April 11, 1960

missiles and rockets

THE MISSILE/SPACE WEEKLY

Polaris Spurs ASW Program

New M/R Department: ASW Engineering . . . 36

AN AMERICAN AVIATION PUBLICATION

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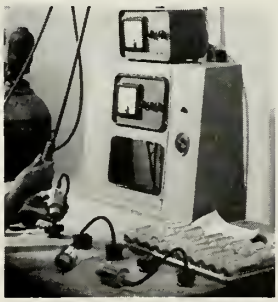

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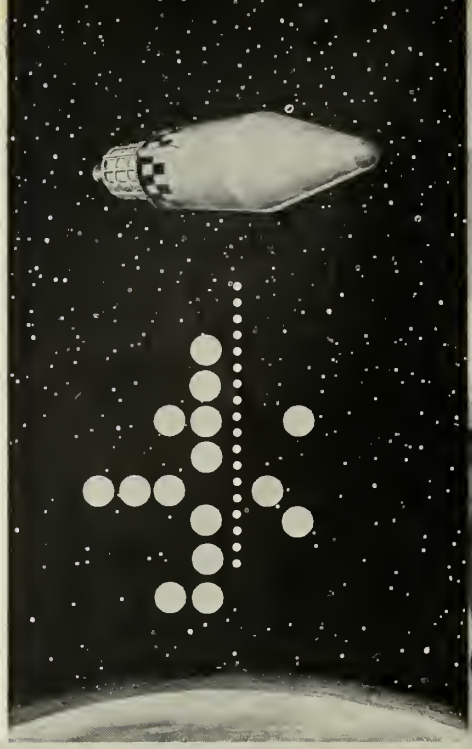

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THE MISSILE / SPACE WEEKLY

missiles and rockets

April 11, 1960 Volume 6 No. 14

THE COVER

Sub-launched missiles—does U.S. have a defense against them? (See p. 36.) Polaris is shown rising from ship motion simulator just before rocket motors ignited.

31,400 copies this issue

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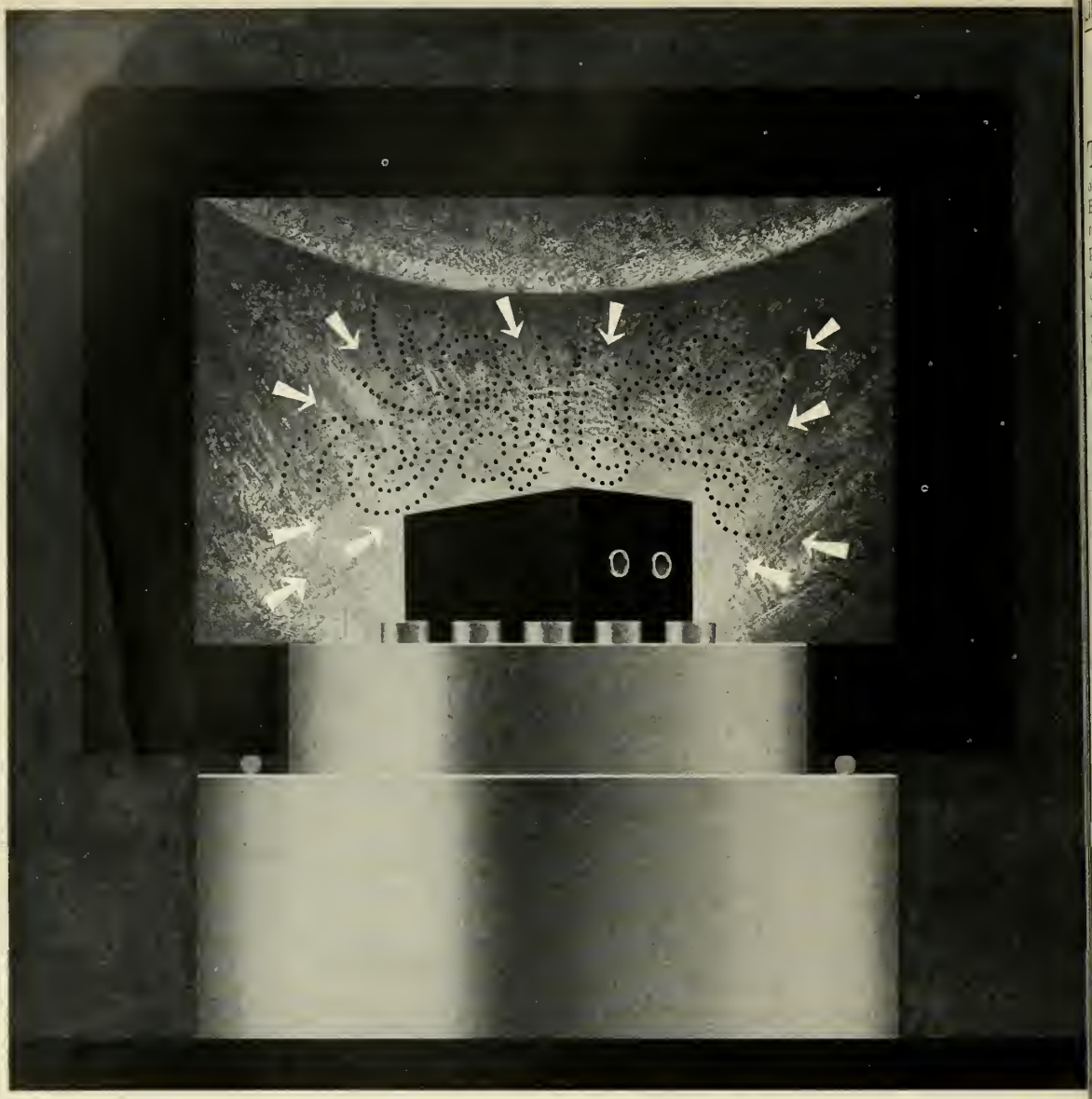

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letters

Heaviest Load?

To the Editor:

Page 15 of the Feb. 29, 1960, issue has a paragraph about heavy objects on pneumatic tires. In 1955 a B-36 successfully took off and later landed with a gross weight in excess of the 350,000-pound weight you are citing as the heaviest. I am not sure of the details, but I believe the gross at take-off was 410,000 pounds and the landing was completed after only one circle of the field. Bear in mind, I don't wish to claim that the B-36 was the heaviest thing on pneumatic tires, but it was heavier than your example.

Stanley V. Castner
The Marquardt Corporation
16555 Saticoy Street
Van Nuys, Calif.

Better Look Up 'Archaic'

To the Editor:

The March 7, 1960, issue of M/R had on its front page, "Threading-New Twist for Solids," and on page 36, "Buttress Threading Cuts Case Weight."

I am sure the Russians must be laughing at the latest attempts to fool them.

It is hard to conceive that archaic methods of threading are in use in the solid rocket program.

George E. Barnhart
Flight Path Control Co.
2228 East New York Drive
Altadena, Calif.

April in Paris

To the Editor:

Our attention has been called to a story appearing in your issue of Feb. 22, 1960, dated Geneva, in which reference is made to certain business shortcomings at present in France. I feel that certain passages of this article are not quite correct, particularly the reference to an old fashioned telephone system.

As a matter of fact, the French telephone system, whose conversion to automatic switchboards is progressing at least as rapidly in this country as in the U.S. To give an example, I live 45 miles southwest of Paris and since 1935 the dial system has been in operation, which allows me to get a call through instantly, whereas, in order to get my home in Port Deposit, Md., from Baltimore or Washington, it has to go through at least four manual relay operators!

Regarding the lack of taxis, I can assure you that on a rainy day in New York it is at least as difficult to get one as it is here in Paris—and the rates are higher.

The reference to strikes in vital services is definitely out of date, since there have been no such strikes here during the past two years—quite a comparison with the longshoremen's situation in New York which not too infrequently makes it right difficult to handle shipments or dock a vessel.

I am sure you will realize that we are giving you a fair picture of the situation here and I would like to add that in the matter of housing the situation in Switzerland is getting very much tighter than it is in France, judging from the reports received recently from our business visitors from Switzerland.

F. P. Farish
General Manager
American Chamber of Commerce in France
21 Ave. George V., Paris

Prime for *Able*

To the Editor:

Regarding the Navy's *Weapon Able,* listed in M/R's July, 1959, Missile Encyclopedia and March 7, 1960, Astrolog; you list Avco as prime contractor. I wrote Avco for further information. Their reply, forwarded from Cincinnati office of Avco, denies they are prime contractor and that they actually made only a few castings. They did not volunteer the prime contractor's name.

Who is right, you or Avco?
Who is prime contractor?
I am a subscriber (a happy one!)

John D. Neff
Cleveland, Ohio

Avco did do early work on Able, but today the Navy is the only real prime, as it does most of the fabrication work.—Ed.

The Gap: Another View

To the Editor:

Standing as I am on the fringe of the "missile gap," as opposed to having my corporate feet hanging over the edge as is the case of Lanphier, Sprague, Watson and Associates, Uninc., I get the distinct impression that most of the dogs are barking up the wrong tree in the woods that surround the thing thus preventing a clear view of the "gap" by the general public.

The fact that such leaders of industry openly criticize the Administration for its handling of affairs of National Defense is indeed a classic tribute to our inalienable right to freedom of speech and that all-American institution, free enterprise. I am sure that all men who are big enough to be "big men" welcome and solicit good constructive criticism. The question is not, "Do these men with outstanding backgrounds in defense production and financing have the right to criticize?" but rather, "Are their criticisms aimed toward the most objective target?"

The big cry, so far as I have been able to ascertain, is that a tightening of the grip on Uncle Sam's change purse has created the "missile gap." All of the biggest beefers emphasize the fact that a paltry $41-billion defense budget is insufficient to properly meet the situation.

If we are going to shroud our critique with patriotic devotion, as ex-hero Lanphier, et al., are doing, leave us first start, not with a college cheer for bigger and better bucks, but with a look to determine

whether or not J. Q. Public is getting the most he should reasonably expect from his defense dollar.

This is my criticism. It is not directed toward the Administration, Congress, DOD (or even "MISSILES AND ROCKETS" which I think does a fine job if at times ill-advised), but toward the lads who are yelling the loudest, American industry.

It is my guess that a "missile gap" does exist, but I am at once of the firm conviction that the President of the United States is in a far better position to be the judge of this than I—even as Mr. Lanphier should be. Unfortunately, the Treasury is just not large enough to foot the bill for closing the "gap" so long as our approach . . . remains the same.

I, too, am imbued with a modicum of patriotic devotion. I am a staunch advocate of free enterprise. I reserve the right to criticize.

Where the defense of the nation and the taxpayer's dollars are concerned, intra-defense-industry jealous competition has no place. Millions and billions of big "D" dollars have been the victim of industry's claim to a "better mouse trap." The three branches of military service must necessarily be considered as parties to both "defense industry" and "jealous competition," since they are charged with the responsibility of spending the allocated funds and each is fighting fiercely for its respective pet project. This makes them ideal dupes for the wiles of industry's salesmanship.

If ever unification of Defense Department services and industry were desperately needed, now is the hour, to plug the "gap" with a single wad.

Our potential enemy may possess superior implements of defense, but you can bet the $41 billion that it doesn't have a fraction of the variety we do cluttering up the many phases of research, development, production, and obsolesence. Until someone comes up with a formula for bending a genuine, concerted effort toward the development of only those weapons which are second to none, rather that the Canaveral cantaloupes we've been getting, the "missile gap" will continue to serve solely as a hole into which we will pour more and more G.I. dollars.

Ted Wallace
Lawrence, Kan.

Good First Impression

To the Editor:

Last week I had the pleasure of receiving for the first time your excellent magazine.

Permit me to say that I found this magazine very informative and of great scientific value.

For many years, I have been a member of the B.I.S., as well as the Swedish, French and Brazilian rocket societies. I am active in Astronomy and Space program activities.

My communication is intended simply to congratulate you.

C. O. Musser
Exec. Vice President
Director of Research
Scientific Industries, Inc.
Los Angeles

Washington Countdown

IN THE PENTAGON

Poison gas rockets . . .

the Army's new *T-238*—are designed to be fired from 45-tube launchers. The Army wants to buy $32 million worth of the approximately four-inch rockets and launchers in FY '61. The Army is developing the *T-238* to counter Soviet work in the field.

• • •

Undersea launchings . . .

of *Dolphins*—dummy operational *Polarises*—are being conducted by the nuclear-powered submarine George Washington at sea. The *Dolphins* are used to train crews and test launching equipment.

• • •

Total funding for *Skybolt* . . .

in the Air Force's FY 1961 budget requests is $60 million. Some $50 million is for R&D; the rest is mostly for procurement of ground support equipment for the Douglas air-launched ballistic missile.

• • •

Field tests for *Cobra* . . .

are being conducted at Redstone Arsenal. The Army is still evaluating the Daystrom anti-tank missile in competition with the Nord *SS-11*.

• • •

One thousand *Cobras* a month . . .

are scheduled to be turned out by Daystrom at its Military Electronics Division plant to fill Marine Corps orders. This is about 20% of the plant's capacity.

• • •

Cost of BMEWS . . .

for the presently-planned interim phase of the program is expected to be $792.4 million for all three sites. A breakdown shows:

. . . The sites in Alaska and Greenland will cost $711.3 million for construction and equipment.

. . . The site in England will cost $81.1 million for equipment. Construction costs will be met by the British.

• • •

New names for Navy missiles . . .

to bear in mind:

. . . *Super Talos*, the seagoing anti-missile missile, is now the *Long Range Typhoon*.

. . . *Super Tartar*, is now the *Medium Range Typhoon*.

. . . *Able*, the surface-to-underwater rocket, is now Weapon *Alfa*.

The first antimissile missile . . .

for use on the battlefield will be the Convair *Mauler*. The missiles will be mounted on trucks. *Mauler* shipping containers will double as launch tubes.

ON CAPITOL HILL

Defense industry legislation . . .

affecting Pentagon procurement procedures and small business is expected to go nowhere during the current session of Congress. More hearings, yes; floor action, no.

• • •

Steve Leo's recall . . .

by Senator Symington to help with his campaign for President came as no surprise to those close to either man. Leo was the Senator's public relations chief and probably closest advisor when Symington was Secretary of the Air Force. He has been given leave of absence for the campaign by Sverdrup & Parcel, where he is vice president in charge of the Washington office.

AT NASA

Pioneer V's big No. 2 transmitter . . .

will be turned on by May 15. By then the satellite will be some eight million miles from earth and its No. 1 five-watt transmitter probably will be beyond the range of all earth tracking stations except Jodrell Bank. The 150 watt No. 2 transmitter may be turned on as early as April 15 if the smaller transmitter fades sooner than expected.

• • •

Project *Echo*'s launching . . .

may be moved up to next month because of the success of the fourth Shot Put balloon experiment. The passive communications satellite will be 100 feet in diameter.

INTERNATIONAL

Dead Soviet astronauts?

A Soviet scientist in London recently didn't exactly quiet rumors that the mortality rate of Red astronauts is rising. She categorically denied that any Soviet scientists have been killed in space experiments. But she emphasized the word "scientists."

• • •

French Gen. Ludy Piollet . . .

had some unkind words to say about U.S. ICBM bases after a tour of Warren AFB. He called Warren the "first block of the American Maginot Line." The first *Atlases* are in place at Warren.

FOR THE ARMY, MSVD is currently developing the LITTLE-JOHN nuclear arming and fuzing system shown undergoing vibration test . . . part of MSVD reliability test program.

MISSILE AND SPACE VEHICLE DEPARTMENT

...center for missile and space technology research and development at General Electric

Progress in arming and fuzing

With this nation's growing arsenal of strategic and tactical missiles, increasing emphasis is being placed upon the development of more sophisticated safing, arming and fuzing systems.

General Electric's Missile and Space Vehicle Department was the first industrial contractor selected by U.S. Army Ordnance to furnish safing, arming and fuzing subsystems for nuclear warheads. MSVD has participated in feasibility studies, development, testing, evaluation and production of safing, arming and fuzing systems for ten major U.S. Army and U.S. Air Force surface-launched missiles, including the Army's LITTLE-JOHN, HONEST JOHN, LACROSSE, NIKE-HERCULES, and the Air Force's ATLAS and THOR.

Engineers at MSVD's Missile and Ordnance Engineering Operation who contributed to many of these projects are today working with new safing, arming and fuzing concepts and techniques. These include the development of new fuze designs intended to overcome possible enemy countermeasures, the study of re-entry-stage arming for long-range strategic missiles, and development of direction sensing devices to aid in gaining even more reliable safing measures.

For more information on MSVD's safing, arming and fuzing achievements for the Army and Air Force and other contributions to U.S. space technology progress, write to Section 160-72, General Electric Missile and Space Vehicle Department.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Philadelphia 4, Penna.

Scientists and Engineers interested in career opportunities in Space Technology contact Mr. T. H. Sebring, MSVD.

Circle No. 5 on Subscriber Service Card.

Industry Countdown

MANUFACTURING

AF interest is perking up . . .

in PERT (Program Evaluation Review Technique) developed by the Navy's Special Projects Office to manage *Polaris* weapon system development. ARDC's Lt. Gen. Bernard Schriever is urging his commands to apply the PERT system to new development programs. PERT's big advantage, already recognized by industry, is that it offers a means of making time-saving decisions in one-time-only R&D. Aerospace Industries Association also is investigating the broader applications of PERT to take into consideration costs and resources. AIA is working with ARDC and AMC to include standard progress reporting and objectives in initial phases of R&D programs.

• • •

Breakdown of 1961 . . .

Defense budget being circulated by the marketing group of one large company shows for missiles: Army $410 million; Navy $400 million; AF $2.7 Billion. This forecast puts missile expenditures in 1970 at: Army $600 million; Navy $800 million and AF $4.4 billion.

• • •

Biggest current gripe . . .

of companies in the missile component field is directed against what they feel is growing trend throughout DOD to increase in-house capability. Many believe that at the same time, because of slight reward for company-funded R&D, reliability is going by the boards.

• • •

Anti-union fight . . .

is being waged by the National Society of Professional Engineers. NSPE objects not only to unionization of its own members, but is campaigning against collective bargaining for engineering technicians, with whom they work.

• • •

There's speculation . . .

the Navy will open a Fleet Ballistic Submarine depot at San Francisco, like the one recently commissioned at Charleston, S.C. But it will be a long time before the Navy takes the step, insiders feel, particularly if there is no immediate large increase in the number of *Polaris* submarines.

PROPULSION

Big sell of continuous mix . . .

process is being conducted by Thiokol, one of the main bidders on the AF's multi-meg solid booster Project 3059. Thiokol, which favors on-site loading for large solid-fueled rockets, demonstrated its continuous mixer March 31 at Marshall, Tex., to about 60 representatives from DOD, Army, STL and two dozen prime contractors.

• • •

It's still a three-horse . . .

race for the NASA contract to build the 200K hydrogen-oxygen engine to power *Saturn's* middle stages. Aerojet-General, Pratt & Whitney and Rocketdyne are the top contenders, with Aerojet rated in the post position. Decision is expected in about three weeks.

• • •

Now flying with production . . .

model General Electric J85-7 turbojet engines is the AF's GAM-72 *Green Quail* decoy missile. The bird, primed by McDonnell, is reported to have exceeded maximum altitude obtained with development engines on recent launch from a B-52.

ASTRIONICS

A dozen organizations . . .

have submitted informal plans to NASA to use their own equipment to bounce signals off the Project *Echo* sphere. They include the Army Signal Corps at Fort Monmouth, N.J.; Alpha Corp. of Collins Radio, Dallas, Tex.; AVCO/Crosley; General Electric; Haverford College; ITT Labs; RADC/Philco, Rome, N.Y.; Development Engineering Corp.; Stanford Research Institute, and Jodrell Bank.

• • •

From Motorola's Dr. Dan Noble . . .

". . . solid state electronics is the next dominant force which . . . will lead, in the next 30-40 years, the new cycle of electronic industry expansion." Noble contends "solid statesmanship" will breach the barrier of equipment complexity and achieve complex-system reliability.

WE HEAR THAT

DOD has withdrawn . . .

participation in the Air & Space Exposition planned for Los Angeles April 14. Major industry support also is lacking, but promoter Charles McLaughlin still plans to hold the show . . . Stanford Research Institute is investigating a new type cermet with randomly oriented grains which are formed by depositing alternating thin layers of metal and ceramic and crushing them. New material is said to have improved ductility . . .

Bomarc Proposal Irks Canada

Parliamentary opposition charges government was sold out by U.S.; defense minister reasserts faith in missile

by James Baar

The Air Force's proposed slash of the *Bomarc-B* program (see M/R, April 4) is causing a major uproar in U.S.-Canadian relations.

The embarrassing questions which the Canadians are asking both publicly in their Parliament and privately in U.S.-Canadian talks are:

- Why should Canada buy two squadrons of Boeing *Bomarc B's* if the U.S. Air Force regards these air-breathing missiles as nearly obsolete?
- Why wasn't Canada informed of the Air Force proposal in advance of its release to the public?

The Canadians are building two *Bomarc-B* bases. One at North Bay, Ontario, is already under construction. The other will be built at Mont Laurier, Quebec.

One squadron of 400-mile-range *Bomarc-B's* is scheduled to be deployed at each base. Each squadron is comprised of 28 missiles.

News of the Air Force proposal—approved last week by the White House—caused an immediate political free for all in the Canadian Parliament.

• **Sell-out?**—Opposition party members charged that the Administration had, in effect, allowed itself to be sold out on the *Bomarc* program by the United States.

Liberal Party Leader Lester Pearson, whose own party had been sharply criticized in the past for its defense policies, said he was stunned by the news that the United States planned to abandon the *Bomarc* program. Other opposition members charged that Defense Minister George Pearkes had been kept in ignorance of what was going on in Washington.

Pearkes denied it. He said Washington had informed him of the Air Force proposal. However, he did not have time to tell Parliament about it before the news broke in the press.

Pearkes said he had "not lost faith in *Bomarc*." He said he would not "give it up on hearsay that it may not be successful."

Pearson said he was surprised that Pearkes' "confidence remained unimpaired." He charged that the $40.4 million left in the Air Force budget for FY '61 was for "funeral expenses."

One opposition member—Hagen Argue—called *Bomarc* "a dead duck." Other opposition members charged that Canada was wasting $125 million on the program.

• **Still in picture**—Pearkes insisted that *Bomarc* would remain an essential part of the North American defense on both sides of the U.S.-Canadian border. He also said the Canadian bases would cost only $15 million. However, this figure apparently did not include the cost of the missiles—about $50 million.

In Washington, Air Force officials pointed out that the United States still would have three *Bomarc-B* bases despite the cuts, as well as five 200-mile-range *Bomarc-A* bases.

Moreover, they continued to insist that the proposed cuts were not brought on by any doubts resulting from repeated failures in the *Bomarc* development program. They said the cuts reflected only the changing nature of the Soviet threat from aircraft to ICBMs.

The Air Force wants to take $136 million of the money saved from *Bomarc* cuts for enlarging *Atlas* squadrons. The last six of 13 planned *Atlas* squadrons would be enlarged from nine to 12 launchers. This would increase the total number of *Atlas* launchers planned from 114 to 132.

• **Angry press**—The Canadians apparently were not assuaged.

The Toronto Globe & Mail suggested in an editorial that Canada had been poorly treated by the United States. The Montreal Gazette said: "The issue of the *Bomarc B* has produced almost complete confusion among the Canadian people. . . . The practice of not taking the people fully and frankly into its confidence has left the government in the position where few Canadians understand what it is trying to do and why it is trying to do it."

