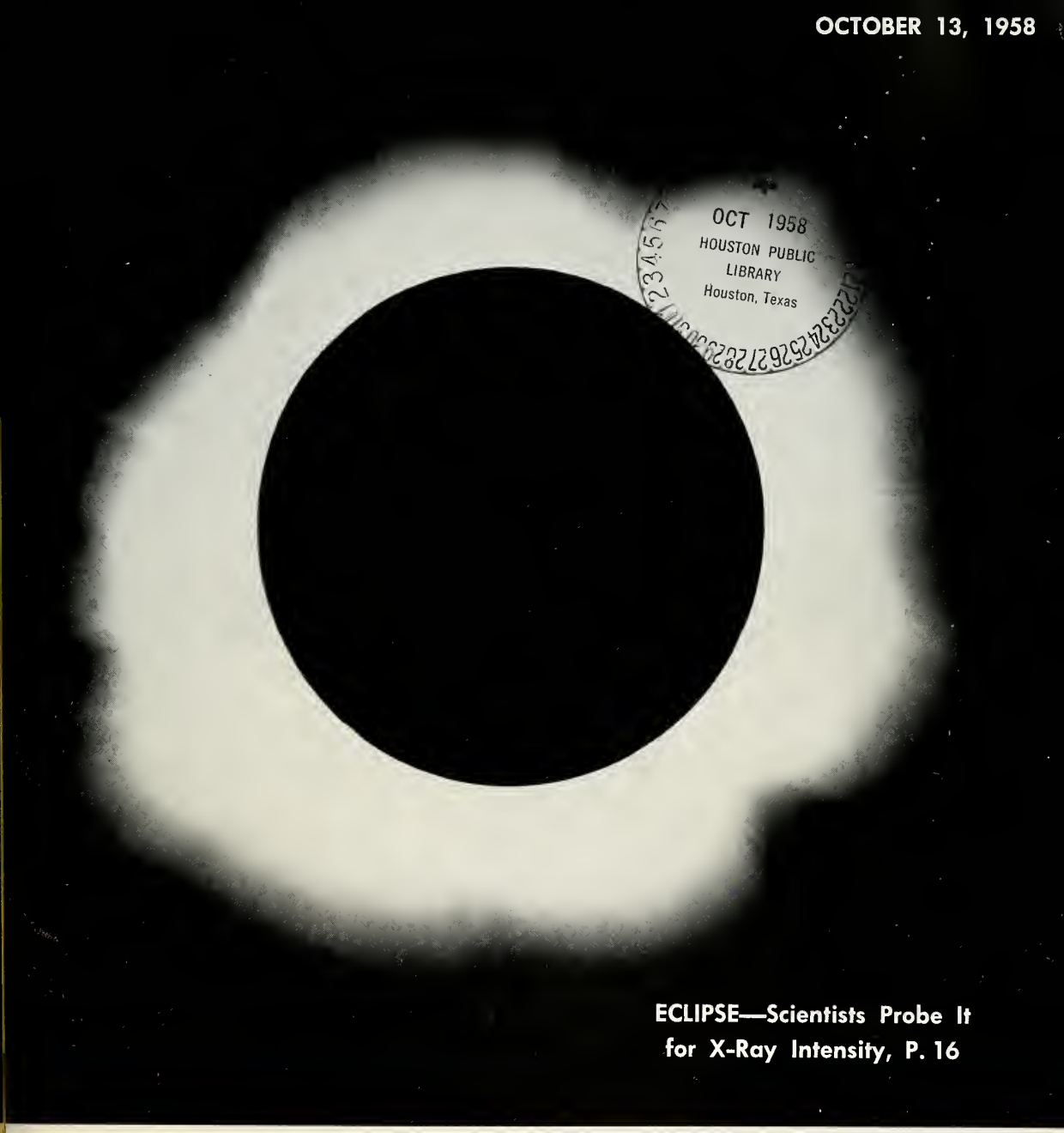
OCTOBER 13, 1958



ECLIPSE—Scientists Probe It for X-Ray Intensity, P. 16

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

News and Business Edition

AN AMERICAN AVIATION PUBLICATION

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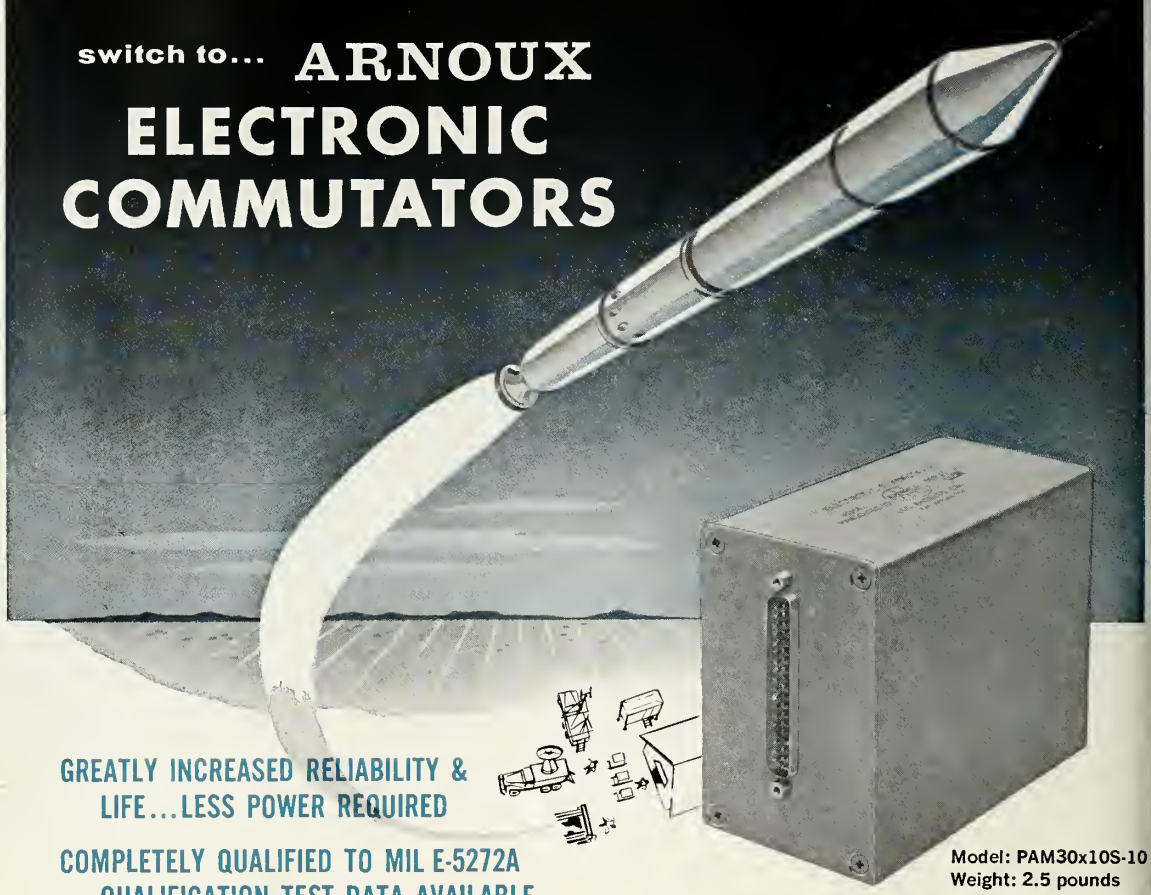

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The ETC cammutator has a guaranteed service-free life of 5000 hours. Without vacuum tubes—built of all salid-state elements—the ETC has no moving parts. There are no switching transients. The frequency variation does not exceed ± 5 percent thraughaut the operating temperature and valtage ranges.

