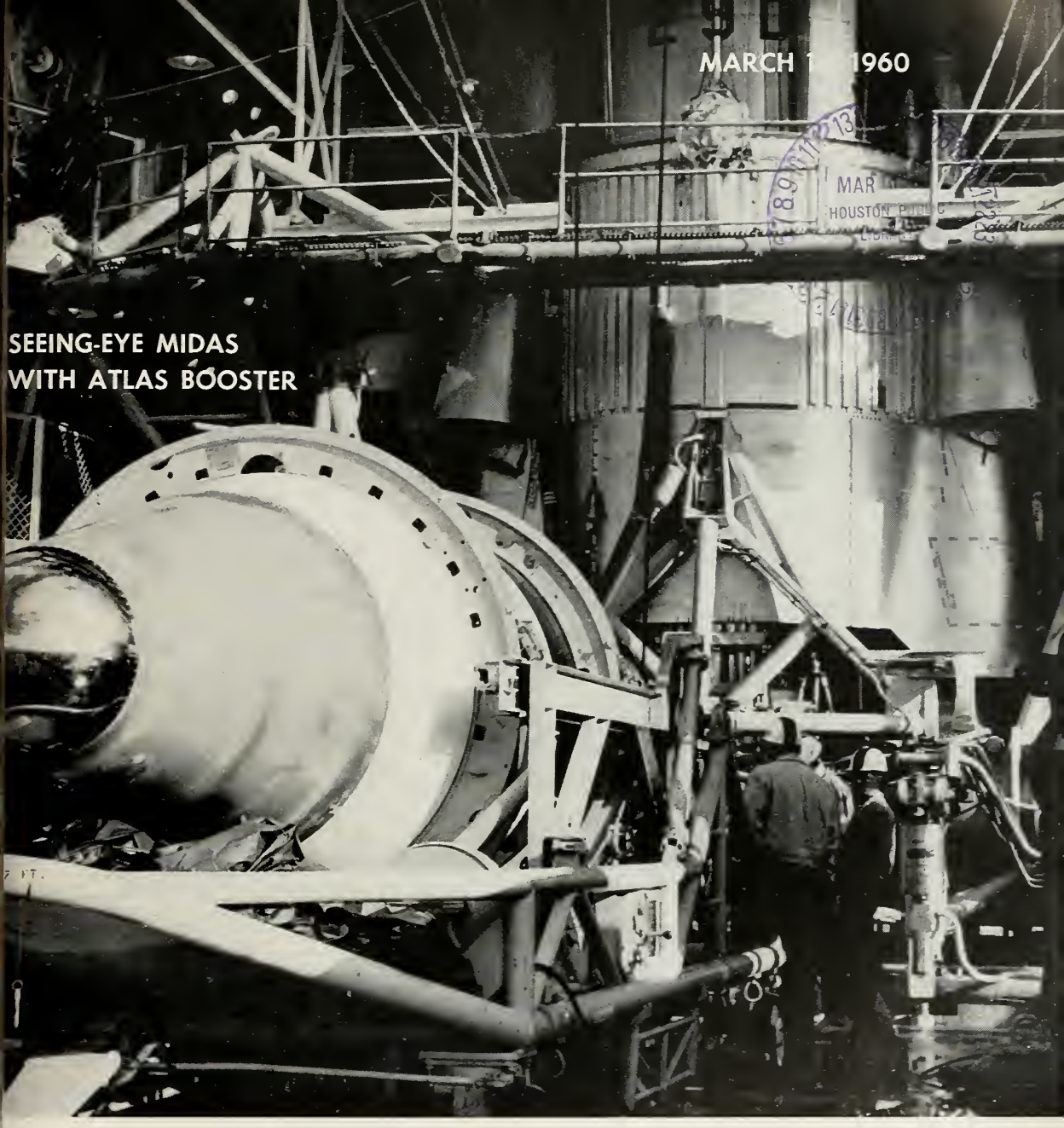
MARCH 1 1960



SEEING-EYE MIDAS
WITH ATLAS BOOSTER



# missiles and rockets

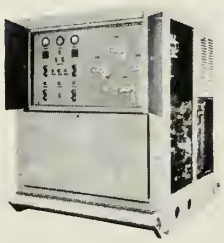
MAGAZINE OF WORLD ASTRONAUTICS



AN AMERICAN AVIATION PUBLICATION


**In a showdown situation – when the target is space and a million dollars' worth of missile rests idly on the ground – a successful shoot depends on the "go, no-go" type of test that pinpoints the trouble.**

This INET 400-cycle ground power unit was tailor-made for the Atlas missile. In meeting all of Convair's specifications for preflight calibration of electrical systems, the unit has performed as one of the most successful pieces of test equipment used in this USAF project.



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Missiles and Rockets Volume 6 Number 1

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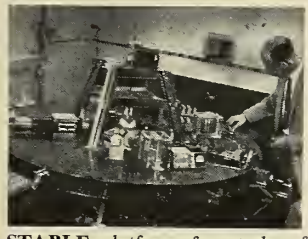
**COVER:** This *Agena* satellite vehicle was mated to an *Atlas* booster to form the first *Midas* carrier. It missed going into orbit from Canaveral Feb. 26, when *Agena* apparently failed to separate from *Atlas*.

**LEADER** of Huntsville's famed German-born rocket team is Dr. Wernher von Braun. The group this week assumes another historic task: developing big space boosters for NASA. See report beginning on p. 22.



**STABLE** platform for study of astronomical satellite is adjusted by NASA scientist at Ames Research Center. Civilian space agency plans to orbit such a satellite by 1963. See p. 26.

**THRUST** chamber mount of 1.5-million-lb.-thrust rocket engine test facility under construction at Edwards AFB, Calif., is inspected by Rocketdyne engineers. Turn to p. 36.


# missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

*30,000 copies this issue*


## MARCH 14 HEADLINES



## ASTRIONICS



## GROUND SUPPORT EQUIPMENT



## ADVANCED MATERIALS



## INTERNATIONAL



## PRODUCTS AND PROCESSES



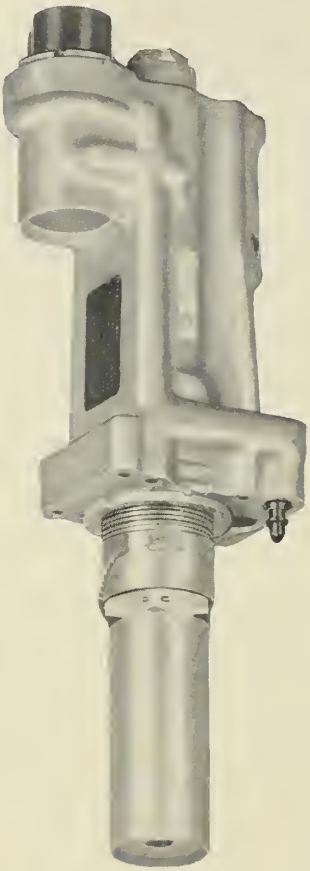
## THE MISSILE WEEK





## DEPARTMENTS

# NEW VOUGHT SERVO ACTUATORS TOP-RATED FOR MINUTEMAN



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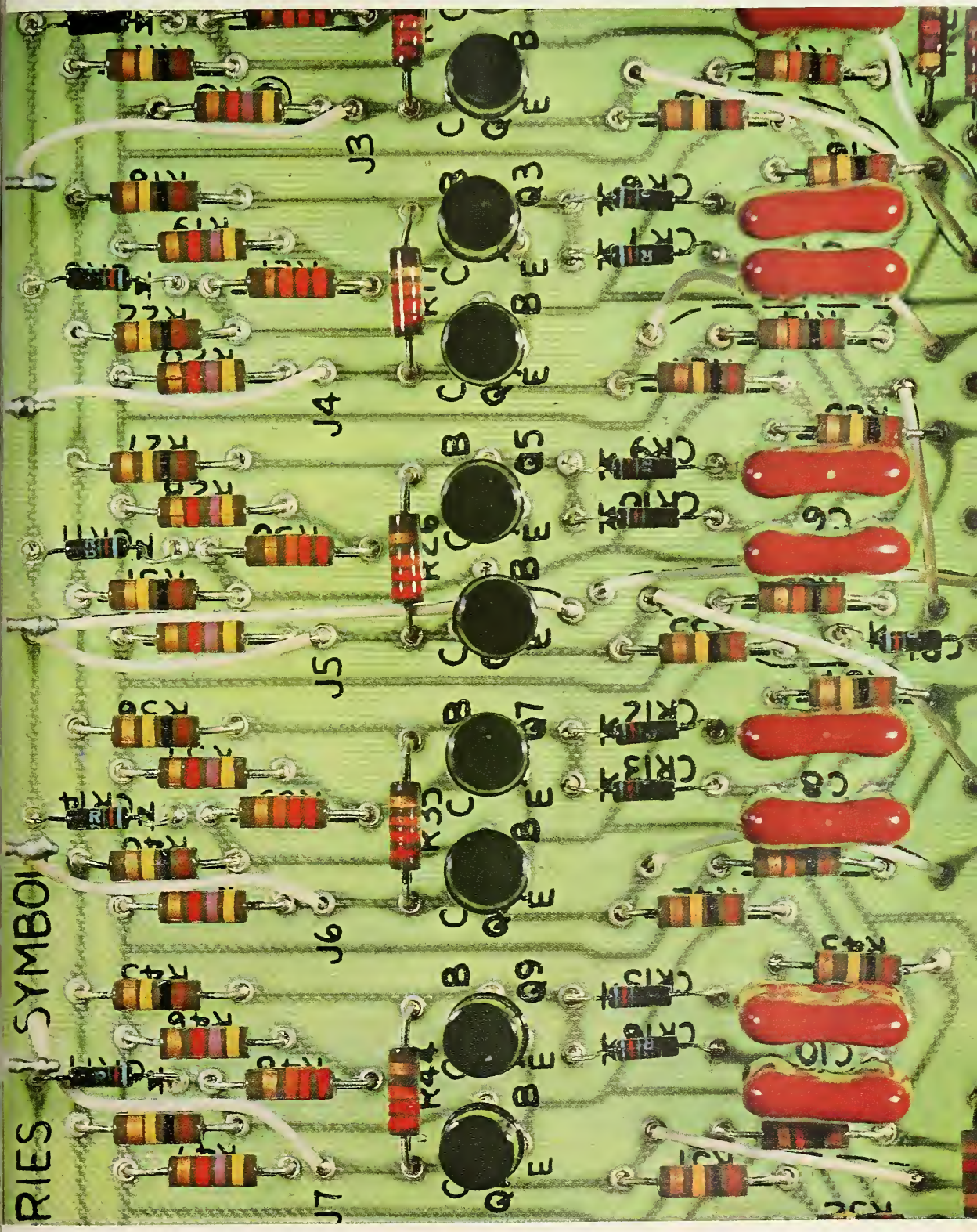
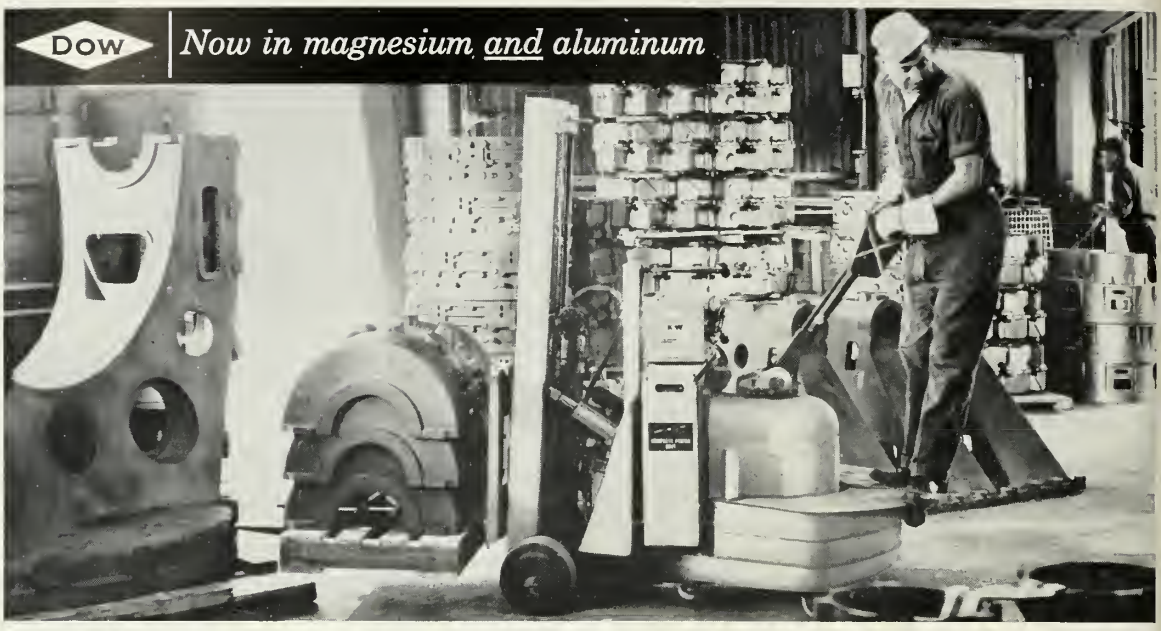
*At 00h00m01s GMT March 1, 1960, Martin logged its 457,080,000th mile of space flight*




Without electronics it is impossible to design, build, test, launch, guide, track or communicate with a missile. That is why 40% of Martin's 7,500 engineers are electronic/electrical engineers.

MARTIN



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Dow magnesium foundry offers experience, production capacity for sand and permanent mold castings of all sizes and shapes.

The unique capabilities of Dow's Bay City, Michigan, foundry help users of magnesium sand and permanent mold castings. Activities at this facility—largest and best equipped of its kind—run the gamut from large volume production jobs to one-shot "specials."

**Huge or tiny castings.** The foundry is capable of producing castings weighing in excess of 3,000 lbs. down to ounces—in all degrees of complexity. Experienced pattern engineers ensure that the best use of casting processes is made. This can result in either lower costs, improved quality, better deliveries, or a combination of all three.

**Newest techniques.** Many milestones in magnesium casting have been reached at this Dow foundry. In fact, Bay City has men permanently assigned to developmental work, keeping the foundry in the forefront of technological advances at all times.

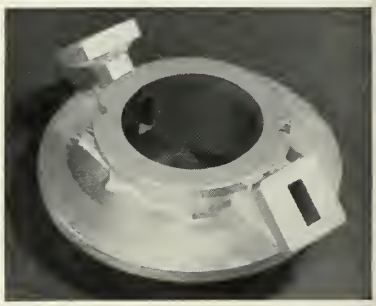
Results of their work include special processes for cast-in inserts and tubeless passages, and improved melting techniques. Casting methods have been developed for many of the newer magnesium alloys, such as the elevated temperature group and the new high damping capacity alloy, K1A.

**Quality control.** A full time quality control team exhaustively checks all work, from alloy composition to the shipping dock. A direct-reading spectrometer makes rapid alloy composition analyses. Its speed is particularly valuable when alloying elements that are hard to hold in the molten state, such as thorium, are present. Chemical analysis is also frequently employed.

**Testing facilities.** Molding and sand cores are analyzed as a regular part of casting quality control. Radiography, fluorescent penetrant inspection and other testing facilities are used to check properties and specifications.

**Experienced magnesium team.** The foundry often draws upon the broad range of specialized experience available throughout the company. To Bay City customers, this means assurance of high quality work, done with utmost efficiency and economy. If your requirements involve magnesium castings, Dow can help you arrive at optimum casting design and reliably supply your production requirements.

FOR MORE INFORMATION, contact your Dow Sales Office or write today for illustrated brochure discussing Dow foundry services. THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Dept. 1001CL3-14



THIS SAND CAST WAVE GUIDE was held to ±.005" on passageway dimensions. Surface smoothness requirements are 63 RMS. The foundry has government approval for any phases of its operations where such approvals are applicable.

THIS BRAKE CARRIER is sectioned to show how the hydraulic lines were integrated by use of tubeless passageway casting techniques.

*See "The Dow Hour of Great Mysteries" on NBC-TV*

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*Division of The Dow Chemical Company*

# Materials Memo

*News of materiel for the aerospace industry — from the 27,000 products of the 3M Company*

## ■ WRAP UP YOUR PRESERVATION PROBLEMS

— Ancient Egyptians had to get by with linen in preserving their birds (and people) — but there's no excuse for your using archaic materials for preservation sealing. Not when new "Scotch" Brand Preservation Tape No. 481 can be had. This weather resistant plastic tape has been designed specifically to meet the preservation sealing requirements of the Armed Forces. Why, even after 2 year exposure to Texas weather, it showed no ill effects and what's more, could easily be removed. Need we say more about its ability to resist the elements?

Of course, if you've never been to Texas, you may want more particulars on the performance range of this pressure-sensitive adhesive backed construction. Application can be made over a temperature range from 25°F to 120°F. Once applied, it can be flexed even down to –60°F and performs well up to 160°F. You'll also find that #481 removes cleanly without adhesive transfer.

The unusually conformable backing of Preservation Tape means that it can be applied to irregular surfaces, even at low temperatures, and still provide an effective moisture vapor seal. Incidentally, it has an MVT of 0.4 grams per 100 square inches per 24 hours.

Other points well worth remembering. This tape's backing is inert to common fuels, lubricants, and oils. Nor do water-based or solvent-based strippable coatings have any adverse effects on it. If you're concerned about applying it over lacquered or enameled surfaces, have no fear. It won't stain even after weathering.

You may have your own ideas about applications for #481 tape. Others are already field testing it as a seam sealer on missile bodies, radar and instrumentation vans and miscellaneous ground support equipment. Your Industrial Trades Tape representative can give you further data on this interesting product, or check the appropriate box below.

## ■ TAKE IT COOL

Does over-heating in your electronic components have you hot under the collar? Don't just go on frying your transistors, there's relief in sight. Recent developments in 3M's thermoelectric research now make it possible to literally pump away unwanted heat. In principle, these thermoelectric devices, based on the Peltier effect, can be tailored to fit a variety of hot spot cooling requirements whether they be in the tenths or tens of watts.

The number of couples built into a specific module depend upon the amount of heat to be moved and the temperature differential desired. For example, in a module containing four couples, one watt of heat will be pumped through a temperature differential of 75°F. Looking at it in another way, it will handle two watts at a differential of 50°F.

These thermoelectric spot coolers operate best with reasonably flat DC current. The maximum temperature differential across the elements in a given unit will occur at approximately 10 amps and an IR drop of 0.4 volts.

Developmental units designed by 3M are already at work cooling fluorescent tubes, transistors and electronic tubes. Our Electrical Products Division will be happy to consider the application of similar units to your systems or discuss with you the feasibility of custom building a suitable unit. You can start the ball rolling by checking with your local Electrical Products representative, or sending in the coupon below.

## ■ A HOT TIP ON RE-ENTRY

There's no need to sweat over finding materials for your individual nose cone or re-entry body construction. — Not when you can select from a series of new "Scotchply" ablative reinforced plastic materials. These are made up of various combinations of heat resistant resins and reinforcing fibers of glass, nylon, asbestos and other ablation materials.

All of these constructions are based on the exclusive "Scotchply" unidirectional fiber concept — which includes among its advantages an unequalled strength-to-weight ratio. Each individual ply is made up of a series of continuous non-woven filaments carefully impregnated with a closely controlled amount of the resin. This means several things to you in your layups. For one thing, you're relieved of the grief

and mess of maintaining uniform resin to reinforcement ratios. It's all done for you. Furthermore, you can tailor the reinforcing fiber orientation to suit your respective ablation needs or strength requirements.

You needn't worry that these materials haven't been put through the paces. They're real cool performers when the heat is really on. Tested in the G.E. water stabilized arc up to 20,000°F, some have exhibited rates down as low as 0.89 milligrams per kilowatt second. Thermal conductivity of several types is in the range of 1.5 BTU's per square foot per hour per degree Fahrenheit per inch. Those who aren't impressed by test data will be interested to know that members of this series have successfully survived re-entry on existing missile systems.

Our Reinforced Plastics Division proudly points out that while these are offered in 6 basic constructions, their equipment and experience is sufficiently versatile to permit constructions with other fibers and/or different resin concentrations (these, of course, on a minimum quantity basis). "Scotchply" ablative materials are available in uncured form, both as tapes and sheets. Why not get more data on their performance from your local Reinforced Plastics representative? Or check the box in the coupon below.

## ■ ABOUT "MIL"

3M's Missile Industry Liaison is a service staffed by technical personnel experienced in rocket propulsion and other phases of space technology. Their job is to translate problems of the aerospace industry to those 3M specialists best qualified to solve them. If you have questions on any of the items mentioned here, or would like to know what else 3M makes — or could make — for your needs, mail coupon.

3M Company, Missile Industry Liaison — Dept. VAB-30
St. Paul 6, Minn.

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# Washington Countdown

## IN THE PENTAGON

**ICBM blowup . . .**
at one of Vandenberg AFB's three operational *Atlas* pads earlier this month occurred during a high-speed loading test. The blast is believed to have been triggered by a loss of pressure.

• • •

**King-size *X-15* . . .**
has been designed by North American for possible use as a two-seater spacecraft. The big rocket plane would be boosted into orbit by *Saturn*.

• • •

**Dyna-Soar pilots . . .**
are being trained at Edwards AFB, Calif. The pilot pool at Edwards also will provide crew members for later larger models of the planned *Dyna-Soar* space bomber.

• • •

**Decision on the *SS-11* . . .**
as an addition to the Army's arsenal of anti-tank weapons is expected within the next two months. The Nord wire-guided missile has a range of some 3800 yards—twice the range of the *SS-10*.

• • •

**More boost for *Atlas* . . .**
would be provided by a new Rocketdyne engine under consideration by Air Force. The new engine—the MA 3—is made of a newly patented aluminum alloy enabling it to provide nearly 400,000 pounds of thrust—an increase of 40,000 pounds.

• • •

**First separation . . .**
of the Martin two-stage *Pershing* in flight is expected within the next few weeks. The first R&D flight for the Army solid-fueled missile carried only a dummy second stage during its first R&D flight last month.

## ON CAPITOL HILL

**Clearer definition . . .**
of the military role in space is being given extensive consideration by the House Space Committee. Several members object to what they call weasel-wording in the Administration's proposed changes in the National Space Act.

• • •

**Senate will return . . .**
to hearings on the Missile Gap and the Space Lag as soon as the civil rights debate ends. The Joint Senate Space and Preparedness Committee is understood to have kept Defense Secretary Gates standing in the wings for the last several weeks.

