



JANUARY 15, 1960

TITAN PRODUCTION LINE

# missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS



**SPECIAL REPORT**

**Fiscal 1961 Budget—  
What It Holds for Missiles and Space ... 19**

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In the Redstone, Chrysler Missile Division engineers employ silicone laminates several ways. As in the case of the F-100, large heat shields behind

the Redstone's engine compartment are fabricated of the laminates because of their light weight, heat resistance, thermal impedance. Also, due to excellent electric strength and creep resistance, silicone laminates are utilized for terminal boards in black boxes within the missile and in Ground Support Equipment control boxes.



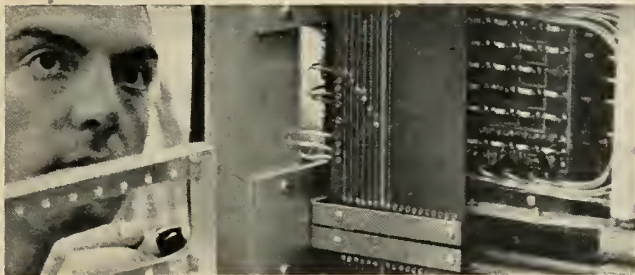
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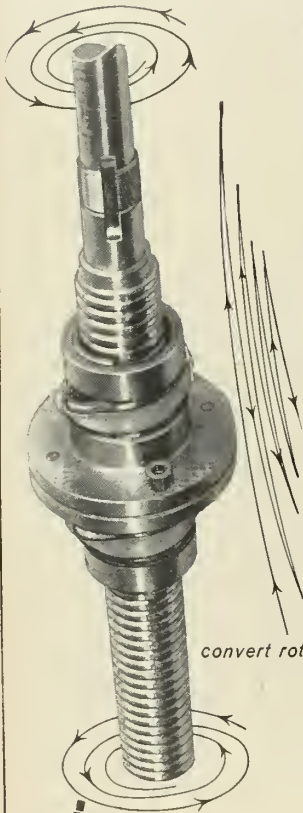
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missiles and rockets, January 25, 1960



# missiles and rockets

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## ▶ JANUARY 25 HEADLINES

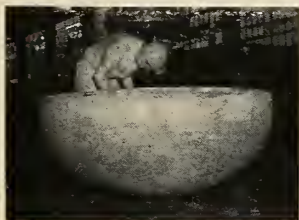
**COVER:** First photo of the *Titan* production line at Martin Co.'s Denver Division. Here are first and second stages in various phases of assembly. For a report on new techniques in the assembly line, see p. 32.



**COMPARING** Northrop Corp.'s space capsule mock-up and his own racing car, driver Jay Chamberlain prepares to test a biomedical instrument system developed by Northrop's Norair Div. to send data from space.



**RP-76** target bird sits in front of *Nike-Hercules* missile which will be simulated enemy in Army *Nike* firings. Radioplane Div. of Northrop Corp. recently received a \$7.5 million contract for 400 RP-76's.



**DESTINED** to be a dome for the rocket motor of the *Minuteman* solid-fueled ICBM, a 300-lb. elliptical head is inspected after pack pressing at the Lukens Steel plant, Coatesville, Pa.

### Fiscal 1961 Missile/Space Budget Totals \$9.3 Billion

Funding request is increased \$2 billion over FY 1960; the bulk of the money goes to military weapons; *Saturn* gets overtime boost, but other NASA projects starve under one-third spending hike

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**JANUARY**

- Institute of the Aeronautical Sciences, 28th Annual Meeting, Hotel Astor, New York City, Jan. 25-28.
- Second Annual Symposium on High Speed Testing, sponsored by Plas-Tech Equipment Corp., Somerset Hotel, Boston, Jan. 27.
- Gas Dynamics Colloquium, Research in Rarified Gas Dynamics, Northwestern University, Evanston, Ill., Jan. 28.
- Seventh Annual Western Spectroscopy Conference, Asilomar, Pacific Grove, Calif., Jan. 28-29.
- American Rocket Society, Solid Propellants Conference, Princeton University, Princeton, N.J., Jan. 28-29.

**FEBRUARY**

- Chemical Institute of Canada, Toronto Section, Symposium on Gas Chromatography, Seaway Hotel, Toronto, Ont., Feb. 1.
- Instrument Society of America, Houston Section, Instrument-Automation Conferences & Exhibit, Rice Hotel and Sam Houston Coliseum, Houston, Feb. 1-4.
- Society of the Plastics Industry, 15th Annual Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Feb. 2-4.
- Sixth Annual Midwest Welding Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology; Chicago Section, American Welding Society, Illinois Tech Chemistry Bldg., Chicago, Feb. 3-4.
- Institute of Radio Engineers, Professional Group on Military Electronics, 1960 Winter Convention on Military Electronics, Biltmore Hotel, Los Angeles, Feb. 3-5.
- Institute of Radio Engineers, American Institute of Electrical Engineers, Seventh Annual Solid-State Circuits Conference, University of Pennsylvania, Philadelphia, Feb. 10-12.
- Annual Meeting of American Institute of Mining, Metallurgical and Petroleum Engineers, Sheraton Atlantic Hotel and Statler Hilton Hotel, New York City, Feb. 14-19. (Metallurgical Society Forum on Navy Problems, Feb. 15)
- Third Annual Missile/Space Industry Conference, National Rocket Club, Sheraton Park Hotel, Wash., D.C., Feb. 16-17. (Dr. Robert H. Goddard Memorial Dinner, Feb. 17.)
- First National Symposium on Nondestructive Testing of Aircraft and Missile Components, sponsored by Southwest Section, Society for Nondestructive Testing; Southwest Research Institute, Hilton Hotel, San Antonio, Tex., Feb. 16-18.
- AIEE Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Feb. 18-19.
- First National Society of Professional Engineers Winter Meeting, Broadview Hotel, Wichita, Kan. Feb. 18-20.



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# FOUR DOW PLANTS OFFER AIRCRAFT AND MISSILE MEN WIDE CHOICE OF MAGNESIUM WARES

**Coiled sheet, thin wall castings, many other production items are now available from Dow's big rolling mill, foundry and fabrication facilities.**

Aircraft and missiles manufacturers on the alert for improved materials and production methods would enjoy a personal tour of the four Dow plants that turn out magnesium products. Next best thing is this quick rundown on the new ways of forming and fabricating magnesium now being practiced in these plants to open up new uses for the lightweight metal . . .



TOOLING PLATE, extra flat, is annealed to eliminate residual stresses.

**At the huge Madison, Illinois, rolling mill,** for example, they're making magnesium sheet that doesn't require stress relief after welding. This is a major step forward in light metal technology and a boon to manufacturers using magnesium assemblies. Madison has also increased the maximum width of sheet to six feet. Five different sheet alloys, including elevated temperature alloys, are now available either flat or in coils.

To keep abreast of the rapidly increasing demand for precision

jigs and fixtures, Madison keeps a close watch on the tolerances of Dow magnesium tooling plate. Typical flatness tolerances, for example, are 0.010 inches in any six feet. This means greater accuracy and less machining for users of Dow tooling plate. Madison is now turning out both magnesium and aluminum extrusions that cover a wide range of sizes: from delicate precision parts to a 30-inch circumscribed circle size—made by Madison's mammoth 13,200 ton extrusion press.

**Over in Bay City, Michigan,** interesting things are happening, too. At the well-equipped Dow magnesium foundry, largest in the U. S., sand and permanent mold castings of all sizes and shapes are being produced on a volume basis. Complete facilities are maintained for heat treatment, styrene DMI impregnation and chemical treatment. A well-staffed quality control team makes sure that all specifications are met or exceeded, and that the most modern equipment and techniques are fully utilized.

The Bay City foundry casts many complex and difficult designs. Large castings with walls as thin



DOW FOUNDRY offers production capacity for sand and permanent mold castings of all sizes.

as 0.100 are now being produced. Other useful developments include cast-in tubeless passageways for use as hydraulic lines, special coring techniques for casting enclosed shapes, and new magnesium casting alloys.

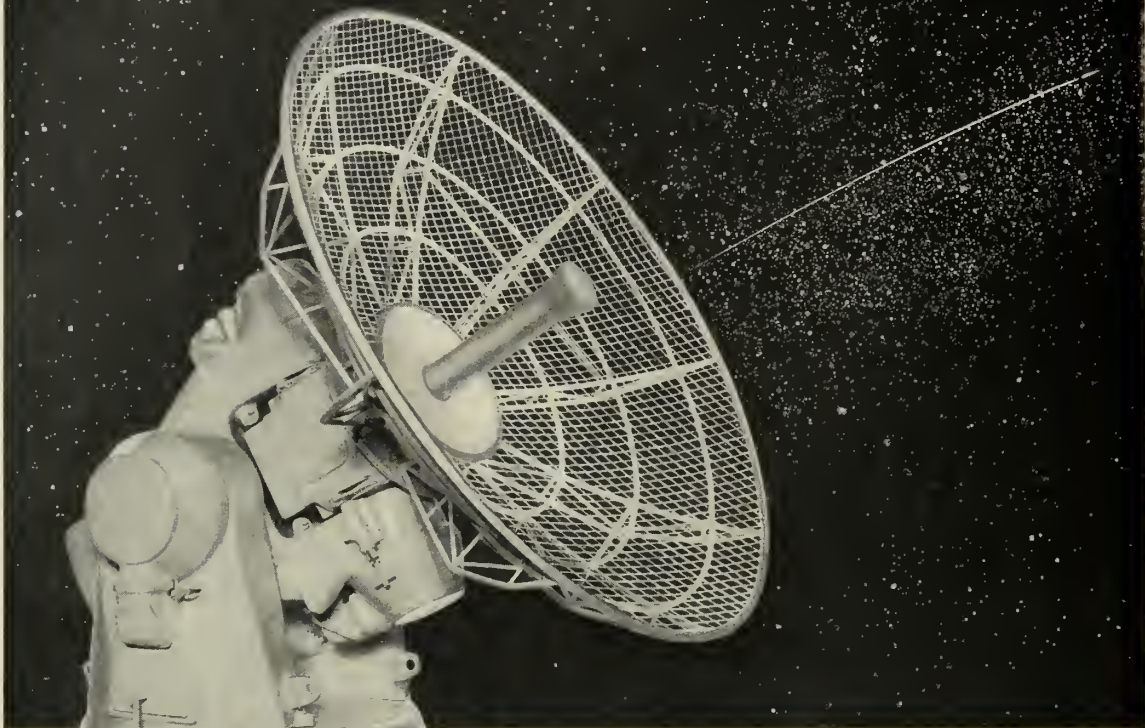
**A new die casting plant** is now on stream at Bay City. This facility houses the most advanced magnesium die casting equipment, including cold chamber metering units which automatically feed metal to the machines and contribute to unusually high production rates. To assure close alloy composition control on both die casting plant and foundry, a direct reading spectrometer provides frequent and precise analyses of the molten metal. Similarly, X-ray equipment is also available where radiography is needed in quality control.

**The Dow fabrication plant,** also in Bay City, offers capacity for volume work on magnesium assemblies. Here, too, developmental work on magnesium is constantly in progress. The plant is set up to handle large or small jobs, and plenty of both. Its activities include deep drawing, bending, spinning, stamping, piercing, machining, arc and spot welding, assembly, chemical treatment and painting. This plant has pioneered many "firsts" in magnesium production, such as hot drawing, spot welding and automatic welding.

**For more information** about Dow's magnesium production facilities, contact the nearest Dow sales office or THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Department 1000CL1-25.



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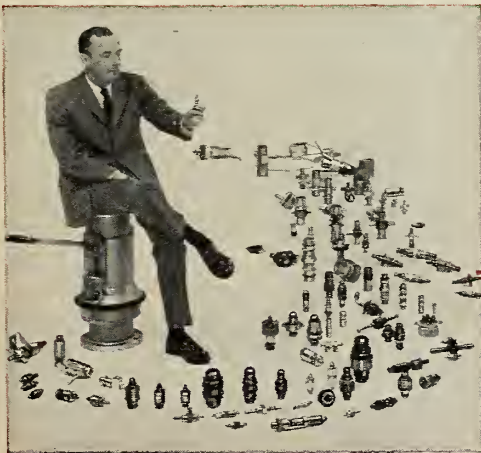
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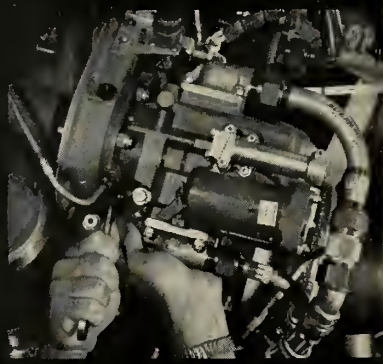
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# Washington Countdown

## IN THE PENTAGON

### Nike-Zeus test shots . . .

now are expected about once a month at White Sands Test Range. Meantime, the \$137 million in pre-production money that Congress voted for the Western Electric AICBM last year will remain indefinitely in the Administration's cold storage vaults.

### Missiles vs. bombers . . .

The outcome can be read in the FY 1961 budget with authorizations for missiles almost topping those for aircraft. And, under present plans, FY 1961 will see the last of the money to be spent on heavy bombers.

### Operational Davy Crocketts . . .

will begin entering the Army's weapon arsenal during the coming fiscal year. The hand-carried missile—a product of the Army's Rock Island Arsenal—carries a fractional-yield nuclear warhead.

First word of what U.S. defense officials thought might be the Soviet big missile shot into the Pacific broke Jan. 20. The Pentagon said it had "unverified reports" of the possible impact of a Soviet nose cone between the Hawaiian and Gilbert Islands.

### Project Sunrise . . .

is ARPA's new program aimed at originating and studying new concepts for advanced military weapons including the space weapons of tomorrow. Studies will be directed specifically to areas which ARPA feels "may not now be receiving adequate attention by the scientific community."

### Detailed Breakouts . . .

from the new defense budget show that in FY 1961:

. . . spending for all electronics and communications including everything except equipment inside a missile or vehicle will rise to \$1,096,000,000—a \$190 million increase.

. . . new obligational authority for all ASW programs will rise to \$1,370,800,000—an increase of \$95 million.

. . . new obligational authority for ASW R&D will drop to \$180,500,000—a \$45 million decrease.

. . . new obligational authority for R&D on the Douglas *Sky Bolt* runs about \$60 million.

## ON CAPITOL HILL

### The Smart Money . . .

is that Congress will vote considerably more money for space programs this year. A number of top members of the congressional space committees are reported to be highly irritated with President Eisenhower's so-called "doubled" space budget.

### The military salesman bill . . .

proposed by the Hébert Subcommittee is expected to be approved by the full House Armed Services Committee after brief hearings. Meantime, the Subcommittee will move on to hearings on incentive defense contracts and the release of a sharp report on the weapon system concept of R&D.

## AT NASA

### At least \$50 million . . .

will be added to the budget for the Huntsville *Saturn* team for FY 1961, if the team's expectations are realized. That would push obligations for the big booster in the new fiscal year to about \$190 million—still \$60 million short of the all-out budget previously sought by *Saturn* advocates.

### Tiros launchings . . .

in 1960 are understood to have been stalled by international politics. The weather satellite is ready for its first test launching whenever the State Department permits.

### The Echo balloon flight . . .

Jan. 16 is reported to have soared close to an airliner bound to New York from Paris. The rocket-boosted ascension from Wallops Island was the second in a series to test the payload for a reflecting *Echo* satellite.

## AROUND TOWN

### The return of Lunik III . . .

to the atmosphere is expected about March 8. The 614-pound satellite that photographed the far side of the moon for the first time was launched last Sept. 18—probably from Mirny.

### The Russian Golem IV . . .

an underwater-launched missile of the same class as *Polaris*, is reportedly under development. European sources say that the Russian shipyard at Severodminsk is designing nuclear-powered subs to carry the new missile.



# DIVERSIFICATION

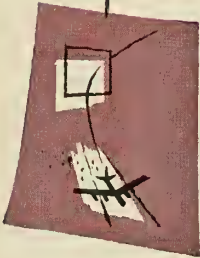
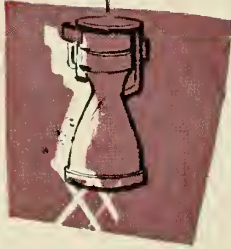
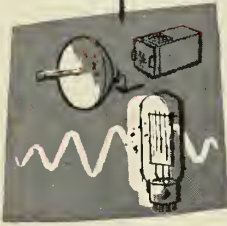
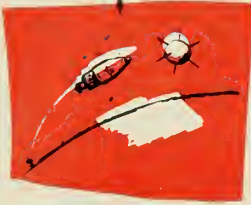
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Bell rocket engines are pushing an Agena into polar orbit with each launching under the Discoverer program. The Air Force has contracted for a Bell all-weather automatic landing system already proven in thousands of actual demonstrations. Bell reaction controls are being used on the X-15 and are being readied for Mercury. Bell accelerometers make up part of the guidance systems for the Army Sergeant and other missiles. The nation's first deflected jet VTOL experimental aircraft, designed and built by Bell, has been flight tested by NASA.

Bell is also actively engaged in many other highly advanced technical projects. These, to name a few, embrace such fields as double-wall construction, automatic drone control, ducted propeller VTOL aircraft, ground effect vehicles, revolutionary new battlefield surveillance techniques and extremely accurate, highly sensitive complete inertial guidance systems for aircraft, missiles and space vehicles.

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# Industry Countdown

## MANUFACTURING

### Total of 125 rail-launch . . .

cars are now planned for the Boeing *Minuteman*—probably five to a train. American Machine & Foundry and ACF Industries—winners of the initial \$1-million design/development contract—are expected to come up with a prototype late this year. Beyond feasibility stage, contract runs to \$6.5-million and also includes design and prototype construction of a railroad launch control car. The feeling now is that the mobility phase of *Minuteman* will be limited. By the time it becomes operational in mid-1963, a “third generation” ICBM is expected to be well along that will be more adoptable to mobile launching—either by rail or ship.

### New Hawk anti-aircraft . . .

missile plant costing \$50 million is being built at St. Médard, France. Missile assembly will be under management of SETEL (Société Européenne de Téléguidage) composed of Thomson-Houston of France, Telefunken of Germany, Finnmeccanica of Italy, Ateliers de Constructions de Charleroi of Belgium, and Phillips of Holland. Rocket engines will be built by SNECMA of France.

### U.S. made components . . .

will go into the first 20 *Nike* and *Hawk* missiles made in Japan. The Japanese plan to make the next 600 themselves in addition to 240 *Bomarc*s, 8000 *Sidewinders* and 400 *Little Johns*—all by 1967.

### France's Super Veronique . . .

research rocket now in the test-evaluation stage will carry a 200-lb. payload to 300 miles. Thrust will be 10 to 15 tons, substantially higher than the earlier version which could carry 120 lbs. to 85 miles. Flight tests of 12 *Veroniques* are scheduled in a series of shots at the Colomb Bechar range in North Africa.

### End of Mace B . . .

funding is scheduled to come in FY 1961. The new budget has \$39.8 million for the Martin surface-to-surface air breather.

## PROPULSION

### New Jupiter IRBM Sustainer . . .

engine S3D has a 245 sec. I<sub>sp</sub> with a 6000 rpm pump pushing in fuel at 4300 gpm. Dry weight is 1930 lbs., diameter is 5.8 ft. and height is 11.8 ft.

### Minuteman 2nd stage sole . . .

source will be Aerojet-General. Thiokol is now sole source for the first stage. Air Force reluctantly went to sole source on the engines for the solid-fueled missile for budgetary reasons.

### Mercury retro rockets . . .

will fire in sequence or simultaneously at the option of astronaut pilot. Each of the 1000-lb.-thrust rockets is almost spherical, having a length/width ratio of almost 1:1. Burning duration is around 10 sec.

## ASTRONICS

### Cryogenic Gyroscopes . . .

is being engineered by General Electric under an Army “Project Spin” contract. To be tested this year, the gyro utilizes magnetic fields produced by superconductors to replace mechanical bearings, thus reducing friction and electrical losses to near zero. Near absolute accuracy and reliability is expected as a direct result of dimensional stability induced by near-absolute zero temperatures.

## WE HEAR THAT

### Lay-offs and hiring . . .

are going on simultaneously at Grumman Aircraft. The company is reducing its aircraft employment by 500 at the same time it is out recruiting shipyard workers to build hydrofoils (it has just boated a \$1.5-million contract from the Maritime Administration for an 80-ton hydrofoil ship) . . . Republic Aviation also is laying off about 2000 workers, causing something of a labor surplus on Long Island . . . ICC regulations have been relaxed to permit shipment of liquid hydrogen any distance from the Linde Co.'s Tonowanda, N.Y., plant. Formerly, it was restricted to 500 miles.



