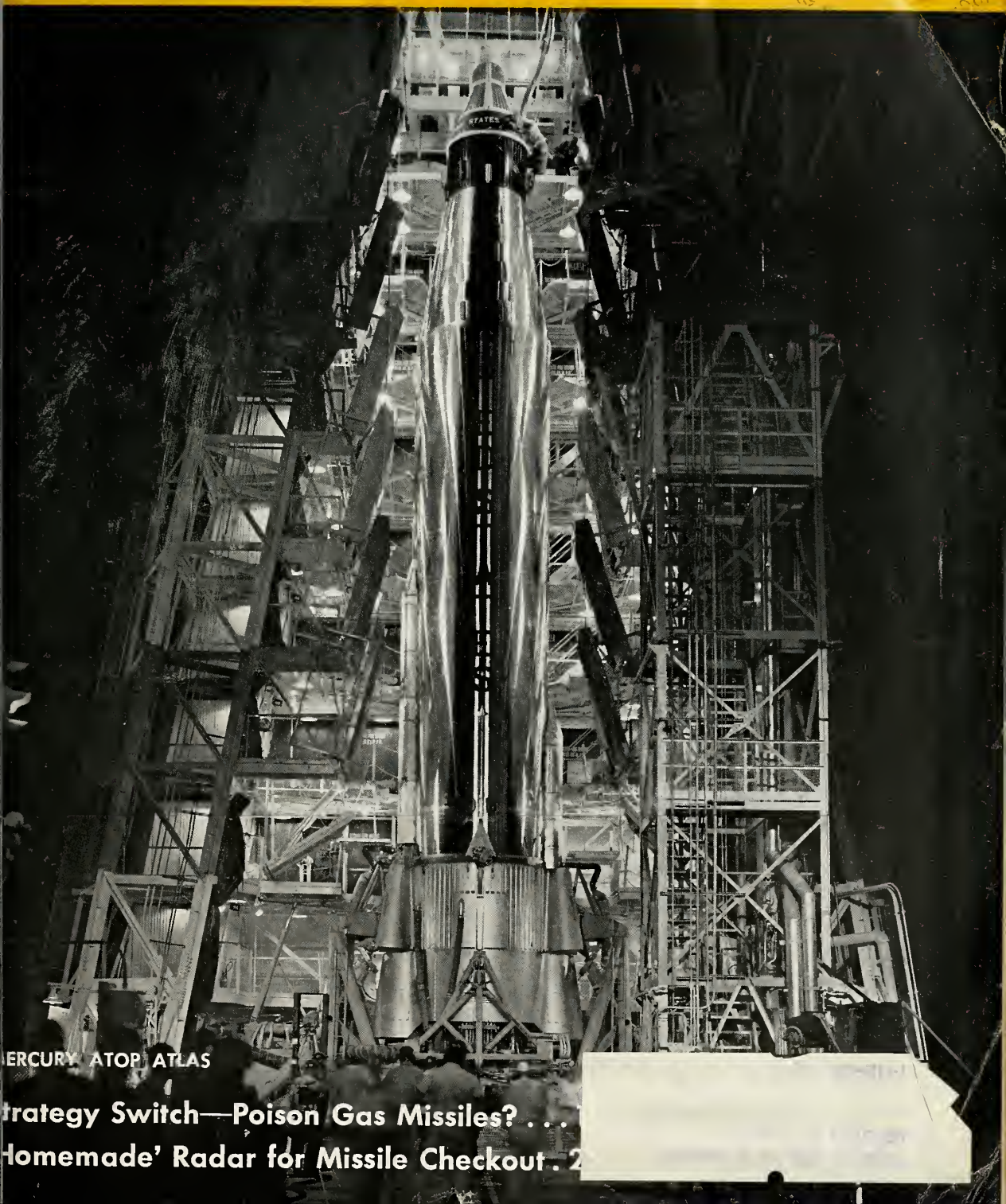
May 16, 1960

# missiles and rockets

THE MISSILE/SPACE WEEKLY





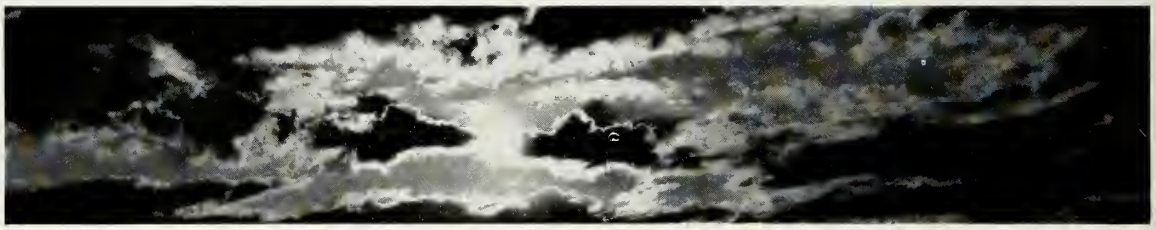
ERCURY ATOP ATLAS

trategy Switch—Poison Gas Missiles? . . .

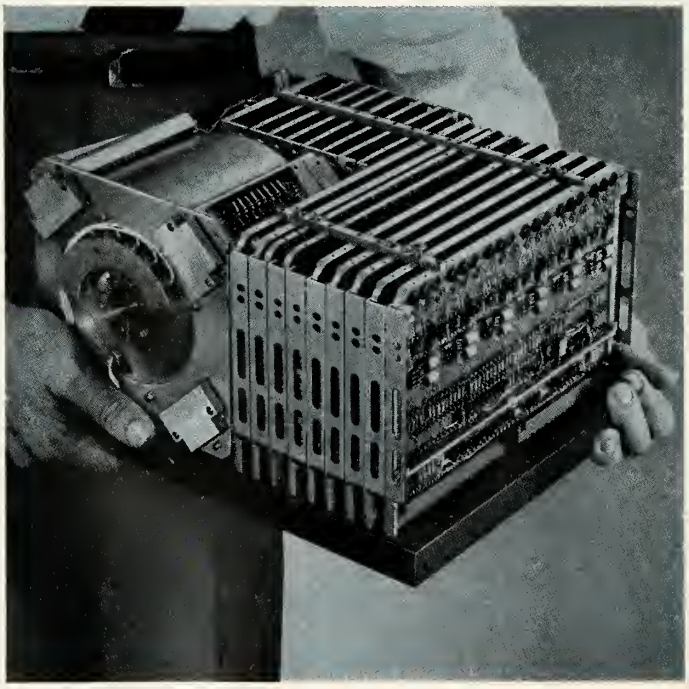
Homemade' Radar for Missile Checkout . 2

# LIBRASCOPE AIRBORNE COMPUTERS

What goes up must fly true. To maintain this condition, Librascope has packaged the rectangular, polar and spherical geometries of flight...in computers easily held in a man's hand or held aloft by an economic expenditure of power...computers unexcelled for 22 years at calculating flight paths, interception courses, fire control trajectories...with answers that come out fast and right. They offer a challenging capability to alert project and design engineers. Write to Librascope, 808 Western Avenue, Glendale, Calif. ■ Librascope, A Division of General Precision, Inc. ■ For information on engineering career opportunities, address Glen Seltzer, Employment Mgr.



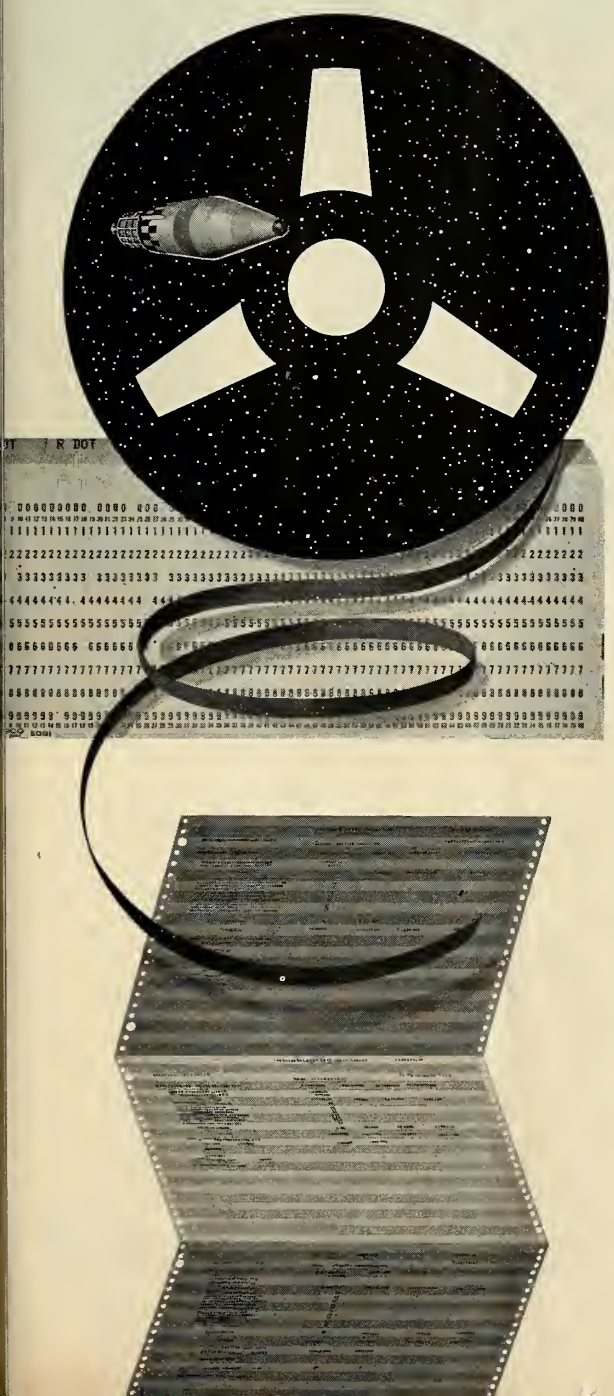
*computers that pace man's expanding mind*



GPD LI-04

Circle No. 1 on Subscriber Service Card.

# INFORMATION PROCESSING



Information Processing plays a vital role in the Lockheed Missiles and Space Division's activities—from aiding basic research and development to supporting current military and commercial projects. The Division's computing facilities are among the most advanced in the country and include: two—IBM 7090; two—Sperry-Rand 1103 AF; one—Control Data Corp. 1604, in addition to a variety of other advanced peripheral equipment. Future plans include several IBM 1401 Data Processors.

Functions of Information Processing encompass: Preparing programs and operating large, high-speed digital computers; responsibility for the Division's analog computing activities—including set-up and operation of analog computers, used both as simulators and in solving problems; the reduction of highly complex and critical telemetry data received from missiles and space vehicles.

Further activities involve performing data reduction for Quality Assurance and Manufacturing, and programming of Administrative Data Processing and Financial Forecasting Problems for the entire Division.

Expanding the scope and depth of present programs in Information Processing has created positions for engineers and scientists with experience in these important areas:

**DIGITAL COMPUTER SYSTEMS DEVELOPMENT** including monitors, compilers and information retrieval systems.

**HIGH-SPEED DIGITAL COMPUTER PROGRAMMING** for satellite control, scientific computation, numerical analysis, and administrative data processing.

**TRAINING PROGRAMS** conducted for computer programmers and operators.

**ANALOG COMPUTER OPERATION** in solving complicated engineering problems.

**AUTOMATIC CONVERSION** of flight data and scientific information utilizing analog and digital converters and advanced automatic control devices.

**FLIGHT DATA AND SYSTEMS ANALYSIS** including research in complex problems, theories and methods of preflight and flight data analysis; test performance research; analysis and performance reports on testing, flight test data and data reduction.

**DATA PROCESSING EQUIPMENT DESIGN** including research and engineering in development of highly advanced data conversion devices.

**Engineers and Scientists:** Work in the broad spectrum of Information Processing functions provides constant challenge at Lockheed's Missiles and Space Division. If you are experienced in the above areas, you are invited to write: Research and Development Staff, Dept. E-29A, 962 W. El Camino Real, Sunnyvale, California. U.S. Citizenship or existing Department of Defense industrial security clearance required.

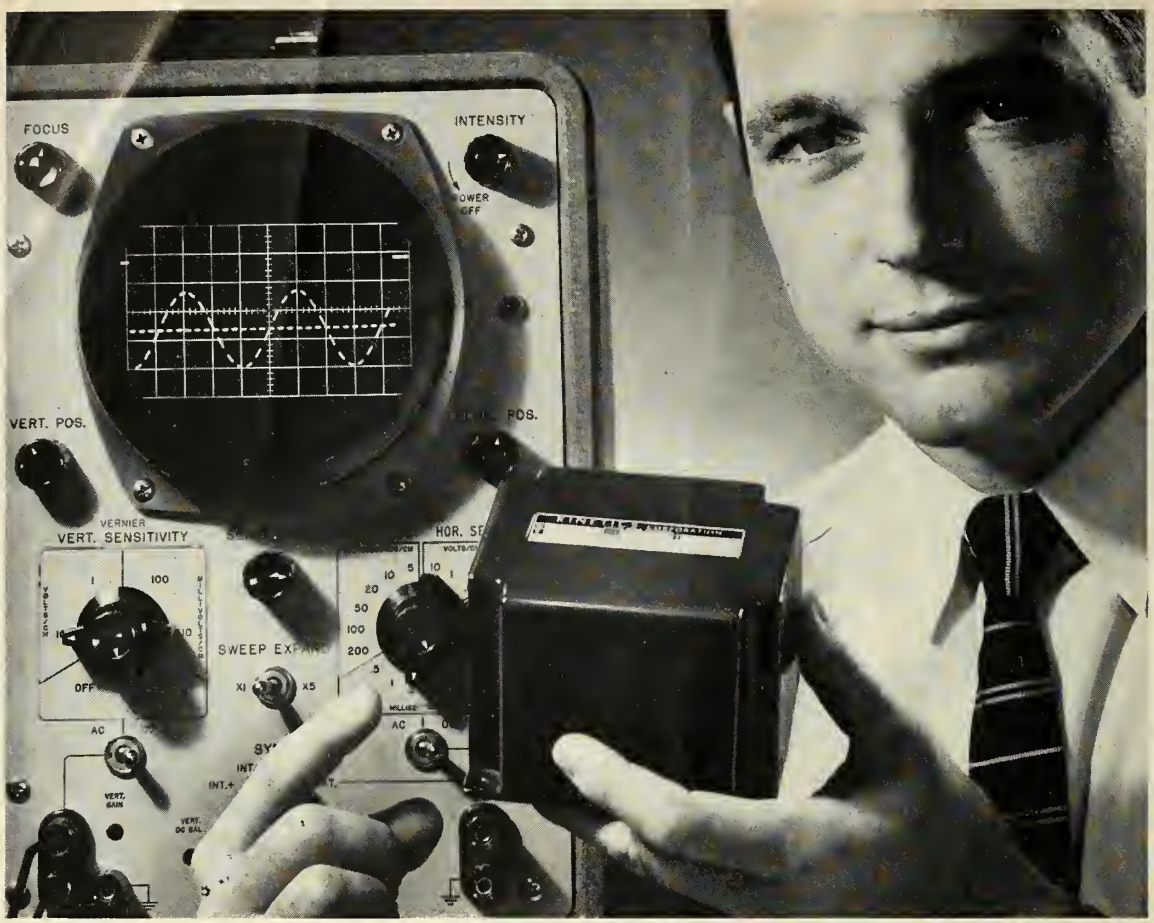
**Lockheed**

## MISSILES AND SPACE DIVISION

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

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

Circle No. 2 on Subscriber Service Card.




# Kinetics electronic commutator offers greater accuracy and over 10,000 hrs. life

The Kinetics electronic commutator features modular construction, achieving maximum space utilization and easy application to various configurations.

As shown by the pattern on the scope, the new electronic commutator now available from Kinetics Corporation offers a high degree of commutation fidelity. Note the extremely short rise and fall times with no apparent deterioration of signal. Faithful reproduction such as this will continue through a forecast life of 10,000 hours or more. This commutator is recommended for all aircraft and missile multiplex telemetering systems where accuracy and long life are required.

There are no built-in amplifiers to affect the signal in the straight-forward Kinetics design. This is a solid state unit—semi-conductor components are used throughout. Operating temperature limits are from $-60°C.$ to $125°C.$ Load resistance of the Kinetics design ranges from 5000 ohms to 2.5 megohms.

This commutator offers excellent low level capability, down in the low millivolt range. Contact resistance is low, from 5 to 10 ohms. Leakage currents are less than .005 microamperes at 5-volt signal levels. Extremely compact construction has been achieved, averaging only .4 to .5 cubic inches per channel, decreasing as channels are added. Power consumption is low. Sampling rates up to 50,000 samples per second are possible.

Write for more information on this electronic commutator. Kinetics Corp., Dept. K-23, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

**KINETICS**
CORPORATION

ELECTRONICS • ELECTROMECHANICS



Circle No. 3 on Subscriber Service Card.

THE MISSILE / SPACE WEEKLY

# missiles and rockets

May 16, 1960 Volume 6, No. 20



Published each Monday with the exception of the last Monday in December by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C.

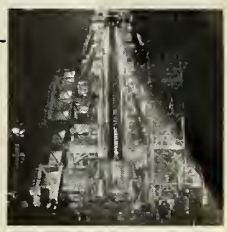
**Wayne W. Parrish**
President

**Leonard A. Eiserer**
Exec. Vice President and General Manager

**Fred S. Hunter**
Vice Pres. and Editorial Director

Printed at the Telegraph Press, Harrisburg, Pa. Second Class postage paid at Washington, D.C., and at additional mailing offices. Copyright 1960, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal Union Nations—1 year, $5.00; 2 years, $8.00; 3 years, $10.00. Foreign—1 year, $10.00; 2 years, $18.00; 3 years, $26.00. Single Copy rate—$.50. Subscriptions are solicited only from persons with identifiable commercial or professional interests in the missile/space industry. Subscription orders and changes of address should be referred to Circulation Fulfillment Mgr., M/R, 1001 Vermont Ave., N.W., Washington 5, D.C. Please allow 4 weeks for change to become effective and enclose recent address label if possible.



## THE COVER

*Mercury capsule sits on the Atlas missile which will carry it down the Atlantic Missile Range in July. The capsule recently passed an abort test (see p. 15).*

## MAY 16 HEADLINES



## GROUND SUPPORT EQUIPMENT



## PROPULSION ENGINEERING



## ADVANCED MATERIALS



## ELECTRONICS



## ASW ENGINEERING



## INTERNATIONAL



## DEPARTMENTS



*32,503 copies this issue*

# letters

## Deep Interest in ASW

*To the Editor:*

We have read with great interest your inaugural issue containing the new section on ASW Engineering . . . in fact, all of the succeeding issues have been equally interesting.

We have distributed your magazine to all of our engineering staff as required reading. We feel that articles such as "The Sea Is Never Neutral" will go a long way in educating the defense industry to the new defense requirements of our country.

We will look forward to future articles with equal interest.

Asa E. Snyder, Executive Vice President
USI Technical Center, Division of U.S. Industries, Inc., Pompano Beach, Fla.

## Burns and Roe and Bomarc

*To the Editor:*

In the January 18 M/R, there was an article concerning *Bomarc* which was of considerable interest to us inasmuch as Burns and Roe, Inc. had complete responsibility under subcontract to Boeing Airplane Company for designing and furnishing all ground support equipment for the IM99A *Bomarc* missile, including design and construction of the Model 1 shelter at Cape Canaveral, and detail design of the Model 2 shelter which is the operational shelter for the early tactical bases.

Your article refers to the paper given by Ostling and Kelly of Boeing at the Society of Automotive Engineers Annual Meeting in Detroit, and mentions Anderson-Greenwood Company by name as having "laid down the basic foundation of the system."

We would like to call your attention to page 4 of the Ostiling-Kelly paper in which they state "Burns and Roe prepared specifications and began active design of the tactical prototype equipment. This included the Model 1 launcher shelter." Also on page 5, ". . . a new subcontract to Burns and Roe for the redesign, with the first four tactical bases being approved for construction using this Model 2 shelter."

As one of our country's largest architect-engineering firms, we are justly proud of the part that Burns and Roe has played in the defense of our country and in our nation's assault on space. Our contributions include important phases of *Bomarc, Nike-Zeus, Talos,* and Project *Mercury,* to mention but a few of the large programs with which we have been and are associated.

Kenneth A. Roe, Executive Vice President
Burns and Roe, Inc., New York City

*We thank Mr. Roe for calling our attention to our omission of his firm's important part in the Bomarc system.—Ed.*

## Admiral Not 'Down'

*To the Editor:*

We were sorry to see Admiral L. J. Dow (USN Ret.) carried as "Down" in The Countdown, M/R, April 25. Naturally, Admiral Dow also was disappointed. Our release repeated his name several times, and we wonder how you could have slipped on this one.

Edward W. Locke, Director, Customer Relations
Defense Product Headquarters
Westinghouse Electric Corp., Washington, D.C.

*We're sorry too. We knew better; we just slipped.—Ed.*

## Deterrent Duplication?

*To the Editor:*

I read with interest Mr. Ted Wallace's letter ("The Gap: Another View") in M/R, April 11, and found myself in agreement with his exposition, up to his conclusion—unification of the Defense Department.

Although this panacea is strongly advocated by many responsible citizens, its major weakness is that "Unification" does not (alter) personalities, training, backgrounds and prejudices of the people who would have to make it work. It would leave a gap of 30 years, to raise O-1 level (ensign, second lieutenant) officers in a unified environment wherein they would not lean heavily on their special backgrounds—air, sea or land.

The basic weaknesses are far more political than fiscal. There is plenty of money in the $41-billion budget to provide adequate hardware to meet our world commitments and potential threats from potential enemies. The difficulty is the displacements of people and industries that would occur if orientations were properly made to meet the threats.

For example, to boil a complex idea down to simplicity, our main objective in a nuclear environment is to scare the Russians out of attacking us with nuclear weapons. We can do this by two methods: (1) Plan to knock out their ability to bomb us or (2) Simply hold over their heads the threat of mass destruction of their cities. The first plan lacks feasibility on several counts, the major ones of which are (1) It assumes that we know where their missile pads are located and (2) Assumes that we would start the war. We would have to know (1) before we could do (2) unless we want to commit suicide by awaiting their retaliatory blow. Further, the second alternative is quite obviously abhorrent to the United States.

For the Russians, it is quite a different story. First, they know where our launching pads are. Second, they have a history of jumping first.

No matter how you slice it, those who have seen the devastation of Hiroshima and Nagasaki, wreaked by "small" bombs, will never believe that an *Atlas* or *Titan* missile, sticking up over the ground like a sore thumb, will ever survive one blast—to say nothing of several, which some people claim it will take to knock them out. And when we are blasted, we are all

blasted, citizens and soldiers alike. Thus, we seem to invite atack on our military might, as we did at Pearl Harbor.

With *Hawk, Falcon, Sparrow, Nike,* and the like, the days of the manned aircraft in a non-nuclear war, for the purpose of bombing an enemy, seem numbered. If we plan to use these aircraft for nuclear attacks through long-range atomic weapons (which we haven't got yet) we are going to have another system duplicating *Polaris, Minuteman, Atlas* and *Titan,* all of which are designed to knock out, or deter, the Russians in their civilian haunts. What with fallout and the prevailing winds, it seems we are spending an awful lot of money to kill the Russians more than once. Since it will be years before the latter three missiles will be operational in any numbers, and still years before our long-range airborne missile is operational, one wonders whether we should not choose but two systems and concentrate on them. If *Atlas* is vulnerable today, it sure as hell will be vulnerable tomorrow.

The "Great Debate" of this election year quite properly should be over the best way of replanning our defense effort for support of the infantryman and marine who will most likely bear the brunt of non-nuclear war. This involves primarily a de-emphasis on the "kill 'em more than once" duplication of nuclear weapons, and an emphasis on mobility of forces overseas, logistics supply, and the means to protect those supplies in transit against a determined, real, in-being Soviet submarine force.

When one contemplates that a single B-58 bomber costs as much as two fully equipped destroyer escorts, and one *Atlas* (plus its pad and environment) costs three time as much (according to Air Force figures), one wonders where the emphasis should be placed. We have had to make mass movements of troops overseas on the two occasions in recent years when our national way of life was at stake. We have had to supply them. The crying need for modern ASW vessels, and the crying Army need for more modern weapons and mobility, are much more immediate requirements than a duplicated (nay, quintuplicated) system of massive retaliation which, excepting *Polaris,* is a dream promising fruition in the vague 1963-65 era.

J. K. Taussig, Jr.
Annapolis, Md.

## ICBM's Called Superfluous

*To the Editor:*

I would greatly appreciate an explanation from someone of why we need our ground-based ICBM's while the *Polaris*-submarine concept is certainly much cheaper, more accurate (because of shorter distance-to-target required), and less vulnerable (because it is a moving target and can travel over four fifths of the earth's surface)?

William Gill
Technical Publications
North Reading, Mass.

*Might try the Air Force.—Ed.*

# The Countdown

## WASHINGTON

### Bureaucrats Descend on SP

With *Polaris* all but operational, bureaucrats are understood to be trying to strangle the Navy's Special Projects Office with red tape. The SP program which produced the submarine-launched missile three full years ahead of schedule is now being reviewed and re-reviewed by dozens of outside government officials. They are getting into the act in time for the curtain calls by suggesting ways the whole thing could have been done cheaper or faster.

### Shelters Get Second Look

High costs of new offensive weapon systems are making some officials take a second look at Civil Defense mass shelter plans—long gathering dust. The argument is heard in some Pentagon circles that the U.S. could buy more defense by spending $20 billion on shelters which could save 50-75% of the population than by investing in more nuclear missiles.

### A Third Time Out

Clayton Fritchey, who helped guide two presidential campaigns of Adlai Stevenson, has now moved into the camp of Sen. Stuart Symington. What's more, the former deputy chairman of the National Democratic Committee is an unpaid worker.

### Question of Boosters

NASA—apparently stung by word going around that it is out of rocket booster money—is now saying it will start launching *Juno II's* at the rate of one every two weeks, commencing in September and continuing for the remainder of the year. Some scientists have been saying the *Juno II* program was being shelved from 12 to 18 months for lack of boosters.

### 2-minute Saturn Test

Look for another full cluster test of the *Saturn* booster within two weeks. This one will run a scheduled two minutes.