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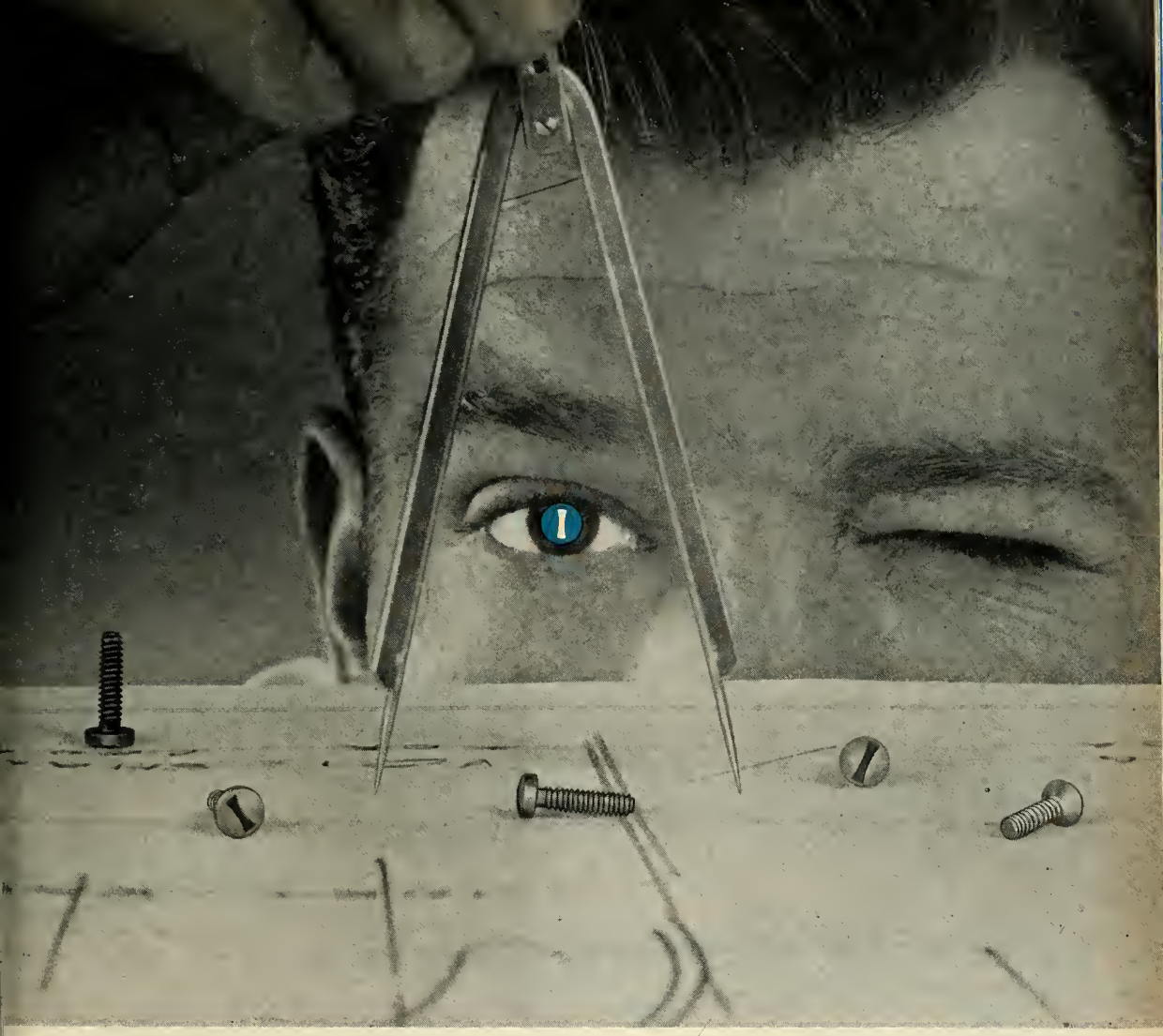
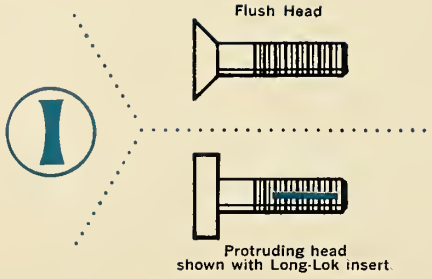


Engineers with an eye for performance look to Miniature Hi-Torque

Time after time, the revolutionary Hi-Torque recess, applied to Voi-Shan bolts, screws, and other turning fasteners, has proved its ability to meet the exacting performance requirements of latest aircraft and missile equipment. Now, this remarkable principle, simple but distinctive in shape, has been applied to Miniature Hi-Torque Fasteners for precision applications. The unique recess design permits greater ultimate torque strength without requiring axial force on the driver to maintain engagement, giving Miniature Hi-Torque an inherent re-usability factor. Available in a wide variety of materials and configurations, Miniature Hi-Torque fasteners can incorporate the Voi-Shan Long-Lok insert to meet self-locking and sealing requirements.