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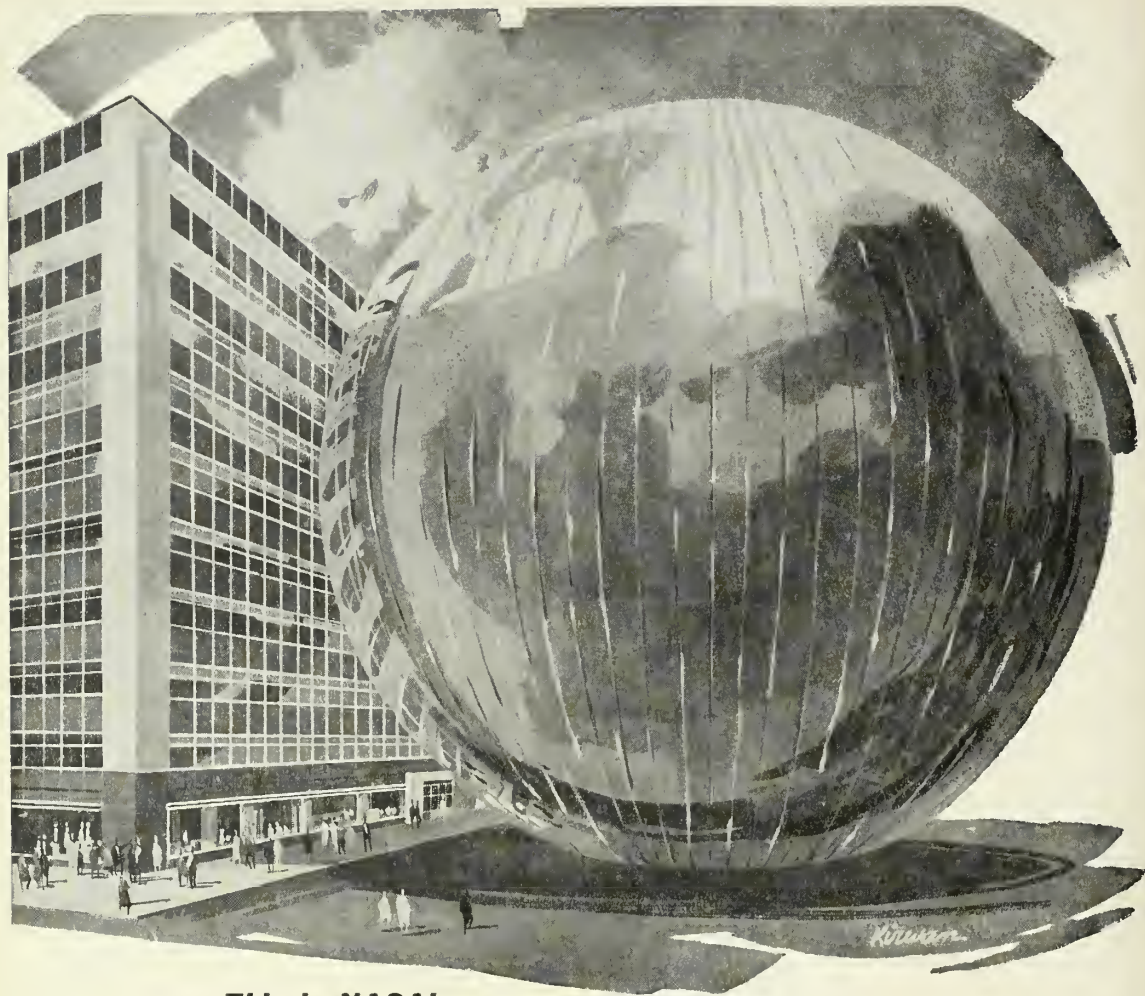


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The NASA inflatable satellite is a significant step in the development of advanced global communications. The satellite will reflect radio and radar signals from powerful earth-bound transmitters for investigation of forward scattering techniques of communications and propagation. NASA has invited scientists around the world to participate in this project.

This endeavor—only one of many now in advanced stages of fruition . . . is indicative of the calibre of NASA projects, personnel and resources.

*If you are a scientist or engineer and would like to become associated with NASA, address your inquiry to the Personnel Director of any of the following NASA research centers:*

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**Lewis Research Center,**  
Cleveland 35, Ohio

**Flight Research Center,**  
Edwards, Calif.

**Goddard Space Flight Center,**  
Washington 25, D. C.

**NASA** National Aeronautics and Space Administration



# Missile/Space Budget: \$9.3 Billion

**Increase of \$2 billion over FY 1960; military gets bulk of money for weapons; Saturn gets overtime boost but other NASA projects starve under one-third spending hike**

by Clarke Newlon

The President presented to Congress a national budget request for Fiscal 1961 which included a total of \$9.3 billion for missile, rocket and space appropriations. This is an increase of about \$2 billion over last year; that increase is largely for weapons. The program (in round figures, millions) breaks down as follows:

All U.S. missile programs .....	\$6,986
Military Astronautics .....	318
Missile maintenance .....	1,030
Foreign military assistance missiles (includes support)	276
NASA space program .....	634
(actual spending)	
AEC missile and space R&D ...	54
Total .....	\$9.3 billion

The total missile program figure of \$6,986 million was compiled and officially released by the Department of Defense. It divides as follows (in millions):

Missile procurement .....	\$3,825
Missile R&D .....	1,481
Missile R&D procurement .....	984
Missile base construction .....	696
Total .....	\$6,986 million

As a further breakdown of the U.S. missile procurement figure, although it is impossible to obtain exact amounts from the budget, the figure of \$3,825 million (quoted by the President) breaks down about like this (in millions):

Procurement of actual missiles ..	\$2,419
Missile support equipment .....	1,406
Total .....	\$3,825 million

The President noted in his message that the nation's space program would be doubled. Actually it goes in R&D expenditures from \$370 million in 1960 to \$634 million in 1961. But the 1961 figure includes \$139.5 million funded for the *Saturn* program in 1960 by the Department of Defense. This makes the comparative figures \$370 million for '60 and \$495.5 million for '61—an addition of only \$124.5 billion, or one fourth.

NASA's space program for 1961 compared to 1960 is as follows (not

including sounding rockets, etc):

	1960	1961
Major deep space probes ..	3	4
Scientific satellites .....	7	8

NASA officials at a budget briefing for newsmen said there was no back-up for any of the 12 projects listed above. The back-up, they said, would simply be the next shot.

The 1961 budget includes \$4,753 million in new obligational funds for manned aircraft, a reduction of \$1,390 million in 1960. This sum will purchase 1,510 aircraft—633 for the USAF, 658 for Navy and 219 for Army, the majority of them missile and rocket equipped. Major purchases in the AF will be for the B-52H, the B-58, the F-105 and the KC-135 tanker. Navy will buy the A3J, the F8U-2n, the F4H and the S2F. Army gets more of the Mohawk, the Caribou and the Chinook helicopter.

• **Hound Dog step-up**—One more B-52 wing has been added, making a total of 14 or some 630 bombers. Future purchases will be the H-model. It and the G-model only carry the nuclear-armed *Hound Dog* missile (two each) but others will be modified until every wing is at least partially equipped. *Hound Dog* production by North American will be accelerated.

The budget includes \$75 million for the stretched-out North American B-70—enough to produce two proto-

types. The B-70 would carry the 1000-mile ballistic, nuclear-armed Douglas *Sky Bolt*, also funded for further study. There is \$50 million for a new MATS transport, presumably jet.

The *Atlas-Titan* ICBM program was increased by seven squadrons—13 *Atlas* and 14 *Titan*. This is not a speed-up—simply an addition to the end of program. *Bomarc* procurement will be completed in Fiscal '61, but not procurement of all of its support equipment. Two *Mace-B* squadrons will be sent to the Far East and Europe at a cost of \$29 million in the budget.

There is a 50% increase in *Dyna-Soar* funding, continued money for the *X-15*.

Overtime will begin on the clustered *Saturn* booster immediately, and a supplemental appropriation for it will be requested later in the year. Development work on the *F-1*, Rocketdyne's 1½-million-pound-thrust engine, will continue.

• **Juggling funds**—The President noted that the F-108 interceptor force would have cost \$4 billion, and in light of missile development considered it best to drop it; also that the B-70 was competing with four ballistic missile systems—the *Atlas*, *Titan*, *Minuteman* and *Polaris*—and thus was stretched out. (Both *Minuteman* and *Polaris* came in for budget increases.)

Of *Nike-Zeus*, the president noted

## TOTAL NATIONAL BUDGET

(in billions)

	1959 Actual	1960 Estimate	1961 Estimate
Budget Receipts .....	\$68.3	\$78.6	\$84.0
Budget Expenditures .....	80.7	78.4	79.8
Deficit or Surplus .....	— 12.4	+ .2	+ 4.2

## DEFENSE BUDGET

(in billions)

	1959 Actual	1960 Estimate	1961 Estimate
Expenditures .....	\$46.5	\$45.6	\$45.6
New obligational authority .....	45.5	44.7	45.3

the difficulties involved in detecting, tracking and hitting an incoming ballistic missile and included funds for further testing—but not for production or facilities. The \$137 million appropriated by Congress for initial production steps will not be used, he said.

The President said that he was sav-

ing \$130 million by suggesting that a new Navy attack carrier be conventionally powered rather than nuclear. The money could be better used elsewhere, he thought. Army's striking power will go up with the purchase of a variety of missiles including the *Sergeant*, *Honest John*, *Little John*, *Lacrosse*,

*Davy Crockett*, *Hawk* and *Redeye*.

Mr. Eisenhower noted that our \$2 billion military assistance gave support to five million army troops, 2,200 combat ships and over 25,000 aircraft (half of them jet) throughout the free world. More than 10% of that \$2 billion goes for missiles and missile support.

# Military Gets Minimums for Defense

by James Baar

The Eisenhower Administration pushed the nation's luck a year further last week with a new military budget of minimum deterrence for FY 1961.

Increasing missile procurement and missile R&D programs all but dominated the budget which had been frozen at \$40.5 billion. But, despite growing warnings from military leaders, the programs continued to stroll—not run.

The new budget includes in direct obligations for missile procurement:

- A boost to \$2,941,000,000 for the Air Force—\$270 million more than this year. It provides for large purchases of North American air-to-surface *Hound Dogs* and McDonnell *Quail* decoy missiles and funding aimed at increasing the total number of planned Convair *Atlas* and Martin *Titan* squadrons from 20 to 27. But the additional squadrons will be purchased in an extended program. This is not a speed-up to meet the Missile Gap.

- A slight drop to \$464 million for the Navy—\$5 million less than this year. Purchases in a wide variety of missiles, particularly Raytheon *Sparrow III's* and GE-Philco *Sidewinders*. Construction of three more *Polaris*-launching submarines and long lead-time items for three more are included, along with high praise from the President. But the Navy had sought to begin construction of nine.

- A slight drop to \$400 million for the Army—\$1 million less than this year. Major purchases will include Raytheon *Hawks*, Emerson Electric

*Little Johns* and for the first time, production models of two advanced man-carried missiles—the nuclear-warheaded *Davy Crockett* and Convair's surface-to-air *Redeye*. But, although the R&D program for Western Electric's *Nike-Zeus* AICBM is funded at nearly \$300 million, the budget doesn't include a dime for producing it.

The Administration clearly continued to frown on military space programs. Direct obligations for all military astronautics total \$318 million. Requests for new obligational authority in this field were held to \$407 million. The bulk of the direct obligations—\$249,740,161—is for the Air Force space program which includes the *Discoverer*, *Samos* and *Midas* satellites.

The Boeing *Dyna-Soar*—the space bomber of the future—received about \$50 million. Continued funding at this rate is expected to delay the development of an operational *Dyna-Soar* until about 1969.

- ASW hiked—the Navy's ASW

programs were boosted 8% to about \$250 million. The budget especially noted progress on two new potent ASW weapons—Minneapolis-Honeywell's *Asroc*, which is scheduled to become operational in 1961, and Good-year's *Subroc*, also nearing a late R&D stage.

The Navy's 1961 shipbuilding and conversion program includes two guided missile frigates, two guided missile destroyers, three nuclear-powered ASW submarines and a conventionally-powered Forrestal Class carrier. However, the Navy's proposals to deploy Lockheed *Polaris* aboard missile cruisers remained buried.

Some \$696 million in direct obligations is included in the budget for construction of missile bases and other missile support facilities. Among these are *Atlas* and *Titan* operational launch sites and a start on the first operational sites for Boeing *Minutemen* which are scheduled to become operational about 1963.

## MISSILE PROCUREMENT

(in millions)

	ARMY		NAVY		AIR FORCE		FOREIGN MILITARY AID		TOTAL	
	'60	'61	'60	'61	'60	'61	'60	'61	'60	'61
New Obligational Authority .....	399	351	379	450	2,466	3,024	—	—	3,244	3,825
Direct Obligational Authority .....	400	401	469	464	2,671	2,941	168	276	3,708	4,083
Expenditures .....	472	413	389	397	2,639	2,669	—	—	3,500	3,479

## RECAPITULATION OF BUDGET AUTHORIZATIONS, OBLIGATIONS, AND EXPENDITURES

(in millions)

Organizational component	New obligational authority			Direct obligations			Expenditures		
	1959 enacted	1960 estimate	1961 estimate	1959 actual	1960 estimate	1961 estimate	1959 actual	1960 estimate	1961 estimate
Army .....	\$ 9,381	\$ 9,679	\$ 9,546	\$ 9,555	\$ 9,966	\$10,008	\$ 9,468	\$ 9,349	\$ 9,383
Navy .....	11,820	11,214	12,013	12,147	11,677	12,139	11,728	11,571	11,683
Air Force .....	18,713	18,475	17,737	19,599	18,854	18,994	19,084	18,823	18,614
Office of the Secretary of Defense .....	1,255	1,279	1,281	851	1,182	1,271	953	1,202	1,315
061 Total, military functions .....	41,168	40,647	40,577	42,151	41,679	42,412	41,233	40,945	40,995
068 Military assistance .....	1,515	1,300	2,000	2,012	1,748	1,797	2,340	1,800	1,750
Total, Department of Defense—Military .....	42,683	41,947	42,577	44,163	43,427	44,209	43,573	42,745	42,745

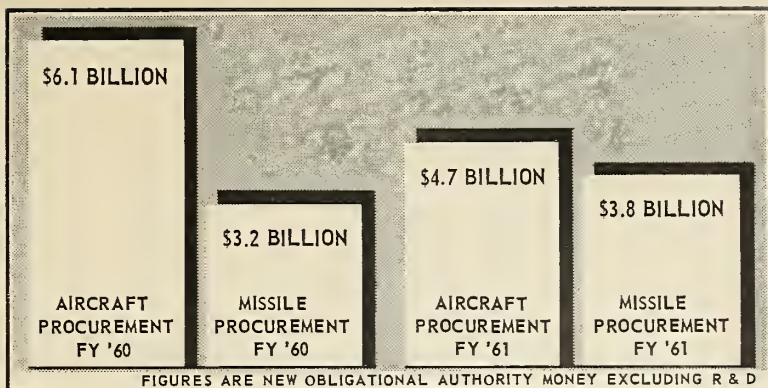


The budget provides a total of \$2,334,800,000 for research, development, test and evaluation in missiles, and military sciences as well as military astronautics. This is a \$21 million drop from last year.

The biggest slice—\$793,200,000 in direct obligations—goes to the Navy, with much of it going into the *Polaris* program. The budget disclosed that the Navy expects to have two *Polaris*-armed submarines on station by the end of 1960.

The Air Force received \$684,814,727 in direct obligations for R&D, including some funds for *Sky Bolt*, the Douglas ALBM that is still in the design study stage. The Army received \$645,828,000—mainly for *Nike-Zeus*, Martin's *Pershing*, JPL/Sperry's *Sergeant*, Convair's *Mauler* and *Missile A*.

• **Electronic support**—One of the biggest cost increases came in operating and maintaining the nation's expanding electronic network of missile support systems—SAGE, Missile Mas-



ter and BMEWS. The budget predicted a cost increase of 70% between 1959 and 1961.

Funds are provided in the budget for the BMEWS stations under construction at Clear (Alaska) and Thule (Greenland) as well as a third that will be built in northern Great Britain.

The overall tone of the military

budget was one of conservative expansion of some missile programs with a simultaneous contraction of others.

It was set by the expansion of the ICBM program to bring the number of *Atlas* squadrons from nine to 13 and the number of *Titan* squadrons from 11 to 14—not quickly but sometime near the mid-60's.

# NASA Boost More Apparent than Real

by C. Paul Means

The \$802-million NASA budget sent to Congress last week indicates that the Eisenhower Administration is interested in space, but not in competing with Soviet space accomplishments.

The budget spelled out plans for leisurely space exploration with no back-up vehicles available in case of failure.

Highlight was the \$122,750,000 (exclusive of salaries) in new spending authority given the nation's man-in-space effort, Project *Mercury*. In critical financial shape during 1959 (M/R, Jan. 11, p. 30), *Mercury* officials should be helped by the new money to meet their original manned orbital flight date in 1961. Including the \$19 million to be asked for in a supplemental FY '60 budget, *Mercury* will now have had \$300 million obligated to it.

The 1.5 million-pound-thrust *Saturn* booster, to be transferred from ARPA in the near future, was funded for \$140 million as the preliminary ARPA budget had suggested. But the president has asked NASA Administrator T. Keith Glennan to tell him how much more money *Saturn* should have in FY '61. This money, probably about \$50 million, will be asked for in a later supplemental budget request.

Of *Saturn's* \$140 million, \$60 mil-

lion will be spent in FY '61. Another \$34 million has already been obligated for *Saturn* this fiscal year.

• **Carrying *Saturn* load**—NASA spending during FY '61 will be increased, but not to the "virtual doubling of spending" that the President spoke of in his budget message. FY '61 spending is estimated at \$600 million, while \$325 million was spent in FY '60. What the President doesn't account for is that \$60 million of the FY '61 figure is for *Saturn*—a project not in the NASA budget last year. If

all ARPA money spent for *Saturn* in FY '60 is included plus the money ARPA is obligated to spend in FY '61, the comparable figures are \$375 million for FY '60 and \$634 million for FY '61. And of the \$634 million, almost \$140 million goes for *Saturn*, a project NASA did not have last year.

The nation's other super booster project, Rocketdyne's single-chamber 1.5-million-pound-thrust *F-1* engine for *Nova*, has been earmarked for \$25 million in new obligational authority. This compares with a little over \$30 million

## NASA APPROPRIATIONS SUMMARY

	FISCAL YEAR 1960 (in thousands)		FISCAL YEAR 1961
	APPROPRIATED	SUPPLEMENTAL ESTIMATES	NEW OBLIGATIONAL AUTH.
Salaries and Expenses .....	\$ 91,400		\$167,500
Research and Development .....	320,350	\$ 12,000	545,153
Construction and Equipment ..	88,825	11,000	89,287
Total New Appropriations .....	\$500,575	\$23	\$802

## NASA EXPENDITURE SUMMARY

	FY '60 (in thousands)	FY '61 (est.)
From NASA funds .....	\$325,000	\$600,000
Obligated DOD funds for projects transferred to NASA .....	45,000	34,000
Total expenditures .....	\$370,000	\$634,000

given to the project last fiscal year.

The space administration breaks down its budget to show \$545,153,000 going for research and development, \$89,287,000 going for construction and equipment, and \$167,560,000 for salaries and expenses.

• **R&D breakdown**—In research and development section of the budget, the two largest line items are \$107,750,000 for *Mercury* and \$81,008,000 for *Saturn*. Lunar and deep space exploration, an area in which NASA has announced it will launch four shots a year, is funded for \$45 million, and scientific satellites, which NASA expects to fire at a rate of eight a year, is funded for \$41,700,000.

Also of interest in the R&D budget was the \$47 million dollars in new obligational authority for *Centaur*, the \$40-million-dollar funding of liquid rocket technology, and the \$10-million-dollar funding of nuclear systems technology. The latter will be augmented by \$26 million in the Atomic Energy Commission's budget.

Only \$2,800,000 was provided in new obligational authority for solid rocket technology in FY '61. The space power technology bank received \$8 million in added funds.

NASA employes, according to the budget, will take home \$167,560,000 in FY '61 in salaries and expenses. Major increase over the \$91,400,000 in the FY '60 budget is the \$55 million earmarked for the 5500 new NASA employes at the Huntsville ABMA facility.

• **New construction**—Major items of construction and equipment in the FY '61 budget are \$18,450,000 for the Huntsville facility, \$8 million for two more of the 85-ft., Goldstone type parabolic radio antennas, \$15 million for the *Mercury* world wide tracking network, \$9.5 million for the new Goddard Flight Research Center near Washington, and \$9.1 million for the

## MAJOR NASA PROJECT'S OBLIGATIONAL AUTHORITY

	FISCAL YEAR 1960 (in thousands)		FISCAL YEAR 1961
	APPROPRIATED	SUPPLEMENTAL ESTIMATES	REGULAR ESTIMATES
Mercury .....	\$ 98,762	19,000	122,750
Nova .....	30,200	.....	25,000
Saturn .....	70,000	.....	140,000
Scout .....	28,000	.....	.....
Delta .....	13,300	.....	12,500*
Centaur .....	37,000	4,000	47,000*

\* not including funds for salaries and expenses, funds and equipment.

## NASA R&D PROGRAMS—Fiscal Years 1960 and 1961

PROGRAM	FY '60	FY '61
	(in thousands)	
AERONAUTICAL AND SPACE RESEARCH: (support of NASA plant; research grants and contract JPL plant.) .....	\$ 27,634	\$ 61,345
SCIENTIFIC INVESTIGATIONS IN SPACE: (sounding rockets, scientific satellites, lunar and planetary exploration.) .....	81,624	94,700
SATELLITE APPLICATIONS: (meteorology, communications.) .....	11,100	26,300
MANNED SPACE FLIGHT: (Project Mercury.) .....	86,962*	107,750
VEHICLE SYSTEMS TECHNOLOGY .....	6,737	21,200
SPACE PROPULSION TECHNOLOGY: (solid rockets, liquid rockets, nuclear systems technology, space power technology.) .....	44,927	60,800
VEHICLE DEVELOPMENT: (Scout, Delta, Vega, Centaur, Saturn.) ...	57,100	140,508
TRACKING AND DATA ACQUISITION .....	16,266	32,550
<b>TOTAL PROGRAM</b> .....	<b>\$332,350*</b>	<b>\$545,153</b>

\*Includes supplemental '60 budget.