### On the Pad

Launching of the next R&D *Transit* navigation satellite will come in about a month. It will weigh about the same as the 275-lb. *Transit* which went into orbit April 13.

## INDUSTRY

### Solid vs. Liquid Sparrow 6B

Battle is on for the contract—expected to hit $27 million over five years—to build a new motor for the advanced *Sparrow 6B*. The Navy has laid down requirements to add 40,000 ft. altitude and give the air-to-air bird a five-year storage life. Already solid proponents are saying pre-packaged liquid won't do the job, and vice versa. Word from BuWeaps, however, is that either type could do the job. Bids are due next week.

### Aerojet Reorganizes

All service functions as well as operating activities of Aerojet-General are being put under one manager at its home plant in Azusa, Calif. Under the reorganization, William L. Rogers has been named vice president in charge of the plant.

### Titanium for Typhon?

Navy missile R&D men are reported seriously considering requiring the use of titanium in the *Typhon* surface-to-air missile (formerly *Super Talos*) to improve either range or warhead capability.

### Job Opening

Rumors making the rounds of Space Technology Laboratories have Richard Horner, former AF R&D chief and now associate director of NASA, heading up the new non-profit corporation the Air Force is forming to replace STL. Lending credence to the reports is the recent revelation by Horner that he is quitting NASA soon. Salary for the new job: probably $40,000 plus.

### Dollars & Pounds

*Scout*—the alleged "poor man's rocket"—now is pegged at $750,000 per copy instead of $500,000 . . . Each *Redeye* costs $1300, including $75 disposable launcher . . . and it's disclosed the production launcher for *Sergeant* will weigh 2000 lbs. less than the 18,000-lb. R&D version.

### New Name Tag

The designation of the Army's *T-238* chemical warfare rocket has been switched to the *M-55*. Norris Thermador is the manufacturer of this 115-mm missile.

## INTERNATIONAL

### French Working on Sub Reactor

The United States has agreed to provide the French with enriched uranium with which to build an experimental reactor for a nuclear-powered sub. The French say, however, they won't cut tin on the sub until the reactor tests are completed—which means it will be three to five years before construction starts.

### Russian Stand-off Missile

A new delta-wing Soviet jet bomber is reported to have as standard equipment 20 air-to-surface missiles with 75-mile ranges.

### Germans Making Research Rocket

Test firings of a new meteorological rocket being made by Deutsche Raketengessellshaft at Hanover are scheduled this summer at Cuxhaven, Germany. The rockets will have a 25-mile ceiling.

### Malafon Almost Ready

A new ASW missile, the *Malafon*, is expected to be operational this year aboard a French Navy escort vessel. The surface-to-underwater rocket torpedo is reported to have a range over 10 miles.

*radical shift suggested . . .*

# Army Seeks Poison Gas Missiles

## *Need seen to balance Red weapons in chemical area; philosophy on gas is changing*

**by James Baar**

High Army officials are pushing for the creation of a vast "deterrent" stockpile of poison gas warheads and missiles.

Sanction of the new Army proposals would entail a radical shift in U.S. strategic thinking. It also would call for a direct reversal of U.S. public opinion on the use of poison gas.

One of the first preliminary steps in the direction of the Army's chemical and biological warfare proposals already is under way. The Army is purchasing thousands of the new 115-mm *M-55* missile—a secret chemical agent-carrying rocket that can be fired on a battlefield in salvoes.

The next logical step would be a build-up of a stockpile of tactical-range missile warheads carrying chemical and biological agents rather than conventional or nuclear charges. The final step would be the stockpiling of similar warheads for IRBM's and ICBM's.

Behind the Army drive are arguments that:

• Russia already has a large capability of fighting with chemical and biological agents and the weapons are already in the hands of the Red Army in quantity along the Iron Curtain in Europe.

• The only way to prevent Russia from using these weapons in any future war is to have a similar arsenal.

MAJ. GEN. MARSHALL STUBBS

• In the age of the H-bomb, chemical and biological warfare has taken on a practical and almost humanitarian aspect.

The Defense Appropriations Bill as it recently cleared the House already has $35.5 million in it for the purchase of more than 100,000 *M-55's* along with multiple 45-tube launchers that fire the missiles in salvoes.

The *M-55*—formerly called the *T-238*—is manufactured by the Norris Thermador Co. of Los Angeles. No contracts have been let for the T-145 launchers.

The Administration asked for $32 million for the *M-55*. The House added $3.5 million more—enough to buy 13,000 *M-55's* alone, along with an undisclosed number of the launchers.

These would provide U.S. troops with a limited capability. However, to give U.S. troops anything matching Soviet capabilities of waging chemical and biological war, far larger funding will be needed in FY 1962 and the years following it.

• **Reds favor chemicals**—Army proponents of building up U.S. chemical and biological warfare capabilities stress that the Russians probably will never use nuclear weapons on Western Europe when they have so much more to gain by using chemical or biological warheads launched by missile.

Such an attack would enable Russia to:

• Capture intact the great Western European industrial centers.

• Temporarily incapacitate and then enslave Western European populations.

• Avoid the uncontrollable effects of nuclear fallout and residual radiation that would result from any all-out attack with nuclear weapons.

These same arguments can be applied to a great extent to the United States.

A Soviet ICBM launched against Pittsburgh could obliterate the city with a multi-megaton warhead. But the same ICBM if equipped with a warhead carrying chemical or biological agents could kill or incapacitate the entire population of Pittsburgh, leaving the city open for Soviet colonization or plunder.

Chemical and biological agents available today to both the United States and presumably Russia are capable of delivering a wide variety of blows to large population centers or military installations. These range from temporary paralysis and loss of ability to function rationally to temporarily

### *What Price 'Humanitarianism?'*

*Maj. Gen. William M. Creasy, former head of the Chemical Corps., on the "humanitarian" reasons for NOT using poison gas:*

*"Iwo Jima was defended by some 21,000 Japanese. In taking Iwo Jima we had some 25,000 casualties. I do not have these numbers reversed. Of these casualties, there were some 7000 deaths, American deaths. At that time, there was available to the military commander chemical agents which he had the logistical capability of using, against which the Japanese forces had no protection. Their masks at that time did not protect against these chemicals. He was denied, by the then existing policy, the use of these materials . . . Presumably this was not the thing for Americans to do.*

*"Let us see what the net result of all this humanitarian fervor of ours was, other than the 7000 dead marines, and the other 18,000 casualties. What happened to the 21,000 Japanese? Most were killed, most by white phosphorus and flame throwers."*

incapacitating illnesses and rapid death. Nor does this require great quantities of the agents.

Maj. Gen. Marshall Stubbs, chief of the Army Chemical Corps, recently told the House Military Appropriations Subcommittee:

"With 10 carriers (ICBM's or aircraft) dropping 10,000 pounds each, it would mean that with dry biological warfare material, a potential enemy would get at least 30% casualties in the total of the United States."

• **The gas "gap"**—Stubbs said the 10 carriers—preferably ICBM's to insure delivery—would drop their lethal charges into the atmosphere at about 30,000 feet. Obviously, a similar attack could be launched against the Soviet Union with more missiles because of the larger area.

However, U.S. strategic planning is not ready for this kind of war which calls for a large land army to occupy areas attacked by chemical or biological agents. On the other hand, Russia already has a large army that could be used for swift occupation of Western Europe or the United States through use of the growing Soviet fleet of air transports.

As for Russia's capability, Col. S. E. Baker, Stubbs' deputy assistant, testified: "We credit the Soviet with the ability to wage biological and chemical warfare on a large scale. He possesses a tremendous capability in chemical warfare."

Asked whether Russia had modern equipment to deliver CW and BW agents, Colonel Baker said: "They have very modern equipment. Throughout their Army there are a great number of rockets. Rockets are fine weapons for disseminating chemical agents."

Lt. Gen. Arthur G. Trudeau, Army Chief of Research and Development, said "one sixth of the Soviet ground potential is chemical as far as weapons with their forces in Europe are concerned."

Asked if a chemical and biological warfare gap existed between Russia and United States military capabilities, Stubbs said: "That is my opinion."

## Aeronutronic Gets Contract For AF Version of Scout

Aeronutronic Division of Ford Motor Co. was chosen last week to be system engineer and payload and test contractor for the Air Force version of NASA's *Scout* solid-propelled satellite launcher.

It received a contract for $2,676,000.

First flights will be held from Cape Canaveral this year, according to Gerald J. Lynch, the Aeronutronic General Manager.

# Giant New Red Rocket Spotted by U-2 Spy Plane

Photographs of several huge Soviet rockets some 200 feet long appeared this last week to have been the secret goal of the U-2 spy plane downed in Russia May 1.

This was reported to be the substance of secret briefings given Congress by Central Intelligence Director Allen Dulles. The U-2 story that emerged from the fog of speculation was understood to go something like this:

• The U.S. already has pictures of the 200-foot rockets which have been moved to a known ICBM and satellite-launching site near the Aral Sea.

• Possibly the rockets were being prepared for a new space shot outstripping anything to date, since the Soviet rockets are only 30 feet shorter than the giant *Saturn*.

• The U-2 was seeking more pictures of the activity at the launching site.

• The U-2 was not hit by a "remarkable rocket" as claimed by the Russians but apparently the pilot was forced to bail out or crash land because of some mechanical difficulty.

The CIA chief, it was learned, said that the glider-like U-2 was under U.S. radar surveillance and there was no sign that it had been hit by a rocket as claimed by Soviet Premier Khrushchev. He speculated that the plane may have stalled trying to change altitude and that the pilot bailed out because the ejection system failed.

• **Fakery?**—A picture of the wrecked plane exhibited by Khrushchev was probably faked, according to U.S. officials, as were pictures that the Soviet premier said came from its cameras. Dulles reportedly told Congressmen that after capture of the U-2 the Russians probably sent one of their own recon planes over the same route. Pilot Francis G. Powers had taken and photographed military installations they considered unimportant enough to make public. Since the CIA knew the U-2 was taking pictures of missile bases, intelligence officials considered it significant that none were revealed by Khrushchev.

Furthermore, one of the photos Khrushchev did make public of an airfield with four-engined bombers lined up wing-tip appeared to have been taken from an altitude of about 7000 ft. The U-2 was reportedly flying at altitudes from 65,000 to 72,000 on this mission.

Dulles reportedly told Congress that the U-2 flights were authorized because of the Strategic Air Command's need to obtain better information about Soviet air defenses. Russia has been spending 18-20% of its defense budget on air defenses and U-2 flights have been attempting to locate installations of the *SA-2* and *SA-4* antiaircraft missiles, as well as the new *SA-6* Soviet anti-missile missile.

• **Better AICBM's?**—The *SA-2* and *SA-4* correspond, respectively, to the U.S. *Nike-Ajax* and *Nike-Hercules* and are said to be as good or possibly better.

Disclosure of the *SA-4* by U-2 and other intelligence sources gave high priority to such projects as *Bullpup* and *Skybolt*, because bombers could not fly out of the reach of the newer Soviet antiaircraft missile.

The *SA-6* AICBM, Dulles reportedly told Congressmen, is further along than *Zeus* and may be in production.

The lower altitude flight was authorized so that the cameras could get a better look at the Aral Sea base. Several Soviet missile bases were in the flight path of the U-2, which took off from either Peshawar, Pakistan, or Adana, Turkey, and was headed northwest to Bodoe, Norway, when it was downed near Sverdlovsk. The U-2 could have flown over a base in the Murgab Oasis (see "Russia's Missile Bases" M/R, Feb. 15, p. 26), and then headed north over Aral'sk and Magnitogorsk, two more ICBM sites. Aral'sk also is a satellite launching base. (see M/R, Sept. 7, 1959, p. 21.)

American military experts were quick to scoff at theories that the penetration of the U-2 some 1300 miles inside Russia indicated any weakness in Soviet defenses against SAC bombers.

*Despite the international political repercussions of the U-2 "incident," the United States is expected to continue using it over Russia until satellite surveillance systems can be perfected. Both* Samos *and* Midas *are believed at least two years from operational capability.*

*At week's end, the Air Force readied a second test of the* Midas *infrared early-warning vehicle. The first attempt to orbit a* Midas *failed on Feb. 26. The first shot of the recently accelerated* Samos *television satellite will be made this fall.*

*The slim new look . . .*

# Way for Combat Zeus Opened—Slightly

Backers of the Western Electric *Nike-Zeus* antimissile missile took heart this last week from the recent transfusion of $25 million into the program for preproduction work.

The money, which the Defense Department authorized the Army to take from other Army funds, will be used mostly for the development of special machines for the mass production of thousands of miniaturized electronic components used in *Zeus* radars.

These components are normally made by hand at an average cost of about $20 each. The Army hopes to reduce the cost to about $5 each through the use of mass production methods.

The new authorization was the first break in the Administration's position on *Zeus* since it froze an extra $137 million in preproduction money voted by Congress for *Zeus* last year. The $137 million remains frozen.

**NIKE-ZEUS airframe maker Donald Douglas, Jr., leans on tactical model.**

Pentagon sources now estimate that with the extra $25 million it should be possible to have an operational *Zeus* system of significant size by 1966. But this would depend on a decision to proceed with production within the next year.

Meantime, the test program with new configurations of the approximately 65-foot AICBM continues.

Tests with the original model which was built with huge fins to gather flight data in the atmosphere have ended. The interim model with greatly reduced fins will be used for the next few tests. The even trimmer new tactical models are expected to be first tested about mid-summer.

The tactical three-stage model is about five feet in diameter. The booster is about 24 feet long; the second stage about 20 feet; the third, including the warhead, about 21.

**FIRST BIG-FINNED *Zeus* configuration roars from surface launcher at White Sands Test Range on Feb. 3.**

**SECOND CONFIGURATION of *Zeus*, with most fins removed, was launched from underground silo at White Sands April 28.**

# Franke Says Polaris Is On Schedule, Will Go 1200 Miles

ANAHEIM, CALIF.—Secretary of the Navy William B. Franke asserted here that despite reports to the contrary the *Polaris* system will be ready on time and will prove as effective as the Navy has claimed it to be.

"All critical tests have been passed with flying colors by both missile and submarine—and the entire system will be ready as advertised," he said in a Navy League speech.

"There seems to be some belief that—since announced ranges for *Polaris* missile test flights have been about 900 miles—the missile will only go that far and not 1200 miles as the Navy has claimed," the secretary noted. "For the record, these test missiles carry heavy recording devices and transmitters which enable us to analyze the performance of the various components of the missile. These instruments will not be required in the tactical missile which will go 1200 miles."

Franke noted that some critics have asserted that accuracy of the *Polaris* is not as good as that of land-based intercontinental ballistic missiles. "The accuracy of *Polaris* promises to be as good as that of any known missile today," he said, "and this includes the necessary accuracy of positioning of the submarine at sea."

The Navy secretary also took note of Air Force criticism that *Polaris* submarines can be tracked and destroyed.

"*Polaris* submarines have detection equipment and anti-submarine torpedoes for protection just like other submarines," he pointed out. "Any nuclear-powered submarine is hard to find when it is avoiding detection—even for our own well-trained forces . . . the possible launching areas available to us and the tactics we intend to use make this a hollow fear."

Franke stated also that at any given moment about one-half of all *Polaris* submarines will be on station and ready for firing—not one-third as some critics have claimed.

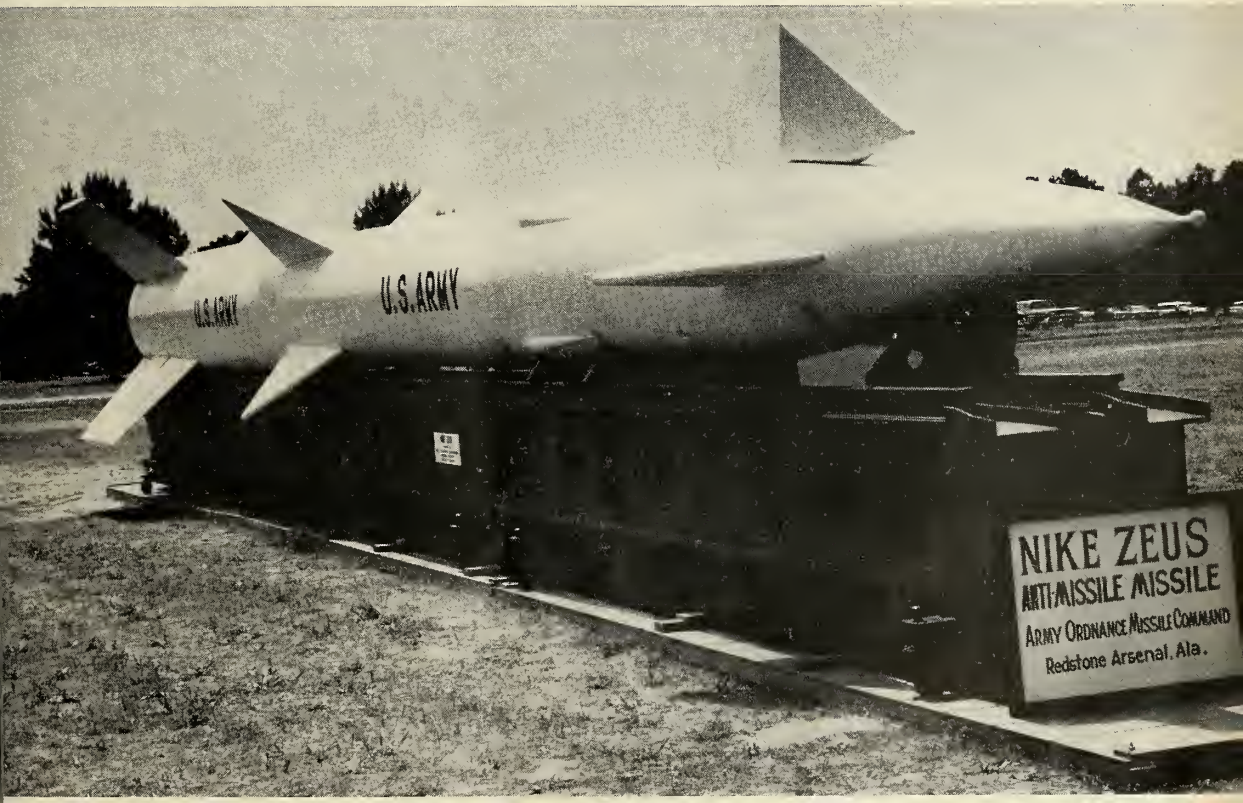
## —news briefs—

**LONG ATLAS SHOT DELAYED**—The Air Force last week delayed again the 9000-mile *Atlas* shot aimed at the Indian Ocean near South Africa. No new date was scheduled but it was expected to be in a few days.

**NUCLEAR SUB CIRCLES GLOBE**—The submarine Triton traveled 36,000 miles on an 84-day underwater voyage around the world ending May 10. Capt. Edward L. Beach was skipper of the 7750-ton nuclear sub.

**HOUSE OKS REVISED FUNDING**—The House last week approved the $39.3-billion defense money bill as drafted by the Appropriations Committee to include additional missile funds over those originally requested (M/R, May 9, p. 14).

**SOVIETS UPGRADE ROCKET FORCES**—Premier Khrushchev last week disclosed the establishment of the rocket force as a separate branch of the armed forces under the command of Marshal Mitrofan Ivanovich Nedelin, a former top artillery commander.




**THIRD EVEN TRIMMER** tactical configuration of *Zeus* was first displayed publicly at Ft. Benning, Ga., this month (M/R, May 9). **Rocket jets enabling the warhead to maneuver are in the forward fins.**

# ARS Meet Hears New Nozzle Concept

LOS ANGELES—A new nozzle concept for liquid propellant rocket engines was introduced by Rocketdyne Division of North American Aviation at last week's American Rocket Society meeting here. The design is claimed to be one step beyond the plug, or spike nozzle recently developed, and is said to incorporate all the advantages of the plug nozzle without its disadvantages.

Other developments unveiled at the semiannual meeting included a Lockheed-devised composite negative/positive ion beam propulsion system which would eliminate one of the major problems of present ion systems: the neutralization of the accelerated, positively-charged beam. A paper by two Chance Vought engineers described a design for a tactical solid propellant missile motor using gimbals to increase accuracy.

The rocketdyne development was brought out in a paper by G. V. R. Rao, who described the nozzle configuration as an "expansion-deflection" type. The expansion of the exhaust gases occurs around the corner of a centrally-located plug, and the flow is deflected by the wall contour of a conventional-appearing exhaust chamber, which is about half the length required for conventional engines in the same thrust-level class.

• **Nozzle advantages**—The E-D nozzle incorporates such advantages as reduced weight and length (over all other types of liquid rocket engine nozzle configurations), reduced cooling requirements, good performance at high and low altitudes, ease of throttling, and possible simplified thrust vector control.

The nozzle, in cross-section, resembles a conventional liquid propellant rocket, with the exception of the inverted-T-shaped plug extending through the center of the injector plate and down the center of the combustion chamber and throat. The other major apparent change is in the shape and length of the exhaust chamber, which has a much more pronounced shoulder contour than previous rocket engines.

To attain the same thrust level, the E-D nozzle need be only half as long as a conventional chamber and the same length as the plug nozzle design. According to rocketdyne, the engine has more design flexibility than the plug nozzle concept, and can more easily have its thrust level varied, in order to perform a specific mission.

Advanced theoretical and experimental work is being done under contract with the Air Force Flight Test Center at Edwards AFB, Calif.

• **Composite ion beam**—Elimination of the problem of neutralization in ion propulsion systems was suggested by M. A. Gilleo and S. W. Kash of Lockheed Missile Systems Division, who proposed one of a number of devices for creating composite beams of such charged particles.

Benefits of the composite system include useful application of the energy currently wasted through radiation from the thermionic emitter surfaces. This energy would be applied to useful thrust in a composite beam device. A more compact ion engine could also result, as well as the use of less chemically reactive materials for fuels than is now possible.

Suggestions include the surface ionization of negative ions, with specific reference to halogen, the ions of which are particularly suitable. Ionizing surface could be tungsten or another refractory metal, activated by thorium, barium or strontium.

• **Gimballed tactical motor**—Five full-scale prototype missiles have been fired by Chance Vought to prove out its method of accurately controlling a tactical missile. The development, reported by R. J. Blalock Jr. and J. G. McCracke, was designated Project Fire, and completely proved the feasibility and practicability of the system, according to the company.

The system provides that, for short ranges and extreme accuracy, the rocket motor should gimbal to provide control up to the time of burnout. For longer ranges, or where control is necessary after burnout, aerodynamic fins attached to the motor casing still utilize the gimballing system to provide aerodynamic control. This system eliminates need for a dual control system, as well as the requirement for elaborate sealing from high temperatures.

The prototype test vehicle developed and used by Chance Vought was 145.5 in. long and 12 in. in diameter, weighed 530 pounds, and had a range of 12 miles maximum and 1000 feet minimum. The solid rocket motor generating 1000 lbs. thrust was produced by the Solid Propulsion Operation of Rocketdyne.

# Undersea Rocket Travel Seen

**by William J. Coughlin**

LOS ANGELES—Development of underwater rocket and ramjet engines for high-speed military and commercial submarines was forecast here at the first session on underwater propulsion ever held by the American Rocket Society.

Dr. George F. Wislicenus, director of the Garfield Thomas Water Tunnel at Pennsylvania State University, told the session large seagoing vessels of the future might travel entirely underwater powered by such engines.

"There is no known reason why travel or the operation of propellers, pumps, or turbines with extensive cavitation should not be feasible," he stated.

He admitted that flow problems involved might be considerable.

"Nevertheless," he said, "since propulsion with thrust values exceeding the weight of the vehicle is regularly accomplished in the rocket field, the possibility of underwater travel at speeds many times greater than those presently used can no longer be ignored."

He said the problems involved should be easier for a propulsor than for a pump and noted that as speed increases, propulsion machinery weight becomes more critical, "forcing progressive change from the propeller to the pumpjet, to the ramjet, to the rocket."

For underwater ramjet and rocket engines, thrust augmentation by means of devices working on the principle of a jet pump could be used to increase efficiency, Wislicenus suggested.

• **Sameness**—Similarity between between underwater and conventional rocket engines was stressed by another speaker at the session, Leonard Greiner of Experiment, Inc., Richmond, Va. He said considerations in choosing the optimum system for a given application in either space or under water are similar.

Greiner suggested that the best fuels for maximum performance of heat engines in underwater missiles might be aluminum and zirconium, using free seawater as both oxidant and diluent.

This might require some unconventional approaches, he admitted. But he noted that to date in underwater propulsion greater emphasis has been placed on practical considerations while attainment of truly high-performance capability has been relegated to a secondary role.

Other papers at this initial ARS underwater session were presented by Robert Brumfield, U. S. Naval Ordnance Test Station, Pasadena, Calif., and Calvin A. Gonogwer of Aerojet-General Corp., Azusa, Calif.

# Congress Split on Joint Space Group

**by Paul Means**

A majority of House Space Committee members—including their chairman—are opposing suggestions by NASA officials that they merge into a joint committee with the Senate Space Committee.

On the other hand, an M/R poll of members of the two committees this week shows those on the Senate space group generally favoring creation of a single body similar to the Joint Committee on Atomic Energy.

The suggestion was made by certain NASA officials, including Assistant Administrator Richard E. Horner (See M/R, April 25) because they felt that NASA employees had to spend too much of their time testifying before Congress. If the two space committees were merged, the space agency experts would have to testify only once, rather than twice, in support of their authorization proposals.

• **Background**—The proposal for a joint space committee was originally written into the Space Act, but was taken out by the House of Representatives. The House has traditionally been wary of joint committees, because they feel that the Senators tend to dominate them.

A poll of House Space Committee members indicated that while the vote might be close, a majority was opposed to merging their group with the Senate Committee.

The basic arguments made for a Joint Committee are:

• Congress would get all of the information it needs, but the witnesses would have to spend only half as much time testifying.

• Since the authorization bill sent to both Houses will be identical, fewer problems would have to be ironed out in conference committee.

• The record of the Joint Committee on Atomic Energy indicates that House members are not overshadowed by the Senators, and that constructive legislation can result from such a partnership.

The basic arguments made against a Joint Committee are:

• It defeats the bicomeral system set up by the Constitution.

• There is an advantage of having witnesses testify twice in that new information is often acquired.