**Space, not defense . . .**
will probably be the next item of business on the Senate Space Committee agenda unless the civil rights debate ends quickly. Gates has to leave for Europe for the forthcoming Defense Ministers Conference, forcing the committee to switch its schedule.

• • •

***Bomarc-B*'s fate . . .**
will hang in the balance at a special congressional hearing planned for the end of the month. Powerful members of the House Defense Appropriations Subcommittee believe the Boeing air-breather may be obsolete before it is operational.

• • •

**'Sole source' negotiation . . .**
of contracts by the Defense Department will come in for some hammering by the Senate Small Business Subcommittee on Procurement next month. Subcommittee members feel the practice may discriminate against small business.

## AT NASA

***Mercury*'s mounting cost . . .**
still does not include military expenses for maintaining the world-wide tracking range. In some cases, the military services are also paying for modification of their equipment for NASA's use.

• • •

**Delivery of *Mercury* capsules . . .**
is now understood to be the only thing holding up launching them on top of *Redstones*. So far, the first date for launching a manned capsule with a *Redstone* has not been set.

• • •

**Military interest . . .**
in the use of both *Saturn* and *Nova* is reported by NASA officials to be slight. The officials said their information is based on talks with unidentified Defense Department officials.

## INTERNATIONAL

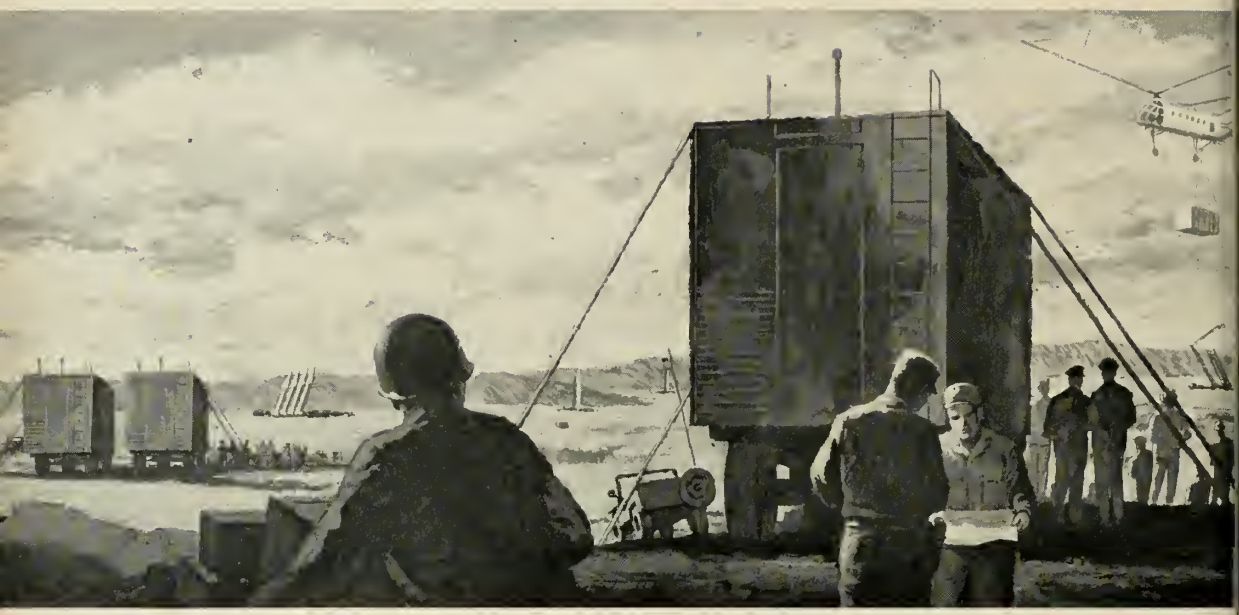
**The British BMEWS station . . .**
planned for construction in Yorkshire is under attack. British critics complain that the station will mainly benefit the United States—not Britain. They say it will give Americans 15 minutes warning of a missile attack; Britons, only four.

• • •

**Woomera will get . . .**
an 85-foot radar telescope built by the United States under a new U.S.-Australian agreement on space exploration. The $4.2-million telescope will be used for tracking shots from both the Woomera Range and Cape Canaveral.

***Multi-Use Automated Maintenance***

# MPTE



The recent demonstration of multi-purpose test equipment (MPTE), developed by RCA under a series of Army Ordnance contracts, highlights *a new dimension in automated multi-use systems support* and culminates a long-term RCA effort in this field. This General Evaluation Equipment is an automated, transistorized, dynamic checkout system. It contains a completely modularized array of electronic and mechanical evaluation equipment, capable of checking a variety of electromechanical devices, ranging from radar subassemblies to missile guidance computers. MPTE provides the stimuli, programming, control, measurement and test functions for the NIKE AJAX, NIKE HERCULES, LACROSSE, HAWK and CORPORAL missile systems and has been extended to other weapons systems related to our defense efforts.

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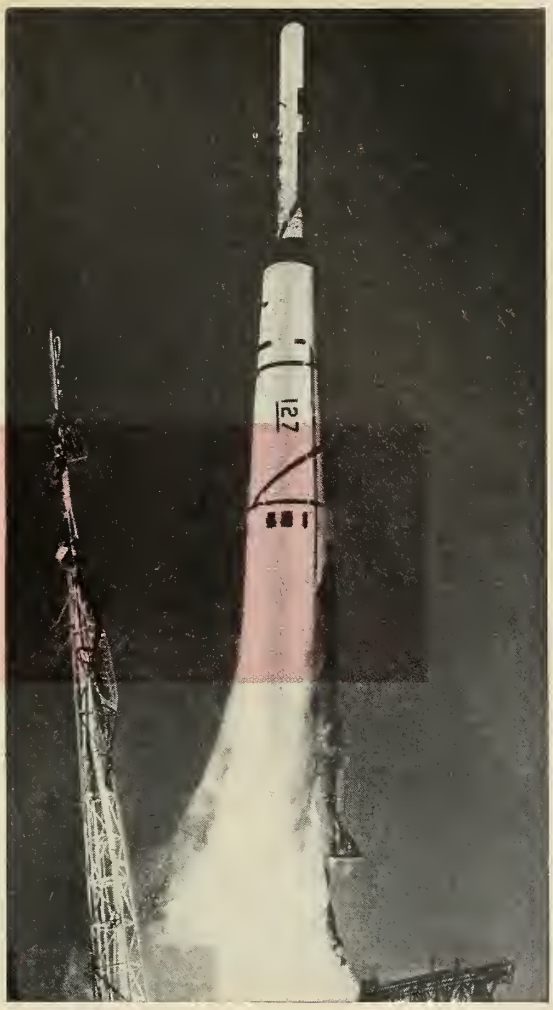

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- ☐ "Liquid Fluorine Unloading Procedure" (PD-TB-85411)
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## Launching from Somaliland

*To the Editor:*

I read with much interest your editorial of Dec. 14, concerning the U.S. catching up with the Russians in space and rendezvous capability.

May I express my views on a point which was not touched upon in your editorial. It may well be the general view of all those who are not permitted—by national fate—to share and play the space game; who are on the edge observing the U.S. and Russian efforts in this field.

The probes and studies carried on so far—as you pointed out—have inevitably carried "us" to the focal point of the rendezvous in space. However, there is no reason why this (rendezvous) should be actually in space and not on the earth itself. Of course, in the latter case the assumption is not that we "catch up" in a race, but that we cooperate with Russia. Fortunately or unfortunately, space business is very costly, and the general feeling is that a point will soon be reached where not even the USA and the USSR will be able to carry out a national program of their own. Money, simply, will be lacking.

That's why, with a keen eye to the future, at the International Astronautical Congress of Amsterdam (1958) I and some U.S. colleagues started friendly discussion on the opportunity to arrive at an international equatorial launching site.

It will interest you to learn that I pointed out some time ago to the competent Italian governmental agencies the possibilities offered by locating a site in the Italian Somaliland. I suggested that a study on such a site should be officially presented to the U.N. and/or NASA. After general approval from the Italian Defense Department, the proposition was sent to the Italian Foreign Affairs Department; there were discussions about the actual carrying out of the study (not begun yet). Meanwhile, the Italian Foreign Office got in touch with the local Somaliland Government, which gave its approval for the installation, in case this should materialize.

The possibilities offered by the area of Kisimaio in the Italian Somaliland for the task of equatorial launchings are outstanding. In particular:

- Utilization of East-directed launchings (use of the rotational velocity of the earth) just over the sea;
- Exploitation as tracking stations of the islands to be found on a straight-on route over the Indian Ocean for an equatorial orbit, and down to the South for a polar orbit;
- Joining over a 7200-mile course (practically on the same parallel) the facilities of the eventual U.S. equatorial launching base at Manus Island, thus realizing the greatest range in the world. With respect to all other localities situated along the Equator, the Somaliland base offers the advantage of weather conditions permitting launchings throughout the year.

The Committee on Science and Astronautics of the U.S. House of Representatives, the NASA Committee on equatorial launch sites, the President of the International Astronautical Federation, all have been advised on this argument.

It is significant that, in principle, the Russians favour such a possibility. The logical way would be to start with the installation of an international tracking station, to be followed by the proper launching base.

I think the question presented herewith deserves a careful consideration; it may well be that through it the key of space is to be offered to all mankind.

Captain Glauco Partel
Via Livorno 61
Rome, Italy.

## Solar Cell Information

*To the Editor:*

Our company is in the process of evaluating and defining the "Solar Cell" market. We would greatly appreciate any information; i.e., reprints, publications, new sources of information, etc., you could submit to us on this subject.

Your magazine has been an invaluable tool to our Marketing department. We greatly appreciate any assistance you would be to us in our project.

E. M. Hansen
Marketing Analyst
Military Products Division
Hoffman Laboratories Division
Hoffman Electronics Corporation
3740 South Grand Avenue
Los Angeles, Calif.

*We have mailed a copy of "Report No. 1, Status Report on Fuel Cells," by the Army Research Office, a comprehensive document covering the field.—Ed.*

## In Re References

*To the Editor:*

The references to technical publications which appear in MISSILES AND ROCKETS articles are very useful, particularly those on Russian reports and translations. However, their value would be increased if you could give a source for obtaining the publications. Perhaps you could include a small section at the end of the magazine (similar to the photo-credits section of some journals) where you would list the publisher or translation source and price of reference.

This is an example of the difficulty we have in identifying and obtaining items referenced in magazines. Any assistance you may give in clarifying the reference will be gratifying, and your consideration of a regular source listing of references will also be greatly appreciated.

Jack M. McCormick
Chief Librarian
The Martin Co.,
Denver, Colo.

*Many of M/R's translations come from government agencies and private sources whose budgets do not permit them to reprint translations. They usually request that such information not be revealed.—Ed.*

## IDL's Telemetry Role

*To the Editor:*

Engineering and production personnel of this company noted with interest the article appearing on page 54 of your February 29 issue. This page attempted to list a large number of contractors engaged in a manufacturing of telemetering equipment. We were interested in this listing to see the magnitude of the effort being put forth in telemetering and we were quite concerned because the name of this company did not appear on that list.

Our personnel are extremely proud of the record we have achieved in the past five years in building telemetering commutators. Some of this pride extends from the fact that IDL commutators were used when Able and Baker were fired into outer space in the *Jupiter* missile. Other commutators have been used during firings of the *Minuteman* and the silo launchings at Edwards Air Force Base late last year.

Still other commutators are currently being flown in the *Bomarc A & B,* both for telemetering and in the guidance radar equipments. Many of the *Snark* firings have carried our equipments during repetitive flights without service and/or repair. Even now, the *Pershing* program is counting on IDL switches to carry a major portion of the telemetering data.

We appreciate the magnitude of the effort that must have gone into preparing the chart as presented. In undertaking such a task, it is obvious that certain company names will be left off and we regret that it happened to be ours at this time . . .

Fred H. Gerring,
Marketing Manager,
Instrument Development
Laboratories, Inc.,
Attleboro, Mass.


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# Industry Countdown

## MANUFACTURING

**Newest market . . .**

opening up is the operation and maintenance of missile units—particularly ICBM squadrons. The Air Force put the yearly O&M for one *Atlas* squadron of nine missiles at $25 million. Presently a total of 13 *Atlas* and 14 *Titan* ICBM squadrons are planned. O&M for them all could run to a total of $675 million a year. By comparison, O&M for aircraft in the AF, Army and Navy totals $633 million.

• • •

**O&M FY 1961 funds . . .**

required by AF ballistic missiles will total $100 million. The amount will keep on rising thereafter. DOD reveals that at the end of FY 1961, the SAGE (semi-automatic ground environment) system will need $157 in O&M support and this amount will rise until it levels off at about $250 million a year. Replacement parts are one of the biggest items and will stir up activity among subcontractors.

• • •

**French *Entac* antitank . . .**

missile is being taken over by Nord Aviation, according to reports. The missile was being developed at the French arsenal D.E.F.A. when Nord was asked to step in.

• • •

**Airlift of *Thor* IRBM's . . .**

to England is now complete. Sixty missiles to equip four British squadrons (15 apiece) and ground support equipment totaling 25 million lbs. have been flown from the Douglas Santa Monica plant in the past 18 months.

• • •

**Only 11 companies . . .**

submitted bids on the multimillion contract to build the airframe for the NASA *Saturn* upper-stage cluster of 20-K engines. Twenty had been invited to submit bids. One which was not invited, Grumman Aircraft, did submit a proposal. Other bidders are Lockheed, Pratt & Whitney, Boeing, Douglas, North American, McDonnell, Chrysler, Bell, Convair and Martin.

## PROPULSION

**There's no thrust spec . . .**

on Project 3059, the AF's feasibility study for a multi-meg solid-rocket motor. The AF instead specified only total impulse, the product of thrust and burning time. While total impulse is classified, bidders are said to be divided between high thrust and relatively short burning time on one hand, and lower thrust and longer burning time on the other.

• • •

**Pictures are being withheld . . .**

of the AF *Minuteman* ICBM silo shots, it's reported, because the missile emerges "black as a burned potato" from backlash of first-stage motor. In first full-size, three-stage tether shot from a silo, the missile climbed several hundred feet on a "short-charge." The casing cracked when it was pulled back to earth. The test, sixth in tether series, was considered a success anyway.

## ASTRIONICS

**First ICBM all-inertial . . .**

guidance package went aloft last week as a passenger in an *Atlas*. The Arma system monitored the radio inertial system during the 6300-mile flight from Cape Canaveral. It will be checked out in a controlling role within a few weeks.

• • •

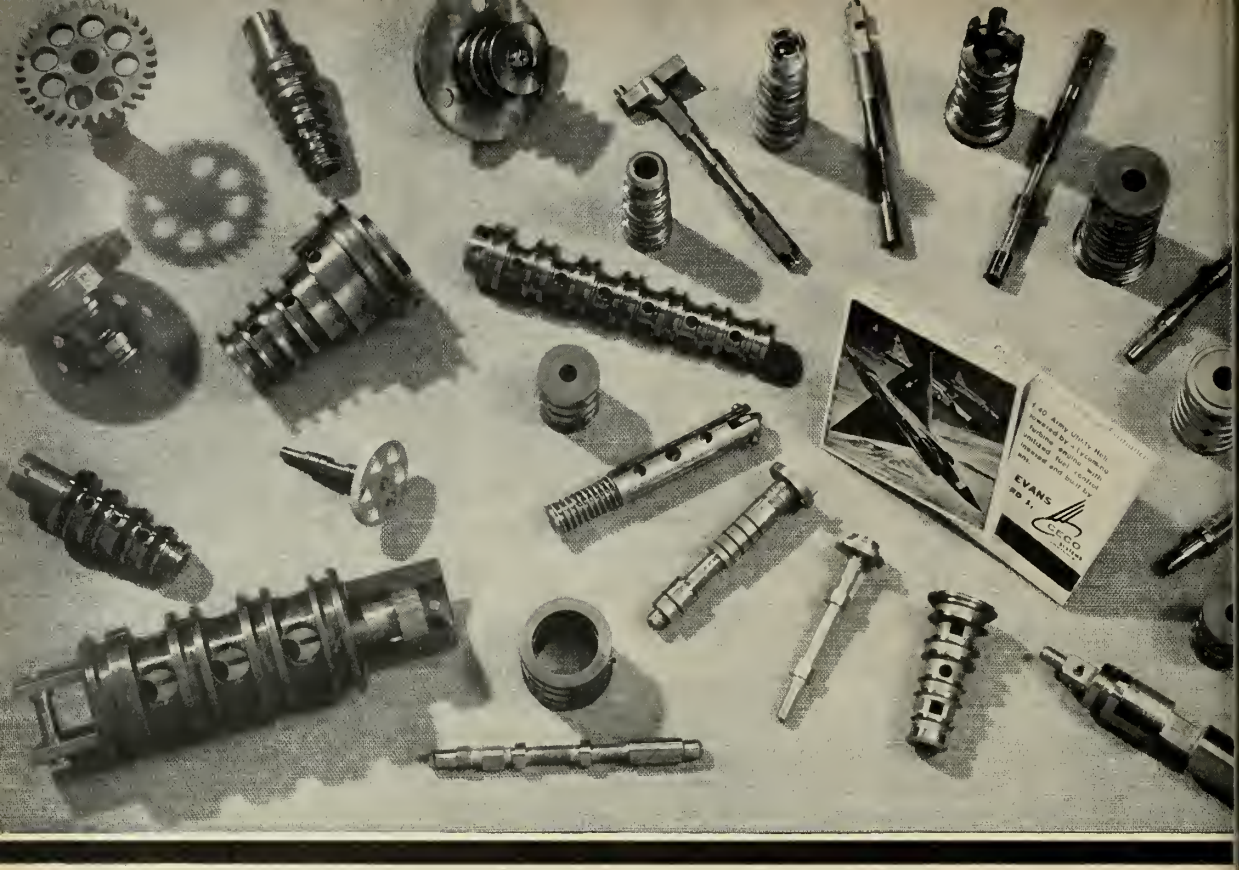
**Tests to recover . . .**

a NERV (nuclear emulsion recovery vehicle) package which will be used by NASA for radiation belt studies are being made off of San Nicholas Island along the Southern California Coast. Dummy packages are being dropped from 37,000 ft. by an AF F-104. Recovery system consists of a parachute, electronic beacon, flashing light, radar chaff and dye marker for visual pickup.

## WE HEAR THAT

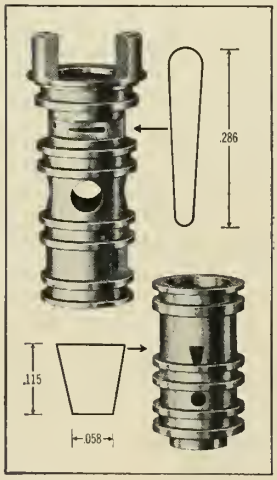
**Grand Central Rocket . . .**

has successfully fired a case-bonded Nitrasol solid gran at −68°F after repeated cycling from −75° to +165°F . . . Washington Technological Associates just outside the Nation's Capital is planning a 5-year $3 million building program . . . Westinghouse's semiconductor plant at Youngwood, Pa., is being expanded by 30% . . . The British are now producing their own nuclear warheads for all operational missiles, including *Thor, Bloodhound, Firestreak, Seacat, Seaslug, Thunderbolt, Malkara, Corporal* and *Little John*. . . .



Looking for a subcontractor with real servo "savvy"?

**. . . THEN TAKE A GOOD CLOSE LOOK AT THE SERVO COMPONENTS DISPLAYED HERE**




As a subcontractor, CECO is equipped to handle specifications demanding production tolerances to 5 millionths of an inch and finishes to .5 RMS. Most of the servomechanism system components shown above were manufactured to just such specifications.

High-precision square holes? Other unusual porting requirements? Assignments like these are considered routine in Chandler Evans subcontract operations.

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# Defense Needs $25 Billion More

## This 5-yr. price tag estimated by Lanphier in stormy Congressional session

**by James Baar**

The great fight over the Deterrent Gap moved toward a new roaring pitch this week as Congress studied the $25 billion-plus price tag placed on survival by Ex-Convair Vice President Thomas J. Lanphier, Jr.

Members of both the House and Senate prepared to renew the bitter fight over the Administration's defense policies as soon as a civil rights bill in some form is passed.

Lanphier, who quite his job at Convair to fight for bigger defense spending, laid his proposals before the House Space Committee at an angry two-hour hearing filled with bickering and cries of "politics" from Republican members. The name of Sen. Stuart Symington of Missouri, contender for the Democratic presidential nomination, came up repeatedly.

The young-looking 45-year old industrial executive accused President Eisenhower of gambling with the nation's very life and called for immediate defense increases across the spectrum of war. He specifically urged:

- Acceleration of both the Convair *Atlas* and Martin *Titan* programs "by all means" and greater funding for the Lockheed *Polaris* and Boeing *Minuteman*. He said Convair could produce five more *Atlas* squadrons by the end of 1962. (This would call for a concurrent increase in hardened bases.)
- Acceleration of the Air Force programs to develop the Lockheed *Midas* early warning and *Samos* reconnaissance satellites.
- The launching of a SAC airborne alert comprising nearly half of SAC's force.
- Purchase of more B-52's and B-58 jet bombers and KC-135 jet tankers, develop the B-70 Mach-3 bomber and the advanced B-58.
- Begin purchasing "airlift for the Army and the Marines, something we haven't done in the budget for the last five years to any noticeable degree."
- "Make certain with dollars" that the U.S. space program is achieved.
- Launch a "sensible civil defense shelter program as a very significant element of the deterrent—something we don't have, something the Soviets most certainly do have."
- **Price Tag**—Lanphier placed a $4 billion to $5 billion a year price tag on his proposals. He said the spending should continue over the next four or five years.

Some qualified observers called his estimate of cost conservative. They said a civil defense shelter program that had any meaning would cost $2 billion to $5 billion a year.

Lanphier said the United States already was "in the process of losing World War III," and could logically be assumed "to be in jeopardy of physical destruction."

He said Russia conceivably could have begun producing ICBM's in late 1957 after launching *Sputnik I*. He said if Convair had been able to begin *Atlas* production in late 1957 the U.S. stockpile today would top 400—almost three times the number of ICBM's that Gen. Thomas Power, commander of SAC, said would be needed to wipe out all U.S. retaliatory power in North America.