Lewis Research Laboratories at Cleveland.

The expansion of NASA's space activities is indicated by the decline of aeronautical research in the budget. But NASA plans to devote about 25% of its "in-house" research support to aeronautics. In dollars: about \$40 million.

Also mentioned in the President's budget was the \$23 million FY '60 supplemental that NASA will ask for in the near future. Some \$19 million will go for *Mercury* (\$12 million for research and development, and \$7 million for construction of the world wide tracking network), and \$4 million for

construction of *Centaur* facilities at Cape Canaveral.

Other information revealed by the President's budget:

- Project *Mercury's* increased funding should permit the first manned orbital flight in 1961;

- *Centaur* should reach the test stage in 1961;

- Completion of the *Saturn* launching system and an addition to the engineering building at the Atlantic Missile Range are proposed in 1961; and

- No new NASA projects at the Pacific Missile Range are proposed, but launching facilities funded under 1960 appropriations will be finished in 1961.

## RESEARCH, DEVELOPMENT AND EVALUATION

(Direct Obligation)

	ARMY			NAVY			AIR FORCE			ARPA		
	FY '59 actual	FY '60 est.	FY '61 est.	FY '59 actual	FY '60 est.	FY '61 est.	FY '59 actual	FY '60 est.	FY '61 est.	FY '59 actual	FY '60 est.	FY '61 est.
Missiles and Related Equipment .....	423,184,926	495,507,000	494,798,000	628,266,859	685,520,577	668,500,000	292,014,360	317,293,761	318,257,455	---	---	---
Military Astronautics and Related Equipment .....	---	---	---	---	---	1,300,000	221,067,724	296,131,486	249,740,161	103,068,549	111,913,744	67,000,000
Military Sciences ...	123,320,342	159,107,000	151,030,000	105,534,614	135,116,500	123,400,000	135,193,731	122,483,136	116,817,111	46,632,193	132,340,000	144,000,000
<b>Totals</b> .....	<b>546,505,268</b>	<b>654,614,000</b>	<b>645,828,000</b>	<b>733,801,473</b>	<b>820,637,077</b>	<b>793,200,000</b>	<b>648,275,815</b>	<b>735,908,383</b>	<b>684,814,727</b>	<b>149,700,742</b>	<b>244,253,744</b>	<b>211,000,000</b>



# R&D Funding Contains No Surprises

Missile and space R&D—the basis of America's future in the Missile Age—will receive some \$3 billion in direct obligations under President Eisenhower's FY 1961 budget. That is about \$150 million more than this year.

Disclosure of the program in the new budget brings no surprises.

Military missiles and related equipment take the biggest share—\$1,481,600, a \$17-million decrease. NASA comes second with \$600 million.

Direct R&D obligations for space in FY 1961, including \$318 million for military astronautics and about \$175 million for the Air Force *Dyna-Soar* program, are expected to total about \$1 billion.

• **Launches without backup**—NASA aims under its program to launch about four space probes and eight major scientific satellites a year. The military services are planning to launch R&D satellites for reconnaissance, early warning, communications and navigation. The Air Force also plans to launch about one *Discoverer* a month at least for the next year.

However, backup boosters in all programs will be very rare. In the NASA launchings, they will be nonexistent.

The Air Force R&D program for missiles and related equipment totals \$318,257,455. This includes funds for the new *Sky Bolt* ALBM, and a number of missiles that are already operational. Additional funds are also included for work on the *X-15* rocket plane and the B-70 Mach 3 bomber which would carry the *Sky Bolt*.

More than \$966 million in procurement money actually is for development, test and evaluation of various missiles including the *Atlas*, *Titan* and *Minuteman*. These programs include

work on a *Titan* fueled with a storable propellant.

The Navy R&D program for missiles is \$668,500,000. This is primarily for the *Polaris* program. It also provides funds for a number of other programs including *Subroc*, Bendix air-to-air *Eagle*, Temco's air-to-surface *Corvus* and the *Super Talos* anti-missile missile.

The Army R&D program totals \$494,798,000. The bulk—nearly \$300 million—is for the *Nike-Zeus* AICBM but the program also includes funds

for a large number of missiles running from the man-carried *Redeye* to the big *Pershing* which is designed to replace the *Redstone*. Others are the *Mauler*, *Missile A*, *Sergeant*, *Advanced Hawk*.

The new budget provides direct obligations for two small but highly significant programs at the Atomic Energy Commission. One—missile propulsion reactors—receives \$40,300,000; the other—satellite power sources—receives \$14.4 million. Together they are being increased about \$17 million.

## Surplus Won't Go To Defense

by William E. Howard

Defense contractors can look forward to a fierce Congressional tug of war over President Eisenhower's hoped-for FY 1961 budget surplus of \$4.2 billion. But, short of a new Russian threat, the chances are remote that any substantial amounts of this ripe plum will be squeezed into missile/space programs.

The President is determined to apply every penny of the surplus to reducing the public debt. He can be expected to wield his veto against any and all large new spending programs propounded by the Democratic-controlled Congress.

Moreover, he is equally determined to protect the surplus from any election-year tax cuts.

There is some question, however, whether the \$79.8 billion Eisenhower budget actually will be topped by anticipated Treasury receipts of \$84 billion when the end of the fiscal year rolls around. For this revenue estimate is based partly on the assumption that Congress will agree to the President's requests for hiking some taxes by a total of almost \$1 billion. This includes \$100 million from a jet fuel tax and \$500 million from a postal increase. That Congress will go along with this notion is extremely unlikely.

• **No new weapons**—Defense expenditures for the coming year are estimated at \$41 billion—about the same as FY 1960. Of the new obligatory authority of \$40.6 billions, approximately \$9.3 billion is sought for missile/space programs. This latter figure is up around \$2 billion over the current year—but the extra money is earmarked largely for the Air Force

*Atlas*, *Titan* and *Minuteman* ICBM's and other "going" programs. The budget does not indicate a single new weapon system. Thus new opportunities will be limited largely to R&D.

Actually, there is considerable likelihood this year will see some missile programs cut back in favor of high priority items now in the production stage—like the *Atlas*—which require greater funding as operational weapons. *Jupiter*, *Thor* and *Lacrosse* have all reached the end of the line in this new budget.

However, the missile support market is being strengthened by the emphasis on operational systems. Air Force support equipment procurement alone is jumping from an estimated \$642 million in FY 1960 to \$802 million. This is due largely to a corresponding increase from \$550 million to \$696 million in missile base construction.

• **Electronics higher**—Electronic demand also will be higher—helped along by NASA's \$634 million spending program, an increase of some \$300 million over the current year—as well as by greater requirements for missiles.

The legislative program recommended by the President contains some proposals affecting the missile/space industry. An extension of corporate taxes and certain excises will be sought for another year beyond June 30.

Mr. Eisenhower also requests that "consideration" be given to changing the law on depreciation provisions. He said in his budget message that administration of this law is "being hampered by the attempts of some taxpayers to claim excessive depreciation before disposing of their property." He suggests that if the gain from the sale

TOTAL  
(In Thousands)

FY '59 actual	FY '60 est.	FY '61 est.
1,343,500	1,498,800	1,481,600
324,100	408,000	318,000
410,700	549,100	535,200
2,078,300	2,455,900	2,334,800

of depreciable personal property were treated as ordinary income—instead of capital gains—"the advantage gained in claiming excessive depreciation deductions would be materially reduced."

For a third time in as many years, the President asked Congress to repeal a section of the law which requires DOD to obtain the sanction of the House and Senate Armed Services committees to carry out certain types of real estate transactions.

He also renewed an appeal to Congress to eliminate a rider which limits competitive bidding by foreign firms on some military supply items. This rider is worse than the "Buy American Act," he commented.

Private industry would be encouraged to finance, build and operate plants to make more helium available for AEC and missile programs under Administration-backed amendments to the Helium Act introduced last year. The President said they need prompt enactment to check the waste of this essential gas.

To relieve the pressure on the Treasury in borrowing money, Mr. Eisenhower urged removal of the "artificial" 4¼% ceiling on new long-term bond issues. He said this is a major barrier to efficient management of the \$290 billion public debt, which he hopes through the application of surplus to reduce to \$280 billion by the end of FY 1961.

## AEC Gets \$700 Million For Missile/Space Support

Over \$700 million of the Atomic Energy Commission's \$2,450 billion FY '61 budget goes directly to support the nation's missile and rocket programs.

The bulk of this amount, \$495 million, goes for nuclear weapons. Though atomic bombs and artillery warheads are included, the greater part of this new obligational authority will go for nuclear missile warheads.

Approximately \$200 million supports the military missile program and the military's and NASA's space programs. This goes for propulsion reactors for missile submarines and ships, atomic missile-carrying aircraft, nuclear propulsion systems for missiles and space rockets, and transportable powerplants for generation of electric power and heat in satellites.

A rough breakdown of the AEC Budget shows \$14 million going for satellite power sources, \$40.3 million for missile and space rocket propulsion reactors, \$73 million for aircraft propulsion reactors, \$85 million for Navy propulsion reactors, and \$15 million for Army propulsion reactors.

# Gates Sees Narrower 'Gap'

The Nation's view of the size of the Missile Gap remained cloudy this week after a series of top-level statements and comments from Administration officials, generals and congressmen.

Defense Secretary Thomas S. Gates told the House Military Appropriations Subcommittee that the latest intelligence information revealed that Russian missile superiority will reach a peak about mid-1962.

However, he said that even in mid-1962 if the Russians were to launch a surprise attack with all of their missiles they would not be able to destroy enough of America's retaliatory forces "to make a rational decision to attack."

He said this would be true even if Russia were to manufacture more missiles than presently expected, and those missiles were more accurate than they are expected to be.

However, the rosier picture presented in secret testimony by Gates (and later released in part) was re-touched in more somber tones by others:

- Several congressmen who heard the intelligence estimates behind closed doors in the Senate and House said they didn't think the reports led to as optimistic a conclusion as the released testimony implied.

- Sen. Stuart Symington (D-Mo.) said flatly on the Senate floor that President Eisenhower's decision to hold defense spending to \$41 billion opened the way for the United States to "become a second class power."

- Gen. Thomas S. Power, commander of SAC, said in New York that unless the United States has adequate warning systems ready in time the Russians could almost wipe out all U.S. retaliatory power in 30 minutes with a total of only 300 ICBM's and IRBM's.

Gates stressed that previous U.S.

intelligence estimates were based on the number of ICBM's Russia was capable of producing. He said the latest intelligence estimate is the first on the "probable ICBM inventory and build up time."

He said—without disclosing figures—that the Soviet ICBM buildup both before and after mid-1962 is not much greater than the buildup in the United States.

None of the figures given the committee were released. However, Gates said the new intelligence estimate has narrowed the earlier 3-1 ratio in Russia's favor based on estimates of capability alone.

He also said the accuracy of Russian ICBM's is believed to be inferior to that of U.S. ICBM's.

The Defense Secretary said it is extremely difficult to make a statistical estimate of how much an attack by any specific number of Soviet ICBM's would cripple U.S. retaliatory forces. He cited two prime factors:

- "We do not know exactly what his accuracy is."

- "We do not know exactly how much warning time we are going to have."

Therefore, he said, any comparison of U.S.-Soviet ICBM strength based on numbers alone gives an untrue picture of the strategic situation.

Both Gates and Gen. Nathan F. Twining, Chairman of the Joint Chiefs of Staff, told the House Subcommittee they felt that the new military budget is "adequate."

Asked bluntly if he thought the United States has the strength to hold its own in the decade of the 1960's, Gates replied:

"I would say that I am confident we are in good shape, if you will couple with my judgment the fact that we cannot rest in our easy chairs and that we must continually review the situation."

## NSF Fund Request Hiked by \$30 Million

Expenditures by the National Science Foundation of \$101 million—an increase of \$30 million over the current year—are sought in President Eisenhower's FY 1961 budget. The extra money would support "promising" basic research proposals, including space and geophysical work.

The President said grants would be for research in the Antarctic and in "weather modification."

The NSF presently is providing

special facilities for radio and optical astronomy observatories, a solar research telescope, university computers and an oceanographic research vessel. It also is supporting some specialized biological laboratories, atmospheric science facilities and the planning for a geophysical institute in Hawaii.

If approved by Congress, the new appropriation would almost double actual expenditures of \$55.5 million in FY 1959.





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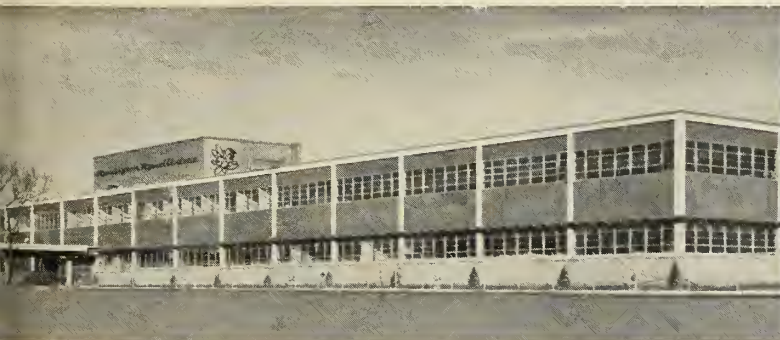
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# Navy Denies Air Force's PMR Charges

Spokesmen reject AF allegations that Navy has master plan to use range to create its own major space role; Air Force accused of trying to sabotage PMR

The Navy is categorically denying Air Force charges that it is trying to parlay the Pacific Missile Range into a major space role at the Air Force's expense.

At the same time, Navy officials are charging privately that the Air Force is trying to sabotage the future development of PMR in order to make Vandenberg AFB the R&D center for military space programs on the West Coast.

The blunt Navy rebuttal came as:

- Chairman Overton Brooks (D-La.) of the House Space Committee disclosed that his committee is contacting witnesses for hearings on the Air Force-Navy fight.

- The Senate Space Committee continued to prepare for hearings on the interservice struggle within the next few months.

- The Administration appeared to be leaning toward permitting NASA to use available *Thor* pads at Vandenberg AFB for launching *Thor-Deltas* into polar orbits rather than build new pads directly to the south at PMR's Point Arguello. However, no decision has been announced.

- New budget figures showed that PMR is planning to spend about \$100 million during FY 1961, of which about \$6 million to \$7 million will be for construction of new facilities—a long way from the hundreds of millions originally planned.

- In line with Defense Department policy against interservice sniping, the Air Force officially remained aloof, not commenting on either the charges from its own officials or the Navy denials.

The Navy hit directly at the Air Force charges which M/R disclosed last week have been laid before congressional investigators. The Navy said it is "constantly alert in its attempt to recognize any program which might enhance the Navy's ability to carry out its part of national security."

"In this light, there undoubtedly will be programs in the future which sometimes are broadly termed 'space

programs,'" it said. "Space is a place and not a program in itself nor a thing."

The Navy denied the Air Force charges point by point. It said:

- The secret Connolly Report is "a study . . . as to what foreseeable programs might possibly enhance the Navy's capability"—not a master plan aimed at giving the Navy a major space role.

- The Navy is not trying to build up PMR at the expense of NASA and the Air Force in order to use it as a springboard for its own long-range space programs. It said it is "implementing the approved programs with regard to the Pacific Missile Range."

- The Navy is not working on a manned maneuverable space system called MMSS.

- There are no plans to develop a clustered *Polaris* for use as a space vehicle. However, the Navy added that "naturally, as it will always do with its weapon systems, every effort will be made to improve the *Polaris* system as time goes by."

- The Navy is not trying to bleed information from advanced Air Force programs to build up naval technical know-how in space. It said "the Navy freely exchanges technical information

with other services and government agencies and receives a free exchange of technical information from those services and agencies."

The Navy added pointedly that it "operates within the provisions of authorized programs approved by proper authority."

"Any programs which the Navy has now or might have in the future in the 'space area' will be duly authorized and approved by appropriate authority," it said.

Just this need for appropriate authority points up the running Air Force-Navy struggle. The Administration's long delay in deciding where NASA *Thor-Deltas* will be launched on the West Coast is a prime example.

Originally, the *Thor-Delta* complex was to be built at Arguello. However, the Air Force offered NASA some *Thor* pads at Vandenberg and NASA warmed to the proposal for economy reasons.

The Navy has complained that the launching of *Thor-Deltas* from Vandenberg into polar orbits will expand the number of costly work-stopping overlights that hamper activities at Arguello.

And herein begins to unravel the story the committees plan to hear.

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## Eleven Nations Ratify IFIPS Laws


Eleven nations have ratified the statutes of the International Federation of Information Processing Societies (IFIPS), which will provide a common meeting ground for computer experts from all over the world.

Countries whose national computer technical societies have ratified the statutes include Canada, Denmark, Finland, France, Germany, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom, and the United States. In addition, Belgium, Israel and

Japan are forming national computer societies to qualify for membership.

The new Federation was formed as a direct result of the first International Conference on Information Processing, sponsored by UNESCO and held in Paris last June. A provisional bureau for the Federation was established with Isaac L. Auerbach, president of Auerbach Electronics Corp., named provisional chairman. Auerbach represents the National Joint Computer Committee of the U.S.





*At 00<sup>h</sup> 00<sup>m</sup> 01<sup>s</sup> GMT  
January 1, 1960  
Martin logged its  
390,660,000th mile  
of space flight*

# Method Makes Long Seamless Cylinders

Seamless metal cylinders with depths totally out of proportion to their diameters are produced by a new process developed by Lodge & Shipley Corp. of Cincinnati.

Termed "Multi-Flo-Reforming," the method extends the recently announced capabilities of a single flo-reforming operation on a Floturned piece. (Flo-Turning essentially consists of the stretching and shaping of metal blanks by "flowing" the metal over a mandrel under the elevated pressure of high-speed rollers. Ordinary flo-turning cannot economically produce long cylindrical pieces of relatively small diameter.)

Multi-Flo-Reforming starts with a blank which is formed by Floturn into a cone. The cone is reformed by a hydraulic press operation into the straight-side cylindrical shape desired. The practical limit of this single-reform operation, particularly when fabricating a shell of great depth and small

diameter, is a function of the metallurgical properties of the substance involved.

Lodge & Shipley say that this may be determined through experiment and expressed as the ratio of the major and minor cone diameters of the Floturned cup—the minor cone diameter being equal to that of the finished part.

If, for instance, the characteristic ratio is 2.06:1 (18-8 Type 302 Stainless Steel) and the calculated ratio exceeds this—but not its square, two reforming operations are necessary.

If the square of 2.06 is exceeded—but not the cube, then three reform operations are necessary. And so on to a point as yet undetermined.

Company spokesmen say there is no theoretical limit to the size of the product possible with the Multi-Flo-Reforming process, but there are difficult practical problems.

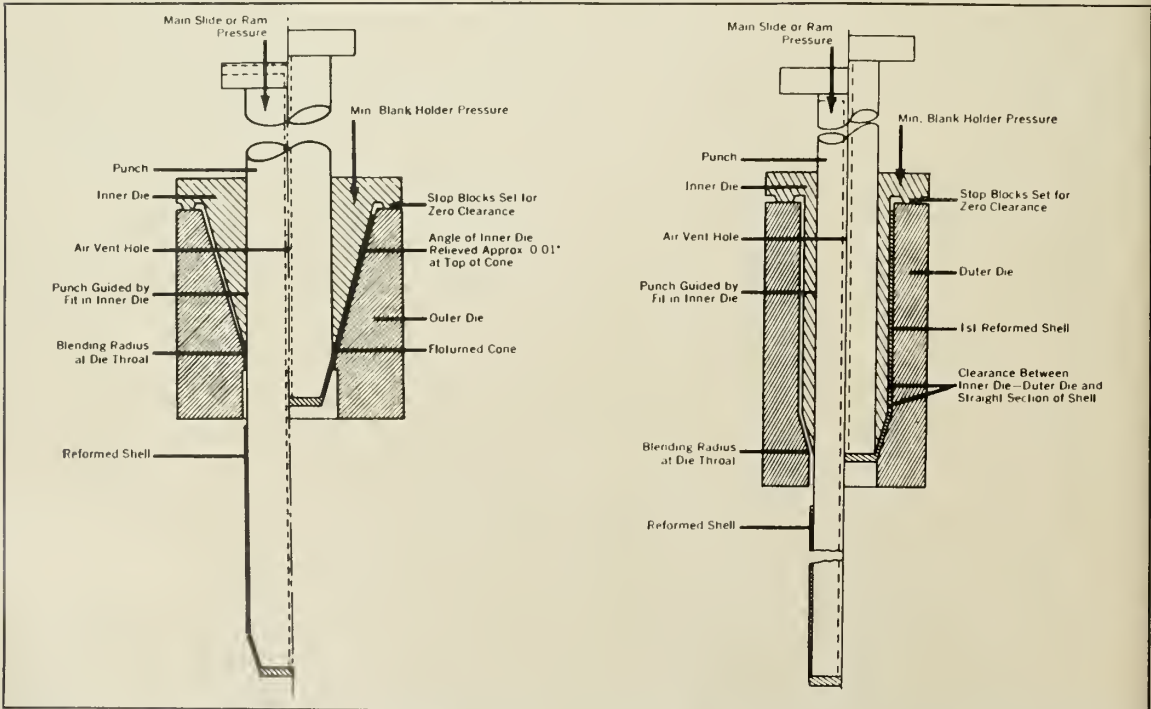
A typical example of the process would start with a 7.5-in. diameter

blank of 302 stainless. The blank is formed into a 7.75-in. deep cup by Floturn and then elongated to approximately 10.25 in. in the first single-reform step. The second reform step results in a finished cylinder 14 in. long and 2.5 in. in diameter.