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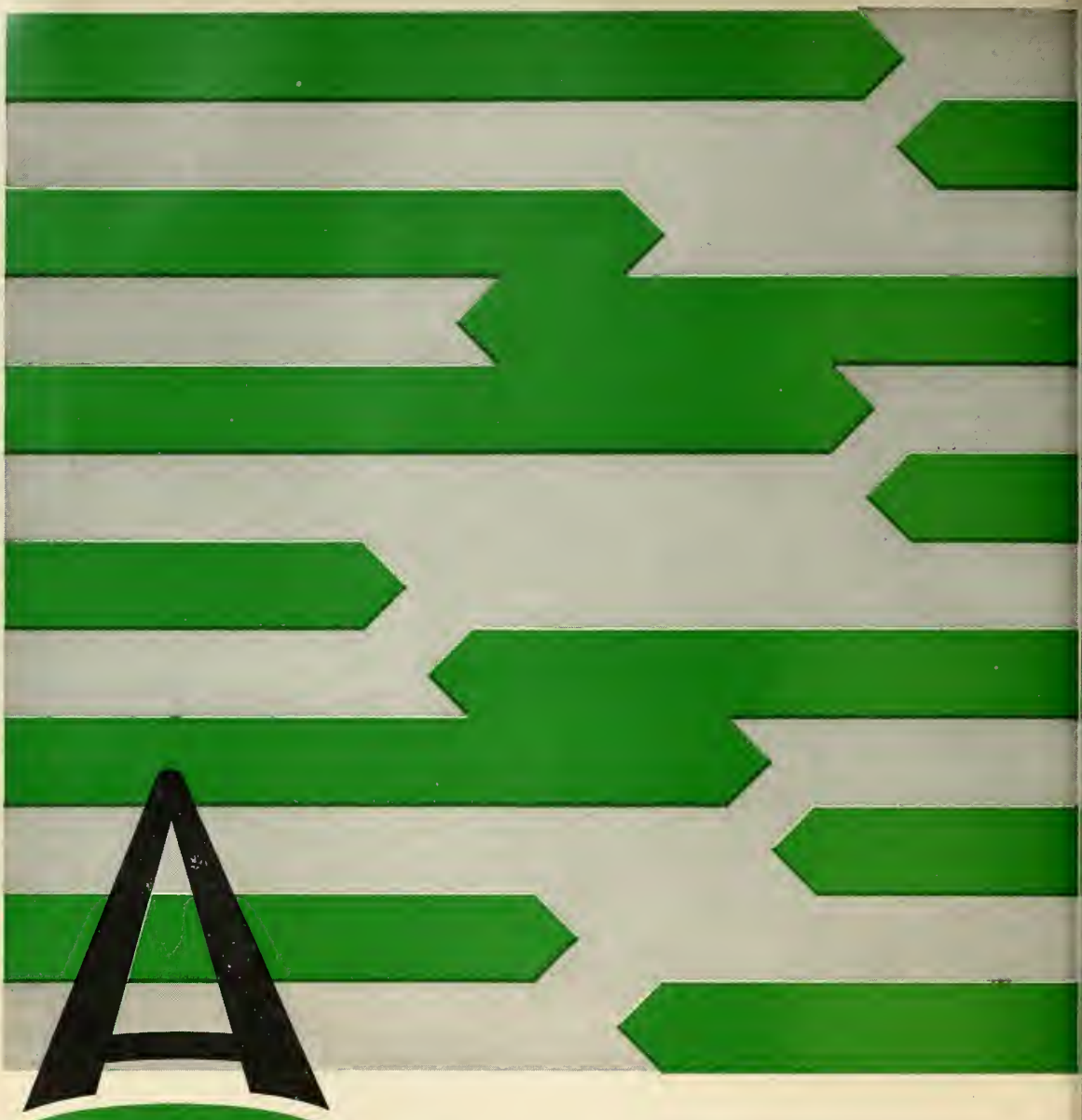

ASTRODYNE —aimed for the future in solid rocketry

Astrodyne was founded early this year to bring together in one productive group all the skills, experience, and facilities it takes to design and manufacture America's major solid propellant missile systems.

From Phillips Petroleum Company came men with impressive backgrounds in research, design, and manufacture of superior solid propellants. From North American Aviation came men who know missile systems management, and who have designed and built the largest rocket engines in use today.

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Inquiries are welcomed on any phase of the solid propellant field—from preliminary design to quantity production.

ASTRODYNE, INC.
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COVER: *Total eclipse of the sun photographed by a team from the U.S. Naval Observatory at Canton Island on June 8, 1937. Yesterday's total eclipse was observed by a U.S. IGY team from a boat in the vicinity of the Danger Islands, between Samoa and Tahiti. Groups of* Nike-Asp *rockets were sent up before, during, and after the eclipse to aid IGY scientists in observation of X-ray radiation from the sun.* *(See Story p. 16)*

missiles and rockets Vol. 4, No. 15 Oct 13, 1958

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in this issue

OCT. 13 HEADLINES

MISSILE ELECTRONICS

DEPARTMENTS

In My Opinion . . .

. . . The U.S. Army now faces the greatest space age challenge yet, lunar space construction. But unless Army leaders do something about it soon, the role of the Army is likely to fade away quickly in the space era.

Many Washington officials now admit we must begin to think sincerely about establishing lunar bases. This kind of research and construction task—traditionally and logically—is a job for the U.S. Army Corps of Engineers. With its vast experience and with the backing of the Signal Corps and the Missile Ordnance Command, the Corps of Engineers should establish a special research group for space base development. Working closely with industries in the architectural-engineering area, plans should be made now for our first automatic military lunar stations.

These, obviously, will be small packages in the beginning, but within ten years they will become bigger and will contain manned observers. It should not be necessary at this point to repeat anything about how hard Russia is pushing her lunar base program. In this base research area, in spite of great enthusiasm on the part of such outstanding planners as Brig. Gen. Homer A. Boushey, who repeatedly has stressed the importance of the use of lunar bases for retaliatory purposes in a future war.

The Corps of Engineers must act now to get the blessing of Lt. Gen. Arthur G. Trudeau, Chief, Research and Development, and move ahead, possibly funded by ARPA.

The Army has suffered badly from poor public relations in the missile program. Army's loss to the USAF in the IRBM roles and mission battle was mainly a result of poor public relations planning. McElroy's modification of Wilson's stubborn ruling limiting the distance of Army missiles is proof enough. The old time Army conservatism will not get the soldiers anywhere in the space race. The Air Force now is advancing at full speed to become the No. 1 service in the space age. One year ago a directive was circulated among top AF officials ordering them not to imply in speeches, press releases, etc. that the USAF was pushing space flight. The word space flight was not to be mentioned. Today,—three-star USAF generals hint the Air Force some day will become the U.S. Space Force.