Lanphier told the committee that he decided to carry on his personal campaign for more defense spending because "throughout this past decade and particularly over the past five years (he had) watched with growing concern the perennial development of defense budgets more and more out of joint with the technological times." He said these budgets were "less and less sufficient to meet the growing threat in the significant areas of ICBM's, anti-submarine warfare and limited war deterrent."

The World War II fighter ace said pointedly that three years ago Gen. Curtis LeMay, now Air Force Vice Chief of Staff, warned "unless our defense program changed from what was then planned the winter of 1959-1960 could find us inferior to Soviet Russia in modern military power."

"In the intervening three years, the only changes in our defense effort have been to diminish it from what it was planned to be," he added.

Lanphier, sitting at the center of the hushed crowded hearing room, flatly blamed President Eisenhower in a series of unequivocal answers.

- **Q & A**—Rep. Erwin Mitchell (D-Ga): "Do you think that the Administration with its policy of defense, its overall policy, is jeopardizing the national security?"

Lanphier: "Yes, sir, I do."

Mitchell: "Do you think that President Eisenhower knows as much about defense as he says he does?"

Lanphier: "No, sir, I do not."

Mitchell: "Do you think the President is taking a gamble?"

Lanphier: "Yes, sir, I think the President is taking an unwarranted risk."

Lanphier said the Administration was to blame on two counts: "Wrong decisions and decisions not made." He cited as an example the decision this winter to build four more *Atlas* squadrons—a year and a half after the proposal to build more *Atlas* squadrons was made.

He said "we never could get agreement" a year and a half ago for a proposal to build eight more. But he said Congress last spring ordered eight more and "this winter the President accepted the money for four."

"I wish he had decided that last year, accepted them last year and accepted all eight of them," he said. "We would be that much better off next year than

## What Industry Says

*Officials of the Defense Industry, contacted by M/R have mixed emotions regarding the outbursts of Thomas J. Lanphier and their usefulness to either industry or the nation.*

*Most agreed that the U.S. lags dangerously behind in military preparedness. The questions came as to Lanphier's motives and methods.*

*Said one: "When he started I took him at face value. I thought he was what he seemed—a modern Don Quixote. Now I'm beginning to fear he cannot escape a self-interest."*

*"He's just doing what he's been doing for the past five years," said another company spokesman. "He's always been fighting for more defense —even when it meant fighting for his competition. He may wake some people up."*

*And another: "I think he's making a damn fool out of himself, but I'm all for it. It's good for business and I'm glad it's happening. But the key question, which no one seems to be asking, is: 'How does he know?' No one in industry has access to information of a broad enough nature to be so authoritative. I doubt if Tom's in a position to know what he's talking about."*

*Voicing a thought that others had hinted at, an old acquaintance said:*

*"It's all just part of a build-up for Symington."*

we are going to be—which is pitiful."

Rep. James G. Fulton (R-Pa.), a high-ranking member of the committee, repeatedly questioned Lanphier on whether his motives were more political and involved more politics than disinterested patriotism.

"Do you have any ideas as to your future?" Fulton asked, bitingly. "Some of us would like to make sure whether this is not the first shot heard round the world (in) a political campaign for a man named Symington."

Lanphier said he respected Symington, agreed with his defense policies and would vote for him for President. But he insisted he spoke only for himself and had no plans to work on Symington's staff.

He said when men in the military services or defense industry called for more defense spending "people think they are grinding an ax."

"This is a valid assumption that a guy has some angle, he is trying to sell missiles or sell his service and it could be so. The unhappy fact is that the very people who are authoritative in the field are these people in industry and in the service."

# Atlas Range Upped 1/3

**by James A. Fusca**

Maximum range of the USAF—Convair *Atlas-D* ICBM, about four of which are now on or near operational status at Vandenberg AFB in California, has been increased by approximately one-third through improvements made over the past year. This represents an increase of about 3000 miles over the maximum range of 6325 statute miles announced by USAF in the past.

Contrary to previously published reports, the *Atlas-D* now set for a 9000 statute mile flight from its launching pad at Cape Canaveral is not a stripped-down version but a fully operational missile which will use an operational nose cone weighted with ballast in place of its hydrogen warhead. This bird will also carry the instrumentation load of about 1000 lbs. that is standard to test missiles fired over the Atlantic Missile Range.

This launching, said to be awaiting Presidential approval, will be the first full range test of the improved *Atlas-D* now being furnished to the Strategic Air Command as a deterrent weapon. The Administration reportedly hopes by this flight to counteract the effect on world opinion of the Soviet Union's 7766 statute mile "super rocket" experimental firing into the Pacific last January.

One reason offered by Administration sources for USAF's delay in receiving Presidential approval for the long range shoot is that no warning has been circulated as to times of firing and the impact area. Employing an operational nose cone, the payload section will re-enter and impact in the ocean where flotation gear will be used for recovery or it will be permitted to sink. These sources point out that the Soviet Union issued warnings on its firing, and that there might be an adverse reaction if the United States did not also.

Planned trajectory for the *Atlas* flight will carry it to an impact point in the Indian Ocean, south and east of Africa's Cape of Good Hope, along a line that passes northeast of the closest point of South America and south of the Cape of Good Hope, circumventing problems that would arise from flights over friendly territory.

The *Atlas-D* is powered by the Rocketdyne MA-2 engine, delivering slightly more than 360,000 lbs. of thrust. The follow-on *Atlas-E* will be powered by the MA-E which Rocketdyne has announced will generate approximately six per cent more thrust than the MA-2 and weigh about 100 lbs. less. The company reportedly expects, however, to increase this thrust to more than 400,000 lbs.

*Atlas-43D*, launched over the full 6325 statute mile range around the first of the year, reportedly had almost 10 seconds of fuel remaining in its tanks at cutoff of powered flight. Each second of burning time of the sustainer engine at altitude, where it would have approximately 80,000 lbs. of thrust, would add about 200 miles to the range capability.

• **Von Neumann Committee**—During 1954 and 1955 the Von Neumann committee laid down what it considered to be optimistic estimates of the capabilities of the first U.S. intercontinental ballistic missiles. Comparing these estimates with the results to date:

• **Reliability** — The committee thought that the first ICBM's might have a reliability of 50%. Last week's firing of *Atlas-46D* in the first test of American Bosch Arma's all-inertial guidance system was the 18th successful flight in a row.

• **Range**—The comittee anticipated a maximum range of 6325 statute miles. If successful, the extended range *Atlas-D* firing will better this maximum by about 50%.

• **Accuracy**—The committee considered that a high probability of striking within a radius of five miles of the desired point of impact at 6325 miles was a reasonable goal. Actual firings at this range have indicated an accuracy of within two miles.

• **Warhead yield**—One of the important factors in accelerating the ICBM program in 1954 was the success of *Operation Castle* which proved the feasibility of reasonably small and relatively light nuclear warheads for missiles. Marked increases in warhead yields for the same size and weight have been achieved in the interim.

## —news briefs—

**PATENT CHANGE**—A House Space Subcommittee has recommended a compromise change to bring NASA's patent rules more in line with DOD's. Under the proposal the patent status of each invention developed under NASA contracts or subcontracts would be written into the contract. The subcommittee proposed several conditions under which NASA could waive title to the inventions or retain title.

**BOEING EARNINGS DROP**—A sharp drop in its 1959 earnings—about $17 million—is reported by Boeing Airplane Co. The company said in 1959 profits were $12.4 million on sales of $1.6 billion against 1958 profits of $29.3 million on sales of $1.7 billion. Backlog on Dec. 31 was $2 billion compared to unfilled orders of $2.4 billion on the same date the year before. The 1960 outlook is for increased earnings, the company said.

**EXPLOSION WHY**—The Feb. 26 failure of an *Atlas-Agena* carrying the prototype of a *Midas* "spy-in-the-sky" infrared satellite has been attributed to an explosion of small retrojets designed to separate the two stages. The explosion ripped into the *Agena's* fuel tanks, destroying the satellite.

**BURKE DISPUTES AF**—Chief of Naval Operations Arleigh Burke disputed the Air Force claim that 300 Soviet missiles could wipe out U.S. retaliatory forces. He said there were more nuclear bomb carrying planes aboard five Navy carriers in the Mediterranean and Far East than in Russia's entire heavy bomber fleet.

**MISSILES TO GERMANY**—Two Army *Lacrosse* battalions are embarking for Europe in the next two months. They will be located in Germany. Each battalion will have four launch trucks and an undetermined number of missiles.

# mergers and expansions

**STL MAY BE RETAINED:** Details of a plan which would permit Thompson Ramo Wooldridge, Inc., to retain its wholly owned subsidiary, Space Technology Laboratories, Inc., are expected to be announced this week. Any such agreement or reorganization proposal must have USAF approval in line with STL's engineering and management responsibilities in Air Force ballistic missile program.

A spokesman for TRW declined to say if STL would be retained intact by the parent company or if some functions would be turned over to the USAF. The TRW-STL relationship has been under some fire on possible "conflict of interests" between STL functions and TRW's production of missile components.

**NORTH AMERICAN TO BUILD:** Negotiations between North American Aviation and the City of San Diego for purchase of a 40-acre site on San Diego's Torrey Pines Mesa are reported to be beyond the discussion stage. If complete agreement can be reached, new research facilities for the company's Autonetics division will be constructed on the site.

**INTERSTATE BUYS:** Interstate Engineering Corp. of Anaheim, Calif., has contracted to acquire Autronics Corp. of Los Angeles, manufacturer of small electronic devices for missiles and aircraft.

**LITTON GROWS:** Litton Industries has signed an agreement with Western Geophysical Co. of America for the exchange of 100% of Western Geophysical's outstanding stock for Litton common stock in an undisclosed amount. Western Geophysical is a privately held company engaged in geophysical exploration and electronics instrumentation development and manufacturing. Its sales totaled $15 million in 1959.

**FORD STARTS NEW GROUP:** Ford Motor Co. has established a Defense Products Group headed by Gerald J. Lynch, company VP and general manager of Aeronutronic Div. The new group will be responsible for all defense programs and will develop commercial product opportunities arising out of defense activities.

**BRITISH C-E-I-R:** A subsidiary company in London has been formed by C-E-I-R of Arlington, Va. This subsidiary will carry on much the same services as the parent company.

**MAXSON PLAN APPROVED:** A plan for combining Electronic Communications, Inc., and the W. L. Maxson Corp., on the basis of exchange of one share of ECI common stock for each 1¾ shares of Maxson capital stock has been approved by the boards of directors of both companies.

**ELECTRONICS FIRMS MERGE:** Control Corporation has become an independent subsidiary corporation of Control Data Corp., by an exchange of stock. Consolidated Diesel Electric Corp. has acquired control of Ultradyne, Inc. of Albuquerque. Antenna Systems, Inc. has purchased Spinform Division from Pan-Tex Manufacturing Corp. and will move the equipment to the Hingham Industrial Center.

**QUARTZ SUPPLIERS BOUGHT:** Pacific Industries, Inc., San Francisco, has acquired Midland Manufacturing Co. and Wright Electronics, Inc. of Kansas City, the nation's largest producers of quartz crystals for the electronic industry.

**COLVIN FORMS COMPANY:** Formation of Pressure Elements, Inc., has been announced by the president of Colvin Laboratories to produce pressure components.

**ALTO SCIENTIFIC DIVIDES:** Two new divisions, Subsystems and Components, have been formed by the Alto Scientific Company of Palo Alto, Calif.

**SPACE ELECTRONICS REALIGNS:** Space Electronics' five new major departments will be named: Subsurface Communications, Terminal Guidance, Telemetry and Instrumentation, Satellite and Space Systems, and Advanced Study and Development.

**TASKER CONSTRUCTING:** Construction has begun in the Van Nuys area for the new consolidated facilities of the Tasker Instruments Corp. The now separate administrative, engineering and production departments will be housed in the facility.

**CABLING DIVISION STARTED:** Missile Systems Corp. of Los Angeles, manufacturers of electronic systems for the missile and aircraft industry, has announced the organization of a new cabling division to operate at the company's North Hollywood plant.

**NEW PLANT FOR TRANSVAL:** Transval Electronics Corp.'s manufacturing, research and administrative facilities will be consolidated into an existing building in El Segundo, Calif.

**REMCO GROWS:** The complete cylinder line of the Turlock Iron & Machine Works—HYPOWER Hydraulic Cylinders, have been purchased by Remco Manufacturing Company.

**NEW AIR SEPARATION PLANT:** Air Reduction Pacific Co., division of Air Reduction Company, Inc., has dedicated a $3-million plant in Richmond, Calif.

**NORTHROP PURCHASES:** The three plants formerly owned by American Standard at Norwood, Mass., as its Military Products Division will begin operation as the Precision Products Department of Northrop's Nortronics Division. The transaction was made in cash.

**TELEMETER MERGES:** Telemeter Magnetics has merged two of its subsidiaries, Invar Electronics Corp. and Digital Instrument Laboratories, into a new organization to be known as Invar Electronics Corp.

**NEW JERSEY FIRMS UNITE:** Thermal Controls, Inc. and O.K. Electronics Corp. of Nutley, will be known as Thermal Controls, Inc.

**GARRETT MOVES INTO JAPAN:** Far East headquarters have been established in Tokyo by the Garrett Corp., forming the subsidiary Garrett (Japan) Ltd.

**LEAR OPENS TOKYO OFFICE:** Lear, Inc. is also establishing offices in the Far East after having maintained a field service representative in the area for some time. Pumps and check valves developed by Lear, Inc., will be manufactured in Canada by Lucas-Rotax, Ltd., of Toronto, Ontario.

**CAMLOC LEASES GERMAN PLANT:** A plant has been leased at Kelkheim, West Germany, by the Camloc Fastener Corp. of Paramus, N.J. The European subsidiary will manufacture under the name Camloc Fastener GmbH.

**PACIFIC AUTOMATION EXPANDS:** Pacific Automation Products, of Glendale, Calif. are forming an architect-engineer division to study and design construction projects for government agencies, the armed services and industry.

**ASTROMETRICS, INC., FORMED:** Astrometrics, Inc. of Santa Barbara, Calif. has been formed by the Arnoux Corp. to specialize in telemetry and advanced instrumentation systems and components complementing the Arnoux line.

**B-W FORMS DIVISION:** Borg-Warner Corp. has formed a new division known as Borg-Warner Controls, Santa Ana, Calif. It will take over personnel, products and existing facilities of the BJ Electronics plant of the corporation.

# Group Taking On Another Vital Role


DR. WERNHER VON BRAUN


EBERHARD REES


DR. ERNST STUHLINGER


DEBUS


GEISSLER


HAEUSSERMANN


HEIMBURG


HUETER


HOELZER


LANGE


MAUS


NEUBERT


MRAZEK

**by Paul Means**

Today a group of American rocket experts of German extraction will be reassigned—probably for the last time in their stormy and portentious career.

The Wernher von Braun team, which produced the first sizable military rockets for the German Army and the first operational IRBM for the U.S. Army, will begin its new task of developing large space boosters for the National Aeronautics and Space Administration.

The 89 original German members of the Von Braun team and their 5000 colleagues at the Development Operations Division of the Army Ballistic Missile Agency are being transferred by the President in order to cement in one space agency the nation's super booster program. Because of the difficulty of transferring large governmental organizations during the middle of a fiscal year, the transfer will not be completed until July 1.

The principal members of the Huntsville team, in the order that their pictures appear above, are: Dr. Wernher von Braun, Director; Eberhard Rees, Deputy Director; Dr. Ernst Stuhlinger, Chief of the Research Projects Laboratory; Dr. Kurt Debus, Chief of the Firing Laboratory; Dr. E. D. Geissler, Chief of the Aeroballistics Laboratory; Dr. Walter Haeussermann, Chief of the Guidance and Control Laboratory; Karl L. Heimburg, Chief of the Test Laboratory; Hans Hueter, Chief of the Systems Support Equipment Laboratory; Dr. Helmut Hoelzer, Chief of the Computation Laboratory; Dr. O. H. Lange, Project *Saturn* Director; Hans H. Maus, Chief of the Fabrication and Assembly Engineering Lab-

oratory; Erich W. Neubert, Chief of the Systems Analysis and Reliability Laboratory; and William A. Mrazek, Chief of the Structures and Mechanics Laboratory.

During the last 15 years, the Von Braun team has traveled from Peenemünde, Germany, to Washington, D.C., from Ft. Bliss, Tex., to Huntsville, Ala. Its participation in the American rocket effort began in 1945 when its leaders decided to strike West and surrender to the Americans rather than stay where they were and be captured by the Russians.

• **From "affront" to immigrants**—The team which was to make some of the most significant contributions to the U.S. missile and space effort was not originally welcome. While the group was stationed at the Naval Gun Factory at Washington, D.C., the Federation of American Scientists protested to the U.S. government that its presence was "an affront to the people of all countries who so recently fought beside us."

The Germans were transferred to Ft. Bliss, Tex. They worked eagerly under the approving eyes of their Army superiors at the White Sands, N.M.. missile range.

Time passed, and the conquered had demonstrated their sincerity to the conquerer; in 1948 the team was allowed to achieve the official status of immigrants by walking across a bridge over the Rio Grande River from El Paso, Tex., to Mexico, and then reentering the country on the same bridge.

The official immigrants—port of entry Texas—were transferred to the Army's new rocket center at Huntsville in 1950. Here the effort to develop large-scale missiles and satellites began in earnest.

• **Proud record**—The record of the Von Braun team during its 10 years at Huntsville has been the most impressive of any similar group in the country. A partial list includes: development of *Redstone,* the first large field missile; the first successful launching of an IRBM, the 1500-mile *Jupiter;* the first solution to the aerodynamic heating problem of re-entry; the free world's first satellite in orbit around the earth; the free world's first satellite in orbit around the sun; and the first recovery of primates after journey into space.

In Huntsville the German team found a new home. Their families joined them, in some cases after years of separation, and they began to enter into community activities.

Today, many of those activities Huntsville is proudest of, including the symphony orchestra, the string quartet, the Mt. Sano Observatory, and the four-lane freeway on the edge of town. were accomplished in part or in full by the new German neighbors.

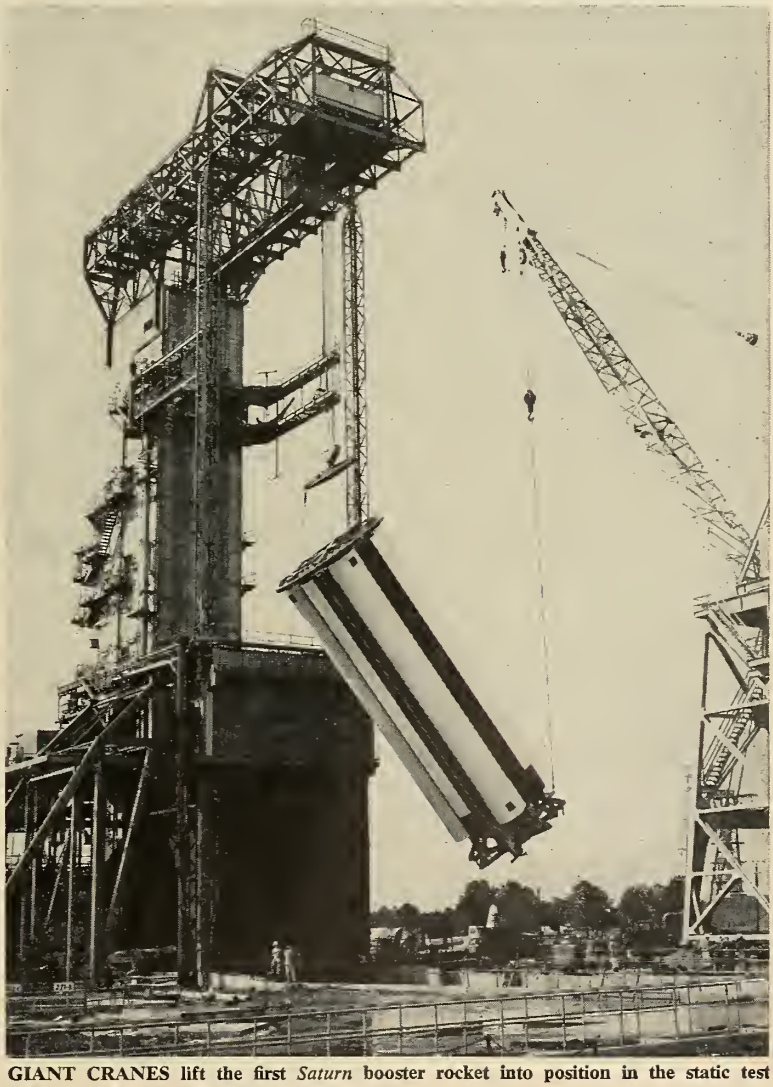
In 1955, the ex-German rocket experts and their families became citizens of the United States.

• **Strength through union**—Project *Saturn,* the team's latest and most significant effort, and the one which eventually led to their transfer to NASA, was started in 1958.

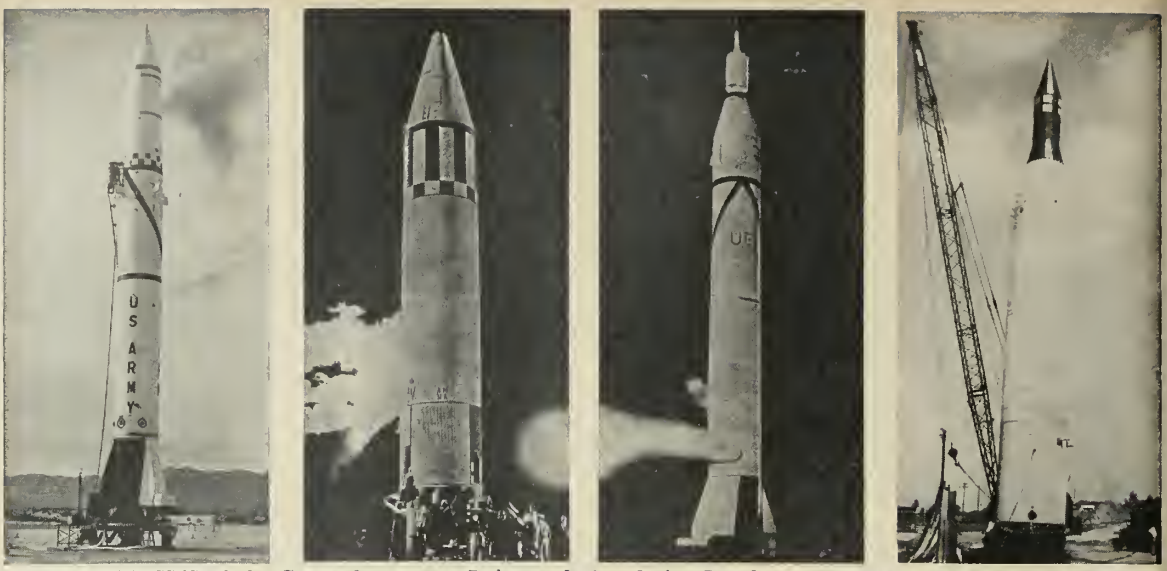
It had become increasingly clear during these first few years of space flight that the U.S. effort was deficient in rocket thrust. Where the Red satellites orbited payloads of a ton or more, the U.S. satellites orbited payloads of only a few pounds.