This process involves ten operations including washing, annealing, and trimming. A similar product, if deep drawn, would call for about 28 operations including as many as 9 separate drawings.

Not only is it economical; Multi-Flo-Reforming significantly improves the metallurgical properties of the workpiece.

Lodge & Shipley has successfully produced many pieces with two-reform operations and experimental work is being done on three-reform procedures. The single-reform method is currently used by the Navy to fabricate missile components.



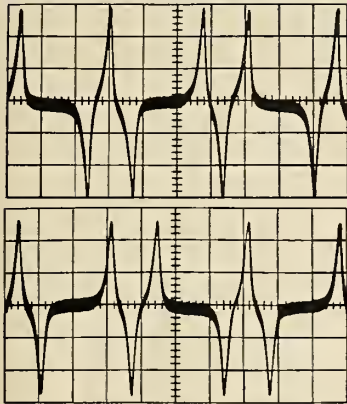
**RIGHT HALF** of each drawing represents beginning of Reform operation. Left half shows tool set and workpiece at the end of each operation. Note that diameter is same in minor Floturned cone and finished cylinder. Principle of operation is same in both steps except for allowances in second because of "blank" configuration. Standard hydraulic presses are used.



# Materials Memo

3M reports on sandwich-type magnetic tape . . . heat reactive tubing . . . sound-deadening pressure-sensitive tape

## ■ A LONG-PLAYING "RECORD"



PLAYBACK wave patterns show standard, open oxide tape (top) and sandwich tape (bottom) output characteristics.


Not Bach or Beethoven—it's a different kind of record we're proud to tell you about. It's the news that over 50,000 successive passes through a tape transport (digital or analog) are now possible with the new "SCOTCH" Brand sandwich-type magnetic tape. If you've never bothered to count the number of passes you've been getting, using conventional magnetic tapes, we'll save you the trouble. Sandwich tape offers you 10 times the life of these older constructions. What's more, the economies don't end there. You'll find that costly recording head maintenance and replacement is drastically reduced. And don't sell short the fringe benefits of no oxide rub-off or head build-up. In language that really counts, this means you can avoid the irritating chore of head cleaning after every run. Among those fortunates already using sandwich tape, there have been cases where fewer drop-outs were noted on each successive pass. On running this down, it was found that these have been due to contamination on the heads which was gradually being removed by the tape!

We won't leave you in the dark as to how all this can be possible. The key is the unique sandwich construction. It starts out with the familiar tough polyester base and the high-potency oxide magnetic coating characteristic of 3M's conventional instrumentation tapes. But here's the difference: Bonded over the surface of the oxide coating is an extremely thin protective plastic layer. The oxide then sandwiched between the two films, has no choice but to stay put for prolonged reliable service. Furthermore, the ultra-smooth protective layer lets the tape glide over the head like a wet snake. While this fifty micro-inch separa-

tion between oxide and head causes a slight reduction in the high frequency or short wave length response, the medium and long wave length responses are essentially unaffected. Sandwich tape comes highly recommended for digital recording, where you can cram up to 500 pulses per inch. It's tops for most AM, FM and PDM applications, as well.

For those of you who'd like up to 50% more recording time per reel, there's a version with a thinner 1 mil base available. Your local MAGNETIC PRODUCTS representative, or the coupon, will bring more facts.

## ■ CONFIDENTIALLY, IT SHRINKS!



Unlike a "Sanforized" shirt, our IRVINGTON DIVISION's new heat reactive plastic tubing is guaranteed to shrink. This unique electrical insulation actually shrinks up to 30% in diameter when exposed for a few minutes to either a radiant heat source or circulating hot air. For example, using a temperature of 300° F, the operation is complete in 4 to 8 minutes. No inflammable or toxic dilating agents are needed. And all the initial flexibility and electrical qualities of this vinyl tubing are retained after contraction. Furthermore, it can provide a tight, smooth, abrasion and chemical resistant insulating cover over even somewhat irregularly shaped objects—like the well-protected pencil on the left.

"SCOTCHITE" Brand heat reactive tubing is not without its share of credentials. It's approved under military specifications MIL-I-631C, as well as receiving acceptance by Underwriters' Laboratories as a 105° C electrical insulation. The cold brittle point is -20°C, which gives you a fairly healthy operating range. With a 0.016" wall, electric strength is 1000 volts per mil; 3200 psi tensile strength assures you of rugged dependable service. Available sizes range from 1/2" to 2 1/2" diameters after shrinking.

Applications for this product seem to be as broad as human ingenuity. It's already been used for wire harnesses, condensers, coils, ground straps, bus bars, tool handles, antennae, and dozens of other electrical applications. Why not discuss your needs with your local ELECTRICAL PRODUCTS DIVISION representative?

## ■ TRANQUILIZER FOR JITTERY BIRDS

Here's a prescription that will not only calm your nerves, but the shakes in your bird as well. It's a new series of aluminum foil tapes which are specifically designed to control the amplitude of vibration of the solid body to which they're applied. It's well known that uncontrolled vibration amplitude can cause not only annoying sound levels but also structural fatigue. If you're trying to lick either of these vibration problems, these tapes may be your answer. With them you could even make a mandarin's gong vibrate like a slab of lead.

There's nothing greatly mysterious about how they work. Basically, there are two principles involved. First, the added mass on the vibrating panel changes its natural frequency and reduces its vibrating amplitude.

The other principle is much more subtle in that the tape's adhesive dissipates vibrational energies. This is done by converting them to a mechanical shearing action within the visco-elastic adhesive. Presto, the vibration decay rate is improved by an important degree. As you may know, this is a relatively new but established concept.

The #428 tape series is available with 5 1/2, 8, or 12 mil backings. All offer an exceptionally high degree of vibration control per unit weight. They also have good solvent resistance and work well over a range of temperatures.

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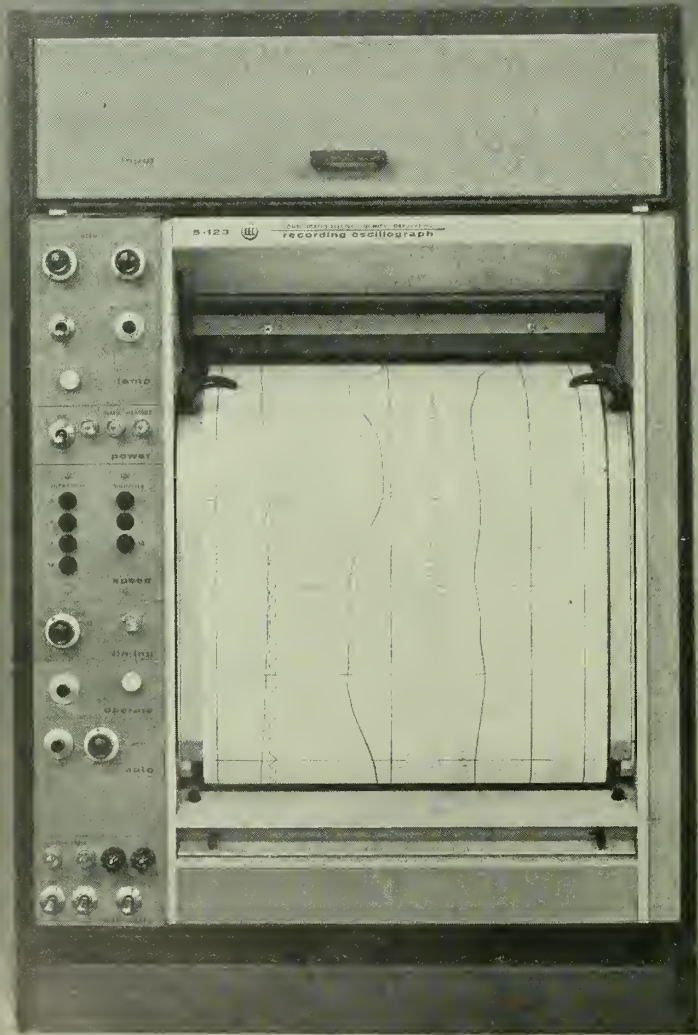
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## Minuteman Lags But First-Stage Ills Are Called Not Serious

by Frank G. McGuire

Development of the first-stage propulsion system for the Air Force *Minuteman* intercontinental ballistic missile has slipped slightly behind schedule, according to Joseph W. Crosby, president of Thiokol Chemical Corp., sole maker of the first-stage solid-propellant engine.

Crosby said the slippage is not serious. He attributed it to attempts to turn out a missile beyond the present state of the art.

Citing specific problems in the missile's development, Crosby and other company spokesmen said inert parts, design characteristics, and seals in the flexible nozzles were the prime sources of trouble. One problem—that of motor case integrity—has been solved.

Crosby referred only to first-stage problems, not to progress on the second and third stages.

• **Troubles located**—Mechanical problems make up the major part of the developmental headache, Crosby said, adding that the burning duration coupled with the heat of the propellant gases had caused trouble. Since case failure was ruled out as a major source of difficulty now, the problem apparently lies with the nozzles and thrust vectoring systems. Company officials emphasized that there have been no difficulties with the missile's case lining. This would seem to place the trouble in the flexible nozzles—used much like a water hose, to control thrust direction. Sealing in the nozzles was believed to be the main source of failure.

Running down a list of complications encountered in the *Minuteman* program, Crosby noted that until now no one has ever fabricated a case of the necessary size and strengths, and this lack of experience has caused miscalculation. Design of such a large solid propellant motor has also never been attempted before, and rushing the program into areas beyond the present state of knowledge has caused faulty design.

High pressures and temperatures in the long-duration exhaust gases have placed unprecedented stresses on the inert parts of the motor, he added, praising the subcontractors in the program for spending their own funds to solve the difficulties encountered.

All things considered, the company feels the slippage is not serious, and has resulted from a combination of factors, each of which is being attacked vigorously.

• **Zeus is behaving**—Contrary to



the problems cited with *Minuteman*, Thiokol is reportedly having no such troubles with *Nike-Zeus*. Although the firm has no production facilities available for the anti-missile missile, the program is doing "quite well" and is on schedule.

Fourth tether test of the *Minuteman* from its underground silo was successful at Edwards AFB recently, but this was not a shot of the full-scale missile. Such missiles are sophisticated mockups for silo checkout.

The most advanced ICBM in the nation's arsenal, the missile is being designed reportedly for use as a multi-purpose weapon, using third stage only for a tactical situation, second and third stages for IRBM ranges, and all three stages for extreme distances.

Air Force decision to accept the possible dangers of sole-source procurement on the first two stages, and probably all three stages soon, indicates that the economy axe being wielded in Washington has even hit such vital projects as *Minuteman*.

## Rawlings Sees Bright Decade for Electronics

Electronics has cause for greater expectations in the coming decade than any other industry, says Gen. E. W. Rawlings, retired former commander of the Air Force's Air Materiel Command.

Rawlings, a General Mills vice president, told the Ground Communications and Electronics Association meeting in Dayton, that electronics is probably the nearest thing to a technological common denominator for the tremendous achievements anticipated in the '60s.

In a speech before the group, he called the development of molecular electronics a major breakthrough. He said that "this concept . . . which is now entering the practical application stage, has possibilities that would have appeared fantastic only a few years ago. Moreover, it is probable that molecular electronics will greatly improve reliability."

Rawlings traced what he termed "the electronic revolution in defense." He cited radar ranges of 2000 miles compared to the 200 miles of 10 years ago; how heat-seeker homing techniques have increased the effectiveness of air defense and guided missile attack weapons; how scatter systems have improved communications; how digital computers track, calculate the trajectory and impact point of ICBM's; and how communications and reconnaissance satellites to be fired into orbit this year will revolutionize communications and military tactics and techniques.

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For complete information on this new oscillograph, contact your nearest CEC sales and service office, or write for Bulletin CEC 1823-X2.



# Titan Tooling Innovations at Martin

*Details of unique tank barrel assembly machine developed for Titan fabrication; program also results in new aluminum welding, chemical milling methods*

One of the unique steps in *Titan* fabrication at Martin-Denver is a custom-built tank barrel assembly machine.

The device feeds on integrally stiffened, extruded 2014 aluminum alloy skin plates supplied by Alcoa and Harvey Aluminum. Since the plates are received flat and in the T4—or semi-hard—condition, Martin initially runs them through several processes—including rough machining, stretch contouring and chemical milling.

The formed panel is then aged to

the T6—or hard—condition.

A group of three of these panels is placed on the assembler, positioned and held by pneumatic, finger-like clamps which grip the "T"-shaped internal stringers. The longitudinal butt joints are secured by actuating the external bridge clamps.

The quarter-barrel subassembly begins as the automatic welding head traverses the welding bridge, closing the seam. The bridge clamps are released, the quarter-barrel assembly moves out from under the bridge and

rotates until the next unwelded butt joint is in position. The welding operation is repeated until all four quarter-barrel subassemblies are completed.

The four subassemblies are positioned on the locator paddles and gripped as before. The tank moves under the bridge and the four quarter-barrels are joined. After two electrical cutting heads trim the barrel ends, the entire operation is finished.

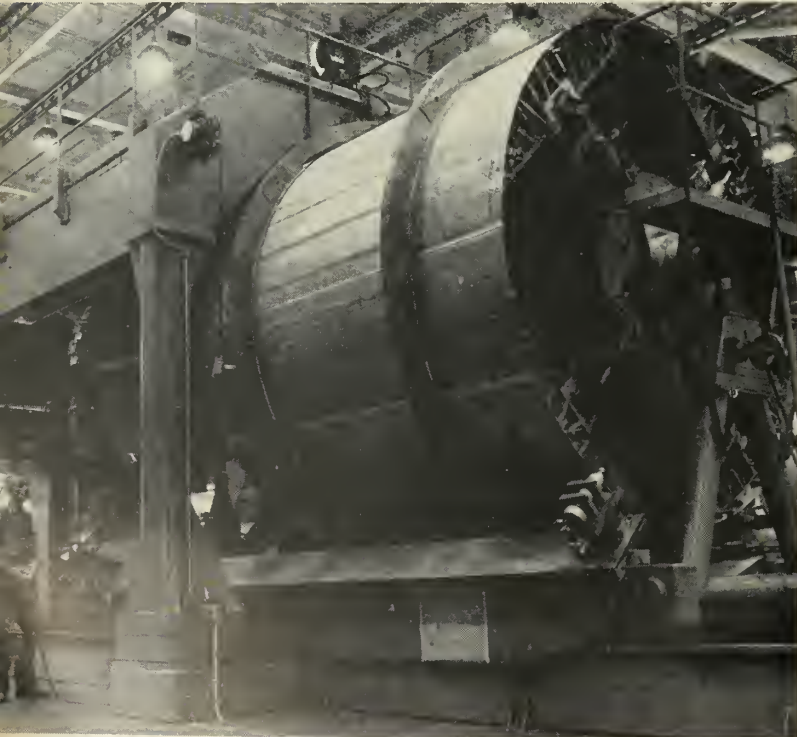
The domes are formed from aluminum alloy "orange peel" sections after initial processing, similar to that of the tank panels, has been performed. The segments are positioned in a weld and trim fixture and the joints closed. The dome is rotated around its vertical axis while the edge is routed to size by a built-in head. The circumferential welding is done by tilting the dome 90° and rotating it around its original vertical axis.

The domes join the tank barrels on an automatic rotating fixture. Two dome assemblies are located and clamped in chucks and the barrel assembly is positioned in the roller rings. The segments roll together, forming butt joints which are closed by a welding head, as the entire assembly rotates, in one continuous operation.

The tank is then stringently checked for weld defects by X-ray and other means. Hydrostatic tests and calibration follow and the tank, if passed, is cleaned, rinsed, de-oxidized and protectively coated.

Hot air blasts the tank dry before it is purged with nitrogen to a dew point of +10°F. The tank is sealed and admitted to the next assembly line for integration with the second stage, the transition pieces and the engine fairing.

Besides larger machines, the *Titan* has introduced at least two new processes—successful welding of 2014 aluminum alloy and quantity chemical milling.



**BARREL ASSEMBLY** machine used by The Martin Company's Denver Division in production of first stages for the *Titan* ICBM. It is the only one of its kind.





Spencer Laboratory is named for Raytheon's Senior Vice-president, Percy L. Spencer, a pioneer in tube development.

**Spencer Laboratory, the newest and most modern research and development laboratory for the design of all types of microwave tubes, has been put into operation at Burlington, Massachusetts by Raytheon.**

**More than 1,000 personnel are developing new tubes, from tiny missile klystrons to super-power tubes with power levels far exceeding any now in existence.**

**RAYTHEON COMPANY. WALTHAM, MASS.**



*EXCELLENCE IN ELECTRONICS*



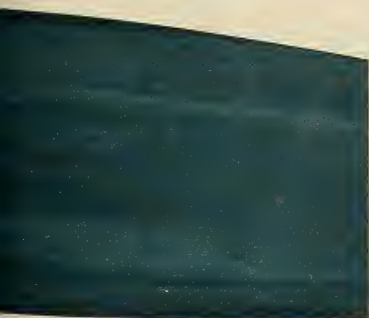




**Lockheed's interest** in the virtually unknown 360,000,000 cubic miles of this planet's oceans, stems naturally out of its underwater environmental development work with the Navy's POLARIS Fleet Ballistic Missile.

Proposed studies in the increasingly important field of oceanography include: oceanographic research vessels; measuring instruments; data collection systems; underwater communication and navigation; and basic research regarding natural phenomena and military aspects of the deep sea.

## EXPLORING THE WORLD OF WATER



**Division Diversification**—Oceanography is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology — from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetodynamics; man in space; materials and processes; applied mathematics; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space communications; space medicine; space navigation; and space physics.

**Engineers and Scientists** — Such programs reach far into the future and deal with unknown and stimulating environments. It is a rewarding future with a company that has an outstanding record of progress and achievement. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. A-29, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

**Lockheed** /

**MISSILES AND SPACE DIVISION**

*Systems Manager for the Navy POLARIS FBM,  
the Air Force AGENA Satellite in the DISCOVERER Program;  
MIDAS and SAMOS; Air Force X-7; and Army KINGFISHER*

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA  
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**BASIC  
BUILDING  
BLOCKS  
FROM KEARFOTT**



**ANALOG-  
TO-DIGITAL  
CONVERTERS**

Kearfott's rugged shaft position-to-digital converters are resistant to high shock and vibration and high and low temperature environments. Ideally suited for missile applications, these converters are available for many uses, including latitude, longitude, azimuth or conventional angular shaft displacement conversion and decimal count conversion. Exclusive drum design provides large conversion capacity in smallest size. Combination counter converter assemblies for both visual and electrical readout also available.

**TYPICAL  
CHARACTERISTICS**

Kearfott Unit No. .... P1241-11A  
Code ..... Cyclic Binary  
Range ..... 0-32,768 (2<sup>15</sup>)  
Bits per Revolution ..... 16  
Revolutions for Total Range  
..... 2,048  
Volts D.C. .... 10.5  
Current (ma.) ..... 20  
Inertia (gm. cm.<sup>2</sup>) ..... 20  
Unit Diameter (in.) ..... 1 1/8  
Unit Length (in.) ..... 3  
Life 10<sup>6</sup> Revolutions or 10<sup>3</sup> hours  
Static Torque (in.-oz.) .. 2 (break)  
1 (running)  
Weight (oz.) ..... 5  
Maximum Speed (RPM) ..... 600

*Write for complete data.*

**BASIC  
BUILDING  
BLOCKS  
FROM KEARFOTT**



**20 SECOND  
SYNCHRO**

This synchro, just one of a broad line offered by Kearfott, provides the extreme accuracy required in today's data transmission systems. Kearfott synchro resolvers enable system designers to achieve unusual accuracy without the need for 2-speed servos and elaborate electronics. By proper impedance, matches up to 64 resolver control transformers can also operate from one resolver transmitter.

**TYPICAL  
CHARACTERISTICS**

	SIZE 25	
	Control	
Type Resolver	Transmitter	Transformer
Part Number	25161-001	25151-003
Excit. Volts (Max.)	115	90
Frequency (cps)	400	400
Primary Imped.	400/80°	8500/80°
Secondary Imped.	260/80°	14000/80°
Transform. Ratio	.7826	1.278
Max. Error fr. E.Z.	20 seconds	20 seconds
Primary	Rotor	Stator

*Write for complete data.*

**BASIC  
BUILDING  
BLOCKS  
FROM KEARFOTT**



**INTEGRATING  
TACHOMETERS**

Kearfott integrating tachometers, special types of rate generators, are almost invariably provided integrally coupled to a motor. They feature tachometer generators of high output-to-null ratio and are temperature stabilized or compensated for highest accuracy integration and rate computation. Linearity of these compact, lightweight tachometers ranges as low as .01% and is usually better than ± .1%.

