion. Stage length case materials and propellants hav been modified; but guidance, thrust ve tor control technique (jetavators), an other subsystems are basically un changed.

The length of the launch tube in th FBM submarines had been greater tha required for the A-1 series of *Polari* A margin of several feet was availab for lengthened missiles. There are co tradictory reports as to whether or n the overall effect of the stage-lengt

Minuteman Nozzles Pass Test

SECOND-STAGE MOTOR for Minuteman is fired in full-duration hold-down test in Aerojet-General's Solid Rocket Plant at Sacramento. Highlight was successful operation of movable nozzles.

alterations on the A-2 takes up this marginal space.

The award to LMSD of the $181 million for R&D in Fiscal 1961 brings to $608 million the funds awarded Lockheed since 1956 for research and development on the FBM program. Additionally, the Navy has awarded LMSD $490 million (as of July 1) for production of flight test vehicles and initial orders for tactical missiles and associated hardware. Another $5.5 million was received for miscellaneous support services.

Contracts during Fiscal 1961 for operational missiles and flight test vehicles to implement the long-range development program are not yet finalized, but are expected to be "substantial."

Lockheed says the program acceleration has chopped three years from the original schedule laid out for the FBM. About 80 flight tests and thousands of ground tests have been conducted during the program. ⁂

AT&T Awaits FCC Okay For Satellite Experiment

Several months' delay in the start of work on the first commercial communications satellite seems likely while the Federal Communications Commission decides whether to grant permission.

The American Telephone & Telegraph Co. applied on Oct. 21 for the right to use the frequency bands 6425-6525 megacycles and 6775-6875 megacycles to make an experimental launching within a year. However, the FCC is expected to conduct a lengthy investigation before deciding on the application.

There probably will be hearings. In addition to its request for the two 500mc bands, AT&T asked the commission to set aside the remaining 300mc bandwidth of the 6425-6925 megacycle region for satellite communications.

In the first experiment, AT&T plans reversible one-way television transmission, alternatively with a series of telephone, telegraph and data transmission experiments. For later launchings, simultaneous two-way television transmissions and communications experiments are planned. The 500mc bandwidth would provide for the simultaneous experiments.

Some Washington observers thought it possible that the FCC might, after investigation, grant permission for the five-year experiment without a hearing. Under such an arrangement, the commission then would hold a hearing on reserving the additional 300mc bandwidth requested for future experiments. The latter hearing might also be combined with an investigation the commission already has scheduled for next March of long-term needs for space communications.

Cluster Seen for Big Solid Booster

Aerojet may draw on AF Project 3059 experience to develop design for NASA vehicle weighing 7 million lbs.

SACRAMENTO, CALIF.—No scientific breakthroughs are required for development of solid rocket motors developing thrusts in the neighborhood of 20 million pounds, according to officials of Aerojet-General Corp.

NASA last week named Aerojet one of three companies to receive preliminary design contracts for solid boosters of up to seven million pounds gross weight, with thrusts of two to three times that weight (M/R, Oct. 24, p. 17).

Karl Klager, manager of Aerojet's Solid Propellant Development Division, says a likely approach to such a vehicle would be one with seven clustered engines, each approximately 100 feet long by 120 inches diameter.

• **Engines segmented**—In this design, Aerojet would draw heavily on experience with its huge Project 3059 solid segmented rocket now being developed under a $4 million Air Force contract.

First static test firing of this rocket is scheduled for next year.

Although no scientific breakthroughs are required, a number of advances in state of art will be designed into the seven million pound gross weight vehicle. These include:

–The use of more energetic oxidizers, fuels and binders to increase propellant performance.

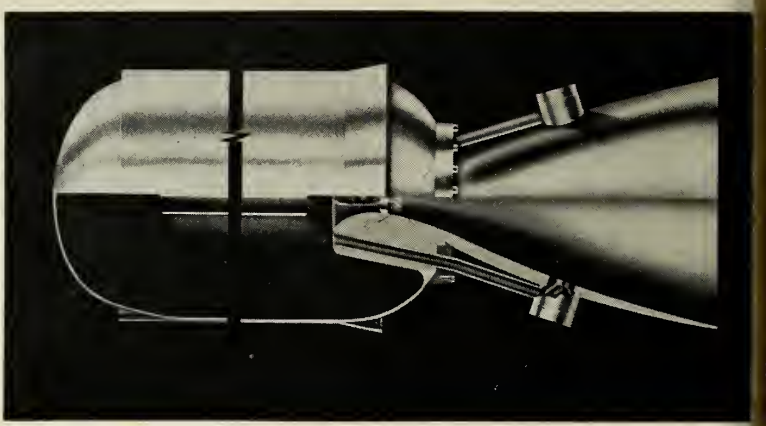
–The reduction of insulation by employing propellant as an insulator.

–The design of unique steering valves to bleed gases into nozzle for steering.

–The use of advanced material such as plastic binders.

"The system is directed toward material development," according to Klager. He reports glass, for example, is considered to have great hope for the future. These developments may result in solid rocket engine with mass fraction of 97.5% compared to today's 85 and 90%.

"What we are trying to do in the next few years is demonstrate we can build really large segmented rockets," the Aerojet official states. Klager believes replacement of liquid boosters like *Saturn* by solids could be accomplished close to the present timetable set by NASA for *Saturn*.



1970 VINTAGE SOLID motor in Aerojet's forecast will have mass fraction of 97. Steering is controlled by novel gas bleed from chamber to vector nozzle exhaust.

• **Test facilities modified**—Aerojet's program on Project 3059 is expected to lead to large solid rocket well over one million pounds thrust. The company is at present modifying its horizontal solid test facilities to handle rockets this size, with 1.5-million pounds thrust as limit. Since the size can continue to be increased by the addition of segments, the future usefulness of test facilities here is limited.

"We now are getting into propellant quantities that require another site," admits Dan W. Tenebaum, Aerojet's Test Division manager.

It is quite likely Aerojet will shift to a water-based site for testing solid engines of larger size. E. R. Roberts, asst. manager of A-G's Solid Rocket Plant, says NASA's decision to study giant solid boosters with multi-million pounds thrust could substantially reduce the cost of space exploration.

"The most productive and inexpensive vehicle for space exploration is one which combines low cost, large thrust, solid fuel boosters with highly efficient liquid propellant upper stages," he says.