The Von Braun team, along with other U.S. rocket experts, realized that large engines with a million pounds of thrust or more were a long way off. In 1958, no such rocket engine was under consideration, and the eventual million-pound-thrust engine for Project *Nova* is not expected to be operational before the late 1960's. To crash the time barrier, Von Braun and his associates suggested to ARPA that the *Jupiter* IRBM engine be improved, and that eight *Jupiters* be clustered into a giant booster producing one and a half million pounds of thrust.

The concept of clustering, with which the Von Braun team proposed to save time, was not new. When it became unfeasible to build larger ship or aircraft engines, greater power was produced by combining the output of more than one engine. The Von Braun team merely applied this principle to rocketry. They assumed that by mating existing reliable rocket engines into a larger single stage with a much higher thrust level, one produced



**GIANT CRANES lift the first *Saturn* booster rocket into position in the static test tower of ABMA at Redstone Arsenal.**




**EARLY SUCCESSES of the German-born team: *Redstone, Jupiter, Jupiter-C,* and *Juno II*. These solved many problems *Saturn* is facing. All are descendents of the Von Braun team-developed German V-2.**

the largest feasible rocket booster in the shortest time.

But the *Saturn* proposal was not just a stop-gap measure. Because the cluster could perform certain missions, or land under guidance after failure of one or two of its engines, the clustered engine added a greater degree of safety and reliability to manned space flight.

• **Weak in funds**—ARPA bought the idea in August, 1958, and the project was on its way. The original schedule would have flight tested the booster in late 1960; with operational flights following in 1962-63.

But, after one year, the project faltered because of inadequate funding and divided military authority.

In FY 1959, $34 million was requested by Von Braun's team and $34 million was received. The second year (FY 1960) $140 million was requested, but only $70 million was received. The third year (FY '61) the team requested $250 million. If the program had stayed under Defense-ARPA management the project would have received only $140 million.

In the face of niggardly appropriations, the Von Braun team tried to cut costs. They tried to make research paid for by NASA and the Departmen of Defense in other areas pay off also for *Saturn*. They put in overtime without billing the government. But all of this could not make up for the millons of dollars the project had been short-changed.

The Army had been kicked out of its space role. It was therefore a little incongruous that the major Army rocket team should spend most of its time working on a space project.

• **Near thing**—Project *Saturn* was almost sent to an early grave when the Department of Defense, prodded by the dollar-conscious Bureau of the Budget, decided that the military would have no need for such a large rocket before 1965. Also jeopardizing its future was an arbitrary 1959 DOD ruling that no military missions existed beyond 600 miles—leaving *Saturn,* a military project, with no military mission.

Out of frustration, *Saturn's* backers turned to NASA as the last chance to accelerate the program. As Maj. Gen. John B. Medaris—a believer in military space—put it, transfer to NASA was "the least obnoxious alternative."

Finally, the chemistry of an election year plus growing public concern about Russian space achievements transferred the Von Braun team to NASA. The series of events leading to the transfer culminated in November, 1959, when President Eisenhower gave NASA the space booster program, the Von Braun team, and *Saturn.*

• **Finding a home**—Von Braun and his colleagues found NASA a benevolent master. At last they had an overseer who believed in, and was willing to fight for the *Saturn* program. Overtime was approved, and NASA asked Congress for $246 million for *Saturn,* just $4 million short of what Von Braun and his colleagues had asked for. For good measure, NASA threw in another $8 million out of its liquid propulsion budget.

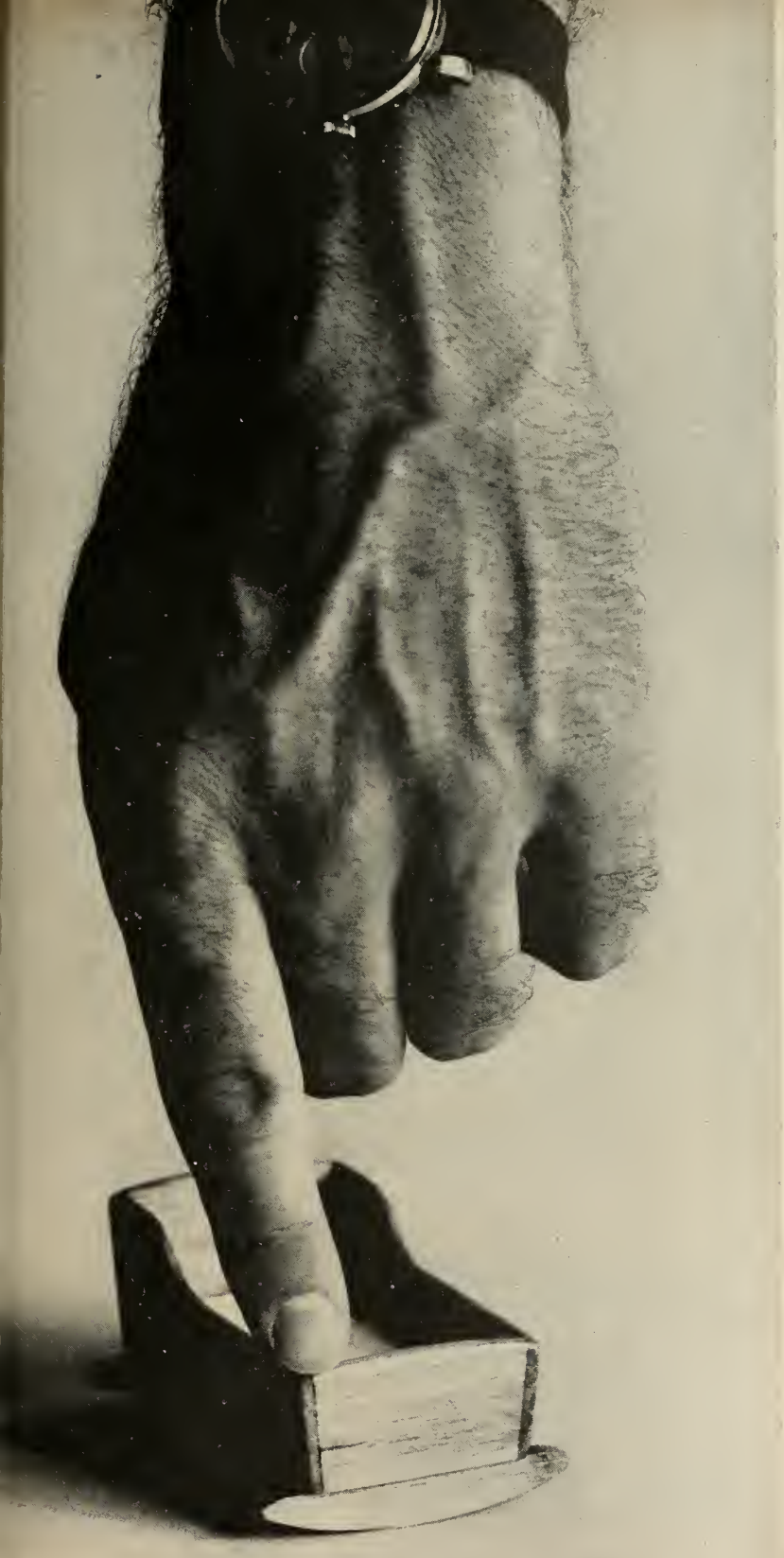
For the first time, the team had enough money for one of its space projects. When asked by a member of the House Space Committee Feb. 8 whether he could use more money, Von Braun replied that *Saturn* now had all of the money that could profitably be spent and that additional money would "probably be wasted."

Von Braun also told the committee that he was "thoroughly satisfied" with the transfer, and urged Congress to approve the President's action as soon as possible. Complimenting NASA for making "clear decisions" immediately upon taking over, Von Braun said his team and the space agency had quickly arrived at a "unanimous decision" on *Saturn's* upper stages.

• **Genealogy**—These upper stages, as they become available, will consist of a cluster of four 200,000-lb.-thrust engines, a cluster of two 200,000-lb. engines, a cluster of four 20,000-lb. engines, and a cluster of two 20,000-lb. engines. The entire vehicle will weigh over 600 tons and will stand over 200 feet tall—nearly half as high as the Washington monument.

The giant booster can be traced back to its granddaddy—the Von Braun team's *V-2*. The eight Rocketdyne H-1 engines are repackaged, uprated and simplified versions of the engine developed at Peenemünde. The first U.S. version was the *Navaho* by Rocketdyne. Then came the *Redstone, Jupiter, Thor* and *Atlas,* all newer versions of the *V-2* engine.

Under the direction of NASA's propulsion chief, Maj. Gen. Donald R. Ostrander, the Von Braun team will have supervision of all super booster projects, including *Nova* and newer boosters not yet prescribed. Under NASA, the Von Braun team apparently has found the niche where it can most help the U.S. space effort.



# He kept the crib from rocking

For accurate firing, Titan and its subterranean steelwork crib must be kept in absolute alignment with the earth's center despite natural movements of the crust or nuclear shock. This AMF production engineer's problem was to build the shock absorbers AMF designed for the job. These are massive, pneumatic cylinders constructed of precision-fabricated, precision-fitted steel parts.

Now, it's no particular trick to fit ultra-fine-tolerance parts together if they're of manageable size. But how, as in this case, could he slide a 600-pound, 6-foot-long steel tube, 1¼ feet in diameter, into another tube when the clearance between the two is *less than 3/1,000 of an inch?* How could he maintain alignment to prevent Brinelling or scouring as one slid a full ten feet into the other?

Here's what he did: He put down heavy steel tracks for a series of wheeled carts. He mounted the tubes on carts, adjusted position...and, slid them together.

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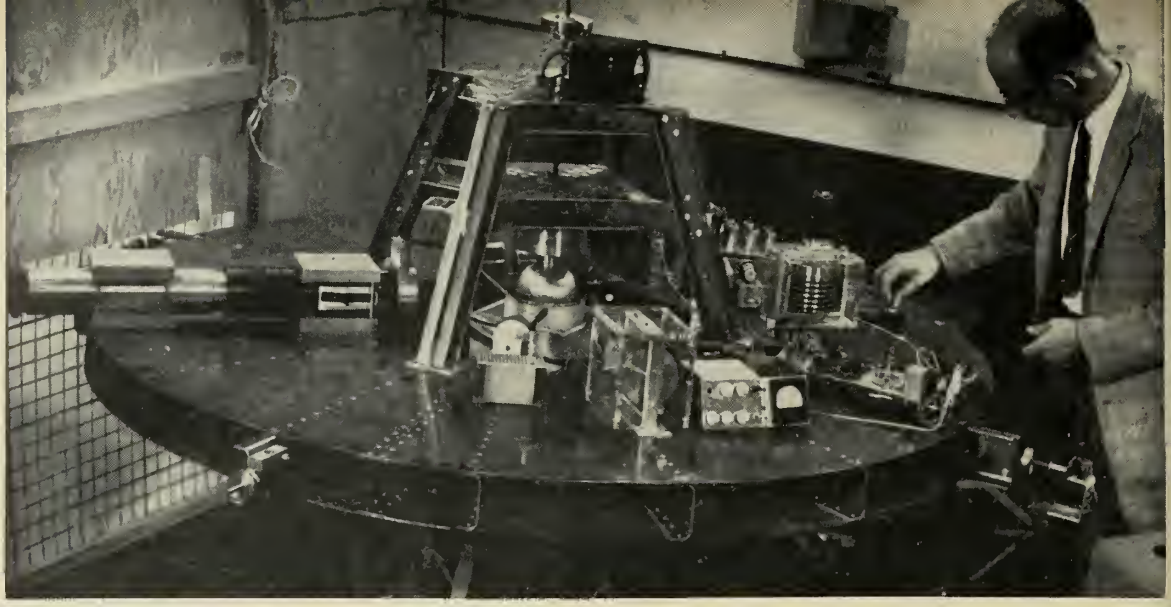


**NASA SCIENTIST AT Ames Research Center makes adjustment on stable platform used in study of astronomical satellite. Long black tube is telescope for sighting artificial light source. Note support structure for the air-bearing surface. Reaction wheels are in housings on top of the platform.**

## astrionics

# NASA Preparing Astronomical Satellite

**by Frank G. McGuire**

MOFFETT FIELD, CALIF.—The National Aeronautics and Space Administration is developing a controllable astronomical satellite which it expects to place in orbit by 1963, putting a payload of about 3500 pounds into a 500-nautical-mile circular orbit aboard an *Atlas-Agena-B* from Cape Canaveral.

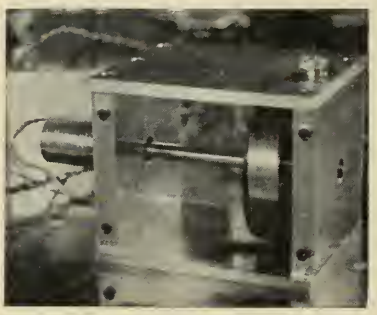
The project, headed by Dr. Nancy G. Roman, has not yet been given a name.

Unprecedented orientation accuracy will enable the vehicle to maintain position indefinitely within 1/10 second of arc. The payload will be oriented by stellar check points, instead of earth, and five separate experiments will be carried out.

NASA feels that a cost figure of $25-million for the program is "in the ball park." This does not count the boosters, and presupposes the absence of major problems. NASA would like a schedule calling for one launching per year until seven vehicles have been launched.

Experiments will include: ultraviolet stellar spectrograph (Goddard Space Flight Center); ultraviolet photometer (University of Wisconsin); ultraviolet sky mapping (Smithsonian Astrophysical Observatory); high-dispersion stellar spectrograph (Princeton University); and solar experiments (University of Michigan).

A preliminary briefing on the project, still in early development stages, was held at NASA headquarters on Dec. 1, 1959. At least 30 interested companies attended.



**REACTION wheel on stable platform shown in its housing.**

• **Management money**—Management of the program is presently divided among NASA and the individual experimenters. NASA makes decisions affecting the overall program or vehicle, but experimenters are free to work within their own areas. It hasn't been decided whether major system management will be in-house or in industry; most contracting, however, will go to industry.

NASA won't be able to take on major funding this fiscal year, but has money available for "small" study contracts which will not cover the entire system. Areas which may yield study contracts are: coarse orientation and slewing system; fine stabilization system; means of balancing the payload in orbit; effect of magnetic and gravitational fields; acquisition television system, and a backup system for same; and the data storage system. Contracts will be awarded on a competitive basis.

Equipment to go aboard the satellite is still being developed; preliminary objectives call for a number of telescopes; a television system which can resolve 6th-magnitude stars to ½-

magnitude, with 500-line per-inch resolution or more; and storage capacity for data acquired. The telescopes will be six to eight feet long, probably with a 32-in. diameter primary mirror —although 36 in. is desired. Backup will be provided only where such a move would enhance reliability.

• **The drill**—The vehicle will need analog data, digital data, and TV data, as well as some 30 command channels. The sequence to be followed during operation: Immediately after injection into orbit, the payload's sun-seeker orients the satellite with the sun, with horizon scanners controlling the other two axes. A television camera with suitable optics (covering a 10x10-degree field of view) transmits a picture to an astronomer at a ground control station.

The ground control operator then orients the satellite in accordance with the displayed information, and sets it toward a target star to be examined. When close to this star, the automatic tracking mode takes over, and the remaining operation is automatic, its program depending on the current experiment. It is unlikely that two experiments will be in process simultaneously; they will probably operate on a time-sharing basis.

The payload will be programmed so that, except in the solar experiment, the instrumentation will look no closer than within 45 degrees of the sun. The remaining experiments are calibrated for much less light. Because of this inability to look toward the sun, it will probably take about one year to map the entire sky.

The orbit, which will be inclined about 35 to 40 degrees, was chosen to get above significant drag, while remaining below the Van Allen belt. Ground control will be by the Minitrack system.

• **Control alternatives**—Three control modes will be incorporated into the satellite's system: acquisition; coarse control (accurate to one minute of arc); and fine control, or pointing. NASA has not specified which attitude control system it will use, saying it will leave this open to contractor suggestions. One method is reaction wheel control, with a motor driving the flywheel and thereby producing an equal torque on the vehicle.

Another way to accomplish the purpose is to use a gyroscope whose flywheel turns at a constant speed, so that a torque is produced by changing the spin axis of the gyro. Both these momentum-transfer schemes demand some way of getting rid of the momentum that is stored on the controls. This might be done with a solar sail or a sliding weight designed to dissipate the angular momentum.

A third system being considered is vapor jets operating at low pressure; a variation would be high-pressure jets —which might also be valuable in initial stabilization of the vehicle after orbital injection.

• **Progress in accuracy**—Preliminary work on attitude control is being done at NASA's Ames Research Center, responsible for research on various engineering aspects of the program. The center is developing extremely-low friction air-bearing platforms for studies of problems involved.

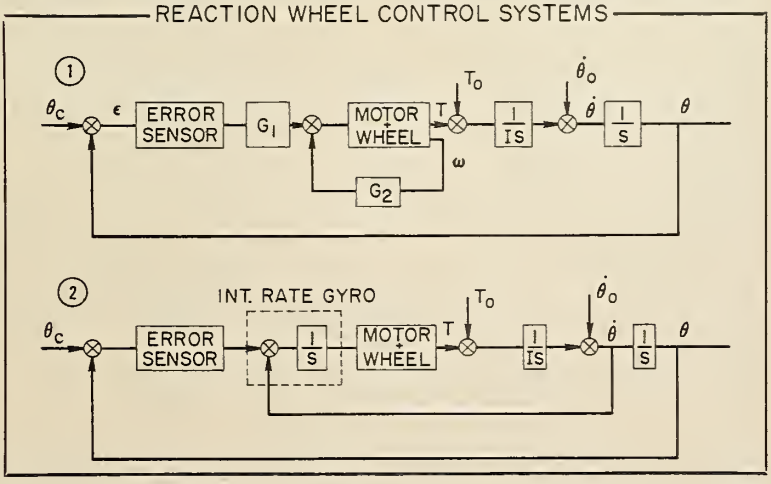
Experimental equipment used at Ames includes a stable platform utilizing 30-psi air supply to support the 200-lb. table, on which are mounted control devices. Among these are a telescope with error detectors and photodetectors. An artificial light source simulates a star, and corrective action of the control system is checked in orienting the table.

Accuracies to one second of arc have already been achieved; it is anticipated that this will improve to the necessary 1/10 second. Since the satellite will have to have accuracy over one order-of-magnitude more precise than present earth-oriented satellites, the perfected system will represent considerable progress.

How long the satellite will be required to maintain a set position in orbit will vary with the experiment being conducted; it will range between a few minutes and an hour.

• **Exquisite reliability demand**—The problem will be reliability. Robert M. Crane, Chief of the Aero-Thermodynamics Division at Ames, says, "We have an extremely complex control system, communications system, and experiment system—and we're asking all

**ARTIFICIAL LIGHT source equipment for NASA astronomical satellite.**




SPACE STATIO
POLARIS FBM
PROJECT ARGUS


# EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

## ADVANCED PROJECTS AT LOCKHEED

**POLARIS FBM**—Now in its advanced development status, the Navy-Lockheed POLARIS Fleet Ballistic Missile is scheduled to be fully operational and aboard its specially designed submarines late this year. Full-scale test vehicles have been successfully flown on a regular schedule of firings for months with only two failures, a remarkable achievement in view of the totally different environmental problems involved in its underwater launch requirement. With three-quarters of the earth's surface being water, practically no target in the world is outside the POLARIS' range of over 1200 nautical miles. The Division is systems manager for the POLARIS under the direction of the Special Projects Office of the Navy.

**SPACE STATION**—An orbiting research facility, to serve as an advanced base for space exploration, has been proposed in practical detail by Lockheed's research and development staff. The station would carry a 10-man crew. Prefabricated compartments for the rim of the wheel, the spokes, and the three hubs would be launched separately by ballistic missiles and assembled in space by means of the specially-designed Lockheed Astrotug.

**X-17, KINGFISHER, X-7**—The Air Force-Lockheed X-17 solid-propellant ballistic missile has pioneered many new techniques, and the valuable experience gained from this program facilitated development of other, inter-service projects, including the Navy POLARIS FBM. The Navy's Project Argus radiation explosion featured the X-17 as the vehicle. Developed for the Air Force, the Lockheed KINGFISHER is designed to simulate enemy attacks to test our nation's anti-bomber and anti-guided-missile defenses. The Air Force X-7 is a unique, recoverable ramjet-engine test vehicle designed to test new developments in advanced components for other missiles.

**SATELLITE PROGRAMS**—The Air Force-Lockheed AGENA satellite is a versatile space vehicle capable of numerous assignments. In its present configuration, it is 19 feet long, 5 feet in diameter with an orbital weight of approximately 1700 pounds. Payload of several hundred pounds includes telemetry, instrumentation, guidance and attitude control systems, re-entry vehicle and recovery capsule. The AGENA has accomplished several significant space "firsts." It was first to be placed on the difficult polar orbit; first to be placed on a precise, predicted, and nearly circular orbit; first to change its attitude on orbit, with a turn of 180 degrees and a downward tilt of 60 degrees; first to eject a capsule; and first to prove advanced space systems such as ground-space communications, instrumentation, attitude and guidance and life-sustaining devices. The AGENA can be modified for a variety of space missions such as navigation; geophysical investigations; lunar probes; long-range communications; and space probes.

In addition to the AGENA program, the Division is developing satellites for the MIDAS program (Missile Defense Alarm System) and the SAMOS strategic warning system. Lockheed is systems manager for these projects under the direction of the Air Force Ballistic Missile Division (ARDC).

The successful completion of projects such as these requires a bold and imaginative approach to entirely new environments. Lockheed's programs reach far into the future. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, Dept. C-29B, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense clearance required.