The Globe put it all more bluntly in a cartoon. It depicted Pearkes tied to a *Bomarc* with chains. Two U.S. Air Force officers stood beside it lighting the fuse.

Horner Will Resign from NASA

Richard E. Horner, Assistant Administrator of NASA and the man who many Washington observers thought might replace T. Keith Glennan as Administrator at the end of the year, will leave NASA for a position in private industry this summer.

Reliable sources have informed M/R that NASA will announce the Horner resignation in the near future.

Richard E. Horner
. . . attracted to industry?

Principal reasons for the resignation are thought to be the attractions of pay and security that employment in private industry offers. Horner, 42, has spent 22 years in government, both in the military and as a civilian. He has two children, one of college and one of high school age.

Horner brought to the NASA position created for him the talents of an administrator combined with technical knowledge. He holds a B.S. from the University of Minnesota in Aeronautical Engineering, and a Masters degree from Princeton University.

Commissioned a second lieutenant in the Army Air Corps in 1940, Horner served as a pilot with tactical units during World War II, winning the Silver Star, the Air Medal with four clusters, and the Presidential Unit Citation. Released from active duty for medical reasons as a Col. USAF, in 1949, Horner became an aeronautical development engineer at the AF Flight Test Center at Edwards AFB.

In 1952, Horner became technical director of the test center; in 1955, deputy director for requirements to the Assistant Secretary of the Air Force for R&D; 1956, Acting Assistant Secretary of the Air Force for R&D; and 1957, Assistant Secretary of the Air Force for R&D.

First Launching of *Samos* Draws Near at Point Arguello

First Atlas-type gantry is almost ready; target date for completion of range instrumentation is June 1

by Richard Van Osten

POINT ARGUELLO, CALIF.—Activity aimed at not-too-distant-future firings of the Air Force's polar-orbiting *Samos* reconnaissance satellite is accelerating at the Pacific Missile Range's Naval Missile Facility here.

The initial *Atlas*-type gantry of the two-position launch complex No. 1 is virtually complete. Fuel and LOX facilities have been installed. Blockhouse instrumentation is well along.

The *Samos* gantry is 135 ft. high—slightly taller than the similar operational *Atlas* version. Total vehicle height will be a little larger than the *Atlas* due to second-stage hardware, but the principal reason for the extra gantry height is to provide adequate work platforms for the upper stage. The vehicle will consist of a modified *Atlas* and the *Agena*.

The basic booster assembly will be moved into position with an *Atlas* transporter erector, but the fixed ground unit for the erection fulcrum is not quite identical to that in the operational *Atlas* system.

Principal positioning of the *Atlas* booster is accomplished by large pins in the erection unit which fit into each side of the booster. Ground location pins used in operational *Atlas* systems are replaced by tie-down rods on either side of the erection unit's aft section.

• **Other changes**—Blockhouse instrumentation is based upon operational *Atlas* control panels as far as the actual *Samos* launch is concerned. Principal visual differences are the addition of second-stage data on the wall-mounted system status panel and the substitution of *Agena* roll control data for other operational controls on what would normally be the launch officer's control panel. Instrumentation includes special display panels applicable to *Samos* and other satellite vehicles.

The Navy describes Point Arguello as a "sanitized" installation. There are no plans to house personnel on the facility other than a small detachment of Marine security guards. All other personnel, military and civilian, are housed or otherwise supported by USAF facilities at nearby Vandenberg, AFB.

Dr. Von Braun Leaves M/R at NASA's Request

Missiles and Rockets regrets the resignation of Dr. Wernher von Braun from its Editorial Advisory Board pursuant to the letter below. Dr. von Braun has been a member since the magazine's first publication in 1956. The letter:

As you know, the Development Operations Division of the Army Ballistic Missile Agency, of which I am Director, is in the process of being transferred to the National Aeronautics and Space Administration. NASA headquarters in Washington has advised me to resign from the Advisory Board of MISSILES AND ROCKETS Magazine because they feel that the commercial aspects of the publication could conflict with some aspects of my new position.

Pursuant to their request, I hereby submit my resignation from the Editorial Advisory Board of MISSILES AND ROCKETS Magazine, effective this date.

Please know that my association with the Board members and editorial staff of MISSILES AND ROCKETS has been a most pleasant one and that I wish you every success in the future.

With kindest regards, I am
Sincerely yours,
Wernher von Braun
Director
Development Operations Division
National Aeronautics and Space Administration

Point Arguello range instrumentation is almost ready for full operational status in line with PMR's support mission. Target date for completion is June 1. First *Samos* launch should take place soon after that.

• **Other range services**—But not all of Point Arguello is concerned with exotic satellite projects. The Marine Corps, for example, conducts regularly scheduled *Terrier* training at the site. For this, NMFPA provides range scheduling liaison, frequency interference control (FIC), target drone service and recovery, range clearance, ground safety, radar tracking and base support to encamped personnel. Both *Terrier* and *Hawk* operations are scheduled for an indefinite period.

For *Thor* and *Atlas* shots from Vandenberg, NMFPA provides range scheduling, FIC, range clearance radar and optical tracking, impact prediction, impact location, data processing and reduction (NMFPA has its own IBM 709 computer leased for $40,000 per month), and telemetry backup. These services will continue into 1960 for *Thor* and into 1964 for *Atlas*.

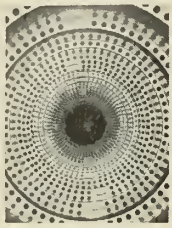
Services for *Discoverer* and *Samos* consist of telemetry, radar and optical booster fallout, range clearance, range safety, photo facilities, range scheduling tracking, FIC, impact prediction for and data reduction. In addition, meteorology and ground safety are provided for *Samos* only. *Discoverer* operations may continue into 1964, according to PMR's schedule. *Samos* services are slated to begin in 1960 for an indefinite period.

Much the same services are provided for two other projects, *Sunflare* solar disturbance studies, and Sandia/AEC's *HAS* (high-altitude sampler) Project *Tumbleweed* operations, both of which are launched from NMFPA, and are scheduled to continue for an indefinite period.

Still another current support program is for the Office of Naval Research's Project *Tepee* aircraft and missile detection system. This also is slated to begin this year and continue indefinitely.

• **Crowded schedule**—Firm future programs for which NMFPA will provide services include *Titan* ICBM launches from Vandenberg, *Midas* (like *Samos*, scheduled for launch from NMFPA) and NASA's *Nerve* (Nuclear Emulsion Recoverable Vehicle). Some tracking facilities are now under construction for PMR's portion of Project *Mercury*. With the exception of *Mercury* and *Titan*, all the above operations are scheduled for NMFPA support beginning this year and continuing indefinitely. *Titan* support, however, is scheduled only to 1964.

—Next Week—Saturn Fabrication



The largest, most intricate fabrication job ever attempted in the missile/space business is Saturn. In next week's M/R, H. H. Maus, Chief of the Fabrication and Assembly Engineering Laboratory of the George C. Marshall Space Flight Center at Huntsville, relates in an exclusive by-lined article some of the problems encountered.

Maus has also contributed a picture story and captions detailing the various steps in Saturn's fabrication.

—news briefs

REDS 5 YEARS BEHIND—Rear Adm. William F. Raborn, commander of the Navy's Special Projects Office, asserts the *Polaris* Fleet Ballistic Missile weapon system is at least five years ahead of any comparable submarine-launched ballistic missile system in Russia. He said the invulnerability of *Polaris* would be enhanced by a projected increase in the missile's range from 1500 to 2500 miles, giving the submarines more room to maneuver.

EXCESS PROFITS CHARGED—Telecomputing Corp., Van Nuys, Calif., was charged by the General Accounting Office with making a 29% profit on subcontracts for $17.5 million worth of *Nike-Ajax* gyros. The agency said Western Electric accepted Telecomputing's prices without obtaining information on its cost experience "or other evidence of reasonableness of the proposed prices."

MILD 'INFLUENCE' BILL—The House Armed Services reported to Congress a mild version of a bill to discourage defense contractors from hiring former military officers for selling jobs within two years after leaving the service. The committee eliminated criminal penalties in the original Hébert Subcommittee measure and instead provided that violators would lose their retirement pay.

MINUTEMAN SILO POP-UP—The Air Force popped a seventh *Minuteman* ICBM from an Edwards AFB silo April 5. The tethered missile carried simulated flight hardware.

ARMS TALKS SNAG—Geneva disarmament talks struck a blind alley when Russia refused to join in an agreement to ban the launching of satellites carrying nuclear bombs unless the United States agreed at the same time to liquidate its foreign military bases. Soviet delegates claimed the U.S. was injecting space control into the talks as a scheme to catch up in this area.

IKE OKAYS FUND SHIFT—DOD plans for beefing up the *Atlas* and *Polaris* missile programs have been approved by President Eisenhower. The new funding emphasis, designed to be made within the $41-billion defense budget ceiling, also calls for cutbacks in *Bomarc* air defense squadrons and in hardening the SAGE system.

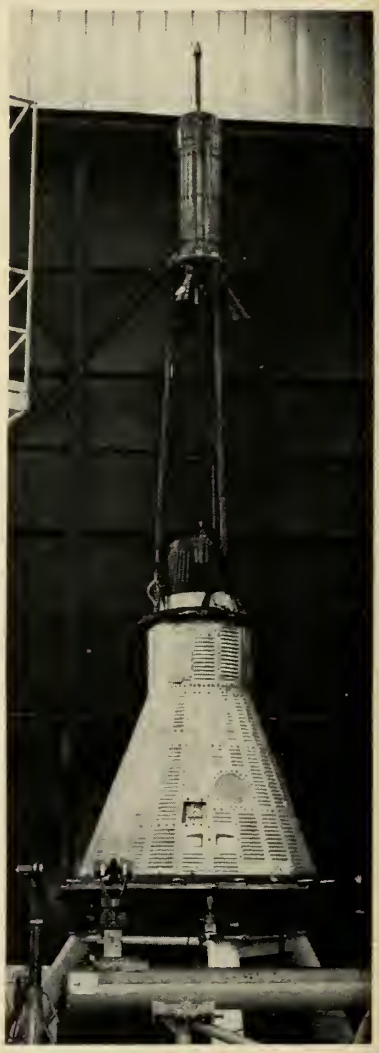
HIGHER NET SEEN—Wall Street sources report Avco Corp. sales and earnings are expected to rise sharply in the current fiscal year which ends for the company on November 30. Sales are expected to be more than 10% greater than the $306 million recorded in 1959.

CUSHY RR RIDERS—*Polaris* missiles will be transported by railroad under a contract signed by the Navy and the New York Central. The Birds will be in containers and ride on large air-filled rubberized pillows.

DOUGLAS CUTS PAY—The pay of 13,500 salaried workers is being cut by the Douglas Aircraft Co. as of April 11. There also will be a 60-day moratorium on merit pay increases. Union officials interpreted the cuts as a move to discourage wage demands in current contract negotiations, but the company said they were one of several economies intended to put the company in a stronger competitive position.

NO CUTBACKS AT PATRICK—Rumors to the contrary, no cutbacks or layoffs are contemplated at the Air Force Missile Test Center, according to Maj. Gen. Donald N. Yates, center commander. The workload at Cape Canaveral actually will increase over the next few months, Yates declared, from 15% to 50% in different areas. The projected shift of some areas of responsibility from RCA to Pan American apparently gave rise to the cutback rumors.

Mercury Capsule



FIRST OF the Project *Mercury* space capsules instrumented for escape system tests have been delivered to National Aeronautics and Space Administration by McDonnell Aircraft for testing at Wallops Island, Va. Delivery of the first capsules was accomplished less than 14 months after contract was signed.

most comprehensive yet . . .

ARS Meeting to Include 29 Sessions

The American Rocket Society Semi-annual Meeting and Astronautical Exposition at Los Angeles May 9-12 promises to be the most ambitious and comprehensive ever held. All phases of the missile/space industry will be covered in 29 technical sessions ranging from education to underwater propulsion. One symposium will be devoted to the marketing aspects of the industry.

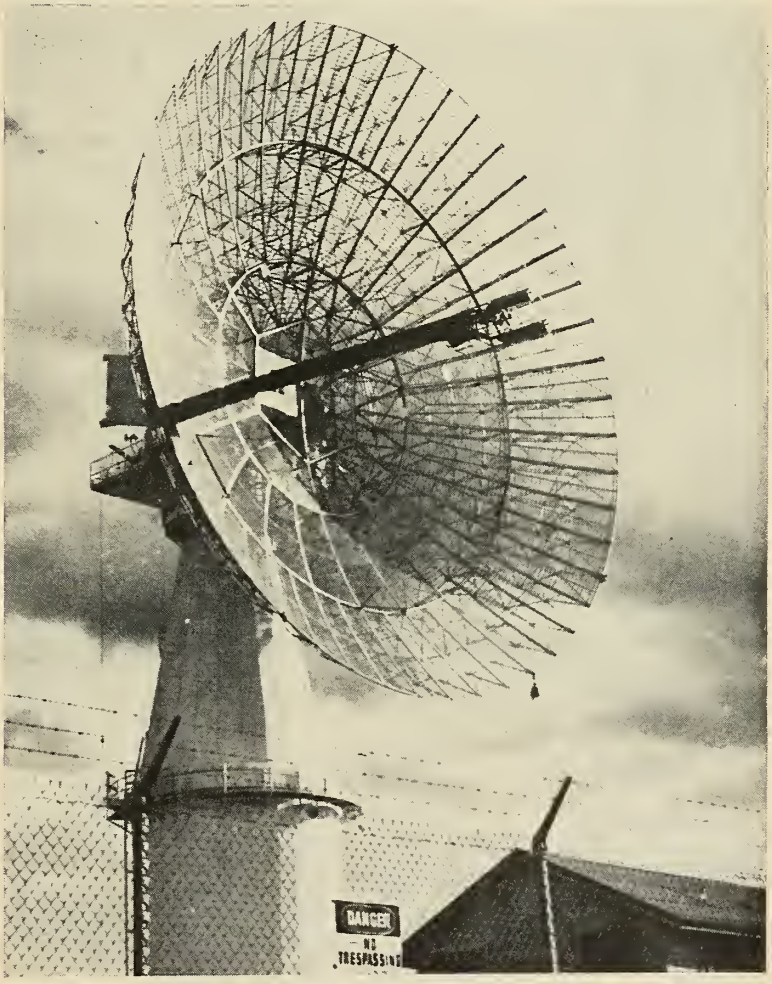
Field trips to Edwards AFB, Rocketdyne, and North American will be available to a limited number of cleared members.

Luncheon speakers include ARS president Howard Seifert; Bruce Old, vice president of Arthur D. Little; and Maj. Gen. Donald Ostrander, NASA.

Technical sessions and chairmen—

- **Hypersonics**—Alfred J. Eggers, NASA, Ames Research Center.
- **Missiles and Space Vehicles**—Richard de Lauer, Space Technology Laboratories.
- **Lunar Exploration**—Herbert Friedman, Naval Research Laboratory.
- **Human Factors Considerations in Maintainability and Trouble.**
- **Shooting**—Stan Deutsch, Douglas Aircraft.
- **Human Factors**—Laurel van der Wal, STL.
- **Ion and Plasma Propulsion**—Rolf Buhler, Giannini Plasmadyne.
- **Hypersonic**—George Solomon, STL.
- **Propellants and Combustion**—Melvin Gerstein, NASA, Lewis Research Center.
- **Latest Events in Space Flight**—Homer Newell, Jr., NASA.
- **Magnetohydrodynamics** — Joseph Neuringer, Republic Aviation.
- **Instrumentation for Combustion Stability Research**—John Witherspoon, Rocketdyne.
- **Hypersonics**—Henry T. Nagamatsu, GE Research Laboratory.
- **New Uses for Liquid Rocket Engines**—Charles H. King, Jr., Pratt & Whitney.
- **Support Equipment for Mobile and Hard Launchers** (secret)—Robert Kendall, Arthur D. Little, Inc.
- **Electrostatic Propulsion**—Nathan W. Snyder, ARPA (Institute for Defense Analyses).
- **Solid Rockets**—H. L. Thackwell, Jr., Grand Central Rocket.
- **Capabilities of Liquid and Solid Rocket Propellant Engines** (secret)—Y. C. Lee, Aerojet-General.
- **Guidance and Navigation**—Donald P. LeGalley, STL.
- **Power Systems**—Eugene B. Zwick, Sundstrand Turbo Div.
- **Space Observation Systems**—Sidney Sternberg, RCA.
- **Underwater Propulsion**—Charles Sandler, Navy Bureau of Weapons.
- **Space Law and Sociology**—Andrew G. Haley, ARS.
- **Space Observation System.**
- **Nuclear Propulsion Instrumentation and Controls**—A. R. Crocker, GE.
- **Nuclear Propulsion**—Raemer Schreiber, Los Alamos Scientific Lab.
- **Astrodynamics**—Louis G. Walters, Aeronutronic.
- **Astrodynamics**—R. M. L. Baker, Jr., AF Ballistic Missile Division.
- **Education**—F. C. Lindvall, Cal Tech.

Big Antenna Goes Up for ARGMA



AN 84-FOOT ANTENNA—largest of its type in the Southeast, and one of the largest in the U.S.—is being installed atop Madkin Mountain for the Army Rocket and Guided Missile Agency. Builder of the antenna is the D. S. Kennedy Co. of Cohasset, Mass.

Part of a system under development by the Ordnance Missile Laboratories Division of ARGMA, the antenna will be used initially in tracking artificial satellites and for radio propagation research. Future plans call for the addition of radar equipment to support the *Zeus* antimissile missile system.

Marquardt Hyperjet Engine Tests Boost Boron Promise

These exclusive first photos of Marquardt Corp.'s hyperjet development engines show the large 36-in. rocket engine used to test high-energy boron fuels at Edwards Air Force Base and the much smaller engine used in flight tests at the Navy's Pacific Missile Range at Point Mugu.

The large rocket engine has been operated at a thrust level of some 100,000 lbs. in facilities at the Air Force Directorate of Rocket Propulsion and Missiles at Edwards.

These tests were part of a program sponsored by Wright Air Development Division to develop a combined rocket-ramjet (hyperjet) engine (M/R, Mar. 21, p. 10.) The company reports that, while the tests just completed were limited to 100,000 lbs. static thrust on the large engine, this same size hyperjet has a design capability with slight modification of 250,000-lbs.-thrust.

The ramjet portion of the engine tested at Edwards has been flown three times on the Lockheed *X-7* at speeds and altitude of over Mach 4 and 90,000 ft. These flights are indicated by the *X-7*'s painted on the side of the engine.

"These large-scale tests proved that it is practical to combine optimum rocket and ramjet performance in a single large powerplant," the company says.

• **Record performance**—Company president Roy E. Marquardt says performance levels produced by the boron fuels are higher than those obtained from other storable liquids and from current nonstorable liquids used in today's missiles.

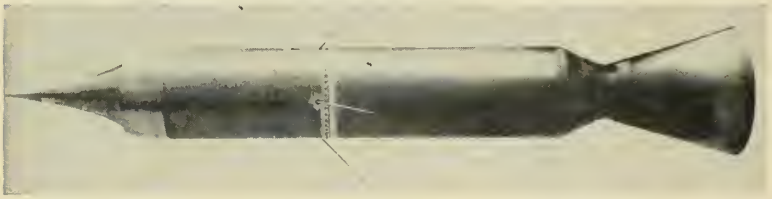
Tests with the large engine resulted in the highest performance ever attained with storable liquid propellants on a large scale. A storable oxidizer was used with the boron fuel.

"The high-energy fuels have the added advantage of being storable on board the missile so that it can be fired instantly," Marquardt said. "The series of tests we have just concluded on our rocket engine demonstrated that performance of boron fuels is superior to that available from solid propellant rockets."

From the photo, length of the large rocket engine appears to be somewhat more than 21 feet. Diameter of the nozzle at the outlet is about 42 in., at the throat about 24 in. Inlet diameter appears to be about 28 in. Piping in the center of the test engine is for fuel.

The smaller engine equipped with telemetering antenna is on a considerably reduced scale. It was flight-tested at Pt. Mugu as long ago as December, 1958. The test vehicle consisted of two *Nike* boosters. The program was conducted jointly by Marquardt and what is now its Cooper Development Division.

Smaller Hyperjet Has Been Flown



Marquardt's 36-in. Hyperjet Engine

Hughes' Missile/Space Sales to Rise in 1960

Hughes Aircraft sales in the space and missile field this year will total $30 million or more, up from $4.5 million last year, according to general manager L. A. Hyland.

"We have always known that eventually there would be a substantial reduction in that part of our business associated with manned aircraft," Hyland said. "We have for years planned against that time. It just came a little sooner than anyone could have foreseen."

Cutbacks in manned aircraft will mean that for the first time in recent years, sales volume during 1960 will be lower for the one year than that of the year before, the Hughes executive told the company's Culver City management club.

Hyland noted that 1958 sales of Hughes in the space and missile field (other than the *Falcon*) totaled $175,000. He cited the $30-million figure for 1960 as an indication of the company's rapid diversification into the missile and space fields.

"We are attacking market problems with our total strength," Hyland said, "and our first objective is to bring new contracts to those sections of the company that have experienced cancellations."

Army Working on Moon Map Better Than Some of Earth

The Army Map Service announces plans to produce a map of the moon that will give "the first man to set foot on the moon better maps than are in existence now for many of the remote parts of the earth."

The Office of Chief of Army Engineers, Maj. Gen. E. C. Itschner, said first steps are under way to produce a 1:5,000,000 scale lunar map. Photographs have been acquired from observatories across the country. From these, the mapmakers expect to obtain enough photographs with stereoscopic effect and image resolution to provide coverage of the area to be mapped.

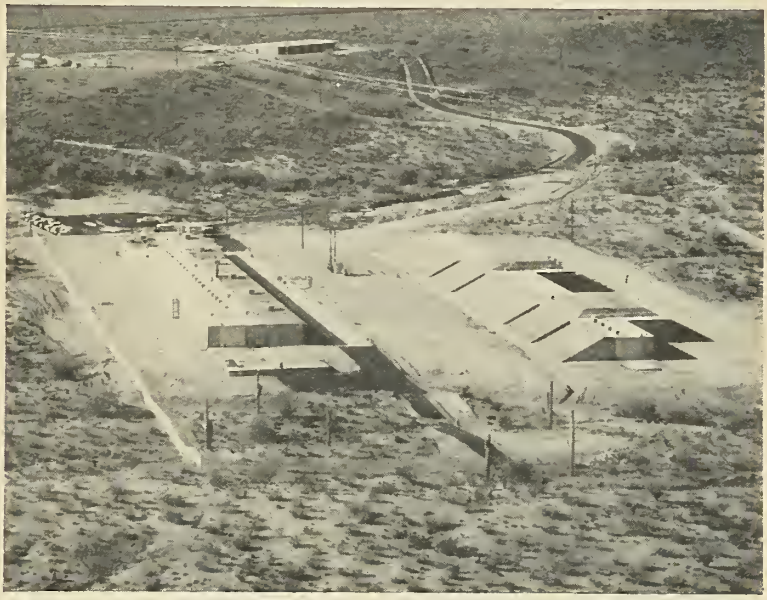
Map Service experts predict even greater accuracy in future maps, as new equipment and techniques are developed. They say a scale of 1:250,000 may be possible when photographs are obtained from aerial balloons.

Minneapolis-Honeywell Sales Set Record

While M-H had a record breaking year in sales, its Philadelphia industrial operation's earnings were cut by a 10-week strike in the first half of the year. Military sales did recover from subnormal 1958 levels.