Kiwi A3 Checks out Fine Under a Full Power Runup

NEVADA TEST SITE—The third te in the *Rover* program was term "highly successful" here after the 1 minute full-power minute run of Kiw A3, four days after the origina scheduled date. The test, probably l in the Kiwi-A series, was held up d to very bad weather conditions at t test site.

The reactor, six feet tall and abo as broad, had an external appearan similar to that of its predecessors, b a re-designed fuel core. Kiwi-A-Prit had spewed out a cloud of sparks pr sumed to be fuel elements during full-power run.

The series consisted of three r actors, Kiwi-A, Kiwi-A-Prime, and K wi-A3. The joint effort was under rection of the Atomic Energy Co mission and the National Aeronaut and Space Administration.

The fission reactor used uraniu fuel (U235) to heat high-pressure g eous oxygen to thousands of degrees seconds. Future tests will utilize liqu hydrogen, as will the flyable rocket.

Tests of the Kiwi-B series, expect to begin in late 1961, will be the fi to use the liquid hydrogen.

Cordiner Outlines GE's Drive into Advanced Areas

General Electric is rapidly develop-ng ventures in five new fields of ad-anced technology, Ralph J. Cordiner, hairman of the Board, has disclosed.

They are: 1) power generation from uclear sources and other new sources,) jet engines for commercial aircraft nd stationary gas turbines for industry nd utilities, 3) space vehicle and re-ted activities, 4) specialized and all-urpose computers, and 5) industrial ectronic projects directed toward utomation.

Cordiner cited a reorientation in he company from traditional appara-us and consumer goods to products of ore advanced technologies. A quarter f the company's total business, or ver one billion dollars, is in the field f electronics.

Net sales for the first nine months mounted to $3 billion, down 3% from he same period last year. Earnings ere down 11%, to $169 million. Third uarter totals were: Sales down 4% to 1 billion, earnings down 20% from he same period last year to $57.5 illion. Back orders total 12% more han the same time last year.

"The total electrical industry is perating at not much more than half apacity," Cordiner said.

This reflects both expanded capa-ilities of major producers and the en-rance of so many new competitors in his field. Early development costs of ew ventures, such as GE's, contribute o lower earnings.

Ball Building NASA's Solar Watch Satellite

Ball Bros., Boulder, Colo., is build-ng a solar observation satellite for aunching in the first quarter of 1961.

Deputy Administrator Hugh L. Dry-en of the National Aeronautics and pace Administration said recently the atellite, weighing about 350 lbs., will e launched by a *Thor-Delta* vehicle nto a nearly circular orbit with an ltitude of 300 miles.

The satellite, called Orbiting Solar bservatory (OSO), will make spectro-hotometric studies of the sun's ultra-iolet and X-ray radiation, in addition o some secondary experiments.

The OSO consists of two sections. he base section is of large diameter Dryden did not specify exactly) and 0 to 16 in. thick, with extended arms o form a gyroscope wheel for spin tabilization. The upper section, half-isc shaped, will carry solar cells to harge the nickel-cadmium batteries.

The spin axis of the base will be riented perpendicular to the line join-ng the satellite and the sun.

names in the news


HARTMAN


COLLIER


NAWALINSKI

Dr. Lawton M. Hartman: Appointed associate director of research-operations at Philco Corp. Prior to joining the firm's Technical Systems Planning Group in 1958, he was associated with atomic energy and ICBM programs at General Electric.

Bernard J. Warren: Former general manager of Altee Corp's Applied Dynamics Division, named manager of development engineering.

John F. Hinchey: Elected director of quality control for Pacific Semiconductors, Inc. Was formerly with the Electrodata Division of the Burroughs Corp.

Leonard Sternfield and **Dr. Richard B. Dow:** Join the engineering staff of The Martin Co.'s Baltimore division. Sternfield, formerly working in flight mechanics research for NASA, is chief of the flight dynamics section. Dr. Dow, who formerly participated in scientific research for the Air Force ARDC, is principal engineer of systems criteria.

Emo D. Porro: Arnoux Corp. vice president-marketing, named vice president, Operations. He will continue marketing activities.

Raymond E. Wiech, Jr. and **Robert F. Strauss:** Elected president and vice president, respectively, of the recently founded Astrosystems, Inc. Both were formerly affiliated with Thiokol Chemical Corp.'s Reaction Motors Division.

Sheldon Newburger: Named director of Adler Electronics, Inc.'s Operations Division. Prior to joining the firm in 1958, he was chief mechanical engineer for Otis Elevator Co.'s Electronic Division.

Thomas E. Nawalinski: Former chief applications engineer, named manager of sales promotion and advertising for Non-Linear Systems, Inc. Prior to joining the firm in 1956 he headed the *Atlas* missile autopilot test equipment group for Convair-Astronautics.

Dr. Richard W. Damon: Joins Microwave Associates, Inc. as director of a research and development group on microwave solid-state control devices. Was formerly a research physicist with General Electric Co.'s Research Laboratory in Schenectady.

Arthur E. Hartung: Joins Elion Instruments, Inc. as manager, Product Engineering Dept. Was formerly manager of RCA's Special Projects Unit of the Radar Advanced Project Development Dept.

George Zissis (Ph.D) and **Gwynn Suits** (Ph.D.): Both of The University of Michigan's Willow Run Laboratories, appointed to the government's newly-formed Technical Advisory Group for Ballistic Missile Defense. Dr. Zissis is head of The Ballistic Missile Radiation Analysis Center and Dr. Suits is head of the WRL Infrared Laboratory.

Dr. Donald W. Collier: Former president of the Thomas A. Edison Research Laboratory Division of McGraw-Edison Co., joins the Borg-Warner Corp. as vice president-research.

Col. Richard K. Jacobson: Appointed director of information for the Air Research and Development Command, replacing **Col. William S. (Pug) Evans,** now assistant director of information, Office of the Secretary of the Air Force.

Daniel S. Schwartz and **Aaron Waldman:** Join Gulton Industries, Inc. as senior research physicist, Research and Development Division, and supervisor of the Instrumentation Division's Electromechanical Group, respectively. Both were formerly senior project engineers with the Kearfott Division of General Precision, Inc.

Herbert E. Weyrauch: Appointed sales manager of Electronics Control Div., Flo-Tronics, Inc. He will also assume all national marketing activities.