This should convince Army leaders that change-overs and breakthroughs constantly will take place. What was good yesterday may not be so good tomorrow. The Army certainly must show more vigor and foresight if it expects to take an active part in our conquest of space. We do need the Army in this big struggle. But Army leaders must wake up and do something about it. A lunar base research and development program must be started now. And industry must be invited to participate.

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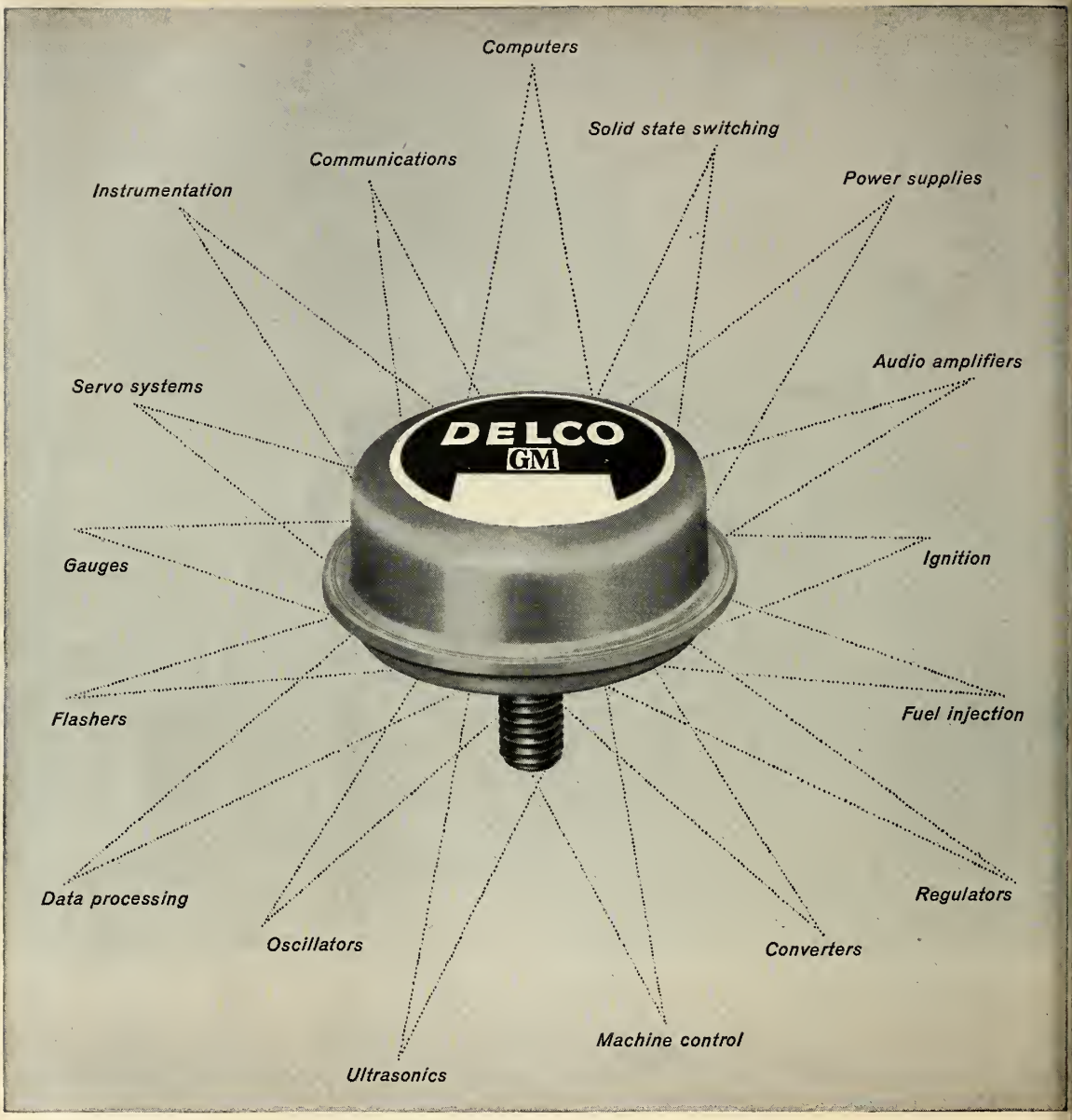

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washington countdown

Washington rumor . . .
that Army Ordnance Missile Command's scientific talent under direction of Dr. Wehrner von Braun would be transferred to administration under NASA, was neither confirmed nor denied by AOMC's Maj. Gen. J. B. Medaris and Washington sources, including Dr. James Killian, the president's scientific advisor. No transfer of personnel is reportedly involved, but sources said NASA has reached—or is about to reach—an agreement with Defense Secretary McElroy approving the administrative change. Such change could be made only by presidential executive order.