**TYPICAL  
CHARACTERISTICS**

Size 11 (R860)  
Excitation Voltage (400 cps) 115  
Volts at 0 rpm (RMS) ..... .020  
Volts at 1000 rpm (RMS) .... 2.75  
Phase shift at 3600 rpm .... 0°  
Linearity at 0-3600 rpm .... .07  
Operating Temperature Range ..... -54° + 125°

*Write for complete data.*

Miniature Fluted Gyro



Electrohydraulic Servo Valve



Scanlog 200-Scan Alarm Logging System



**KEARFOTT DIVISION**



**GENERAL PRECISION INC**  
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West Coast Office: 253 N. Vineta Avenue, Pasadena, Calif.

**Engineers:** Kearfott offers challenging opportunities in advanced component and system development.



# propulsion engineering . . .

By JAY HOLMES

## Solid hydrocarbon fuel . . .

is used by Thiokol in its hybrid engine. Security precludes any further identification of the fuel—or any disclosure about the storable liquid oxidizer. The company does say, however, that the propellant combination used in the engine developed by its Reaction Motors Division is hypergolic.

Engineers at Reaction Motors believe the combination of a liquid oxidizer and a solid fuel has a better chance of achieving specific impulse values above 300 sec. than any other non-cryogenic system. The best oxidizers available currently are liquid, they reason, and the best fuels are solid.

Since the specific impulse advantage of bi-propellant liquid combinations is often offset by the low bulk density of the liquids, their idea is to get the hydrocarbon into solid form—obviously by polymerization—and offset this disadvantage without any loss in  $I_{sp}$ .

## An Air Force contract . . .

supports the Thiokol work. The company's announcement earlier this month (M/R Jan. 11, p. 14) was the third in recent months of progress on hybrid engine development. In October, Aerojet-General reported it had turned up some promising data in studies with company funds. The Naval Ordnance Test Station at China Lake, Calif., said it had achieved a specific impulse between 225 and 265 sec. with a common nonaluminated double-base propellant and an ordinary halogenated oxidizer.

Thiokol spokesmen declared the results of their test programs indicate the high performance and controllability inherent in liquid-solid engines. Shutdown and restart capability also has been demonstrated. The engine is throttleable over the full thrust range.

## Problem of handling . . .

cylindrical rocket case sections during manufacturing process is solved by pneumatically operated grabs. Presray Corp., a subsidiary of Pawling Rubber Corp. in Pawling, N.Y., has just received clearance to report wide use of the device, which it calls the Pneuma-Grip.

The handling problem stems of course from the extraordinary sensitivity of high-strength metal to the slightest scratch or the smallest stress concentration. The pressure of ordinary grappling tongs might wrinkle the cylinder wall enough to introduce weak areas. Or a scratch might introduce a notch sensitivity.

## Neoprene pneumatic members . . .

channel rings of adjustable size hold the cylinders. Since air maintains the pressure of the members against the metal, the load is distributed equally. Presray, says Avco-Lycoming, General Electric, Allison Division of General Motors, Wright Aeronautical and Kaiser Fleetwings, among others, use the device in handling rocket case sections they make for the *Minuteman* and *Polaris* programs. A spokesman says this is one of the first instances where a small company has been able to standardize a critical materials handling system for many companies involved in a single defense project.

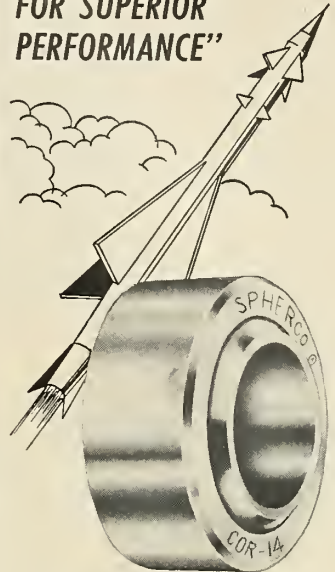
## Heat treaters are complaining too . . .

about what they call whimsical tolerance specifications by missile designers. They report that purchasers often state extreme specifications for a part and then recoil in horror when the supplier gives an honest cost estimate. At the last minute, the designer waives the requirements and admits he didn't need them in the first place. Some heat engineers have thrown up their hands in despair and concluded the whole business is a boondoggle.

# SPHERCO®

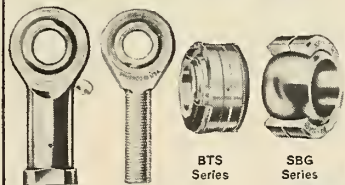
## SPHERICAL BEARINGS & ROD ENDS

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### FEATURING...

- Quality engineered and produced
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Forged One-Piece  
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A PRODUCT OF  
SEALMASTER BEARING DIVISION  
STEPHENS-ADAMSON MFG. CO.

25 RIDGEWAY AVE. • AURORA, ILL.  
Circle No. 36 on Subscriber Service Card.

## Unit Monitors Atmospheric Particles

A new atmospheric-particle counting instrument has been designed for application to the continuous monitoring of outdoor air or atmospheres of indoor locations, such as ultra-clean work areas by Royco Instruments Inc. The unit presents, on a strip-chart recorder, a permanent record of aerosols present in an overall range from 0.3 microns to any desired upper limit. This record is differentiated into 15 sub-ranges and recorded in sequence at intervals which can be predetermined in length. Stability problems are eliminated by the fact that the unit is continuously self-calibrated.

Included in the instrument is an alarm system which can be set for a remote indication of particle concentrations in any of the monitored sub-ranges exceeding a predetermined maximum.

Counting rate of the PC-200 is 1000 particles per minute with a 1% coincidence loss at the standard flow rate of 100 cc per minute. Recordings

are made on a 6-in. strip chart at a standard movement of 8 in. per hour. Operation is from a 115-v 60-cps supply with a current of 3 amp.

Weighing approximately 150 lb., the unit is 21 x 19 x 32 in. overall. It is mounted on greaseless, dustless casters. Price \$6975 f.o.b. Mountain View.

Circle No. 225 on Subscriber Service Card.

## Adhesive Aids Bonding Miniaturized Components

The increasing pressure for instrument miniaturization in fields such as computers, missiles and data processing systems has given rise to many critical assembly problems.

Take the case of a recently designed shaft position digital encoder which the ASCOP Division of Electro-Mechanical Research, Inc., is now supplying manufacturers of computers, telemetry and remote control devices, data processing

equipment, and so forth.

The device, measuring 2¼" in diameter and approximately 1¼" thick, converts directly into electrical binary code impulses, the shaft position of self-balancing potentiometers, radar antennas, machine tool carriages, navigation and fire control devices, weather forecasting instruments, etc. ASCOP managed to pack the necessary mechanical and electrical components into the compact housing, but an unexpected complication arose—how to attach the plastic insulating sleeve containing the output circuit wires to the cover plate of the housing. This had to be done without employing a connective device which would protrude into the interior of the instrument. This restriction suggested the use of an adhesive rather than a mechanical connector.

In considering the use of an adhesive, ASCOP engineers were faced with the problem of permanently bonding two dissimilar materials; polyvinyl chloride (the sleeve), and anodized aluminium (the cover plate). They were naturally anxious to use as small



*Why it pays you to specify*

## Bendix QWL Electrical Connectors for use with Multi-conductor Cable

For use with multi-conductor cable on missile launching, ground radar, and other equipment, the Bendix\* QWL Electrical Connector meets the highest standards of design and performance.

A heavy-duty waterproof power and control connector, the QWL Series provides outstanding features: • The strength of machined bar stock aluminum with shock resistance and pressurization of resilient inserts. • The fast mating and disconnecting of a modified double stub thread. • The resistance to loosening under vibration provided by special tapered cross-section thread design. (Easily hand cleaned when contaminated with mud or sand.) • The outstanding resistance to corrosion and abrasion of an aluminum surface with the case hardening effect of Alumilite 225 anodic finish. • The firm anchoring of cable and effective waterproofing provided by the cable-compressing gland used within the cable accessory. • The watertight connector assembly assured by neoprene sealing gaskets. • The addi-

tional cable locking produced by a cable accessory designed to accommodate a Kellem's stainless steel wire strain relief grip. • Prevention of inadvertent loosening insured by a left-hand accessory thread. • The high current capacity and low voltage drop of high-grade copper alloy contacts. Contact sizes 16 and 12 are closed entry design.

These are a few of the reasons it will pay you to specify the Bendix QWL electrical connector for the job that requires exceptional performance over long periods of time. \*TRADEMARK

Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec. Factory Branch Offices: Burbank, Calif.; Orlando, Florida; Chicago, Ill.; Teaneck, New Jersey; Dallas, Texas; Seattle, Washington; Washington, D. C.

Scintilla Division

Sidney, New York





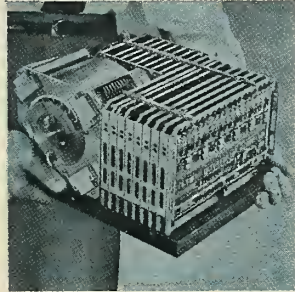
# LIBRASCOPE MISSILE COMPUTERS

To the moon and back and wherever missiles fly, Librascope computers deliver ready answers for in-flight control ■ guidance, optimum trajectories, impact prediction, data reduction and analysis. Throughout flight... Librascope missile computers are uninterrupted by environmental extremes... and they will automatically and continuously check their own built-in accuracy. The compact size, minimum weight and performance of Librascope missile computers have earned them important roles in our conquest of space. For information on how

Librascope advanced computer capabilities can answer your questions, write to Librascope, 808 Western Ave., Glendale, California.



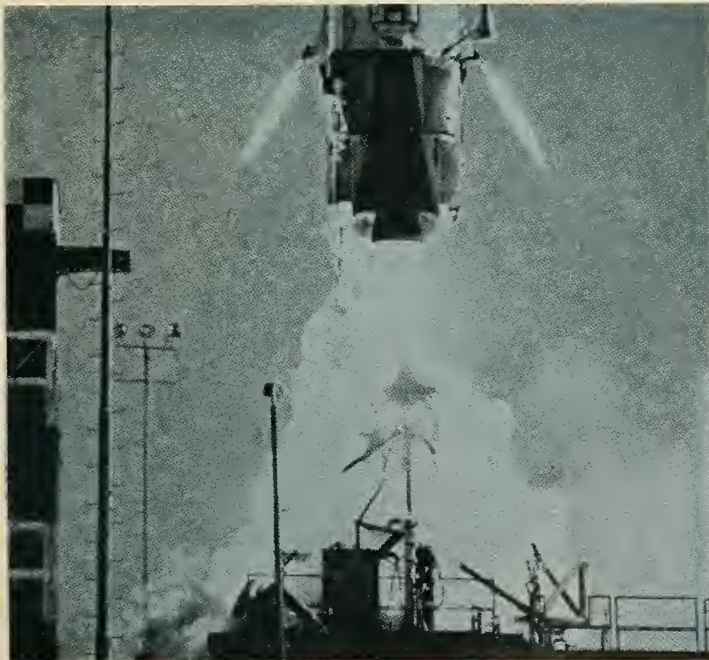
Division of General Precision, Inc. ■ For career opportunities, contact Glen Seltzer,



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*computers that pace man's expanding mind*



LI 0-1

## ... new missile products

a bonding area as possible and hoped to achieve the bond within a reasonably short period of time.

From the experience ASCOP had in solving some other unusual bonding problems, its engineering group recommended Eastman 910 Adhesive, recently introduced by Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co. This high-strength adhesive is characterized by its ability to form rapid bonds with a wide variety of materials. This, plus the fact that it does not require a catalyst, evaporation of solvents, or more than holding pressure, appears to have completely solved ASCOP's problem.

In production, the housing cover is placed on the holding plate of a small toggle jig and the plastic tubing is inserted through the cover so that it protrudes slightly. The protruding portion of the tubing and the area of the cover plate immediately surrounding it is cleaned by wiping with a small quantity of nitromethane solvent after which a small quantity of the adhesive is applied. A Teflon tool attached to a toggle device flares and flattens the end of the tubing against the cover plate. With-

in 2 to 3 minutes a bond stronger than the plastic is formed.

It should be noted that because of the almost universal nature of the adhesive, it is necessary to coat the Teflon tool with silicon grease to prevent any excess adhesive from bonding the tool to the vinyl tubing.

As mentioned above, ASCOP is using this unusual adhesive in other ap-



plications. In one of these it is necessary to bond aluminium identification plates to modular airborne telemetry instruments. Because these devices must be capable of plug-in assembly on any face with other instruments, the identification plates must be flush with the surface of the housing. In such cases the area to receive the plate is milled

out to a depth of about .018 inches, a drop of adhesive applied, and the plate pressed into place. Within minutes the plate cannot be removed without severe distortion.

Circle No. 226 on Subscriber Service Card.

## Dead Weight Calibrators Useful on Thrust Stand

Aeroscience Inc. announces a line of dead weight calibrators used in the laboratory to calibrate load cells to a high degree of precision, or in the field to calibrate one or more of the six load components directly on an engine thrust stand.

Two series are supplied. One is a direct dead weight loader applying precision-calibrated dead weights. The second employs a flexurally supported beam balance. The company provides loading units from 5000 lbs. or less, to over 1,500,000 lbs.

These systems employ flexure pivots, which are many times more efficient and reliable than knife-edge pivots. The flexures use a point of rotation which is always fixed. Parts containing critical dimensions are machined from a solid block, making an integral rugged construction which maintains the critical dimensions during hard usage, and pro-



# TELEFLIGHT®

## NEW Model 181 AIRBORNE PRESSURE TRANSDUCER

Now a NEW Taber TELEFLIGHT, weighing less than 12 ounces has been designed with an adapter that permits an amplifier to be built in to increase output signal to five volts as used in telemetering systems. BONDED STRAIN GAGE construction makes it relatively insensitive to vibration or shock. Resolution is INFINITE. Handles extremely corrosive media, including fuming NITRIC ACID.

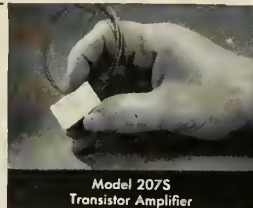
Features Pressure Cavity clean-out and standard built-in pressure overload protection. Pressure ranges: 0-250, 0-350, 0-500, 0-750, 0-1,000 PSI. Linearity 0.3%, Hysteresis 0.25% of F.S. at any given point, Ambient Temperature -100° F. to +275° F.

A complete line of Miniature Transistor Amplifiers such as Voltage, Power, Servo & Audio Amplifiers available to your specifications. ➔

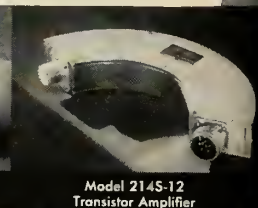
Write or telephone for literature and prices.

### TABER INSTRUMENT CORPORATION

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North Tonawanda, N. Y.  
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Model 207S  
Transistor Amplifier



Model 214S-12  
Transistor Amplifier



vides assured accuracy in measurements.

Units are compact and weight handling is said to be simplified by an efficient amplifying system, permitting use of lighter incremental weights which are easy to handle, require no massive structures, and can be loaded automatically.

Accuracies range from 0.05% of applied load in beam balance calibrators, to 0.01% of applied load in a dead weight type.

Circle No. 227 on Subscriber Service Card.

## Integrated Gyro Has Missile Uses

Kearfott Company, Inc. has announced the development of the M-2514-01 Miniature Floated Rate Integrating Gyro, designed primarily to be utilized as a control gyro in fire control or autopilot systems in missiles.

The M2514 features a newly developed high viscosity damping fluid which permits low-temperature storage without detrimental effects to pig-tails.



The wide angle capability of this component permits large angular inputs without consequent loss of reference.

The company says this high performance unit also features an AC drag cup torquer which is capable of high torquing rates, assuring a gyro which responds quickly to command signals.

Circle No. 228 on Subscriber Service Card.

## NEW LITERATURE

**ETCHING CONTROL.** A newly-introduced control material for metals-working industries which employ etching, photo milling, or plating techniques is described in a pamphlet available now from Eastman Kodak Company. Kodak Metal-Etch Resist was developed to assist in accurate and economical control of the removal of superfluous and hard-to-get-at metal from in-process pieces through etching or chemical milling. Kodak Metal-Etch

Resist protects the surface of the in-process piece in those areas where the removal of metal is not required or is undesirable. The entire surface of the piece is first coated with Kodak Metal-Etch Resist. The piece is then exposed to high-intensity light, from a carbon-arc or mercury-vapor lamp, through a photographically prepared line negative which "masks" the piece, passing the high-intensity light to areas which require protection and excluding it from areas to be worked. This exposure forms an image of the desired pattern. After treatment with Kodak Metal-Etch Resist Developer, the protected areas will resist the action of the etching solutions. Because it is a non-conducting material which adheres readily to a number of metals, Kodak Metal-Etch Resist is expected to be widely used also in plating to permit the plating of a piece in specific areas, while excluding the plating from other areas.

Circle No. 200 on Subscriber Service Card.

**WAVEGUIDE DATA.** A new "Standard Waveguide Data Chart," one of the most complete listings of waveguide information available today, has been prepared by the Narda Microwave Corp. Featuring military as well as EIA designation numbers, the chart shows virtually all required electrical as well as mechanical parameters for all waveguides in use today. Some of the parameters covered are: cut-off frequency, theoretical attenuation for both brass and aluminum waveguides, theoretical C.W. power rating, and the waveguide wavelength from the lowest to the high frequency in any given band. Mechanical dimensions are also given for all waveguides, along with their tolerances. This is especially valuable, since these figures can be used as a guide to minimum tolerances throughout the rest of a system under design. Engineers who do not work with microwaves on a regular basis will also be able to use this chart to find radius dimensions, type of flange available—either cover or choke—in both aluminum and brass; as well as dimensional information to help them determine frequency ranges consistent with the mechanical and dimensional requirements of the equipment with which they are working.

Circle No. 201 on Subscriber Service Card.

**INFRARED GLASS.** The fourth in a series of infrared "Progress Reports" has been published by Bausch & Lomb Optical Co., Rochester, N.Y. Report #4 describes three types of glass, specifically developed for refractive systems to be used in the near-infrared part of the spectrum.

Circle No. 202 on Subscriber Service Card.

## Here's a NEW FILTER ELEMENT that FORBIDS MEDIUM MIGRATION



From the SKINNER  
"LAST NAME"  
in filtration  
SKINNER

-400 F  
to 1800 F

From SKINNER—a name famous in filtration since 1927—comes a unique, high temperature filter element for high performance aircraft and missile applications. A unique acid resistant bronze and fabrication method whips the problems of acid compatibility and restricted temperature ranges. Temperature limits are from -400 F to 1800 F in continuous fluid-operating ranges. *No filter medium migration.* A smaller envelope is another advantage of this highly efficient element. Any type of housing applicable and delivery is immediate. If you have a filtering problem, write Skinner . . .

# SKINNER FILTER

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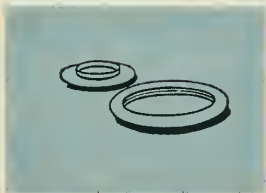
Circle No. 22 on Subscriber Service Card.

**You'll like  
Garlock's  
habit of being  
on time . . .**

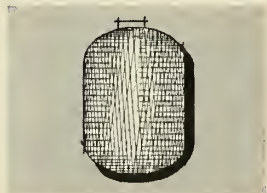


At Garlock, delivery of high quality rocket motor components in the shortest time is of prime importance. To meet this objective, research and development, product design, tool design, pilot manufacturing, and production staffs work together as a fully integrated team. By solving problems of design and production jointly, they avoid time-consuming redesigning and retooling.

*Flexible, Diversified . . .* Garlock will swing into prototype production on short notice and follow this with full scale production as needed . . . will design and manufacture rocket motor components from a variety of basic materials—rubber, metals, phenolics, fluorocarbon plastics.



**GARLOCK METAL FITTINGS** for rocket motor cases such as blast tube and thrust terminator support rings are machined to extreme tolerances. Materials afford minimum weight, maximum strength and rigidity.



**FILAMENT WOUND ROCKET MOTOR** cases made by exclusive Garlock method result in structure much lighter and stronger than steel.



**INSULATION** for solid fuel rocket motors made by Garlock is rubber-like compound which encounters gas velocities of Mach 3-5, temperatures to 5500°F, prolonged ambient temperatures of 300°F.



**MISSILE PARTS** from inert materials including newly developed asbestos-phenolic compound for nozzles . . . nose cones of fluorocarbon plastics.

Garlock engineers will work to your design or help you in developing designs. Call or write Military Products Department, The Garlock Packing Company, Palmyra, New York.

**GARLOCK**



Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Garlock components are presently used in the development and production of—

- Vanguard
- Polaris
- Minuteman
- Super Vanguard
- Terrier
- Nike Hercules
- Super Tarter



# Hébert Legislation May Pass Congress

**Opposition to establish uniform curbs on 'influence peddling' expected to be slight, but attempts to strengthen House bill may result in battle**

Despite its failure to establish any wrongdoing, the Hébert Subcommittee's recommended legislation to establish uniform curbs on "influence peddling" in connection with defense contracts is expected to receive congressional approval.

Opposition will be negligible. But there is a possibility that a controversy may develop over attempts to make the measure even more stringent.

As sent to the House Jan. 19, the bill specifically bars all former military and civilian personnel from selling to the Pentagon for two years after leaving DOD service. However, some lawmakers are known to favor upping the "keep out" time to a period of three years or more.

It is also possible that a new definition of "selling" included in the House Armed Services Investigations Subcommittee report accompanying the legislation also may be written into the bill. This is set forth as:

"Selling to the Government includes all activities which bring a contractor and his representatives into contact with officials of the Department of Defense for the purpose of obtaining contracts from that Department for the procurement of tangibles or intangibles in existence at the time or to be produced in the future; and the participants in such transactions are a part of that process."