Robert C. Main: Joins Sperry Products Co., a division of Howe Sound Co., as manager of engineering, a newly-created position. Previous post: American Machine & Foundry, where he was responsible for the design of the *Terrier* guidance system.

contracts

NASA

Nacimco Products, Inc., San Diego, for cryo genic precision measurement instrument Amount not disclosed.

$6,000,000—Chance Vought Aircraft Co Dallas, prime contractor for the *Scou* launch vehicle system.

$404,000—Lockheed Nuclear Products, Atlanta for a low-power reactor to be used fo critical experiments at Plum Broo facility.

$372,716—Compudyne Corp., Hatboro, Pa., fo services and materials for an integrate automatic tunnel control system.

$225,000—Bivins and Caldwell, High Point N.C., for services and materials used fo repair and/or recalibration of instru ments.

MISCELLANEOUS

$4,400,000—Avco Corp.'s Lycoming Div., fo production of additional missile rocke chambers.

$105,200—Airite Div., of The Electrada Corp. for titanium pressure vessels to be usec in missile programs.

NAVY

General Dynamics Corp.'s Convair Div., San Diego, for design of a real time compu tation system for the Pacific Missile Range. Amount not disclosed.

$181,000,000—Lockheed Missiles and Spac Div., Sunnyvale, Calif., for research and development of long-range *Polaris* mis siles.

$32,500,000—General Dynamics Corp.'s Con vair Div., Pomona, for production of *Terrier* and *Tartar* guidance and control groups and other components.

$26,800,000—The Johns Hopkins University Applied Physics Laboratory, Silver Spring Md., for continued R&D in the fleet Bum ble Bee guided missile program.

$9,294,465—General Electric Co., Washington D.C. for submarine propulsion systems.

$4,000,000—Sperry Gyroscope Co., Great Neck N.Y., for the "key" navigational systems in five new *Polaris* missile-launching sub marines.

$3,689,534—Aircraft Armaments, Inc. Cockeysville, Md., to design, develop and fabricate submarine ASW training facility, Pearl Harbor.

$1,000,000—Specialty Electronics Development Corp., Syosset, N.Y., for phosphate glass radiation dosimeters and antenna multi couplers. (Two contracts).

$110,598—The Martin Co., Baltimore, for hydrofoil craft structural study program.

$73,466—Minneapolis-Honeywell Regulator Co., Hopkins, Minn., to design and fabricate *Redeye* simulator.

$50,000—American Research and Mfg. Corp., Rockville, Md., for design of wind tunnel and hydrodynamic models.

AIR FORCE

$1,527,933—General Electric Co., Syracuse, N.Y., for services for onsite operation and maintenance of the AN/FPS-17 radar systems.

$1,527,000—General Electric Co.'s Heavy Military Electronics Dept., for operation and maintenance of radar sets overseas.

$524,000—Federal Electric Corp., Paramus Industrial Park, N.J., for non-personal services for phase-out activities from operation and maintenance of White Alice System in Alaska.

$233,000—The Martin Co., Orlando, for *GAM 83* guidance equipment for installation in F-105D aircraft.

$182,656—United Shoe Machinery Corp.'s Research Div., Advanced Development and Systems Dept., for design, development and manufacture of scoring systems for an advanced rocket-powered target.

ARMY

amilton Standard's Electronics, for the study and development of electron beam welding of electrical connections for micro-assemblies. Amount not disclosed.

,130,009—Sperry Utah Engineering Div., Sperry Rand Corp., Huntsville, Ala., for continued research and development of the *Sergeant* missile system.

,425,380—The Martin Co., Orlando, for replenishment spare parts, research and development, ground support equipment, launchers, and engineering services on the *LaCrosse* weapon system. (Six contracts).

,350,000—Aerojet-General Corp., Sacramento, for rocket motors for the *Hawk* missile system.

)22,032—Douglas Aircraft Co., Inc., Santa Monica, for *Nike-Hercules* booster fin shipping kit and shipping containers.

14,000—Nassau Construction Co., Inc., Woodside, N.Y., for improved *Nike-Hercules* control systems, schedule 1, various sites in New York.

400,061—The Martin Co., Orlando, for modification of GFE vans to *LaCrosse* system and procurement of Lacrosse range safety ground stations.

287,737—Western Electric Co., Inc., N.Y. for *Nike* replenishment spare parts. (Five contracts).

150,413—Douglas Aircraft Co., Inc. Santa Monica, for *Nike* replenishment spare parts.

31,000—The Martin Co., Orlando, for *Pershing* weapons system.

—expansions—

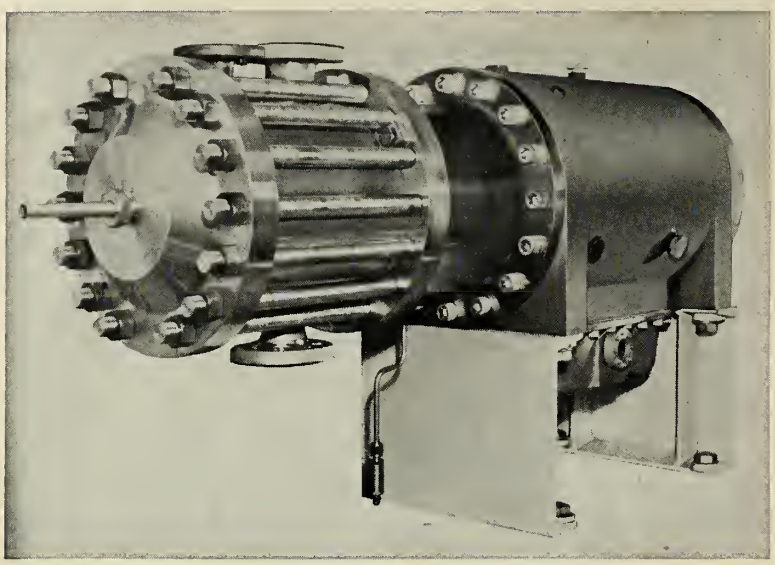
AUTONETICS, INC. has established a Quality, Reliability and Standards technical division at Downey, Calif. Robert E. Moore, who has been with North American Aviation for five years, will head the division.

SYLVANIA ELECTRIC PRODUCTS INC., subsidiary of General Telephone and Electronics Corp., has broken ground on a new electron tube research development center at Emporium, Pa. The 6500-sq.-ft. addition to the refractory metals processing plant of the Chemical and Metallurgical Division will be completed late this year.