Better protection . . .
for proprietory rights, patents, etc., is afforded by a just-issued Armed Forces Procurement Regulation, Part 2, Section 9. The revised AFPR limits the amount of technical information a company is required to divulge to competitors.

The scientific mind . . .
sometimes dreams up titles reminiscent of New Deal days in Washington. The recent International Committee of Scientific Unions' conference list included SCOR (Special Committee on Oceanic Research), SCAR (Special Committee for Antarctic Research), COSPAR (Committee on Space Research) and CETEX (Committee on Contamination by Extra-Terrestial Exploration.)

Greater efficiency . . .
and maneuverability of the Ballistic Missile Division's handling of space projects is the reason for the new Ballistic Missile Systems Office. When BMD was set up that's all it dealt with—ballistic missiles. Evolution of the art has resulted in true space vehicles and two separate deputies for Gen. Schriever.

Rep. John E. Moss . . .
(D-Calif) has accused the Air Force of withholding a report, "Survey of Management of the Ballistic Missiles Program" from his House Information Subcommittee. Consequently Moss has ordered an investigation even though Air Force Secretary James H. Douglas announced that the release of the report would have a serious adverse effect on the department. Moss charges that the situation is intolerable when a federal agency is allowed to throw a cloak of secrecy over possible mismanagement.

'No great concern' . . .
was the comment of NASA Administrator T. Keith Glennan when he was asked the delicate question recently on how his agency can pursue the things it wants to without restrictions from the military. Glennan replied "I am very naive and very optimistic." Evaluating U.S. progress in the so-called first year of the space age, Glennan expressed the belief that "progress has been really substantial."

Successor to *Houndog* . . .
may be in works judging from comment recently of Lt. Gen C. S. Irvine who said an air-to-surface guided missile "perhaps for the B-52 and most certainly for the B-70" had been proposed.

The Air Force . . .
will put its planes and missiles on parade October 20-30 at the sixth annual Weapons Competition. Tactical fighter phases will be run at Nellis AFB, Nevada. Interceptor phases will be run simultaneously at Tyndall AFB, Fla. There is a report that industry planes will televise a high-altitude air-to-air missile intercept.

The steady stream . . .
of contracts involving *Jupiter* continued this week as the Army announced four more totaling $6.5 million. The majority of such small contracts are for service, support and personnel required.

Navy scientists . . .
set a new record when a 1,600 pound ASP rocket with a *Nike* booster climbed to 152 miles from the LSD, USS Point Defiance in the South Pacific near the site of the IGY Solar Eclipse Expedition. It was the first shipboard *Nike-Asp* launch and a record altitude for ship-launched rockets.

industry countdown

Small solid propellant rockets . . .
will be used in the *Nike-Zeus* anti-missile missile system for generating auxiliary power for the weapon's hydraulic and electrical system. Garrett Corp., producer of the units, is working under subcontract to Douglas Aircraft, one of the recipients of the recent million contract for further R&D on the *Zeus* system.

Douglas Aircraft is currently . . .
in the second phase of a far-reaching engineering realignment program for greater utilization of the company's increasing missile and space systems activities. Douglas, Martin and Lockheed are currently the top three (percent of individual income) prime contractors in the missile industry.

Another example of the diversified expansion . . .
of the missile industry is exemplified by the recent contract released to the Universal Match Co. for component manufacture for the Navy ASROC missile. The anti-submarine rocket, produced by Minneapolis-Honeywell, is similar to the RAT rocket launched torpedo.

With odds in favor of the *Thor* . . .
over the *Jupiter*, when the selection between the two is made, production of the Army-developed missile is expected to continue until at least three or more squadrons are available. Decision is expected sometime in November after completion of the intensive study now underway. Meanwhile, Chrysler has received an additional five Army contracts totaling $4.9 million for *Jupiter*.

The *Bomarc* area defense missile system . . .
which could easily top $2.5-billion before the planned program is a reality, has been accepted by Canada as a replacement for the Avro *Arrow* supersonic fighter. The *Arrow*, equipped with air-to-air *Sparrow* missiles, is currently Canada's major air defense. Canada wants to produce the Boeing missiles under license by Canadian firms.

If confidence will win contracts . . .
Boeing is well on the way to obtaining the *Dyna-Soar* weapon systems award. Boeing recently assigned two pilots from its Seattle Division for first tests of the boost-glide vehicle. An official from one of the competitors was overheard to say that the selection of the sons of present-day pilots as test personnel would have been more apropos.

The long sought after . . .
Special Civil Air Regulation from CAB authorizing the CAA Administration to take into consideration rocket engine standby power for transport aricraft has been adopted. This regulation will permit aircraft a higher maximum weight when equipped with either liquid or solid propellant rocket assist take-off units.