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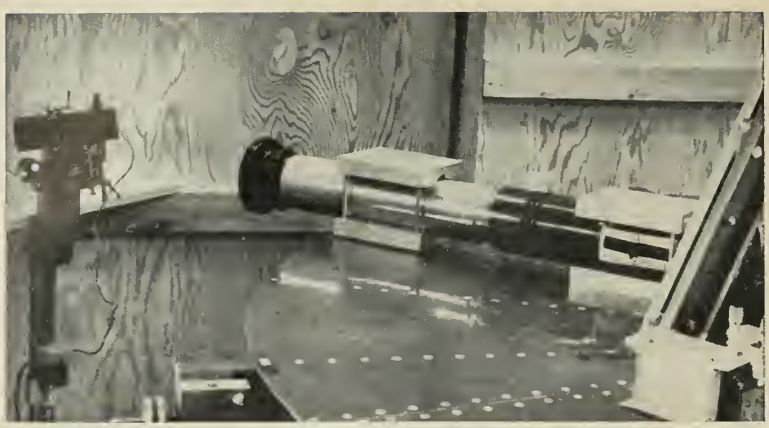


**TELESCOPE ON stable platform sights toward artificial light source to orient platform. In left foreground is balance adjustment for the platform. Plywood structure surrounding platform was built by NASA solely to prevent random air currents in laboratory from disturbing experiment.**

of them to work unattended for twelve months."

Power supply for the vehicle, yet to be established, will probably consist of solar cells and storage batteries. A nuclear power source has been considered, but this might have adverse effects on the instruments.

Some unique problems have arisen regarding thermal balance. Optical devices, photocells, photo detectors, and other equipment must be kept cool; storage batteries and other electronic equipment must be kept warm, and solar cells for recharging storage batteries must be kept cold. Optical devices may go out of focus during thermal change, but this may be combated either by providing a re-focusing capability or by using materials which are not drastically affected. The latter is considered the most likely solution.

• **Ultraviolet spectrograph**—The ultraviolet stellar spectrograph experiment is expected to get absolute-energy distributions of stars in the wavelength regions from 4000 to 1000 angstroms, and also to obtain spectra, on an absolute basis, of emission nebulae which occur in the sky and galaxies.

The telescope used in this experiment will consist of a 32-36-in. mirror operating around f/1, and a secondary mirror which will put a return beam through the hole in the primary mirror of about f/5. The light will pass through a diaphragm on the collimating mirror, back into the telescope, on to a large grating, thence to a camera and a detector system.

Objective of the experiment is in photometry more than in high resolution; the spectral resolution will vary from one angstrom to about 50 angstroms. The detection system will consist of one or more photomultipliers, each having a slit before it and covering a certain wavelength band. The grating (15,000 lines and 10 in. across) will be rotated in finite steps approximately every 20 seconds. The field of view will be about 3 seconds of arc.

Two channels of telemetry are expected to handle data from the experiment, and core memory will likely be used. The feeling is that tape-recorder moving parts would give rise to torque and other problems in the delicate balance and stability required of the satellite.

It will probably take between five and 20 minutes to look at a celestial object and obtain all necessary data on it.

• **Ultraviolet photometry**—The experiment on ultraviolet photometry will measure radiation from stellar objects and from interstellar gas in a restricted wavelength region. Scientists hope to get a clearer picture of the energy distributions in stars and of the intensities of emission lines in gaseous nebulae. Typical of the data sought are the number of ergs per second per square centimeter per angstrom incident on the outside of the earth's atmosphere from a stellar source.

Instrumentation will consist of four mirrors, the focus of each directed off to the side through diaphragms and filters to a small mirror with a field lens, projecting an image of the telescope objective onto a photomultiplier. Both the diaphragms and filters could be changed. The system would include acquisition of the star and data-gathering capabilities.

Continuous transmission of data is desired during the experiment, so that ground stations will know immediately when a star is acquired.

• **Updating charts**—Sky mapping experiments will gather similar data as the previous two cited, that is, spectral intensity distribution of stars and interstellar matter. Observations will be made of the 10 million stars brighter than magnitude 15 photographic (roughly 10,000 times fainter than can be seen with the naked eye).

The objective is to establish the existence of as many stars as possible, and get available data on them. Time considerations prevent use of diaphragms or photocells, television will probably be used. The TV system

## *Vehicle Requirements*

Moment of Inertia—800 Slug-Ft$^2$
Weight—3500 Lb

**I. Initial Stabilization**
1. Initial Vehicle Rate—1 °/Sec
2. Final Vehicle Rate—.002 °/Sec
3. Solar Orientation—±1°

**II. Remote Control (TV)**
1. Max. Slewing Rate—180° in 5 Min.
2. Pointing Accuracy—±15 Min.

**III. Automatic Control**

| | Course | Fine |
|---|---|---|
| 1. Initial Pointing Error | ±30′ | ±2′ |
| 2. Final Pointing Error | ±1′ | ±0.1″ |
| 3. Initial Vehicle Rate | .002°/Sec | .002°/Sec |
| 4. External Torques | 100 Dyne-CM | 100 Dyne-CM |
| 5. Max. Bias Error | —— | ±0.05″ |
| 6. Saturation Time | —— | 100 Min. |
| 7. Angular Momentum | $2.1 \times 10^8$ C.G.S. | $6.0 \times 10^5$ C.G.S. |

## *Engineering Aspects*

**I. Attitude Control**
1. Systems Concepts
   (a) Reaction Wheel
   (b) Gyro Wheel
   (c) Vapor-Jet
   (d) Cold-Gas Jet
2. Error Sensors
   (1) Television
   (2) Solar Trackers
   (3) Star Trackers
3. External Disturbance Torque
4. Dissipation of Angular Momentum

**II. Power Systems**
1. Solar Array
2. Power Storage

**III. Thermal Balance**

**IV. Communications**
1. Command Systems
2. Data Acquisition & Storage
3. Data Transmission

**V. Vehicle Layout**

## *Systems Evaluation*

1. Dynamic Performance
2. Power Required
3. Weight
4. Reliability
5. Complexity
6. Longevity
7. Availability

would be live, and controlled from the ground when within view of the control station. This would constitute something on the order of 10% of the time in orbit. The remaining time would not be actively used for this experiment and as little power as possible will be expended.

With this method, a scanning rate of one frame per second and a 150 kc band path would be needed to transmit data to the ground. No satellite storage is contemplated, but ground storage will be utilized.

(No firm choice has been made as to power supplies for all the experiments; the effect of a nuclear power package upon the experimental instruments will determine whether this possible source is chosen.)

There are no plans to try to recover any data capsules or other portions of the satellite, because such efforts would involve changing the orbit of the vehicle or changing its balance. The former would destroy its future usefulness; the latter would make it extremely difficult to carry out additional experiments due to inability to rebalance the payload to within a part of $10^3$ or $10^4$.

• **Gases between stars**—The high dispersion stellar spectrograph experiment will be aimed at investigation of the dark gaseous matter existing between stars. Methods of doing this are difficult, because of the dark nature of these gaseous clouds. Examination of a very hot, bright star will yield data, however, because of the effect of the gas clouds on the starlight. Such gas clouds have considerable effect, but it is restricted to very narrow wavelength regions.

Hence, it is necessary to resolve the spectrum well enough to see such an effect. It is expected that lines with a width of a tenth of an angstrom will be measured.

Equipment will consist of a 24-in. light collector aperture with a ratio of f/3. A secondary mirror, Cassegrain secondary, will change the overall ratio of f/20. Light is brought to focus at a point on a slit with a spectrograph, the entrance slit of the spectrograph being five microns wide. Located roughly in the center will be a concave grating, which will be struck by light and form the spectrum along the edge of a Rowland circle. Along the edge of this, behind exit slits of the same five-micron width, will be a series of photo tubes.

This experiment is the one which demands accuracy of 0.1 second of arc for an indefinite period of orientation accuracy.

• **Look at the sun**—Solar experiments will examine small areas on the surface of the sun, such areas having a maximum size of one square minute of arc. Both quiet areas of the disc and various disturbed areas will be studied.

Equipment will be a large spectrograph with a small collecting surface. Diameters of the collecting mirrors will be on the order of an inch or two, except for the far ultraviolet and X-ray regions. Three grating spectrometers will cover sections of the spectrum from 3000 to possibly 75 angstroms. Each will have a photomultiplier output.

In addition to these three instruments, a spectroheliometer will be set on Lyman-alpha line of hydrogen at 1216 angstroms. An image of the sun will be produced in this radiation and will be monitored by vidicon, either by command or storage. Smaller instruments may be included to cover X-ray and other areas, as well as possibly a second TV camera to photograph the sun in other wavelengths.

# New Space Tracking Proposed by ACF

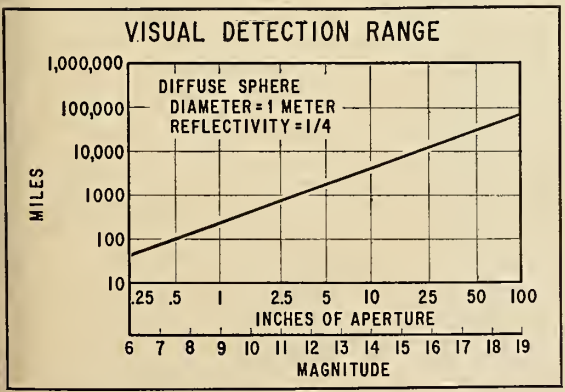
**by Charles D. LaFond**

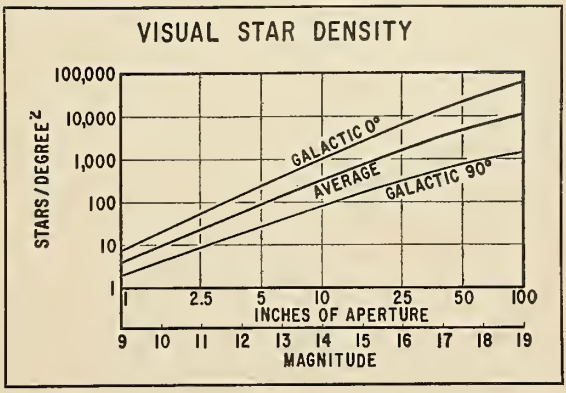
The color difference between activated and recently vacated spots on a radar screen can be used to discriminate moving from fixed targets over short time intervals, according to ACF Electronics of Paramus, N.J.

Use of this phenomena has been proposed by Harvey Dubner, manager of the division's Advanced Development Laboratory, for the development of a very sensitive "Celestial Moving Target Indicator."

A technique could be used, said Dubner, to supply an electrical processing analog to the current procedure of comparing photographs of the same sky area to detect movements of luminous objects. This standard technique of astronomers is quite satisfactory over long time intervals, but is impractical in missile or satellite applications where very short observation intervals are often necessary.

By employing only today's components, Dubner believes a satisfactory CMTI with a 30° field of view could be produced. The proposal is based on a characteristic of the P-7 phosphor screen, used in most radar systems and long-persistence oscilloscopes. For a continuously activated spot, the phosphor fluoresces blue-white; a recently vacated spot phosphoresces yellow. Fixed stars, therefore, appear blue-white while moving targets leave a yellow trail. It is this color difference



that could be used.

In operation, the sky field is imaged onto a beam intensifier whose output appears on a P-7 phosphor screen. The resulting light output is viewed with a two-color television-type orthicon which gives a signal for blue separate from that of the yellow. Since the blue-white fluorescence consists of blue and yellow components, while the phosphorescence contains only yellow, subtraction of these signals can be made to yield a signal representing only the moving sources.

The moving source signal may then be recombined with the blue or star-reference signal for presentation on a storage-type cathode-ray receiver. Ideally, the receiver would be two-color. The combined signal also would be available for use in an orbit or impact-point computer.

• **Varied applications**—Although this technique is particularly applicable to orbiting satellites, it can also be used for tracking rockets during their boost phase and for missiles carrying flash bombs, said Dubner. The system can be operated to plot a single moving target path or a multitude of moving target paths. While maximum potential is obtained at orbital elevation points, this system can be operated successfully from the surface of the earth. Range capability is of the order of thousands of miles.

Figure 1 shows the visual detection ranges obtained with telescope apertures of varying sizes from a one-meter sphere. The sphere is assumed to be approximately half-illuminated by the sun and to have a reflectivity of one-half (net reflectivity is 25%). Ranges are calculated on the basis that the eye can just perceive an object when it receives 16,000 photons per second (sun spectrum).

Figure 2 shows the density of visually detectable stars as a function of telescope aperture. (A scale of stellar magnitude is also included.) Even for telescopes of moderate size, star density is high.

It might be expected that some help could be obtained by using spectral discrimination, but this is not true, according to Dubner. If the total integrated intensity of all the stars as received at a detector is analyzed, he said, it is found to correspond closely to a temperature of 5800° K or to a spectral distribution very similar to that of our sun. Because of this, reliable spectral discrimination appears impossible between a source based on reflected sunlight and the star background.

Figure 3 shows star density as a function of detection range for the one meter sphere.

• **Screen characteristics**—The P-7 phosphor is a two-layer screen widely

used for radar application. During excitation by an electron beam, the phosphor produces a bluish-white fluorescence of short persistence of the order of $10^{-5}$ seconds.

After excitation, the phosphorescent light output is constant for a time $T_0 = 3 \times 10^{-4}$ seconds and then falls off inversely with time. The color is greenish-yellow. A wrattan No. 12 filter can be used as a dichroic reflector and provides a maximum discrimination between the short persistence fluorescence and long persistence phosphorescence.

• **Detector characteristics**—The light from the moving source and star background is collected by the optics and focused on the sensitive surface of the image intensifier, the final stage of which is the P-7 phosphor. Spectral response of the photo-surface must be matched as closely as possible to the sun spectrum.

A tri-alkali photo-surface is the most sensitive photo-emitter presently available, and its peak response is very close to that of the sun. The noise equivalent power per resolution element is 320 solar photons per second.

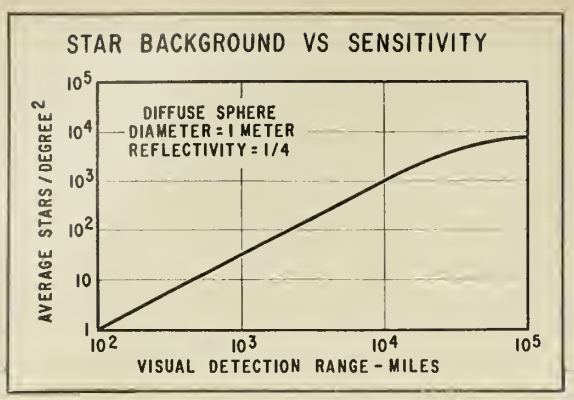
• **Background level**—The CMTI technique discriminates against fixed targets, but, for the moving target to be detectable, energy received must exceed normal background level of radiation.

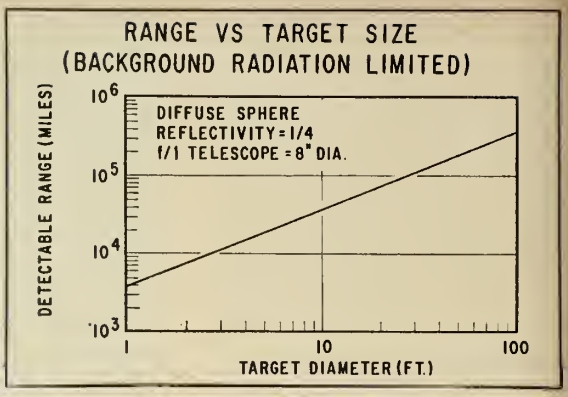
The total star energy received at the top of our atmosphere is approximately $9.6 \times 10^{-11}$ watts/cm²/steradian. Most of this energy is resolvable as points and can be discriminated against. The portion of the energy from very dim stars forms a background level of radiation which the moving target must exceed by a reasonable factor.

For example, 82% of received stellar energy comes from stars brighter than 16th magnitude. For an 8-in. optical system with a resolution of 0.5 milliradian, consideration of star density, resolution, and energy distribution indicates that approximately 15% of the total star energy is distributed in what could be considered a random manner. The background thus is approximately 5000 solar photons per second per resolution element, which is considerably higher than the dark noise equivalent power.

Assuming a threshold signal-to-background level of 5, detection range of the CMTI system can be computed. Figure 4 shows range plotted as a function of target size.

• **Star twinkle**—The CMTI technique is based on the different spectral outputs from a P-7 phosphor for a steady activation compared to a temporary activation. The effect of star twinkle may degrade the efficiency for




discrimination because the steady star source is replaced by a fluctuating source. The degradation depends on the amount of modulation introduced by the twinkle. Principle characteristics of star twinkle are (1) brightness fluctuations, (2) lateral movement of the image (giving rise to a shimmer disc, a luminous disc in place of an image spot), and (3) changes in image color.

Since the physical phenomena that cause these characteristics are based on diffraction and refraction effects, brightness fluctuations also are attributed to diffraction effects. They develop from the interaction of the light with small turbulent irregularities. Shimmer discs are said to be due to refraction of light by relatively large turbulent areas.

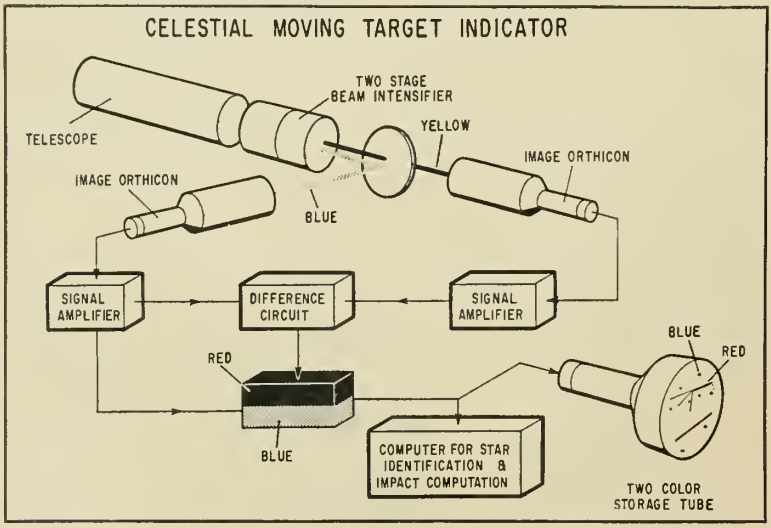
The color phenomena appears to be a combination of these effects. It has been found that the frequency and amplitude of the brightness fluctuations depend on the aperture and the zenith angle at which the telescope is oriented. When the fluctuations are Fourier-analyzed, frequencies are below 100 cps, with the majority grouped at lower frequencies.

For the system parameters considered, preliminary calculations indicate very little degradation due to star twinkle. If necessary, twinkle effect could be reduced by high altitude operation, use of large aperture telescopes, and fast signal processing.

• **Low-velocity limitations**—As the angular rate of the target decreases, the effective intensity of the long persistence phosphor also decreases.

If the elemental resolution area just vacated by the moving target is observed, the average intensity of the area appears to be less with a slow target than with a fast target. The effective reduction in intensity is a function of the focal length and resolution of the optical system, the velocity of the target, the range of target and the long persistence characteristics of the phosphor.

The velocity limitation seriously degrades the CMTI system performance and is directly traceable to the characteristics of the phosphor. The most serious single degrading factor is the persistence characteristic of the P-7 phosphor. Development of a special phosphor more suited for this application would extend the range capability from the order of thousands of miles to tens-of-thousands of miles. It is in this direction that ACF believes the next development stage should now proceed.




## EIA Seminar to Discuss 'More Bang per Buck'

"More Defense per Dollar" will be the theme of an Electronic Industries Association seminar set for March 15 in Washington. Panel sessions will bring together 13 top defense planners in government and industry to evaluate defense planning to date and investigate ways to shorten the gap between weapons system conception and hardware delivery.

The military panel will be chaired by Sidney Curtis, senior vice president of Stromberg-Carlson. Members will be representatives from the Navy, Army Signal Corps, Air Force's Air Research and Development Command, and Defense Department research and engineering.

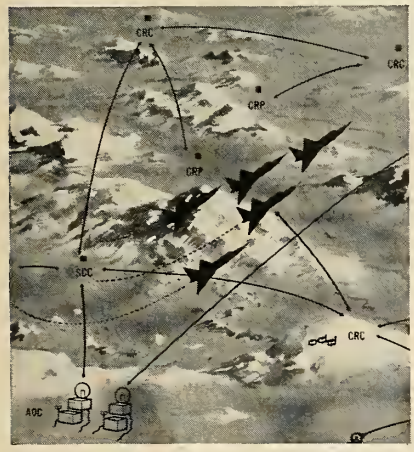
Vice Adm. John H. Sides will chair the industry panel. Top planning and marketing personnel from Lockheed, General Electric, Hughes Aircraft, and RCA will serve as panel members.

Approximately 150 DOD representatives with major responsibilities in planning have been invited to the seminar. Several hundred from industry are expected to attend.

John M. Sprague, Deputy Assistant Defense Secretary, will speak on "Fiscal Operations and Military Planning" at the seminar luncheon. Rep. Gerald Ford, Jr. (R-Mich.), ranking member of the House Armed Services Appropriations Committee, will address the dinner meeting on "Congressional Responsibility in Defense Planning."

The marketing seminar will be the opening feature of the EIA Spring Conference.

**A Tracking Center** collects, evaluates and displays pertinent information on all air activities within its area of responsibility. Each tracking site can track while scanning many high speed maneuvering targets. Position information and supplementary intelligence is available for insertion into the system from the communications network which involves all stations in the system.




**The Control Function** results in accomplishment of tactical air missions assigned by the command center, including intercepting air targets, air attacks on ground targets, return-to-base missions and response to emergency situations. The vectoring computer group calculates optimum intercept vectors, and guides the assigned aircraft to the target, constantly correcting for target maneuvers and drift. One air controller can monitor many air missions, providing a greatly expanded capacity over manual systems.

**Communication** is accomplished in ground-to-air messages by automatic voice or digital techniques. Microwaves, tropospheric scatter or land line communication is used between sites. Compact message structure and efficiently programmed time-sharing insures rapid updating of a maximum number of targets. Communication facilities are flexible and can easily be reorganized to accommodate a change in the number of sites.

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# Military Division

## TACS—*combining data processing, communications and control functions—demonstrates total systems capabilities.*

A significant example of the capabilities of the Remington Rand Univac Military Division is the AN/TSQ-13 Tactical Air Control System. This USAF System automatically performs air surveillance, evaluation and control functions in a 160,000 square mile area, reassessing the air situation every 30 seconds to facilitate command decisions.