VANADIUM-ALLOYS STEEL CO. has organized a Cast-to-Shape Products Dept. to meet the requirements of American industry for tool and special steel castings.

MARQUARDT CORP.'s Cooper Development Division will move from Monrovia, Calif., to Van Nuys, location of Marquardt's Power Systems Group. The move is expected to provide greater depth and scope to Cooper's operations by access to the larger facilities.

KOLLSMAN INSTRUMENT CORP. has formed a Research Division to undertake basic and applied research related to advanced tracking, computing, communications, control, instrumentation and display systems. Dr. Arthur S. Robinson has been appointed director of research.



High-Pressure, High-Flow Pump

The Cosmodyne Corp. is manufacturing a high-pressure, high-flow cryogenic pump, which delivers up to 20 gpm (equivalent to 120,000 std. cu. ft./hr. of nitrogen gas) at pressures up to 15,000 psi.

The unit is a 5-cylinder, fixed displacement pump, with pistons driven by one-piece push rods in contact with a rotating, axial swash plate.

The lubricated drive end of the pump operates at ambient temperatures, thus eliminating lubricant freezing. The cryogenic section, where the pumping of the liquefied gas occurs, contains the pistons, cylinders, and valves, and operates free of any lubrication. The intermediate section provides a thermal barrier to separate the cryogenic and ambient ends of the pump together with housing seals which prevent lubricant contact with the cryogenic fluid.

Circle No. 225 on Subscriber Service Card.

Air Bleeder Valve

An air bleeder valve for hydraulic circuits has been developed by The Lenz Co. The valve is designed to be installed at the highest point in the hydraulic circuit, the point at which air accumulates.

The Lenz Bleeder Valve is of compact, functional design with only two metal parts. No packings are employed. The valves are available in range of popular sizes in cadmium plated steel, and in stainless steel on special order.

Circle No. 226 on Subscriber Service Card.

Electronic Soldering Flux

A mildly activated resin type flux called the Fusion RU series has been developed by Fusion Engineering. The flux has been tested neutral both before and after soldering making it acceptable for electrical and electronic work where non-conductive, non-corrosive flux residues are required.

A wide range of metals are easily wet by the flux. Included metals are mild steel, brass, copper, tin, lead, cadmium, and silver plate.

Circle No. 227 on Subscriber Service Card.

Full Vision Digital Clock

Pennwood Numechron Co. has developed a direct reading full vision in line digital clock.

Some of the features of this clock are: digits that can be reset individually by independent front panel reset controls, large 5/8 in. digits on the 1 hour clock and 5/16 in. digits on th 24 hour clock and calibrated rotatin visual 1 RPM seconds wheel. Cloc movement built to withstand shock o 2000 lbs./in.

Circle No. 228 on Subscriber Service Card.

Squeeze Action Valve

Airmatic Valve, Inc. has available Tube-O-Matic valve (R) in whic squeeze action automatically control the flow of air, oil, chemicals and eve grinding slurries, without the use o poppets or spools. There are no metal to-metal contacts and no metal-to rubber seals.

When the valve is open, suppl pressure through the inlet port force an elastic rubber sleeve against th tube, forcing the media to flow aroun the inlet plug and through the outle port.

To close the valve, pilot pressure i applied between the inside diameter o the tube and the outer periphery of th rubber sleeve. This collapses the sleev over the rounded ends of the inlet an outlet end plugs, sealing off the suppl pressure. The only action is the flexin of the sleeve.

Circle No. 229 on Subscriber Service Card.

Radiation Measurement

An expansion of its radiation mon toring products and services has bee announced by Allied Research Assc ciates, Inc. Plastic scintillators are no available in three types having pea emissions at 4200, 4350 angstrom Fluors of special chemical compositio or emission spectra are prepared o request.

Scintillators are now produced i many dimensions with considerable em phasis on special configurations. Cy inders can be manufactured up to 4 in. in diameter and in various length slabs to maximum dimensions of 3 f and in thickness ranging from ¼ i to 1 ft.

Circle No. 230 on Subscriber Service Card.

Swivel Joints Series

A series of swivel joints designe for use in servicing fluid systems available from Consolidated Contro Corp.

The joints permit turning of rigi and semi-rigid lines carrying such fluic as nitrogen gas, petroleum fuels, hy draulic oils, helium gas, lithium chlo ide, and cryogenic liquids.

Low swivel torques, ranging from 16 lb.-in. for a ¼-in. swivel to 240 lb.-in. for a 2-in. liquid oxygen joint, are maintained through an ambient temperature range from –420° to 275° with adequate safeguards against momentary exposure to the heat of missile flame spill-over.

Circle No. 231 on Subscriber Service Card.

Viton Compound Developed

Haveg Industries, Inc., Taunton Division, has developed a new Viton compound based on duPont's Viton B polymer. The compound is approved under MIL Spec 25897C covering high temperature, oil and fuel resistant elastomers. Designated as Haveg Grade 16075, it was especially formulated to provide superior compression set resistance under severe operating conditions.

Circle No. 232 on Subscriber Service Card.

Parametric Amplifier

A V-8350 parametric amplifier providing a wide instantaneous bandwidth of 35 to 40 megacycles, low overall noise figure of 2.0 db. and stable gain of 20 db is available from Varian Associates.

The V-8350 uses two wideband variable reactance up-converters for simultaneous amplification and frequency conversion of a signal and its associated source of local oscillator power.

By pumping both converters from the same source of X-band power, the IF frequency stability is maintained even with variations in pump frequency or phase.

Circle No. 233 on Subscriber Service Card.

Flexible Printed Circuits

Continental-Diamond Fibre Corp. has available copper-clad unsupported Teflon and single-ply glass fabric Teflon grades for flexible printed circuit applications.

CDF has designated its copper-clad unsupported Teflon grades as DI-CLAD FT-1. It is available in widths up to 18 in. lengths up to 42 in., and base thicknesses 0.003 in. to 0.060 in.

Circle No. 234 on Subscriber Service Card.

new literature

FUSION WELDING — Sciaky Bros Inc., has published a pictorial report c their developments in highly precis fully automatic fusion welding equip ment. Features include actual applica tions where subject equipment has bee in use for the past two years in Nort American Aviation's B-70 Program Raytheon's "Hawk" processing, as wel as others. Equipment descriptions ar also contained.

Circle No. 200 on Subscriber Service Card.