RP/T Opens Big Arizona Solid Plant

LOW-COST *Phoenix* **rocket-powered space probe, which will seek new data on the upper atmosphere, was built by RT/P.**



SOLID FACILITY near Mesa includes (at left) building for preparational and finishing operations, (at right) heavily barricaded structure for hazardous mixing, curing and loading, and (background) 7000-square-foot engineering building.

MESA, ARIZ.—Facilities for production of 100,000 pounds of solid rocket propellant per month have been put into operation here by Rocket Power/Talco, a division of the Gabriel Company of Cleveland. The new facilities, built from the start as the most modern solid rocket production area possible, can turn out solid rockets of 5000 pounds weight.

RP/T, headed by Charles E. Bartley, is currently producing polysulfide, polybutadiene, and composite propellants, and is conducting research on fluorocarbons ("most promising"), boron, acrylic acid, and light-metal propellants. Company research is also being done on ion and colloidal propulsion devices at its Pasadena research facility.

The company foresees $5- to-$10-million in sales for the division during calendar 1960.

With the opening of its latest facility, RP/T brings its production and research locations to three: Falcon Field (just outside Mesa), the engineering center two miles north of Falcon Field, and the Pasadena Research facility.

• **Elaborate operations**—Administration offices, machine shops, test laboratories and warehouses are located at Falcon Feld. The 68,000-square-foot facility consists of renovated and expanded buildings at the site of the Mesa municipal airport.

Engineering offices for the division are located two miles north of Falcon field, in a 7000-square foot building.

Rocket Production Facilities are adjacent to the engineering building in a 50,000-square foot pair of buildings, each 500 feet long and separated by a service area. Constructed of reinforced concrete, these two structures feature separate barricaded areas for each operation in the rocket motor production process.

Preparational and finishing operations, including inspection, assembly, quality control and development laboratory work, are located in one building. The second building accommodates mixing, curing, loading and static firing operations. Separate bays of reinforced concrete are used at the propellant plant for static firings, while the Falcon Field area has a 360-foot track for ballistic tests.

The division presently has 300 employes, and expects this number to increase to about 500 within the next two years.

Automation is a principal feature of the production area, providing both safety and efficiency.

• **Products varied**—One of the newly-designed products being made by RP/T is the *Phoenix*, a low-cost probe capable of taking a twelve-pound payload to over one million feet altitude. The *Phoenix* was designed, developed and test fired within 100 days, under an Air Force research program on behalf of the University of Maryland. Payload is reportedly being designed by Dr. S. Fred Singer.

Other products developed by RP/T include devices for manned aircraft escape systems, including canopy actuators, leg-arm positioners and man-seat separators. The company's products in this line are now standard equipment on such aircraft as the *X-15*, B-58, B-47, B-70, A3J, F-104, F-106 and F8U. In addition, RP/T produces components for the *Hound Dog* and *Corvus*, as well as rocket motors for sleds, drones and aircraft. Infrared emitters, gas generators and actuating cartridges are also produced.

Key personnel include: Charles E. Bartley. President, founder and former president of Grand Central Rocket Co.; Frank A. Marion, Executive Vice President; Sidney E. Danyow, Vice President for Ballistic Operations; John K. Elder, Vice President for Chemical Operations; Milton Farber, Vice President for Research; A. Lincoln Pittinger, Vice President for Marketing; John W. Sheehan, Vice President, Administration; and David E. Shonerd, Vice President, Engineering.

WEST COAST Electronics Center of Radio Corporation of America was dedicated at Van Nuys, Calif., last week. Dedicated to "strength through electronics," the new RCA facility has a staff of more than 400 space electronics engineers working on such projects as this data readout system being developed for BMEWS.

GE REORGANIZES: General Electric's Electronic, Atomic and Defense Systems group has been renamed the Electronic and Flight Systems group. Headed by C. W. LaPierre, VP and group executive, it includes Defense Electronics division, Syracuse; Electronic Components division, Owensboro, Ky.; and Flight Propulsion division and Aircraft Nuclear Propulsion department, both of Cincinnati. The Industrial Electronics division has been transferred to the Industrial group under VP Arthur F. Vinson. The Communications Product department moves from the Industrial Electronics division to Defense Electronics division.

C-E-I-R: PURCHASES TSI: C-E-I-R, Inc. of Arlington, Va. is purchasing Telecomputing Services, Inc. for $940,000. The California data-processing firm entered 1960 with a backlog of $2,850,000.

VARIAN ACQUIRES SEMICON: Varian Associates is entering final negotiations to acquire 100% ownership of stock in Semicon Associates, Inc., an electronics firm specializing in dispenser cathodes.

DATAGRAPHIC GROWS: Microfilm Co. of California has been acquired by DataGraphic Systems, Inc., jointly owned by Douglas Aircraft and General Aniline & Film Corp. DataGraphic VP Russell S. Ellsworth will be president of Microfilm.

LING-ALTEC FORMS COMPANY: Ling-Altec Electronics, Inc. has formed a new company, Ling-Altec Service, to service and install vibration and high-intensity sound equipment produced by the firm.

STAUFFER BUILDING: Groundbreaking ceremonies were recently held by the Stauffer Chemical Co. for a new $1.6-million research center at Richmond, Calif.

LEAR GETS NEW OFFICES: Corporate executive offices will be housed in a new building planned by Lear, Inc., in Santa Monica.

AMERICAN TIME MOVES: American Time Products, Inc. has moved to new headquarters in Woodside, L.I., N.Y.

ELECTRONIC COUNTERS RELOCATES: Electronic Counters, Inc. announces the occupancy of a new manufacturing plant in Syosset, L.I., N.Y.

BUDD CO. BUYS TESTING FIRM: The Budd Co. has acquired the assets of Metrol, Inc., manufacturers of electromagnetic nondestructive testing equipment. The new California department will operate as part of The Budd Co.'s Instruments Division.

LOCKHEED ELEC. TO MOVE: Lockheed Electronics has purchased a 212-acre site near Princeton University to make future headquarters. Plans call for expanding the Military Systems-Stavid Division and accommodating several new operating divisions now being formed within the organization.

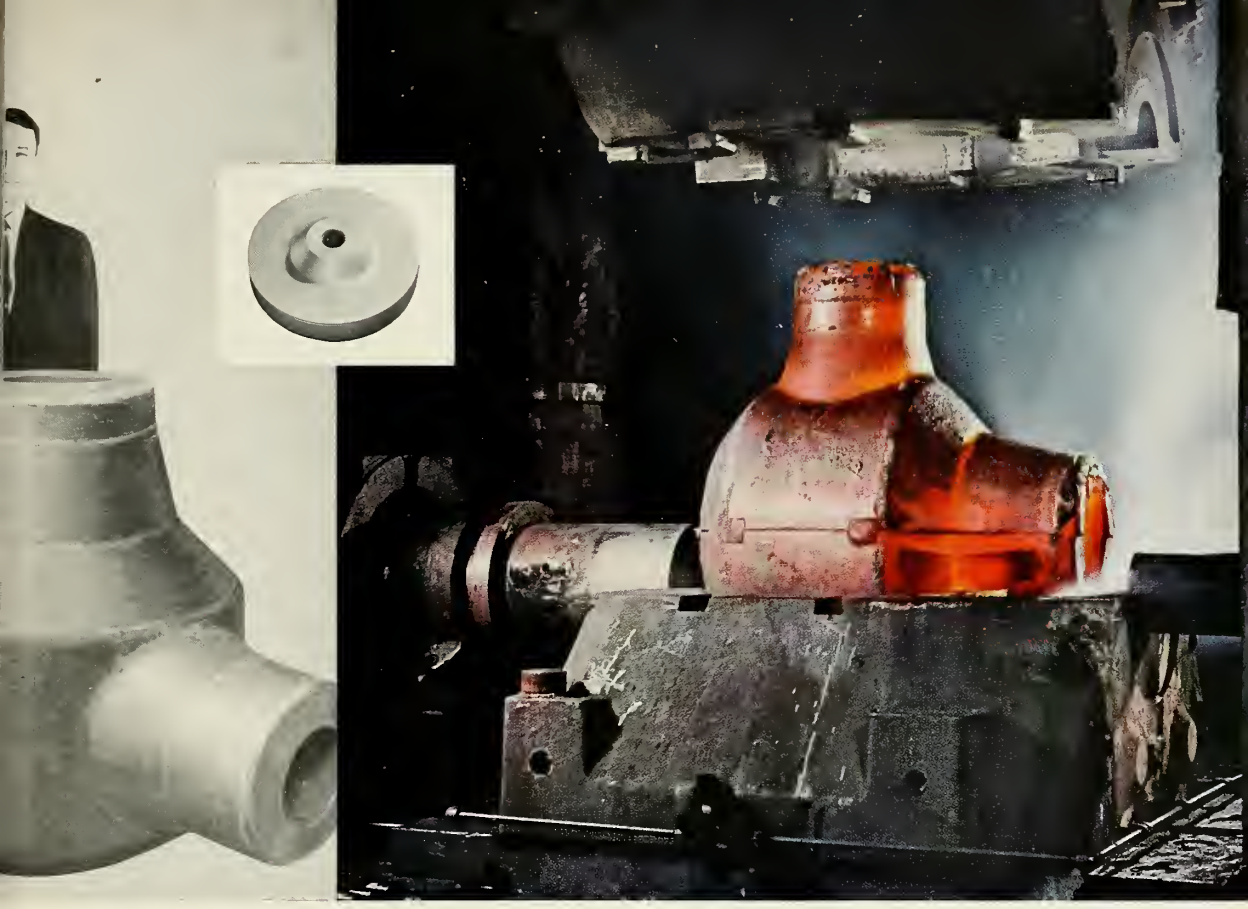
LINDE TO BUILD PLANT: North Haven, Conn. has been chosen as the site of a new Flame-Plating process facility by Linde Co., Div. of Union Carbide. Ground will be broken in May and completion is expected in December.

UNITED-CONTROL ESTABLISHES IN L.A.—An engineering services and liaison office will be established in Los Angeles by United Control Corp., of Seattle.

FLEXONICS WILL RE-LOCATE: Flexonics Corp. will build new headquarters on a 50-acre tract in Bartlett, Ill., near Elgin. General offices, R&D and manufacturing operations will be located there.

FLORIDA'S FIRST 'AIR' PLANT: Ground-breaking recently was held by the Air Reduction Sales Co., division of Air Reduction Co., Inc., in Tampa, Fla., for the state's first commercial liquid air separation plant.

(continued on page 48)



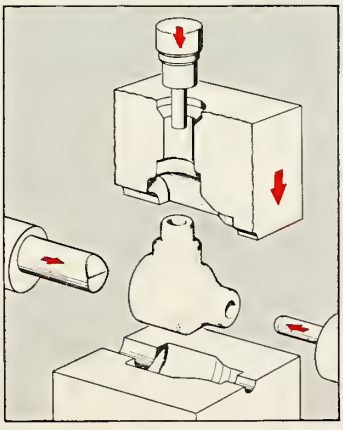
CAMERON FORGINGS

New properties — new quality for new design demands.

Cameron split die ferrous forgings have now been produced for more than a decade — a very short span in the ancient art of metal forming, but just in time to fulfill and stimulate new demands in an age which has made the greatest demands in the history of metallurgy. Our processes and forgings have no exact counterpart in previous forging practice. The 13,000 pound throttle valve body of chrome moly material, photographed above as it emerges from its split die in one of our side ram presses, is a typical Cameron solution to a recent problem, requiring large size, unusual shape and top quality.

The inset photograph gives an idea of our range in size and shape while producing the same superior properties. This jet engine turbine wheel, A-286 material, weighs about 13 pounds, but is one of today's most demanding applications for a precision member.

Large or small, our forgings possess unusual metallurgical properties because:



1. Cameron techniques allow intricate shapes to be forged in one heat, yielding uniformly high properties from center to surface and uniform fine grain size.

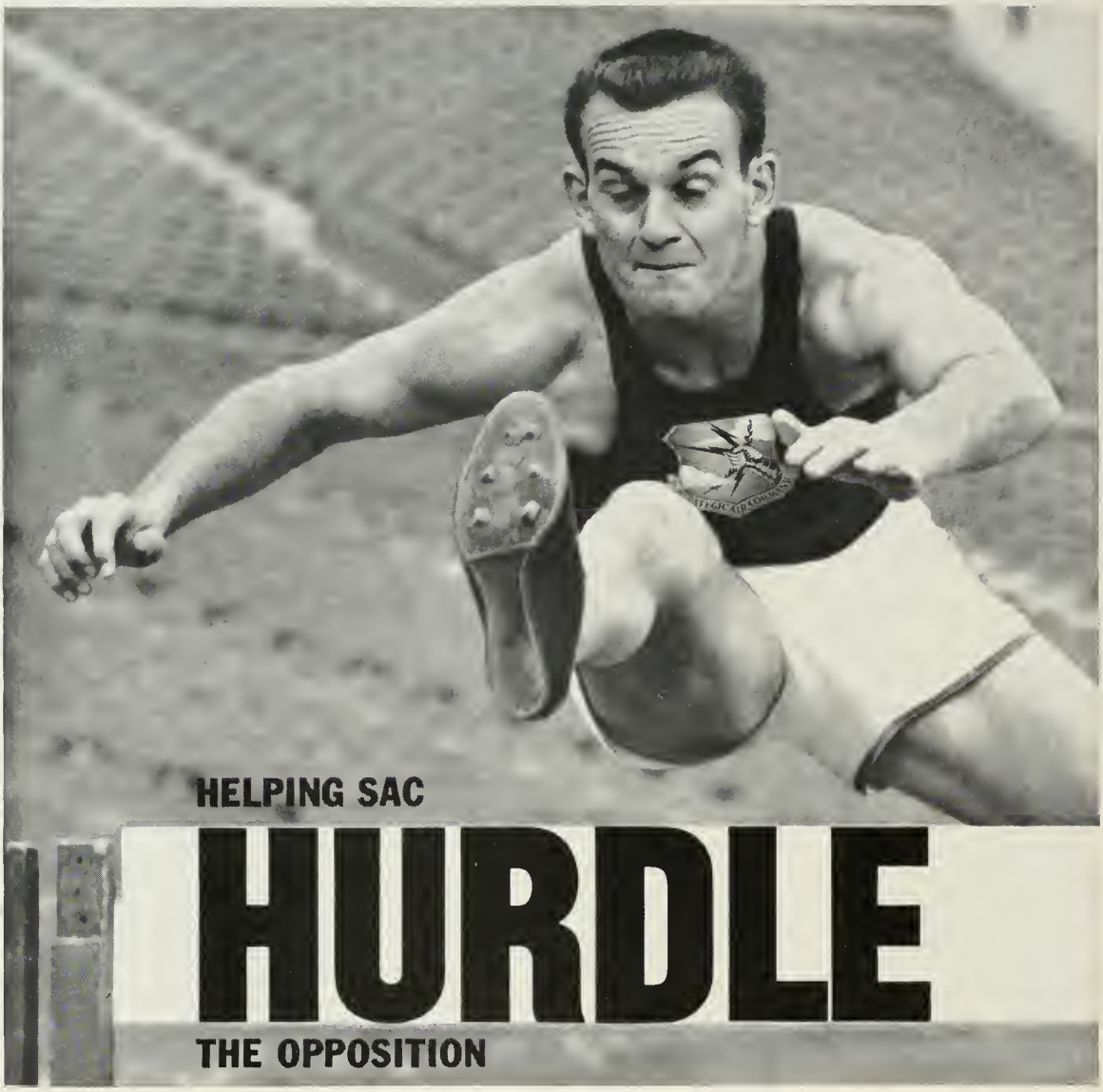
2. The movement of metal under high internal pressure increases the transverse ductility properties several times above normally expected values.

3. The internal working of the metal breaks up segregated material inherent in the center of steel and high density alloys and yields forgings that consistently meet high ultra-sonic standards.

4. The totally enclosed method of forging avoids flash line magnetic indications and the localizing effect of the flash grain on transverse, fatigue, and stress rupture properties.

If you specify or purchase ferrous high density alloy or refractory forgings and would like more information about our facilities, write, call or come by . . .

Cameron
IRON WORKS, INC.
SPECIAL PRODUCTS DIVISION
P. O. Box 1212, Houston 1, Texas



HELPING SAC

HURDLE

THE OPPOSITION

SAC is now off and running with its new Hound Dog missile. With the supersonic GAM-77 missile, the B-52 bomber can more easily hurdle ground defenses on the way to a target. In the short span of just 30 months, the Hound Dog air-to-surface missile grew from the drawing board to a powerful member of SAC's deterrent team.

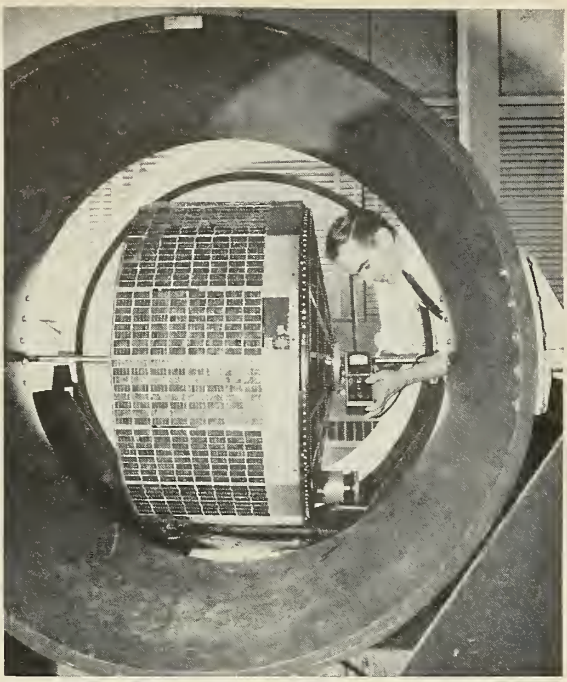
Silencing enemy ground defense centers while the mother ship speeds on toward the main target is just one of the jobs of the versatile GAM-77 missile. Slung beneath the swept-back wings of a B-52, a pair of GAM-77's can either clear a path for the bomber, or be sent right in on the main target itself. This triple-threat capability lets a single B-52 command a target approach corridor over a thousand miles wide.

To further confuse the enemy, these inertially-guided missiles can feint at pseudo-targets before turning toward their real objectives. Speed and altitude variations can also be programmed into the GAM-77's target approach.

The Hound Dog missile greatly extends the useful life and striking power of SAC's B-52 bombers—the backbone of America's strategic power. The GAM-77 is being produced by the Missile Division of North American Aviation.

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC.
Downey, California

COMPLETE SATELLITE is positioned for tests of solar cell power supply at RCA Astro-Electric Products Div., Princeton, N.J., where *Tiros* and its ground system were built for NASA under Army direction, by Asst. Project Mgr. A. Schnapf.



DRUM-SHAPED *Tiros* is placed on its side in a special AEP magnetic drag test device to measure effect on satellite of earth's magnetic field. Engineer Robert Wilkes observes effect as satellite rotates on its axis between large magnetic coils.

Tiros Presages Long-range Forecasts

Highly successful first launching also proves feasibility of military reconnaissance satellite

by Paul Means

Mark Twain's observation that "everybody talks about the weather but nobody does anything about it" lost a little of its weight on April Fool's day with the launching of *Tiros I*, the 270-pound camera-carrying weather satellite.

The satellite—the first of a series to give the Weather Bureau a satellite's eyeview of the earth's cloud formation—doesn't actually do anything about the weather, but eventually it will enable meteorologists to anticipate storms many days in advance.

The satellite also demonstrated the feasibility of a reconnaissance satellite which could seek out enemy missile bases.

The payload, which looks like a giant pillbox, is encrusted with 9200 solar cells developed by Hoffman Electronics Corp., and contains two miniature television cameras, video tape recorders, transmitters, rechargeable battery power supplies, and an array of control and communications equipment.

Orbiting in a 48-degree angle of inclination from the equator, the wide-angle camera, which has a resolution of about a mile and a half, will take a strip of overlapping pictures of the earth each 135 miles long and about 800 miles wide.

The smaller camera, with a resolution of about 1500 feet, will take pictures of about 100 miles in width.

• **Northern exposure**—Both cameras, developed by the Astro-Electronic Products Division of the Radio Corporation of America, have been programed so they will operate only while over the Northern Hemisphere, and in the sunlit area. During the lifetime of the satellite (approximately three months and 1300 orbits), its cameras will have taken pictures of most of the Northern Hemisphere.

Both of the cameras use a one-half Vidicon tube designed for satellite use. A focal plane shutter permits still pictures to be stored on the tube screen, and an electron beam converts the stored picture into an electronic signal which is transmitted to ground receivers.

The wide-angle camera has a f/1.5 lens speed; the narrow-angle camera f/1.8. Shutter speed for both cameras is 1.5 milliseconds, lines per frame is 500, frames per second one-half, and the video bandwidth is 62.5 kc.

Linked to each camera is a minia-

Tiros Data

Weight	270 lbs.
Apogee	468.28 statute miles
Perigee	435.5 statute miles
Period	99.15 minutes
Angle of inclination	48 degrees

INTERNAL ELECTRONIC system of the satellite includes (foreground) one of the two TV cameras, surrounded by other subsystems, and (left and right) two specially developed magnetic tape recorders. AEP engineer is Robert Schmicker.

ture television magnetic tape recorder which stores 32 photographs on tape for later relay. Picture data can also by-pass the tape and be transmitted directly to the ground within range of a station. The Mylar-base tape is 400 feet long and moves 50 inches per second during recording and playback. The cameras and their equipment operate independently of each other.

• **Transmission & tracking**—During ground transmission, photo data is transmitted from one camera at a time and takes 3½ minutes per camera. The satellite is within transmission range of the ground stations up to 12 minutes. Connected to each photo system is a two-watt FM transmitter operating at a nominal frequency of 235.00 mc which relays picture information on command to ground stations.

Two readout stations are operated for the satellite: one by the Air Force at Kaena Point, Hawaii, and one by the Army Signal Corps at Fort Monmouth, N.J. They consist of approximately 15 bays of electronic control, transmitting, receiving and picture storage equipment. The antennas are 60-foot automatic tracking types with a command antenna on the outer edge.

The nickel-cadmium battery cells, which are actually overcharged by the solar cells, are hermetically sealed and rechargeable, and were developed by the Sonotone Corp. They can be recharged thousands of times and are designed to live as long as the satellite. Sixty-three Sonotone "F" cells, each three and one-half inches long and one and a quarter inches in diameter, and weighing approximately eight ounces, were used.

Data concerning the satellite's spin-axis attitude is provided by the infrared horizon scanner developed by the Barnes Engineering Co. The radially-oriented scanner senses the thermal radiation discontinuity between the earth and space. As the spin-stabilized satellite rotates, the scanner develops an electrical pulse whenever the thermal horizon crosses its field of view. Thus, as the scanner sweeps across the earth, two signals are produced—each one marking an edge of the earth. These signals are transmitted to the ground stations to provide data determining the satellite's attitude.

Two beacon transmitters, operating on 108.00 mc and 108.03 mc, both with a power output of 30 mw, will be used for tracking purposes. They can be modulated to provide information on satellite attitude, environmental conditions, and satellite equipment operation. For backup purposes, both frequencies carry the same data. Besides the two readout stations, the satellite will be tracked by the Minitrack fence.

• **Propulsion**—The *Thor-Able* vehicle used in the *Tiros* launching weighed more than 105,000 lbs. at liftoff.