Accessory power development . . .
is showing a definite trend toward complexity, with the result that future advanced vehicles may well be limited by development trouble of accessory powerplants, rather than of main propulsion systems. These development problems wil have the spotlight during this year's 8th Annual Aircraft Hydraulics Conference to be held in Detroit Nov. 12-14. A special report on the design complexities of the *Dyna-Soar* and *Minuteman* systems is expected to draw considerable attention.

Sometimes technical competence . . .
is overshadowed by engineer presentation capabilities. Although in most instances the technical capabilities decide the selection of the contractor, a top R&D official of the Air Force stated that many companies lose out during competitive studies as a result of poorly written presentations. This is especially true during some project assignments by top level personnel with administrative instead of technical backgrounds.

Sperry Rand's new $3-million . . .
electronics facility constructed to expand supply of advanced radar and missile instrumentation has been tabbed the Sperry Microwave Electronics Co. The facility is currently producing *Jupiter* ground support equipment.

A Senate military procurement . . .
subcommittee has recommended that an investigation be conducted to determine the reason for the decline in subcontract percentage awards in the Navy *Bullpup* hardware production. The recommendation was very critical of the Bureau of Aeronautics handling of small business awards and the general DOD policy toward the smaller firms.

OCTOBER 13, 1958
VOL. 4, NO. 15

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

First of 60 IRBM Missiles Reach England

First *Thor* Squadron "Operational" by end of '58
Under RAF Control; British feel vehicle untested

RAF STATION, LAKENHEATH, ENGLAND—*Thor* Intermediate Range Ballistic missiles are arriving steadily and on schedule at this big RAF airdrome, destined for IRBM bases which are being constructed along the East Anglia coast.

They arrive in USAF C-124 Globemasters and are off-loaded to special lorries which transport them to nearby firing sites. The first *Thor* appeared in August. A total of 60 is programmed to make up the full four IRBM squadrons in England. The first will be "operational" by the end of the year.

Feltwell is the site of the first major IRBM installation. The location of others is protected by security, as are the exact details of deployment.

There probably will be, m/r has learned, four major sites, one to each squadron, with possibly four "satellite" firing pads clustered around the "mother" installation. Each pad will have three missiles on location.

In rotation, one missile will be on alert firing status at all times, with the other two in a somewhat lesser ready state. When operational the situation will be about as follows:

- **Guidance**—Each missile zero-ed in on a pre-selected target.
- **Fuel**—Alert missile partially fueled, and counted down to about 30 minutes, with high hopes of reducing this time as skills and familiarity increase.
- **Warhead**—Stored nearby and under U.S. control as required by law, but not too far away to delay operations once the word should be given.

British IRBM Bases Necessary

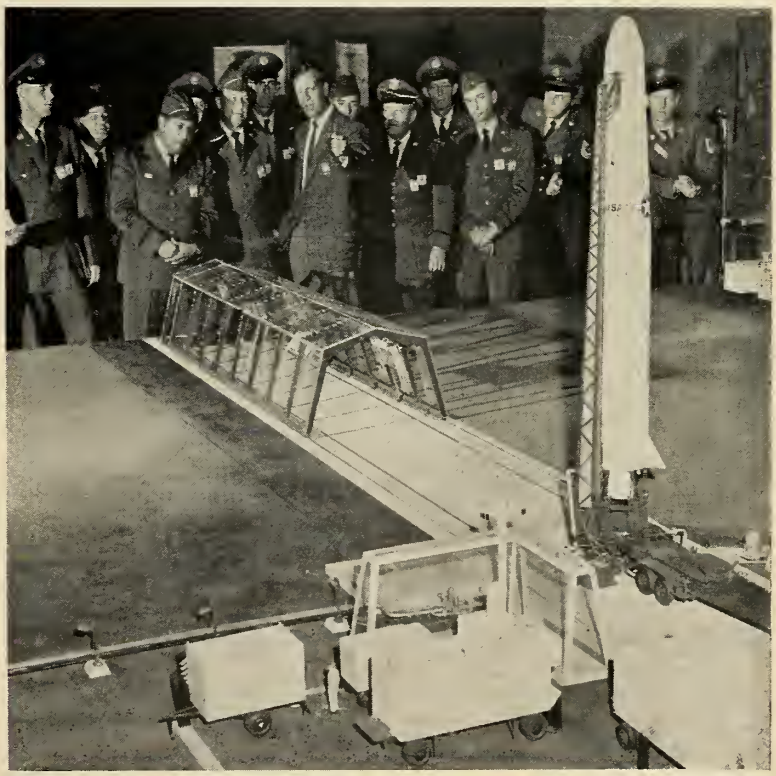
Under original plans, when the agreement was signed to station American-made IRBMs in England, two U.S. squadrons of airmen commanded by USAF officers were to be sent to Great Britain. They would set up the first installations, position the missiles and operate them. Some RAF missile men were to be trained in America, others on the job in East Anglia. As they became proficient they would be phased into the American squadrons and, at some later date, would staff them fully. Details of manning the second two squadrons were left fluid, depending on RAF training and proficiency.