• Senators cannot always meet at times when Congressmen can, and vice versa.

• **Brooks opposed**—"Unalterably opposed" to the Joint Committee idea is Rep. Overton Brooks (D-La.), chairman of the House Committee.

Brooks maintains that joint committees defeat the Constitutional intent of a bicameral legislature. He also thinks that House members of joint committees are overshadowed by their Senate colleagues, and that the House does not look on joint committee legislation as having been deliberated upon by one of its own committees.

Another objection Brooks has is that many members of the House Committee gave up good assignments on other committees to join the House Space Committee, and would feel "let down" if they now had to share their authority with the Senate.

Agreeing with Brooks is Rep. John W. McCormack (D-Mass.), House Majority Leader and ex-chairman of the temporary House Space Committee.

Rep. B. F. Sisk (D-Calif.), fifth-ranking Democrat on the Committee, said that while he opposed joint committees in general, the present situation might "show justification" for a joint committee, and the idea ought to be considered. Sisk said he hadn't made a final decision either way.

• **Break for House members?**—Supporting the theory of joint Committees is Senate Space Committee member Clinton Anderson (D-N.M.), who is also chairman of the Joint Committee on Atomic Energy.

Anderson, who has written articles about the workings of his joint committee, thinks that House members are not overshadowed by Senators on joint committees, but that they actually play a more active part.

This is true, Anderson says, because House members are limited to one active committee and their joint committee assignment, while senators may be members of two or three active committees. This gives the Representative more time for his joint committee assignment than the Senator.

## NASA Successfully Tests Production Line Capsule

NASA has successfully completed an abort test with the production line *Mercury* capsule and its escape system.

The capsule will next be tested on top of an *Atlas* down the Atlantic Missile Range in July (see cover picture).

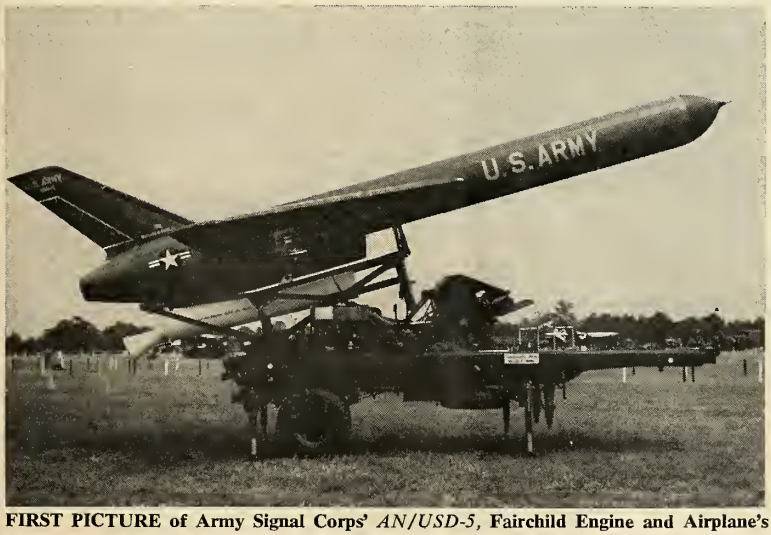
Launched off of a rail at Wallops Island May 9, the capsule was lifted 2400 feet into the air, where it was caught by the wind and dropped into the water three-fourths of a mile off the beach. Total time elapsed between lift-off, pickup by helicopter, and return to Wallops was 17 minutes.

The capsule will be sent back to McDonnell for tests.

The production line escape system which lifted the capsule was a six-ft.-long, one-ft.-diameter solid rocket by Grand Central which produces 50,000 lbs. of thrust through three nozzles for one-half second. Its thrust would subject the astronaut to 24 g's during a pad abort.

The test was accomplished by bolting the capsule's adapter ring to a rail. Explosive bolts release the capsule from the adapter ring at lift-off.

## *Fairchild's New Drone*




**FIRST PICTURE of Army Signal Corps' *AN/USD-5*, Fairchild Engine and Airplane's surveillance drone, shows bird on its mobile ground launcher.**

# Underground Nuclear Tests to Resume

President Eisenhower last week approved resumption of underground nuclear explosions for the purpose of improving detection techniques.

The U.S. plan was put before a committee of U.S., British and Soviet experts at Geneva. The President told his May 11 press conference that no nuclear explosion will be set off without coordination with the international group of experts.

James C. Hagerty, the President's press secretary, said earlier the explosions would not necessarily be below a seismic magnitude of 4.75 (an arbitrary international standard based on the effect of a 20 kiloton Hiroshima-size bomb buried deep in the tuff at the Nevada test site).

As to timing, Hagerty said merely that it is hoped the tests will begin before the end of the year. Actually, the Atomic Energy Commission is able to proceed much faster. The test site has been on standby readiness since tests were suspended Nov. 1, 1958. In the meantime, work has continued on digging and readying tunnels.

The new tests will be conducted under Project Vela, a scientific program directed toward an improved capability to detect and identify clandestine explosions, both underground and in outer space. Officially, they will not be directed toward weapon development.

• **For reliability data**—Nevertheless, it is obviously impossible to conduct nuclear explosions without learning something of value in designing weapons. Even if the experiments are identical to those conducted in the past, information is learned of the reliability of such devices.

It can be safely assumed that reliability is a subject of considerable interest to nuclear weapon designers. When testing ended in 1958, the *Minuteman* ICBM was in an early stage of development. Even if the *Minuteman* warhead design had been completed by then, it could not have been tested very extensively. Thus reliability would have to be a problem.

To some extent, this must also be a problem with respect to *Polaris*. Although the fleet ballistic missile was farther along than *Minuteman* in 1958, there have been some changes in *Polaris* design in the interim. Again, one must assume that further tests of the operational warheads would improve reliability.

Hagerty said the President's decision bore no relationship to the change in U.S.-Soviet relations that followed the downing of a U-2 reconnaissance plane inside the Soviet Union May 1. He recalled that Soviet negotiators at Geneva had agreed to a proposal that underground explosions be held to improve detection techniques.

• **Salt bed project**—Another program of underground tests also is based on agreement between scientists of East and West at Geneva. The Atomic Energy Commission is going ahead with plans for several experiments under its Project Plowshare, a program of developing non-military uses for nuclear explosions. The furthest along is Project Gnome, a plan for a 10-kiloton explosion in a deep salt bed near Carlsbad, N.M.

The AEC in March asked bids from contractors on preparation of the site. The actual tests, a year away, would not be held without the specific approval of the President. However, an AEC spokesman noted that Soviet delegates at Geneva have already agreed in principle to underground tests for development of non-military applications.

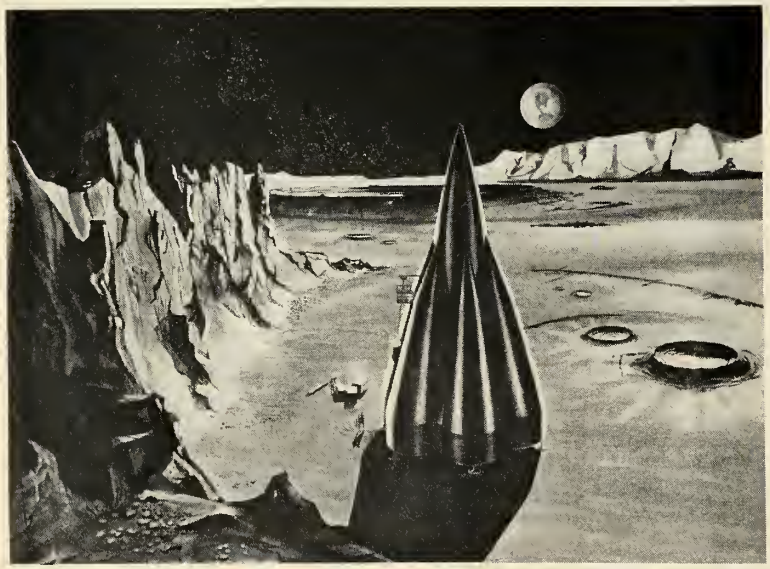
The purpose of Project Gnome is to study the behavior of the explosion in salt, to examine seismic effects and to get measurements on the recoverability of isotopes and the feasibility of power production from underground explosions. The Gnome explosion would take place at a depth of about 1200 ft. and melt the salt for about 20 days. About one-third of the energy of the explosion would be captured in the molten salt.

The Gnome results would have obvious bearing for Vela. Last week, the Atomic Energy Committee released testimony by experts indicating that it is much easier to muffle a nuclear explosion in salt than in granite or the tuff underlying the Nevada Test Site.

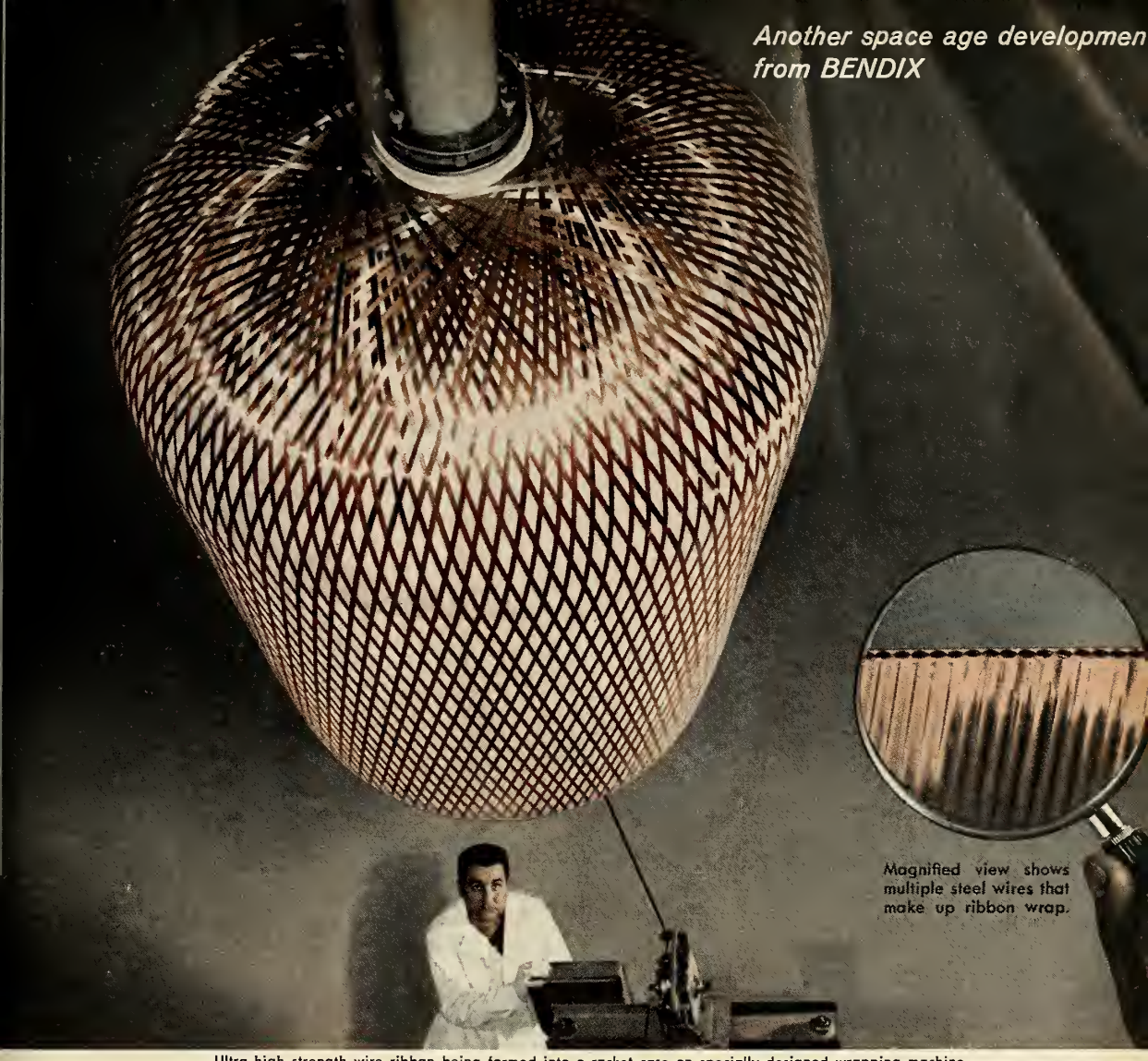
• **Muffling contrast**—For example, Dr. Richard Latter of the Rand Corp. calculated for the committee that the seismic effect of a 20 kiloton bomb in a hole 360 ft. in diameter would be reduced by a factor of 300 if the hole were in salt—but only by a factor of 50 if the hole were in Nevada tuff.

Witnesses told the committee the maximum reduction of seismic effect is by a factor of 300. The volume of such a hole would be about 91,000 cubic yards per kiloton. A one megaton warhead fired at the center of a hole with a volume of 91 million cubic yards would give a seismic effect the same as a 3-kiloton device packed solid.

## *Nuclear Spaceship Concept*



**MARS IN A MONTH and thorough exploration of the moon are capabilities of a nuclear-powered spaceship such as shown in this Douglas Aircraft Co. artist's conception. Max W. Douglas, assistant chief engineer-space systems, says a trip to Mars in a ship powered by a low-energy system might take nine months compared with one month for the nuclear. For travel to the moon, he said, a nuclear transport could weigh less than a DC-8 jet plane and carry a 17,000-lb. payload.**




Ultra high strength wire ribbon being formed into o racket case on specially designed wrapping machine.

# UNIQUE BENDIX WIRE *RibbonWrap* REDUCES WEIGHT, INCREASES RELIABILITY OF ROCKET CASES

Bendix has licked the problems of weight and reliability in flight weight pressure vessels. Secret of the Bendix-developed rocket cases: many tiny ultra high strength steel wires formed by adhesive bonding into a highly efficient ribbon. Weight and distribution of the binding adhesive is precisely controlled. Result—rocket cases with test strength as high as 531,000 psi, *equivalent to a hoop stress of 350,000 psi UTS in a homogenous case.* A specially designed Bendix machine generates the rocket case. The best wrap pattern for each case is mathematically determined and precisely controlled. Finished product is a rocket case tailor-made for configuration, strength and reliability.

For more complete information, write Rocket Equipment, Bendix Products Division, South Bend, Indiana.

*The Bendix wire RibbonWrap gives you these important advantages:*

**Design Flexibility**
**Controlled Minimum Weight**
**Close Tolerances**
**High Temperature Strength**
**Shortest Prototype or Production Lead Time**
**Automated for Low Cost**
**Inherent Reliability**

Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

Circle No. 6 on Subscriber Service Card.

# Charyk Outlines STL's Non-Profit Replacement

Here is how Dr. Joseph V. Charyk, Air Force Undersecretary for R&D, describes "Corporation A"—the technical organization that will take the place of Space Technology Laboratories in directing Air Force development programs. He told Congress recently:

. . . The plan which has been evolved calls for the formation of a new non-profit corporation which will provide the desired technical support to the Air Force's ballistic missile and space programs for the foreseeable future. Functions appropriate to the new organization, which have been handled by STL up to the present time, will be transferred to the new organization as expeditiously as possible. It is anticipated that a nucleus of personnel from STL will provide the initial technical skills required by the new corporation.

In order to avoid any possible disruption of the approved development plans, STL will retain detailed systems engineering and technical direction responsibility for *Atlas, Titan* and *Minuteman*. The present restrictions imposed on STL and Thompson Ramo Wooldridge in regard to competition for hardware contracts arising directly from these projects will be maintained. STL will also receive certain experimental space projects presently under contract and due to be completed in the near future.

Functions to be assumed by the new corporation under Air Force program management include advanced systems analysis and planning, research and experimentation, initial systems engineering, initial technical direction, and technical monitoring in the field of ballistic missiles and space systems. In addition, the new corporation will provide technical staff assistance in the evaluation of ideas and proposals submitted by private industry.

The proposed nonprofit corporation will work closely with the Air Force in long range planning, systems analysis and systems comparison studies. As technical advisor to the Air Force, it will review ideas and concepts generated throughout the industry and government in order to insure the proper interaction between military requirements and technical capabilities. This detailed analysis, together with appropriate supporting experimentation, will provide the soundest possible basis for the initial engineering specifications of a system, including the sub-systems requirements, specifications, interactions, and interfaces. This initial systems engineering work will provide the basis for requests for proposals to the industry.

The new corporation will also play an important role in the evaluation of the resultant proposals, and so provide the Air Force with the best technical assistance for the selection of the contractor who will have responsibility for the detailed systems engineering and the major sub or associate contractors. After the contractors have been selected and the development program launched, the new corporation, through technical review, monitoring, and analysis will serve to insure that technical deficiencies and weaknesses are isolated and that the impact of new data, new developments, and modified requirements on the total systems concept is properly assessed and that, accordingly, appropriate changes are introduced as promptly as possible.

The details of corporate structure, organization, and staffing are now being formulated and will be announced at the appropriate time.

## Perry Now Industry Editor

For more than a year, Donald E. Perry, one of the pioneer writers in the missile/space field, has ably served as the managing editor of this magazine. He now has asked to return to a job where he can resume his work as a writer, and we are happy to announce that he has been appointed to strengthen our coverage of the nation-wide missile/space industry. His first assignment will be to expand coverage of M/R's newly established ASW Engineering department. He is well qualified to do this—Don was designated Qualified in Submarines in 1942 and served more than six years in submarines, most of the time on combat patrol. William E. Howard, associate editor for over a year, has been named Acting Managing Editor.

**Clarke Newlon**
**Executive Editor**

## financial news

**Boeing Airplane Co.**—Earnings for the first quarter more than doubled that of the same 1959 period, at $4 million up from $1.7 million. Sales rose to $395.7 million from $325.1 million. However, backlog on March 31 was down to $1,960 million compared to $2,329 million in 1959.

**Radio Corp. of America**—First-quarter profits increased slightly to $13 million from $12.9 million in the like period last year. Sales rose to $361.2 from $321.8 million a year ago.

**Burroughs Corp.**—Earnings rose 60% on a 22% revenue increase. Net income totaled $2.4 million on revenues of $98.7 million. Current defense contracts for computer and classified electronic communications devices total some $16 million.

**The Martin Co.**—Sales and revenue for the quarter ended March 31 totaled $140.4 million, about $18.5 million over the same period in the previous year. Net income was $3.5 million, almost $5 million more than 1959's first quarter total.

**North American Aviation**—Sixth months net income dipped somewhat, although sales for the half-year ending March 31 were higher than that of the same period in 1959. A net income of $11.6 million was realized on sales of $498 million while in the corresponding period last year income was $13.2 million on sales of $449.1 million.

**Westinghouse Electric Corp.**—Net income for the first quarter in 1960 increased 35% and sales increased 4% over the same 1959 period. The company had an income of $19.4 million on billings of $458.8 million. New defense orders more than doubled those booked in the first quarter of 1959, with total orders increasing 20%.

**Texas Instruments**—First quarter sales and net earnings hit record highs for the company's 30 year history. First quarter sales totaled $56.2 million, compared to the previous years $30 million. Earnings reached $3.9 million over $2.4 million for first quarter 1959.

**Consolidated Diesel Electric**—Reported a first half net income (ending Jan. 31) of $106,505 on sales of $12.9 million compared to a loss for the same period a year ago of $161,298.

**Chance Vought**—Profits dropped sharply, because of a sharp decline in scheduled deliveries of jet fighters, according to the company. Net income dropped to $883,162 from $1.5 million for the first quarter ending March 31. Aircraft and missile sales declined to $52.2 million from $66.3 million in the like 1959 quarter. Income from other divisions brought gross income to $62.7 million off from $66.3 million in 1959.

**Allis-Chalmers Mfg.**—The machinery maker's sales totaled $126.4 million compared with sales of $84.1 million for the same three month period ending March 31, 1959. Net income climbed to $2.6 million, compared to a net loss of $3.6 million the year before, when strikes occurred in ten of its plants.

# Missile Work Brings Boom to Ogden

OGDEN, UTAH—A sleepy little Western rail and livestock center of a generation ago has grown in a scant four years into one of the nation's major missile development and production centers.

By the time the *Minuteman* ICBM goes into full production next year, almost 10,000 will be employed directly or indirectly by missile/space contractors in this community on the desert shore of the Great Salt Lake.

The Ogden metropolitan area has more than doubled its population since 1940—mostly in the last few years—from 56,000 to an estimated 116,000.

Marquardt Aircraft Corp. in 1956 became the first major missile contractor to settle in Ogden. It decided then to build a major ramjet engine production center; Marquardt and the Air Force have since spent more than $15 million to build the facility, which employs 1700 persons.

• **Air Force aid**—The following year, Thiokol Chemical Corp. bougbt 11,000 acres of desert land around Brigbam City, in Ogden's northern suburbs. With the Air Force picking up 40% of the check, Thiokol built a $16-million center for research, development and production of solid propellants. Employment at Thiokol reached 3100 this year.

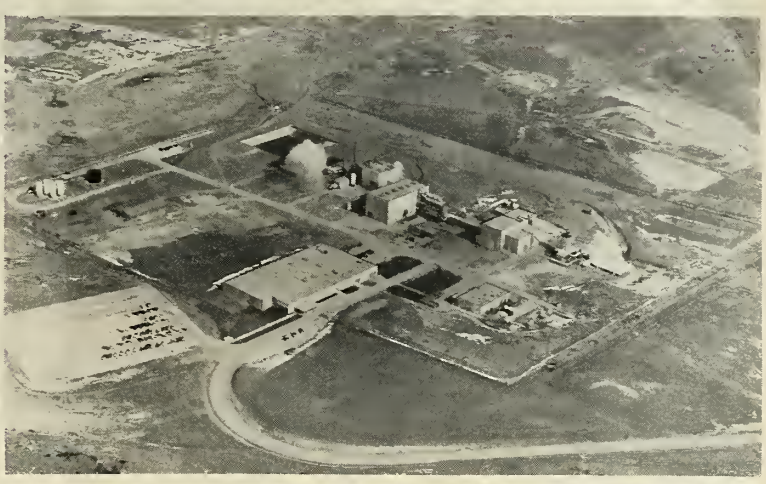
Last fall, the Air Force chose Thiokol as sole source for the first stage and backup source for tbe second stage of *Minuteman*. Construction has begun on a $34-million production plant that will employ another 1500 when it is completed.

In February, Thiokol decided to establisb a headquarters here for its far-flung rocket operations, under the direction of Vice President Harold W. Ritcbey.

At Hill Air Force Base, 15 miles from Ogden, the Air Force and Boeing Airplane Co. are building an $11-million plant for tbe assembly and recycling of *Minuteman* missiles. At least 1000 will be employed tbere.

A fourth major missile/space concern, Sperry Rand Corp., moved into the Ogden area in 1959. The Sperry Rand plant, which assembles the Army's *Sergeant* missile, has 900 employes and another 700 are anticipated.

• **Small firms too**—The influx of new industry was at least in part a result of a well planned and financed industrial development program, launched by the Ogden Chamber of Commerce in 1954. During the first two years, the new Industrial Bureau succeded in inducing several small plants employing 10 to 25 people to locate here.



**WORLD'S LARGEST ramjet engine test center, operated by the Marquardt Corp. for the Air Force, is on the east shore of Great Salt Lake near Ogden.**

Smaller concerns continued to move here along with the bigger manufacturers. Supporting plants provide tooling, engineering and similar subcontract services for the area's new industrial giants. Not all the newcomers are in the missile/space business. They include a Pacific Iron and Steel Corp. fabrication plant, a Westinghouse facility and a Del Monte Food Products distribution depot.

An average of $30 million a year is being spent on commercial construction in Ogden—whose total assessed valuation was less than $50 million a decade ago. Home construction, both in new starts and total value, in the first two months of 1960 was double that of 1959. New roads are being built in the area at a rate of about $20 million a year—a level that would have been a two-year budget for all of Utah a few years ago.

School construction is booming too. The two Ogden school districts are spending more than $15 million a year on construction. A few years ago, the entire city budget was less than $2 million.

"The field for tool, die and engineering plants, small or large, is wide open here right now," says Bernie R. Diamond, manager of the Ogden Chamber of Commerce. "The Ogden growth story has been an exciting one because it has shown what can happen when business and industrial leaders pool their resources and brain power."

## mergers and expansions

**HUGHES AIRCRAFT CO.'s** ground system group will hire 600 engineers and scientists during the next nine months. Current work force at the Fullerton, Calif. facility numbers 6000 people working on 26 military contracts.

**NARMCO RESINS & COATING,** division of Narmco Industries, Inc., has changed its name to Narmco Materials Division. Narmco Industries itself was recently acquired as a wholly-owned subsidiary of Telecomputing Corp.

**HERMETIC SEAL CORP.** of Nutley, N.J. has taken over complete management of Connector Seals Corp. in Pasadena, Calif. Connector's line of hermetically sealed connectors is used in aircraft, missile and atomic energy programs.

**CONTROLS CO. OF AMERICA** has merged its subsidiary, Solid State Electronic Controls, Inc., into the parent company to be operated as the Electron Division.


You're on the inside of the entire $45 Billion Military Market when you advertise in Armed Forces Management—reaching 17,000 top military and civilian personnel in the Department of Defense. Over 4,000 copies go to the Pentagon alone! It reports with authority on military policies, politics, plans . . . editorial material of interest, value and importance to all the military services.

**Send for detailed Armed Forces Management Market/Media Brochure**—Armed Forces Management offers you a marketing manual giving a complete analysis of the military market. It explains how to reach the top military (major and above) and civilian executives (GS-13 and above) who have the most to say about policy, purchase, specification and procurement of the many thousands of items the armed services buy. Write for your copy.

AF m ARMED FORCES management

AMERICAN AVIATION PUBLICATIONS, INC.
1001 VERMONT AVENUE, N. W., WASHINGTON 5, D. C.

# Technical Countdown

## PROPULSION

### Nitrogen Textroxide Capacity Boosted

Hercules Powder Co. is quadrupling production capacity at its nitrogen tetroxide plant in Hercules, Calif. $N_2O_4$ is the storable liquid oxidizer planned for *Titan*. Fuel will be 50-50 mixture of hydrazine and UDMH. AF gave go-ahead for new Olin Mathieson anhydrous hydrazine plant last month (The Countdown, May 2). Present UDMH capacity is reported adequate.