MAGNET WIRES—A 50-page catalo covering General Electric's complet line of magnet wires has just bee issued by the company's Wire an Cable Dept. One feature of WC-828 covers such types of wire (according t insulation) as Formex, Alkenex, poly urethane, cotton, nylon, Teflon, glas fiber, Dacron glass, asbestos, self-bond ing, solderable, and others which ar combinations of these.

Circle No. 201 on Subscriber Service Card.

VARIABLE INCREMENT COMPUTERS—An 8-page bulletin on GEVIC—General Electric's variable increment digital computer, is available from General Electric Co. It describes what GEVIC is, how it operates, how it is applied to high-performance weapon control; guidance and navigation application in air and space vehicles, missiles, and portable surface-based equipment.

Circle No. 202 on Subscriber Service Card.

GAS TURBINE ECONOMICS—The economics of gas turbine power generation for U.S. Defense sites and for commercial applications are discussed in new Bulletin 202, just issued by Clark Bros. Co. A comparative analysis of gas turbine, steam, and diesel generating plants is made which points up the unusual economic advantages of the gas turbine plant, for both stationary and mobile installations. Major factors such as installed cost, fuel, operating cost and the time value of money are thoroughly reviewed with the help of charts and graphs.

Circle No. 203 on Subscriber Service Card.

TEMPERATURE PROBES — Catalog No. 66030, containing illustrations, specifications and descriptive material on precise platinum temperature transducers (probes) is available from Rosemont Engineering Co. Thirty-six different aerodynamic, immersion and surface temperature types are catalogued.

Circle No. 204 on Subscriber Service Card.

INSTANT FLIGHT

Varied stresses of programmed flight will soon be duplicated at ground-level. A $10 million static test facility, designed by Vitro for the U.S. Air Force, will shortly begin operations at Wright-Patterson. Here, major components will be subjected to programmed aero-dynamic heating and dynamic loading of supersonic flight. ■ In eleven major Vitro projects, the precise simulation of unusual environment was vital; twenty-one Vitro projects required design of nuclear containment. This is Vitro know-how.

Vitro

RO ENGINEERING COMPANY / A Division of Vitro Corporation of America / NEW YORK • WASHINGTON • LOS ANGELES / OVERSEAS: GENEVA • MILAN • BOMBAY

Readers Respond

(Continued from page 12)

peded willy-nilly and want to duplicate the same thing. Let's tell the whiskers "Go ahead and explore the moon, or Venus or Mars. If you find a new and liveable planet we hope you *all* go out there. It will solve most of the world's problems. Meanwhile we are going to stay home and utilize the funds we'd have to throw away on this "outer space race" for bolstering our conventional military forces to maintain the strongest possible position here on the home planet."

I feel certain that a bill of comparative costs—Russia's costs versus our costs in the "outer space race" field—would be a shocker. General Trudeau once stated that the cost of the modern tank to Russia is the equivalent of 2000 pairs of shoes, whereas our cost for the same item is equivalent to 10,000 pairs of shoes. How much greater the ratio must be in these monstrous missiles swarming with high-paid personnel!

I view the "outer space race" as a potential gambit on the part of our chess-playing enemy designed to weaken us on *this* planet and featuring effects in the military, economic and psychological fields. After all, the doctrine of Lenin is explicit in calling for control of this world, not Venus or Mars, etc. Every billion dollars we throw away trying to go to the moon is a debit against the fixed amounts available to us for keeping our conventional military surface forces strong. The Army, Navy, Marine Corps and Air Force are each doing without many things they know they should have to be truly superior; therefore they could use saved funds to the very real advantage of our country. Our government has held the line on inflation by spending within its income and this has been the foundation of our strength. But it means a limit to available funds. Let's not let our enemies stampede us into throwing these hard-earned dollars into space needlessly. We must use them with great care down here on the surface of the planet the Communists swear they are going to conquer.

(Name withheld on request)
Monterey, Calif.

For More Direction

The opinions which I put forth below are strictly my own and do not necessarily represent the opinions of my present employer, Rocketdyne.

Of greatest importance, in my opinion, is the re-establishment of the decision-making machinery in the United States Government. This should come from the Executive Department and should be directed by the President.

The key items in your proposals are: clear-cut directions, courage, and conviction to support these directions even in the face of criticism which by necessity will be apparent when large numbers of people are involved.

Looking at your proposed space program, I feel that you have picked rather isolated projects which in themselves co tradict the primary goal that you w after; namely, the establishment of *strategic programs* in space. I would l to cite the example of the X-1 Aircr which was successfully flown supersor for the first time in 1947. Howev as of this date we do not have a sup sonic long range striking force in op ation. Now, there is a big step betwe an isolated space supremacy accompli ment and an *operational* space striki ing force, which I can envision co be modelled somewhat after our pres SAC Air Force. I feel that any timeta should stress the *operational* date of su a force. If we follow this approach will then have the capability to acco plish specific space missions for politi and prestige purposes which the Russi have so ably exploited in the past. will then not be faced with having to pend on single space shots in the exp mental stages which will never guaran technical accomplishment and politi supremacy.

Another item I would like to co ment on is the subject of defense fu ing. It is obvious that this country can afford to develop weapon systems in areas that all people might conceive be needed. The decision-making proc of the Executive Department should strengthened to encourage the lower ec lons of the Government to concentrate areas where we have the most capabil maximum technical advance within shortest period of time. In other wor the way to a successful fiscal policy an organized and concentrated direct of effort.

It becomes inevitably necessary to the incentive method back into the fense business. It may well be that a nu ber of Government agencies and indust organizations presently engaged in the fense business may fall by the waysi but if we are to survive we should business only with those industries agencies which will give us the most fective weapon system for our doll and develop and accomplish a given t within the time span specified.

Proposals, as you mentioned, are c troversial and can include many m goals than you put forth in your 2nd p posal. However, a service is being r dered to your readers and my perso opinion is that editorials of this nat are constructive and helpful.