The first stage was a conventional *Thor,* minus guidance and modified to receive additional stages. It generated 150,000 lbs. thrust for 160 seconds. The stage weighed more than 100,000 lbs. The Rocketdyne engine burns LOX and kerosene.

The second stage was an Aerojet-General *Able* that weighed 4000 lbs. Its 7700-lb.-thrust engine burned about 100 seconds. Propellants were unsymmetrical dimethyl hydrazine and white fuming nitric acid. It ignited immediately after first-stage separation.

Six small solid-propellant rockets, generating 130 lbs. thrust for a half-second each, spun the second and third stages just before separation of the third stage. The spin rockets, each about the size of an orange juice can, were manufactured by Atlantic Research Corp.

The second and third stages were separated about 1½ seconds after firing of the spin rockets. Then the third stage coasted for about 400 seconds. The solid-propellant third-stage rocket was manufactured by Allegheny Ballistics Laboratory, a division of the Hercules Powder Co.

The third stage weighed over 500 lbs., of which about 450 lbs. was double-base propellant, and about 50 lbs. was dead weight, including the laminated fiber glass-plastic casing. The rocket generated 3100 lbs. thrust for about 40 seconds.

The payload was separated from the third stage by a set of springs about 25 minutes after third-stage burnout. Separation of first and second stages, and second and third stages, was accomplished with retro-rockets.

Six tiny solid-propellant rockets, also manufactured by Atlantic Research, are mounted on the satellite itself for firing at intervals to stabilize the orbit. The rockets are designed to produce 5 lbs. thrust each for 0.3 second. A pair will be fired about every 20 days to maintain the steady 9 to 12 rpm spin needed to keep the satellite properly oriented.

Atlantic Research said the tiny rockets would be the first to be fired by ground command after so long a period in space.

• **Nearly postponed**—Countdown of the first *Tiros* shot came within three minutes and forty-five seconds of postponement. A faulty telemetry beacon delayed the shot for a considerable length of time. Further delay was caused by a stuck valve in the ground support LOX equipment. The launch was finally executed at 6:40 a.m. Cut-off would have been at 6:43:45.

Heat Repulsed Here

Lightweight Silicone Laminates Withstand Continuous 750 F

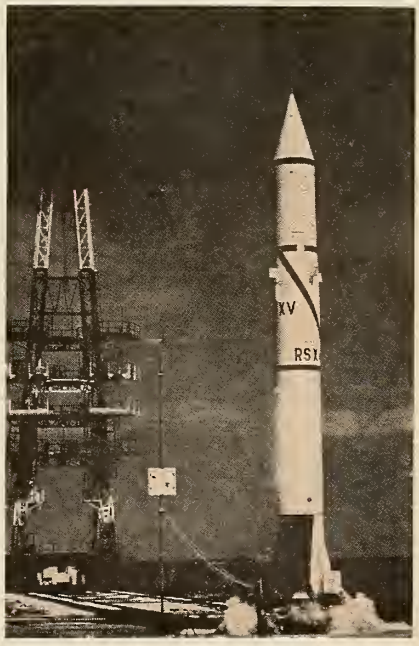
Ducts, pods, heat-shields, electronic components and other high-temperature parts for missiles or aircraft can be fabricated easily of lightweight silicone laminates. These laminates have good strength, good heat resistance, and are unaffected by moisture, weathering, ozone and corrosion, thermal shock or fungus attack. Dow Corning silicone resins, coupled with glass cloth or other inorganic fillers, give better strength-to-weight ratios "at temperature" than many light metals. And they're simple to form.

In the North American Aviation Super Sabre F-100, for example, designers needed a rigid material for the drag-chute case. As this chute case fits right up against the engine at the rudder base, the rigid outer wall of it must: 1) reflect heat away from the chute: 2) resist jet engine ambients: 3) retain structural strength without necessity of replacement.

Development engineers tried numerous "high-temperature" plastics without success. Too much heat. Then they hit on silicone-glass laminate, gold-metallized for heat reflectance. Not only did this prove entirely suitable, it also turned out to be more easily formed. The finished part can endure continuous service at 750 F and intermittent exposure to 1200 F. Vibration resistance is excellent.

Silicones for the Army Redstone

In the Redstone, Chrysler Missile Division engineers employ silicone laminates several ways. As in the case of the F-100, large heat shields behind the Redstone's engine compartment are fabricated of the laminates because of their light weight, heat resistance, thermal impedance. Also, due to excellent electric strength and creep resistance, silicone laminates are utilized for terminal boards in black boxes within the missile and in Ground Support Equipment control boxes.



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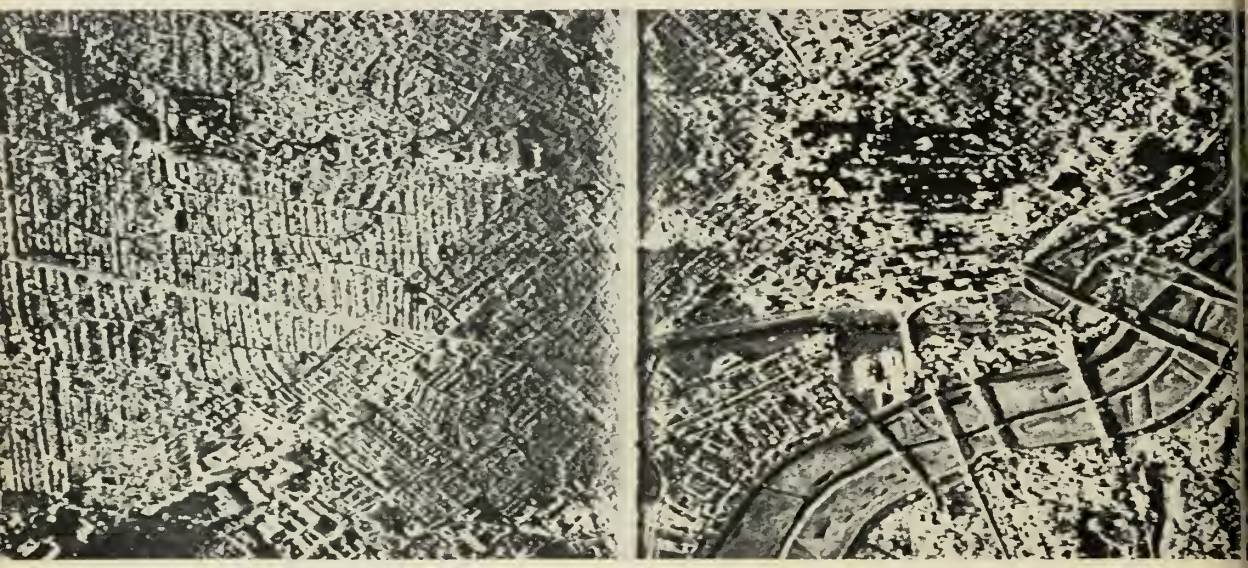
T-I Reveals Startling X-Band Radar



RADAR MAP of Dallas was made by Texas Instruments' AN/APQ-55 surveillance radar. Downtown Dallas is marked by radar shadows from skyscrapers. White line through center indicates path of mapping aircraft.

Details have just been released on a revolutionary side-looking surveillance radar developed by Texas Instruments for the Air Force. Designed for mapping and reconnaissance, the AN/APQ-55 can produce aerial maps of thousands of square miles per hour, night or day, in any flyable weather. The X-band radar gives field commanders near-photographic, up-to-the-minute information on enemy troops and material movements and pin-points targets in enemy-held territory.

Radar mapping provides surveillance data within moments after the surveillance craft makes its pass. A new microwave data link can transmit directly from the radar receiver and feed data back to a film recorder and processer at a remote combat post, to provide detailed photographs of the mapped area.

Development of the AN/APQ-55 was begun by Texas Instruments in 1955, under an Air Force contract, and completed and flight-tested within 16 months. The system is designed to map from either piloted or unmanned craft at ground speeds of 200-800 knots, simultaneously recording strips of terrain, either 3 or 6 miles wide, on both sides. A modified version will map 10- or 20-mile widths. Another modification will allow mapping at ground speeds up to 2200 knots.

Designed for low-altitude operation —1000-5000 feet—the system weighs only 350 lbs., with antennas. Key factors in the small size and light-weight achievement, according to TI, are the extensive use of transistors and a unique switching device that allows a single radar to look alternately from either side of the aircraft through side-looking back-to-back antennas.

Radar returns are displayed as a single modulated trace on a cathode ray tube and recorded on film. A film-pulling mechanism carries the film past the trace on the tube face at a rate proportional to the ground speed and altitude of the aircraft, producing a continuous, high-resolution film strip.

It's reported that an even more sophisticated system with greatly extended range is being developed and undergoing flight tests.

Star Radiation Seen As Space Navigation Aids

Future astronauts may use electromagnetic radiations from stars to determine speed and course on a long space journey, according to scientists at Franklin Institute. After a study just completed for the Air Force, the Institute reported that optical frequencies hold the greatest promise for early successful application to space navigation.

The proposed method is based on the doppler effect. Variations in frequencies received at the space vehicle from the sun or stars would vary in relation to the vehicle's velocity. Measurement of these variations would yield the vehicle's course and speed.

Signal levels of these natural radiations are very low, however, and significant advances will be required to produce equipment sensitive and compact enough to be carried aboard the space ship.

Some such navigation method is a necessity for future space travel. Radar is not suitable since it is effective only for relatively short ranges. The greater part of a space trip would be out of radar range of earth and destination.

Low-noise Receiving System Developed

The combination of a low-noise antenna and traveling wave maser developed by Bell Telephone Laboratories promises a significant advance in satellite-relay and long-range space communications. The system reportedly has a lower overall noise temperature than any other complete receiving system ever demonstrated.

Such a low-noise system could be used to extend the range or increase the bandwidth of telemetering equipment used for rocket probes into space. It would also extend the range of radio telescopes by an order of magnitude in detecting radiation from hydrogen gas emitted from far-distant galaxies. It would be useful in investigating interplanetary radio signals of all kinds.

Experiments with the antenna pointed vertically show an overall input temperature of 17.6°K at 5.65 gc (gigacycles, or kilomegacycles). According to Bell scientists, improvements under development indicate the feasibility of systems with a noise temperature of 7.5°K at 6 gc or of 5°K at 2 gc (reception near sky zenith).

For the low-side-lobe horn-reflector antenna pointed at the horizon, noise input rises to a value near 200°K. Therefore, the advantages of the low-noise receiver cannot be fully utilized in point-to-point earth communication. On the other hand, in space or satellite communication—where the antenna is pointed ten degrees or more above the horizon—the system gives a thirty-fold improvement over a conventional microwave receiver, which has an equivalent noise temperature in the neighborhood of 1000°K.

Based on measurements with the antenna pointed directly upward so that it intercepts a minimum of the earth's atmospheric envelope, the zenith sky temperature is about 2.5°K at 6 gc. Theoretical calculations confirm these measurements.

• **Horn-reflector antenna**—The receiving system uses a unique narrow-beamwidth highly directional horn-reflector antenna with low noise pickup from the surrounding terrain coupled to a low-noise traveling wave maser that amplifies in one direction only.

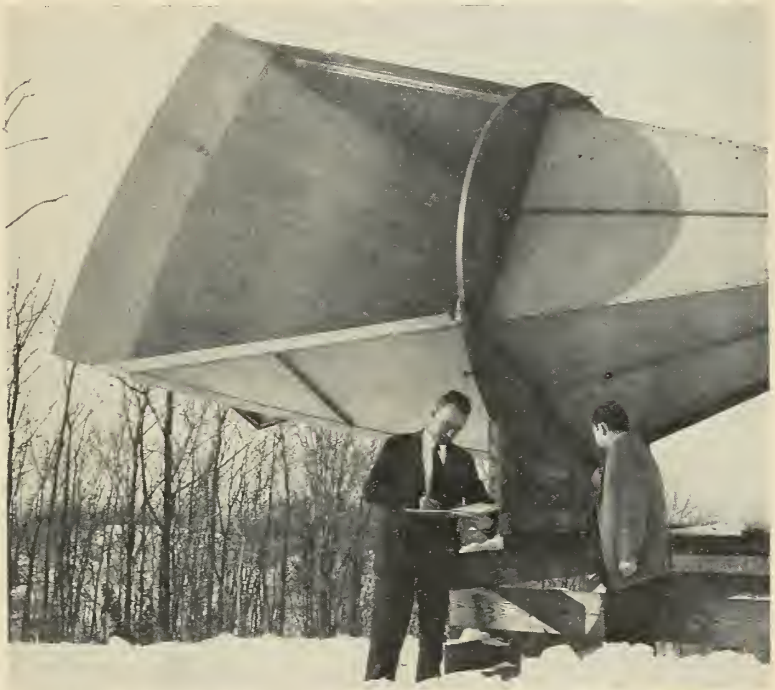
This antenna consists of a section of parabola fed by a rectangular horn. It was developed originally by Bell Labs for transcontinental microwave relays.

Because of the unique design, the lowest frequency of operation of the antenna is limited only by the size of the waveguide feed. The highest frequency is limited only by the mechanical precision of the parabolic surface.

The antenna can simultaneously handle the vertical and horizontal polarizations of the 4, 6, and 11 gc radio relay system with a return loss greater than 46 db (VSWR less than 1.02).

The experimental antenna is approximately 18 feet long, 6 feet high, and 8.5 feet wide. It has a radiating aperture of approximately 50 square feet, and a gain of 41 db at 5.65 gc. Side lobes (except those adjacent to the main beam) are down about 55 db and back lobes about 75 db on the average from the main beam.

• **Traveling-wave maser**—The traveling-wave maser used in the low-noise system was also developed at Bell Labs. With a bandwidth on the order of 30 mc, the TWM has sufficient gain to override the noise of a microwave crystal mixer. It is a two-port device designed to give unidirectional amplification in the forward direction only. Forward gain is 30-40 db and reverse loss 40+db. Pump frequency of the maser is 18.5-18.9 gc at 100 mw.



LOW-NOISE ANTENNA comprises a section of a parabola with a radiating aperture of approximately 50 square feet, and picks up relatively no noise from surrounding terrain. It has a gain of 41 db at 5.65 gigacycles.

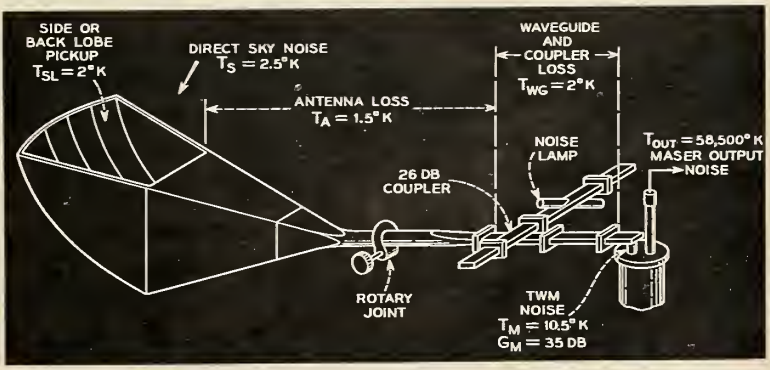


DIAGRAM OF TEST setup shows horn-reflector antenna, input waveguides and connection to traveling wave maser. Various sources and levels of input noise are also indicated.

DOD Handles Much *Mercury* Support

Use of military facilities and personnel to support the man-in-space project will save time and money

by Hal Gettings

PATRICK AFB, FLA.—International politics, economics, and interservice cooperation are all involved in the support program for Project *Mercury*.

Since economics is perhaps the major consideration, the National Aeronautics and Space Administration last August formally requested the Department of Defense to furnish certain equipment and services in support of *Mercury*. This was done, in the words of the House Committee on Science and Astronautics' first interim report on *Mercury*, "to avoid costly and time-consuming duplication." This solution was apparently a feasible one, and the program is moving along under a full head of steam.

Maj. Gen. Donald N. Yates, commander of the Air Force Missile Test Center here, was designated by the Secretary of Defense as DOD representative for *Mercury* support operations, responsible for all military forces, facilities, and assets assigned to the program. This includes the vast network of tracking, telemetry, communications, and monitoring facilities of the Atlantic Missile Range as well as other military-operated bases, ships, ranges, and communications facilities.

Also operating under the military will be civilian contractor operation and housekeeping personnel assigned to existing range stations as well as some new facilities implemented under the support program.

All three services will have major roles in the operation which has been cited as an outstanding example of interservice and military-civilian cooperation. The feeling among working-level participants seems to be that Gen. Yates is doing a remarkable job in getting the interservice team together and working well.

• **Army**—First missile-borne flights of the astronauts will be via Army *Redstone* boosters, modified to carry the capsule. A total of eight *Redstones* will be furnished, the first few of which will be used to fire unmanned capsules into ballistic trajectories. Later firings will carry the astronauts on short ballistic non-orbiting flights. *Redstone* launches will be from existing Complex 56 at Canaveral.

Other Army facilities to be utilized include White Sands Missile Range tracking equipment, and worldwide communication system. White Sands personnel will also operate NASA-provided equipment at the South Texas station. Army will assist in recovery of *Redstone*-boosted capsules and conduct test and launch operations.

• **Navy**—Prime Navy responsibility centers around recovery operations and hardware. It will provide ship and aircraft support for Wallops Island solid-rocket booster tests and the AMR *Atlas*-boosted tests.

FIRST space flight by astronauts will be made in *Redstone* boosters. Eight will be used to fire manned and unmanned capsules in short-range ballistic trajectories. (Retouched photo is artist's conception of mated booster and capsule.)

Commander, Naval Ordnance Test Unit, AFMTC, has been designated as deputy for recovery operations and naval support. He is responsible for preparation and execution of contingency plans for global recovery operations to cover the possibility of impact outside of designated AMR impact areas.

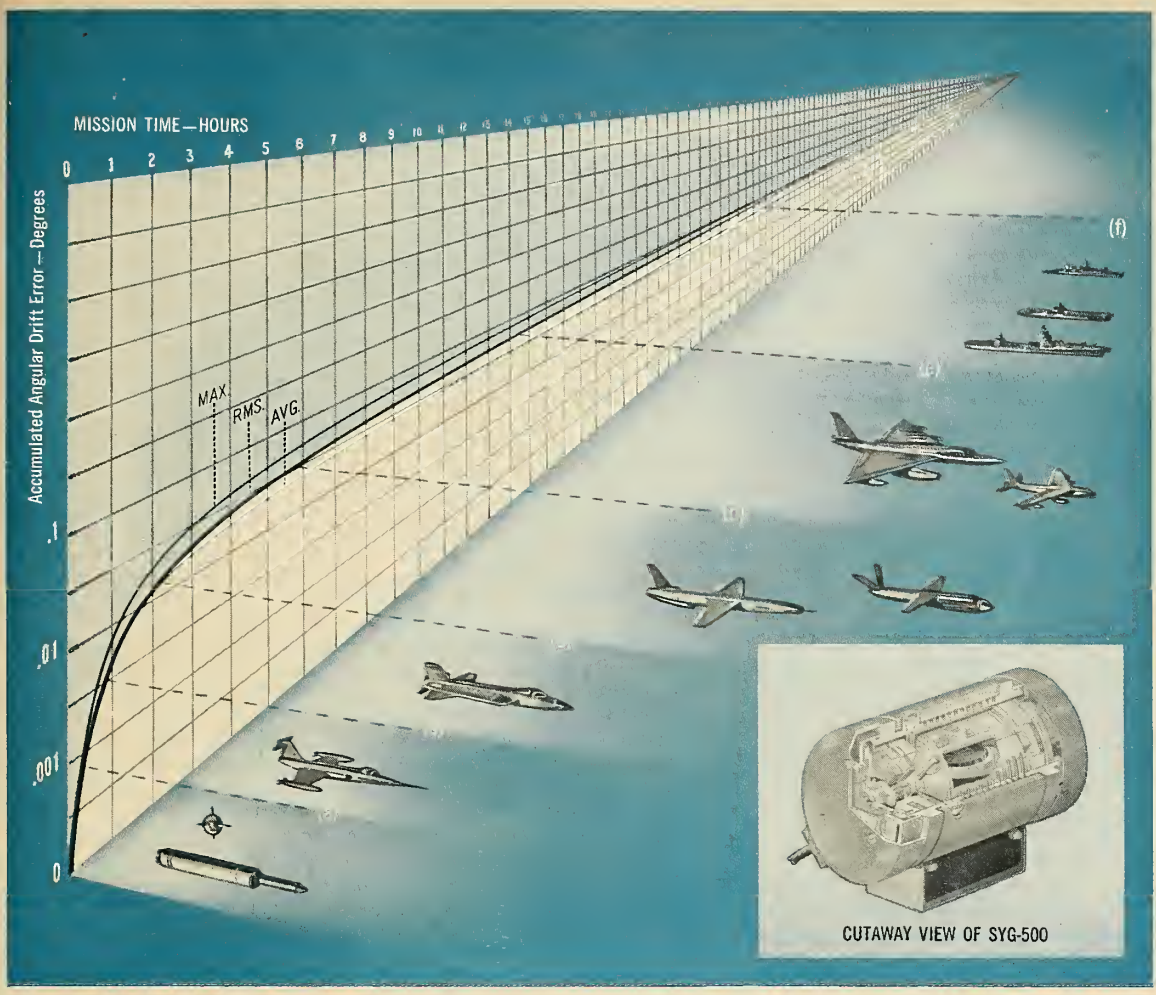
Services and facilities of Navy's Pacific Missile Range will also be used in support of *Mercury*. These include instrumentation for tracking, telemetry, communications, command control, and data reduction. Locations involved are Pt. Mugu, Pt. Arguello, and Hawaii.

Navy Seabees will be used for construction of facilities and support of mobile equipment on Canton Island in the Pacific.

• **Air Force**—General Yates has overall responsibility for the support program. The Air Force's primary contribution will be the AFMTC facilities, including Cape Canaveral and the Atlantic Missile Range, and some support from the Eglin AFB range instrumentation. AF will provide 13 *Atlas* boosters, launch crews and pads, tracking and communications instrumentation, transport, rescue service, recovery planning assistance test and data collection facilities, and direction of the bio-astronautics support.

• **Pan American World Airways and RCA Service Co.**—As AF contractors, these firms will operate the range ships and man, supply, and operate the other stations under Air Force cognizance. This work will be an extension of present AFMTC contract. Cape Canaveral support and similar operations, considered to be in the regular line of present range support, will be paid for by the Air Force. New large equipment items, new construction, etc., primarily for the *Mercury* program, will be paid for by NASA.

• **Bio-astronautics**—One of the major areas of military support for *Mercury* centers on the bio-astronautics—or space medicine—aspects of manned space flight. For many reasons, it was decided that this phase could best be



PERFORMANCE ACCURACY OF SYG-500 GYRO PLOTTED AGAINST MISSION TIME: a) Satellites and Ballistic Missiles, Ascent Phase; b) Tactical Aircraft (Short Range); c) Hypersonic Glide Vehicles; d) Cruise Missiles; e) Strategic Aircraft (Long Range); f) Marine Craft.