• **"No escape"**—Subcommittee Chairman F. Edward Hébert (D-La.) said this was intended to be a "no escape" definition. "No excuses on account of the kind of a thing sold, whether tangible or intangible, in existence or to be produced." He said, "beer and turbines, planes and weapon systems, get the same treatment. Pounds and proposals are weighed in the same scale."

Heretofore, selling has been defined in military transactions as almost exclusively dealing with the exchange of money. The new definition, if not incorporated in the bill, will become part of the legislative history. Maximum

penalties for those found in violation would be a \$10,000 fine, a year in jail, or both.

The subcommittee also recommended repeal of the Navy's present life-time prohibition against selling. Citing several conflicting regulations, the investigators said a clearly-delineated law with a two-year "cooling off" period for all the services was the best answer.

In addition, the subcommittee asked that the law be changed to permit the secretary of defense to waive present dual compensation regulations on a temporary basis so that DOD can rehire "indispensable" men. At hearings last year, there were complaints that retired military men had no choice but to go to industry. For they would forfeit retirement pay by taking a job with the government.

• **Code asked**—The subcommittee called for establishment of a "Code of Ethical Conduct"—like that of the American Bar Association—which would continue after the cooling off period. The code, however, would prohibit them from ever directly engaging in matters which that had specialized in while in the service.

The code—to be generated by DOD—would require:

• A retired commissioned officer to notify DOD when taking a job with a defense firm.

• DOD to organize a central public file of the information.

• Defense contractors to list for DOD on the effective date of a contract the names of all retired officers on the payroll. Primes would be required to furnish information on behalf of their subs. Failure to comply "shall cause the suspension of all payments, whether retired pay or contract payments, as the case may be, until such information is furnished."

Revealed in the report were the names—and pay—of 240 retired flag and general officers now working for defense contractors. Of the top 100

DOD contractors, the subcommittee said a survey showed 72 had retired military personnel of all ranks on their payrolls—the highest at \$100,000 per year—and the remaining 28 had none.

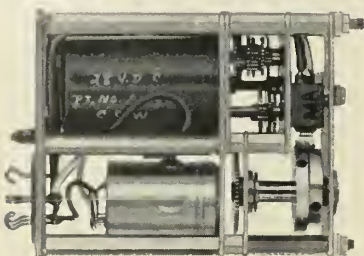
Total number of retired captains and lieutenant commanders and above surveyed was 1401. The report noted there were 33,326 regular Army, Navy, Marine Corps and Air Force officers on the retired lists as of last June 30—3353 of flag or general rank. "Thus, we are not dealing with substantial numbers of persons considering total defense contractor employment," the report said.

• **Newspaper ads deplored**—No changes were asked in the laws governing taxes, advertising, entertainment or trade associations—four subjects also explored by the investigators during the lengthy hearings. However, the report deplored the newspaper advertising controversy between Boeing's *Bomarc* and Western Electric's *Nike-Hercules* interceptor missile programs as "detrimental" to the defense effort. Said the subcommittee: "It provokes controversy and promotes dissension, and introduces biased, narrow, and prejudicial considerations into purely military decisions."

While not mentioning The Martin Co. by name, investigators said they would let the previously released documentation of the firm's entertainment of high-ranking military officers in the Bahamas stand as their "commentary." But, then they added, "public confidence is undermined, especially when both propriety and discretion appear to be wanting in the personal codes of many persons in high places."

Such organizations as the Association of the U.S. Army, the Navy League, the Air Force Association and Aerospace Industries Association, the report said, accumulate many millions of dollars. "Its use, either good or bad, depends upon the degree of discretion of officials and directors." Investiga-

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tors said they felt the recent Internal Revenue Service ruling disallowing tax deductions on dues to organizations for lobbying activities was an effective

way to handle the situation.

Hébert himself seemed somewhat skeptical as to the effectiveness of his proposed law, even if adopted.

No.	Defense position	Name of company	Total number of employees	Number of retired military officers employed	Number of retired flag and general officers employed
1	1	Boeing	89,981	61	5
2	2	General Dynamics Corp.	91,700	186	27
3	3	General Electric	282,029	26	7
4	4	Lockheed	45,530	171	27
5	5	United Aircraft	61,688	24	5
6	6	A. T. & T.	(3)	6	0
7	7	North American	54,660	92	8
8	8	Douglas	76,400	40	5
9	9	The Martin Co.	27,269	63	9
10	10	Hughes Aircraft	(3)	22	5
11	11	Sperry Rand	101,016	30	3
12	12	Chance Vought Aircraft	16,596	16	3
13	13	McDonnell Aircraft	27,107	5	2
14	14	IBM	83,782	9	1
15	15	RCA	78,000	35	15
16	16	Northrop Aircraft	25,600	26	4
17	17	General Motors	(3)	6	2
18	19	Republic Aviation	10,675	14	4
19	20	Chrysler Corp.	136,187	12	3
20	21	Grumman	13,000	14	3
21	22	Raytheon	28,347	19	2
22	23	Curtiss-Wright	26,311	7	1
23	24	Bendix Aviation	50,266	29	3
24	26	General Tire & Rubber	28,000	66	11
25	27	Ford Motor Co.	191,759	7	1
26	29	Fairchild Engine & Airplane	12,711	12	5
27	30	I. T. & T.	128,000	44	14
28	31	Avco Manufacturing Co.	24,569	8	6
29	32	Bell Aircraft	15,000	3	1
30	33	The Texas Co.	53,340	5	0
31	34	Continental Motors Corp.	5,600	5	0
32	35	Burroughs Corp.	33,000	14	3
33	36	American Bosch Arma	7,704	0	0
34	37	Socony Mobil Oil	(3)	1	1
35	38	Philco Corp.	19,983	29	3
36	39	Thompson Ramo Wooldridge	19,352	12	5
37	40	Cities Service	(3)	3	1
38	41	Collins Radio Corp.	10,092	11	1
39	42	Marquardt Aircraft	3,700	9	0
40	43	Hayes Aircraft Corp.	1,200	11	1
41	44	Olin Mathieson	39,000	4	1
42	45	Food Machinery & Chemical	15,103	10	2
43	46	Goodyear Tire & Rubber	101,386	8	1
44	47	Thiokol Chemical Co.	2,911	12	1
45	48	Newport News Shipbuilding	12,452	14	2
46	49	General Precision Equipment	1,500	12	6
47	51	Garrett Corp.	11,020	4	2
48	52	Tidewater Oil Co.	9,763	4	0
49	53	Bethlehem Steel Corp.	(3)	12	3
50	54	Lear, Inc.	3,868	2	1
51	55	Sylvania Electric Products Co.	27,300	19	1
52	56	Firestone Tire & Rubber	88,323	4	0
53	57	The Rand Corp.	(3)	14	6
54	58	Marine Transport Lines	(3)	1	1
55	59	Bath Iron Works	1,531	2	1
56	61	States Marine	(3)	1	0
57	62	Kaman Aircraft	1,270	1	1
58	63	Westinghouse Air Brake	17,275	1	0
59	64	Todd Shipyards	8,468	11	0
60	66	Motorola, Inc.	12,000	12	1
61	68	Temco Aircraft	7,839	11	3
62	70	White Motor Co.	8,800	1	0
63	72	Shell Oil Co.	40,465	4	1
64	73	Fairbanks Whitney	(3)	4	3
65	75	Hercules Powder	11,179	1	0
66	76	Eastman Kodak	50,300	5	0
67	77	Richfield Oil	6,177	3	0
68	78	Cessna Aircraft	5,556	1	0
69	80	Beech Aircraft	8,128	2	0
70	83	Ryan Aeronautical Co.	7,134	54	7
71	84	Union Carbide Corp.	77,000	8	1
72	18	Westinghouse Electric	128,572	31	9
		<b>Total</b>		<b>1,426</b>	<b>251</b>

(3) No figure available.



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MISSILES & SPACE DIVISION

# AAS Hears New Propulsion Concept

by Jay Holmes

A Martin Co. scientist proposes development of a space propulsion system based on a series of 0.01 kiloton nuclear explosions.

Dandridge M. Cole of Martin's Denver Division told the American Astronautical Society convention last week in New York that an average thrust of 800,000 lbs. can be generated with the explosion of one pulse per second with a 0.01 kiloton bomb encapsulated with liquid. He assumed 40% conversion of bomb energy to rocket exhaust energy.

The Martin Co. scientist said his plan has no relationship to Project *Orion*, a highly classified study of the feasibility of propulsion by contained nuclear explosions being conducted by General Dynamics Corp. for the Defense Department.

Cole, who offered three differing types of systems, said all would be cheaper and provide larger payload fractions than chemical or nuclear heat-exchange propulsion for very large vehicles.

One model, which Cole said could be based on state-of-the-art design, would accelerate a 350,000 lb. payload through a velocity change of 26,000 feet per second. It would use 2400 capsules and slightly more than 2,000,000 lbs. of water as propellant. Although this would be sufficient to lift from the earth's surface, Cole said departure from orbit might be preferred to avoid atmospheric contamination. If so, he said, a *Nova*-like booster rocket could be used.

Looking farther into the future, Cole also outlined parameters for larger nuclear pulse rockets and a nuclear pulse jet, which would use air as an expellant during its passage through the atmosphere.

• **"Clean" bombs possible**—On the assumption that the latter types would require 10 years or more for development, Cole said it is possible that "clean" bombs could be developed by that time, avoiding the contamination problem. He made no estimate of the time required for developing a nuclear pulse rocket of "state of the art" design.

The energy capsules are the largest item in the cost of such a system, Cole declared. Nuclear bombs are now reported to cost \$250,000 apiece. He said it may be possible to reduce the cost to between \$10,000 and \$100,000 apiece, thus leading to total propellant

costs between \$24 and \$240 million and payload costs of between \$70 and \$700 per lb. Lower costs will result from development of larger vehicles, he added.

• **Defends Mercury policies**—At another session, Brig. Gen. Don R. Flickinger, USAF, vigorously defended policies for selection and training of the first group of astronauts.

At a man-in-space symposium, a floor speaker noted that all seven astronauts are married and questioned whether this was advisable, since a bachelor might be willing to take greater risks.

Flickinger, who has charge of the man-in-space program for Air Research and Development Command, declared that neither the marital status nor religion of the candidates was known by the selection board. Lt. Col. Stanley White of NASA's Langley Research Center remarked that only one or two of the original 500 test pilots considered were single.

Flickinger also disputed the proposal by Dr. T. C. Helvey of Radiation Inc. that tranquilizers and other drugs be administered to astronauts taking off on long missions to combat the development of hallucinations.

Helvey said that drugs might be useful to combat fatigue, to create desirable hallucinations and to stimulate desirable actions. The other panelists, A. M. Mayo of Douglas Aircraft Co. and Lt. Col. Burt Rowan of Edwards Air Force Base, joined in opposition to the idea. Flickinger said ARDC studies showed the best way to combat hallucinations is to keep the man busy.

The Radiation Inc. scientist also suggested a relaxation of what he called the "very conservative" maximums for radiation dosage of astronauts, based on the Atomic Energy Commission standards for industrial workers.

Helvey argued for the philosophy that a man exploring space can take as much risk from radiation and other dangers as a soldier going into battle.

• **Other papers**—In other papers given at the Society's sixth annual meeting:

• **Lithium vaporization** was proposed as a system for cooling ballistic nose cones. Henry K. Hebler of Boeing Airplane Co. said a system based on liquid lithium would be much lighter than a beryllium heat sink or an acrylic ablator, and competitive with a quartz ablator.

• **Cost of transporting** a pound of material to the surface of the moon

can be reduced with chemical propellants to about five times that of carrying it to a low-altitude earth orbit, Robert Cornog of Thompson-Ramo-Wooldrige estimated. The cost can be cut in half with a high-thrust nuclear rocket having a specific impulse of 930 sec.

• **A nuclear rocket engine**, even with 17,500 lbs. of personnel shielding, requires vehicles of smaller gross weight than a chemical system based on liquid hydrogen and liquid oxygen, three Aerojet-General scientists reported. A. H. Flagg, H. S. McQueen and C. H. Trent based their calculations on a minimum specific impulse—700 sec—for the nuclear rocket.

• **Beryllium** was suggested as an ablating-type heat sink for very short-time applications by J. Frisch of the University of California.

• **Midcourse correction** to reduce target miss was analyzed by Jack Lorell of NASA's Jet Propulsion Laboratory.

• **Methods of computing radiation dosage** in space flight were outlined by Angus F. Bond, Michael G. Del Duca and Andrew D. Babinsky of the Tapco group, Thompson-Ramo-Wooldrige Inc.

• **A straight-line flight plan** to reach Mars was suggested by Dr. T. C. Tsu of Westinghouse. The one-way trip would require just over three months, compared with nine months for a curved trajectory. Dr. Tsu said straight line flight could be accomplished by continuous propulsion, either by a solar sail or an electric propulsion system.

## RCA Opens Communications Laboratory in Arizona

A new surface Communications Systems Laboratory was dedicated recently by the Radio Corp. of America at a site 20 miles southeast of Tucson, Ariz.

RCA said the 13,000-sq.-ft. facility will be used for work on advanced electronic systems such as the global communications program for the Air Force and the *Minuteman* solid-fueled missile. It will also provide quarters for development work on a complete area communications system for the Army.

An RCA official said the Tucson Laboratory would supplement other facilities the corporation has established in the far West, including the major electronics center under construction at Van Nuys, Calif.



## E. B. on the FBM

### Subcontractors Get 25% of Boats' Cost

WASHINGTON—About 25% of the \$50 million the Electric Boat Division receives for a nuclear submarine is spent with subcontractors, a company official estimates.

William G. Atkinson, contract control manager for the George Washington, told this to a recent luncheon meeting of the National Rocket Club. Electric Boat, a division of the General Dynamics Corp., receives about half of the total \$100 million cost of a nuclear sub.

Atkinson said most of Electric Boat's expense is labor in putting the vessel together. The subcontracting is mainly for pumps, valves, metal and other raw materials.

Asked about the date of the first test launching of a *Polaris* from a sub, Atkinson said merely that it would be this year. The Navy schedule calls for *Polaris* missiles to be operational this year aboard the USS George Washington, which was commissioned last month.

Atkinson declared that the navigation problem involved in accurate *Polaris* firing has been solved. He said the problem is much greater because a sub is moving constantly and it is not always possible to take a celestial fix. Nevertheless, he said, navigational aids are available and will do the job.

Electric Boat and Reynolds Aluminum are jointly studying the possibility of using aluminum hull plates, he reported, but thus far the decision has been to stay with steel. Aluminum is used in nuclear subs for non-strength members, however, he added.

In answer to other questions, Atkinson added:

- **Superior sailors** are assigned to the *Polaris* submarines. It isn't true that the complex weapon system is getting beyond the sailor's capability. Each sub has two crews. The crew ashore receives constant training.

- **Submersible submarine tenders** are feasible—depending on just what mission they should perform.

- **Building facilities** at Groton, Conn., are not taxed to the limit. He knows of no plan by E. B. to acquire another shipbuilding facility, on the West Coast or elsewhere.

- **Closed ecological environment** experiments are in progress at E. B. The problem in a sub is similar to that in a space ship. Men must live in a closed capsule for long periods of time with a hostile environment—whether water or airless space—outside the capsule.

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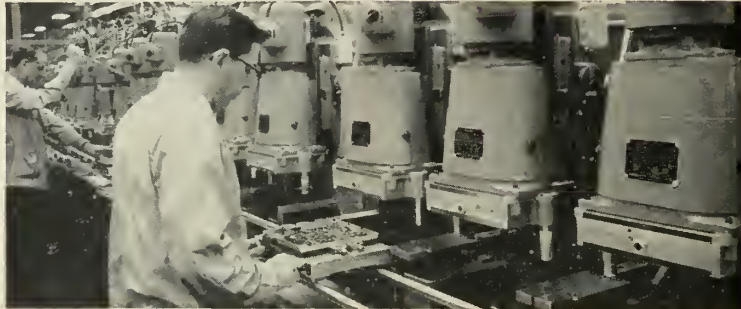
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# So. Cal. Expects to Keep 15%

Southern California expects to maintain its present 15½% of the nation's total defense dollar during calendar 1960 and fiscal 1961, according to opinions expressed by the area's industry leaders at a business outlook conference in Los Angeles.

On a statewide basis, California is expected also to hold its current 22% slice of defense spending. Year-end statistics show that 1 out of every 15 persons employed in the state is in defense work of some type—280,000 in Southern California alone—against a state total of 391,000. Employment, however, will shift within defense industries during the coming year to reflect military procurement changes.

Key points stressed at the conference were:

- Continued emphasis on missiles and space systems with at least a 10% increase in total sales and a moderate increase in total missile industry employment.
- Increased competition for contracts at both prime and sub level with longer gaps between contracts. Economic effect on winners and losers will be greater than ever.
- More movement of personnel between companies.
- An increase in electronic industry employment of about 20%, but overall electronics expansion for 1960 will be at a rate below that of prior years.
- Missile and space vehicle propulsion industry will remain relatively stable at its present 10,000 employee level in Southern California. Propulsion business is expected to increase after 1960.
- Missile support, test and checkout equipment will gain as a factor in Southern California defense industry with a resulting increase in this type of business.
- Research and development business will definitely increase in an expanding search for new product development.

Speakers pointed out the other side of the picture, too, but with objectivity and little pessimism.

- The effects summit conferences may have on military spending. Any changes from this factor would probably not be felt for another year or two, however.
- Reduction in aircraft employment in the immediate future with new aircraft developments coming after 1960 at a reduced rate of production.

- Fewer items to be produced because of the increased capabilities of each item.
- All production runs will be limited in both time and number.
- Many local missile programs are reaching full production. Additional production will depend upon attrition through test firings and development of alternate uses.

## Redesigned, Lighter Thor Passes First Flight Test

CAPE CANAVERAL, FLA.—A streamlined Thor IRBM, redesigned from head to toe to obtain much greater range and payload for use in space probes, has proved successful in its first test.

A cone-shaped aluminum fairing, which adds 8 feet to the regular 65-foot height, reduced some of the drag created by the Douglas Thor's normal blunt-nose shape in its upward flight through the atmosphere. The new fairing was built by the General Electric Co. Missile and Space Vehicle Department.

In the engine, weight was saved by wrapping the combustion chamber with fiber glass, a process first introduced in the Atlas ICBM (M/R Dec. 28, pp. 18-19). The start sequence and pumping system were modified to produce greater thrust.

North American's Rocketdyne Division, manufacturer of the engine, also believes that reliability will increase because the number of components was decreased.

In the first test Jan. 14, a data capsule was picked up less than two hours after launch 1700 miles down the Atlantic Missile Range to the normal target area off Antigua. The shot was not a part of the Thor military test program, which had already been ended by the Air Force.

The engine redesigns took advantage not only of the Atlas improvements but of modifications of the Rocketdyne H-1 engine required for clustering it into the Saturn booster. The engine originally had 135,000 lbs. thrust. Current military models used in the Jupiter and Thor IRBM's had increased the thrust to 150,000 lbs. For the Saturn, the H-1 has been increased to 188,000 lbs., so that eight of them will total 1½ million lbs.

The new Thor is taking advantage of the H-1 improvement for the Saturn. However, it has not yet reached the full 188,000 lbs. thrust. The actual thrust achieved is classified. Specula-

tion puts it in the neighborhood of 170,000 lbs.

The new GE fairing, a long cone, shrouded the Thor's blunt, heat-sink type re-entry vehicle and reduced aeronautical drag on the upward flight. It was separated from the re-entry vehicle by a small explosive device immediately after shutoff of the rocket engine. Then the vehicle continued its space flight in the normal manner.

The major change in the engine is the increased capacity of the turbo-pump assembly—achieved simply by running the two pumps faster. Simplification of the start sequence was also achieved, along with a reduction of the number of components.

In the combustion chamber, fiber glass filament winding, impregnated with an epoxy resin, replaces the steel bands formerly used as restraining material around the outside. The substitution saved more than 50 lbs. of weight. The process is similar to the fabrication of laminated fiber glass solid-fueled rocket cases.

Thor engines are produced at the Rocketdyne plant in Neosho, Mo. R&D was done at the division's main plant and propulsion laboratory at Canoga Park, Calif.

## Atomic Fuel Gauge Is Developed for the Navy

A fuel gauge which uses gamma radiation to measure the amount of propellant in missile and aircraft tanks has been developed for the Navy by Atomic International Division of North American Aviation.

Radiation sources and detectors mounted on the sides of each fuel tank, and gamma rays pass through the fuel supply, decreasing in intensity. The amount of fuel is determined by the intensity of the rays reaching the detectors. A ratemeter converts pulses picked up by the detectors into d-c voltages which record the quantity of fuel in pounds on an indicator or provide a signal to a telemetering output.

The gauge is said to be capable of measuring amounts of fuel with greater accuracy and reliability than conventional devices. It has been environmentally tested at altitudes to 38,000 feet, and has performed accurately at all flight attitudes.

All types of solid and liquid propellants can be measured by the lightweight transistorized gauge, and its performance is not affected by impurities in the fuel. Easily installed, it automatically compensates for differences in hydrocarbon or petroleum-based fuels which affect the accuracy of conventional units.

## —more about the missile week—

• **New York**—Brig. Gen. Don R. Flickinger, head of the Air Force life science space program, predicts Russia will orbit two men in a space capsule this year—possibly when President Eisenhower is visiting Russia in June. He believes Russia has solved all the technical problems of getting the men up and their re-entry.