### Minuteman Second Stage Tested

Aerojet-General reports full-duration test firings of flight-weight *Minuteman* second-stage powerplants. The number of such tests was not disclosed.

### Redstone Engine Production Ends

The last *Redstone* engine has been rolled out of Rocketdyne's Canoga Park, Calif., plant for delivery to the Army. The Chrysler missile, first flight-tested in 1953, was the first large rocket-powered missile to reach production status in the U.S.

### Big Mixer Under Construction

United Technology Corp. has contracted for construction of a 200-gallon mixing machine at its new development and test center south of San Jose, Calif. Swinerton & Walberg Co. will build the mixer by July 1. It will be the first building in a 60-structure complex.

## GROUND SUPPORT EQUIPMENT

### Expensive Experimentation

It costs $2000 per hour to operate any one of its 19 test stands in the Santa Susana mountains, Rocketdyne estimates.

### Saturn Equipment Design Started

Hayes Aircraft and Brown Engineering have won the first contracts for engineering and drafting services in connection with design and development of support equipment for *Saturn*. Birmingham Ordnance District awarded the contracts of $674,000 and $517,000.

### Combo Analog-Digital Computers?

Future electronic computers will combine analog and digital techniques to provide a better system than is supplied by either method alone. A committee of representatives from Sperry, Stromberg Carlson and Melpar made the prediction in a special report to the American Ordnance Association.

## ASW ENGINEERING

### Navy Writes Early to Santa

The Navy has two "desired" items for oceanic research—when and if money becomes available: a large shore facility for systematic, rapid data handling, reduction and publication; and a fixed habitable laboratory to be placed at great depth.

## ELECTRONICS

### TAHA Tests Nearly Complete

Service test evaluation of TAHA—reported to be the world's largest receiving antenna and the only tapered-aperture antenna—is scheduled for completion next month. The antenna—1000 ft. long, 500 ft. wide and 250 ft. high, was built by Development Engineering Corp. for the Army Signal Corps under a $900,000 contract at La Plata, Md.

### Better Test Radar for Hercules

The Army has installed extra high-power acquisition radar and more versatile tracking radar for the *Nike-Hercules* at White Sands. The new system is designed to provide greater detection ranges for smaller and faster targets.

### Guidance Accuracy Betters Requirement

Better than 1′ of arc accuracy is claimed for the Ball Bros. guidance system for the satellite preceding NASA's orbiting astronomical observatory. The NASA requirement was 5′.

### Transistor Sales Spurt

Sales of transistors in the first two months of 1960 were almost double that of the same period last year, according to an EIA announcement. Volume is running close to $25 million a month.

### Tracking Ship Instrumentation Begun

Chance Vought's Range Systems Division is producing instrumentation for the first Navy tracking ship assigned to the Pacific Missile Range. Under a $2-million contract, CV will provide telemetry, tracking, data transmission, navigation, timing, aerology, communications, radio command, surveillance and other equipment for the S. S. Skidmore Victory, which had been in mothballs. Work will be done at Ingalls shipbuilding yards, Pascagoula, Miss.

### Ideas, Anyone?

For installation in drones, the Navy is waiting for someone to come up with a scoring device that does not require any special instrumentation in the missile.

## ADVANCED MATERIALS

### Titanium Process Developed

Clevite Corp. has developed a low-cost process for manufacturing parts from powdered titanium—with strength and corrosion properties similar to wrought. In another titanium development, the Army reports use of the metal has lowered the weight of the bazooka-fired *Davy Crockett* by 80 lbs. Titanium Metals Corp. of America estimates Ti requirements for *Davy Crockett* will be 2 million lbs. over the next five years—compared with overall total shipments of 6.5 million lbs. last year.

### Simulation Chamber Planned

General Electric is following the trend to bigger simulation facilities, with plans for a big vacuum chamber and a solar source at its MSVD, Philadelphia.

# Homemade Radar Checks Out Missiles

***Do-it-yourself system built from scraps and surplus by GE specialist to test missile radar beacons***

**by Hal Gettings**

CAPE CANAVERAL—A homemade radar system—fathered by urgent need and the lack of money in the budget—is being used here to check out *Atlas* radar beacons. Reminiscent of earlier days at the Cape when "make-do" was the rule, the system was built by a General Electric instrumentation specialist with salvaged parts to his own design. Total cost of parts and labor amounted to less than $5000. A comparable manufactured system would have cost $20-25,000.

Missile radar beacons must be tested while the bird is in the hangar and again on the pad prior to launch. Range facilities at Canaveral were not always readily available for this testing. Money for a separate checkout system was not in the budget. In addition, time did not allow for the usual procurement, design and development lead time. But the fact remained that the beacons had to be tested before flight, and launches could not be held up for the test.

The problem was solved by an ingenious do-it-yourself project under Henry R. Brown of GE's MSVD Instrumentation Laboratory at the Cape. Using a combination of available surplus parts, scrap, modification, and original design, he came up with a radar system that has done the job well and provides the potential design for a manufactured system.

• **Antenna**—Probably the best example of ingenuity in the building of the "Mark Zero" radar is the antenna. Since no C-band antenna reflectors were available in the scrap pile, one had to be built from scratch. For the basic shape, Brown used the shipping cover from a Mark II nose cone. This was converted to a parabola by filling the center portion with plastic and covering the entire inside surface with aluminum foil. The focus was determined by aiming the dish at the sun and measuring the focal point. The foil was then tensioned and taped in place to fix this point at the proper distance.

**RADAR ANTENNA was built from discarded nose cone shipping cover partially filled with plastic and covered with aluminum foil.**

The antenna feed was made from a coax-to-waveguide adapter and held in place with salvaged steel scraps.

Final gain figure of 35 db compares favorably with a manufactured antenna. VSWR was measured at 1.2:1.

• **Transmitter**—The big problem in the design of the transmitter was the necessity of using an available magnetron. The one on hand was designed for 200 watts peak power with five volts on the filament. For this application, it was necessary to overdrive the magnetron to produce 1000-2000 watts peak with six volts on the filament. In spite of the heavy overload, the original unit was still going strong after many hours of use.

A special delay line and transformer combination was designed to provide the maximum power output, a minimum usable pulse width (100 pps), and maximum antenna gain.

• **Receiver**—Prime target of the receiver design was maximum sensitivity. This was achieved by a hybrid video amplifier designed to take advantage of both tube and transistor characteristics. The high input impedance of the vacuum tube provides maximum gain, while transistors give threshold of noise control for maximum pulse amplitude and minimum noise amplitude. The negative spike from the main bang has been reduced to a negligible value.

Frequency measurement and diplexing posed interacting problems. These were overcome by marrying a secondary standard (frequency meter) cavity with a C-band mixer and using a standard 60 mc i-f strip.

• **Performance**—The beacon checkout system is located near the hangar and about two miles from the launch pad. It is used to test the beacon both in the hangar and on the pad. Digital readout counters tied to receiver and transmitter check the number of pulses received against number transmitted.

In addition to its primary function, the system is used to monitor range checkout during the countdown.

Performance of the "jury-rigged" system to date, according to GE engineers, has been most satisfactory. It is but one more example of the imagination and ingenuity necessary to get the big birds off the pad and to their target.

# 'Copter Makes Air Catch

**by Donald L. Zylstra**

New helicopter techniques are being developed to solve the thorny problem of "air-catching" *Discoverer* data packages—and perhaps even manned *Mercury* capsules.

Up to now the Air Force has been trying to snag *Discoverer* capsules with a trapeze-type gear dragged by fixed-wing aircraft. So far the airplanes have not had a real chance at a mid-air catch, since none of the capsules have been sighted. An attempt to recover the capsule of *Discoverer XI* failed when the 300-lb. capsule apparently went into orbit.

Sikorsky Aircraft Division of United Aircraft Corp. and the All American Engineering Co. recently demonstrated to a military-technical group how a Sikorsky S-55 helicopter could catch a 124-lb. package suspended from a parachute 24 ft. in diameter. The demonstration, at Sussex County Airport, Del., included the lowering of the 141-lb. total to the airport apron with All American's 15C pick-up winch.

The S-55 trailed a 20-foot pole pointing diagonally downward and aft, from a position directly below the winch. The pole supported a grapnel-like hook attached to a nylon towline leading from the winch. When the hook caught the parachute canopy or shrouds, the line was paid out 60 to 75 feet, so the chute and package could be towed without danger of fouling with the helicopter.

• **Lots of time**—Chutes and packages were released from a light, fixed-wing aircraft from a 10,000-foot altitude. Rate of descent for the chutes was approximately 1500 feet per minute. With this rate of fall, helicopter pilots demonstrated that they had ample time for multiple passes at the chute—up to seven or eight tries in recent successful recoveries.

Sikorsky's chief pilot D. D. Viner and test pilot Robert Perrone said "several attempts could be made" on chutes with rates of descent as fast as 2000 to 3000 feet per minute. During the Sussex Airport tests, observers saw the copter retrieve a chute on the first pass as well as on the third try, with recoveries being made at altitudes ranging from 8000 to 1000 feet.

Because recovery is made at speeds from 20 to 60 knots in helicopters, the aircraft can achieve more approaches and can make corrections in approach later and closer to the parachute than fixed-wing planes. Airplanes are forced to close on the chute-borne package at speeds from 105 to 150 knots.

Because of slower speeds, helicopters may experience greater difficulty in "arriving at the recovery scene," pilots said. But, if three or four helicopters were airborne at the time and site of missile re-entry, at least one would have an excellent chance of arriving on time. Such tactics are possible with slower, more maneuverable helicopters. Faster airplanes would endanger each other if used in this way. Even if fixed-wing craft make the recovery, as in the case of drones, waiting helicopters could probably relieve them of their heavy, dangling loads and lower them safely.

• **Eye on canopy**—Pilot Viner explained that approaching descending parachutes is a technique well within the skill of any competent helicopter pilot. In retrieving airborne instruments, the pilot aligns himself with the drifting chute, employing an aerial counterpart of the "seaman's eye." If he can keep the convex parachute canopy just visible above his instrument panel during the final seconds of approach, he has an excellent chance of completing his recovery.

Predictions that downdrafts from helicopter rotors would collapse the parachute canopy proved entirely unfounded, test pilots said. Pendulum reactions after the hook engaged the chute damped out promptly after the "towing" began. Swinging motion of the package also proved negligible in lowering payloads to the ground. Drag while towing posed no problem in maneuvering the helicopter.

## Buried Moon Bases Studied By Army

Buried lunar bases are the long-range objective of a series of studies under way at the Army Corps of Engineers.

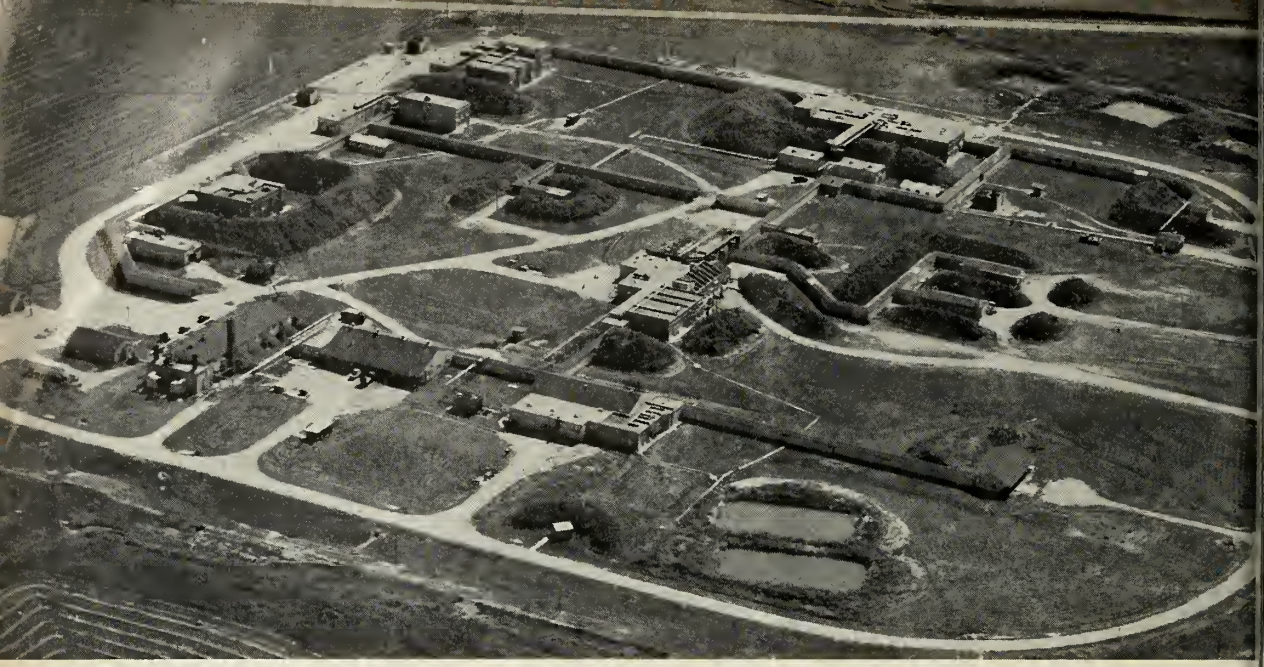
Chief Engineer Lt. Gen. Emerson C. Itschner told the House Space Committee last week that U.S. space vehicles will be capable of taking teams to the moon within the next decade—making such facilities mandatory for all but preliminary explorations.

One concept envisions prefabricated units sent by cargo rockets and assembled on the moon with a minimum of labor. Another alternative would be inflatable structures. All would have to be buried for insulation and meteorite protection. Power would be supplied by small nuclear reactors.

The capability of the Corps of Engineers for this type of work is amply illustrated by the construction, this summer, of a semipermanent camp housing 100 men beneath the Polar Ice cap in Greenland, says Itschner. Nuclear power will supply light and heat.

Lunar conditions are much worse than those found on earth; for this reason, a long R&D program will be necessary. Itschner says this program should be initiated soon, since it must be carried out simultaneously with development of rockets large enough to handle the transportation phase.

Army Engineers are already working on moon maps and, in addition, are planning special satellite instruments to supplement existing photographs.

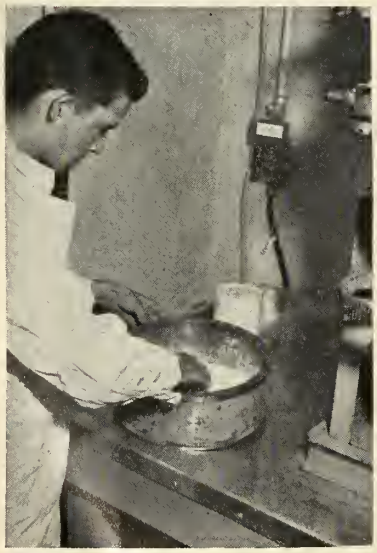


SOLID PROPULSION plant, now wholly owned by Rocketdyne, occupies 12,000 acres near McGregor, Tex.

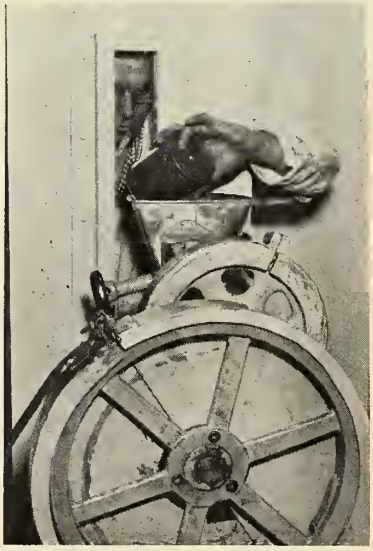
## propulsion engineering

# Rocketdyne Solid Operation Grows

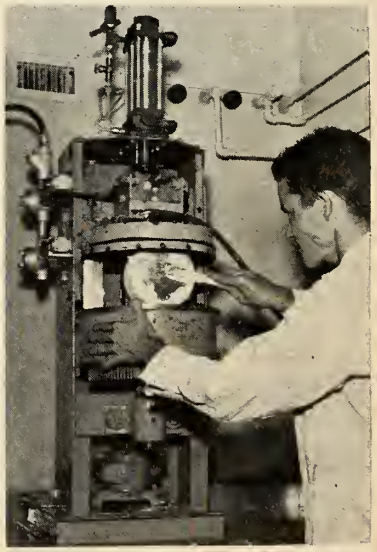
*Former Astrodyne facility increases R&D; company feels it is now ready for any solids job that needs to be done*



PRE-MIX of oxidizer, metal powders and inert binder for igniter is carried out by Rocketdyne's R. L. Powell.



PROTECTED behind heavy glass and steel partition, worker pours propellant ingredient into mixing bay hopper.



MIX-MULLER blades are cleaned after remote-control mixing operation is completed and material is dried.

by Jay Holmes

McGregor, Tex. — Rocketdyne's Solid Propulsion Operations—a bomb-loading plant in World War II and a JATO producer in the Korean War—now says it can take on any solids job that needs to be done.

Two ownership changes in the last two years have marked the latest shift in emphasis—from straight production to production mixed with a heavy share of research and development.

Phillips Petroleum Co. operated the plant from 1952 until 1958 as its Rocket Fuels Division, producing JATO units for the Air Force. In February, 1958, Phillips and North American Aviation joined to form Astrodyne Inc.

The new company set out on a long-range program of modernizing facilities and expanding research capability.

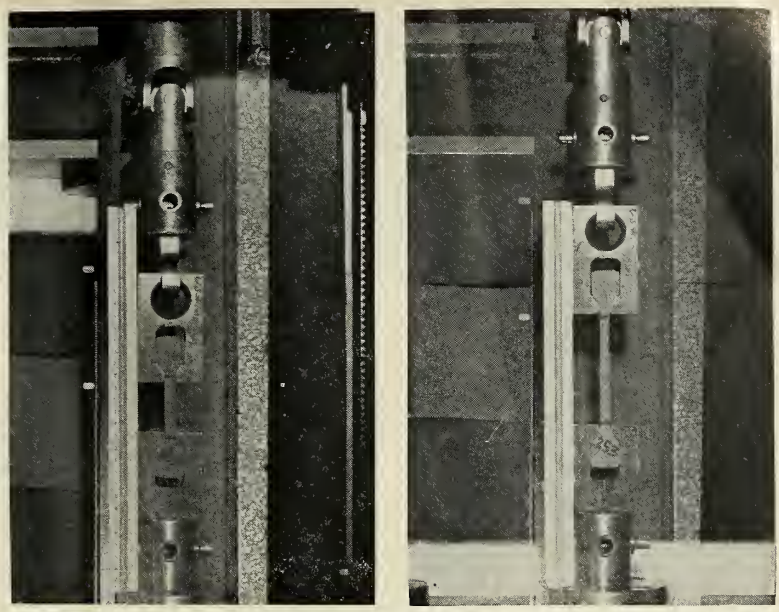
On Oct. 1, 1959, North American bought the Phillips interest and established the plant as Rocketdyne's Solid Propulsion Operations. The solid propulsion team at McGregor now is supported by basic research in advanced propellants carried on at Canoga Park, Calif.

• **Big leaguers**—The Rocketdyne team, headed by Vice President T. E. Myers, now feels it has graduated to the major league in solid propulsion. Symbolizing this, Rocketdyne is one of six bidders in the current competition on Air Force Project 3059, a proposal to build a booster of about 100 million pound-seconds total impulse.

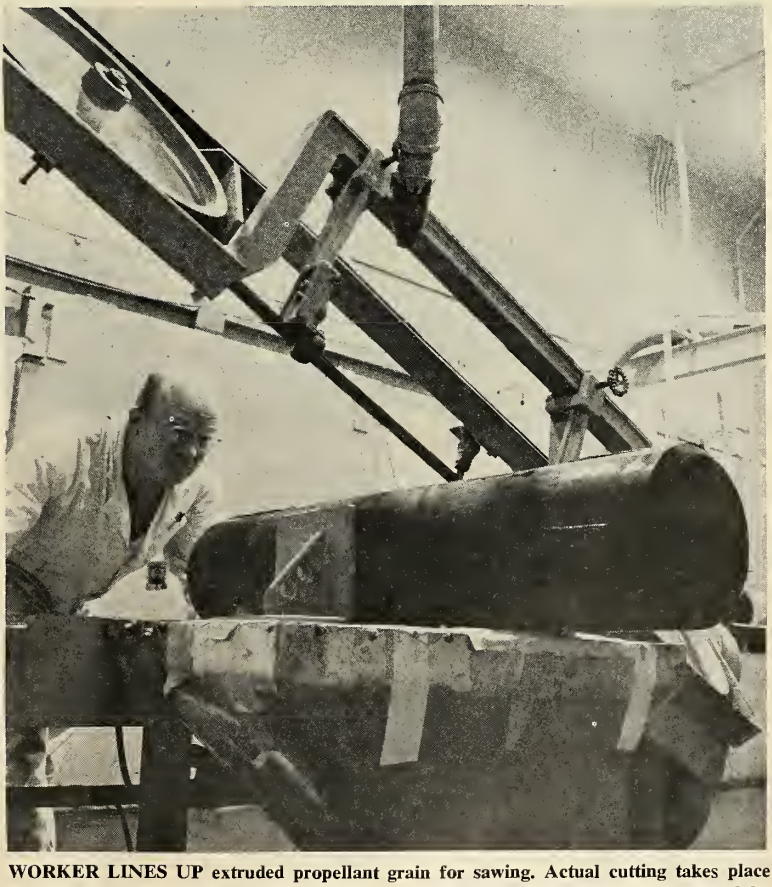
So far, Rocketdyne SPO has not snared any major ($10-$20 million) contracts from the big operators in the field. The present production activity consists of a small amount of residual JATO work and a few gas generator contracts. Gas generators are a growing field as the major liquid engines switch from liquid to solid gas generators for simplicity. SPO already has one contract to supply turbine starters for a Rocketdyne liquid powerplant, and makes the generator for the Navy's solid-propelled *Tartar* and *Terrier*.

Research is a major activity here. S. C. Britton, research lab group leader, heads a staff of 50 studying such areas as propellant ballistics and physical properties, processing techniques and new missile and spacecraft applications at company expense and under Air Force study authorizations.

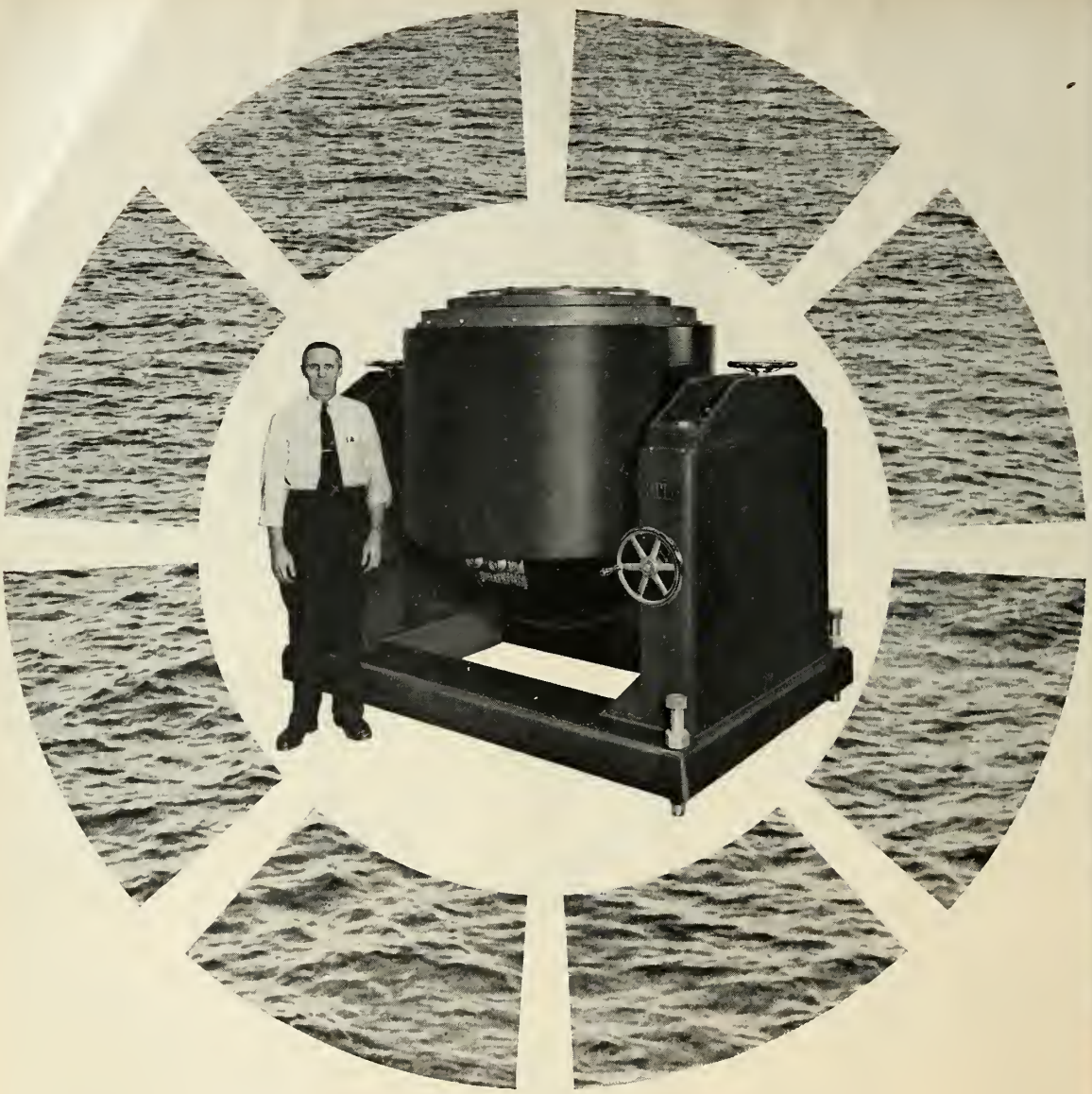
Although it has done some work with polyurethane-base propellants, Rocketdyne is beginning to be identified with the polybutadiene class, very similar to the polysulfides. Britton said improved physical properties have been developed in two classes of polybu-



**TENSILE TESTS** demonstrate physical properties of Rocketdyne propellant. At left is material before tension is applied. At right, under tension. Propellant base is chemically similar to synthetic rubber.