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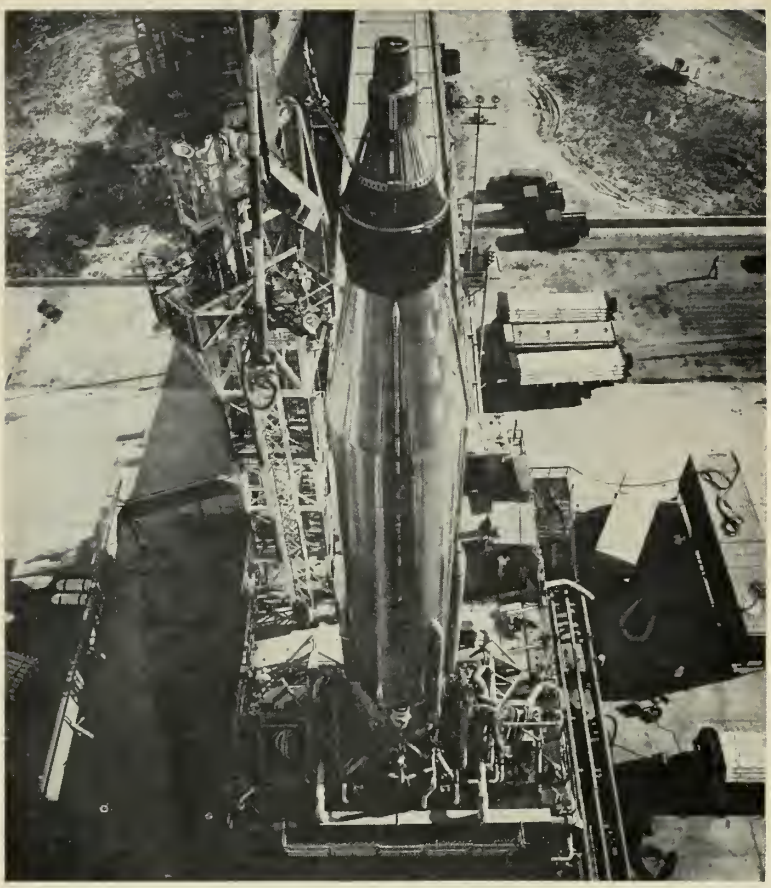


CAPSULE WILL be put into orbit with *Atlas* booster. Air Force will provide 13 *Atlases* as part of its contribution to Project *Mercury*.

handled by a military group—under NASA direction—backed up by a team of civilian and military experts as consultants.

Col. George Knauf—Yates' Assistant for Bio-Astronautics and AFMTC Staff Surgeon—heads a team of space medicine men from all three services.

These space medics will be located at each tracking station and virtually hold the astronauts' hands—via telemetry and voice communications—all during their history-making flights. According to Col. Knauf—a positive and sometimes controversial individual who looks more like a heavy-construction crew chief than an M. D.—"we'll get 'em up and back in good shape." And his conviction is convincing.

The primary function of the medics —officially designated "space surgeons" —will be to monitor the astronauts' physical characteristics—pulse, respiration, coordination, etc.—during flight. These characteristics will be continuously relayed by telemetry to display consoles at each station. In addition, they will use two-way voice communications to talk with the astronauts throughout the in-flight phase. On the basis of their observations the medics will keep the control center continuously advised as to the physical and psychological conditions of the man in space. They will give no orders, but their advice and recommendations will play an important part in NASA decisions affecting the flights.

In the post-flight phase, the bio-astronautics team will provide any medical care required, conduct a medical de-briefing, and reduce and evaluate the data gained for subsequent flights.

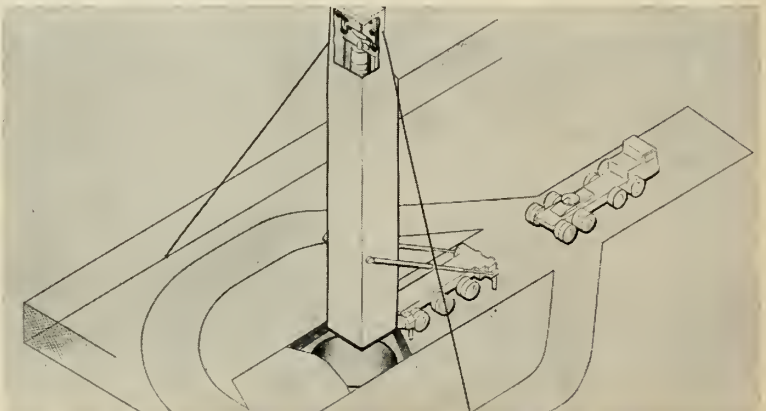
• **Doctors in depth**—The space surgeon will be a member of a three-man team at each tracking station (the other two: flight supervisor and equipment observer). These men—representing all three services and, possibly, even other countries—will be backed up by top-flight medical consultants, both military and civilian. In addition, considerable civilian talent will be used in the post-flight analysis.

First-line space medics, however, will all be military men. This is considered necessary due to the long-time requirements for training and operational phases during the project. In addition, it is desirable to maintain a trained cadre for future projects.

The space surgeons have already been selected on the basis of their experience. Plans are being formulated for extensive training of these and supporting medical personnel; the training programs were scheduled to begin about April 1st. A preliminary program was primarily concerned with acquainting senior Army, Navy, and Air Force medical officers with the problems involved and possible approaches to their solution.

Both Navy and Air Force have reserve training programs and resident schools in aviation medicine which are expected to provide a pool of space medics for future operations. AFMTC has been running one-week classes on the medical aspects of missile/space operations for the past 18 months; students are senior medical officers from all three services.

Minuteman Erector



MAJOR ELEMENT of transportation system for the Boeing *Minuteman* solid-fueled ICBM will be this large tractor-trailer combination called a transporter-erector, shown in recently released artist's drawing. The 63-ft.-long vehicle will haul the missile from assembly to launch site and lower it into the silo.

Temco Process Descales Titanium

LOS ANGELES—Industry is rapidly showing interest in a process for descaling titanium and its alloys after fabrication. The process, known as Ti-Brite, was developed by Temco Aircraft and is being marketed exclusively by Pennsalt Chemicals Corporation.

Increased use of titanium in the missile industry is expected to greatly expand the requirements for Ti-Brite processing, and Pennsalt says it has recently concluded an agreement with an unnamed customer for an "extremely large" installation.

At present, the world's largest such facility, with a tank length of 14 feet, is being operated by Northrop Corporation at its Norair Division.

Basic method used in Ti-Brite involves immersing the part in an electrolytic bath and subjecting it to an electric current of between six and 36 volts. The bath consists of an aqueous solution of hydrofluoric acid and a sulfate selected from the group consisting of the ferrous sulfates and aluminum sulfates.

Actually developed in 1957, the process has not seen maximum use, due to the hitherto limited use of titanium and the reluctance of companies to sacrifice present investments in processing equipment.

• **Safe and simple**—Tailored specifically to removal of oxide scale from titanium components after hot-forming or stress-relieving operations, the Ti-Brite process is reportedly safe, inexpensive and simple.

Unless expensive, elaborate precautions, such as inert gas atmospheres or chemical retardants, are used, the oxides of titanium form on the metal surface during fabrication and must be removed before further processing.

• **Standard methods**—Three standard methods used for scale removal involve immersion of the titanium part in a nitric-hydrofluoric acid bath, the use of molten salt, and various forms of abrasion.

The greatest disadvantage of nitric-hydrofluoric acid bath is that the action is considerably retarded by oils, greases, stamping inks and other materials used during plant processing operations. Manual effort to remove these materials is time consuming and expensive.

The molten salt bath involves a composition of the salts of the alkali metals, heated and maintained at a temperature above 700°F and usually at temperatures between 800° and 900°F. Close temperature control is essential, since a low temperature bath reduces the descaling reaction rate, and a high temperature bath may ignite the metal.

Disadvantages of the molten salt bath, therefore, are its high initial cost, high operational cost, close temperature control requirements, and the necessity for further chemical treatment to obtain a satisfactory surface.

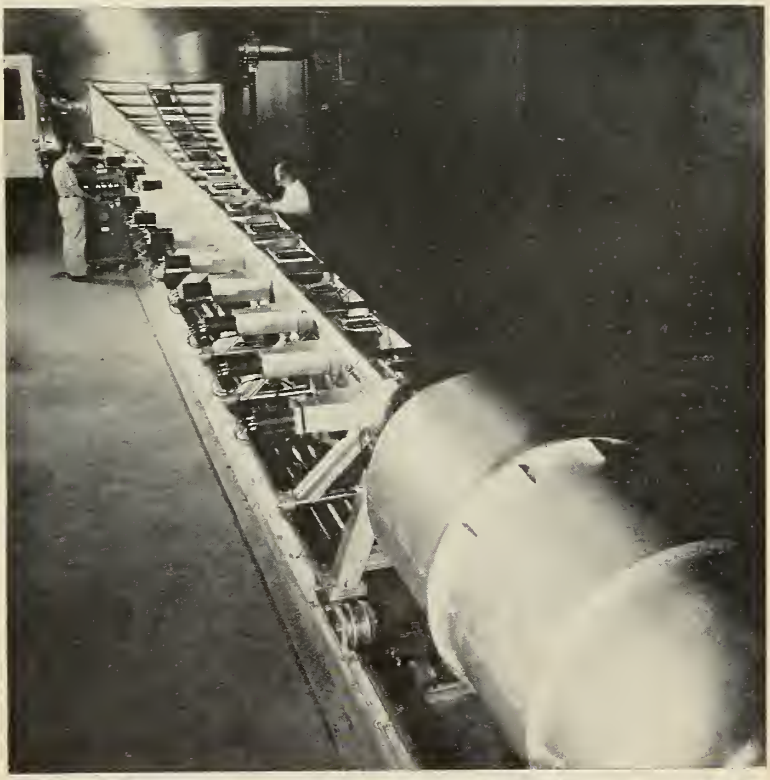
Abrasion methods for scale removal are usually applied to forgings or heavily scaled parts and employ grit, vapor blasting or grinding. These may impart a matte or scratched surface to the component and often result in discoloration.

• **Ti-Brite advantages**—Pennsalt's Ti-Brite process avoids all the disadvantages of these standard methods, plus performing more effective scale removal, according to the company.

The process provides a method and a composition whereby titanium articles of substantially any size of configuration can be freed of oxide scale which forms in the temperature range of 400° to 1300°F. Upon completion of the process operations, the titanium is clean and bright, and requires no costly hand work.

Time required for the Ti-Brite oper-

Simulating Orbital Re-entry



MINIATURE TEST model to simulate orbital re-entry was fired in this Ames Laboratory simulator. Tank in foreground is high-pressure air source. At far end, pipe leads to vacuum sphere. **(Story on p. 30)**

ation depends on the current density, oxide scale thickness and bath concentration. Parts have been deliberately left in the working solution for periods of one hour, without any severe etching or gage loss.

Ames Center Simulates Orbital Re-entry

Orbital re-entry conditions have been simulated on earth for the first time at the National Aeronautics and Space Administration's Ames Research Center, Moffett Field, Calif.

The test model, about 0.25 in. diameter and resembling the *Mercury* capsule in leading edge configuration, was recovered after a short but eventful trip through the Center's Atmosphere Entry Simulator.

A series of shock waves inside a three stage gun, using helium as the propelling gas, ejected the model into the Simulator at 17,000 mph.

The simulator itself resembles a long, trumpet-shaped nozzle, which accelerates a flow of high pressure air so that there is a duplication of the thinning out of the atmosphere at high altitudes. At the widest section of the nozzle, low air density conditions typical of the beginning of a re-entry flight are maintained. As the nozzle narrows, air density increases, matching the environment of an actual flight. Temperatures in excess of 20,000°F were recorded immediately in front of the speeding model.

The miniature satellite survived all of the experiences of a full-scale vehicle returning from orbit.

• **Precise speed requirement**—The biggest headache in accomplishing this feat was achieving correct pressures, aim and velocities in the experiment. The test model was caught undamaged in a cylinder filled with foam rubber. If the model traveled too fast, it disintegrated in the "catcher."

There were other damaging effects if speed fell short of desired rate.

The recovered model was carefully weighed and analyzed. Less than 5% of the plastic ablation material had vaporized during the flight. Spark shadowgraph pictures were taken during the flight in order to study the shock wave and wake generated by the passage of the vehicle.

The test conditions were more severe than what the actual *Mercury* capsule will experience. This, in effect, was another confirmation of the type of heat shield selected for the manned orbit project.

Ames scientists and engineers are currently working on methods of duplicating in the laboratory the speeds expected of craft re-entering from lunar and planetary missions.

AC Seeks and Solves the Significant—Inspired by GM's pledge to contribute heavily to our national defense, AC, an acknowledged leader in the new technology, plans to reach far beyond such accomplishments as AChiever inertial guidance systems. / This is AC QUESTMANSHIP. It's an exciting scientific quest for new ideas, components and systems . . . to promote AC's challenging projects in guidance, navigation, control and detection. / Mr. Jack Briner, AC Director of Field Service, believes his department's Career Development Program "offers young engineers world-wide opportunities in the practice of Questmanship." They learn a product from its technological theory through its operational deployment. Following this training, "they utilize their own ingenuity to support AC products in the field, with more effective technical liaison through training, publications, maintenance engineering, and logistics." / You may qualify for this special training, if you have a B.S. in the electronics, scientific, electrical or mechanical fields. Special opportunities also exist at AC for men with M.S. and Ph.D. degrees. If you are a "seeker and solver," write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

GUIDANCE / NAVIGATION / CONTROL / DETECTION / AC SPARK PLUG *The Electronics Division of General Motors*

Bonus for Thermonuclear Research

Missile/Space cryogenic techniques should reduce costs and material needs in generating magnetic fields

by Jay Holmes

Rapid developments in cryogenic techniques resulting from America's missile-space program have generated an unexpected bonus in an entirely different field—the research on controlled thermonuclear reactions.

This development was outlined by Dr. Richard F. Post of the Atomic Energy Commission's Lawrence Radiation Laboratory recently, at one of a series of hearings on Frontiers in Atomic Energy Research before a subcommittee of the Joint Congressional Committee on Atomic Energy.

The thermonuclear reaction—the fusion of hydrogen-isotope nuclei as in the H-bomb—is considered desirable as a power source because it is "clean"—that is, there are relatively few radioactive byproducts. In the fission of uranium, plutonium and thorium, on the other hand, almost all of the fission fragments are radioactive.

Another advantage is the abundance of hydrogen, compared with fissionable material. In recent years, however, it has become clear that much more uranium is available than had been believed. Ultimately, thermonuclear power is expected to provide a form of propulsion for large interplanetary space craft.

• **Cheaper energy**—Improved cryogenic techniques, in addition to better metals technology and increased knowledge of electrical conductivity at low temperatures, will make possible huge reductions in the cost and amount of material needed to generate extremely intensive magnetic fields, Post told the committee. He explained the development as follows:

Since electrical resistance drops at low temperature, the power required to generate a magnetic field of given strength decreases. This does not involve the phenomenon of superconductivity, since superconductivity cannot exist in the presence of a high magnetic field.

A savings in the overall energy cost is possible, however, only if the cost of the power required to energize a refrigerated coil plus the cost of refrigeration is less than the cost of the ordinary coil at room temperature.

At very low temperatures—for example, 20°K—the limiting factor is the purity of the conductor. This meant that as recently as 10 years ago the possible improvement would not have made up for the large cost at the time of cryogenic refrigeration.

Now, however, very high-purity aluminum and high-purity sodium encapsulated in stainless steel tubes are available for windings. And the cost of refrigeration has been reduced to a small fraction of the former figure.

Post said a small test coil of refrigerated and encapsulated sodium has achieved a reduction in resistance of almost 6000 to 1. He remarked that the conductivity of the sodium becomes so high that, relatively, the stainless steel acts as an insulator.

The intense magnetic fields are needed in various devices to trap or contain plasma at temperatures in the tens of millions of degrees so as to light the thermonuclear fire in which heavy hydrogen nuclei fuse to form helium.

• **Thermonuclear reaction**—Another witness, Dr. James L. Tuck of the AEC's Los Alamos Scientific Laboratory, reported that a plasma reaction achieved in a machine built there has now been established as thermonuclear.

The machine, called Scylla, consists of two identical single-turn coils mounted coaxially along a shock tube and connected to a low-inductance capacitor bank. Magnetic fields up to 40,000 gauss were built up in the central region within about one microsecond, so as to shock-excite the gas to about 200,000°K. Then the result-

Spotlight on Materials?

ARMY SURPLUS searchlight was converted by engineers at Thiokol Chemical's Reaction Motors Division to a solar furnace for testing material properties at high temperature. Dr. Stanley Tannenbaum, Dr. Frank Loprest and Steven Tunkel are shown adjusting the furnace, which can produce temperatures of 6300°F at ¼-in. focal spot. Electronic couplings enable furnace to track sun automatically and control temperature at sample.

ing plasma was further heated by compression. Radio frequency excitation provided partial ionization of the gas before beginning the shock.

Results from the Scylla machine were reported at the 1958 Geneva atomic energy conference, Tuck said, but Los Alamos did not have enough information at the time to be sure that the flow of neutrons was the result of a thermonuclear reaction. "We really think it is thermonuclear now," he said, adding:

"We seem to have a plasma of hot deuterium in the form of a small egg-shaped fireball about 2 cm. in diameter, containing about 5 x 10^{16} deuterons/cc with a temperature of 1.3 ±0.1 kev. The electrons have a temperature of about 240 electron volts and the fireball lasts about 0.9 microsecond in the original Scylla I apparatus and in this time it emits about 10,000,000 thermonuclear neutrons."

• **Much still to be done**—A more advanced machine, designated Scylla II, uses two magnetic squeezes, a fast one and a slow one, and extends the duration of the neutrons to about 7 microseconds, he said. A still larger machine probably will be built, he added, but in the meantime much study of Scylla II is necessary.

The energy attained to date is far from the amount necessary for a self-sustaining thermonuclear reaction, which would generate more energy than is put in. Dr. Arthur E. Ruark, chief of the AEC Controlled Thermonuclear Branch, said a deuterium-tritium plasma must be heated to a temperature of at least 50 million degrees, which is equivalent to a particle energy of about 5,000 electron volts.

"It is my belief that we shall obtain thermonuclear temperatures in a relatively short term of years," Ruark declared. "This belief is not to be confused with the general verdict of thermonuclear physicists that 10 to 20 years might be required for development of the first fusion powerplant. Indeed, no one can say with certainty that this second step will be feasible. The answer depends on further study of extremely hot gases, squirming and turning in every way to escape the imprisonment we seek to force upon them."

AEC Designing Follow-On Reactor for *Kiwi* Series

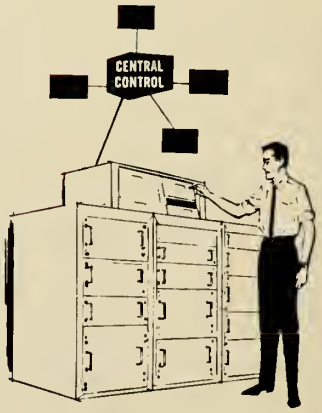
The Atomic Energy Commission is designing a follow-on reactor to the *Kiwi-A* series *(Kiwi-A, Kiwi-A Prime, Kiwi-A3)* as an advanced phase of the *Rover* nuclear rocket program.

Kiwi-B is scheduled for operation

AWAKE IN THE DEEP

and ready...checked out by PBE system

Soon American seamen aboard swift, nuclear-powered submarines will patrol "Awake In The Deep"...armed with the U. S. Navy's devastating POLARIS fleet ballistic missile. Besides alertness there will be readiness, guaranteed by automatic production checkout units designed and built by Packard Bell Electronics for the Missiles and Space Division of Lockheed Aircraft Corporation. The factory checkout system for POLARIS consists of a central control station and remote test consoles for *Receiving Inspection, Package, Flight Control and Systems* checkout. All units are self-powered, self-checked, modular designed, fully automatic and solid-state. All can be adapted for use with any missile, aircraft or other weapon system.



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in 1961 at the Nevada test site of the Atomic Energy Commission. It is still on the drawing board, and its design has not yet been frozen. *Kiwi-B* will take advantage of the knowledge gained from the *Kiwi-A* series.

Meanwhile, the second reactor in the Project *Rover* program will be assembled and ready for initial tests at Los Alamos Scientific Laboratory by mid-summer. The assembly operation is expected to begin this week on *Kiwi-A Prime* at the laboratory (M/R, April 4, p. 24).

LASL currently has about 50 personnel manning its Nevada Test Site on the *Rover* program. Their principal interest now is revising the existing system to meet the requirements of the two latest reactors, and simplifying the actual operation and control of the new reactors as much as possible.

A second test cell, dubbed Test Cell C, is scheduled for completion in early 1961. Work on the communication and utility facilities for this installation has already begun. This cell will be similar to Test Cell A but will permit more sophisticated experiments. Test Cell C will be located about a mile west of the present test site and about two miles north of the *Rover* control point.

It is anticipated that the cost of the new cell will be about $8-million. Contracts have been let for extension of a railroad, a vehicle road and a water line to the installation. The first major construction contract will be awarded within a few months.

NASA Plans to Renew Bell's H-F Rocket Engine Contract

The National Aeronautics and Space Administration expects to renew the Bell Aircraft Corp. contract for developing a liquid fluorine-liquid hydrogen rocket engine, it was learned last week.

Bell recently static tested an H-F engine up to 17,000 lbs. thrust. Chamber pressure was about 250 psi.

The Niagara Falls, N.Y., company has been working with fluorine engines since 1956. Last spring, NASA granted Bell a $1,070,000 one-year contract to continue the work, originally funded by the Air Force.

This year, it was learned, NASA plans to renew the contract for nine months, at a cost of about $700,000.

Hydrogen and fluorine provide the highest specific impulse of any known chemical combination. At an oxidizer/fuel ratio of 4.5/1 and chamber pressure of 500 psi, the combination theoretically yields specific impulse of 373 seconds—about 13 seconds greater than the hydrogen-oxygen combination.

The major problems in using fluorine as an oxidizer are its high cost ($2.65-$3.75 a pound), difficulty of storage, and corrosive combustion products. NASA liquid rocket specialists see the major application of hydrogen-fluorine engines as final stages in large vehicles such at *Saturn*.

Hughes, NA, Ford Design Rough-Land Moon Capsule

Hughes Aircraft Co., North American Aviation's Missile Division and Aeronutronic Division of Ford Motor Co. have been chosen to make competitive designs of a 300-lb. capsule for a rough landing on the moon.

Jet Propulsion Laboratory of California Institute of Technology chose the three from 14 companies invited to bid on the design for Project Ranger, under which the National Aeronautics and Space Administration plans to land a package of scientific instruments on the moon's surface.

The studies are to be completed in six weeks.

Grand Central Fires Nitrasol Grain at -75°F

Grand Central Rocket Co. reports a completely case-bonded, cast-in-place grain of Nitrasol propellant has been temperature-cycled repeatedly from –75 to 165°F and successfully fired at –68°F.

Irwin Spitzer, GCR engineer in charge of Nitrasol development, said that until the recent achievement, "no really high-performance rocket motor ever had been made that could be fired successfully at low temperatures after temperature cycling."

The size of the experimental motor was not given. However, Spitzer said continually larger Nitrasol motors will be tested.

Successful Test Made of B-58 Escape System

The rocket-catapult assembly for the escape system of the B-58 Air Force Mach 2 bomber was tested successfully March 29 at the Hunter Bristol Division of Thiokol Chemical Corp., Bristol, Pa.

J. S. Jorczak, Hunter Bristol vice president for specialties operations, said the complete unit, conditioned to 160°F, completely fulfilled design requirements.

Thiokol manufactures solid-propellant rockets to catapult the escape capsule, which Stanley Aircraft Corp. is developing for Convair Division of General Dynamics Corp.