Richard F. Gomp
Edwards AFB, Cal

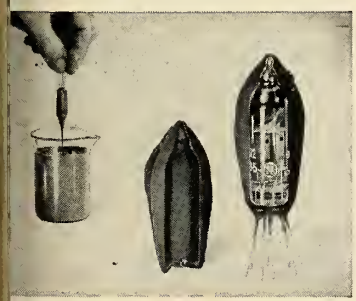
Stressing Sea Bases

I would like to present my own vi on what I think is a sound approach guaranteeing our survival. We must troduce a program of expediency in reg to production emphasis of our wea system programs. Such a program wo put all the production effort on those tems having the best chance of surv in the event of sustained warfare; and tems which do not offer the chance long-term survival even after many mo of war would be cancelled as being n ginal in potential value. The excep

General Electric Silicone Rubber finds dozens of uses in missile systems. How many more will prove vital?

General Electric silicone rubber has the "thermal toughness" to stand up under the searing heat of rocket blast-off or possible atomic attack. Add very good electrical properties and excellent resistance to aging, weathering, moisture, flame, ozone and corona and you can easily see why silicone rubber is now being used in virtually every U.S. missile and space vehicle.

Since both space technology and silicone rubber are relatively new, General Electric believes there are many more areas not yet explored where silicone rubbers can help keep a missile functionally reliable and combat-ready. To help designers in their evaluation work, we list here the principal properties and applications of G-E silicone rubber.



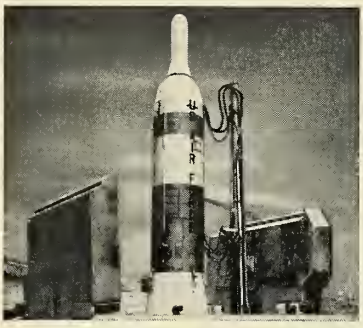
RTV LIQUID SILICONE RUBBER — One of the most versatile materials developed in recent years, RTV is a liquid rubber that cures at room temperatures. Like all silicone rubber, it remains flexible over a wide temperature range and is virtually ageless. Since it comes in a wide range of viscosities, it can be poured, sprayed, dipped, painted or applied with a pressure gun or spatula. It bonds tightly to metal when a primer is used. When not trimmed, you can readily remove RTV and then reapply more. You can impregnate tightly wound coils with RTV or form sections several inches thick.

You can control cure time from two minutes to 24 hours. These are RTV's typical properties:

Viscosity	from 120 poises (very pourable) to 12,000 poises (paste)
Specific Gravity	1.2 to 1.5
Solids Content	100%
Shrinkage	0.2%
Heat Resistance	from —90°F to 600°F, and as thermal insulation, in 5500°F flame for minutes
Ozone Resistance	Comparable to Mica
Electrical Properties	See last table

Applications—RTV is used as a high temperature structural sealant in missiles, satellites and space vehicles. It is used to pot and encapsulate electronic components and assemblies for electrical and heat insulation and for protecting delicate components from physical damage. It is commonly used as an impregnating insulation in transformer coils, to pot and hold cable in raceways and to pot cable breakouts. You can make flexible molds with RTV and hence make accurate, duplicate castings from originals.

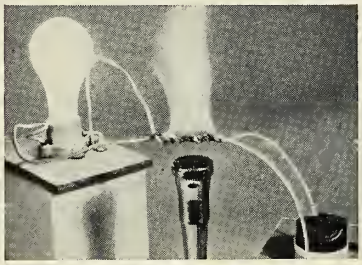
RTV is an excellent thermal barrier and as such is applied on and around missile nozzles. Tests show RTV's resistance to flame temperatures as high as 5500°F for several minutes. RTV also functions as a flexible ablative material and is used around probe holes, along raceways, and between stages and structural joints on the missile skin.



HEAT CURED SILICONE RUBBER PARTS —Silicone rubber gaskets, port seals, O-rings, shock mounts and other mechanical parts are not only used on missiles but have wide application in ground support equipment. For instance, missile silo doors use silicone rubber seals that will stand up to outside weathering, ozone and abuse for years and which will also resist the heat of missile launching and nuclear attack. Silicone rubber also resists brief exposure to cryogenic materials.

Silicone rubber has long-lasting temperature resistance from —150°F to 600°F, with excellent electrical, weathering, ozone, corona, radiation and non-aging properties at these temperatures. High tensile strength and low compression set are also within its range of desirable properties:

Tensile Strength, psi	800—1500
Elongation, %	100—600
Hardness Durometer (Shore A)	25—80
Compression Set, %	10—80
Tear Resistance lb/in	40—200
Radiation Resistance	1 x 10^8 roentgens
Electrical Properties	See table below



WIRE AND CABLE INSULATION — The long term reliability of silicone rubber when operating in high ambient temperatures and when current over-loads cause the conductor to approach 500°F is an important feature of silicone insulation. In an 1800°F flame, specially constructed silicone rubber insulated cables will continue to insulate for hours, forming a non-conductive ash that gives off no toxic fumes. And short term reliability is obtained even when silicone rubber is exposed momentarily to a direct flame of 5500°F.

Because of this excellent heat resistance, more current can be carried than in conventional cable (or smaller cable can be used). Other features: best compression set of all elastomers at temperature extremes, so that silicone rubber wire and cable does not deform under clamps; high ozone, corona, radiation and weather resistance, low moisture absorption, flexibility down to —100°C. These are the typical properties:

Volume Resistivity	10^{15}—10^{16}
Dielectric Strength, volts/mil	600—650
Dielectric Constant, 60 cps	3.0
Power Factor	.0010—.0050
Radiation Resistance	1 x 10^8 roentgens
Physical properties	Similar to table above.

Applications—Wiring harness made of silicone rubber insulation is often found throughout missiles. Cable offers added reliability for use in various places throughout the launch complex below ground from power plant to silos. All combat vessels built for the U.S. Navy during the last ten years, including fleet ballistic missile submarines and the new nuclear-powered cruiser and aircraft carrier, have silicone rubber insulated cable installations in all fixed wireways. In every case, silicone rubber is chosen because it is virtually non-aging, stands up to intense heat better than any other flexible insulating material, and continues to operate even when subjected to fire.

●

There are many more places where G-E silicone rubbers' inherent properties can be vital in missiles, satellites and space vehicles. For further data, call your nearest G-E sales office or write Section **01033, Silicone Products Department, General Electric Company, Waterford, New York.**

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GENERAL ELECTRIC

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would be those cases involving stop-gap systems designed to be immediately available for a short time, until high-survival-probability systems can be made operational.