**WORKER LINES UP** extruded propellant grain for sawing. Actual cutting takes place by remote control, while being sprayed with cooling water. Workers are protected by steel walls from possible fire.



# LING'S LIQUID-COOLED SHAKERS DISSIPATE HEAT FAST WITH WATER

Improved system efficiency goes with the improved design of Ling's new series of liquid-cooled shakers. For instance, Model 249 shown above not only offers an impressive 28,000 pound force rating, but a number of other advantages. The new closed-loop cooling system, employing clean raw or distilled water, dissipates heat so efficiently that less is dumped on the testing site. The series also features a new web-design armature of lightweight aluminum. Force is transmitted to the table with maximum rigidity. Finally, special construction details make these liquid-cooled shakers adaptable for environmental chamber testing without special accessories. Tests can be conducted from −100°F to 300°F at any altitude. Field and armature coils are designed to help eliminate corona at altitudes; special thermal barriers can be supplied which control heat flow from the shaker to the chamber. This built-in adaptability and high efficiency grow from Ling research; For details on the liquid-cooled shaker series, write Dept. MR-2 at either address below.

LING
ELECTRONICS

A DIVISION OF LING-ALTEC ELECTRONICS, INC. • 1515 SOUTH MANCHESTER, ANAHEIM, CALIFORNIA • 120 CROSS STREET, WINCHESTER, MASSACHUSETTS

tadiene propellants, carboxy-modified polybutadiene and polybutadiene acrylic acid (PBAA).

• **One-piece route**—Good physical properties are essential for very large grains, such as that envisioned for Project 3059. With the industry split between advocates of segmented and one-piece casting, Rocketdyne is going the one-piece route. This requires on-site loading and a propellant with particularly good physical properties.

The whole industry recognizes that there are serious problems in making motors that will withstand temperature extremes and in making the very large monolithic grains hang together. Britton says he believes PBAA is a better propellant than others on both counts.

As an example, Britton provided calculations showing maximum dimensions of grains with ordinary PBAA and with the Rocketdyne variety. Holding the inside diameter constant, he said, it is possible with the Rocketdyne PBAA to increase outside web diameter 80 to 100% and at the same time increase inside web thickness more than 325%.

For on-site loading, Rocketdyne is developing a continuous mixing process it calls Quickmix (M/R, Nov. 30, 1959, p. 21). "It is showing excellent progress and we are now certain that Quickmix is a feasible process. The propellants we have produced by the process show improved physical properties and higher specific impulse than those produced by batch mixing and a degree of reproducibility in propellant composition that is fantastically high," he said.

"Quickmix shows several advantages over other continuous mixing methods and the dispersion of ingredients is superior to any other mixing method."

• **Ratio debated**—The industry is also divided on the big booster's propulsion characteristics. Some believe is should generate a very high thrust for a relatively short time. Others prefer low thrust and longer duration. "Personally," Britton said, "I believe a low-thrust, long-duration motor will have a better chance to advance the state of the art. The problems of insulation and long-duration nozzle cooling might be tougher."

Actually, however, the Rocketdyne proposal indicated an intention to look both ways on the thrust-duration question.

"Some believe that polyurethane propellants yield a higher specific impulse," he said. "But Rocketdyne's calculations and measured $I_{sp}$ show no significant difference."

He said the specific impulse attained by Rocketdyne PBAA is at least as high as the propellant going into *Minuteman* and *Polaris*.

To get higher energies, Rocketdyne is conducting research on a broad spectrum. Typical areas of interest are the nitro compounds and borohydrides —which provide higher energy or lower molecular weight—and the encapsulation of such highly reactive ingredients as lithium aluminum hydride.

## GE Engineer Proposes Jet-Powered Booster

A General Electric Co. engineer proposes the use of composite air-breathing and ballistic systems for launching space vehicles to gain a payload advantage over a ground-launched system.

Morris A. Zipkin, manager of advanced propulsion systems in GE's Flight Propulsion Laboratory Department, last week suggested that an air-breathing system such as a turbojet might take off and accelerate the vehicle to cruising speed. Then the first stage would separate and the rocket system would take over.

The air-breathing stage could be recovered. Similarly, he said, a second-stage hypersonic ramjet powerplant could take over for long-range transport flight between points on earth.

## Development of Skybolt Propulsion Will Cost Less

Aerojet-General says development of the propulsion system for the 1000-mile-range *Skybolt* will cost 20% less than what has been spent in the past for powerplants of comparable size.

The program will benefit from work performed earlier on Army, Navy, Air Force and NASA projects, Aerojet said.

G. William Lothrup, 42, was appointed program manager for Aerojet's part in developing the air-to-ground missile. John Baird, 36, was named project engineer.

## Army, Thiokol Open New Facilities at Redstone

The Army and Thiokol Chemical Corp. last week dedicated new solid propellant facilities at Redstone Arsenal, Ala., valued at $4.5 million.

Twelve major operating and engineering buildings have been erected, including mixing buildings, casting buildings, a radiographic inspection building, a motor preparation building, curing ovens and office buildings.

The new equipment includes a 200-gallon mixer and a 300-gallon vertical mixer. Thiokol said that with the additions, Redstone Division is capable of developing motors of any size required by the Army.

# Metals Men Discuss Changing Needs

***Meteorite penetration hazard is a major problem area; speakers agree on need for space probes with materials tests***

**by John F. Judge**

CINCINNATI—High temperatures, meteorite protection, radiation and vacuum problems were the major topics of discussion at the Tri-Chapter Meeting of the American Society for Metals held here April 27-28.

There was strong sentiment at the gathering in favor of scheduling as soon as possible some space probes including experiments with materials.

Four hundred metals men heard various key experts in all phases of rocketry define their current and future material needs and, in most cases, the expected sources of improved or new materials.

Kurt Stehling, National Aeronautics and Space Administration, began the sessions with a description of the expected problems in the overall civilian space program. The NASA scientist indicated that funding is increasing in this area and, as more and more space penetrations are made, constant changes emerge in problem definition in materials.

Stehling mentioned a growing awareness of the necessity for protection from meteorite penetration, as did several of the other speakers.

• **Solid limitations**—Another session revealed that large solid rockets can be ruled out of heavy payload systems simply because of the long lead time involved in the development of nozzles.

Specifically covering launching systems, Dr. William Harris, Executive Director, Materials Advisory Board, National Academy of Sciences, said the potential in large liquid engines is much greater from a materials standpoint.

In the solid motor case area, Dr. Harris said the future of reinforced plastics appeared promising but that not enough work is being done.

The high-temperature metal coming to the forefront is tungsten, according to the scientist, but its lifetime may be measured in months, as was its predecessor, molybdenum, in this fast-moving field.

• **Trouble at top**—Typically, Dr. Harris finds that some of the materials problem lies in administration. He called for less dissipation of research and development knowledge and programs and more concentrated efforts—small groups capable of processing and fabricating these materials.

The money being spent in this vast area is sufficient—it is the management that leaves something to be desired. Coordination among the Atomic Energy Commission, National Aeronautics and Space Administration and the Department of Defense is poor when it comes to materials problems.

• **The environment**—In space itself, many problems that have preoccupied science in the past may prove to be phantoms—while others yet undiscovered may take their place.

Dr. John C. Simons of the National Research Corp. outlined the materials problems created by the environment of space. He said that many investigative efforts can be conducted in environmental testing on earth—but, as Lockheed's Dr. M. A. Steinburg also pointed out later, some space probes involving experiments with materials will have to be undertaken—and soon.

Simons divided the effects of space into non-destructive, or reversible, where the material acts as an intermediate, and destructive, or irreversible, change.

Among the former is the absence of a conducting medium, the possibility of a charge since the body is isolated, secondary or induced radioactivity, and the radiation disturbances of solid-state devices.

The well-known destructive elements include material evaporation, fatigue, creep rupture, instrument failure due to temperature gradients, erosion and sputtering.

Steinburg outlined a materials space probe consisting of an oriented cube, which could provide a great deal of surface information. In addition, he said, it's hoped that in-flight bearing tests concerning lubrication and bearing torques will be put into effect this year.

The Lockheed scientist pointed out that the synergistic effect of space is not known to any great extent. The only way is to probe with the proper instrumentation. This has not been done to a satisfying degree as yet.

• **Energy conversion**—Dr. Clarence Zener, Director of the Westinghouse Research Laboratories, guided the metals men through the mazes of direct energy conversion systems whose efficiency could be improved with new or better materials.

He said that although many of the problems are unique to metallurgy, it has been chemists who have led the pack in developments.

This is regrettable, he said, because the field of energy conversion is suffering from a lack of the type of background peculiar to metallurgists.

Nuclear space power systems were described in terms of materials needs by Robert Brooks, G.E. Flight Propulsion Department. Improvements in the alkaline metal-refractory alloys relationship must be forthcoming if nuclear power is to be a reality in space.

Brooks anticipated wide use of beryllium in radiators. He mentioned that no reliable method of welding stainless steel and columbium alloys has yet been perfected for reactors.

Russ Edwards of G.E.'s Flight Propulsion Department aptly summed up the materials requirements in electric propulsion by stating that all that is needed is a refractory metal very similar to sponge rubber—to absorb energy without loss and/or for use as an electrode in ion engine systems.

• **Polaris cases**—After a brief description of the utter simplicity of solid rockets, William Cohen, Chief Civilian Engineer, *Polaris* Propulsion System, presented a graphic outline of the state of the art in solid motor cases—at least as far as the *Polaris* program is concerned.

Most of the cases in the *Polaris* are of the roll-and-weld variety which means, according to Cohen, that this aged method of fabrication has incorporated some of the highest quality techniques and inspection methods known to the metalworking industries. Cohen had no answer to offer in the

weld grinding controversy which rages among manufacturers. Briefly, it is a pro and con argument as to the efficacy of grinding weld marks to overall surface smoothness. Cohen says both acceptable cases have been produced with and without grinding.

Hydrospinning, which involves the forming of cases from forged rings, eliminates longitudinal welds and some of the peripheral ones. Cohen again remained objective in his description of this process but did add that a few rings had been rolled and welded before spinning.

Cohen also mentioned that attempts are being made to manufacture cases from strip steel by winding—and binding with either resins or spot welds. Highly difficult to weld, a strip steel cylinder presents some problems in successfully attaching the closures.

Another mild ripple among case manufacturers concerns surface decarburization. According to Cohen, some say it is desirable and do it and others say it might be desirable but how do you control it and do not do it. 6434, H-11, D6A and Tricent are the major steels being used in the *Polaris* program. Cohen anticipates that in about a year, a proven motor case will come out of one of the above, heat treated to the 240,000 to 250,000 psi range.

• **X-15 demands**—A rapid summation of the materials involved in the *X-15* experimental vehicles began with Wayne Reinsch, Materials and Process Engineering supervisor for North American Aviation, concentrating on structural metals.

Maximum speed of Mach 7, metal temperatures up to 1200°F during re-entry and the containment of large quantities of LOX and ammonia determine the general materials requirements of the vehicles.

Iconel X is the main structural material for this design. In the advanced *X-15*, where speeds up to 25,000 ft. per second and temperatures up to 5000°F will be encountered, leading edges will be of a ceramic material, supporting wing structure is designed for molybdenum or columbium alloys and the fuselage design calls for a nickel based alloy. Where temperatures exceed 1500°F, molybdenum or columbium alloys will be used.

• **More re-entry**—Material considerations in re-entry in general were developed by William Pellini, Superintendent of the Metallurgy Division of the Naval Research Laboratory. Two main divisions are possible—lift vehicles and drag vehicles. There is also a combination of both.

Lift vehicles in particular were treated by Wilfred Dukes, Chief of Structures, Aero-Space Department, Bell Aircraft. The critical areas as far as materials are concerned are the lower surface, the leading edge and the fuselage nose.

Refractory materials with radiation cooling will be used in the leading edge applications. Molybdenum and graphite programs are in full swing in this area says Dukes. But even the most refractory materials are of questionable value in the fuselage nose. If the nose is small enough, some sort of heat sink can be employed. The remainder of the airframe will involve the use of insulated and cooled structures.

## Solar Cell Weight/Power Ratings May be Cut by NRC

Solar energy conversion units with weight/power ratings of 16 lbs. per kilowatt may be the result of a unique photo-emission technique under investigation by National Research Corp.

Present conversion methods using silicon cells weigh up to 400 lbs. per kilowatt.

In addition, the cost of the new method appears to be competitive because of mechanical simplicity and inexpensive materials.

The theoretical conception of the principle of operation originated with Prof. Thomas Gold of Cornell University, an NRC consultant. Small-scale laboratory demonstrations have been successful.

## Hardened Missile Site Parts Testing Expands

Silo shock testing programs, involving one of the largest sand drop towers on the West Coast, are in operation at American Laboratories Division, American Electronics, Inc.

The new drop tower is part of seven different types of test facilities—capable of meeting the requirements of MIL-S-4456, Jan-254, MIL-C-19500A and MIL-A-8421.

The firm's large horizontal shock tower is being modified to test assemblies of 50,000 pounds or more against Zone C requirements of the Air Force's Lowry, Larson and Ellsworth bases.

Rigid shock specifications have been written into these sites because they must remain operational through near-hits by thermonuclear devices. Pumps, valves, regulators and welded structures may be tested, and abnormal requirements such as square wave and saw tooth inputs can be handled.

## *Solar Mirror Squint*

**EMPLOYE OF Ryan Aeronautical Co. peers into a solar mirror, cast from plastic for Ryan's advanced research in solar energy and radar dish concentrators.**

# The ITP Approach: Improve–Then Buy

Extremely high reliability and confidence can be built into an entire space program at less than current costs by applying a systems engineering concept to the testing techniques involved.

Robert H. Hover, Reliability Research Specialist at the Missile Division of North American Aviation, has evolved such a process based on extending established designed experiments to encompass entire programs.

The Integrated Test Program, as it is called by its author, has two objectives: to increase the rate of reliability improvement, and to provide a measure of reliability amenable to direct testing.

Two proposals for advanced weapon systems made by the Missile Division to the Air Force included the Integrated Test Program.

• **Improve—then buy**—If a conventional reliability program is plotted on a reliability vs. calendar scale, a growth similar to a curve designated "Buy, then improve" will be demonstrated. In the ITP, the curve becomes "Improve, then buy" and a rapid growth in reliability is apparent.

Essentially, the customer delays buying until the device is almost matured. This means the "Buying date" may be later than that in the conventional program but the "Useful date" should be significantly earlier. The earlier useful date will result because the supplier will provide a larger portion of the reliability improvement before delivery to the contractor.

In a conventional program the measure of reliability is characterized by Hover as a Poisson distribution—mean-time-between-failures. This function is actually untestable until late in the program; there is some doubt as to its value outside of certain limits. Hover says such a program emphasizes operation to failure.

In the ITP, Hover says, "parameters such as flow, voltage, and pressure are measured in terms of variance about a mean value and, through a testable time, a wearout curve is established so that degradation of this variance can be extrapolated for longer periods." Since a statement of variance can be expressed in terms of probability of success, the measure of reliability is explicit. Thus the program emphasizes successful operation of equipment because an analysis of variance and regression is the purpose of designed experiments.

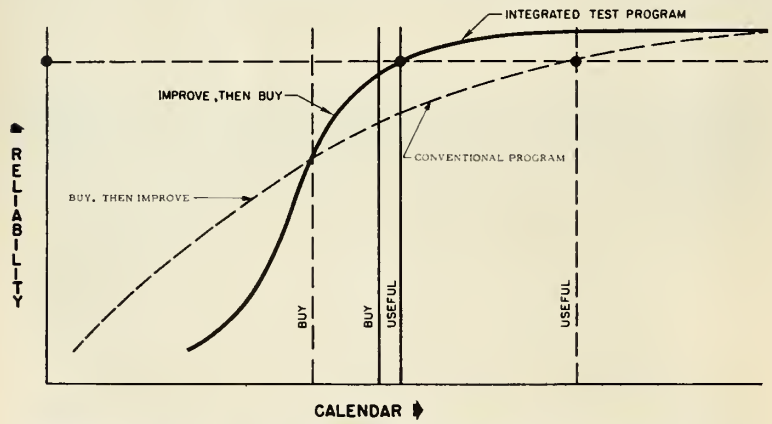
• **Level isolation**—According to Hover, the reason for testing components, systems, combined systems and articles is to isolate the peculiar effects of each level. System testing involves the interaction of components and not the testing of components themselves. The capabilities of each component should be known. Progressively, in combined systems, the interaction of systems, not the particular system, is the testing object. At this point, Hover says, the terms involved should be satellite, booster or missile and not system or component.

The article level means satellite-booster combinations with all the ground support and logistics included. Hover states that this obvious order of testing can seldom be accomplished in a "Buy, then improve" program because it is not known how good, or poor, the components are.

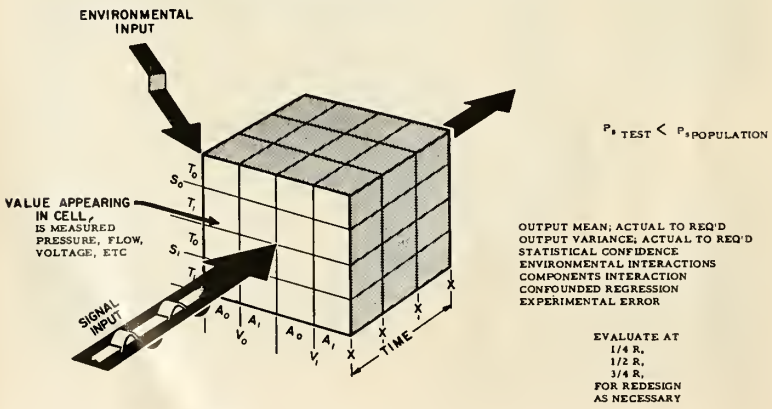
In a component factorial design, the force exerted is composed of input signal and environmental effects. Knowledge of the output signal is the object, during or after exposure to the environmental forces.

Using a 16-cell design, Hover can subject the component to a variety of environments as the component passes through the test. The results may be evaluated after ¼, ½ or full replicate.

***Reliability Growth***




***Component Factorial Design***



(A replicate is the filling of all cells in a particular order.)

Following through, it can be seen that if the results after a ¼ replicate are not up to snuff, redesign is indicated. The results are simply the observation of a specific variance about a mean value while the test items are exposed to the four environments singly and in combinations.

• **Acquired information**—According to Hover, if the redesigned component passes a full replicate, the following develops:

• Probability of successful operation within parameter limits can be stated with statistical confidence.

• The influencing environments are discovered.

• Information about component variation is known because 16 components had to be made to successfully pass the factorial test.

Any number of environments greater than two can be utilized. Fractional replicates can be employed to limit total testing but with limitations on information about specific higher order environmental interactions.

In systems and combined systems factorial tests, a minimum number of systems are utilized to reduce cost. For example, four systems are run eight times each with four different environmental inputs, for a specified duration. Then the same statements as were made in the component tests apply. The environmental treatments imposed here would nearly simulate the actual progression of usage through handling, preflight, boost, and—if necessary—the closest simulation of an actual orbital state.

Hover includes an off-design test in this stage to verify that the system is actually operable within the limits set forth in the analysis.

• **Few items**—The number of test items may not be as large as expected from a comparison with conventional programs. In the ITP, all of the items and input-output signals are statistically coordinated. This is not true with conventional approaches. Test progression can be stated in terms of fractional replicates—involving a single record and not a multiplicity of data. Redesign can be applied sooner, thus increasing the number of successful tests within a shorter time.

Hover explains the associated engineering areas by defining in terms of a component and stating that the application can be effectively applied to systems and higher levels.

In planning tests, test equipment and simulated environments, the skills of test engineers, statistical mathematicians, dynamicists and designers are all involved in the factorial design. One or two unfilled cells can be accommo-

dated in the ITP to allow for inability to conduct certain multiple combination tests. Operator error is reduced by clear and established procedures and involvement of operator technicians in original generation of the test plan.

• **Fabrication**—Besides engineering, component fabrication represents the beginning of a continuing production of components; the question of quality control must be handled to insure repeatibility. Hover says a survey of suppliers would be based on their ability to conduct the outlined component test plan. Contracts would be on an incentive basis and would provide for redesign before buying. Reliability has always begun with the originator of a component—the ITP merely integrates tests with the originator so that there is a continuation of check points in a manner most applicable to earlier determination of overall reliability.

Hover says the organizational effect of the ITP would begin with the contractor's engineering teams establishing specifications through coordination at each level. This would assure compatibility of inputs and outputs, compatibility of tests at various levels, proper utilization of test equipment, and a continuity of procedures.

The rate of change in reliability is such that by the time a full replicate is completed, a component is through the major improvement phase. This corresponds to the "Buy" point.

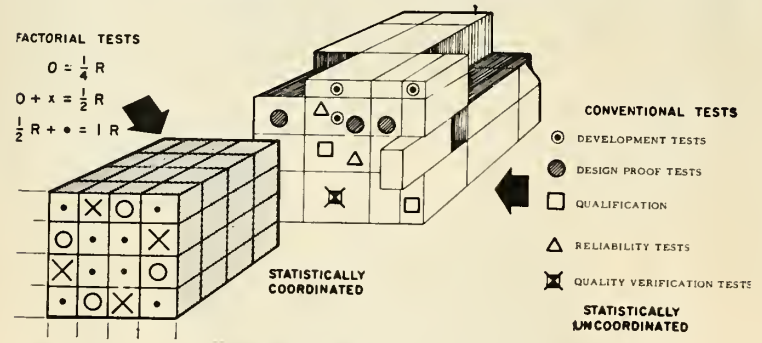
During production, each component, after proper order replicate tests, is diverted to systems, combined systems, articles, etc., for additional improvement information. This information would revert to the component producer and be incorporated at that time. Occasional production components that do not closely duplicate preceding values in the factorial cell are, by definition, failures—and are excluded from delivery.

Because the component improvement is over the hump before "Buy," the remaining improvements are associated with the user's operation. Hover expects that the "Useful time" then will be very close to the "Buy" time.

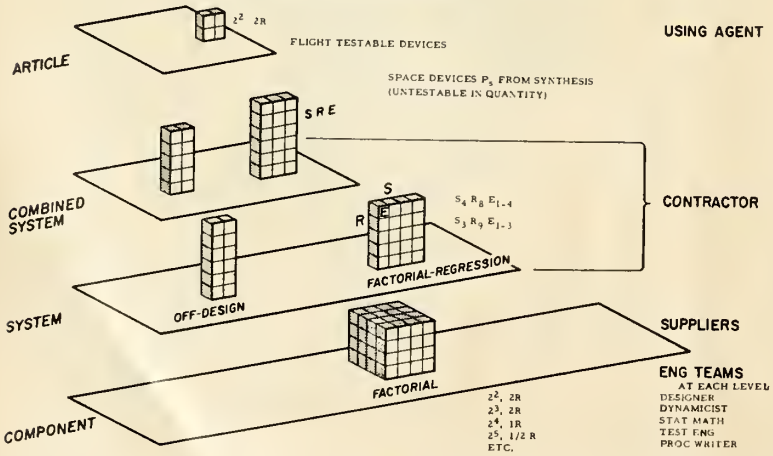
Considering both development and production programs, the total cost of the Integrated Test Program of reliability should be less than that of conventional reliability measures.

If the environment is unknown or cannot be simulated on earth, the ITP provides a high probability-high confidence statement based on the environments that can be measured. Uncertainty as to unknowns can be considerably narrowed.

***Simplification of Test Nomenclature***




***Test Plan Schematic***




## Gallium Phosphide Crystals Zone-Melted at Bell Labs

Transparent gallium phosphide crystals are being grown at Bell Telephone Laboratories—for the first time allowing visual observations of the effects of varying conditions of doping and electron density.

The knowledge gained from such studies should be applicable to other members of semiconductor materials in the III and V groups of the periodic table. Some of these such as gallium arsenide and indium antimonide have shown promise in point contact and Esaki diodes.

C. J. Frosch and M. Gershenzon prepared the pure single crystals through the floating zone technique. Gallium phosphide decomposes at temperatures just below its melting point unless held under gaseous phosphorous at high pressures. The molten zone is contained within a sealed quartz tube which is in turn enclosed in a steel pressure chamber equipped with viewing ports. Because of the tendency of the walls of the quartz tube to fog over at low temperatures, the entire tube must be held at over 950°C.

Small crystals have been grown by vapor reaction methods using gallium suboxide and phosphorous gas. These crystals show a whisker form or habit and are usually n-type semiconductors —although they can be doped p-type.

## Tenney Increases Price On Environmental Chambers

A 7.5% increase in the price of environmental test chambers produced by Tenney Engineering, Inc., Union, N. J., went into effect the first of this month.

Vice President Robert H. Brown blamed the increase on the rising cost of materials and the extreme degree of simulation necessary due to space research. The price change will affect both catalogue and custom items.

Brown said that outstanding quotations would be honored according to the terms of the bid.

# SECOR System Will Aid Army Mapping

by Richard van Osten

SAN DIEGO—Future *Transit* satellites will help the Army select "pinpoint" base points for survey and mapping teams.

The Corps of Engineers has signed a contract with the Cubic Corp. San Diego, Calif., for an electronic system which can locate sites on the earth's surface to within 90 ft. over a reference range of 4000 miles.

Portions of the system, named SECOR (SEquential COllation of Range), will be delivered within the next few weeks. Full-scale operation in conjunction with the Navy-sponsored *Transit* navigation satellite will probably not get under way until early 1961.

Basic components of Cubic's SECOR consist of four ground tracking stations and a satellite-borne transponder. Four of the latter are called for in the Army's contract, but only one per satellite is required in the SECOR system. The present transponder is in two versions.

Three SECOR stations, housed in air-transportable shelters, will be set up at Seattle, Salt Lake City, and somewhere in Southern California. The fourth station will be at an unknown point to be surveyed.

In operation, the three stations measure range between ground points and a 5-lb. transponder in the satellite. The satellite ephemeris is computed by the three stations at known locations. Fourth station position is then computed by measuring the station's range to the satellite at several known points of the vehicle's orbit.

• **Heart of system**—SECOR was originally developed by Cubic for the Air Force as a velocity and distance-measuring system for IRBM and ICBM guidance system evaluation. Heart of SECOR is distance-measuring equipment (DME) located in at least three stations which, in turn, are so located as to provide optimum measurements in areas of interest.