ASW Engineering

. . . M/R Establishes a New Department

AIR DEFENSE against submarine threat rests largely today on Lockheed Neptunes and Grumman Trackers.

The ASW Threat:

The Sea Is Never Neutral—She Favors Only Those Who Understand Her Best

by William Beller

Suddenly the U.S. has awakened to a new threat—attack on its shores by missile-bearing submarines. During the appropriation hearings going on, Congress says it wants something done about it now and is willing to spend over a billion dollars for the work. The Navy answers that the problems are tough and even money may not buy the solutions.

The Sea is never neutral. She favors those who understand her best.

For a while, this understanding meant leaving her alone. This served our Republic well in her early days. During peace time, she was insulated from the squabbles going on in Europe and Asia. And when war came, she had thousands of miles of water that kept her cities and countryside from being invaded.

During the early months of the First and Second World Wars, the United States was surprised to learn that her oceans were not as fine an insulation as she had thought they were. German submarines were coursing freely through them, destroying thousands of tons of shipping and nearly defeating the Allies at the same time.

Each time the United States was taught the partisanship of the Sea, but the learning has come hard. Even now, the Navy not only admits but also announces to anyone who will listen how little the service understands about the medium over which she sails.

"We know less about the ocean than we do about the moon."

"To detect hostile ships, we are still using the means first enunciated by Leonardo da Vinci over 450 years

SEA DEFENSE is the hunter-killer task force represented here by USS Valley Forge, flagship of Group Alpha, and escort craft.

ago.

"We know the terrain under less than two percent of the world's seas."

• **Threat and counterthreat**—One reason for this negative boasting is clear. The oceans have become a conductor for rather than an insulator against enemy attack. To deter or counter this threat, the Navy is asking Congress this year for nearly $1.4-billion for antisubmarine warfare.

Two new factors entering the ASW scene are calling for a budget this large. The nuclear-powered submarine is here and it works very well. Although the United States is the only country having such craft now, the Soviet Union is building similar ships and will have them operating soon.

The second new factor is the emergence of a submarine-launched IRBM, for the United States, the *Polaris*—in effect, a global range missile.

Two years ago an Underseas Warfare Advisory Panel advised the Joint Committee on Atomic Energy that "The day is rapidly nearing when the Soviet can possess, first a few, and then a large fleet of intermediate-range ballistic missile-launching nuclear-propelled submarines." The Panel ominously concluded, "Our existing and presently planned defensive system could not stop such a missile attack." Today the statement is still true. Herein lies our great peril.

If we turn the coin, we see we have the very weapons in being that the Soviet still has in development. We have more. In the *Polaris* we have a weapon system that as far as anybody can see today is close to invulnerable. Herein lies our hope.

• **Three problems**—The Navy thus has three big problems. One of them is as old as the service itself, and two are modern ones.

First, how can the Navy keep the sea lanes open? There can be no compromise here. The lifeblood of the Free World nations circulates through the oceans. Note that a week after the start of the Suez crisis and resulting restricted shipping, Europe was out of fuel and desperate!

There are many impressive statistics, each gravely reflecting what would happen if shipping were interfered with. The most significant seem to be these: The Soviet operates about 60% of the world's submarines but, with her satellites, accounts only for 10% of all merchant shipping. Obviously, the USSR submarines are meant to hit the Free World where she is most vulnerable.

In the instance of the Korean conflict, a limited war condition, imagine our consternation had our 5000-mile pipeline bringing men and materials

Commends M/R's ASW Effort

Adm. Hayward Answers: The Challenge of ASW

Vice Admiral J. T. Hayward, Deputy Chief of Naval Operations for Development, is a man greatly concerned with the rising threat of the missile submarine and how to counter that threat.

Although forbidden by Defense Department public relations policy from signing or bylining stories for the public press, he has transmitted to M/R the following views on the question, "What is the Challenge of ASW?"

"In two world wars the submarine played an important role, yet it was not a submarine in the true sense of the word but rather a surface ship that could submerge. For a matter of fact a large percentage of the attacks by submarine were made on the surface with the submarine only submerging to avoid counter-attack.

"Since World War II we have seen a marked change in the character of the submarine both operationally as well as technically. Operationally, it is now capable of attacking land installations with powerful atomic missiles where before it was only a menace to shipping. Technically, it has become a true submersible capable of sustained underwater operation and high submerged speeds. Where in World War II a submarine could be held down by a relatively small number of ships and planes until exhaustion, today the submarine is capable of indefinite submergence and speeds equivalent to the surface craft designed to hunt and kill it. Its volume of operation has been increased both by greater speed and greater submerged depths.

"Thus the submarine, always an elusive foe, has acheived new proportions as to its deadliness and evasiveness. These new characteristics are taxing the Navy's ingenuity and it is with pride and hope that we see industry willing to share this burden with us.

• **"Liquid space"**—Although outer space serves to hold a hypnotic attraction to this generation probably because it is the great unknown, the exploration of liquid space is just as difficult and requires similar scientific disciplines. It is shocking to realize that we know less about the ocean as a medium than we do of outer space and yet approximately 70% of the earth is covered with water. Space may hold the answer to the earth's origin, but some believe the sea holds the answer to man's past and probably his future.

"At any rate the submarine has focused the Navy's attention on how little is known about the oceans below the surface. The problems are analogous to those found in missiles and rockets; that is why it is heartening to know that interest is being shown by people versed in this field. As an example there is sufficient similarity in the following areas to warrant people trained in one to look at the other. Hydrodynamics versus aerodynamics, power in rarefied air versus power under terrific pressures, transmission of electromagnetic waves through the ionosphere versus acoustic energy through temperature gradients, structural strengths of acceleration versus structural strength against pressure, meteorology versus oceanography.

"The submarine offers a challenge to all scientific endeavors and it is only through a mutual understanding between the Navy and industry coupled with a desire to cooperate with each other towards a common goal of national security that problems as large as that of antisubmarine warfare can be solved.

"It is encouraging to see Missiles and Rockets take an active interest in the field of antisubmarine warfare and we in the Navy are looking forward to the interest that we expect will be shown by the readers of the magazine."

across the North Pacific been cut!

Second, how can we prevent missile-launching submarines from threatening continental United States? The danger can be imminent.

Third, how can we exploit the *Polaris* so that it will be used to the fullest extent as a major deterrent to war? There are political answers. The technical ones, if we admit needing an enlarged *Polaris* force, is how best to develop, build, operate, disperse and maintain such a fleet.

• **An all-Navy job**—Antisubmarine warfare is a major Navy mission. There is no doubt about this when one sees that the service will be apportioning nearly 30% of its Procurement and RDT&E FY 1961 budget for ASW work.

In ASW operations, the task is to detect, localize, identify and be ready to destroy underseas enemy craft. To do this, every facility in the Navy is needed. This includes surface as well as underseas ships, aircraft, ordnance and ammunition, electronics equipment, and the services of applied and basic research. The job demands full resources of both industry and the Navy.

...tools the Navy needs in ASW

Rear Admiral H. A. Yeager, CNO's antisubmarine warfare readiness executive, recently told the House Appropriations Subcommittee that, "Our exercises have revealed that with highly trained personnel, current ASW techniques are effective against conventional diesel-electric submarines." He added, in understatement, "Destroying the high-speed nuclear sub and the submarine-launched missile are more difficult problems."

He might have emphasized how extremely sensitive ASW searching is to the personnel doing the work. Ocean noise and the poor resolving power of acoustic waves lead to more killed whales and porpoise schools than "hostile" targets.

• **Tools demanded**—To meet the challenge of Soviet underseas weapons, Yeager says that his service needs:

Intelligence on Soviet submarines.
Increased detection ranges.
Improved localization ability.
More rapid classification techniques.
Higher speed ASW vehicles.
More early attack weapons systems.
Additional ASW forces.

To satisfy these needs, the Navy is proposing a $1.364-billion budget for direct ASW work. A big piece of this budget, 56%, is for ship construction and conversion. The Navy wants 13 additional ships, modification of the submarine *Albacore*, and 14 World War II destroyers updated.

In the breakdown, the program looks like this:

• The Navy wants in FY 1961 to buy three guided missile frigates and two guided missile destroyers, all with long-range sonar, *ASROC* missile systems and homing torpedoes.

• The Navy wants two improved destroyer escorts. These will have "new sonar equipment, expected to provide much improved detection ranges on submarines," will be equipped with *ASROC* and, in addition, with a drone helicopter for weapon delivery—the DASH system.

• The budget also calls for three nuclear-powered attack submarines similar to the four that Congress provided for in the FY 1960 budget. Those will have sonar systems, for both passive and active detections, will carry high-speed torpedoes, and perhaps *SUBROC*.

• One oceanographic research ship, designed as a mobile laboratory, will be built to study effects of environment on sound transmission.

• An escort research ship will be built to evaluate new hydrodynamic and propulsion designs. This craft will be doing for future surface craft what the whale-shaped experimental submarine Albacore has done for modern submarines—will be giving naval architecture a scientific boost.

• Albacore, which initiated the family of high-speed submarines of new hull design, will be having another research modification.

• An experimental very deep-diving submarine is included to explore the fields of deep submergence, and its effects on extremely long-range detection and attack capabilities.

• Fourteen World War II destroyers will be given new sonars, the drone-helicopter system, *ASROC*, and new torpedoes.

Total cost of this shipbuilding program, including development work, will be $762.3-million.

AIRCRAFT

After ships, the largest part of the ASW budget, a quarter of it, will be spent on aircraft and ASW equipment associated with aircraft. The Navy will be buying Sikorsky HSS-2 helicopters, Grumman S2F-3 fixed-wing carrier-based aircraft, Lockheed turboprop P3V patrol planes, and for the destroyers, Gyrodyne's gas-turbine-driven DSN-3 drone helicopters. The Navy also will be using some money for modernizing its present patrol and carrier-based fixed-wing aircraft. The ASW aircraft procurement program amounts to $340.1-million.

RESEARCH & DEVELOPMENT

A little more than 13% of the ASW budget will be going into Research, Development, Test and Evaluation. A third of this money will be used to find some way to improve the Navy's detection, classification and localization equipment. Unless more sensitive and discriminating search techniques are found, the service will have to keep on supporting forces in numbers to make up for lack of forces in perception.

Research in acoustic energy is being pushed because it is the only one that is expected to yield significant dividends in improving detection. Of the more than 100 ASW research projects, about half are concerned with acoustics and oceanography.

The oceanography programs, which are coordinated efforts of Naval and civilian laboratories, are supporting 16 research ships. In FY 1961, the service plans to allocate $17.7-million to the subject, an increase of $4.2-million over FY 1960.

In the vehicle and propulsion research areas, work is being done on reducing the size of nuclear reactors and in developing small gas-turbine engines. The total RDT&E FY 1961 budget calls for $180.5-million.

Filling out the ASW portion of the Navy budget is an ordnance and ammunition appropriation for $56-million, and major electronics procurement for $25.5-million.

ORDNANCE

The most important influence in ASW ordnance and ammunition is the Navy's eagerness to get a good attack capability at the earliest possible moment. Suiting the deed to the wish, the Navy says that this summer the Fleet will be getting for the surface ship a "rocket-assisted weapons delivery system which will employ either a homing torpedo or a nuclear

depth bomb as a warhead," the *ASROC.*

The Navy is limiting its ASW torpedo procurement to four types. Two of these are homing torpedoes, one of which will be used by surface ships and submarines, and the other by surface ships and aircraft. Their targets will be advanced submarine types. The third torpedo is a submarine-launched type of advanced design. The fourth torpedo, which is expected to match advances in nuclear submarine design and performance, is being bought for testing. Its operational evaluation will begin early in 1962.

With these facts in mind, Admiral Yeager assured the House Appropriations Subcommittee that "By 1963 we will have standardized our torpedoes for aircraft, surface ships and submarines. These torpedoes should be capable of destroying the best enemy submarines producible over the next ten years."

The Admiral pointed out the need for greatly improved submarine-laid antisubmarine mines. He told Congress, though, that he believed the Navy had just such a mine in the newly developed MK 57. Part of the budget money will therefore be used for evaluating this weapon.

ELECTRONICS NEEDS

Major ASW electronics purchases are of three types. The first is for variable depth sonars, which will be going into the older destroyers. This equipment will let these ships lower sonar transducers below the thermal layers. These layers are temperature gradients in the ocean which, unhappily, can tremendously reduce the effectiveness of hull-mounted sonar equipment.

The second item is a new high-powered surface-ship sonar, which is being bought for back-fitting to the newer destroyers, to give these ships modern ASW capability. The third item is for communication and training equipment.

Dr. J. W. Horton, in his book *Fundamentals of Sonar,* Naval Institute Publication, points out that around the time Columbus was sailing to America, Leonardo da Vinci made the following entry in his scientific notes:

"If you cause your ship to stop, and place the head of a long tube in the water, and place the other extremity to your ear, you will hear ships at a great distance from you."

Any other description of a sonar system differs only by the addition of details, remarks Horton. It is still necessary to stop your ship if you intend to hear "ships at a great distance from you." The only addition in principle not included in da Vinci's statement is the provision for causing an otherwise silent target to become a secondary source of acoustic energy.

• **Limitations**—Chances for finding a detection principle that will improve upon da Vinci's are slim. Light and other electromagnetic radiations penetrate water only a short distance. The only useful "window" that has been found in water is in the acoustic band. And here, maximum detection range of an object is given in terms of thousands of yards, a poor parallel for radar sight.

There are other disadvantages to acoustic or sonar detection means, which it appears the Navy must live with. The speed of an acoustic wave in water is slow, carrying a pulse only 250 yards in the time it takes a radio wave to circle the globe.

In addition, because acoustic wave lengths are long with respect to those of light, about a quarter of a million times longer, sonar detection is poorly descriptive. For example, the number of rivets in a ship's hull can be counted if exposed to light, whereas only the ship itself might be discernible if perceived by acoustic means. Even then, it is frequently difficult for the sonar operator to discriminate between a small ship, a whale or a school of flying fish. The dilemma of the Navy commander is obvious.

• **Deeper problem**—Even so, Navy experts say they are not too worried about detecting diesel-electric submarines. They are relatively noisy, have fairly well-defined noise patterns, do not go very deep, nor travel very fast. It is the nuclear submarine that is nearly invisible. It goes almost silently, travels deep and travels fast. It is also the most lethal.

There are two basic types of sonar detection systems. The first is the direct-listening type, a passive system.

ASW PORTION OF NAVY APPROPRIATION
(in millions)

Navy Appropriation	FY 1959	FY 1960	FY 1961
Shipbuilding and conversion	$1,012.6	$ 485.7	$ 762.3
Aircraft and related procurement	266.3	476.8	340.1
Research, development, test and evaluation	202.7	225.3	180.5
Procurement of ordnance and ammunition	54.1	50.2	56.0
Major electronics procurement	60.1	37.9	25.5
Total, all appropriations	$1,595.8	$1,275.9	$1,364.4

BREAKDOWN OF FY 1961 ASW PORTION OF NAVY BUDGET
(in millions)

Shipbuilding and conversion		$762.3
3 (DLG) guided missile frigates	231.6	
2 (DDG) guided missile destroyers	92.5	
2 (DE) improved destroyer escorts	50.5	
3 (SSN) nuclear-powered attack submarines	171.6	
1 (AGOR) oceanographic research ship	4.9	
1 (AG) escort research	29.3	
1 (AG) deep diving	25.8	
14 (DD FRAM, MK 1) WWII destroyers conv.	142.1	
1 (AG) SS Albacore, conv.	14.0	
Aircraft and related procurement		$340.1
HSS-2		
S2F-3		
P3V-1		
DSN-3		
Modernization of A/C		
Sonobuoys		
Command and control (Incl. Trng.)		
Research, development, test and evaluation		$180.5
Classification, detection and localization	63.4	
Weapons, ordnance and fire control	64.2	
Vehicles and propulsion equipment	29.6	
Collateral, supporting and related equipment	23.3	
Procurement of ordnance and ammunition		$ 56.0
Missiles and support		
Depth charges		
MK 37 Torpedo and support		
MK 44 Torpedo and support		
MK 45 Torpedo and support		
MK 46 Torpedo		
Torpedo support (in service torpedoes)		
MK 57 Mine		
Fleet service mine test		
Miscellaneous ASW ammo		
FRAM support		
Major Electronics Procurement		$ 25.5
Sonar and detection equipment	22.0	
Communications	2.6	
Trainers	0.9	

WORLD'S LARGEST amphibious helicopter, Sikorsky's HSS-2, conducts dip tests of its sonar detection gear.

Here the target generates the signal being picked up. It is a simple system requiring only a transducer to convert acoustic energy into electrical energy. It can be made a directional system merely by maximizing the acoustic energy received. If two transducers separated by some distance are used, then triangulation can give the target's range.

The detection distance depends upon the acoustic energy output at the target and background noise. If the noise characteristics of the target are known—and this is a constant Navy study—then the sonar can restrict its listening to appropriate frequency bands. This technique gets rid of some of the background noise, and consequently gives a longer range.

SONOBUOYS

One of the most effective devices we have today for keeping track of underwater sound is the sonobuoy. This is an expendable and short-lived floating FM broadcasting station, dropped from aircraft over the area being surveyed. Upon impact, the sonobuoy automatically drops a microphone or hydrophone for submarine detection, and raises an antenna for its contact with the aircraft. Range of the sonobuoy is short, variously estimated at between 3 and 30 miles, and its cost is nominal, averaging about $160.

However, the Navy is having some problems with sonobuoys. Their reliability is less than what is wanted, particularly in the "shelf life" regime. For this reason, some sonobuoy money will be put into reliability studies. Specifications will be tightened up so that manufacturers will be turning out standard products. Specifically, this means that sonobuoys will have to meet not only performance specifications but also detailed ones.

• **New approaches**—There is in the works the concept of relatively long-life sonobuoys for anchoring in the floor of the ocean at strategic points or in telling patterns. Such systems are said to be related to the highly classified *Artemis* and *Atlantis* systems. Navy officials disclosed late last month that work was nearly completed on Project *Artemis*, which they said is a study to establish the feasibility of ocean area surveillance. It is believed that such a surveillance would be made by active sonobuoys distributed along the Atlantic continental shelf.

Project *Atlantis* is believed to relate to ensonifying and using for submarine surveillance the transatlantic cables. In this view, it does not seem odd that several months ago a Russian trawler "accidentally" fetched one of the cables up in their fishing nets.

The second sonar detection technique is that of echo-ranging. This is an active system particularly useful against relatively silent targets.

In this system, an acoustic signal is sent out and its echo listened for. If there is a reflecting body within range, then the echo time delay will tell its distance; and the maximized signal, its bearing. The problems here are in accurately knowing the velocity of sound in water, particularly in view of the many variables involved; and also in being fairly certain that the echo is not coming from some ocean-bred phenomenon that gives rise to reflected acoustic signals.

STRIPPERS

Put a high-pressure sound in the water and it can be heard for hundreds, perhaps a thousand miles. This is the basis behind explosive echo-ranging. Used in this type detection are the "stripteaser" series of sonobuoys. Julie and Jezebel are two examples. These are amply described by what is purported to be the derivation of their names, said to belong to Philadelphia burlesque queens who were able to make active that which was passive.

Underwater communication, another sonar technique, is merely an echo-ranging system in which a vocal signal is substituted for a pinging one. Because sound is such a slow traveler, in underwater telephony between stations only a mile apart, operators experience a six seconds' lapse between the end of a transmission and its subsequent reception. How much can happen to a submarine in six seconds!

OCEANOGRAPHY

Since the entire ASW effort is built upon having a knowledge of the sea, the Navy in FY 1960 embarked on a ten-year oceanographic program—TENOC. This is a contract research program paralleling similar work being done in Navy laboratories. R&D funds required for this program, and approved by the Chief of Naval Operations, increase from about $10-million in FY 1960 to almost $28-million in FY 1969, totaling a little over $190-million for the decade. Besides, the TENOC program is asking, in round figures, for $12-million for buildings, $52-million for 18 oceanographic research ships, and $1-million for pier construction. This brings a total of all TENOC funds for the decade to over a quarter of a billion dollars. It has been emphasized by the Navy that this program is in direct support of ASW. Work will be stressed in the following areas:

- General circulation of the oceans.
- Horizontal and vertical diffusion, that is, density stratification.
- Salinity and electrical conductivity.
- Compressibility and sound velocity.
- Characteristics of noise producing animals.
- Topography of ocean bottoms. (Congress has been told that the Soviet ocean-surveying effort at the present time exceeds ours by at least threefold.)
- Reverberation.
- Exchange of energy at the ocean boundary.
- Transmission of light and elec-

tromagnetic radiation.

- Sound scatterers and absorbers.
- Surface wave motion.

From this listing it is seen that every phenomenon that influences the transmission of sound in water is being studied. This procedure indicates again the seriousness of the Navy in looking, not for breakthroughs in ASW detection work, but rather for progress in a reasonably planned program of technical studies.

Magnetic Anamoly Detectors (MAD gear), which depend on the submarine to change locally the earth's magnetic field, are detection devices carried by ASW aircraft. They have the advantage of being able to work aloft, unlike sonobuoys, but the disadvantage that their detection ranges are sharply limited. For efficient use, MAD equipment is flown not much more than 500 feet above the ocean's surface, and even then will give magnetic indications down only about 100 to 300 feet below the water's surface. How severe this limitation is becomes stark when we realize that the Navy *Trieste* went down nearly seven miles! Still, MAD is about the only way we can do search from aircraft, unless a submarine pokes above the water and gives radar a chance.

• **What is it?**—Classification, knowing what kind of a target we think we have, is a problem at least the equal of detection. Rear Admiral John S. Thatch, recently of Task Force Alpha, estimates that, "For every solid submarine contact, we are led astray on spurious contacts that may number from 10 to 100."

Even if the naval commander knew that enemy submarines were in the area, even then he could not promiscuously try to destroy every target he detected. The time and money wasted would be astronomical.

Data processing and correlating techniques, using as inputs the sonar characteristics of the target, is one way the classification problem can be worked. It is a slow way, though, and almost requires a cooperative enemy.

• **Where is it?**—Hand-in-hand with classification goes localization. The target must be pinpointed and tracked until something can be done about it. Aircraft if not going in for a kill can ring the suspected area with sonobuoys and at the same time call for surface ship help. Or the aircraft can try to keep contact with MAD gear. Helicopters can use their dunking sonobuoys, the sonar detection gear that is pulled through the water by the craft as though it were trolling for fish.

The coordinated effort of air, surface and underseas craft are needed to find hostile targets and destroy them. One such effort is Task Group Alpha, a hunter-killer armada comprising 10 ships and about 50 aircraft. Specifically, it contains an aircraft carrier, 4 aircraft squadrons, 7 destroyers and 2 antisubmarine submarines. Its peacetime mission is to develop ASW tactics, doctrine, and equipment in order to give maximum ASW readiness to the Atlantic Fleet.

WEAPONS NEEDED

Alpha's big kill weapon is *Betty*, an airborne atomic depth charge. Usable only if political conditions permit, *Betty* has a kill radius of several miles. Less lethal than *Betty* and presently operational are Westinghouse's *Mark 37* and General Electric's *Mark 44* acoustic homing torpedoes. These can be launched from aircraft or ship, are supposed to discriminate between decoys and real targets, and pursue their targets by radiating out in a spiral pattern.

A proud destroyer weapon are Hedgehogs (multiple ahead-thrown bombs), which are similar to mortars and have a range of between 250 and 300 yards. The beauty in their use is that a bomb pattern can be laid out in one shot, thereby fencing in the presumed target. Also, the strategem of an enemy submarine escaping down the attacking ship's wake cannot be used.