The transportability of the System allows Control and Reporting Centers to be quickly moved into far forward positions to give surveillance of tactical territory. A communications network, involving both voice and digital techniques, coordinates these functions with weapon groups and other military activities to successfully meet the fast-changing needs of the tactical air situation.

Designed and built by the Military Division, the Tactical Air Control System fully integrates the computation, communication and control functions. The System represents a solution to a complex problem and exhibits the characteristics which have become identified with Remington Rand Univac achievements in the military area—compact size, high speed of operation and reliability under demanding environmental conditions.

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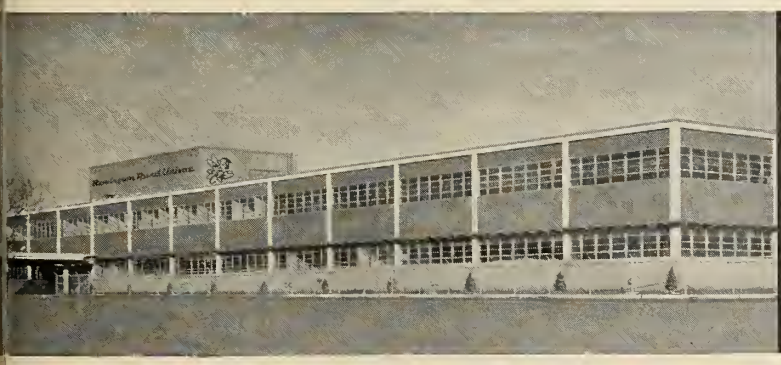

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Univac Park, St. Paul 16, Minnesota

Other control and data systems developed by the Remington Rand Univac Military Division include:

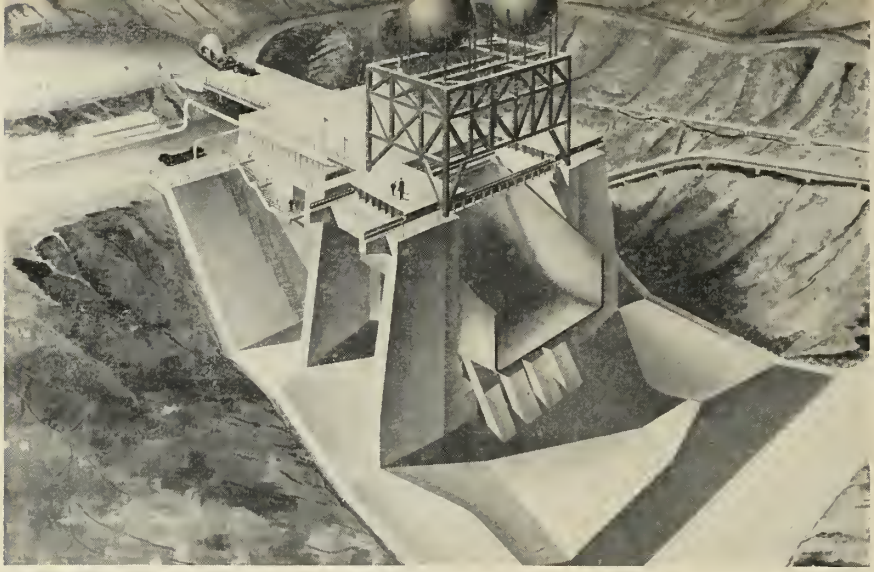
**ATHENA,** the Ground Guidance Computer for the U.S. Air Force ICBM TITAN.

**BOMARC** Computer for the U. S. Air Force Target Intercept Program.

**SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY**

**AN/USQ-20** (Advanced Computer for the U. S. Navy).

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.



**WHEN FINISHED, Rocketdyne's 1.5-million-lb.-thrust test stand at Edwards AFB will look like this. Engineers of Aerojet-General's Aetron Division who designed the stand, say it should ultimately accommodate 6 million lbs.**

## ground support equipment

# Concrete Being Poured for F-1 Stand

Pouring of massive footings to anchor the static test stand for the nation's first 1.5-million-lb.-thrust single-chamber F-1 rocket booster is now under way at Edwards AFB, Calif.

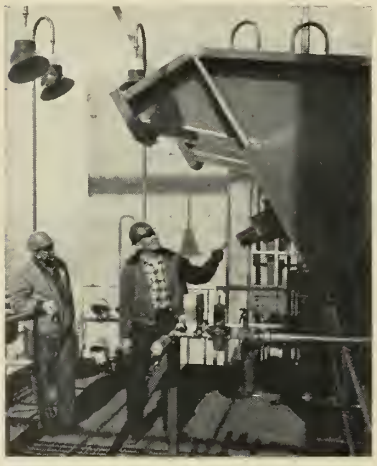
The 230-ft.-high stand is expected to be finished late this year. Static firings will commence in early 1961. It is being built into the side of Leuhman Ridge, a granite cliff already studded with Air Force test stands that overlooks the Mojave Desert.

Cost of the 1-B test stand, two smaller test stands and a central control bunker for this NASA complex will total an estimated $12 million.

The 1-B's foundation will require 12,000 yards of concrete, enough for a good-sided dam or a mile of eight-lane freeway. The stand will have a steel flame deflector weighing 260 tons. It will be water-cooled with 60,000-gal.-per-min. spray system. A small lake at the bottom will capture the excess for recycling.

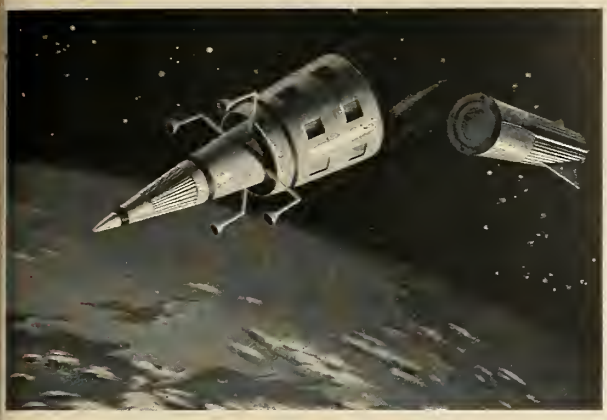
Two stainless steel spheres sitting atop the reinforced girder framework will hold the fuel and oxidizer. The F-1's turbopump will deliver fuel at the rate of about three tons per second during mainstage operation.

Design of the foundation structure was by Aetron, a Division of Aerojet General. The Army Corps of Engineers is supervising construction,



**ENGINEERS inspect thrust mount for F-1 test facility.**

**THESE HIGH-PRESSURE gas containers will be used in testing NASA's F-1, or *Nova* vehicle, rocket engine. Tanks service Stand 2-A at Edwards.**



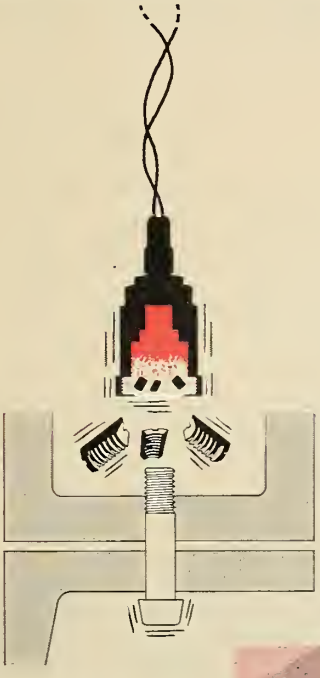
**TYPICAL APPLICATIONS**

- SEPARATION OF MULTI-STAGE VEHICLES AND NOSE CONES.
- RELEASE FROM LAUNCHING PADS.
- RELEASE OF BOOST ROCKETS AND LAUNCHING SLEDS.
- RELEASE OF TANKS AND JETTISONABLE ITEMS.

## FOR SEPARATION SYSTEMS

## THE NEW

# SEPARATION NUT



A unique, safer and more efficient method for separation systems is offered by the Separation Nut.

The Separation Nut is unique because its controlled separation is a highly reliable mechanical function activated by a very small explosive charge.

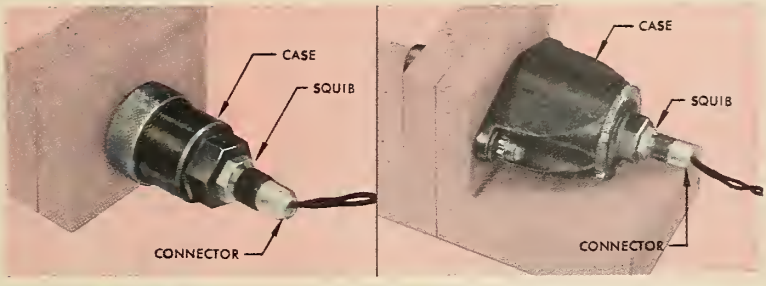
By using the Nut's small explosive charge rather than the "brute force" explosive techniques so commonly used to fail high strength material in explosive bolts, the Separation Nut can substantially reduce a potentially hazardous condition to installation crews and to the vehicle itself.

More compact joints can be designed since Separation Nuts are used in combination with standard diameter, high strength bolts used at full allowables.

Separation Nuts reflect another new fastening concept developed in Hi-Shear's specialized engineering and laboratory test facilities for the specific needs of space vehicles and high performance aircraft.


Write for brochure . . . describes how the Nut works, high speed photos, design goals, typical applications and summary of the test program.

PATENT APPLIED FOR.

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Basic configuration . . . accommodates bolt thread sizes including ¼-28 thru ¾-16.

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which is under contract to Del E. Webb Construction Co. The Rocketdyne Division of North American Aviation, prime contractor for the F-1 engine, is in charge of the overall design and construction of the complex.

• **Thirty-degree firing**—A two-position thrust chamber testing facility being built on the opposite side of the ridge is almost finished. Here, at test stand 2-A, the F-1 thrust chambers minus their pumping mechanism will be fired at a 30-degree angle.

Propellants will be delivered under high pressure from 6-in. steel spheres through 14-in. lines. Contractors for this site include the Ralph M. Parsons Co., Mid Valley Utility Constructors, Alex Robertson, Southwest Welding & Mfg., and Chicago Bridge and Iron.

Near this site, a former *Atlas* engine stand has been torn down to its foundation and is now being rebuilt to hold the F-1 engine mount structure. From this 1-A stand the big space engine will be fired 130 ft. downward into a water-cooled deflector. Principal contractors are Kaiser Steel, Southwest Welding and John A. Minasian, a structural steel consultant.

All of the foundations are government-funded. Rocketdyne, as part of its overall $102-million contract, is changing $5.5 million for the superstructure and control equipment, according to a recent Government Accounting Office report.

A shortage of steel caused by the steel strike, NASA officials say, has delayed construction of the stands in certain areas. Actual dates when the stands are to be used have not been disclosed. However, Rocketdyne expects to put the smaller 1-A and 2-A stands into use this year.

Design of the turbopump with a 3-ton per sec. capacity is still being proven out in tests of model parts. A full-scale F-1 mockup using a full-scale, uncooled combustion chamber has already achieved completely stable combustion at more than 1 million lbs. thrust, according to NASA.

# *Minuteman* Silo Tests Winding Up

## *BMD completing one-third scale model firings in improvised Edwards facilities*

A three-year-old program to develop a hardened underground silo for launching the *Minuteman* ICBM is approaching its final stage at Edwards AFB, Calif.

Some time soon—Air Force Ballistic Missile Division's exact schedule is classified—designs will be established for a few variations of procedures and configurations to be tested in a series of full-scale tests, which will set the guidelines for launch facilities at Cape Canaveral.

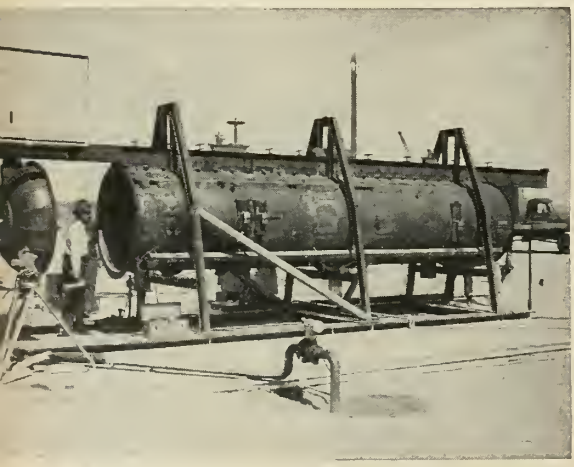
Preparatory to the full-scale testing, a series of about 25 one-third scale firings has been under way for more than a year. The one-third scale tests were designed to provide data on basic configuration, effects of missile emergence, flame detector design, silo depth and diameter, canted nozzles, silo liners and support structures without going to the expense of a lengthy series of full-scale tests.

Of the many designs originally considered, only a few variations will appear in the full-scale tests, which will use the first full-sized *Minutemen* built.

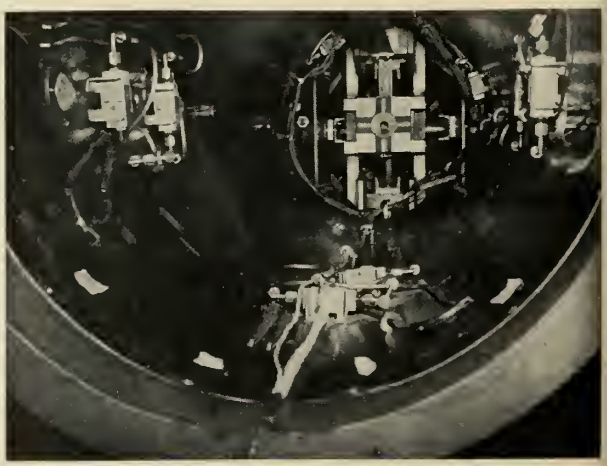
• **Silo development laid out**—AFBMD laid out the silo development program in 1957, when only a few large rockets had been fired and there was but meager data on the effects of a large rocket fired from an underground facility.

The Silo Launcher Development Program at Edwards was given a free hand except for one restriction: cost was to be kept to a minimum. The first launch from a silo took place at Edwards in March 1958. A 4000-lb. rocket borrowed from the rocket sled test program was modified and fired from the bottom of a pipe 24 in. wide and 12 ft. deep.

• **The first tests**—After a few such exploratory shots, a series of tests was begun in October 1958 with a solid-



**SIMULATED SILO, or tube in which scaled-down *Minuteman* test program is conducted. At left is one of the deflector plates being studied.**



**INTERIOR OF horizontal test silo, showing some of the instrumentation connections. Overhead track is at top; back shows braces for vehicle.**

propellant air-to-air rocket, 2.75 in. in diameter, held captive inside a plastic tube. A layer of fine mesh wire furnished the first data on how firing would affect the missile and silo configuration. By June 1959, 213 such rockets were fired, yielding a great deal of data on the effects of silo diameter and primary flame deflector shape on heating of the missile within the silo.

Next, the rockets were tested at 1/20 scale—a diameter of 3.25 in. in the first stage—by the Boeing Airplane Co., which had been chosen in the meantime as a major associate contractor for *Minuteman* assembly and test. Boeing ran more than 1200 tests of aerodynamic effects, using compressed nitrogen. The "cold flow" tests were found consistent with the "hot" tests. AFBMD and Space Technology Laboratories then decided on the series of one-third scale tests. The first took place Feb. 17, 1959.

The "Third" tests take measurements of pressure, temperature, acoustical environment, vibration, thermal radiation and amount of strain registered at various points by load cells. Fed into a computer, these measurements provide answers to the prime questions. For information on the effects of missile position changes, data are collected on heat transfer, missile frame stresses, acoustical environment and the initial shock wave in the silo.

The facility consists of a horizontal test silo of AIS 1020 steel plate ¼ in. thick. One end is closed by a movable steel flame deflector plate ¾ to 1½ in. thick, depending on test objectives. The tube is anchored by steel girders in a concrete pad 33 x 58 ft.

From the open end of the silo, an overhead metal track runs into a laboratory van parked at the edge of the concrete. Supporting hangers along the track make it possible to move the test missile into the silo. The deflector also hangs from the track.

Six holes ½ in. in diameter around the center of the deflector are inlets through which 240 gallons of water a minute is sprayed into the silo at burnout at 150 psig pressure.

An M-47 Army tank, rendered immobile and heavily modified, standing behind a bunker 200 ft. away, is the blockhouse and control center. Some controls and communications facilities are in three nearby vans.

The test missiles will carry a cluster of four Atlantic Research Corp. solid rockets in the booster stage, inside a ¼ in. skin—considerably thicker than in the actual *Minuteman*. Second and third stages have the same shape and general configuration as the real missile but are filled with instruments rather than propellant.

During slightly more than three seconds of firing, over 140 measurements are transmitted to equipment in the vans, most of which was designed and initiated by Stavid Engineering.

Maj. Rex Gray of the AFBMD Field Office at Edwards is in charge of the Third tests.

## AC Spark Plug Opens R&D Facility on Coast

EL SEGUNDO, CALIF.—Plans to use the Air Force *Titan* ICBM as a space booster for lunar and Martian probes were revealed here last week as AC Spark Plug Division of General Motors opened a new research laboratory.

The company said the new facility, Advanced Concepts Research and Development Laboratory, "will be investigating the complexities of missiles and space exploration with specific emphasis on the *Titan* system for use in lunar and other planetary probes, namely Mars."

Other projects to be handled by the lab include an azimuth-elevation star tracker for inertial guidance, satellite stabilization, space navigation applications and advanced digital computers.

• **Strictly R&D**—The 67,000-square-foot facility, near Los Angeles International Airport, houses electronics, optics and digital computer laboratories, and employs over 100 engineers and scientists. It will do no manufacturing, but will take a system to the point of prototype construction.

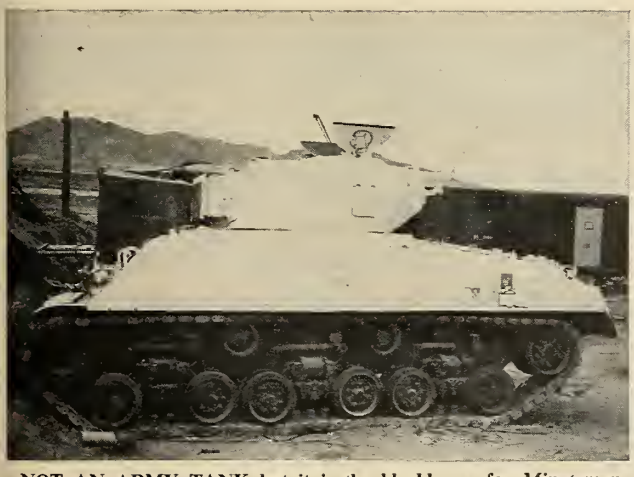
Four operating groups make up the laboratory:

• The Advanced Systems Planning Group; responsible for development of advanced guidance systems and techniques, space guidance and establishment of requirements for advanced components.

• Guidance Analysis Group; responsible for development of navigational schemes and equations, air analysis and statistical studies, and computer services.

• Design Analysis Group; responsible for dynamic analysis and analytical design of the various elements of guidance and control systems, analytical studies leading to development of advanced components and techniques, and the analog computer simulation laboratory.

• Development Laboratories Group; responsible for mechanization of complete guidance systems, development of electronic, electromechanical, and optical components, the electronic laboratory and the optical laboratory.



**NOT AN ARMY TANK but it is the blockhouse for *Minuteman* test site. It's fitted with control panels, periscope, and communications equipment.**

**SCALED-DOWN, one-third model of *Minuteman* ICBM is readied in van for insertion in horizontal test silo at Edwards AFB, Calif.**

# Seals With ± Zero Tolerance

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## Forms Airtight Weather-Proof Enclosure

Aircraft and missile engineers have found an effective material for sealing airframe members and other parts. It's Silastic RTV, the Dow Corning room temperature vulcanizing silicone rubber.

In the F-102 and F-106* canopies, for example, engineers at Convair Division of General Dynamics (San Diego), specified that the windows be "floated" in Silastic RTV. This window seal maintains cockpit pressure but resists cracking and checking and other effects of weathering and ozone. It remains pliant in spite of stratospheric cold.

And Silastic RTV seals are easy to form. Semi-fluid in nature, the RTV can be applied by caulking gun directly to the spot you want sealed. In a short time (you can vary the time from a few minutes to a whole day) the fluid sets up to a rubbery solid, and you have a seal with tolerances to ± zero. Other uses of Silastic RTV, aside from caulking and sealing, include potting of electronic gear and making of molds for prototype parts. Various consistencies are available for application methods other than caulking gun. For further information on this product, send for literature: "How To Use Silastic RTV." Address Dept. 7603.

*SHOWN F-106 DELTA DART.

**TYPICAL PROPERTIES OF SILASTIC RTV SYSTEMS**

| *After Vulcanizing (24 hours at 77 F)* | *Fluid Grade* | *Caulking and Putty Grade* |
|---|---|---|
| Hardness, Shore A ..... | 30 to 65 | 20 to 55 |
| Tensile Strength, psi ... | 250 to 850 | 225 to 450 |
| Elongation, percent .... | 100 to 250 | 120 to 400 |
| Brittle Point, degrees F .. | —100 | —178 to —100 |
| Shrink, linear, percent | | |
| after 3 days* at 77 F | 0.6 | — |
| after 6 days* at 77 F | 0.8 | 1.2 to 1.6 |
| after 14 days* at 77 F | 1.1 | — |
| Water Absorption, percent after 70 hours immersion at 212 F.. | 1.0 | 1.0 |
| Working Time ..... | 10 min. to 3 hr | 2 to 5 hr |

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# Press Development May Speed Research

## *Capability of applying pressures of 1.5 million psi could open new manufacturing processes*

by James A. Fusca

NEW YORK—Research in the opening field of ultrahigh pressure techniques may be facilitated, possibly leading to new manufacturing processes, with development of an ultrahigh-pressure press capable of applying pressures up to 100,000 atmospheres (1.5 million psi) at temperatures from near absolute zero to 5000°F.

The press has been developed by Engineering Supervision Company, a subsidiary of F. H. McGraw & Co.

The effects of ultrahigh pressures have been under study in research laboratories both in this country and the Soviet Union for several years with very small capacity presses. These techniques have been applied by General Electric, in a project headed by Dr. Tracy Hall, to production of small industrial diamonds. The new press, however, reportedly can be built with capacities large enough to be used in commercial manufacturing processes.