Each DME station measures a target's velocity and slant range. This enables the target to be located on a hemisphere of known radium and rate of expansion or contraction. Target position in space and true velocity become the intersections of three or more such hemispheres.

### SECOR SPECIFICATIONS

(Geodetic application)

**Range:** 10,000 mi.
**Frequency:** 482-512 mc (nominal)
**Sequencing:** 40 cps, adjustable for optional signaling

#### TRANSMITTING SYSTEM

**Power:** 500 watts
**Frequency:** 512 mc
**Antenna gain:** 20 db
**Modulating signals:** 480.234 kc, 60.029 kc, 7.503 kc, 0.938 kc, 0.0938 kc

#### RECEIVING SYSTEM

**Sensitivity:** 0:05 $\mu v$
**Frequency:** 482 mc
**Antenna gain:** 20 db
**Output:** digital range, analog (dial) range

#### SYSTEM CHARACTERISTICS

**Automatic Ionospheric Refraction:** Correction—double frequency method for positive, real time correction
**Sequencing:** Allows single satellite transponder
**Real Time Centralized Data:** Three methods —land line transmission Retransmission of range-time values through the transponder Addition of phase memory oscillators at all sites and round trip functioning

To determine range, the ground stations transmit an FM signal to the satellite's transponder, which demodulates the signal and retransmits the same modulation on a new carrier. When this carrier is received and demodulated at the ground stations, target range is determined by the round-trip phase shift. A signal coding system permits DME stations in the SECOR chain to interrogate the transponder in turn.

Radial velocity is measured by doppler techniques. Frequency ratio of the ground-to-air and air-to-ground carriers is kept constant by the transponder. The DME is reported capable of measuring range with a resolution of 1.5 ft. and range velocity with a resolution approaching 0.1 ft. per sec.

In the *Transit* application, the Army says, SECOR will not be used for detailed mapping and charting, but will provide specific "bases" for use by survey teams. An important use will probably be for more precise location of missile launching sites in the U.S. as an aid to greater trajectory accuracy.

• **Knapsackable**—Cubic Corp. is reticent to discuss full military possibilities of the SECOR system, but it has been noted that a DME station could be carried as a back pack by one man. If the miniature station could be located, by an air drop or other means, in an enemy target area, a precise target position could be determined. In this application, signals would be transmitted to the satellite, then relayed on to U.S. ground stations.

Initial use of the Armys' portable system, contained in 5000-lb. "packages," is likely in South Pacific areas where there is little accurate knowledge of distances.

Although the SECOR system as slated for Army use with *Transit* involves a geodetic application, the system also has capabilities and applications in cislunar guidance, translunar navigation and other radio-type long-range radio navigation.

## ITT's Star Tracking System Amplifies 2,000,000 Times

An experimental electronic star tracking system for space navigation, developed by International Telephone and Telegraph Corp., uses a photomultiplier tube which transforms a star's optical image into an electrical signal and amplifies it 2,000,000 times.

A similar tube was used in the recent high-altitude observations of Venus which indicated the presence of water vapor on that planet.

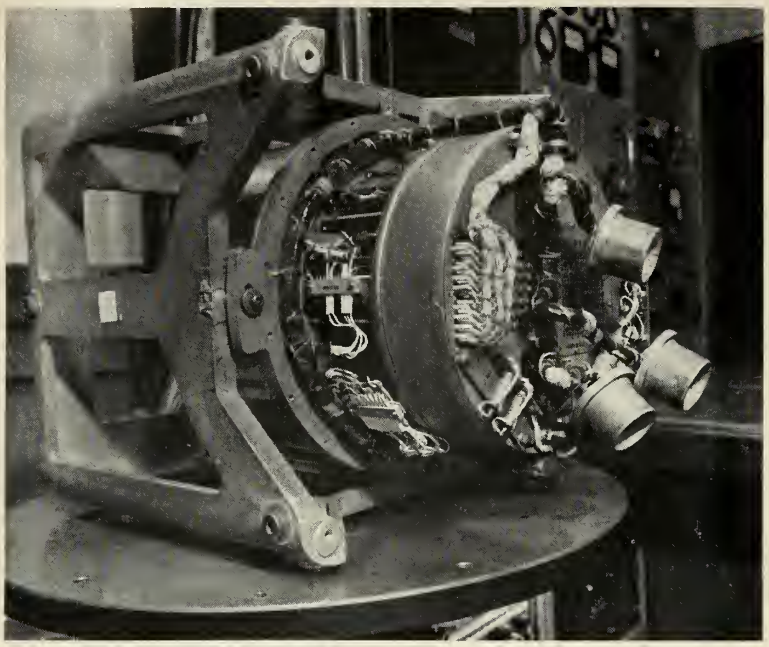
According to ITT, the star tracker can establish star lines to within one-thousandth of a degree for stars of fourth or higher magnitude. It uses magnetic or electrostatic scanning to eliminate undesirable mechanical vibrations of conventional systems.

## New Technique Dramatically Improves Radar Sensitivity

A new high-frequency amplifier tube, used in combination with "synchronous pumping," is credited with spectacular improvement of radar receiver sensitivity. Developed by Zenith Radio, the technique is said to give an MTI radar system an equivalent 50% increase in range or a five-fold boost in transmitter power.

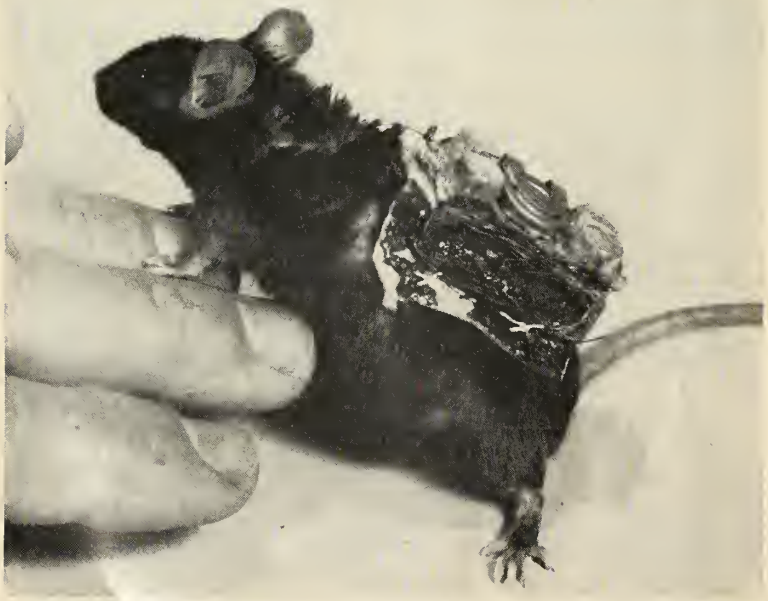
The Zenith electron beam parametric amplifier, described as a "promising newcomer to the vacuum-tube family," provides high signal amplification over a broad frequency band with

## Inertial Guidane for Titan



**TITAN ICBM will be guided on its first two minutes of flight by this reference system built by Minneapolis-Honeywell. The system is an advanced version of the "strap-down" concept—first used on *Vanguard*—in which the gyros are rigidly attached to the missile frame and react according to preset time signals and external guidance commands. The system consists of three integrating gyros, attitude programer, and electronic timer. It provides three-axis reference and roll-and-pitch programing to guide the missile from launch until radio guidance takes control.**

## A Rodent-sized Radio



**RADIO ATTACHED to mouse's back is powered by a tiny mercury battery, weighs less than 20 grams, and was developed by the USAF School of Aviation Medicine to transmit data on the mouse's physical activities from a bio-satellite in space to earth receiving stations.**

extreme stability and very low noise.

Recent tests of the equipment at RADC reportedly confirmed the expected benefits of the synchronous pumping technique. Sensitivity improvement, however, was not as good as the 7db figure expected, probably because of a "noisy" antenna used in the tests.

According to Zenith, the experiments definitely disproved a widely held belief that performance of paramps was inevitably impaired by noise picked up by the idler channel and dumped into the signal channel of the amplifier tube.

## Tube vs. Transistor Fact Book Published by Council

A new fact book on tubes and transistors has been published by the Electron Tube Information Council. The 64-page book, "Tubes and Transistors: A Comparative Study," will be mailed this week to electronic engineers, purchasing agents in government and industry, and to electronic parts distributors throughout the country.

The new fact book discusses the advantages and limitations of both components, to help equipment manufacturers and design engineers select the most practical device for specific applications.

The Electron Tube Information Council, composed of representatives of CBS Electronics, General Electric, Radio Corporation of America, Raytheon Company, Sylvania, Tung-Sol Electric Inc., and Westinghouse Electric Products, was formed in March, 1959.

## Delco Digital Modules Available for Guidance

Off-the-shelf digital building-block modules for missile guidance and other computer applications has been announced by Delco Radio Division of General Motors.

Modules are available in 10 basic types and 15 variations, each vacuum-encapsulated with epoxy resin. Each module contains up to 35 standard components per cubic inch, averaging more than 50,000 components per cubic foot.

According to Delco, typical applications include computers and digital data systems, digital frequency dividers and frequency standards, telemeter data handling, digital test equipment, timing and pattern generators, logical decision networks, encoding networks, memory test systems, data sampling systems, binary, octal or decimal conversion equipment, data format conversion equipment, counters, shift registers, and adders.

# Navy Set to Fight for Existing ASW Organization

**by Donald E. Perry**

The Navy indicated last week it would fight to the last carrier to keep its present antisubmarine warfare organization as is, even though management has been sharply criticized by the powerful House Appropriations Subcommittee which wants a *Polaris*-type single manager approach.

The Navy "unofficially" took issue with the Mahon committee's findings that "there is no indication of dramatic or dynamic leadership (in ASW)," and that development work should be divorced from control of semi-autonomous bureaus in the Navy Department.

In response to a query by M/R, Navy said it could not comment on the committee's remarks. But it issued an official statement that it considers its present organization "both adequate and appropriate to cope with the ASW problem." Navy added that it considers establishment of a single project office for single management of ASW "not appropriate."

Congress accepted the committee's recommendations last week and passed legislation which adds $321 million to ASW warfare, including $100 million for R&D. Total Navy appropriation for ASW category now amounts to $1.684 billion. The committee had chopped out $293 million for a conventionally-powered aircraft carrier, and approved funds for three, instead of two, nuclear-powered attack-killer submarines. Whether Navy will use these added ASW funds remain to be seen; it can not divert them to some other Navy purpose.

• **There'll be changes**—The committee did not "direct" the Navy to do anything on management of ASW, but it holds the purse strings, and will be asking next year for answers on its recommendations.

Observers believe that Navy before then will come up with new management plans for ASW, which probably would involve strengthening the role of Rear Adm. Howard A. Yeager, Anti-Submarine Warfare Readiness Executive to the Chief of Naval Operations.

Navy takes the position that ASW is organic to all Navy operations and will not lend itself to a single management procedure, such as applied in the *Polaris* system. Rep. George Mahon (D-Tex.), chairman of the committee, told M/R, however, that "the only one who appears to be in charge is the Secretary of the Navy."

Navy wants ASW to be managed as an integral part of the entire Navy management plan because it feels it is a multitude of weapon systems meeting requirements for all phases of Naval warfare—hunter-killer operations, ocean surveillance and patrol, striking force operations, amphibious warfare, and convoy protection.

• **The split of philosophy**—It takes the stand that it has recognized the complexity and importance of the ASW problem and has superimposed on "its regular and well-proved management tools a monitoring and coordinating structure."

At the Secretarial level there is an ASW committee which reviews and decides upon major issues of policy. In the CNO level, Admiral Yeager acts, the Navy said, as "assistant to the President for ASW matters." Navy also established in 1959 a Deputy Chief of Naval Operations (Development) to coordinate all research and development in the Navy, including ASW. Coordinators for ASW matters also were established within each of the technical bureaus—Ships, Weapons, ONR.

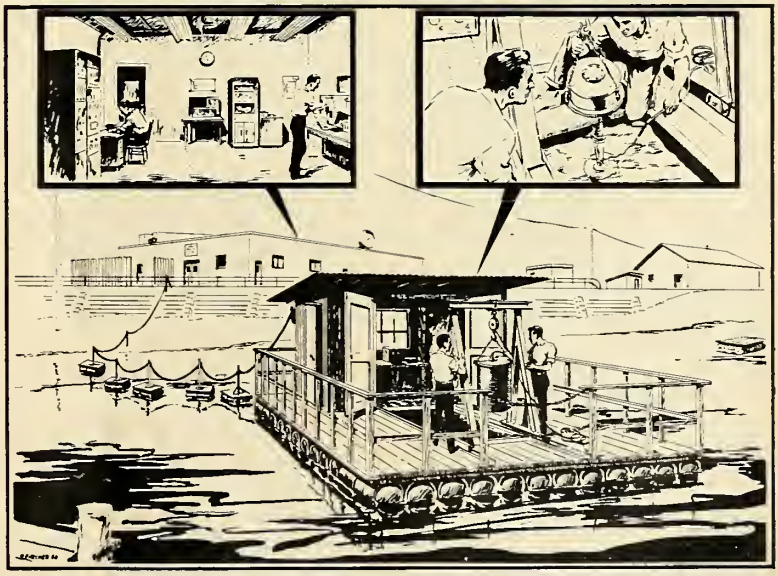
Basically the House subcommittee feels that while the Navy may have coordination between bureaus, a single manager system is still needed. Some quarters in the Navy, on the other hand, maintain that Special Projects Offices are not solutions, and if one were established for ASW, the next move could be one for Mine Warfare and ad infinitum.

## Sperry Simulates Sea in Backyard

"Indicative of the importance that we attach to ASW, some 700 engineers in five corporation divisions are involved in antisubmarine warfare work," a Sperry Rand official disclosed last week. "More than 60% of these engineers' activities are oriented towards system development."

To provide a laboratory for such developments, Sperry Gyroscope Division, Great Neck, N.Y., is completing work on a simulated "sea" in the company's backyard. The test basin is 400 ft. long, 200 ft. wide and 25 ft. deep. It is part of the company's ASW Laboratory to be used for evaluating and developing undersea devices.

The "shore facility" is getting an elaborate array of testing consoles, including a 14-channel hi-fi tape recorder which will be transmitting, and in some cases, recording sounds of sea life.



**MAIN ILLUSTRATION shows Sperry Gyroscope barge floating in backyard basin used for testing and developing ASW equipment. This 17 by 29 ft. craft will be used as a mount for underwater detection devices, while the floats going from the barge will be used to carry communications channels, linking barge with test laboratory. At upper right is a rotary mechanism used for turning a transducer that will be searching for the sounds of subs. Upper left shows the console room in the shore facility.**

*sacred cow treatment . . .*

# Is U.S. Kidding Itself about R&D?

## *Rand expert says dollar figures give misleading idea of real expansion, calls for new classifications*

The United States may be dangerously deluding itself by judging the progress of its research and development programs on a basis of how many dollars are spent on all kinds of R&D.

David Novick, Chief, Cost Analysis Dept., The Rand Corp., says ". . . there is seemingly a blind belief that by doing more research we will outrun our international competitors in the military race or, on the commercial side, make larger and larger profits."

Since billions are being spent on both private and governmental R&D, Novick says, it is time some answer was found to the question of how the money is being spent. "Are we really spending more dollars in essential R&D approaches, or are we merely reclassifying traditional areas?"

The Rand cost expert says he was unable to accurately measure the growth of R&D since 1930 primarily because of the ambiguity of the terms "research" and "development." The demarcation line between development and production is a thin and elusive one, and is often drawn in terms of company or federal policy. Some of this growth is probably due to the new respectability which R&D has attained.

• **Statistical mess**—According to Novick, accounting shifts and blown up "Big Deal" figures are used in an effort to make a research project look more important than it really is.

Then there are conflicting definitions in industry. In the aircraft business, R&D depends on the position of the Department of Defense—costs tend to be classified according to availability of funds in the defense category.

Uncle Sam does the same thing. For example, the cost of the 1960 Census was figured as part of the overall R&D dollar in the federal budget. While the census is an important research function, it is substantially different from any other kinds of research, says Novick, and this feeds fuel to the confusion.

Novick says that we are not ahead of the Russians in production techniques—and we do not hold a significant lead in basic research. The lead times in both countries are about the same. If the Russians are ahead of us in getting the final product, it is simply because they:

• Probably have a more direct approach—more emphasis on early application.

• Are more willing to gamble either on reduced cost or on final performance.

• Seem to freeze design for production and make fewer changes once a decision has been made toward operational use.

• Have continuity in program and personnel in complete systems, components or basic research.

Our handling of nuclear fission, from discovery to bomb, is a classic example of our method of seeking assurance before commitment and then proceeding in a start-stop-stop-start manner.

• **Rand method**—Novick suggests a classification based upon four steps in research and development.

1. Basic or experimental R&D—"Brave New World" type of research where the promise is great but not identified to specific purpose and the possibility of fulfillment is highly uncertain.

2. Applied research, advanced development, basic evaluation and testing—application identified, economy and efficiency uncertain. Promise still high.

3. Product development, testing, evaluation, pilot production—specific devices or methods appear as likely solutions but must be brought reasonably close to final application to determine effectiveness and economy.

4. Product application research, applied testing and evaluation—some success assured because this is evolutionary rather than revolutionary. New uses and applications or modifications of existing uses or applications are sought for existing methods.

Novick estimates that the $10 billion spent on R&D in 1959 might be broken down per area into $100 million for 1, $300 million for 2, $2.6 billion for 3 and $6 billion for 4.

It is obvious that the fundamental object of classical R&D, that of gathering new knowledge, takes approximately 1% of the total R&D figure.

Our present-day assumption that all research contributes to the nation's general welfare confuses the object of research—new knowledge. Under this naive definition, such things as marketing research and other similar projects fit into the scheme—while some basic research activities of real significance may be excluded.

Novick says that the great expansion of R&D cannot be completely attributed to statistical delusion. Price changes in salaries, equipment costs and the value of the dollar over the last 20 years have a significant effect on the supposed expansion. Using this, Novick finds that there was a twenty-five-to-thirty-fold increase in real terms—instead of the sixty-fold expansion derived from dollar figures.

Furthermore, in terms of scientists and engineers directly involved in research, the growth is even slower—roughly twice the number of people in 1952 as in 1941.

• **$$ no measure**—Money is a difficult yardstick. In some cases, substantial basic research can involve a blackboard, a piece of chalk and a brain. Novick says the most fair appraisal of the present rising trend in R&D expenditures is that it is going up because we think it should be going up. How much of it represents needed or even desired contributions cannot be determined until more effective identification and accounting practices are developed.

• **Scientific impetus**—The four major factors in U.S. scientific expansion in the last 50 years, according to Novick, were—World War I, World War II, the Cold War and the mass transplanting of European scientists. Whether or not these provide sufficient basis to accomplish what is needed, possible and valuable for our survival and well-being is not clear.

Novick says he wonders how allocation of R&D funds can be made in the face of all of the currently existing uncertainties. Furthermore, he questions the sufficiency of research aimed at the long-range future—beyond currently identifiable products and methods.

Treating research as a fashionable sacred cow, concludes Novick, may be destroying its effective contribution to national survival.

# Saturn Cluster Can Burn Far Longer

**by Frank G. McGuire**

LOS ANGELES—Concern over melting the flame detector caused an early termination of the first static test of the full eight-engine *Saturn* cluster, the Army revealed last week.

William A. Mrazek, Director of the Structures and Mechanics Laboratory, Army Ballistic Missile Agency, said the cluster could have been burned much longer than the actual eight seconds of the April 29 test.

(It was learned in Washington that the programed goal of 1.32 million lbs. thrust was achieved. When fully loaded, the *Saturn* booster will be capable of burning at that thrust level for 115 seconds.)

Mrazek told the annual meeting of the Aviation/Space Writers Association here that the huge booster is expected to be tested in mid-1961. The first two-stage test will take place in 1962. After several three-stage tests in 1963, the C-1 early model of *Saturn* will become operational in 1964.

• **Composition**—The C-1 will consist of the eight-engine cluster as booster stage, a second stage Douglas S-4 consisting of four 20,000-lb.-thrust Pratt & Whitney hydrogen-oxygen engines, and a modified Convair *Centaur* as third stage consisting of two P&W hydrogen-oxygen engines.

The booster will stand 82 ft. from the exhaust nozzle to the top of the transition section, and will be 21½ ft. in diameter. The S-4 will be 220 in. in diameter. The modified *Centaur* will be 120 in. in diameter.

The booster consists of nine propellant tanks, five for liquid oxygen and four for RP-1 fuel. The 105 in. diameter center tank will contain LOX, and be surrounded by the other eight 70 in. diameter tanks.

All tanks are connected to provide equalization of liquid levels during loading and flight. The total mainstage propellant capacity is 750,000 lbs., but it is not necessary to utilize the total capacity if the mission does not require it.

Tanks are secured to an eight-legged "spider beam" at the top of the booster, and an eight-legged thrust frame assembly at the bottom, to which the engines are mounted.

The four inner engines in the two-square pattern are rigidly mounted in a 3° cant. The outer four, canted at 6°, can be gimballed ±7° for first stage control during flight.

The manifold propellant flow and pressurization system, plus an adequate malfunction detection system, give *Saturn* the capability of completing its mission, even if one engine fails and must be shut down, even at lift-off.

• **Saturn C-2**—The 185-ft. *C-1* configuration will be followed by the *C-2* model, which would use the same basic *Saturn* booster, or a modification thereof, with new upper stages.

A new second stage under consideration would develop about 400,000 lbs. thrust and use two hydrogen/oxygen generating 200,000 lbs. thrust apiece. The four-stage *C-2* would be 230 ft. tall.

Nuclear stages are also being contemplated for future versions of the vehicle.

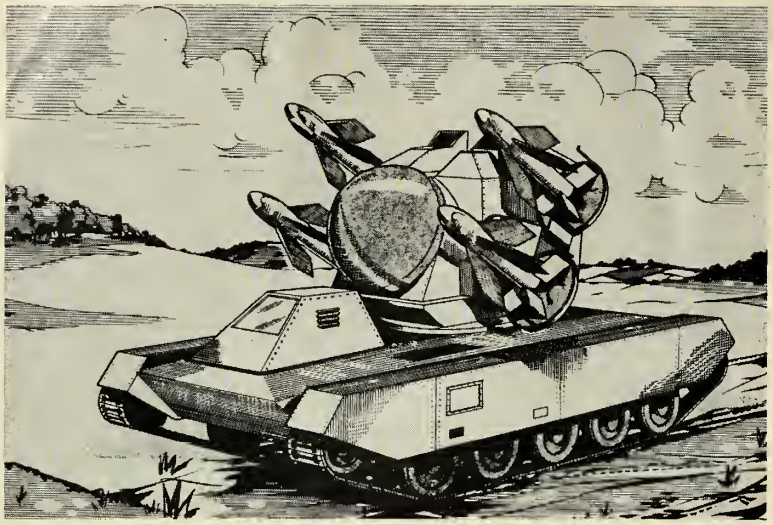
Payload capabilities for *C-2* would be drastically greater than the *C-1* model. *C-1* could place about 20,000 pounds in a 100-mile orbit, 4500 pounds in a 22,700-mile orbit, and over one ton soft-landed on the moon.

A three-stage *C-2* could double each of these payload figures, and the addition of a fourth stage would triple the 24-hour orbit (22,700 miles) and soft lunar landing capabilities.

A nuclear stage, of appropriate size, would have a high-payload, low-orbit capability and be able to put seven tons in a soft lunar landing.

Each of these figures could be increased by a factor of ten or more if orbital refueling were utilized.

The *Saturn* transporter for overland moving of the vehicle is unique in that the frame of the booster serves as the main carriage of the transporter. The assembled booster and its support cradle are jacked up as a unit, and two wheel/axle assemblies installed.



# British Reveal Tigercat

Prototype models of the *Tigercat* —land version of the surface-to-air *Seacat*—reportedly have been fired successfully by British Army personnel.

No design details of the new missile have been disclosed. However, it is to be mounted upon an armored vehicle (see drawing) to include radar and targeting equipment in a self-contained unit. Like its sea-going brother, the *Tigercat* will be solid-fueled, just under 5 ft. long and with a maximum fin span of 2 ft. It would be deployed with forward units for tactical air defense. Manufacturer is Short Brothers & Harland Ltd., Belfast, Northern Ireland. *Seacats* are now deployed aboard four Hampshire-type naval vessels. They have been ordered by Sweden, Australia and New Zealand.

## British Study Sharing Blue Streak

LONDON—Great Britain may offer the controversial *Blue Streak* to European and Commonwealth nations for a major joint space venture.

Minister of Aviation Duncan Sandys said at a recent House of Commons meeting that the Government had the idea "under study." At the same meeting a Labor Party motion to censure the Government for delaying the cancellation of the *Blue Streak* weapon system was defeated by a 302 to 225 vote. Labor had contended that the Government had wasted money on the rocket.

Although Conservative leaders Sandys and Harold Watkinson, Minister of Defence, stressed that the Government intended to maintain an independent nuclear deterrent program, the opposition did not seem to be convinced.

Sandys admitted that the Government has tried for a long time to find a substitute for the *Blue Streak*. Indications are that it will be the U.S. *Skybolt*. Sandys said that the decision to cancel *Blue Streak* could not have come sooner because of U.S. security restrictions on release of missiles to other countries.

*Skybolt* would presumably be chosen for military purposes to replace *Blue Streak* because it can be launched from an aircraft outside the range of enemy defenses. *Blue Streak* must be fired from fixed sites, and Britain's small size makes wide dispersion impossible.

## AGARD Committee to Meet On Radio Wave Absorption

PARIS—Athens will be the site of the next meeting of the Ionospheric Research Committee of the NATO Advisory Group for Aeronautical Research and Development (AGARD), June 20-23. The Committee will discuss Ionospheric Research concerned with "Radio Wave Absorption."

Participating scientists will include Prof. Ratcliffe, Cambridge University, (England); Mr. Finn Lied, Director of the Norwegian Defense Research Establishment (Norway); M. Nicolet, Director of the Centre National de Recherches de l'Espace (Belgium); and Prof. Vassy, of the Faculté des Sciences, Université de Paris (France).