I would propose the following modifications to your nine-point proposal:

Under Point 4:

Establish military commands on the basis of function—namely "Strategic Forces" and "Internal Security Forces." There is no need for any others. The strategic forces would include in their command all Naval forces, the elements of SAC and TAC, the Marine Corps, and Army elements which now consist of STRAC, the airborne and the special forces units such as the Rangers and the so-called "Special Forces."

These "Strategic Forces" would be adapted to a mobile base concept, these mobile bases would consist primarily of ships and submarines, which would be capable of acting as bases for the strategic forces for a year or more without coming into port. This idea is not as far-fetched as it sounds. I cite as examples the Little America operation in the Antarctic and the long duration of whaling ship voyages, even in times far past. Naturally, ships would not be able to do all of it, and mobile land bases would have to be worked out, using off-the-road vehicles and the railway systems of North America. In the event of brush-fire wars, the strategic forces would serve the functions of tactical forces.

The "Internal Security Forces" would be charged with the serious responsibility of preserving the internal security of the U.S. and her citizens against all enemy action, including sabotage. These duties would include: setting up detachments of Army troops around all population centers to organize the defense of our cities against invasion and to assist and direct the evacuation of civilians, the care of wounded, the control of damage after an enemy attack. In addition, the internal security forces would man the radar systems, antimissile systems and other weapon systems or devices which would be needed to counter enemy attacks on our homeland itself.

Under Point 5, I feel that spending should be directed as follows:

a) Place the *Polaris* missiles and submarine production systems on a crash, 24-hours-per-day, seven-days-per-week basis. Air Force claims to the contrary notwithstanding, this is the first system that can deliver us invulnerable missile-launching capability and high reliability in any sort of quantity.

b) Place the new tactical bomber on the same sort of crash program. In addition, develop the new longer-range, short field bomber as a shipboard aircraft so that it can be integrated into our shifting carrier—air bases at sea.

c) Place the new weapons and equipment for our ground troops on a crash production program similar in nature to *Polaris;* however, heavy tanks should r be produced.

d) Accelerate the B-70 developme and produce a small number of them soon as possible. Do not place this pla in volume production unless it can given a short, dirt field capability w runways under 5000 ft.

e) Greatly accelerate *Dyna-Soar* a develop it with an eye towards a weap system which in *final form* can be *launch* and *recovered* by highly mobile syste *at sea.*

f) Initiate a highly accelerated pi gram to launch and recover satellites fr sea-going systems.

g) Cancel the *Minuteman* weapon s tem, for the same basic reasons that t SM-62 *Navaho* was cancelled—name that by the time it's ready a superior s tem will be operational.

h) Place the production of hunt killer submarines on a crash progra These subs are vitally needed to prot *Polaris,* screen our carriers, and tra enemy subs which would launch missi against our country.

i) Start working out railway-bor airfields. Such a system will augment c carriers and be the means of maintaini and launching our new intercontinen tactical bomber and possibly an ST B-70 with lift-fans from short strips l out at railside.

j) Place the Navy's new Missileer a craft on an accelerated program.

k) Greatly accelerate all antisubmari warfare R&D—and the production systems.

l) Augment our manned aircraft n bile base capability with either more c riers or a submarine launch-and-reco system. Either of such systems would built around the new tactical bomber. T sub idea is not far-fetched—the Frer had a plane-carrying sub prior to Wo War II, and the Navy has launched a planes such as the Regulus from subs.

m) If railways could be the means preserving the life of a missile or pla then they should be able to preserve lives of our citizens. Accordingly, pl should be made to use railways to perse our citizens in event of war.

n) Largely reduce and taper off efforts with the liquid-fuel *Titan* and *A* missiles. No new starts on bases should made. These systems for one reason another are dragging their feet, and th launchers are ultimately vulnerable, as the *Minuteman's.*

o) Develop a super-*Polaris* to repl the big-warhead, land-launched liq rockets.

As a last word, I would like to that carriers and other surface vessels have a good chance of survival provi they do not approach the proximity the enemy's land mass until his defer have been considerably reduced by mis bombardment, and also provided that t hide from the enemy's subs or are able be well defended by the antisubma systems.

Strategy which is based on harde bases will not work.

George B. Willi
Cincinnati

GE's Defense Magazine

Your excellent "Modest Proposal" to Mr. Nixon and Mr. Kennedy states emphatically that "the people of the United States desperately need to know where they stand, where they are going. More than anything they need to have objectives." In short, there must be greater public understanding of U.S. defense—not only in regard to space matters but in regard to all defense questions.

With this assertion we could not agree more completely. The purpose in General Electric's founding of its own magazine, *The General Electric Defense Quarterly*, is precisely to further this objective of greater understanding of U.S. defense matters, with the belief that defense understanding is a wholly non-partisan affair. The magazine's current issue, published this month, has as its theme "Public Understanding and U.S. Defense."

J. B. Stroup, Defense Business Information
News Bureau
General Electric Co.
Schenectady, N.Y.

Fiscal Balance First

As a rebuttal to your open letter to the Presidential Candidates, let me make the following points:

1. The present administration has not ignored the existence of a Space Race with the Soviet Bloc. Rather, under this administration we have made substantial strides forward in the field of ICBM's and IRBM's. Although we do not have the spectacular successes exploited so well by Soviet propaganda, our results with *Atlas*, *Polaris* and *Titan* are not minor advances in the Space Race.

2. You encourage increasing the ICBM, *Polaris* and B-70 efforts to a maximum regardless of budget ceilings. Not only is this bad business, but history is replete with accounts of militarily strong, fiscally weak nations which have gone down to ruin. I agree that we must continue to spend as much as possible to keep us in the Space Race, but let's not encourage this sort of thing at the expense of other governmental commitments such as welfare, education, etc., and especially let's not obtain our space ascendancy at the expense of a deficit economy.

3. I wholeheartedly concur with Item 3 of your proposal, which recommends streamlining of defense regulations. This is a field in which I feel we can gain in economy as well as effectiveness.

Finally, it is good to feel that we in the missile field are important to our government and to the ways of advancing science and peace. I agree with you completely on that comment. But we cannot forget that we are only a part of the "team" and that, as "Captain," the president must be aware of, and balance, all the factors in order to win the more important ideological race between communism and free democracy.

O. R. Cutler
Salt Lake City

when and where

OCTOBER

IRE, AIEE, ISA 13th Annual Conference on Electrical Techniques in Medicine and Biology, Sheraton-Park Hotel, Washington, D.C., Oct. 31-Nov. 2.