Engineering Supervision Co. believes the press offers important opportunities for investigation of:

• Improvement of physical properties of metals and other materials. For example, in experiments made by General Electric, high-speed tool steels which normally increase their grain size under heat treatment have been heat-treated while under ultrahigh pressures, with no increase in grain size. In this manner, the improvements in physical properties provided by heat treatment have been combined with the smaller grain size—equivalent to higher ductility—of the untreated state.

• Production of new metallic alloys and new chemical compounds. For instance, titanium and magnesium cannot be allowed at atmospheric pressure because the boiling point of magnesium is lower than the melting point of titanium. Alloying of the two metals is believed to be feasible, however, under ultrahigh pressures—provided the proper temperatures are generated.

• Phase transformation. The transformation of graphite into diamond is an example of this class of reactions. Methods for the production of other chemical compounds such as garnets have also been developed.

• Densification of powders. Under the present-day method of hot-pressing and sintering, powders can be densified to 90-95% of their theoretical density. With application of ultrahigh pressure, however, some powders have been densified to within 99.8% of their theoretical density.

Research has revealed that several unknown solid phases often exist under high-pressure conditions. For example, while only one phase of bismuth exists at normal atmospheric pressure, eight phases are known to exist at 120,000 atmospheres and 500°C. Therefore, the possibility of using pressure treatment to produce alloys with certain desired physical properties exists, either without or in conjunction with conventional heat treatment.

In other laboratory experiments, high pressures and temperatures have been used to form certain minerals not normally found in nature. For instance, coesite has been formed from quartz at pressures of 65,000 atmospheres and a temperature of 750°C. Another mineral formed at the same pressure but at a temperature of 1500°C is borazon.

An application of great interest in the rocket engine field, but one that lies in the indefinite future, is the theoretical possibility of creating metallic hydrogen under extremely high pressures. As a rocket engine fuel, metallic hydrogen offers a specific impulse of approximately 2500; but, in addition to other problems, its production requires presses capable of ten times the pressure of those available today.

The company has already sold seven of its newly designed presses. It also has an Air Force contract to build and operate and ultrahigh-pressure test facility in its laboratory.

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# Lord Damping Extends Structures' Life

The lifetime of structural materials exposed to high-intensity acoustic energy can be extended by a factor of 20 through application of a new damping development at Lord Manufacturing Co., Erie, Pa.

Designated as "Dyna-damp," the medium can reduce resonant amplification from 20-100:1 to 3-5:1, and maintain this over a temperature range from −65° to 250°F.

The medium, a special form of Lord's Broad Temperature Range (BTR) Elastomer, is incorporated into structures by lamination. Panels consist of plies of metal plates with the elastomer sandwiched between the plates and bonded to them. The threeply laminate can be sheared, punched or used in the same manner as aluminum sheet.

The panels can be formed to some extent over a gentle radius but company spokesmen point out that special handling techniques must be employed if severe forming is contemplated.

The structural elements are also laminates. Hat and angle sections are slotted to reduce elastic stiffness and are made rigid again by sandwiching a layer of the elastomer between the slotted beam sections.

• **Adaptable**—The damped structural sections and panels may be added to existing structures or fabricated as complete damped assemblies. These sections have approximately 60% of the strength of solid aluminum, allowing integration with load-carrying structures.

Lord engineers consider the BTR elastomer damping medium an integral part of the structure. The elastomer, a direct result of several years' intensive research, is not in a viscous state in its finished form.

The firm intends to market the development either as an add-on to an existing structure, or as components manufactured to the customer's specifications to be included as part of an original design. Dyna-damp components are currently being used in the *Hawk* missile system.

# U.K. Now A Lusty Electronics Rival

LONDON—The recently released verbal montage of British electronics, by the Electronic Engineering Assoc., London, reveals not only a healthy industry but a vigorous and growing competitor for the world markets.

Vehicle for this composite of accomplishment is E.E.A.'s Annual Review of 1959, a short summary highlighting various phases of the British Electronics Industry.

With a gross production output for the entire industry at approximately £475 million, total exports of capital goods are estimated to be £28 million (5.9%)—a figure that is growing steadily. Industry growth is estimated at £30 million/year, or 6.75%. [For comparison, the U.S. Electronic Industries Association provided the following figures. Gross production output for 1959—$9.3 billion; industry growth is estimated at $1.4 billion/year, or 16.5%. Business and Defense Services Administration, Commerce Dept., estimates total U.S. exports at $412 million (4.4%).]

According to BDSA, the U.S. is by far the largest single foreign market for U.K. electronic products, with Australia and Canada running second and third. U.K. exports to the U.S. exceeded the combined total of Australia and Canada during 1958 (figures are not yet available for 1959).

U.K. electronics imports from the U.S. total about half the value of its exports to this country.

While U.S. exports have dropped by nearly 5%, British exports are on the increase. Most significant drop by the U.S. is in radio communications equipment—over $20 million in the first nine months of 1959. (This has been partly offset by a 65% increase in radio and TV broadcast equipment exports.)

One particularly interesting figure in the E.E.A. report is an estimate of 10% for the average amount of annual profits currently being invested by leading U.K. firms in self-sponsored research. (The M/R staff estimates U.S. industry is ploughing back from 20-30%, but the British are carrying an unusually heavy tax burden which doesn't leave much to play with.)

• **New advances**—In describing recent major technological advancements, two items stand out in the report, but details are scanty because of security restrictions.

One is a new "distributed amplifier" capable of handling signals from 2-24 mc and requiring no tuning.

Also, a new transmitter has been developed that can "radiate two or more completely independent transmissions" simultaneously and at different frequencies.

• **Output** — The report exhibited high confidence in two of Britain's principal fields of interest—instrumentation and radar. Said the report, ". . . Britain controls a market for the supply of instruments and test equipment," exclusive of other large amounts of military-type electronic equipments sold around the world. "Airborne search radar has had particularly wide acceptance, again against considerable efforts by American companies to command some of our markets."

Maritime radars of British make are being installed at a rate of at least eight ships per working day throughout the year, according to E.E.A. "The existing orders are a fair indication of the command this country now has over international marine markets.' One firm has received orders for over 1300 ship radars in one year.

Having invented it, the British seem intent on hanging onto the earnings of at least one of their many developments.

Other areas in which the British electronics industry is making itself felt are communications systems—VHF and SHF multichannel, tropo-scatter, fixed and mobile microwave instruments and test equipment; radar simulators; radar early warning systems. It also appears that the industry has made gains in developing data handling systems for missile and aircraft defense.

In the field of nuclear electronics Britain is vying heavily for the world market in experimental reactors, instrumentation, test and control equipment.

## Troubles Plague Russia's Tube Plant Construction

MOSCOW—Russia is having trouble getting construction machinery laborers and materials for what will be the largest tube-drawing shop in the country.

Operations for the reconstruction of the Sinarskiy Tube-Making Plant in Kamensk-Ural'skiy are being held up partly because materials were ordered from remote suppliers despite the fact that the Sverdlovsk Economic Region is able to supply them. *(Pravda, Feb. 8.)*

## NAA Engineering Praised At British Meeting

LONDON—North American Aviation was praised as being foremost in the world in rocket facility engineering by two top British engineers.

Mr. L. H. B. Forster (chief engineer) and Mr. L. Breen (senior engineer) of British Oxygen Wimpey, Ltd., lauded the American firm in a lecture on problems encountered in the design of large rocket test beds at a joint meeting of the British Interplanetary Society and the Institution of Plant Engineers, Feb. 23 in London.

Choice of site, design of mountings, blast deflector construction, and techniques used in assembling and operating equipment for handling LOX and liquid nitrogen were among the subjects covered.

British Oxygen Wimpey, Ltd., is the main contractor for the construction of the rocket test facilities at Spadeadam, Cumberland.

## Swiss Rocket Clustering Method Wins British Patent

LONDON—A Swiss firm, Brevets Aero-Mechaniques S.A., of Geneva, has obtained a British patent for a method of mounting clusters of small air-to-air or air-to-ground rockets.

Except for the first and last member of a cluster, each rocket supports and is supported by other rockets. The first member is supported from the aircraft or other launching structure; the last member is of course the first to be fired.

Firing then takes place successively. The holding means for each rocket is so designed that its strength is greater than the thrust exerted on it when another member of the cluster is fired.

# contracts

## NAVY

$3,173,820—Collins Radio Co., Richardson, Tex., for design, fabrication and furnishing of eight data terminal sets.

$2,453,608—Motorola, Inc., Chicago, for producing 484 all-transistor, 10-inc. radar repeaters.

$133,079—Microwave Associates, Inc., Burlington, Mass., for conducting a feasibility study and investigation of the behavior of beam plasma amplifiers.

$65,487—Electronic of Clearfield, Inc., Clearfield, Pa., for oscilloscopes.

$48,000—Avien, Inc., Woodside, N.Y., for temperature and shock monitor controller systems for use on the *Polaris* missile.

## MISCELLANEOUS

$335,000—The Martin Co., Baltimore, for developing a mathematical method of predicting what the major effects will be on a small nuclear reactor as changes are made in the size, shape and content of its fuel core.

## AIR FORCE

Sigma Electronics Research Corp., Seattle, Wash., for design, test and manufacture of telemetry VSWR monitors for the *Minuteman*. Amount not disclosed.

$37,126,810—Hughes Aircraft Co., Culver City, Calif., for *Falcon* missile warhead case; missile shipping and storage container; spare parts and data. Two contracts.

$2,400,000—Hughes Aircraft Corp., Culver City, Calif., for continuation of development, testing and reports on fire control system and *GAR-9* missile.

$1,400,000—Bell Aircraft Corp., Buffalo, for development of manufacturing methods to produce an insulated double-wall type cooled structure which would enable space vehicles to survive the severe high temperatures generated when re-entering the earth's atmosphere.

$800,000—General Electric Co., Syracuse, for precision trajectory measurement system and supporting equipment.

$217,661—Aerojet-General Corp., Azusa, Calif., for design, development and fabrication of five *Astrobee 200* sounding rockets.

$200,000—Paul-Munroe Co., Bell Gardens, Calif., for the building of specialized hydraulic ground support equipment to be used at *Atlas* missile launching sites. Subcontract by Western Gear Corp.

$191,333—Polytechnic Institute of Brooklyn, N.Y., for continuation of research on "Plasmas and High Density Beams."

$116,000—Space Electronics Corp., Glendale, Calif., for studies and experiments in subsurface propagation of electromagnetic waves.

$84,867—Electromagnetic Research Corp., Washington, D.C., for research directed toward a determination of characteristics of atmospheric plasmas.

$63,424—Bell & Howell Co., Chicago, for motion picture cameras with various accessories, 100.

$50,000—Sperry-Rand Corp., Phoenix, Ariz., for microwave command guidance system operation and support.

$49,883—Wold Research and Development Corp., Boston, for research on correlation type data processing systems.

$49,612—Stanford Research Institute, Menlo Park, Calif., for development of improved methods to analyze meteorological data.

$49,006—AeroChem Research Laboratories, Inc., Princeton, N.J., for continuation of research on "Chemical and Aerodynamic Studies in a Low Density Atomic and Ionic Wind Tunnel."

$46,988—Aerojet-General Corp., Azusa, Calif., for IR tracking electronics system.

$45,660—Boeing Airplane Co., Seattle, for photographic reproduction and photolithographic negatives applicable to *IM-992* missile.

$35,000—University of Chicago, for research relating to molecular structure by means of high-resolution spectroscopy primarily in the vacuum ultraviolet region.

$33,864—General Electric Co., Research Laboratories, Schenectady, N.Y., for services and material necessary to monitor a moon-reflected signal.

$31,470—Ampex Data Products Co., Los Angeles, for recorder to be used in support of the *WS-133A* program.

$29,800—Northrop Corp., Hawthorne, Calif., for copy suitable for photographic reproduction and photolithographic negatives in support of *SM-62A* missile.

$25,396—American Science and Engineering, Inc., Cambridge, Mass., for research directed toward the study of radiation from the moon.

$22,000—U.S. Transistor Corp., Syosset, N.Y., for germanium PNP alloy junction transistors.

## ARMY

$2,129,471—Raytheon Co., Waltham, Mass., for replenishment repair parts for *Hawk* missile system.

$2,060,416—Robert E. McKee General Contractor, Inc., and Nordic Construction Ltd., Honolulu, for construction of dual *Nike-Hercules* battery.

$1,278,131—Waldrip and Harvick Co., Long Beach, Calif., for a self-propelled seventeen-story service tower for servicing space missiles.

$1,352,900—Price-McNemar Construction Co., Van Nuys, Calif., for construction of a single *Nike-Hercules* battery.

$1,143,500—Sperry Utah Engineering Laboratory Div., for repair parts for the *Sergeant* missile.

$863,000—Sperry Rand Corp., Salt Lake City, for repair parts for *Sergeant*. (Two contracts.)

$486,375—Douglas Aircraft Co., Santa Monica, for launching area items.

$443,266—Aerojet-General Corp., Azusa, for research and development.

$400,000—Douglas Aircraft Co., Santa Monica, for *Nike-Hercules* launching area items.

$309,955—Raber-Kief, Inc., Seattle, for *Nike-Hercules* guided missile field maintenance shop, Mt. Home AFB, Idaho.

$303,612—California Institute of Technology, for development of advanced *Juno II* clusters.

$228,667—Western Electric Co., New York City, for *Nike* spare parts and components. (Four contracts.)

$224,864—Emerson Electric Mfg., St. Louis, for components, repair parts and special tooling for *Little John* rocket.

$81,360—Sperry Rand Corp., Utah, for *Sergeant* missile.

$41,275—The Martin Co., Orlando., for furnishing technical advisory services for the *Lacrosse* system.

# names in the news

BEGOVICH

**Dr. Nicholas A. Begovich:** Former director of engineering named assistant manager of Hughes Aircraft Co.'s Ground Systems Group and director of product line operations. Previous posts: Consultant to the Weapons Systems Evaluation Group of the Department of Defense, research engineer for the War Metallurgy Committee, and instructor in electrical engineering at California Institute of Technology.

**Adm. Sherman E. Burroughs, Jr.** (USN ret.): Named special assistant to the president at Librascope Division of General Precision, Inc. Was assistant to the president of the firm's parent company, General Precision Equipment Corp.

**Dr. Albert C. Hall:** Director of research and engineering for The Martin Co., named vice president-engineering with headquarters in Denver. Joined the firm in 1958 and has concentrated on the *Titan* program, of which he became engineering director in January, 1959.

**Joseph Hughes:** Former Navy commander, joins the Electronic Systems Division of Dalmo Victor Co. as military advisor.

**John F. Kramer:** Transfers from Vickers, Inc. Electric Products Division's Cleveland office to the firm's Washington, D.C., office as district manager. **Thomas Orr** joins EPD to take over its Cleveland office.

**James Marmor:** Appointed contract coordinator of the Military Products De-

partment of The Garlock Packing Co. Was formerly with the Missiles and Space division at Lockheed, where he was technical coordinator for the *Polaris* program.


WILEY

**W. J. Wiley:** Formerly manager of production programming and control, elected manager, missile manufacturing at Aerojet-General Corp.'s Downey plant. Previously held management positions with Consolidated Vultee, Ryan and Rheem Manufacturing Co.

**Sidney Wiesner:** Former director of quality control for General Transistor Corp., joins Rheem Semiconductor Corp. as quality control manager.

**Dr. Clark T. Randt:** Former scientist for Space Medical Research, elected director of NASA's new Office of Life Sciences.

**R. J. Miller:** Formerly with Electronic Specialty Co., elected marketing manager of the Erie-Pacific Division of Erie Resistor Corp.

**Bruno J. Pawlowski:** Former chief engineer, appointed engineering marketing manager of The Gabriel Co.'s Electronics Division.

**Warren E. Jackson:** Joins Trans-Sonics, Inc., as a staff engineer. Was formerly chief engineer at Arthur C. Ruge Associates, Inc.

**Earl H. Flath, Jr.:** Joins Temco Aircraft Corp., Electronics Division as a senior scientist to plan developments in the fields of radiation, antennas and microwave systems.


DERDERIAN

**S. K. Derderian:** Appointed a member of the board of directors at Metal Hydrides Inc. Will continue to serve as vice president and general manager. Joined the firm in 1943 as an analytical chemist; appointed general manager in 1954 and elected vice president and general manager in 1955.

**Dr. John V. Atanasoff:** Elected vice president of Aerojet-General Corp., Atlantic Division. Was previously manager of the division.

**Dr. Frank S. Stein:** Former manager of Device Development at Westinghouse Electric Corp., Semiconductor Dept., joins General Instrument Corp. as manager of the Semiconductor Research and Development Dept. Under Dr. Stein will be **Dr. R. W. Hull,** as director of semiconductor research, and **Stanley Possok,** as chief of development.


FINDLEY

**L. J. (Jack) Findley:** Appointed application engineer for the Aero Hydraulics Division of Vickers Inc. Was group engineer responsible for auxiliary power systems and flight test coordination at Douglas Aircraft Co. Major engineering assignments included analysis of the *Thor* missile ground support equipment.

**Howard J. Libby:** Former Jacuzzi Brothers, Inc. controller, joins Epsco-West as assistant general manager.

**John K. Hilliard:** Named vice president and director, and **Dr. Walter T. Fiala,** chief physicist, of the newly formed Ling-Altec Research Division of Ling-Altec Electronics, Inc.

**Dr. Arnold M. Small:** Former manager of the reliability and quality assurance laboratory, appointed manager of the product effectiveness laboratory of Hughes Aircraft Co., Ground Systems Group. Prior to joining the firm in September, 1959, was engineering staff specialist at Convair; head of the human factors division of the San Diego Naval Electronics Laboratory, and head of the psychological acoustics section of the University of California.

**Jesse Stitzer:** Named engineering manager at Sorensen & Co., a subsidiary of Raytheon Co. Formerly manager of High Voltage Systems Laboratory.

**Donald R. Seals:** Former chief chemist for Climax Molybdenum Corp., elected research chemist for the Frank R. Cook Co., a subsidiary of Telecomputing Corp.

A reorganization of the Research subdivision of Rocketdyne, division of North American Aviation, Inc., has brought about the following changes:

**Dr. Jack Silverman,** promoted to chief in charge of chemistry; **Dr. L. C. Struckenbruck,** chief of solid propulsion; **Dr. R. S. Levine,** chief of the physical processes section; **S. P. Greenfield,** chief of liquid propulsion section; **J. E. Witherspoon,** head of physics and mathematics group; **Dr. R. B. Lawhead,** process dynamics; **Dr. K. H. Mueller,** experimental chemistry; **G. S. Gill** and **J. V. Hobbs,** group scientists for liquid engine applications and research instrumentation; **Charles Bernstein,** propellants and polymers; **R. D. Sheeline,** solid propellant applications, and **C. H. Martinez,** special projects.

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## reviews

**TELEMETERING SYSTEMS,** Perry A. Borden and W. J. Mayo-Wells. Reinhold Publishing Co. New York. 349 pp. $8.50.

This badly needed basic text is the first authoritative work in this field in several years.

Written by two men who have been intimately connected with telemetry since its early days, the book covers all aspects of both industrial and military systems. It includes the latest developments and contains existing authoritative standards.

It is written without resort to complicated mathematics and can be easily understood by anyone with an interest in the field. The stated objective of the book is to provide a working knowledge of the principles and practices of present-day telemetering and its use in a wide range of applications. It describes the wide range of telemetering systems, their history, uses, limitations, basic components and subsystems.

**HOW TO USE METERS,** Second Edition. John F. Rider and Sol D. Prensky. John F. Rider Publisher, Inc., New York 11, N.Y. 216 pp. $3.50.

This book satisfies the practical interest of those concerned with measuring devices, their basic principles and application. The most advanced developments—transistorized voltmeters, digital displays, refined laboratory instruments which provide greatly increased sensitivities, indication features in meters providing long-arc (250°) meter scales—are brought to the reader.

Details are given on construction, operation, and application of all types of electrical meters used for making different kinds of measurements in electronic and electrical equipment, and industrial applications.

In the new chapters on specialized measurements and advanced meter features, attention is given to the important extension of measurement capability.

**RADIATION COUNTERS AND DETECTORS,** C. C. H. Washtell. Philosophical Library Inc. New York 16, N.Y. 115 pp. $7.50.

The book was written to provide a simple introduction to radioactive detectors and measurement techniques for the reader with a general scientific background whose work involves making radioactive measurements.

Material includes the atomic structure, radiation detectors, Geiger-Muller tubes, other types of detectors based on ion collection and methods of detection not based on ion collection.

**THE AERODYNAMICS OF POWERED FLIGHT,** Robert L. Carroll. John Wiley & Sons, Inc., New York. 273 pp. $8.50.

This book is intended to be an introduction to the aerodynamics of powered flight. The simplicity of presentation makes the book useful as an instrument of self-study for professional personnel working in the field.

Since the rocket as a system affords the greatest simplicity of analysis, the concept of lift has been based on the analysis of rocket thrust.

The presentation throughout is thoroughly modern, and many of the topics covered are ones which older books either neglect or treat inadequately.

**MOON BASE, TECHNICAL AND PSYCHOLOGICAL ASPECTS,** T. C. Helvey. John F. Rider Publisher, Inc., New York. 80 pp. $1.95.

Main problem areas in the construction of a moon base are explored from a simple, but technical, viewpoint. In selection of a crew for this base, the author proposed a team made up of two men and a woman.

The author also explores the design of a moon-base prototype and discusses the technical description of some of the features of a prototype and the psychological analysis of the smallest operational

**RESEARCH HIGHLIGHTS OF THE NATIONAL BUREAU OF STANDARDS,** Annual Report 1959. Order National Bureau of Standards Miscellaneous Publication 229, from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 169 pp. $.55.

This illustrated report brings together the most important developments in the research program of the Bureau during 1959. It describes a wide range of scientific studies, laboratory experiments, and instrumentation developments.

Much of the material is concerned with the new technology of the Space Age. Progress is reported in extending the calibration range of optical pyrometers from 2400° to 3800°C, development of a high-current arc as a source of controlled temperatures, and design of a special type of high-temperature resistance thermometer for interpolating between fixed points on the International Temperature Scale.

There are reports on special efforts to improve the high temperatures. Some of these studies deal with solid-state reactions in high-temperature alloys, refractory coatings for aircraft and missiles, and new cements for high-temperature strain gages.

Radio research includes ionospheric soundings, development of a communications system which reflects messages off meteor trails, refraction of radio waves in the earth's atmosphere, and many other topics.