Invited papers will cover the following areas:

Studies of Absorption, Ionization and Absorption in Ionospheric D and E regions, Measurements by Artificial Satellites, Correlation of Ionospheric Disturbances with Solar Flares, Polar Cap and Auroral Absorptions.

Although attendance is unclassified, authorization to attend must be procured from either the AGARD National Delegates or by Members of the AGARD Avionics Panel.

## Canadian Space Societies Move Nearer a Merger

MONTREAL—A move to establish a central astronautical organization for the study of space sciences is under way in Canada.

Two major astronautical societies have led the move. The Guided Missile Division of the De Havilland Aircraft Corporation of Canada, operating as the Canadian Astronautical Society, and the Astronautical Society of Canada already plan a common official publication in the near future. The two groups have approximately the same number of members—over two hundred—and share a vote in the International Astronautical Federation, each voting on alternate years.

Other Canadian societies being contacted include the Astronautics Section of the Canadian Aeronautical Institute, the Prince Rupert Astronautical Society, the Calgary Student Amateur Rocket and Missile Club, the Acadia Amateur Rocket Society, and the McGill Rocket Society.

## Woomera Tracking Range Has Outstanding Record

LONDON—The Woomera tracking range in Australia has maintained over the past two years a measurement of position to an accuracy of within 20 seconds of arc, according to a statement released by A. S. Hulme, Australian Minister of Supply.

The base, also cited by NASA as the best-maintained of the ten existing Minitrack stations, was the first of the world's 12 optical stations to photograph the tracks of four satellites: *Atlas* (1958), *Vanguard II* (1959), the paddlewheel *Explorer VI* (1959), and *Explorer VII* (1959). It took the only

picture of *Discoverer VII* and obtained a good picture of the 6-in.-diam. *Vanguard I* at a distance of 2500 miles and *Explorer VI* at 14,500 miles.

In the latter six months of 1959, Woomera tracked 435 passages of satellites in the southern hemisphere photographically, 657 electronically, and received telemetry information on 717 occasions.

## British Offer Germans Use of Hebridean Range

LONDON—The British Ministry of Defence has officially offered training facilities at the South Uist rocket range in the Hebrides to the NATO organization—an offer in which West Germany has expressed considerable interest.

No application has yet been made by Bonn for the range. A spokesman for the British Ministry is reported as commenting on the uselessness of equipping West German forces with rockets without proper training in their use. Present training is concerned primarily with the use of the U.S. *Corporal* missile.

## British Outline Plans For Three Symposia

LONDON—Three important symposia on problems of rocketry and outer space travel are planned in England during coming months.

On Sept. 1, 1960, a group of papers on aspects of rocket and satellite instrumentation will be presented at a meeting jointly sponsored by the British Interplanetary Society and the Society of Instrument Technology at Manson House, London. They will include:

**The British Satellite Programme,** by M. O. Robbins.

**A Design Study on a Communication Satellite,** by B. V. Somes-Charlton.

**An Analyser for Rocket Recording,** by Dr. W. R. Beakley.

**Transducers for Motor Testing,** by W. R. Dean.

**An Experiment to be Carried Out in a British Satellite,** by Dr. A. P. Willmore.

**The Measurement, Transmission and Recording of Data in the *Skylark*,** by Dr. E. Dorling.

Space navigation on the moon will be the subject of a meeting jointly planned by the BIS and the Institute of Navigation for Nov. 18. Dr. Herrick, an American guest speaker, will give the opening paper.

A two-day symposium on rocket propulsion, organized by BIS, the College of Aeronautics and the Royal Aeronautical Society will take place at the College of Aeronautics, Cranfield, Jan. 6-7, 1961.

# soviet affairs

**By DR. ALBERT PARRY**

### Radiation and magnetic field research

was rewarded recently by Russia's highest prize committee. Four Soviet scientists were given the Lenin Prize, Moscow's equivalent of the Nobel Prize, for "discovery and investigation of the outer-space radiation of the Earth, and investigation of the Earth's and the Moon's magnetic field." The date of the awards, April 22, was chosen because it marked the 90th anniversary of the birth of Vladimir Lenin, the founder of the Soviet state.

### The prize winners

are: Sergei N. Vernov, a corresponding member of the Soviet Academy of Sciences, and Alexander E. Chudakov, a doctor of the physics-mathematical sciences, both on the staff of the Academy's Lebedev Physics Institute; Nicholas V. Pushkov, director of the Academy's Institute of Earth Magnetism, Ionosphere, and Radio-Waves; and Shmaya S. Dolginov, chief of the Magnetic Laboratory of the same Institute. The honor carries with it a considerable sum of money for each man. The importance of the work of Vernov's group in official Soviet estimation may be judged from the fact that their names top the list of all the Lenin Prize winners.

### No mention of Dr. James Van Allen

of Iowa State University, or his discoveries of the radiation belts now bearing his name, was contained in the official Moscow announcement. The four Russians' achievement was represented as the first and only one in the field. Vernov himself was a little more generous to Van Allen. In an interview in *Komsomolskaya Pravda* he said, among other things: "Until the first Soviet artificial satellites of the Earth appeared in the sky, scientists generally did not know there were around us the so-called belts of radiation, that is, an enormous number of particles with speeds approximating the speed of light. Our *Sputniks'* signals permitted us, first, to discover these belts; secondly, to make our initial steps toward our study of them." He then briefly added: "We must not fail to mention in this connection also the work of our American colleagues, Dr. Van Allen and his collaborators, who have made a large contribution toward the solution of this problem."

### The American share

in the study of cosmic radiation, when referred to by Soviet writers and speakers, is acknowledged not as leading but always as merely paralleling the Soviet effort in the field. And when Van Allen's role is discussed at all by the Russians, it is mostly in statements by Soviet scientists and hardly ever by Soviet bureaucrats. Typical is the omission of Van Allen's name in an article in *Izvestia* of April 22 by V. Yelyutin, minister of higher and secondary specialized education of the USSR and vice-chairman of the Lenin Prize Committee. In his praise of Vernov and his group for "the creation of methods and instruments to investigate" radiation and magnetism in outer space and for "processing and theoretical interpretation of the data received," the minister says not a word about Van Allen's pioneer work. On the other hand, Academician A. Severny, who heads the Crimean Observatory, mentions Van Allen along with Vernov in an article on "The Physics of the Sun" in *Yuny Tekhnik* for March, 1960. In fact, his mention of the American's contribution is contained in the very first paragraph of the article.

### But even in such statements

by Russian scientists, there is no concession of priority to Dr. Van Allen. In Severny's article, Van Allen is mentioned *after* Vernov. The hidden feeling of inferiority still gnaws at the Russians. Despite their great progress in so many fields, they must claim priority in everything, at whatever cost to objectivity.

# Advisors Gather at M/R Dinner

The second annual dinner for members of MISSILES & ROCKETS' advisory Board and Contributing Editors was held in Washington April 25.

Preceding the dinner was a reception at the home of Wayne W. Parrish, President of American Aviation Publications, Inc.

Members of the Advisory Board present were Dr. Peter Castruccio, Director of the Astronautics Institute of the Westinghouse Corp.; Conrad H. Hoeppner, Chief Scientist of Radiation, Inc.; Robert P. Haviland of General Electric's Missile and Space Vehicle Dept.; and Vice Admiral Harry Sanders (Ret.) Director, ASW Engineering, Chance Vought Aircraft.

Contributing Editors of M/R present were Heyward Canney of NASA, James J. Haggerty of Aerospace Industries Association, and Dr. I. M. Levitt of the Franklin Institute.

Distinguished guests at the reception and dinner in addition to those pictured here included Dr. Herbert York, Assistant Secretary of Defense for Research and Engineering; Dr. Joseph V. Charyk, Under Secretary of the Air Force; and Rear Admiral William F. Raborn, Director, Navy Special Projects.

**Doug Larsen of General Dynamics Corp. chats with Fred Archibald of General Motors Corp.**

**Charles LaFond, M/R Associate Editor, listens to James D. Secrest of the Electronics Industries Association.**

**Together in the Parrish garden are Leonard Eiserer, Executive Vice President and General Manager of AAP; Warren Smith of Fairchild, aerospace writer Jim Haggerty (back to camera), Phil Drotning of Phil Drotning and Associates, and Maj. Gen. Lucas B. Beau (Ret.) of Consolidated Diesel.**

**Jim Haggerty and Leonard Eiserer have a chat by the Parrish pond.**

**Gen. Beau talks with Maj. Gen. William W. Quinn, Army Chief of Information, and Joseph M. Rowland, Martin Co.**

**Conrad E. Hoeppner of Radiation Inc., talks to Dr. Peter Castruccio of Westinghouse and Vice Admiral Harry Sanders (Ret.) of Chance Vought.**

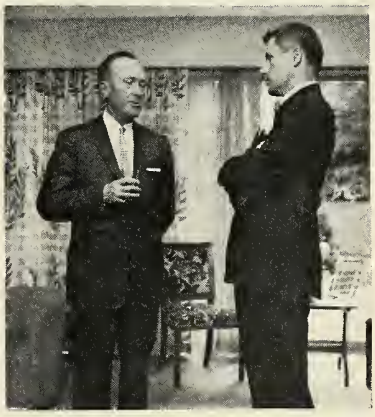
J. E. Hadley of the Bendix Aviation Corp. and Mr. Parrish.

EIA's President David Hull of Raytheon chats with EIA's Mr. Secrest.

Walt Brown, Advertising Sales Manager of M/R converses with Kim Hallamore of Hallamore Electronics and T. S. Pendergast of Jack & Heintz.

Burt English of AIA chats with Homer Joe Stewart, Director of NASA's Program and Planning Evaluation Office; Bill Beller, Associate Editor of M/R, and Ernie Stout of The Ralph M. Parsons Co.

T. S. Pendergast shares a story with Walt Brown.



Rohert P. Haviland of General Electric talks to Hal Gettings, Associate Editor of M/R.

Edward D. Muhlfeld, Puhlisher of M/R, and Mr. Parrish greet Don Chadwick as Clarke Newlon, Executive Editor of M/R, gets ready to greet the next guest.

Heyward Canney of NASA and John Judge, Associate Editor of M/R, listen to James D. Secrest.

Patio talk among E. R. Field of Gilfillan Corp., William J. Coughlin, chief of M/R's West Coast Bureau, Don Chadwick and Charles LaFond.

# ABMA Sets Up R&D Group To Replace Transferred DOP

Army Ballistic Missile Agency is establishing a Research and Development Division at Huntsville to replace the Development Operations Division scheduled for transfer to NASA on July 1. The new division will have cognizance over all Army missile and rocket programs, with an estimated budget for Fiscal Year 1961 of more than $261 million.

Dr. Arthur Rudolph, present *Redstone* and *Pershing* project director, will be director of the new division. Lt. Col. Lee B. James will be deputy and John McDaniel technical director.

Directors of the division's six laboratories announced to date: Gerhard Reisig, Research; Charles Hussey, Analysis and Preliminary Design; Holm Hinrichs, Propulsion; Kurt Lindner, Guidance-Control and Aeroballistics; Lewis Gober, Systems Design and Development; William Grafton, Test, Evaluation, and Firing.

Project officers selected for the various Army missile programs: Carl A. Pinyerd, *Pershing;* Robert Whitley, *Jupiter, Redstone, Sergeant, Corporal* and *Nike-Zeus* target missile; William Rotenberry, *Honest John, Little John, Missiles A* and *B;* Alfred Finzel, Special Weapons, *LAW* (Light Anti-tank Weapon) and Small Rockets.

Approximately 1000 scientific, technical, and administrative personnel will staff the division's laboratories, project offices, and supporting groups when it becomes operational in July. Division management is reportedly interviewing applicants for key positions still unfilled.

## Pioneer V Switched to Big Transmitter by Command

*Pioneer V's* large 150-watt transmitter was turned on Sunday, May 8, while the satellite was streaming through space 8.3 million miles from earth. The sun-orbiting payload has now traveled about 100 million miles through space and has picked up valuable information about solar radiation.

NASA earlier predicted that the transfer would not take place until after May 15. (See M/R, May 9.)

The command signal was sent from the 250-ft. radio telescope at Manchester, England. The probe responded with its first 150-watt transmission one and a half minutes later.

Transferring from the five- to the 150-watt transmitter required a three-step sequence. Early Saturday a signal was sent to the payload putting power into tube filaments through a current-limiting resistor. Later the first step was repeated and a second command removed the current-limiting resistor and supplied full filament heating for several minutes. The final signal energized the 150-watt transmitter as well as the electric signal serving it.

The larger transmitter will allow the 60-ft. parabolic dish at South Point, Hawaii, to command *Pioneer V* at the rate of one bit per second, and Jodrell Bank to command it at 8 or 64 bits per second.

The Jodrell Bank telescope is capable of tracking *Pioneer V* for a distance of 50 to 100 million miles from earth.

## Astronauts Will get Hot Meals by Pushing Button

Astronauts while circling the earth will be able to press a button and within the hour get their food presented piping hot, says REF Manufacturing Corp., Mineola, N.Y.

The company quotes the Air Force as believing that "astronaut morale and efficiency will be improved by warm food," and that "heating food to at least 150°F insures destruction of potentially harmful bacteria."

During a recent AF project set up to test survival devices designed for manned space capsules, a subject was sealed in a capsule for seven days. Included in his equipment was a small (14 x 14 x 4 in. deep) REF food warmer which was used to heat strained turkey, mashed potatoes and other food, which were contained in plastic squeeze tubes. Warmed by three resistance-heating elements in the oven, the food was taken to 170°F in little over an hour.

A more exotic food warmer being proposed by REF for outer space missions would use solar energy as a heat source. A magnesium "window" would let solar radiations into an insulated oven, and slides on the window would regulate the unit's temperature.

## Congressmen Urge Outside Selection of Rover Chief

Four members of the Joint Congressional Committee on Atomic Energy have stepped into the controversy over Project *Rover* with a proposal that a boss be chosen from outside NASA and the AEC.

The four have asked AEC Chairman John A. McCone and NASA Administrator T. Keith Glennan to clear any such choice with them. Late last week, it was reported that they had received no reply. Rep. Carl T. Durham (D-NC), committee vice-chairman, heads the group. The others are Reps. Chet Holifield (D-Calif.), Melvin Price (D-Ill.) and James E. Van Sandt (R-Pa.).

## *Doubling Dose of Sidewinder*

**ADDED STING will be given Navy's Chance Vought F8U-2N Crusader, now to carry four instead of two GE-Philco air-to-air *Sidewinders*. Doubling up, approved by Navy, is possible through use of new pylon which will hold brace of birds.**

# contracts

## NAVY

**The Garrett Corp.'s AiResearch Manufacturing Division, Los Angeles, has been awarded a contract by Bendix Aviation, Inc.'s Pacific Division to supply a highly compact, lightweight auxiliary power unit for the *Eagle* missile. Amount not disclosed.**

**$600,000—P.I. Steel Corp., Los Angeles, for construction of three buildings at the *Polaris* missile base at Point Mugu.**

**$435,000—Dorne & Margolin, Inc., Westbury, N.Y., for airborne antennas and related electronic systems. Subcontract from Grumman Aircraft Engineering Corp.**

## AIR FORCE

**$2,676,000—Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., for system engineer and payload and test contractor on high-altitude rocket-space program known as Hyper-Environmental Test System 609A.**

**$1,454,703—Bendix Aviation Corp., Teterboro, N.J., for the *Titan* AN/GJQ-9 programing set with spare parts and ground support equipment.**

**$894,781—Bechtel Corp., Los Angeles, for architectural and engineering services in connection with the *Atlas* silo launching program (three contracts).**

**$365,180—International Business Machines, New York City, for SAGE data processing equipment.**

**$300,000—Yardney Electric Corp., Los Angeles, for fabrication of Silvercel silver-zinc batteries for the *Minuteman*.**

**$223,750—General Motors Corp., AC Spark Plug Division, Flint, Mich., for supplies and services to operate distribution and storage depot for guidance subsystem of Sm-75.**

**$140,000—CompuDyne Corp., Hatboro, Pa., for instrumentation and control modifications in the operational propellant-loading system of six *Atlas* bases.**

## ARMY

**$6,307,649—General Dynamics Corp., Convair Div., Pomona, Calif., for continued development of the *Redeye* missile.**

**$5,320,224—Emerson Electric Manufacturing Co., St. Louis, for *Honest John* repairs.**

**$1,500,000—The Martin Co., Orlando, for *Lacrosse* missile test equipment.**

**$1,500,000—Minneapolis-Honeywell Regulator Co., Hopkins, Minn., for continuation of a classified project.**

**$880,000—Chrysler Corp., Detroit, for work on a hypersonic ballistic target missile system.**

**$525,572—Chrysler Corp., Detroit, for maintenance support of the *Jupiter* system.**

**$124,011—Ray M. Lee Co., Atlanta, for construction of *Saturn* loading and unloading facility at Redstone Arsenal.**

**$79,000—Cornell Aeronautical Laboratory, Inc., Buffalo, for wind tunnel testing on contractor furnished models of the *Pershing*.**

**$58,000—New York University, for basic research entitled "Atom Beam Scattering Studies."**

# reviews

**GRAPHICAL REPRESENTATION OF REENTRY TRANSFER ORBITS,** L. E. Wolaver, for WADC. Order PB 151938 from OTS, U.S. Dept. of Commerce, Washington 25, D.C. 72 pp., $2.

To analyze the circular orbit of a typical satellite rotating in a vacuum above Earth's spherical orbit, two parameters were studied: the eccentricity *(e)* and semilatus rectum *(p)*.

Graphs consisting of modified Vertregt diagrams of both direct and apogee routes show loci of reentry angle and velocity retrothrust required, its angle and target lead angle when the thrust is applied, time and range to impact, and the final target-satellite angle upon impact.

Various curves are superimposed upon each other to derive formulae for minimal retrothrust and resultant time to impact at a safe reentry angle. Equations are developed to measure the same criteria with increased retrothrust.

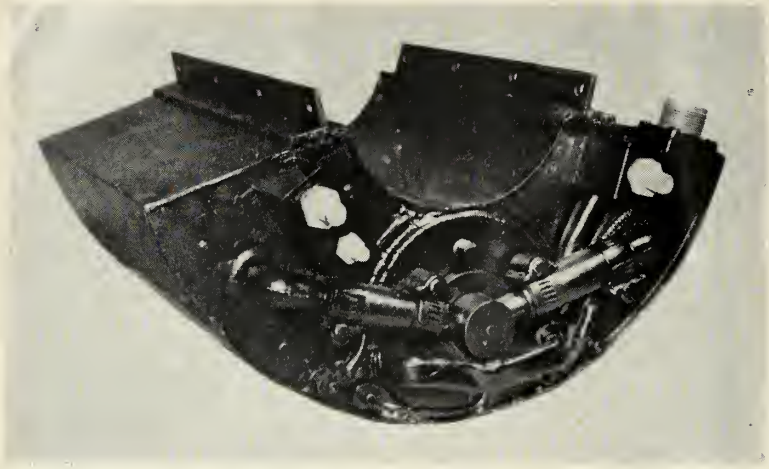
**THE PHOTOGRAPHIC EXPOSURE TIME FOR ASTRONOMICAL PICTURES,** R. K. H. Gebel, Aeronautical Research Lab. for WADC. Order PB 151939 from OTS, U.S. Dept. of Commerce, Washington 25, D.C. $.50.

The report contains studies on the minimal number of quanta necessary to secure a recognizable image of a star on photosensitive film. Wave lengths of sunlight were analyzed and allowances were made for absorption and dispersion of light in the atmosphere.

**SYSTEMS PRELIMINARY DESIGN,** part of Grayson Merrill's "Principles of Guided Missile Design" series, Joseph J. Jerger, Van Nostrand, New York, 625 pp., $14.75.

This text is intended to be a unifying volume in the "Guided Missile Design" series by bringing together for systems analysis the various technologies that go into making a guided missile. For this purpose and also for the added one of preliminary design, the author includes chapters on reliability theory, servomechanisms analysis, heat transfer, static and dynamic stability of aerodynamic and space vehicles, and missiles structures. Also, an analysis of the kinematics of homing, beam riding, and command guidance types of missile-target combinations is included for purposes of getting work equations and data for establishing missile and system design requirements.

The author does succeed in giving the reader a valuable handbook for early design work. He safely and rightly stays away from the more sophisticated problems that come in later design work and that often are unique to the problem at hand.



## Curved Battery Fits Missile Skin

A circular segment-shaped silver-zinc battery for use in missile auxiliary power supplies has been developed by Cook Batteries.

The Model P13A battery is designed as a main power supply for missile electronic equipment and instruments, guidance and control systems, telemetry equipment and warhead arming. The 40 dry charged cells in this primary (one-shot) unit are automatically activated by an electrically ignited solid propellant gas generator. The battery may be installed, activated and operated in any position.

Duplicate ignition circuits provide protection against open or shorted wires. The unit is equipped with thermostatically controlled electric heaters to maintain proper operating temperatures. The container is hermetically sealed against leakage, evaporation or contamination.

The P13A produces an output of 11 kw. Current rating is from 180 amps to 1000 plus, with a maximum of 3700 amps. The capacity of the 56 battery is 7.5 ampere-hours, with a discharge (shorting) time of 2.5 min.

The activation signal required is 115 at 4 amp. The battery takes only 0.5 seconds to reach the specified voltage after application of the activation signal. The unit will withstand environmental extremes of temperature from −65°F to ±220°F. It is resistant to vibration forces of 3 g's, shock acceleration to 60 g's. It meets requirements of MIL-E-5272A.

The battery weighs 24.6 lbs. and has a circular segment shape which is designed to fit snugly into the missile's exterior skin. It has 12.3 in. outside diameter by 146°, and is 11.7 in. long. Displacement is 1200 cu. in.

The P13A is completely inert during a storage period of up to five years. It contains no vacuum or pressure storage components and requires no periodic charging or maintenance of any kind prior to actual use.

**Circle No. 225 on Subscriber Service Card.**

## Water Submersion Actuator

A salt water actuator that automatically inflates escape capsule and nose cone flotation bags when submerged is being marketed by the Walter Kidde & Company.

The salt water, acting as an electrolyte in the actuator, completes a circuit—firing a cartridge or explosive squib to open a passage in a valve on the compressed gas container. The released gas, such as carbon dioxide, flows through tubing to inflate the bag.

Circuit voltage can be either AC or DC. Typical is a 24 to 28 volt DC source which will pass a minimum of 8 amperes through the actuator when immersed in a 3 per cent by weight salt water solution. Time to energize circuit upon submersion—1 second or less; weight of actuator—0.3 lb.; envelope dimensions (inches)—4-15/32 x 1-13/32 x 1-13/32.

**Circle No. 226 on Subscriber Service Card.**

## Gas Density Switch

A high temperature, sub-miniature Gas Density Switch, capable of operating in temperatures up to 400°F has been added to the product line of Newark Controls Co.

The switches are designed for use under high shock, vibration and acceleration. The RM-76 is available in actuating pressure ranges of .0026 to .0060 lb. mols/cu. ft. These switches are operable within a temperature range of −45°F to 400°F, and have an accuracy of ±0.5 psi from −85°F to 185°F and 1.5 psi from 185°F to 400°F.

These switches are capable of signaling leakage of insulating gases from closed packages where normal gas pressure varies with temperature; signaling when equipment has been filled to the proper molecular gas density during production or field maintenance. They are also used to detect purposeful discharge applicable to gas filled containers. However, the switch must be at the same temperature as the gas being sensed. The RM-76 actuates along any pressure-temperature line of an ideal gas from 10 psia at −85°F to 55 psia at +400°F.

Weighing less than 1.8 oz. and measuring 1-27/32″ in length and 7/8″ in diameter, RM-76 meets stringent environmental specifications including MIL-E-5272.

**Circle No. 227 on Subscriber Service Card.**

## Continuous Mix Cooler

A heating and cooling unit, developed especially for continuous mixers employed in compounding plastics or processing other materials, where accurate temperature control is a must, has been developed by the Chemical Machinery Division of Baker Perkins Inc.

Presently adapted for the 4-inch size Ko-Kneader type continuous mixer produced by the company, the unit controls temperatures to within ±2°, regardless of the mixer area involved.

Its function is to heat or cool pressurized water which is circulated through the jackets of the mixer and also an extruder, if one is employed. It will control the batch temperature in the mixer and extruder even if it is necessary to add heat in some zones and remove it in others.

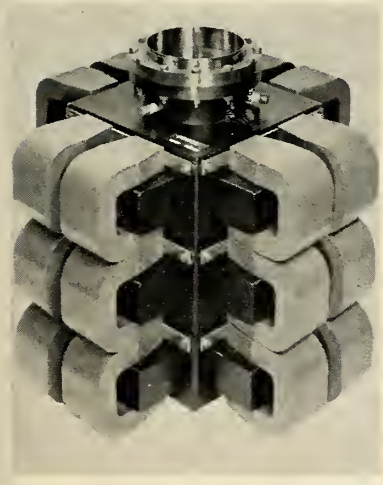
The versatility of the unit is such that if more heat is required without any cooling requirement, the cooling bundle can be used as an additional heater. With slight modification, according to the company, the same unit may be used with heat transfer oil as the circulating medium. This would provide a maximum medium temperature of 600°F, or a total heat to the batch from both circuits of 60,000 Btu per hour.

**Circle No. 228 on Subscriber Service Card.**

## Electronic Vacuum Pump

Designed for systems requiring clean, oil-free vacuums, a new high capacity, ultra-high vacuum pump with no moving parts is now being offered by Ultek Corp. The new pump uses neither fluids nor other contaminants, and achieves a vacuum below 1 x $10^{-9}$ mm Hg.

The pump, the UlteVac 327,



achieves its vacuum by utilizing a cold-cathode discharge in a magnetic field to remove gas molecules and atoms from circulation by the formation of chemically stable compounds and ion burial.

Invulnerable to power failure, the pump is designed for exceptionally long life through the exclusive use of compact, all metal couplings with rotatable flanges, and rugged, unitized, internal structures to eliminate virtual leaks. The pump is designed to draw current in a linear relationship with pressure, permitting it to double as a vacuum gauge.

**Circle No. 229 on Subscriber Service Card.**

## Induction Melting Unit

The latest in compact, self contained power and control units for high-frequency induction melting and heating has been developed by Inductotherm Corp.