1960 Fall Radio Meeting, sponsored by Electronics Industries Association, Engineering Dept. and IRE Professional Groups, Hotel Syracuse, Syracuse, Oct. 31-Nov. 2.

NOVEMBER

Conference on Electrostatic Propulsion, ARS and U.S. Naval Postgraduate School, Monterey, Calif., Nov. 3-4.

Government Contracting Course, NDEI, sponsored by NSIA and Harbridge House, Inc., Dayton, Nov. 7-18.

First National Die Casting Exposition and Congress, Society of Die Casting Engineers, Detroit Artillery Armory, Detroit, Nov. 8-11.

National Convention, National Aeronautics Association, Indio, Calif., Nov. 14-16.

Sixth Annual Conference on Magnetism and Magnetic Materials, sponsored by: AIEE, American Institute of Physics, ONR, Institute of Radio Engineers, American Institute of Mechanical Engineers, New Yorker Hotel, New York City, Nov. 14-17.

IRE Mid-American Electronic Convention, (MAECON), Hotel Muehlebach, Kansas City Mo., Nov. 14-16.

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editorial . . .

Nixon Drops Party Line on Space

VICE PRESIDENT NIXON'S reply to the MISSILES AND ROCKETS open letter to both candidates, asking that they declare their stands on the defense and space issue, is notable in that on two major points of the issue he differs sharply from the Eisenhower-Administration line.

It is also notable in that it marks the first time Candidate Nixon has made known publicly and clearly his feelings and opinions on the U.S. defense and space exploration posture *vis-a-vis* that of the Soviet Union.

In replying to Point One of our nine-point proposal to gain parity or better with the Russians in defense and space, Mr. Nixon said:

"The Eisenhower Administration long ago recognized we were in a strategic space race with Russia. Today we are ahead."

On Point Three, proposing that the United States must insure "freedom of space" before we can guarantee "space for peaceful purposes," the Vice President declared:

"Freedom of space, like freedom of the seas, is essential to the progress of mankind. *Our military forces must have the mission and the necessary strength to defend freedom of space.*"

Actually, the Eisenhower Administration, to our knowledge, has never recognized that we are in a strategic space race with Russia. *It has never admitted we are in any kind of a space race with Russia.*

In fact, the Administration has on several occasions gone out of its way to deny or refute such a suggestion. On several occasions, it has declared that we are not in a race in order to explain why our achievements, while greater in quantity than the Russians, are of lower strategic quality.

On Point Three the Administration has frequently brushed off lightly the suggestion that the military services had a right or a need to be in space. Publicly, at least, the fact that freedom of space may not come from wishful thinking has not been recognized.

As recently as Sept. 22, in his address to the United Nations, Mr. Eisenhower proposed that space, like the continent of Antarctica, be declared "off limits" to military preparations.

The key word there, perhaps, is "preparations." We suggest that we are already prepared to defend the freedom of Antarctica should it be threatened. We are not, but we must be, equally prepared to defend the freedom of space should it be threatened.

WE ARE GLAD to record Mr. Nixon's stand on these two points—as on the others in the nine-point proposal. We are glad to be the medium to bring his views into the open, as we previously published the views of Senator Kennedy.

We doubt that the public fully understands the vital implications of the competition with Russia in the defense and space areas. Or understands that the two—defense and space—are rapidly becoming one and the same, and that the outcome of this competition may decide our survival, both as individuals and as a nation.

It may be that the complexity of the issue has prevented more complete debate. Certainly it is not that the issue lacks importance. Nor do the views of the candidates, as we have presented them.

Clarke Newlon

TO SPACE AND BACK!

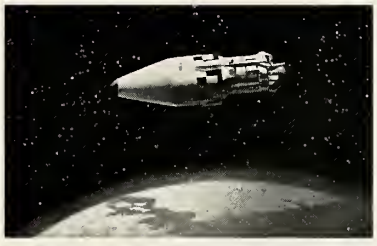
America's Agena is first orbiting satellite to send a capsule back from space

On August 11 a Lockheed-built Agena satellite gave America a monumental "first" in the race to conquer space. With perfect timing, it dropped its payload into a recovery area near Hawaii.

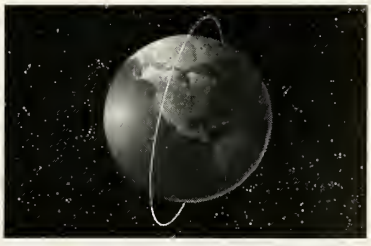
This brilliant feat, verifying the recovery technique, could not have been accomplished without the spadework already done by earlier Agenas in the Discoverer program of the U.S. Air Force. The Agena was first to be put on a predetermined orbit, a nearly circular orbit, and the difficult polar orbit; first to be commanded, monitored, and maneuvered on orbit; first to stabilize itself at an exact angle to earth; first to eject a recovery capsule. But the Discoverer program's most important achievement has been to provide the Air Force with a tested satellite for its vital Midas and Samos programs.

A larger, more powerful version, the Agena B, will be used in the satellite, lunar, and deep-space programs of the National Aeronautics and Space Administration for several years.

After first-stage Thor booster dropped away, Agena satellite's own rocket engine ignited and drove it to exact speed to reach its planned polar orbit.



2. As soon as it reached its orbit, the Agena satellite swung itself around 180°, so that it sped tail first on its 18,000-mph, 94-minute journey around the world.



3. During the Agena's 17th pass around the earth, a timing device triggered gas jets that tilted its nose downward to a 60° angle for ejection of re-entry vehicle.

After the vehicle's retro-rocket (see main illustration) had slowed it to a safe re-entry speed, a parachute lowered the 300-pound capsule to recovery area.

5. Agenas are made at "Satellite Center, U.S.A."—headquarters of Lockheed's Missiles & Space Division at Sunnyvale, California. Lockheed is prime contractor for the Discoverer program. Subcontractors are the General Electric Co. (recovery capsule), Bell Aircraft Corp. (Agena engine), and Douglas Aircraft Co. (Thor booster).

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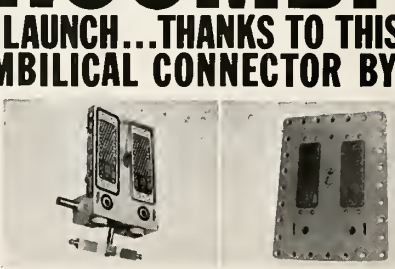

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