• **Andrews AFB, Md.**—Lt. Gen. Bernard A. Schriever, ARDC commander, said both the U.S. and Russia “have an equal chance of putting a man in space first.” But he declined to estimate just when this country would attempt a manned shot. Expressing doubt over reports the Soviets had already put “people” in space, Schriever said, “I just don’t go along with the idea that we are way behind in space.”

• **Washington**—General Dynamics Corp. with \$1.61 billion total contract awards, or 7.2% of the total defense dollars, led the list of the top 100 DOD contractors in FY 1959. G-D edged out Boeing Airplane Co., which dropped from first into second place with \$1.167 billion net contracts. North American—with contracts totalling \$1.018 billion—was third and General Electric was fourth with \$914 million in new contracts. Others in the

top 10: Lockheed—\$898.5 million; Douglas—\$676.4 million; United Aircraft—\$538 million; Martin—\$524 million; Hughes—\$494 million; American Telephone & Telegraph—\$476.5 million.

• **Marshall, Tex.**—Thiokol reported it was able to resume partial production Jan. 18 at a solid-fuel mixing building just 10 days after it was damaged by an explosion. There were no injuries. The company’s Longhorn Division said the accident did not impair deliveries of Nike-Hercules engines to the Army.

• **Washington**—Mergers & Expansions: Boeing Airplane Co. has entered into an agreement to buy Vertol Aircraft Corp. Subject to stockholder approval Feb. 15 . . . Bell & Howell shareholders have okayed the acquisition of Consolidated Electrodynamics Corp. . . . Electro-Pulse Inc., Culver City, Calif., is merging into Servo Corp. of America as its West Coast subsidiary . . . General Electric has set up a new defense systems engineering company—Apparaten-industrie Defense Electronics N.V.—at the Hague, Netherlands . . . At Los Angeles, Aeroquip Corp. has opened an 11,000-sq.-ft. addition to its Marman Division.

## Autonetics Sets Up MM Group

A *Minuteman* System Management Division has been set up at Autonetics division of North American Aviation in Downey, Calif., to handle work on

the company’s \$115-million *Minuteman* guidance contract.

Jesse Y. Bowman, former *Minuteman* program manager, has been

named system manager. R. E. Moore will be his assistant manager.

The contract is an Air Force research and development contract for fabrication and test of inertial guidance and flight control systems. It also covers ground support equipment for the solid fuel intercontinental ballistic missile which is to be a successor to the Convair *Atlas* and Martin *Titan*.

The new division was formed to provide management skills consistent with current and future program requirements, according to the North American announcement.

The new group will have responsibility for over-all management of NAA’s *Minuteman* program.

North American says formation of the new division is an additional step in reorganization of Autonetics which started several months ago with the establishment of four product divisions: Armament and Flight Controls, Computers and Data Systems, Inertial Navigation, and Industrial Products.

Four technical and administrative divisions also were set up: Research and Engineering, Market, Financial and Central Operations.

Appointed to posts in the new division were C. H. Sword, contract and controls manager; R. M. Osborn engineering manager; E. R. Buxton assistant engineering manager; C. P. Ballard, system test manager; W. A. Chapin, quality control manager; E. E. Ashworth, purchasing agent; E. B. Lindaman, master programming, and M. C. Biging, administrative assistant

## Snap Generator Still Producing



SNAP-3 midget electrical generator fueled with radioisotopes has operated successfully in a vacuum and at temperatures down to 100° below zero. Martin’s Nuclear Division, which designed and built the units for the AEC, reports that the original generator was still producing electricity after a full year of continuous operation.



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Fiberite No. 6500 asbestos reinforced phenolic; Fiberite No. 4030-190, Fibreglas reinforced phenolic; Fiberite No. 2630, graphite cloth reinforced phenolic; these compounds are selected for both thermal insulation and erosion resistance.

## **FIBERITE**

### **Compression molded blast tubes**

Fiberite No. 1370, graphite and ceramic fiber reinforced phenolic; Fiberite No. 2630, graphite cloth reinforced phenolic; these compounds are selected for erosion and ablation characteristics at temperatures exceeding 5000° F.

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**Peter Schenk**, former president of the Air Force Association and assistant to the president of Raytheon Co., goes to the Mitre Corp. on Feb. 1 as executive vice president.

**Alfred H. Canada**, manager of advanced engineering physics for General Electric's advanced electronics center: selected to fill a one-year appointment on the analysis staff of the Institute for Defense Analyses in Washington, D.C.



CANADA

Canada's appointment to IDA is part of a program designed to bring together top scientists and engineers from industry and education in a brain-power pool to supply technical support to the nation's military research and development effort.

He holds eight patents and was awarded a medal of commendation for infrared development.

**Dr. Fred P. Baughman**, formerly a special services engineer with E. I. du Pont de Nemours & Co., joins Taylor

Fibre Co., as a group leader in the technical department heading up the physical chemistry-fundamental studies group section.



**Dr. Ralph A. Schaefer**: named director of an enlarged research and development department of engineering at The Bunting Brass and Bronze Co.

Dr. Schaefer, who joined the firm a year ago, was formerly technical advisor to the president of Clevite Corp.'s Graphite Bronze Division. He holds many patents and has a number of developments to his credit in the laminated sleeve-bearing and sintered-metal fields.

**H. S. W. Massey**, leader of Britain's space research team and the Quain Professor of physics at University College, London, was one of the few scientists featured in Queen Elizabeth's New Year Honours list. He is to become a knight. He will visit America this month with detailed proposals for a joint Anglo-American satellite launching program.

He and his team will discuss with NASA officials such questions as the payload space which will be available to them in the *Scout* vehicle, so that a decision can be taken on the type of instruments which Britain will construct.

Also on the Honours list were **Sir George Horatio Nelson**, Chairman of English Electric Co. Ltd., who becomes a Baron; **Rear-Admiral Sir Matthew Sausse Slatter**, Chairman and Managing Director, Short Brothers and Harland, Ltd., a Knight of the Order of the British Empire; and **H. Lloyd**, projects officer on *Black Knight* for Saunders-Roe, Ltd., a member of the Order of the British Empire.

**Dr. Lloyd G. Lewis**: named manager of Electronic Associates, Inc.'s newly formed process control group. He was previously with Standard Oil of Indiana as head of the analog computer section and was responsible for design and development of several servo systems.

**Earl Q. Bowers** and **Richard J. Dempsey**, design development engineers, join The National Cash Register Co.'s Electronics Division.

Bowers, formerly a Hughes Aircraft Co. engineer will work on design and checkout of a digital computer. Dempsey, previously with North American Aviation, Inc. and Servomechanisms, Inc., joins a circuit analysis group.



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# contracts

## NASA

\$1,000,000—Northrop Aircraft, Inc., Van Nuys, Calif., for airborne pressure devices for X-15.

## MISCELLANEOUS

\$30,000—Cubic Corp., San Diego, for tracking and radar equipment to be used on Project Mercury. Subcontract from Bendix Aviation Corp.

\$100,000—Laboratory for Electronics' Computer Products Division, Boston, for production of Bernoulli-Disk Memory system. Subcontract from Lockheed's Missile and Space Div.

## NAVY

\$100,000—Yardney Electric Corp., New York City, for manufacture of silvered silver-mercury batteries for Mark 32 torpedoes.

\$1,612—ITT, Federal Division, Clinton, N.J., for modifications to simulator, radar signal artillery and guided missile operator trainer device 15D2.

\$1,400—Sperry Piedmont Co., Div. of Perry Rand Corp., Charlottesville, Va., for tender tools and test equipment for MK 19, Mod 3 gyro compass.

## AIR FORCE

\$100,000—Westinghouse Electric Corp., for mobile type search radar sets and spares.

\$100,000—GPL division of General Precision, Inc., Pleasantville, N.Y., for airborne navigation systems.

\$100,000—ITT Corp., Ft. Wayne, Ind., for defensive electronic counter measure checkout system for the B-58 bomber.

\$1,000,000—American Machine & Foundry Co., Greenwich, Conn., and American Car and Foundry Division of ACF Industries, Inc., for design and development of railroad rolling stock for the Minuteman ICBM program plus preliminary design of launch car superstructure and provisions for erecting and leveling the missiles. Subcontract from Boeing Airplane Co.

## ARMY

\$35,271,000—Raytheon Mfg. Co., Waltham, Mass., for work on Hawk system. (Three contracts.)

\$10,500,000—The Martin Co., Orlando, Fla., for the Pershing system.

\$7,500,000—Radioplane Div., Northrop Corp., Van Nuys, Calif., for production of 400 RFP-76 rocket powered target missiles.

\$6,303,393—Continental Motors Corp., Detroit, for engines and spare parts.

\$5,816,800—Western Electric Co., New York City, for research and development on Nike-Hercules.

\$2,962,262—Bechtel Corp., Vernon, Calif., for construction of Atlas silo launch test facility at Vandenberg AFB.

\$1,735,071—Union Carbide Consumer Products Co., New York City, for dry batteries.

\$1,136,771—Brown Engineering Co., Inc., Huntsville, Ala., for engineering and machine shop services.

\$1,000,000—Douglas Aircraft Co., Inc., Santa Monica, Calif., for Nike-Hercules system components.

\$951,001—The Martin Co., Orlando, for engineering services for Lacrosse system.

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**WHITTAKER GYRO:** Leading designer and manufacturer of electromechanical and non-electric gyroscopes, including rate gyros, vertical gyros, and position gyros. In addition, this Division is active in the sub-systems field with stable platform, inertial guidance equipment, and auto pilots for missiles.



**MONROVIA AVIATION:** Producers of precision aircraft structural assemblies, Monrovia Aviation's products are installed on America's principal military and commercial jet aircraft. This Subsidiary also designs and manufactures customized portable air conditioning units for missile ground support purposes.



**TELECOMPUTING SERVICES:** Skilled in the establishment and operation of data processing centers, primarily for military and civil agencies of the Government. At White Sands Missile Range, TS processes and analyzes missile test data. At Vandenberg AFB, this Subsidiary provides data processing services for SAC's 1st Missile Division.



**ELECTRONIC SYSTEMS:** Specialists in systems management, this Division also designs and manufactures a wide variety of equipment in the fields of electronics and nucleonics for highly classified Military Programs. In addition, Electronic Systems designs and produces Air Traffic Control equipment for the Federal Aviation Agency.



**DATA INSTRUMENTS:** Leading designer and producer of data reduction systems for ground support and range instrumentation. Product line includes shaft rotation digital equipment, decommutators, and other highly complex and specialized instruments for missile and aircraft testing, telemetering and in-flight operation.



**ELECTRONIC COMPONENTS:** Designs and produces components, including magnetic amplifiers, transformers, micro-miniature relays, delay lines and high temperature ceramic capacitors. These reliable components are being selected for installation in many of the country's principal missile and space programs.



**COOK BATTERIES:** Designers and manufacturers of automatically and manually activated silver zinc batteries for specialized missile application. These auxiliary power units provide primary or secondary electrical power. This subsidiary also produces power conversion and other electronic apparatus.

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# U. K. Starts Satellite Studies

by Anthony Vandyk

NICE, FRANCE—The United Kingdom government has started design studies for adaptation of British military rockets now under development to make possible all-British launchings of earth satellites, if this should be desired.

This is disclosed in a report to the COSPAR Meeting here by the British National Committee on Space Research. The report discusses in some detail space research activities in the United Kingdom in 1959. They fall into four categories: (1) Upper-atmosphere research with rockets. (2) Tracking, both optical and radio, of satellites and space probes. (3) Activities of the Satellite Prediction Service and World Data Centre C. (4) Design of scientific instruments for use in satellites, and design studies of methods whereby British rockets could be used to launch earth satellites.

• **Upper-atmosphere research**—The British contribution in this field has been developed jointly by the British National Committee on Space Research and the Ministry of Aviation, using the *Skylark* upper-atmosphere research rocket. This rocket is launched at Woomera in South Australia, by agreement with the Australian Department of Supply, and with the help and cooperation of the Woomera Rocket Range authorities.

A number of successful experiments were carried out during 1959, the following being the most important: University of Belfast: Measurements of upper-atmosphere winds and temperatures by observation of sodium clouds released from rockets; University of Birmingham: Use of positive ion spectrometers ejected from the rocket on a long cable, to record ion spectra at heights ranging from the lower ionosphere to approximately 150 km. The measurement of electron density by a dielectric method has detected a narrow sporadic 'E' layer at about 100 km altitude;

University College London: Data on upper-atmosphere winds and temperatures have been obtained from observations of grenade bursts. Solar Lyman radiation and solar X-rays have been monitored by nitric oxide ionization chambers and emulsion detectors. Langmuir probe equipment has been used to study sporadic E ionization, and electron and ion concentrations in the ionosphere;

Imperial College London (Department of Meteorology): Observations, by radar, of the motion of clusters of

resonant dipoles released from rockets have yielded data from which upper-atmosphere winds can be deduced; Imperial College London (Department of Physics): Variation of Cosmic Ray intensity with height above Woomera has been determined up to an altitude of some 700 km using a single Geiger Counter;

International Rocket Week 1959: Three *Skylark* rockets were prepared for launching during the week 16-22 November, 1959. Unsuitable weather delayed the firings, but all three were successfully launched on November 30th-December 1st. The results will be made available when analysis of the data has been completed. The main experiments carried out were: Observations of sodium vapour trail, giving wind and temperature data. Observations of grenade bursts, giving wind and temperature data. Observations of electron density, using a dielectric method. Observations of the drift of a cluster of resonant dipoles, giving wind data.

It is intended that the experimental programs of the groups already mentioned will be continued and widened during 1960. In addition, early firings concerned with measurements of the geomagnetic field, observations in the ultraviolet of the Southern Sky, and ionospheric investigations using propagation methods are planned.

• **Tracking of satellites and space probes**—The optical and radio tracking of satellites and space probes has continued. There are plans to extend the optical observations by kine theodolites or other instruments, in particular by distributing sites more widely so as to minimize bad weather limitations. The radio telescope at Jodrell Bank, near Manchester, has been used on a number of occasions to receive signals from both American and Russian space probes, and the Radio Research Station at Slough is extending its facilities for radio tracking.

• **World Data Center**—The World Data Center for rockets and satellites established at the Radio Research Station, Slough, in October, 1958, is fulfilling its intended purpose of collecting data on space research and exchanging it with the other two centers in Washington and Moscow. The flow of data is still relatively small and consists mainly of satellite positional observations, though reduced radio observations tables of orbital elements and ephemerides of certain satellites are also being received. The Center houses a large number of published and unpublished reports.



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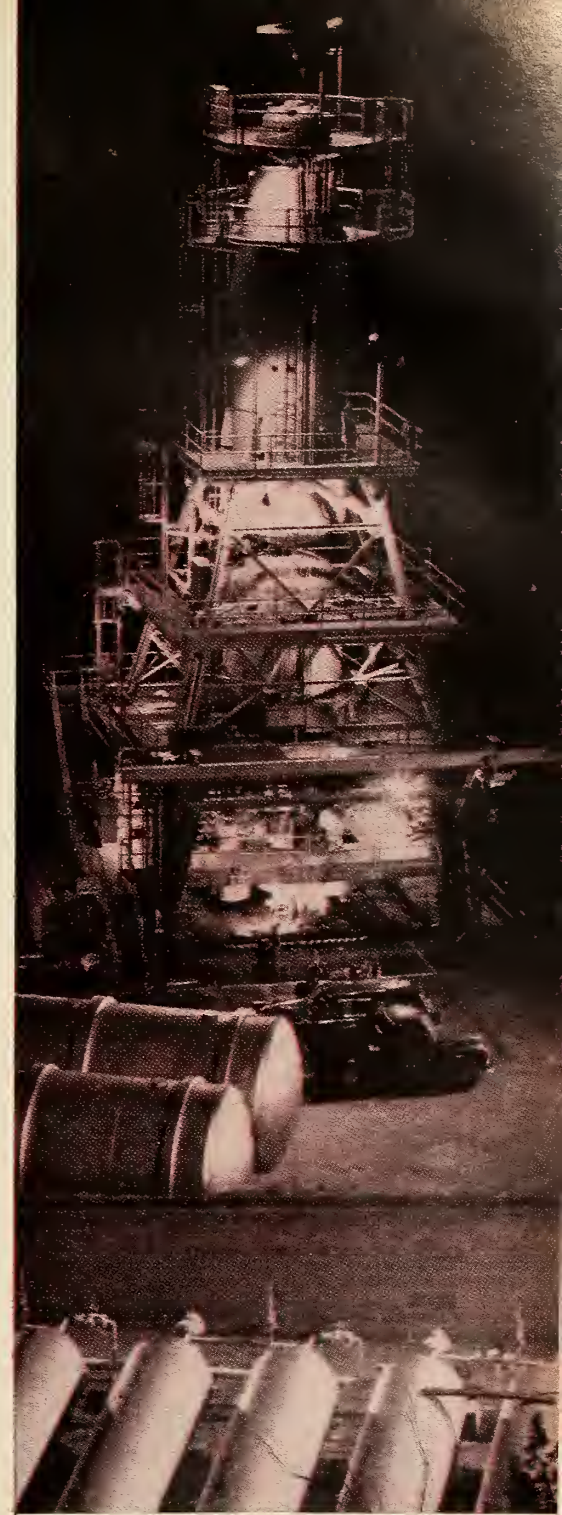
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## Textbooks Needed

*Editor's Note: For some time, the editors of Missiles and Rockets have had a private astronautics correspondence school with a teenage Bombay space enthusiast. Our circulation setup does not permit the lad to buy the magazine, but one editor "slips" him a copy and occasionally he's sent technical textbooks which other publishers send us for review. Now's he's interested in finding a U.S. university where he could take mathematical astronautics courses by mail. We know of no university, but perhaps an M/R reader does. He says he's "very good" at differential and integral calculus, differential equations, etc. He adds he's "good" at thermodynamics, fluid flow and three-dimensional geometry. But he needs more text books on these subjects. Perhaps M/R readers will have some advice for him after reading these excerpts from his last letter:*

"... We (other youths) have decided to form a society (in Bombay) on Astronautics... I am glad to inform you that I am receiving a good amount of information and literature from NASA, and on atmospheric research through rockets, from Dr. Homer E. Newell, Jr. What nice and great people you Americans are. I feel worried when I hear of any rocket failures in your country and further wonder why is it that your country in spite of conducting heavy research in astronautics sometimes brings such unwanted failures? To be honest and frank, I would say that I was one of the happiest men in the world when the first Explorer was put into orbit. I was further not surprised when... the British Interplanetary Society recently mentioned that American satellites and probes have brought a considerable (greater) wealth of scientific information on outer space on a per pound basis than the USSR probes. Anyway I heartily wish for your country's to have major breakthroughs in

space exploration in this new year..."

R. V. S. Mani  
6/595, E, Mani Villa,  
Vincent Rd. Matunga,  
Bombay, 19, India

## Another Pioneer

To the Editor:

I wish to join Vector Manufacturing Company, Inc. of Southampton, Pa., in the group of companies in the telemetering field which were not mentioned in your article, "What's Wrong in Telemetry," (M/R, 10/5/59).

Spectacular among these items is our transistorized oscillator which is smaller than a lump of sugar. We have also recently developed a transistorized transmitter with a radiated output of one-third of a watt; three miniature radio frequency power amplifiers which extend the power of the transmitter to as high as 100 watts; and a new electronic commutator which permits the transmitting of 25,000 data samples per second. We have two very small oscillators, one weighing only 1 3/4 ounces, the other disc-shaped, with a diameter of 2.6 inches and a thickness of 5/16 inch.

We pioneered this year a new concept of modular system integration which eliminates the chassis entirely, results in weight savings and costs and provides for more flexibility in the assembly of telemetry systems.

We developed in 1958 a completely transistorized phase lock discriminator. Its size is one-sixth that of the conventional tube type. It uses less power and generates almost no heat.

Stanley S. Wulc,  
President, Vector Manufacturing Co., Inc.,  
Southampton, Pa.

## Mountain out of Molehill

To the Editor:

As a member of the California Historical Society, I am something more than

mildly interested to learn that Cortez's protégé Gaspar de Portolá (and, later, Father Junipero Serra) was able to journey through the California coastal country on his explorations without discovering (or, if he did so, without making reference to) 21,500-foot Mt. Tranquillon, which you have pictured on page 17 of your fine Dec. 28 report on the Navy's Pt. Arguello facility.

As a member of the Sierra Club, I am happy to report to you that a team of climbers is even now sharpening its crampers for an assault on the previously unconquered slopes, faces and cols of this majestic escarpment. How thoroughly it dwarfs Mt. Whitney!

As a worker in the telemetry field, however, I am concerned about oxygen supplies for the chaps assigned to the tracking station, and arctic-type wearing apparel to protect them against what must undoubtedly be mighty cold weather at the snow-crested summit.

Carl Briggs  
Los Angeles

*M/R was awaiting comment on its upgrading (in a picture caption) of 21500-foot Mt. Tranquillon. (The correct height was given in the first sentence of the story.) Our apologies to Mt. Whitney (14,495 ft.), still California's, and the United States' tallest mountain. We think there was a gremlin—or an abysmally aberrant Abominable Snowman—on our copy desk. Anyhow, we think big!—Ed.*

## The Real Dynamos

To the Editor:

Congratulations for pointing out (in your Nov. 16 editorial) the one really dynamic force in the thought-to-be age of the industrial giant—the creative, fast-moving and uncluttered individuals who have founded the hundreds of small, pioneer-oriented companies.