The Integral 100 is a 100 kilowatt motor-generator powered unit and the console measures 72" wide x 35" deep x 66" high, housing the entire power supply, capacitors, control and safety devices necessary to operate one or two high-frequency induction furnaces or coils.

The unit contains an 8-step auto transformer and 30 steps of capacitance values for maximum flexibility in meeting any heating or melting requirement.

Installation requires only a 60-cycle, 440 volt power connection, a cold water connection and a water drain. One or two coils or furnaces with capacities up to 500 lbs. may easily be connected directly to the Integral 100 by means of Inducto water cooled leads that contain conductors inside the water-bearing hoses.

**Circle No. 230 on Subscriber Service Card.**

## Digital Scanning Meters

Transistorized, digital capacity meters for automatically scanning large numbers of capacitors and measuring their capacitance and dissipation factors has been developed by Electro Instruments, Inc. The analog parameters are converted to their digital equivalents, and this data is presented in both visual and 10-line decimal contact closure form.

Important features of the new meter include transistorized design, capacities from 10 mmfd to 999.9 mfd, dissipation factor from .001 to .999, accuracy from 1% and ± 1 digit and automatic and manual ranging.

**Circle No. 231 on Subscriber Service Card.**

## Strike Camera Tester

The quality and reliability of radar film recordings made with radar strike cameras is assured when the cameras have been pretested with the LM-56A Radar Recording Camera Test Set. The LM-56A performs four basic functional tests which completely check shutter, film movement, and control operations of five different radar recording cameras and their related controls.

Designed and built by Mast Development Company, Inc., the LM-56A is primarily for the bench testing of the O-15, O-23, KS-30 (formerly O-20), KS-31 (formerly O-30) and KS-32 (formerly O-32) cameras. The LM-56A is also used for testing the M-1 and M-2 Control Systems and the LD-6 Exposure Frequency Control.

The four basic test phases are

facilitated by a series of mechanical-optical displays.

Phase I provides a simulated sweep display which is photographed by the camera being tested to check the shutter operation and to check film shift.

Phase II, similar to Phase 1, also involves photographing a display with the camera being tested. The resulting exposures are of a graduated, circular scale with a superimposed light path created by a rotating light spot. The exposures can be read directly to determine the "shutter open" and "shutter closed" time periods with a .001 of a second accuracy.

Phase III utilizes a display of stationary lights to simulate an optical "bombsight." The display is photographed, and the exposed film is inspected to check camera accuracy for alternate photographing of a radar scope display and the target simultaneously viewed through a bombsight.

Phase IV provides electrical pulses which are used to check camera controls. It also provides a means for visually checking camera shutter operation and for checking camera range lights.

**Circle No. 232 on Subscriber Service Card.**

## Magnetic Particle Sprays

Magnetic particle inspection materials are now available in pressurized spray cans and plastic squeeze-bottles, produced by Magnaflux Corp. These materials can be used with any of the magnetic particle inspection equipment or test kits already in operation throughout industry.

The ready-to-use Magnaflux-Magnaglo materials eliminate previous bulky containers, and the problems of mixing to formula, or filling application devices, and reduce set-up time to inspect complex parts. The sealed dispensers keep out dust, moisture, and other contamination during storage.

The No. 14M Fluorescent Magnaglo Bath and No. 9BM Magnaflux Bath are offered in 12 oz. pressure spray cans. The No. 1 Gray Powder is now available in plastic squeeze-bottle dispensers, each containing one full pound of magnetic particles. Perforated top is designed for even powder dispersion with easy hand squeeze.

**Circle No. 233 on Subscriber Service Card.**

## High Loss Foam Blocks

High loss, low weight ceramic foam block, useful in constructing VHF high power loads, is being marketed by Emerson & Cuming, Inc. Suitable designed loads made with the Eccosorb WG are capable of average power dissipation in excess of 2000 watts without forced air or water cooling. Operating temperatures up to 1000°F are possible without permanent deterioration.

Each block has holes drilled through it so that a large surface area is available for heat dissipation. Supplied in blocks 10″ x 15″ x 3″, weighing less than 3 lbs., Eccosorb WG has a useful frequency range from below 100 mc to about 1000 mc.

**Circle No. 234 on Subscriber Service Card.**

## Universal Ear Plugs

A universal size silicone rubber ear plug is being marketed by Sigma Engineering Co. to protect personnel against the growing noise problem in missile work.

Unusually durable, pliable, non-toxic, non-allergenic, resistant to ear wax and skin oils, COM-FIT ear plugs may be boiled and sterilized to make them interchangeable amongst the wearers. They are made with a triple flange to guarantee complete sealing of the ear canal.

Independent laboratory tests proved white noise attenuation of these ear plugs equalled 36.3 decibels. The frequency versus attenuation charts indicated a maximum attenuation of 63 decibels at the frequency of 4000 cycles per second with equally impressive attenuation at various other levels.

**Circle No. 235 on Subscriber Service Card.**

## Quartz Load Cell

A 510 Quartz Load Cell, featuring high capacity, excellent repeatability, and utmost rigidity, in a small package, has just been introduced by Kistler Instrument Corp. for measuring rocket engine thrust.

Measuring less than ¾″ diameter by ¾″ long, the 510 deflects less than .001 inch under a rated maximum load of 5000 lbs. One-hundredth of a pound variation in load can be measured at any level from 0 to 5000 lbs.

Static pressure signals, caused by loads existing before a measurement, can be eliminated by momentarily grounding the signal lead. Basically designed for compression forces, the 501 will measure very small tension forces because of a preload on the crystal. With a special tension adaptor it can be converted readily for measuring large tension forces.

**Circle No. 236 on Subscriber Service Card.**

# new literature

ENCODERS. A 12-page brochure "Shaft Position Digital Encoders With Magnetic Readout" is available from the ASCOP Division of Electro-Mechanical Research, Inc. The literature gives complete specifications for the company's 13-bit, 8-bit, and incremental encoders. In addition, operating principle of the new type of magnetic readout is described in detail with illustrations. Recommended simplified transistor circuity is given for interrogation playback, detection, and amplification of the new magnetic encoders. A conversion table is included for conversion from binary code to decimal or Gray codes.

**Circle No. 200 on Subscriber Service Card.**

FLIGHT LABORATORY SERVICES. A 16-page illustrated color brochure describing full services for testing airborne equipment quantitatively and qualitatively in flight is available from the RCA Flight Laboratory, Radio Corporation of America. Services include flight-test instrumentation, data reduction and analysis, and aircraft installation, maintenance and modification.

**Circle No. 201 on Subscriber Service Card.**

BUILDING BLOCKS AND DIGITAL SYSTEMS. A folder which features a quick-reference table showing all 85 Digital Equipment Corp. building blocks and 22 accessory units by type and price. Units are arranged by type —patchcord interconnecting Digital test equipment and plug-in system building blocks—and by speed—500 kilocycle, 5 megacycle, and 10 megacycle. The folder also describes Digital's computers—Programed Data Processors 1 and 3—and DEC Memory Testers which are built from the company's standard line of logic modules.

**Circle No. 202 on Subscriber Service Card.**

NGINEERS:

# A NEW CONCEPT IN PROFESSIONAL JOB SELECTION

*New technical tests enable you to calculate your probability for success at LMED – in 1 hour at your own home!*

BY GENERAL ELECTRIC'S LIGHT MILITARY ELECTRONICS DEPARTMENT

**If you've been thinking of changing your job some day—or in the near future—but have hesitated because of the many uncertainties involved, Light Military's new concept in professional job selection will be of paramount interest to you.**

### What is it?

The new concept is based on a series of technical tests developed and pretested by Light Military engineers. They are designed to be taken, scored and evaluated by the individual engineer, all in the privacy of his own home. And, because the sole purpose is to provide you with a novel, objective means for self-appraisal, your score need not be divulged to us at any time.

### Here's how it works:

First, fill out the coupon below and check off the tests which apply to your training and professional experience. Forward the completed coupon to us and in a few days you will receive the tests, a sealed answer sheet and explanatory material.

During a convenient hour at home, take the test and score it with the answer sheet provided. Then, compare your performance with the criterion group composed of Light Military engineers at all levels who took the same test. In most cases you will be able to relate your score to years of experience, from 2 to more than 10.

### What it measures:

If your adjusted score is equal to, or more than the years of experience you possess, the probability is excellent that a significant community of technical interest exists between you and The Light Military Department. In addition, a valid assumption can be made that a high probability for success awaits you here. And remember, your score need not be divulged to us at any time; it is for your own guidance exclusively!

### CURRENT AREAS OF ACTIVITY AT THE LIGHT MILITARY DEPT.

SPACE COMMUNICATIONS & TELEMETRY • MISSILE & SATELLITE COMPUTERS • SPACE VEHICLE GUIDANCE • UNDERSEA WARFARE SYSTEMS • THERMOPLASTIC DATA STORAGE • SPACE DETECTION & SURVEILLANCE • COMMAND GUIDANCE & INSTRUMENTATION • INFRARED MISSILE APPLICATIONS

## Facts about the tests

1. Each technical test is composed of 40 multiple choice questions.
2. To find answers for some questions, mathematics is involved—but only to the degree normally associated with the work.
3. The "mix" of questions includes some easy ones, some bordering on the state of the art.
4. None of our engineers achieved a perfect score.
5. The test for Engineering Administration is psychological, designed to reveal aptitudes and abilities most often found in good engineering managers or administrators.

## MAIL THIS COUPON FOR YOUR TESTS

Mr. R. Bach
Light Military Electronics Dept.
General Electric Company, French Road, Utica, New York

*Please send me tests (limited to 2 subjects per individual) answer and self-evaluation sheets covering the areas checked:*

☐ RADAR ☐ MICROWAVE ☐ ELECTRONIC PACKAGING (ME)
☐ COMMUNICATIONS ☐ ADMINISTRATIVE ENGINEERING

NAME _____

HOME ADDRESS _____ HOME PHONE _____

CITY _____ ZONE _____ STATE _____

DEGREE(S) _____ YEAR(S) RECEIVED _____

73-WT

LMED

LIGHT MILITARY ELECTRONICS DEPARTMENT

GENERAL ELECTRIC

# names in the news

**Dr. James M. Carter:** Appointed director of the Physical Science Division of Space Systems Laboratories, where studies will be directed primarily toward the development of advanced systems capable of operation in space. Dr. Carter will also be responsible for coordination of the division's activities with those of the engineering and life sciences division.

**Dr. Marvin Fox:** Nuclear physics scientist, joins Hughes Aircraft Co.'s nuclear electronics laboratory as a senior staff physicist. Was formerly director of the sodium reactors department of Atomics International.

**Dr. David L. Douglas:** Named to the newly created position of manager of fuel cell engineering for General Electric's Aircraft Accessory Turbine Dept. Formerly served as a physical chemist with the firm's Research Laboratory in Schenectady.

**William T. Smither:** Former vice president and manager of the Los Angeles division of Servomechanisms Inc., promoted to the position of general manager of the corporation, responsible for directing overall operations.

**Charles W. Curtis:** Named manager of the newly-formed components division of Hughes Aircraft Co., which will develop and market commercial microwave components. Was formerly acting manager of the microwave laboratory.

**Dr. David Van Meter:** Appointed manager and **John W. Gerdes,** assistant manager of the applied science division of Melpar, Inc.'s Watertown, Mass., facility. Dr. Van Meter, who joined the firm in 1955 as supervisor of the electronics and physics laboratory, was formerly chief of the division's technical planning staff.

**Paul F. Pearce:** Formerly manager of project engineering at the Lockheed electronics and avionics division in Los Angeles, named manager, systems design, information technology division in Metuchen, N.J.

**Noah Dietrich:** Elected to the board of directors of Transval Electronics Corp. Currently serves as chairman and director of Houston Fearless Corp. and Tool Research and Engineering Corp.

**Richard L. Hoff:** Reappointed development metallurgist at Superior Tube Co., after serving a one-year term as a senior engineer at Aerojet-General Corp.

**Kenneth A. Waldron:** Named marketing manager for government and industrial products, and **Ira Molay,** product manager-audio components, at CBS Electronics, division of Columbia Broadcasting System, Inc.

**Lloyd C. Flatt:** Project aerodynamicist on assignment at the *Redstone* missile center, named head of Continental Technical Service, Inc.'s newly opened Huntsville, Ala., office.

**Melvin Landau:** Former supervisor of mechanical design for Bogen-Presto Corp., appointed chief mechanical engineer for ESC Corp.

**Simon R. Wagler:** Named corporate marketing manager for American Bosch Arma Corp., directing activities for the Arma division. Prior to joining the firm served as assistant director of contract administration for Reeves Instrument Corp.

**Fordyce E. Tuttle:** Scientific advisor to the general management of Eastman Kodak Co., awarded the Citation of Merit from the U.S. Navy. The unusual peacetime award went to Tuttle for his work as chairman of the Anti-Submarine Warfare Advisory Committee of the National Security Industrial Association.

**Vernon M. Welsh:** Vice president-communications for General Dynamics Corp., resigns to organize his own communication consultation business. Will continue to be associated with the firm on specific projects.

**William F. Schmidt, Jr.:** Former West Coast district sales manager, Electronic Products Division, Vickers, Inc., joins the staff of American Electronics, Inc.'s Precision Power Division in the newly created position of field engineer for rotary and static equipment products.

**William J. Brackmann:** Joins the ASCOP division of Electro-Mechanical Research, Inc., as director of research and engineering. Prior to joining the firm in 1958, he was associated with Norden Laboratories Corp. and its successor, the Norden-Ketay Corp., consecutively as head of the electrical division, assistant director of engineering, assistant director of research and manager of missiles research and engineering.

**E. H. Urquhard:** Named staff sales engineer for Texas Instruments Inc. Geosciences & Instrumentation division's instrumentation product group.

**Dr. Charles F. Gell:** Joins the Astronautics Division of Chance Vought as chief of life sciences. He will head a team of physiologists, psychologists and engineers specializing in extending man's capability in the environment of space.

**Ronald G. Davis:** Formerly a design engineer with the electronics division of Curtiss-Wright Corp., appointed senior design engineer with International Resistance Co.

**Michael D. Conforti:** Appointed technical service representative in the Chicago area for the Specialty Blower Division of The Torrington Manufacturing Co., providing sales and engineering services for special blower units in aircraft, missile and electronic cooling applications.

**Dr. Elmer L. Zimmerman:** Joins Hughes Aircraft Co.'s nuclear electronics laboratory as head of nuclear circuitry research. Was formerly head of critical experiments units at Atomics International and prior to that at Nuclear Development Associates.

**Norman Van Dine:** Formerly with MacMillan Industrial Corp. and MacMillan Laboratories as assistant sales manager, appointed director of marketing for Adams-Russell Co., Inc., engaged in research, development and manufacture of electronic equipment, antennas, RF systems and components.

**William M. Fautz:** Named chief engineer by Acor Inc., and **Henri de Forrest,** manufacturing manager. Fautz was formerly assistant chief engineer for Viking Industries; de Forrest was owner-manager of Forrest Mfg. Co.

**Fredric F. Kubias:** Elected district sales manager, Western District, for General Electric's Light Military Electronics Dept., with offices in Los Angeles.

**James R. Vine:** Appointed Chief, Computer Applications, a newly-formed group within the engineering department of Beckman Instruments, Inc. Was formerly manager-data processing services, Electrodata Division of Burroughs Corp.

## Advertisers' Index



EMPLOYMENT



### M/R BUSINESS OFFICES


Washington 5, D.C.—1001 Vermont Avenue, NW; STerling 3-5400
Walton E. Brown, Advertising Sales Manager

New York 17, N.Y.—20 East 46 Street; YUkon 6-3900
Paul B. Kinney, Eastern Advertising Manager
Paul N. Anderson
Raymond G. Quirk

Los Angeles, California—8929 Wilshire Blvd.; OLeander 5-9161
James W. Claar, Western Advertising Manager
Charles R. Martz, Jr.

Detroit 2, Michigan—412 Fisher Building; TRinity 5-2555
Kenneth J. Wells

Chicago 2, Illinois—139 N. Clark St.; CEntral 6-5804

Dallas 24, Texas—202 Wynnewood Professional Building
John L. Hathaway

Miami, Florida—208 Almeria Ave., Coral Gables
Richard C. Hager

London, W.I, England—28 Bruton Street; Grosvenor 8356
Norall and Hart

Geneva, Switzerland—10 Rue Grenus; Geneva 321044

Paris, France—11 Rue Condorcet; TRU 15-39


## when and where

### MAY

**New York University Conference, "The Critical Million—How to Talk to the Nation's Scientists and Engineers . . ."** NYU, New York City, May 17.

**ASME Production Engineering Conference,** Shroeder Hotel, Milwaukee, May 17-19.

**Society for Experimental Stress Analysis, 1960 Spring Meeting,** Hotel Severin, Indianapolis, May 18-20.

**Society of American Military Engineers, National Convention,** Washington, D.C., May 19-20.

**National Telemetering Conference, ARS, IAS, ISA and AIEE,** Miramar Hotel, Santa Monica, Calif., May 23-25.

**German Society for Rocket Engineering and Space Flight Research, 12th Annual Meeting,** Heidelberg, West Germany, May 23-25.

**TAPPI Coating Conference, 11th Annual,** Edgewater Beach Hotel, Chicago, May 23-25.

**ASME Design Engineering Conference & Show,** Statler Hilton Hotel, New York City, May 23-26.

**American Society for Quality Control, Annual Convention,** Sheraton-Palace Hotel, San Francisco, May 24-26.

**Japanese Rocket Society, Second International Symposium on Rocketry and Astronautics,** University Club in Tokyo, May 24-28.

**IAS Specialists Meeting, Guidance of Aerospace Vehicles,** Hotel Somerset, Boston, May 25-27.

**The Psychophysiological Aspects of Space Flight, sponsored by the School of Aviation Medicine, ATC, to be held at the Aerospace Medical Center, Southwest Research Institute,** San Antonio, May 26-27.

**Society of Naval Architects and Marine Engineers, Spring Meeting,** Statler Hotel, Washington, D.C., May 26-28.

**Fourth International Symposium on the Reactivity of Solids,** Amsterdam, May 30-June 4.

### JUNE

**6th Annual Radar Symposium, University of Michigan, sponsored by Army, Navy, Air Force Willow Run Laboratories,** Ann Arbor, June 1-3.

**Instrument Society of America, Annual Instrumental Methods of Analysis Symposium,** Montreal, June 1-3.

**Fourth Annual Summer Conference on Vacuum Metallurgy, New York University College of Engineering,** NYU Heights Campus, Bronx, N.Y., June 2-3.

**ASME Summer Annual Meeting and Aviation Conference,** Statler Hilton Hotel, Dallas, June 5-9.

**Society of Automotive Engineers, Summer Meeting,** Edgewater Beach Hotel, Chicago, June 5-10.

**Machinability Seminar, Pennsylvania State University,** University Park, June 6-10.

**National Society of Professional Engineers, Annual Meeting,** Statler Hotel, Boston, June 8-11.

**American Nuclear Society, National Meeting,** Palmer House, Chicago, June 12-14.

**Seminar in Design Engineering, Pennsylvania State University,** University Park, June 12-17.

**American Institute of Mining, Metallurgical and Petroleum Engineers, International Powder Metallurgy Conference,** Biltmore Hotel, New York City, June 13-15.

## editorial . . .

# Will Satellites be Targets, Too?

Whatever else may come from the shooting down of the American U-2 over the Soviet heartland, one fact is pretty obvious. It could be the last important surreptitious reconnaissance attempt made in peacetime with a manned aircraft.

Future efforts in this line will be made with satellites most probably, or with some form of unmanned missile. This fact in itself points up some brand new problems in space exploration and usage.

The secret of the U-2 operation was remarkably well-kept. The State Department announcement said that the Lockheed broad-winged jets had been operating over Iron Curtain territory for four years. For much of this time the facts of the secret operation have been known to the Pentagon Press corps. Reporters covering the Department of Defense not only went along with the weather reconnaissance cover plan and didn't write the real story—they stopped less well-informed special writers from putting it in print.

There is little doubt that the Russians also have long known about the activities of the U-2 planes. Certainly they must have tracked them by radar. The altitude of the planes protected them from Russian fighter aircraft, as was planned. How many times the Russians shot at them with ground-to-air missiles may never be known. Nor why they weren't hit before, if this one was. The U.S. has missiles which certainly are capable of reaching the U-2's altitude.

Secretary Herter's admission that the U-2 was engaged in espionage must have been as great a shock to the Russians as it was to the U.S. people, and to our European friends. Spies are traditionally expendable. Normal procedure would have been for our State department to have said, in effect: "This guy was drunk or out of his mind or both. He wasn't over Russia on our orders. We disclaim any responsibility for him."

The Russians would have recognized this as playing the game. We've caught their spies red-handed, too. And they've blandly disclaimed any responsibility. It's all very normal in the international espionage business.

Whether we have been incredibly naive or set up a new system of rules—this will take some time to tell.

But some sort of new rules are necessary under espionage by satellite. The U.S. has already launched one *Tiros* satellite which has sent back remarkably clear pictures of cloud formations and the continents beneath them.

From this it is only a short step and a short span of time to *Samos,* which will be able to send back pictures just about as good as those from the U-2.

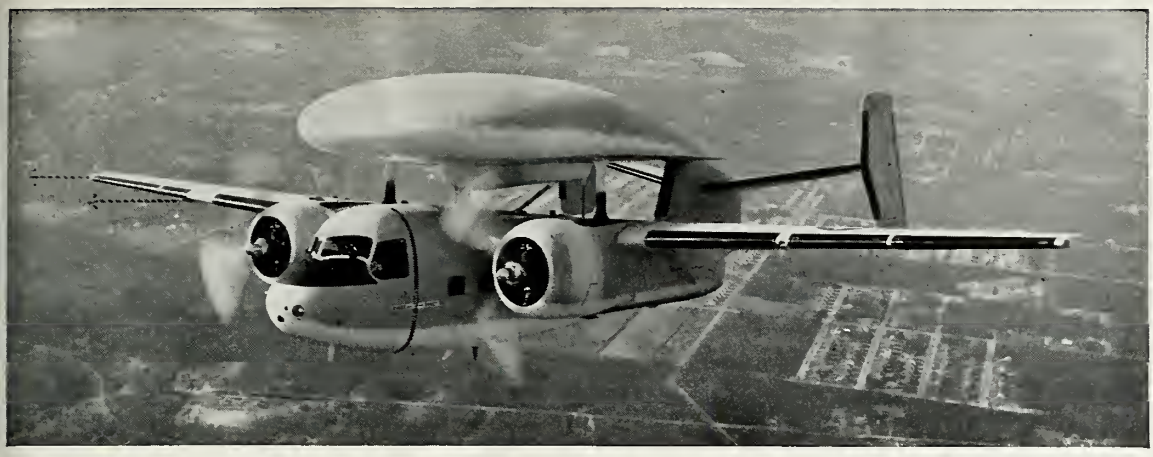
The only real difference between the concept of *Samos* and the U-2 is altitude. One flies 15 miles high and the other 300. Shooting down a satellite in fixed orbit might actually be easier—or perhaps more certain—than downing the jet plane.

There can't be much of a cover plan for the reconnaissance satellite. We probably won't even attempt one. Under the new rules we've just established to do so would be laughable.

What do we do then? Publicly release our pictures of the dark side of Russia—much as Russia released her pictures of the dark side of the moon? And if Russia objects? Or shoots down our satellites?

It would be pleasant to think we had plans for these eventualities. One thing is certain: any plan will be just as good as our strength to back it up. Wide-eyed naiveté isn't much good in a real crisis.

**Clarke Newlon**



*GRUMMAN'S "SAUCER-TOPPED" WF-2 TRACER, early-warning airplane for Navy carrier operation, carries long-range radar detection equipment.*

# BENDIX 20 KVA GENERATING SYSTEM PROVES TREMENDOUS VERSATILITY

Here is a lightweight, transistorized, AC generating system that brings extreme dependability to its many applications. First developed for the USAF for one of its Century series fighters, the Bendix 20 KVA system will soon be flying for the U.S. Navy on Grumman's WF-2 and Sikorsky's HSS-2.

The Bendix system regulator will provide close voltage regulation and will hold transients to a minimum with rapid recovery. The protection panel will protect the critical aircraft components from under- and over-voltage and from under- and over-frequency.

Offers unusual effectiveness on missiles and on a wide variety of aircraft—in fact can be used on any engine-driven, air-driven, hydraulic-driven or pneumatic-driven application . . . either airborne or ground. Get further details from BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Office: 117 E. Providencia, Burbank, Calif.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.
Canadian Affiliate: Aviation Electric, Ltd., P. O. Box 6102, Montreal, Quebec.

Red Bank Division — Bendix AVIATION CORPORATION


*SIKORSKY HSS-2, designed for long over-water flight and low-altitude hovering—even alighting on water—during sonar anti-submarine missions.*

Circle No. 12 on Subscriber Service Card.

**NOW! 2 GREAT NEW AMPLIFIERS**

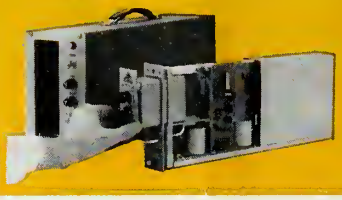
**Model A14**—High input source impedance for operational applications.

**Model A15**—Noise level less than 1 microvolt!

# Electro Instruments Model A12 D.C. Amplifier

Totally transistorized—dissipates only 7 watts.
Long term drift less than 2 microvolts.
.01% linearity and stability.
100 megohms input impedance—40 milliohms output impedance.
1 db DC to 10 KC.
Noise less than 10 microvolts wideband.
Single ended or differential input.
Operates to specifications from 0° to 50° C.
Self-contained power supply—operates on any line frequency from 50-400 cps.
Mil-type chopper gives unmatched reliability for the life of the instrument.
7" x 19" panel accommodates 8 instruments.

**Plug-In attenuators** of the A12 provide convenience, flexibility and economy. Special variations, gain settings, etc., can be tailored to your system at no extra cost.



## FULLY TWO YEARS AHEAD of the FIELD!


**Electro Instruments, Inc.**

3540 AERO COURT
SAN DIEGO 11, CALIF.

Circle No. 13 on Subscriber Service Card.