The report also summarizes the Bureau's Calibration, Testing and Standard Samples, programs, publications program, and cooperative research with industry. A brief summary of some of the programs planned for this year is included.


## Tiny Digital Display Developed

A miniature incandescent digital readout which displays the digits zero through nine on a common 1" x 1" area is now available from the Burroughs Corporation, Electronic Tube Division, Plainfield, New Jersey. The unit (Type LD-11) presents high density white-on-black (or black-on-white) numerals instantaneously with the lighting of each bulb. Special units which can display as many as ten complete messages in the same 1" square viewing area are also available.

The LD-11 utilizes an adaptation of Burroughs' lenticular optic technique which eliminates the need for projection lenses. The result is a display which is free from the common defects of incandescent displays; i.e., non-uniformity due to lens distortion and partial illumination caused by filament sublimation and sagging. Other outstanding advantages are its modular construction designed for direct panel mounting and its small over-all size (1" x 1" x 3") which reduces the behind panel space requirements.

The unit is offered with long life bulbs designed for operation from 2½, 6, 12 or 28 volt systems. The display is easily read from a wide angle of view and complements the existing line of Burroughs display devices; LD-22 and LD-35 Multi-Message Displays (16 or 20 messages on 2½" x 2½" or 3" x 5" viewing screens) and Ultra Long Life NIXIE Indicator Tubes.

The LD-11, utilizing a 2½ volt bulb, is priced at $24.00, in quantities up to 99. This miniature readout is immediately available from stock.

Circle No. 225 on Subscriber Service Card.

## Wire Soldering Dispenser

Kormat, a new wire soldering dispenser developed by PFI Products, is a safe, cost-reducing wire solder dispenser tool offering broad application flexibility to the point of solder.

The unit's push button feeder adjusts the right amount of solder for each and every application—not too much or too little—the ideal solution to wire.

A selection of attachments including straight or curved probes in several lengths for hard-to-get-at areas, and a 20 ft. roll of 60/40 rosin core solder of .050" diameter wire are available. Flip action reloads wire solder in seconds.

Circle No. 226 on Subscriber Service Card.

## Portable X-ray Unit

The Norelco PG 300, a new portable industrial X-ray unit that provides high penetrating power and excellent radiographic definition, is available from Philips Electronic Instruments.

Completely self-contained, the new unit is shockproofed, rayproofed and weatherproofed for outdoor operation.

Safety Devices effectively prevent overload on the tube. Tubehead weighs only 231 lbs. and therefore may be hoisted to remote areas for radiography of more than 3 inches of steel.

Emergent beam angle is 40 degrees and focal spot size is 2.3 mm. X-ray voltage is continuously adjustable under load in a stepless range from 65 to 300 kv. Load rating is 5 ma (milliamperes) up to 260 kv and 4 ma from 260 to 300 kv. Duty cycle is 100% continuous with water cooling—intermittent with air.

Oil insulated, with inherent filtration equivalent to 4 mm of aluminum, the PG 300 tube head has a diameter of 9⅜ in. and is 47⅝ in. long, including handles. Control cabinet measures 19 in. by 12⅝ in. by 11¼ in. and weighs 77 lbs.

Power requirement for the PG 300 is 220 volts, 50/60 cycles, 9 amperes. An automatic reset timer is included with the control unit.

Circle No. 227 on Subscriber Service Card.

## Missile Valved Couplings

Development of a "15 Series" quick connect-quick disconnect valved coupling, designed primarily for military and missile applications, has been announced by SnapTite, Inc.

The new series is a self-sealing

coupling designed for "no-spill" service in accordance with military specifications for use in airborne and ground hydraulic systems.

Variations have been designed to meet special coupling situations, such as remote handling of liquefied gases. The couplings are available in ¼ to 1¼ in. sizes. The new "15 Series" couplings also may be used with fuels and other fluids with working pressure up to 3000 psi, and temperatures up to 400°F in the ¼ in. size.

Circle No. 228 on Subscriber Service Card.

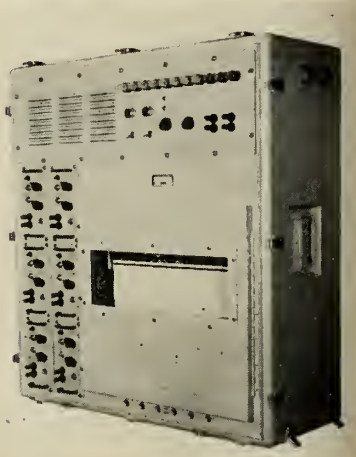


## Six Channel Recorder

A six channel, AC-DC recorder has been developed. High stability and virtual drift free operation are obtained by positioning the recording stylii by means of servomechanisms instead of the conventional galvanometers. The stylii are thermal writing and product rectilinear traces.

Initial application of the instrument is for recording error signals from fire control computers used with shipboard guided missile systems.

In addition to recording signals with a bandwidth of from 0 to 30 cps, each channel is capable of accepting modulated signals on both 60 cps and 400 cps carriers and provides a phase sensitive recording with no additional equipment required. The type of signal to be recorded is selected by a front panel control on each amplifier. Maximum sensitivity of each channel is approximately 2.5 millowatts per millimeter of stylus deflection. Minimum



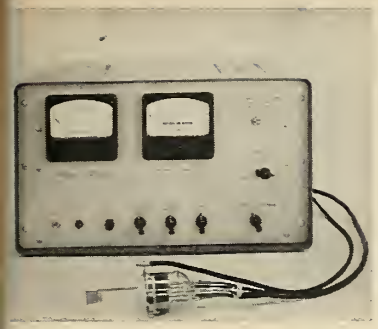
sensitivity permits recording signals of up to 300 volts peak to peak.

Each recording channel is 5 centimeters wide. The zero position of the recording stylii may be placed anywhere within the channel by means of a front panel zero offset control. Two event marking channels are also provided in addition to the six recording channels. The recorder may be mounted in either a vertical or horizontal table top position.

Circle No. 229 on Subscriber Service Card.

## Vacuum Gauge Control

An ionization gauge control that overcomes the zero drift tendencies inherent in ultra-high vacuum models and that meets both the emission and out-gassing requirements of any Bayard-Alpert type ionization gauge, in-



luding the Nottingham Gauge has recently been developed by NRC Equipment Corp.

The new control, designed to measure from $10^{-3}$ to $10^{-10}$ mm Hg by direct methods, and from $10^{-10}$ to $10^{-12}$ mm Hg by indirect methods, will indicate pressures down to the limit of detectability of the gauge tube within ±5% of full scale. Pressures of these magnitudes are of prime interest to engineers and scientists engaged in research and production of subminiature electronic elements, in space simulation, in thermo-nuclear apparatus, and in general process and materials studies relating to solid state physics.

High stability, convenient operation, and the ability to outgas and read any of the ultra-high vacuum ionization gauges are the outstanding characteristics of the new control.

Most gauge controls must be zero set after relatively short periods of operation or shutdown. With the Model 751 control, zero drift is less than 1% of full scale in 24 hours. A typical production control, after 24 hours of operation, displayed no discernible drift over the next 72 hours. The same control, turned on after a 24-hour shutdown, required no zero adjustment. This stability is achieved with a specially designed electrometer circuit. The output is linear from 0 to better than 20 volts, and line voltage variations from 105 to 125 volts will not affect the reading.

Circle No. 230 on Subscriber Service Card.

## Oscilloscope Camera

A versatile, simplified oscilloscope recording camera is introduced by Beattie-Coleman. Known as the "Minute Man Oscillotron," it features a Polaroid Land back providing either 60 second prints or transparencies. Attaches to any 5" Oscilloscope. Swings out, lifts off for easy accessibility. Light and compact, it is a precision instrument built for continuous duty. Wollensak 75 mm f/2.8, f/1.9 standard or f/1.9 flat-field lenses are interchangeable.

Of modular design, it can instantly

be converted to record a wide range of object-to-image ratios, and can be removed from oscilloscope for other instrumentation photography.

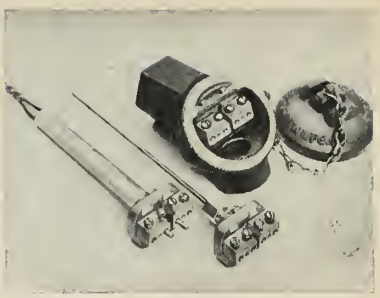
Easily attached accessories include: Binocular viewing hood; adapter to record up to 10 traces on a single frame; 35mm pulse camera; 35mm continuous motion magazine; data chamber with watch, platen and counter; data card to record in frame; external focusing control; electric shutter actuator.

Circle No. 231 on Subscriber Service Card.

## Heavy Duty Thermocouple

The E. C. Smith Mfg. Co., Inc., has announced a new, small-size industrial thermocouple connection-head which is rugged, weather-proof, and is designed for high-ambient temperature and corrosive-atmosphere applications. Called Mini-Head, it is the first to use an all-stainless-steel chain and non-removable screws. The screw cover absolutely cannot be dropped or mislaid.

Made of semi-steel, the new connection-head contains a high-temperature refractory terminal block which will fit B&S No. 7 gage or smaller T/C wires, and B&S No. 12 or smaller extension wires. A special heat-and moisture-resistant gasket is retained in



the cover to assure a tight seal.

The Mini-Head accommodates both conventional thermocouple wire-elements and the new metal-sheathed thermocouples featured in Smith's Cerami-Kouple line. Special adapters hold four sizes of metal-sheathed thermocouples: 1/16", 1/8", 3/16" and 1/4". A red silicone paint protects the connection head.

Circle No. 232 on Subscriber Service Card.

## Pressure Sensitive Adhesive

A new pressure sensitive adhesive that is particularly suited for general purpose applications, including the bonding of fabric, paper, wood, plastic, glass, metals and many other materials, has been announced by Schwartz Chemical Co., Inc.

The adhesive is supplied with heavy syrup viscosity for fast drying application with brush, roller or Doctor Knife. It remains soft and can be used within a few minutes or covered with release paper for deferred use. One gallon will prepare approximately 200 square feet.

Circle No. 233 on Subscriber Service Card.

# New Literature

REMOTE CONTROL. A 12-page color catalog on mechanical remote control systems for the missile industry is available from Teleflex Inc. Typical control systems described are: gate valve operation; umbilical cord disconnect; main fuel control; and nozzle feedback. Engineering information is listed tabularly, including cable sizes, minimum bend radii, weights, maximum operating loads, materials, temperature ranges, and physical dimensions.

Circle No. 200 on Subscriber Service Card.

FASTENERS. A 24-page illustrated catalog describing the complete line of Huck fasteners is now available from Huck Manufacturing Company. It includes discussion of a broad variety of tension and featherweight Huckbolt fasteners, self-broaching Huckbolt fasteners, self-sizing Huckbolt fasteners, pull-thru blind rivets, friction-lock self-plugging blind rivets and lock-spindle self-plugging blind rivets. Driving cycles, strength data, typical applications, grip ranges, significant dimensional data, hole size recommendations and installation notes are included for each fastener in the Huck product line.

Circle No. 201 on Subscriber Service Card.

HAND TORCHES. Air Reduction Sales Company has issued a newly-revised 36-page catalog on its line of gas welding and cutting hand torches, outfits, tips and accessories. The company's complete group of equipment is covered in detail with general descriptions, features, specifications and photographs given for each product. Also included are specification charts on Airco welding and cutting tips listing all pertinent information that a user might need to make the proper selection for both general purpose and special gas welding and cutting.

Circle No. 202 on Subscriber Service Card.

ELECTRICAL PRODUCTS. Two new catalogs have just been issued by Buchanan Electrical Products Corporation. Both cover Buchanan sectional and one-piece terminal blocks, solderless connectors for wire splicing and terminating, squeeze-type connectors for non-metallic sheathed cable, insulated conduit bushings and knock-out plugs.

Manufacturing and Production Catalog No. 76 is especially prepared for design engineering, production and purchasing personnel. It features complete technical data, detailed engineering specifications and drawings on Buchanan sectional pressure-blocks. Contracting and Maintenance Catalog No. 35 is especially prepared for electrical contractors and plant maintenance departments. It features Buchanan pressure-connectors for wire splicing and terminating.

Circle No. 203 on Subscriber Service Card.

INDUCTION HEATING. A folder on induction heating equipment for automated metal heating has been published by Robotron Corp., Detroit, manufacturers of industrial electronic controls. It explains company technical services available to the customer—problem analysis, research, design engineering and manufacture of tailor-made end product—with illustrations of facilities and equipment to do the job.

Circle No. 204 on Subscriber Service Card.

ELECTRON TUBES. Latest trends in the design and manufacture of electron tubes for entertainment, industrial and military applications are discussed in a new booklet published by Sylvania Electric Products Inc.

Circle No. 205 on Subscriber Service Card.

## —when and where—

### MARCH

**Electronics Industries Association, Defense Planning Seminar,** Statler Hilton Hotel, Washington, D.C., March 15.

**Institute of Radio Electronics, 1960 International Convention,** Waldorf-Astoria and New York Coliseum, New York City, March 21-24.

**American Rocket Society, Ground Support Equipment Conference,** Statler-Hilton Hotel, Detroit, March 23-25.

**Symposium on Optical Spectrometric Measurement of High Temperatures, sponsored by University of Chicago's Applied Science Laboratories, Jarrell-Ash Co., National Science Foundation,** University of Chicago, March 23-25.

**22nd Annual American Power Conference, sponsored by Illinois Institute of Technology, American Society of Mechanical Engineers and others,** Sherman Hotel, Chicago, March 29-31.

### APRIL

**University of Connecticut, Sixth Annual Advanced Statistical Quality Control Institute,** Storrs, April 3-15.

**Solar Energy Symposium, American Society of Mechanical Engineers, and Mechanical Engineering Dept.,** University of Florida, Gainesville, April 4-5.

## Advertiser's Index



EMPLOYMENT

# 'Freedom of Space?' Who Says So?

Congress is considering certain changes in the National Aeronautics and Space Act of 1958. They are largely administrative.

They do not alter the fact that nothing important will be done in space, no important program started, no important goal set unless the President, whoever he is or may be, personally orders it.

They do not alter the basic fault of the law—the fact that it attempts to define the roles of NASA and the Department of Defense in space by *program* rather than by mission. It is probably the only important similar legislation on the U.S. statute books so written.

The President and the Administration, who in effect dictated the Space Act, have repeatedly held that the military has no mission in space.

This is like saying the military has no mission on the sea, on the ground or in the air.

The military has a mission in space simply because space is there.

This mission no more quarrels with the role of NASA than the mission of the Navy quarrels with that of the President Line or the mission of the Air Force quarrels with that of TWA.

The mission of the military does guarantee the right of merchant ships and commercial airliners to operate free of predacity and tribute. Its mission anent NASA or any other American enterprises in space should be equally recognized and established.

In other words, as NASA is given the mission of exploring space for peaceful purposes, the military should be given the mission of guaranteeing that NASA (the U.S.) is duly protected at all times in carrying out its task.

Then the military could work out its program based on such a mission and budget for it—in the same way it now plans and budgets in other areas its job of protecting this country against potential enemies.

After defining NASA's role in peaceful exploration of space for scientific purposes, the National Space Act amendment dealing with the military role backs into the problem thusly:

"Sec. 309. (a) Nothing in this Act shall preclude the Department of Defense from undertaking such activities involving the utilization of space as may be necessary for the defense of the United States, including the development of weapon systems utilizing space vehicles and the conduct of supporting research connected therewith."

And then yanks the rug out with:

"(b) In order to accomplish the most efficient utilization of resources, responsibility for the development of each new launch vehicle, whether intended for use by the Administration (NASA) or the Department of Defense or both, shall be assigned by the President to either NASA or the Department of Defense."

We submit that as the military has the mission of otherwise defending the United States, it equally should have the job of defending our right to travel in and to explore space; it should have the mission of guarding against enemies who may try to deny us such exploration or try to use space as a battleground against us.

The National Space Act should say to the military "This is your mission. Coordinate with NASA. Submit a program to Congress and the people that looks ahead ten or even twenty years —a program which accomplishes your mission to the best of your ability."

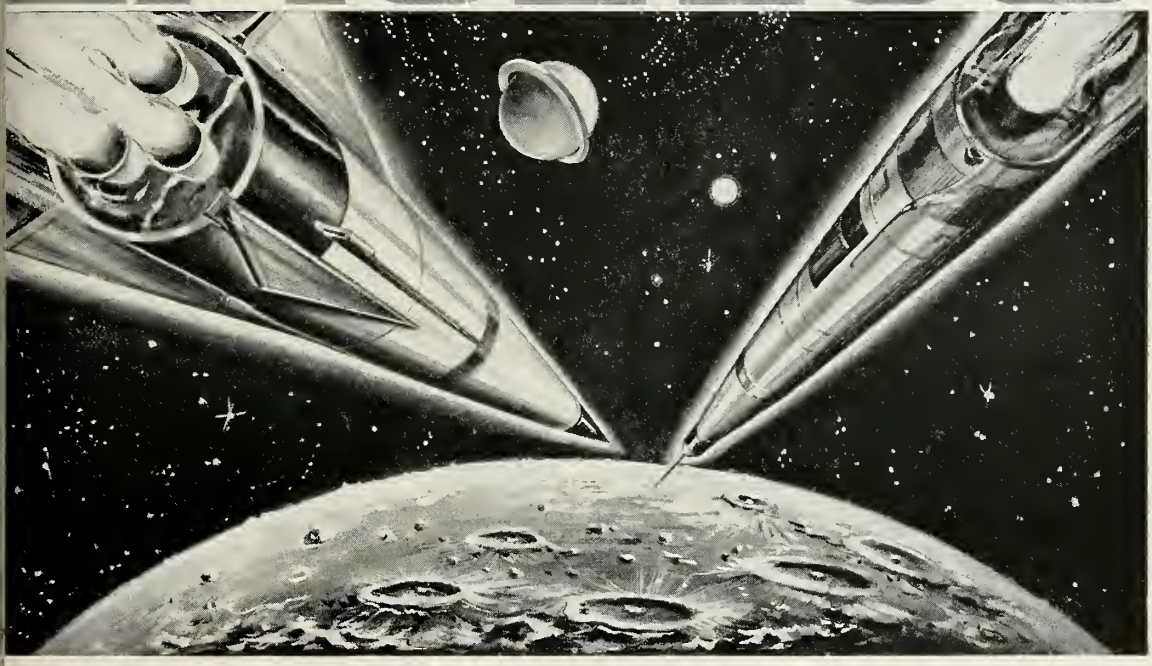
The National Space Act has a well-meant, even noble preamble. It reads:

"The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

When—when in this world has it ever been possible to maintain a peace without maintaining the means to defend it fiercely?

**Clarke Newlon**

# EXCELCO



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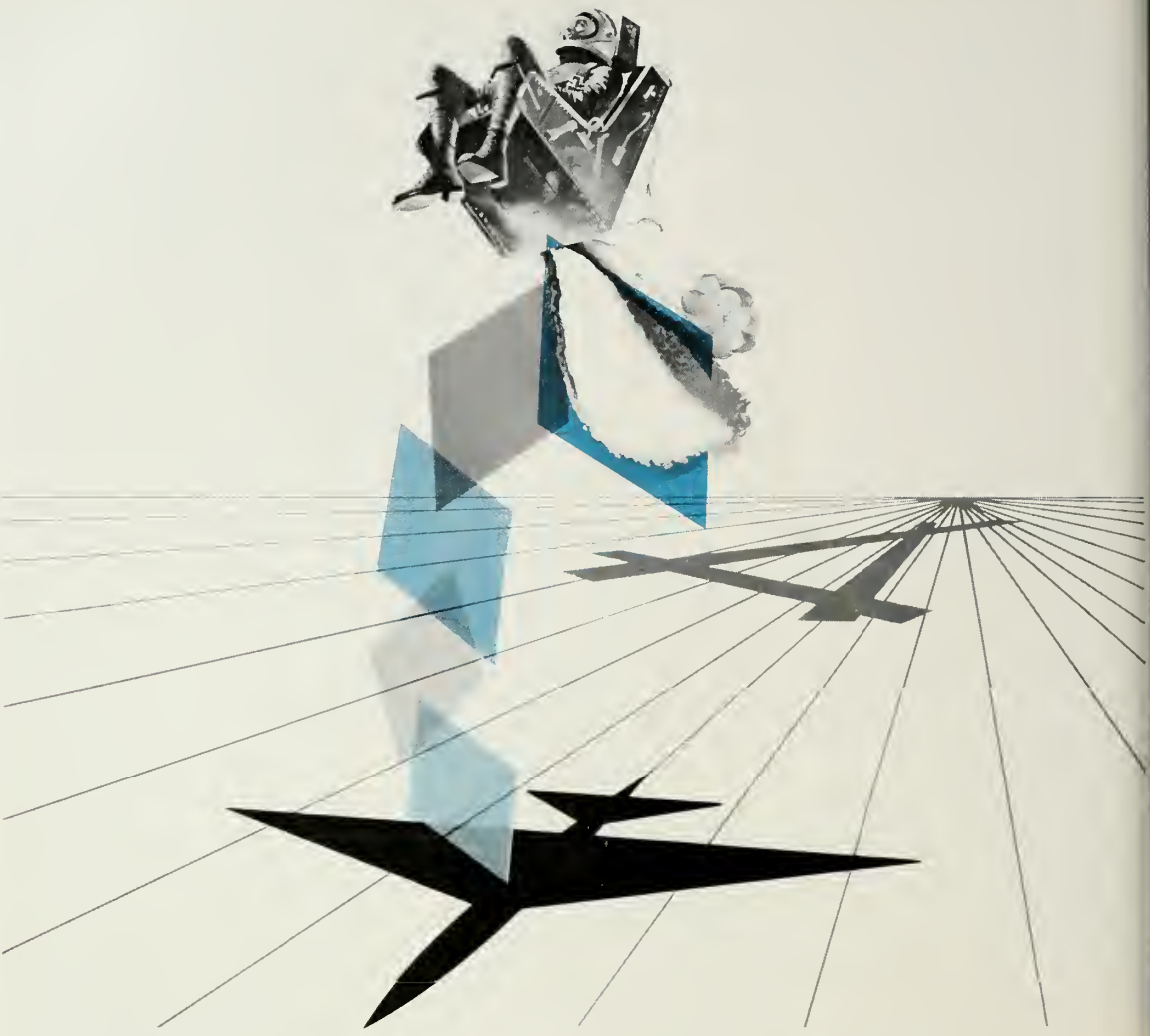

# Getting Jack out of the Box . . .

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