Their credo of "Serving a Need" is possible only in the self-generated environment of the American Giants.

C. W. Reiniger  
Sales Manager  
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Avco Corporation  
Cincinnati 25, Ohio

## Teflon Resistivity

To the Editor:

It was a pleasure to see the excellent condensation (M/R, Jan. 4) of our technical paper on high temperature resistivity of wire constructions insulated with TFF resins.

For the record, should any of your readers desire a complete copy of this report, they are available, and I would be happy to handle such requests.

J. C. Reed  
Polychemicals Department  
Du Pont Company  
Wilmington 98, Del.

## HOW WET IS A DRY CIRCUIT?

For the answer to this, and an interesting article on Relays, write to Sam Kass, component specialist, care of...



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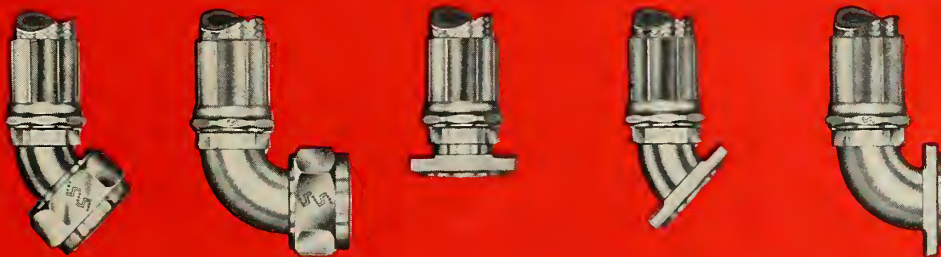
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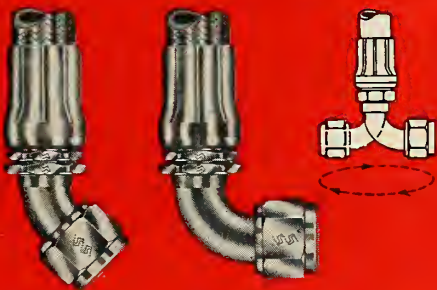
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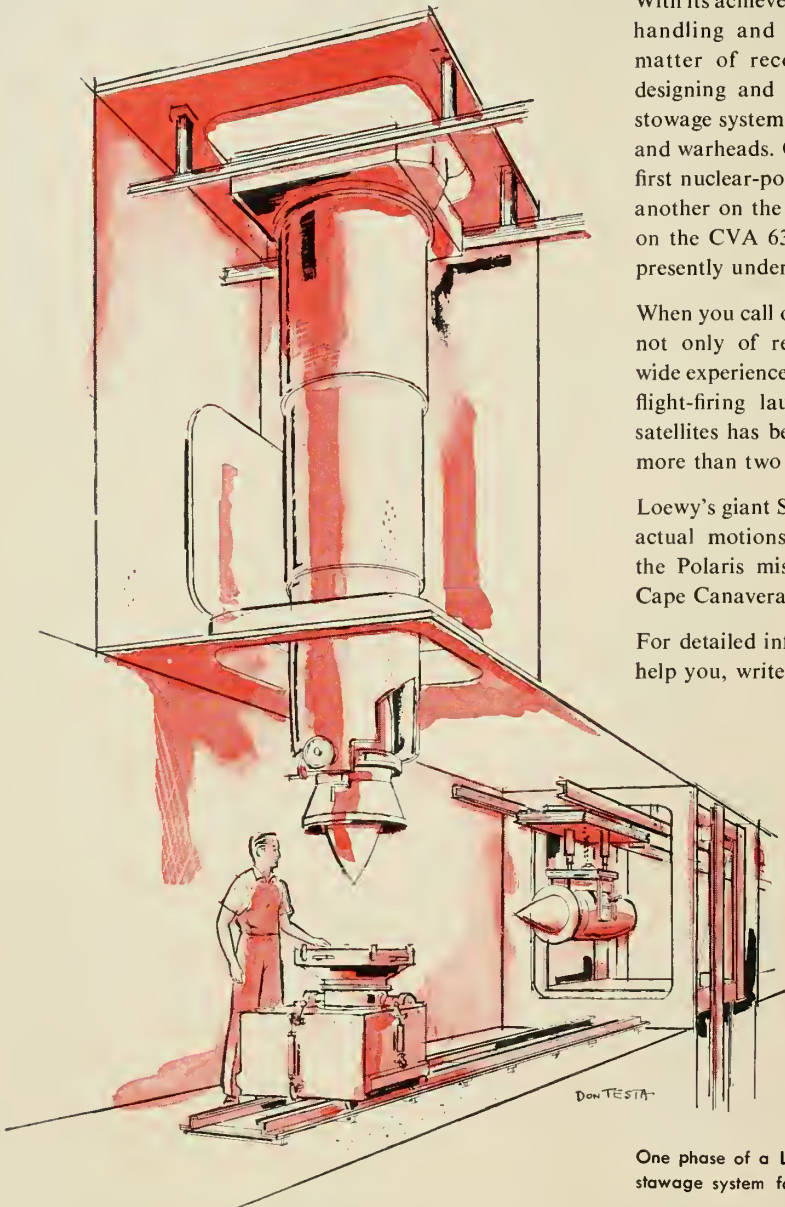
# For Terrier and Talos missiles and warheads . . . new shipboard handling and stowage systems by Loewy

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# Simplicity Called Key to Red Success

by an M/R Correspondent

STUTT GART, WEST GERMANY—A German rocket expert recently released by the Russians says the Soviets are ahead in the missile/space race because their scientists concentrated on a few rockets and vehicles, made them simple and rugged, and were free from outside pressure in their selection of components.

"The Soviets achieved (their lead) without the help of mysterious fuels or exotic metals," according to Dr. Helmut Gröttrup, who also said many Soviet feats were made possible by German brainpower—but not since 1950.

Gröttrup was captured by the Russians after World War II and put to work on their rocket program. He was recently permitted to return to Germany.

• **One at a time**—The main reason for Russia's successes, he claimed, was that her scientists developed only a small number of models; two missiles for the same basic purpose were never developed simultaneously, because a

special committee was set up to prevent costly and diversionary competition.

"There never would be a *Thor* and a *Jupiter* in Russia," he declared.

• **Virtue of simplicity**—Russian missiles are much simpler in construction—and therefore more rugged—than U.S. birds, Gröttrup said. Far less attention is paid to miniaturization, and there is no need to stuff the bird with delicate instrumentation. As a result, Soviet missiles are more reliable.

Furthermore, he noted, Soviet rocket designers who wish to incorporate certain components into their "baby" do not have to respect the interests of various companies or individuals connected with the project—they simply choose the parts they consider best.

• **A little knowledge**—Gröttrup suggested another, paradoxical, reason for the frequent U.S. failures: American engineers have developed gyroscopic guidance apparatus of an accuracy long believed impossible to achieve, and thus created the prerequisites for inertial guidance. As a result, highly delicate

instruments inside the rocket have been made responsible for its guidance.

In contrast, the telemetering systems chosen by the Russians are mainly based on the ground. Inside the rockets are merely several small, simple and very rugged instruments.

Gröttrup also labeled "insufficient" every U.S. launching in which the last stage of the rocket had to be spin-stabilized. "Without guidance of the last stage and without proper timing of the burnout," he said, "the necessary flight accuracy can never be achieved!"

• **On their own**—According to Gröttrup, the German "Raketenkollektiv"—a group of scientists held prisoner by the Russians from 1945 until 1950—worked intensely on long-range rockets and designed several types of vehicles which were—compared to parallel developments in the U.S.—"incredibly advanced."

But he said that with the exception of guidance systems all Soviet developments after 1950—such as multistage rockets, new fuels and satellites—were achieved entirely by U.S.S.R. scientists.

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# west coast industry . . .

By FRANK G. MCGUIRE

"Within five years, any company with all their eggs in the rocket business will be in serious trouble—just as the airframe manufacturers are today," Quote from Joseph W. Crosby, president of Thiokol Chemical Corporation. It makes very interesting reading, and Mr. Crosby's reason for his statement was just as interesting. The five-year estimate is a revision of his original belief that the situation described would occur within ten years, for the following cause:

"The very same factors that are forcing the airframe companies to go into such fields as electronics and shipbuilding will force rocket engine and propellant manufacturers to do the same type of thing. There will be many more companies in the field than business will support." In view of this belief of its president, Thiokol is planning an expansion into the industrial chemicals field, and will avoid placing all its eggs in the rocket basket.

Crosby frankly discussed many aspects of the firm's business, saying for instance that it had been a mistake to build a facility at Elkton, Md., because of inability to carry out necessary expansion at that site. He also stated that the job of management will be much tougher in the next five years. "I hope my successor does a better job than I have," he said, ignoring the fact that the stock market seems to disagree with this implication.

Thiokol, which entered the solid propellant field under Crosby's direction in 1947, now has ten plants scattered throughout the country. From its \$5.9 million gross in 1949, the firm soared to \$89 million gross in 1958. First-nine-months gross for 1959 was \$127,883,796, while the like period in 1958 showed a \$54,607,976 figure. Previously an Eastern company, Thiokol very shortly will headquarter all its rocket activities at its Utah facilities near Brigham City.

## Merger of CEC with Bell and Howell . . .

is not a joining of two unlike organizations, as first glance may indicate. Consolidated Electrodynamics Corp. has been in information retrieval, data processing and conversion, while B&H has been active in graphic intelligence conversion and display. These will complement each other admirably, and may well give the partners a basis on which to bid jointly on future military contracts.

## North American's 43,000 employees . . .

will get a two-cent-per-hour cost of living increase as of Jan. 24. The raise will bring to six cents the total cost of living raises gained by the employees.

## Martin Company has set record straight . . .

on its last *Titan* explosion. Company has emphasized reliability of the relay involved, and says an undesirable location placed 250 g on the relay, which was designed for a maximum of 50 g. Relay has been relocated.

## Packard-Bell has consolidated . . .

two divisions and a subsidiary into its new Defense and Industry Group, expanding the firm's operations in advanced military and industrial electronics. Comprising the new organization are the Technical Products Division, the Packard-Bell Computer Corp. (which has been operating as a division), and a subsidiary, the Technical Industries Corp. Head of the new group will be Richard B. Leng, formerly vice president of the Technical Products Division.

## Narmco's acquisition by Telecomputing . . .

if approved by Narmco's shareholders, will result in a firm having well over \$50 million annual sales. The merger, scheduled for completion around February, will involve 497,000 shares of TC common stock, which will be exchanged on a ratio of two shares of TC for one share of Narmco. TC's sales in the fiscal year ended Nov. 1 were \$38,333,000, while Narmco's annual sales are running around \$12,000,000.

## Solar Aircraft may merge with IH . . .

if a proposed offer of stock is approved, on a basis of 2¼ shares of Solar stock for each share of International Harvester common. IH has filed a registration statement with SEC for the 266,064 shares of its stock involved.

## RESEARCH OPPORTUNITIES

IN

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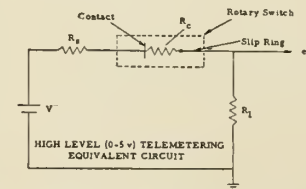
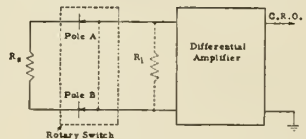
### ROTARY SWITCH CONTACT NOISE

The noise of rotary switches is a serious problem in many applications. The noise is a complex function of a number of factors, including the mechanical design of the switch, the electrical design of the circuit, and the operating conditions of the switch. This noise can be analyzed and measured using the techniques described in this paper.

The noise of rotary switches is a complex function of a number of factors, including the mechanical design of the switch, the electrical design of the circuit, and the operating conditions of the switch. This noise can be analyzed and measured using the techniques described in this paper.

Figure 1 shows the noise spectrum of a rotary switch. The noise level is plotted in dB versus frequency in Hz. The noise level is highest at low frequencies and decreases as frequency increases. The noise level is also higher for switches with more contacts and higher RPS.

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THE SPACE DIARY, 1960, Compiled by L. J. Carter Esq., A.C.I.S., Secretary, The British Interplanetary Society, T. J. & J. Smith, Ltd., London, W.1. 180 pp.

The author—well known in international astronautics—has compiled a handy pocket diary which should serve as finger-tip information on astronautics.

The diary originally was designed for children, until English newspapers commented that more than 25% of its contents were unknown to 95% of adults. Result: Title was quickly altered.

In addition to regular diary space for date notations, it contains a glossary on astronautics, background information on the B.I.S. and International Astronautical Federation, and facts and figures on astronomy, propulsion, rocket structure, satellites and tracking.

SOME NOTES ON MATHEMATICS AND MATHEMATICIANS IN THE SOVIET UNION, a preliminary study by Warren B. Walsh, Chairman of the Board of Russian Studies, Syracuse University, Syracuse 10, N.Y.

This study has found the United States superior to the U.S.S.R. in mathematics generally, but this must be qualified in terms of fields.

The Soviets are currently in the lead in analysis; in the theory of control circuits; in the branch of geometry dealing with convex figures, and perhaps in the field of topology.

The report has found they are at least on a par with the United States in probability, partial differential equations, differential equations, applied mathematics, and number theory as a whole. They lag somewhat behind in mathematical logic, modern algebra, algebraic geometry, and geometry as a whole.

THERMOELECTRICITY ABSTRACTS. Two volumes, Order PB 151657, 112 pp. \$2.50 and PB 151810, 81 pp. \$2.25 from Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

References to the literature on research, development, and application of thermoelectricity accumulated by the Library of the U.S. Naval Research Laboratory, are contained in these two volumes.

The bibliography shows abstracts of unclassified literature on thermoelectricity gained from abstract journals, indexes, and bibliographies. Early and recent material is included.

HEAT CAPACITY DETERMINATION OF MINERAL AND SYNTHETIC ENGINE OILS, LUBRICANTS, FUELS, AND HYDRAULIC FLUIDS IN THE TEMPERATURE RANGE 70-500F. T. M. Medved, C. C. Bolze, C. E. Hansen, and J. W. Barger, Midwest Research Institute for WADC. Order PB 161030 from OTS, U.S. Dept. of Commerce, Washington 25, D.C. 64 pp. \$1.75.

Heat capacities are reported for 33 mineral and synthetic engine oils, lubri-

cants, fuels, and hydraulic fluids at 80-, 185,290,393 and 500°F.

Calorimeter constants were obtained by internal standardization, eliminating use of standard liquid. A comparison of latent heats of vaporization of phenyl ether samples is included.

The work is a continuation of that described in an initial report, PB 151210, available from OTS for \$1.25.

Used together, the two reports describe the unique, simple, rapid method used for measuring and calculating heat capacities over a wide temperature range.

DETONATION INDUCTION DISTANCES IN COMBUSTIBLE GASEOUS MIXTURES AT ATMOSPHERIC AND ELEVATED INITIAL PRESSURE; I METHANE OXYGEN, II CARBON MONOXIDE OXYGEN, III HYDROGEN OXYGEN, L. E. Bollinger, and R. F. Edse, The Ohio State University for WADC. Order PB 151873 from OTS, U.S. Dept. of Commerce, Washington 25, D.C. 98 pp. \$2.25.

Intended to collect data to aid rocket designers, this study determined the effect of initial pressure on detonation induction distances of various methane-oxygen and carbon monoxide-oxygen mixtures.

In addition, the effect of tube diameter for hydrogen-oxygen mixtures was determined for two values of diameter at an initial pressure of one atmosphere.

One conclusion was that the induction distance decreases with increasing initial pressure for all fuel concentration studied. However, the decrease in length with increasing pressure inversely follows the variation of burning velocity with pressure.

RAPID SEPARATION AND GRAVIMETRIC DETERMINATION OF ALUMINUM IN FERROUS METALS, L. A. Keyser and C. D. Houston, WADC, USAF, Order PB161003 from OTS, U.S. Dept. of Commerce, Washington 25, D.C. \$50.

A rapid method for separating iron and aluminum was developed.

The technique is useful for analyzing aluminum in ferrous metals in the absence of nickel. Separation is achieved by the sodium hydroxide method. Aluminum is precipitated with 8-hydroxyquinoline and determined gravimetrically.

MASTER RECEIVING-PICTURE TUBE SUBSTITUTION GUIDEBOOK, H. S. Middleton. John F. Rider Publisher, Inc. New York, N.Y. 352 pp. \$7.45.

The engineer frequently has occasion to substitute one tube type for another. Most tube types have equivalents in other tube types, but they are not always excellent substitutions.

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## Space Gets a Crust From New Budget

The President's space budget for Fiscal 1961 will be a bitter disappointment to the many people in this country who hoped it would provide sufficient funds for something more than the lackadaisical program it promises.

In his message Mr. Eisenhower says:

"The National Aeronautics and Space Administration is carrying forward the nonmilitary space projects started by the Department of Defense and has initiated additional programs that will lay the foundations for future exploration and use of outer space. Estimated expenditures of \$600 million during the fiscal year 1961, nearly double the expenditures in 1960, will carry forward the programs now under way and those becoming the agency's responsibility in 1961."

This is literally "double talk." Far from "doubling" the 1960 program, the 1961 adjusted expenditures actually will only increase last year's program by one fourth.

Last year's NASA R&D money was \$370 million. This year's is \$634 million. But that \$634 million includes \$139.5 million transferred from the Defense Department for the development of the clustered booster, *Saturn*—a project NASA did not fund last year. So, in reality, NASA's spending (in addition to *Saturn*) will total only \$495.5 million. This is an increase of \$125.5 million—or only about 25%—over \$370 million.

This fact is further emphasized by the fact that the 1961 program of space projects is just about the same as that in 1960. They may be somewhat more sophisticated, a little more costly, somewhat more advanced (they should be) but numerically they add up almost the same.

In major space probes we will have four. In FY 1960 we had three.

In scientific satellites we will have eight. In 1960 we had seven.

Worse, no back-up is provided in the budget for any of the twelve projects. If one of the four space probes fails it will simply fail, and its objectives will be carried forward to the next probe—three months or so later—if they can be included. The same is true of the satellites.

NASA officials feel that the program is designed to give the nation's space scientists a lot of information and that it will advance our space knowledge along the broad technological front.

But—they make no pretense that this is a program designed to compete with the Russians. They are obviously not enthusiastic about its extent. They do not say that the limitations are of their setting. They admit they could "do a lot more."

The President has sent a letter to Congress suggesting changes in the National Space Act—changes which have been advocated on this page. The changes he suggests are three-fold: that he be relieved as project officer for the space program; that the National Space Council be abolished; that the Military Liaison Committee be likewise abolished.

He suggests that this will leave the Department of Defense in charge of military space activities and NASA in charge of scientific or peaceful—i.e., space—exploration.

These are steps in the right direction—management steps. But, we submit, no amendments to laws and no shifts of management will amount to a tinker's damn until we have recognition at the top level—meaning Mr. Eisenhower—of the tremendous political and psychological importance of the U.S. space program in international prestige and national survival.

CLARKE NEWLON





## He put a new twist in an old trick

His problem was to take a 3"x6"x 3-foot piece of wave guide tubing made of .08-inch thick aluminum and to twist one end 90° to the other *without buckling or stretching any part of it...so that a cross section taken anywhere along its length remained a perfect rectangle.*

The standard solution for a problem like this: Support the tube internally with a solder-like substance that's melted in, cooled, melted out after twisting. It won't work here because the mass of the substance is too great.

Here's how this AMF production engineer found the answer. First, he visualized the concept that, in any symmetrical twist, *the center axis never moves.* Then he applied this concept by stringing a metal rod through the center of 288 rectangular shims, inserted them in the tube, cushioned them with the same solder-like substance. Jaws clamp on either end. One of them rotates *slowly* (twisting time: over 2 minutes) giving the metal time to flow. The result: Perfect twists, every time.

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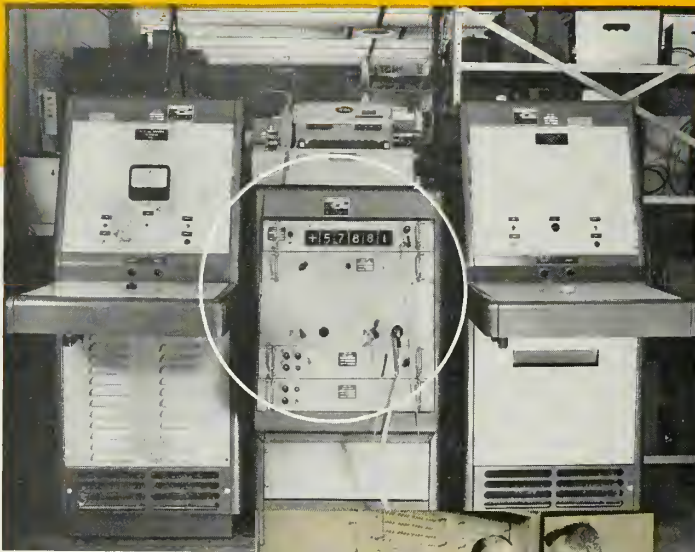
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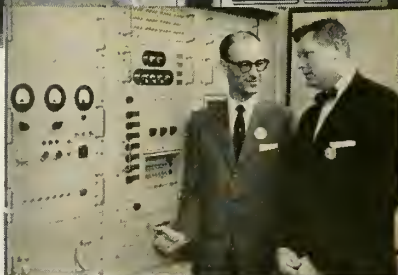
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