Two important missiles expected to be Fleet operational by 1961 are Goodyear's *SUBROC* and Minneapolis-Honeywell's *ASROC*. Both can use nuclear or conventional warheads. *SUBROC* will be the first weapon effective against nuclear submarines. It was designed as an underwater-to-surface-to-underwater missile but it can be used for surface-to-underwater work. As with all naval type missiles, it is solid-fueled. It has a 25- to 50-mile range in the air. Thiokol is handling the propulsion, Kearfott the guidance, and the Naval Ordnance Lab the weapon's development.

ASROC is a rocket-assisted torpedo and depth bomb. It is an expensive weapon, $1.2-million per installation. It is said that whenever an *ASROC* is launched, it is like throwing away a color television set.

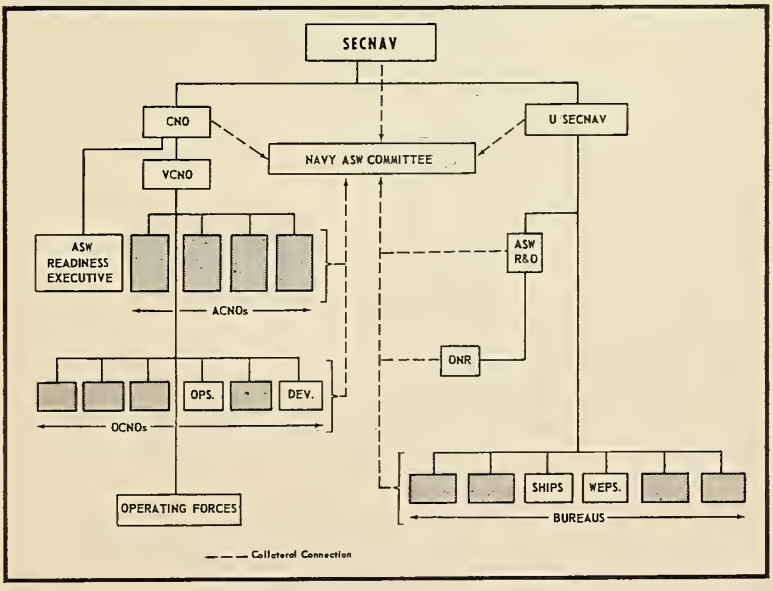
If we have these weapons then we must assume that a potential enemy does. This means that when moving in for the kill, one finds it safer to keep surface ships out of the way and let aircraft have the kill. If this does not work, then destroyers with Hedgehogs will have to be sent in or *Weapon Alpha*, a 500-pound rocket-propelled depth charge, or the antisub subs.

CARRIER REQUIREMENTS

The carrier-based Grumman S2F Tracker is the aircraft workhorse in ASW. In this vehicle is a complete package of radar, electronic countermeasure equipment, MAD gear, sonobuoys, and conventional electronics communication equipment.

The larger counterpart of the S2F is the Lockheed P2V Neptune, a land-based craft. It carries essentially the same equipment as the Tracker but more powerful types and more of them. Admiral Thatch says that like the S2F, "the P2V needs automatic navigation and control systems to make it truly all-weather and to keep track of the forces deployed over the wide area

How Navy's Organized for ASW



it can control." He goes on to say that the craft's "APS 20 radar is far superior to the S2F's, but is still so frustrated in its search for the elusive periscope that any appreciable wave height gives the peeking submarine an easy immunity."

The Douglas AD-5W, the Guppy, is essentially an elevated antenna for Task Group Alpha. It is used as an automatic relay for radar and communications over the vast search area. Another Alpha craft is the Sikorsky HSS-1 helicopter. It has the highly desirable automatic all-weather capability, and a sonar transducer that can do intensive exploring while the helicopter proceeds at low or zero forward speeds.

Introduced into the Fleet in 1961 will be a new all-weather search helicopter, the HSS-2, and a new improved carrier-based antisubmarine warfare aircraft, the S2F-3.

DASH, a drone ASW helicopter system, is also scheduled to become operational for the first time early in 1961.

USE FOR BLIMPS

Also useful in ASW work, but not with Task Group Alpha but rather for surveillance, are the non-rigid airships. Exemplary is Goodyear's 3PG-2W, a million cubic foot envelope used in coastal patrol. It cruises at about 50 knots. Goodyear is presently proposing its counterpart of a nuclear submarine, a huge nuclear-powered airship that could stay aloft for an indefinite length of time. Unhappily for airships, the Navy is not planning to buy any more of them for its ASW program.

• **What's lacking**—Where the Navy really needs help, according to Captain W. H. Groverman, Director ASW Weapons Systems Division, CNO, are in the following areas.

In instrumentation. What are needed are rugged operational instruments, not research ones, that will give continuous readings, while a ship is moving, of such things as temperature in the ocean, current distribution, density distribution and salinity. Today, the Navy has no practical device that will do any of these things. If the Navy did, it would permit them to do technical surveys of large areas of the ocean in a short time.

Until the Navy has a better knowledge of the water of the sea, it cannot effectively design equipment to solve its problems. For example, multipath transmissions of acoustic waves are difficult to predict because the values of the variables involved such as salinity and density are not known. If these were known, then techniques of signal processing and data processing might well enhance the chances of getting the kind of equipment needed for good ASW work.

In order to test the new families of ASW weapons, the Navy needs a fully instrumented deep-water test range. By deep water is meant 1000 fathoms. Such a range in makeshift form exists now in a location off the Atlantic seaboard. However, within the next five years, an operational matured facility is essential. This means that industry must develop instruments that will function with accuracy and reliability in very deep water. Typical needed components are highly compact long-life power units, untended sensing devices, and underwater propulsion devices.

For the range, data processing will be highlighted because of the complex medium in which ASW work is done. In addition, as testing goes deeper, problems associated with increased pressure become serious. Not only for the test range but also for the Navy, increased research is needed on metals, materials, seals, and propulsion against back pressure.

• **Touching all bases**—The future of ASW promises to take advantage of all the modern discoveries in compact electronics, high-energy fuels, and long-life secondary power units. If the Navy has any visions of setting up in the near future underground storehouses, underwater tugs, or underwater flotillas, they have not been revealed in unclassified circles.

In time of war, the Navy's job will be well done if the service's presence is sufficient to deter underwater craft. Also, in time of war, the Navy will not be spending too much of its energy searching the seas for hostile submarines. Rather, the service will be closing in on the ports from whence underseas craft will be issuing.

Portable Sonar

PORTABLE TRANSISTORIZED sonar system, powered by flashlight batteries, has been designed for use by Navy divers and frogmen. The AN/POS-1 equipment, developed by Stromberg-Carlson and the Navy Electronics Laboratory, has an effective range of 300 yards. Earphones provide the user with audio information on objects detected by the searching sonar beam. System weighs 20 pounds and is slightly larger than a basketball. Ten prototypes will be delivered under a BuShips contract.

Underwater Engineering Conference Scheduled

A classified seminar on underwater missile engineering has been scheduled for July 10-22 at Pennsylvania State University. Discussions will center on underwater missile design problems in acoustics, electronics, flow noise, noise reduction, control, hydrodynamics, and propulsion. Attendance is limited and subject to Navy Department security approval.

Lectures and discussions will be augmented by demonstrations and tours of the University's Ordnance Research Laboratories including the Garfield Thomas Water Tunnel and Black Moshannon Calibration Station.

for better navigation . . .

Polaris Sub Radome Battered in Testing

The ability of the *Polaris* submarine radome to survive the smashing impact of high seas is being tested in a unique series of experiments at an abandoned granite quarry near Boston. Conducted by Nortronic Precision Products Department for the Navy's Special Projects Office, the development is aimed at improving foul weather navigation for *Polaris* submarines through radio astronomy.

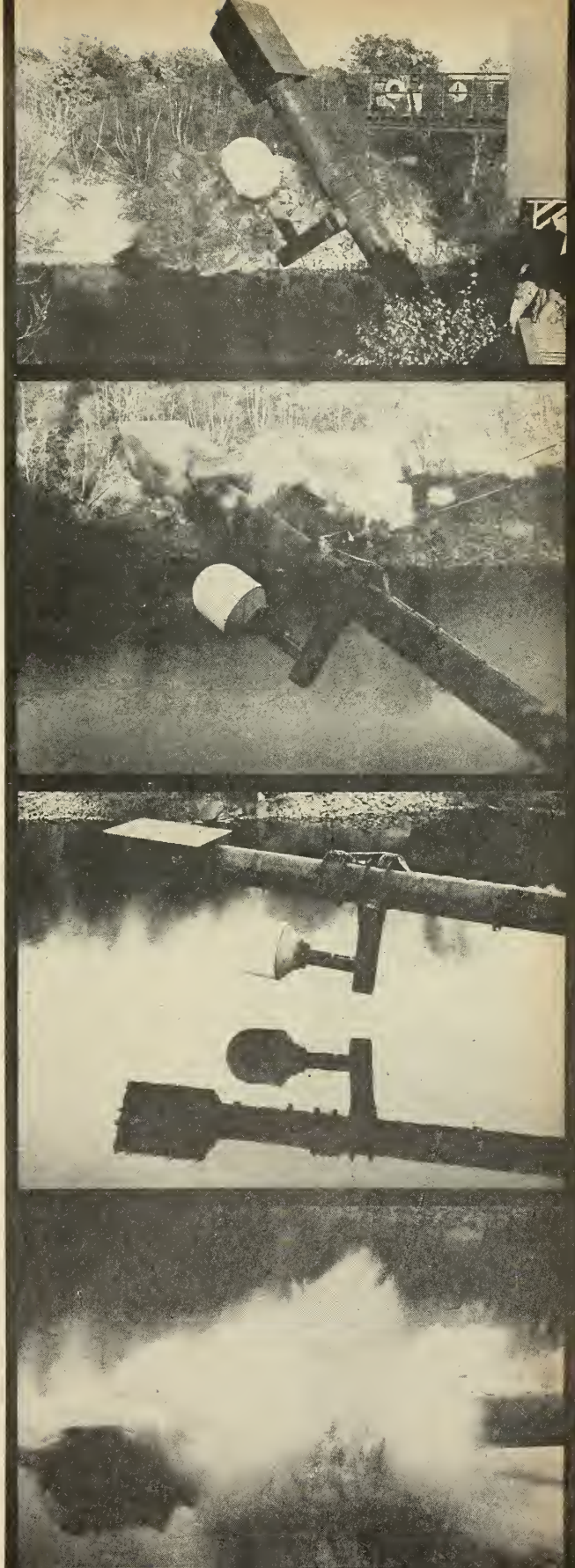
For the tests, the radome is mounted on a 40-ft. steel boom hinged to the vertical face of the quarry. The boom is then released and the radome smashed into the water.

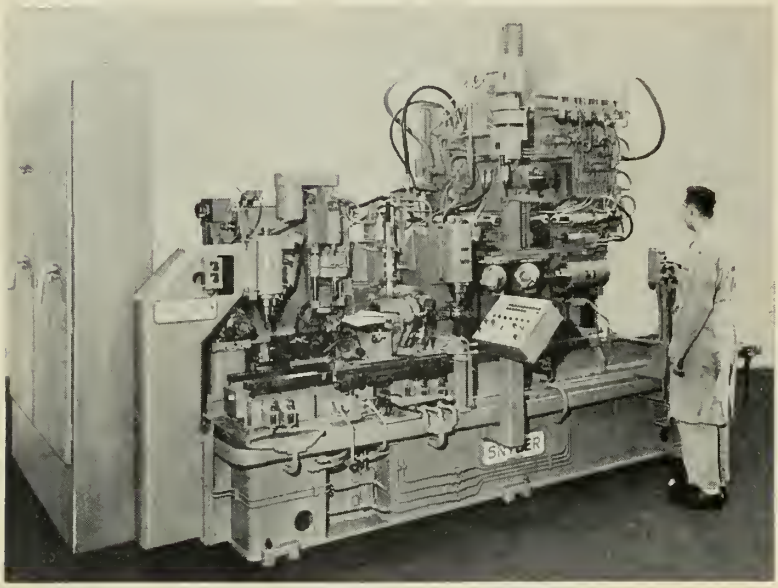
The top photograph shows the boom being lowered into position above the water for a test drop. Next the boom is poised for release from a calculated height. The center photo catches the dome in flight just before it hits the water. After the impact, a two-man team boards the boom to inspect the radome and secure the cables for another test.

The new radome was built to house the antenna for a radiometric sextant that lets the *Polaris* sub see through bad weather and shoot the sun by zeroing in on the radio signals continuously emitted by the sun, or by signals from the moon.

On the submarine, the radome protects the antenna dish mounted on top of a stainless steel mast. An automatic system to direct the antenna is located below decks.

Such a radio telescope for submarine use represents a milestone in navigation systems. The system requires astronomical accuracies in the drive and control systems and yet must meet the rugged environmental conditions encountered underseas.





Tool Designed for Aluminum Alloys

A programed tool that performs a wide variety of milling, drilling and tapping operations on cast aluminum alloy missile wings at a rate of 17 pieces per hour at 100% efficiency has been designed and built by Snyder Corporation.

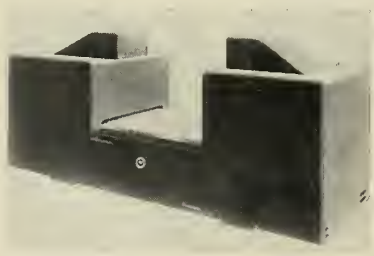
Basically the unit is a line-index type in which the missile wing is clamped in a fixture and traversed on hardened and ground ways to various machining positions. In completing the machining of the part, the work fixture is moved by a hydraulic cylinder arrangement along a 68-in. long path.

The tool has a welded steel base to which are bolted welded bases, arms and columns for several different types of moving and fixed machining units. The fixture is located by shot pins for machining operations in intermediate positions and by stops at each end of the travel. Some machining operations are carried out while the fixture is being indexed from one fixed position to the next.

Eleven different machining operations are performed at five fixture positions on the missile wing by an assortment of machining units including a Snyder standard way-type unit, two air-powered motorized drilling units, two motorized three-spindle drill heads, a two-spindle motorized tapping unit, nine motorized precision spindles, four air-powered, air-fed single-spindle drilling units and three air-powered, air-fed lead screw single-spindle tapping units.

The Snyder special missile wing Programed Tool occupies a floor space approximately 176-in. by 120-inches. It is about 132-in. high. Hydraulic power for indexing and slide operation is provided by a separate motorized hydraulic pump and tank unit. Electrical controls are in a panel at the side of the machine.

Circle No. 225 on Subscriber Service Card.



Vibration Test Table

A new type of electromechanical vibration table for the environmental testing field is being introduced by Westinghouse Electric Corp. Conceived as a single unit or "package," the "Duopower" will be the first of a complete line of vibration test equipment to incorporate a slip plate or table between two shaker heads and thus eliminate power loss of present systems due to the coupling equipment.

The shaker table also has been designed to vibrate in a horizontal plane as its prime function—a radical departure from present tables—because company engineers found a majority of test requirements called for this type of testing. It is possible to test in a vertical plane merely by using a "knee" mounted to the table.

The table will develop 3000 pounds of force for testing the reliability of rocket, missile and aircraft components and their ability to withstand extreme vibration of actual blast-off and flight.

The Duopower testing equipment, through operation of the two shaker heads in a push-pull manner, will offer a more equally-distributed first vibration as well as a truer picture of complex motion. Through elimination of many of the expensive test fixtures, the table will permit greater working area and now make it possible to mount and test larger components than before.

At the same time, the magnesium slip table has been built to afford the user a much lower work area to avoid motion loss and provide more rigid and useful vibration testing of the machine.

Weighing 5000 pounds, the vibration table is 33½ in. high, 78 in. long and 29 in. wide with the power supplied from a Westinghouse audiopower amplifier designed specifically for vibration testing. It is enclosed by an aluminum cover except for the working table area and includes dust-proof jackets on the shaker heads.

Circle No. 226 on Subscriber Service Card.

Moulding Compound

A moulding compound offering advantages in the production of components that must withstand tremendous heat and pressure has been produced by Johns-Manville.

Offering maximum resistance to flame erosion in high-temperature service, "Thermomat" is composed of a non-woven asbestos felt saturated with a thermosetting phenolic resin and an inorganic filler, and is furnished in sheet form for easy one-piece lay-up.

As supplied for fabrication, the partially-dried slabs of Thermomat are extremely conformable and allow convenient one-man lay-ups. Random fiber dispersion provides maximum reinforcement to the cured Thermomat, yet allows easy working together of joints and seams and free flow of material during the moulding operation.

Flexible before curing, tough and

rigid after cured, Johns-Manville Thermomat is extremely resistant to high temperatures and offers exceptional resistance to physical abrasion and erosion during the ablation process. In a typical missile application, Thermomat, fabricated in a ⅛-inch thickness, protected the metal casing of a solid fuel compression chamber operating at

5000° F for approximately 90 seconds, in an area with no flame erosion. Typical physical properties of Thermomat Style 179, cured as directed, indicate a density of 106 pounds/cubic foot, shear strength of 20,300 psi, tensile strength 15,474 psi, and an ultimate flexural strength of 25,300 psi.

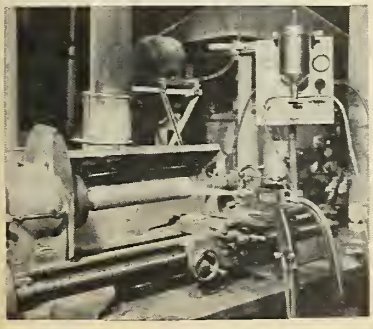
Thermomat is available in a variety of styles, with varying resin, asbestos fiber, and additive contents to allow fabrication of components with the final properties desired for specific application. Thermomat is available in slabs 14-inches wide, approximately 12-feet long, and 3/16-inch thick.

Circle No. 227 on Subscriber Service Card.

Spraywelder Unit

A lightweight, compact Spraywelder Unit which features a high spray rate (over 12 lb/hr) and exceptional deposit efficiency (up to 95%) is now available from Wall Colmonoy Corporation. The new equipment provides 20% reduction in spray pistol weight.

Major physical improvement in the redesign of the Spraywelder pistol is



simplification of controls. Former trigger and powder flow control have been combined into one simple positive-acting operating valve. Elimination of the trigger mechanism substantially reduces the space requirement, permitting a more compact pistol design and leading to a principal advantage of reduction in weight.

The pistol is 20% lighter than the former Model C-2 design. The smaller, lighter unit is easier to manipulate and less fatiguing to handle, factors of particular importance in manual spraying applications. The new pistol design utilizes the established Colmonoy principle of using air for powder feed. This arrangement permits full efficiency operation in any position through 360° in vertical or horizontal planes and insures non-porous powder deposits.

A simpler tip alignment procedure makes tip changing easier in the new pistol design. A pistol holder (optional) is available for mounting the Model D pistol in the lathe tool post. This device makes possible use of the lathe's traverse mechanism to achieve uniform, rapid build-up when spraying cylindrical parts. The holder design includes a positive lock-up mechanism which insures positive mounting.

The hopper portion of the new Spraywelder Unit has been enlarged in keeping with the increased spray rate capacity of the Model D pistol. It has a powder-storing capacity of 15 lb.; enough for 1 to 1½ hours of steady spraying. The hopper is provided with a new sight-gauge powder level indicator.

The Model D unit has been provided with a more efficient air filter and regulator. Double-action moisture separation is accomplished through utilization of a sintered metal moisture removal cartridge as well as a centrifugal drying mechanism.

Except for the elimination of the trigger, there is no difference in operation of the new Model D unit as compared with former designs. The same Sprayweld Process techniques and procedures apply.

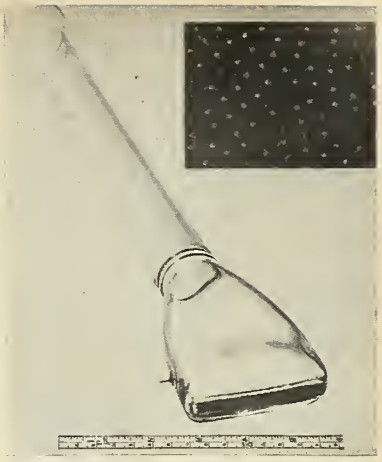
Circle No. 228 on Subscriber Service Card.

High-Speed Printing Bulb

A cathode ray bulb with 35,000 separate wire conductors embedded in a face plate only 3 by ¼ inches in size has been developed for high-speed electronic printing by the Corning Glass Works.

The new process is capable of printing 20,000 characters a second. It also can be used to transmit by microwave or wire systems facsimiles of graphic and printed materials—documents, records, maps—even mail.

Corning produces the vacuum-tight bulb with wire-embedded face plate for use in the Videograph process developed by the A. B. Dick Company. Bulb design was a cooperative effort by Corning and Sylvania Electric Products, Inc. Sylvania processes the finished tube.



Each conductor in the rectangular matrix of the fact plate is .001 of an inch in diameter—half the thickness of a strand of human hair. Nominal space between conductors is .003 of an inch.

These conductors serve to transfer an electrostatic charge from an electron

beam to moving paper. The information can be obtained from a computer or from magnet tape. The videograph, according to the A. B. Dick Company, prints the information as fast as it can be fed to the equipment.

Circle No. 229 on Subscriber Service Card.

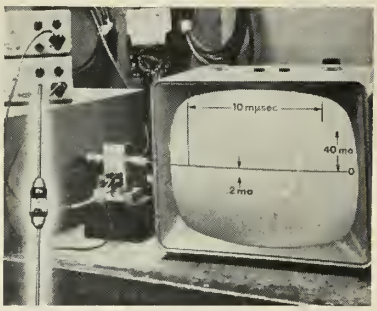
Ultra-Fast Diode Developed

A silicon switching diode now available has a maximum operating time of 8×10^{-10} second and is believed capable of performing 5×10^{8} logic functions in less than one second.

Developed by Sylvania Electric Products, Inc., the new diode is designed for use in high speed military computers, such as missile guidance and tracking systems, and in commercial equipment.

The device has a typical rating of 0.3 millimicrosecond. Switching time of the fastest diode previously available was approximately 3 to 4 millimicroseconds.

As other components of comparable speed are developed, it will be



possible, for the first time, for logic circuits to process ideas in a few billionths of a second, according to Sylvania.

Designated type D-4121, the new diode is hermetically sealed and capable of operation at 150° C. It offers superior performance despite extreme conditions of vibration, shock, temperature change and moisture, said the company. It is also capable of operation in the microwave range (1000 mc and upward).

Circle No. 230 on Subscriber Service Card.

New Literature

MOLYBDENUM SPECIFICATIONS —The Refractomet Division of Universal-Cyclops Steel Corp. has published a molybdenum mill products specifications booklet. The booklet covers unalloyed molybdenum and Mo-0.5 Ti alloy billets, bars, plates and sheets. Material specifications for each of these standard mill products include: scope, manufacture, chemical composition, structure, mechanical properties, dimensions, finish and inspection.

Circle No. 200 on Subscriber Service Card.

RELAYS. Diaphlex Division, Cook Electric Company, announces the release of a new Relay Manual featuring 30 types of relays, (with 1,000 variations), for communications, computers, industry, and the military. Using photographs, line drawings, tables and descriptive material, the publication presents detailed data on the many established pile-up relay types, variations in spring arrangement, timing, coil voltage, contact ratings and other useful classifications are outlined.

Circle No. 201 on Subscriber Service Card.

ALUMINUM MANUAL. The Aluminum Association has published a 392 page Aluminum Construction Manual ($3) providing in a single volume data essential to designers, engineers and architects concerned with stressed aluminum structures. The book presents for the first time computations of allowable loads for beams and columns of aluminum alloy 6061-T6, one of the most widely used aluminum structure alloys.

Circle No. 202 on Subscriber Service Card.

SEALLESS PUMPS. Sealless leakproof pumps are described in new four-page, two-color Chempump Bulletin 1030-2 available free from Chempump Division, Fostoria Corp.

Circle No. 203 on Subscriber Service Card.

BALLOONS. A new 16-page brochure titled "General Mills Balloons" is an up-to-date summary of the company's plastic balloon capabilities for upper air research. It describes and illustrates conventional-type, free floating polyethylene balloons, captive Aerocaps, antenna-supporting kite balloons, Mylar spherical satellite balloons, plastic missile shelters, and other developments. The two-color brochure also describes and pictures some of the special equipment and special balloon services available at General Mills.

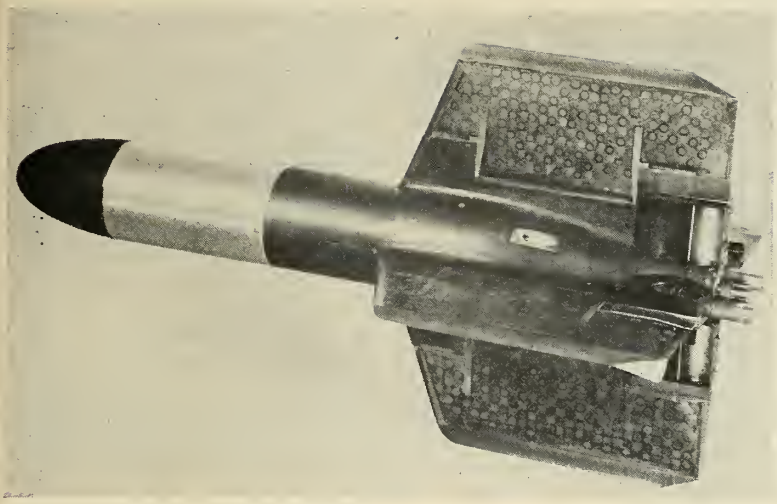
Circle No. 204 on Subscriber Service Card.

PRINTED CIRCUITS. A new two-color bulletin on Printed Circuits has been issued recently by Whitney Blake Co. The folder discusses the benefits accruing from the use of printed circuits and provides a list of information needed by the manufacturer when quotations are to be made. In addition, the types of insulating materials and the current capacity in relation to width of copper conductive pattern are described. The folder also lists the choice of metals available for the conductive pattern as well as the types of plating recommended to achieve desired results. Recommendations covering materials available for switch and contact patterns are also included as is a list of the company's facilities and a partial list of companies served.

Circle No. 205 on Subscriber Service Card.

CHECK VALVES—A comprehensive new brochure on multi-flapper check valves has been made available by Bobrick Aero Missile Products, division of Bobrick Manufacturing Corporation. Included in the new brochure are illustrations, specifications and technical descriptions of the new line of valves which cover duct valves, ground start inlet and check valves, and various types and sizes of insert valves. Designed for fuel and LOX handling as well as for air conditioning application, types of the new valves are currently in use by Boeing, Convair, Douglas, Lockheed, Martin, Republic and Norair.

Circle No. 206 on Subscriber Service Card.



One Man Can Fire *Bantam*

The wire-guided *Bantam* now being developed for Sweden by Aktiebolaget Bofors is primarily an antitank missile with an effective range of 1000 to 6500 ft. Weighing 19.8 lbs. overall in its carrying container, the *Bantam* can be operated by one man.

Recently disclosed specifications of the *Bantam* show it to be somewhat similar to the Nord wire-guided *SS-10* and *SS-11* antitank missiles. The *Bantam* has two solid-propellant motors, a booster and sustainer which accelerates it to a top speed of 190 mph.

Length of the missile is 2.5 ft. It has a body diameter of 3.9 in. and the cruciform wings have a span of 15.7 in. Firing weight is 13.2 lbs. and warhead weight (either armor-piercing or high explosive) is 3.1 lbs.

Corners of the wings are bent, making the missile rotate in its trajectory. Directional control is obtained by actuation of electrically-driven spoilers through a transistorized receiver. The control unit weighs 4.3 lbs.

Germans Arming in 3 Stages

A three-point program for equipping German Armed Forces with guided missiles and planes has been outlined by the Director of Air Technical Division, German Ministry of Defense.

Dr. Theodor Benecke said the plan's first stage, now concluded, involved rearmament with Allied equipment. The second stage, now going on, is Germany's gradual adoption of NATO armament systems, and finally, the third phase will be Germany's attempt to provide its own armament.

Benecke said the *Sidewinder* infrared guided missile program for the Luftwaffe's F-104 is an important aspect of allied cooperation. *Sidewinder* license production will be promoted jointly by Norway, Denmark, the Netherlands, Greece, Turkey and Germany. The bulk of the European orders will be placed with a specially founded subsidiary of Bodenseewerk, Perkin-Elmer GmbH at Uberlingen, Germany.

European *Hawk* production, Benecke said, will be a joint French, Italian, Belgian, Netherlands and German effort, with American assistance. A special NATO organization in Paris has been established for this program, and the French firm, SETEL (Societé Européené de Téléguidage), figures as prime contractor.

Soviets Claim Van Allen Belt

A Soviet astrophysicist has advised his fellows that "Soviet scientists can claim priority in discovering the inner belt and have played an important role in studying the outer one."

Professor A. Lebedinskiy credits Prof. James Van Allen of the US with the discovery of the inner "belt," but he finds that it was not until measurements had been performed with *Sputnik III*—launched May 15, 1958—that it was possible to determine the boundaries of the inner zone and to evaluate the energies of the zone.

Lebedenskiy points out that the counters installed on the first and third US satellites did not significantly differ from those carried by *Sputnik II*. *(Pravda, Mar. 23, p. 6, cols. 1-2.)*

British Electronics Council Will Serve Growing Market

LONDON—United Kingdom electronic interests have formed an Electronic Industry Council much like the Electronic Industries Association in the United States to serve their £200 million market.

Led by the Electronic Engineering Association, the Radio and Electronic Component Manufacturers Federation and other bodies have joined in the formation of the new group.

The Council will be concerned with electronic instruments, sound and television transmitters, radio communication equipment, radar and radio navigational aids, computers, industrial electronic control equipment and industrial television and the electronic components used therein.

All associations or federations of manufacturers of electronics components apparatus or equipment are eligible for membership except those in the broadcast radio and television receiving industry and public telephone services.

The EIC will function much like its American counterpart in dealing with matters of concern to the whole industry, while its constituent bodies remain autonomous in their own fields of activity.

Firm Will Help Small Companies Sell Overseas

A firm to handle international technological licensing and help smaller firms form joint ventures abroad has been formed under the name Ladd & Little, Inc.

Foreign patent owners will also be represented by Ladd & Little for sales in this country. It has already received commissions for several French patents.

Montague V. Little, George T. Ladd and several other former executives of the Al Fin Division of the Fairchild Engine & Airplane Corp. lead the firm. It will be located in Huntington Station, L.I., New York.

mergers and expansions

(continued from page 18)

SPERRY BREAKS GROUND: Construction began on Sperry Semiconductor's new headquarters in Norwalk, Conn. The new plant will be completed in September as part of a multimillion-dollar expansion program.

ALLEGHENY LUDLUM PLANS: A $40,000,000 program of expansion and modernization of Allegheny Ludlum Steel Corp.'s plant facilities is underway at principal locations of the firm's operations.

KEY POLYMER FORMED: Jacob Lichman, Sydney Comins and Adrian Comins have formed Key Polymer Corp. in Lawrence Mass. It will specialize in adhesives and coatings from epoxy and polyurethane polymers.

NEW COMPUTER CORP: Embree Electronics Corp. will enter the computer field with a line of related products in the field of electronic analog computers. R&D is being performed by the University of Virginia.

DEUTSCH PLANS BUILDING: The Electronics Components Division will be increased by 40% by a new building to be completed late this summer.

GENERAL DEVICES ON WEST COAST—A West Coast field engineering, service and sales office has been opened in Los Angeles by General Devices, Inc. The new operation will serve Western States and Rocky Mountain area.

SYLVANIA PLANS NEW LAB: Sylvania Electronics Systems, division of Sylvania Electric Products, Inc., plans an Applied Research Laboratory facility and headquarters building—45,000 sq. ft. of new construction each—on a 55-acre site adjacent to present facilities in Waltham.

GERMAN BRANCH EXPANDS: Consolidated Electrodynamics Corp., a Bell & Howell subsidiary, has expanded its wholly owned subsidiary in Germany, Consolidated Electrodynamics Corp., Gmbh. The German corporate headquarters has moved to larger quarters in Frankfurt and branch offices have been opened in Hannover and Paris. Assembly of some CEC products by the German operation will begin in July.

NEW HUGHES DIVISIONS: Hughes Aircraft Co. has established two new divisions for development, production and marketing of commercial vacuum tube devices. New groups will be known as Microwave Tube Div. and Vacuum Tube Products Div.

ATLEE BURGEONS: Atlee Corp. has acquired and merged with Industrial Electronics Co., Inc. and Applied Dynamics Corp., and will operate under the Atlee name.

S-F-D LABS GROW: The Varian Associates' subsidiary is increasing its facilities by about 2/3.

financial

• **Lockheed MSVD**—The division has disclosed that its sales objectives for 1960 are $42 million, and $61 million in 1961.

• **Lear, Inc.**—A net income of $2.4 million for the year ending Dec. 31, 1959, is reported, comparing to $1.6 million for 1958. Shipments rose 37% over the previous year, totaling $87 million. New business climbed to a record $100 million, and the division has a backlog of $63 million.

• **Marquardt Corp.**—Highest sales in the company's history were realized at $69 million, 39% over the previous year. Earnings amounted to $1.3 million, 15% over 1958's $1.1 million.

• **General Dynamics Corp.**—Last year G-D became the nation's leading defense contractor, and had record sales of $1.9 billion in 1959, compared with $1.6 billion the year before. Earnings dropped somewhat, however, mainly because of cost of developing the Convair 880 and 600 air transports and building new facilities, according to the company.

• **Lockheed Aircraft Corp.**—Although sales exceeded the $1 billion mark for the first time last year, Lockheed earnings fell from $18.8 million to $8.7 million. The company said the principal factor was the excess of costs over selling prices of commercial aircraft.

• **Vitro Corp. of America**—Income before special charges amounted to $565,000. Special charges of $1.4 million were made against income, resulting in a net loss of $911,000 in 1959 compared with 1958's net loss of almost $1.5 million.

• **U.S. Industries**—U.S.I. sustained a loss of over $1.7 million for 1959, which the company attributes to retarded machine tool buying and to the prolonged steel strike. Sales totalled $86.6 million, compared to $86.4 million in 1958, in which year profit was $672,000.

• **Chance Vought Aircraft, Inc.**—In a year of several large contract cancellations by the Navy, including *Regulus I*, Chance Vought suffered a drop in sales from 1958 of almost $80 million. Total sales for 1959 were $254.6 million, as opposed to the previous year high of $333.1 million. Net income fell almost to half, $4.9 million of 1958's $8.9 million. Backlog at end of 1959 amounted to $253 million, also considerably under 1958's year-end orders of $370 million.

• **Allegheny Ludlum Steel**—Sales and revenues increased, $232.6 million compared to 1958's $202.6 million. Net earnings doubled, $11.3 million to $5.9 million.

• **Textron Electronics, Inc.**—Net sales for twelve months ending Jan. 2 totalled $308.2 million, compared with '58 total of $244.2 million. Net income also showed a nice increase with $16.6 million to $10.7 million in the previous year.

• **The Sanborn Co.**—Net sales were $15.0 million, and earnings $.6 million. 1958 totals were $12.9 million and $.5 million earnings.

—contracts—

NAVY

$4,895,000—General Electric Co.'s Light Military Electronics Dept., Utica, N.Y., for continued production of the *Sidewinder* air-to-air missile.

MISCELLANEOUS

Lear, Inc.'s Industrial Products Group, Santa Monica, received a contract to produce ten remotely operated automatic control systems for nuclear reactors being developed by Martin's Nuclear Division, Baltimore. Amount not disclosed.

Blaw-Knox Co., Pittsburgh, Pa., received a "several-million-dollar" contract to design and fabricate a 120-foot tropospheric scatter communication antenna for expansion of the northern defense radar system. Subcontract from Western Electric Co., New York City.

AIR FORCE

$3,500,000—General Electric Co., for five high-powered long-range air defense radar sets.

$537,629—Eitel McCullough, Inc., San Carlos, Calif., for electron tubes.

$87,063—Thiokol Chemical Corp., Elkton, Md., for rocket motors to be used in support of Project *WS-133A*.

$74,215—The Martin Co., Rias Div., Baltimore, for determination of the characteristics of cosmic radiation in the vicinity of the earth.

$47,276—Bomac Laboratories, Inc., Beverly, Mass., for electron tubes.

ARMY

$12,499,147—Raytheon Co., Andover, Mass., for 22 battery sets for *Hawk* ground support system.

$5,500,000—Convair Div., General Dynamics Corp., Pamona, Calif., for development of a new air defense missile to be known as *Mauler*.

$2,016,250—Western Electric Co., Inc., New York City, for 165 sets of digital data terminal equipment for use with the missile monitor system.

$1,962,900—Western Electric Co., New York City, for *Nike-Zeus* communications and instrumentation facilities for testing the weapon on Kwajalein Island.

$1,630,624—U.S. Steel Corp., Consolidated Western Steel Div., Los Angeles, for rocket motors and containers.

$1,594,000—Chrysler Corp., Detroit, for design and development of hypersonic ballistic target missile system.

$1,564,970—Kurz & Root Co., Appleton, Wis., for 2,131 generators.

$1,300,000—Sperry Rand Corp., Great Neck, L.I., N.Y., for modification of an existing contract for work on Doppler navigation equipment.

$1,145,402—Thomas Bate & Sons, Inc., Denver, for construction of a guided missile and technical supply building at Lowry AFB.

$1,120,000—Chrysler Corp., Detroit, for the *Jupiter* missile system.

$1,119,941—Boeing Airplane Co., Wichita, for overhead door hinge assemblies for *Atlas* missile launch complexes.

$1,040,000—Stanford Research Institute, Menlo Park, Calif., for continuation of study of air defense systems.

$760,000—Chrysler Corp., Detroit, for *Redstone* missile system repair parts.

$720,316—Raytheon Co., Waltham, Mass., for concurrent repair parts for *Hawk* missile system.

$697,883—The Martin Co., Orlando, for *Lacrosse* research and development.

$405,691—Douglas Aircraft Co., Santa Monica, for *Nike* replenishment spare parts. (Six contracts.)

$344,800—Todd Ship Yards Corp., Houston, for construction of a 180-ft. barge to transport *Saturn* space rocket booster from Huntsville to the launch site at Cape Canaveral.

$325,437—Radioplane Co., Van Nuys, Calif., for flight services for the *RP-76* target missile.

Edward J. Horkey: Named vice president-engineering at Houston Fearless Corp. Will also remain president and chief executive officer of the firm's subsidiary, Horkey-Moore Associates. Prior to joining the firm in 1953, was vice president of Pastushin Aviation Corp. and prior to that chief technical engineer at North American Aviation, Inc.


HORKEY

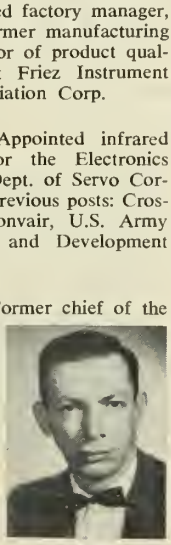
Charles Jackson: Formerly of Minneapolis-Honeywell Co., joins Monitor Products Co. as chief engineer and **Charles Manson** of Bendix Corp. named purchasing agent.

Ralph I. Cole: Manager of military project planning, engineering services at Melpar, Inc., appointed to the committee on Missile Support Equipment of the Advisory Council on Federal Reports.

Arthur S. Pawling: Formerly assistant factory manager, named factory manager, and **E. R. Harrall,** former manufacturing manager named director of product quality and reliability, at Friez Instrument division of Bendix Aviation Corp.

Andrew Ireland: Appointed infrared systems consultant for the Electronics Systems Engineering Dept. of Servo Corporation of America. Previous posts: Crosley Div. of Avco, Convair, U.S. Army Engineering Research and Development Laboratories.

Justin L. Bloom: Former chief of the materials management branch of the U.S. Atomic Energy Commission, San Francisco Operations office, named project engineer for advanced SNAP programs in the Nuclear Division of The Martin Co.


BLOOM

Robert W. Cuthill: Former assistant and advisor to Maj. Gen. John B. Medaris, ABMA, named chief engineer of The Martin Co.'s Orlando Division.

Varian Associates names three vice presidents: **Paul B. Hunter,** Patent Dept.; **Dr. Theodore Moreno,** Tube Division; **Dr. Emery H. Rogers,** Instrument Division.

Joseph Rae Conway, Jr.: Former senior engineer in charge of gyro design and development with Eclipse-Pioneer division of Bendix Aviation Corp., appointed director of marketing at Whittaker Gyro division of Telecomputing Corp.

J. P. Henry: Vice president and general sales manager, elected a director, and **Henry C. Fechtmeyer** named vice president, at Ampco Metal, Inc.

Charles E. Baugh: Appointed manager of Garrett Corp.'s Atlanta sales office, replacing **Ray Gambon,** now in the Los Angeles office.

Hughes Aircraft Co. appoints three to directorships in the recently formed Advanced Projects Laboratories: **Dr. Fred P. Adler,** former manager of advanced planning in the Systems Development Laboratories, named director; **Dr. Leonard Gross,** assistant manager of systems and analysis named assistant director, and **Dr. Renne S. Julian,** technical director of the guided missile laboratory, named technical director.

Thomas N. Kasabali: Elected manager of military relations, Customer Relations Dept. at Summers Gyroscope Co. Prior to joining the firm in 1958 was a design engineer at Douglas Aircraft Co.

Robert M. Wood: Former plant manager, Semiconductor Division of Sylvania Electric Products, joins Pacific Semiconductors, Inc. as manager of the transistor plant, and **David M. Edwards** selected as manager of Manufacturing Planning and Control.

F. H. Gerhard: Former senior research engineer at Autonetics Division of North American Aviation, joins Espco-West as senior design specialist responsible for all analog circuit design. He developed the amplifiers in the autonavigator that guided the Nautilus under the North Pole, and is the holder of nine patents.


GERHARD

P. G. Smith: Appointed executive vice president, and **Donald E. Butler,** vice president-sales, for the Royal Jet Division of Royal Industries, Inc.

John A. Swint: Former president of Vard, Inc., appointed director of The Marquardt Corp.'s Utah division.

Norman J. Golden: Named vice president-research and development for Hoffman Electronics Corp.'s Semiconductor Division, succeeding **Dr. Morton B. Prince,** now division vice president-general manager.

Dr. Richard W. Eppley: Joins the Astro Systems and Research Laboratories of Northrop's Norair Division to participate in development of foods for space travelers.

Robert E. Lorenzini: Joins the technical staff of Rheem Semiconductor Corp. and will be concerned with development of new crystal growing techniques for semiconductor materials.

Harold P. Field: Former director of marketing of Stromberg-Carlson's Electronics Division, joins System Development Corp. as director of plans and programs.

W. Van Alan Clark, Jr.: President of The Sippican Corp., simultaneously elected to the board of the Electronic Engineering Co. of California and The Sippican Corp. He is also a director of Avon Products, Inc. and Tibbetts Industries, Inc.


VAN ALAN CLARK

W. G. Lohmeyer: Formerly senior project engineer with the Defense Products Division of Fairchild Camera and Instrument Corp., joins DeJur-Amsco Corp., as director of research and engineering.

Arthur L. Koehler: Appointed manufacturing manager of Sorensen & Co., subsidiary of Raytheon Co.

James A. Koch: Joins Precision Instrument Co. as senior applications engineer and **Mortimer Fleishhacker, Jr.** Assumes duties as assistant to the controller.

Charles E. Dolberg: Appointed director-systems management for Philco Corp.'s Government and Industrial Group, responsible for management of command and control systems, data transmission systems and integrated electronic data processing systems. Holder of eight patents dealing with electronic equipment.

Adolphe S. Kromer: elected president and general manager of Flexonics Corp., a subsidiary of Calumet & Hecla.

Wyman-Gordon Co. announced the appointment of three new vice presidents: **Joseph R. Carter,** general manager, Eastern Division; **James L. Roach,** director of marketing; and **Robert E. Zell,** general manager of the Ingalls-Shepard Division.

Henry Foster Dever: vice president of Minneapolis-Honeywell Regulator Co. in charge of its Industrial Products Group, has been elected a director of F. J. Stokes Corp., Philaldelphia.

ADVERTISER'S INDEX

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The Fight for Proprietary Rights

At this writing there are several bills before Congress relating to Small Business.

The fact that there is very little chance that any of them will be acted upon at this session should not prohibit American business from fighting some of the present evils largely affecting Small Business—evils which come not from laws but from directives issued by the Department of Defense.

Some months ago on this page (Oct. 26, 1959) we advised Small Business that any of the several bills pending before Congress could, instead of eliminating some government restrictions, actually make Small Business even more a captive of the government; that the Small Business Administration under the guise of protecting small industry was really intent on reducing it to its lowest level of competency.

And further—that it was up to responsible Small Business to fight for its independence and integrity.

At the moment a company which is neither small nor large—the Garrett Corporation of Los Angeles—is one of the leaders in a fight against Defense Department decrees which are striking at the heart of the American free enterprise system.

By congressional testimony and through other means, officials of the Garrett Corporation are calling attention particularly to the acquisition and use of contractors' drawings by DOD under the provisions of Armed Forces Procurement Regulation IX, Part 2, and MIL-D-70327, which defines Class 2 drawings.

Without going into highly involved details, we can roughly define Class 2 drawings as those executed by engineers for private industry, as opposed to those executed by engineers directly in the employ of the government.

And ASPR IX, Part 2, directs that prime or subcontractors must, when the article they make is made for military contract, turn over to the government a complete set of Class 2 drawings which will enable it to be reproduced elsewhere.

The drawings must include operational data which will provide information for instruction, operation, maintenance, evaluation or testing. They must have descriptive data or design drawings which will "permit manufacture by other competent firms."

The directive pays lip service to proprietary rights but defines them in such a way as to exclude even those things which our common law courts have repeatedly held up as being proprietary. It says, for instance, that if the Government can determine the manufacturer's know-how by a process of reverse engineering, then these drawings are non-proprietary; the government is free to use them to shop around among competitors for a lower price.

This degree of almost direct confiscation directly affects most of all the subcontractors, because the prime is protected by the very bigness of his product.

But the big prime can suffer also. He loses control of the performance of his products in the field, and runs the risk of having inadequately controlled parts contaminate inventory by the low-bidder route.

And the middle-size operator, too, can see his spare parts business ruined and the designs of his end items pass into the public domain without recompense to him.

As we said several months ago, it is up to responsible business of all sizes to carry this story and this fight to Congress. It is only the incompetent who wants to be captive, but the incompetent is frequently the most vocal. There is still time, but the campaign to restore and retain the rights and fruits of free enterprise must be organized and it must be strong.

Clarke Newlon

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