Her Majesty's loyal opposition, the Labor Party, however, got wind of this and fairly raised the roof of Parliament. Was England to permit Americans to man ballistic missile bases on their island from which—conceivably—atomic weapons might be fired without—again conceivably—Britain having any control in the matter? Understandably, a great many Englishmen didn't like this and there followed considerable backtracking.

The United States gave in gracefully. A great deal more than the command line was at stake. The British press was already raising a storm about SAC's bombers over-flying England and had to be reassured they weren't carrying nuclear weapons on practice missions. Having IRBMs in England was an important part of the strategic deterrent plan, and—just possibly—England might have a point. Now, with England firing the missiles and America holding the warheads, dual control becomes obvious.

Training was stepped up and now, the squadrons manning the missile pads are Royal Air Force squadrons, both officers and other ranks. There are American advisors, American technicians, both in and out of uniform, helping. But the command line is British, direct to Air Marshal Sir Harry Broadhurst, Chief of RAF Bomber Command. USAF Col. Harry Zink, originally one of the squadron commanders, is serving as on-scene advisor.

(Continued on following page)



MISSILE AIRMEN TRAINEES see a miniature scale model of the *Thor* IRBM firing pad, hangar and support material.

England: A Little Dubious

The British are viewing the entire operation with some uncertainty, based largely on two points:

1. They feel the *Thor* is still insufficiently tested.

2. They feel that reaction time is too great—that it could easily take longer to fire a salvo of *Thors* than the warning time Britain might have of a Soviet missile attack.

In addition, they worry because the missile must be largely serviced from a horizontal position and fired, of course from a vertical posture; that the sites themselves cannot be hidden and will not be hardened, leaving them extremely vulnerable as far as location and attack is concerned.

But, with all, the British view these matters realistically, knowing that their own *Blue Streak* is not even in the hardware stage, superior as it may look on paper (a 2,000-mile solid fuel missile, firing from a hole in the ground, similar in the last two respects to the USAF's projected *Minuteman*).

Word of the first *Thor*'s arrival and location of the first site at Feltwell broke, oddly enough, from Amsterdam to Lord Beaverbrook's ebullient Daily Express. Previous to that time, although the London press knew in fair detail what was going on missilewise, they were held in check by a Defense of the Realm Act. This is an arrangement whereby the government can simply warn English publications that thus-and-so story is off limits. The press bows.

Thus when the Daily Express broke the story from Amsterdam during the International Astronautical Federation meeting there, it was generally understood to be via a very high intentional leak. The government ignored the Express's full page spread on the *Thor* and its English bases for several days and then releasead an official announcement very routinely. Other papers picked it up. Little more has been said.

The Americans, for their part have come to be pretty relaxed, too. The giant *Thors* arrive in England bare, ready for the Royal Air Force markings, which are immediately stenciled on.

SAE Discusses Missiles

Transportability and mobility of missiles were the center of a day-long discussion, as the Society of Automotive Engineers turned its attention to missiles at a recent Los Angeles meeting.

Ground and air means of transporting missiles must be studied anew, according to Ron Stoner, Missile Space Engineering Division, Douglas-Santa Monica.

Tests Find Anti-Lox Materials

Shock Treatment Used by Martin To Determine Explosive Factors

by Alfred Zaehringer

BALTIMORE—Results of impact sensitivity tests conducted in the Materials Laboratory at The Martin Company's Baltimore Division reveal the following materials which when saturated with LOX and subjected to shock would explode:

1) Synthetic elastomers and Thiokols.
2) Cellulose based papers.
3) Silicone and silicate based oils and greases.
4) Thermo-plastics such as nylons and phenolics except pure uncontaminated Teflon.
5) Thermo-setting resins such as phenolics, silicones, epoxies, etc.
6) Petroleum based oils and greases.

This work was extremely important since seals and gaskets subject to LOX contact would often detonate when subjected to surge impact. Spillage of LOX on asphalt was also dangerous since the asphalt would also explode when inadvertently stepped on.

In 1957, meetings were held at Ramo-Wooldridge Corp. by the LOX Lubricants Standards Committee to develop interim specs on LOX-compatible materials. Martin-Baltimore carried on impact tests to screen suitable materials.

The tester used consists of a guillotine impact tester, with a 71.75 pound weight falling through a distance of one foot. A stainless steel hammer mounted on the weight transmits the impact force to a striker resting on a sample of the material being tested in an aluminum sample cup.

The weight is dropped by a quick-release mechanism actuated by a solenoid. Materials were ½-in. squares 0.05-inch thick. The test cup with test specimen was filled with LOX and additions of LOX were made until boiling ceased, then subjected to impact.

Some 63% of the materials tested were impact-sensitive. Of these about 75% were moderately to extremely sensitive. Materials were classified for all future rocket or ground support systems used in or near liquid oxygen:

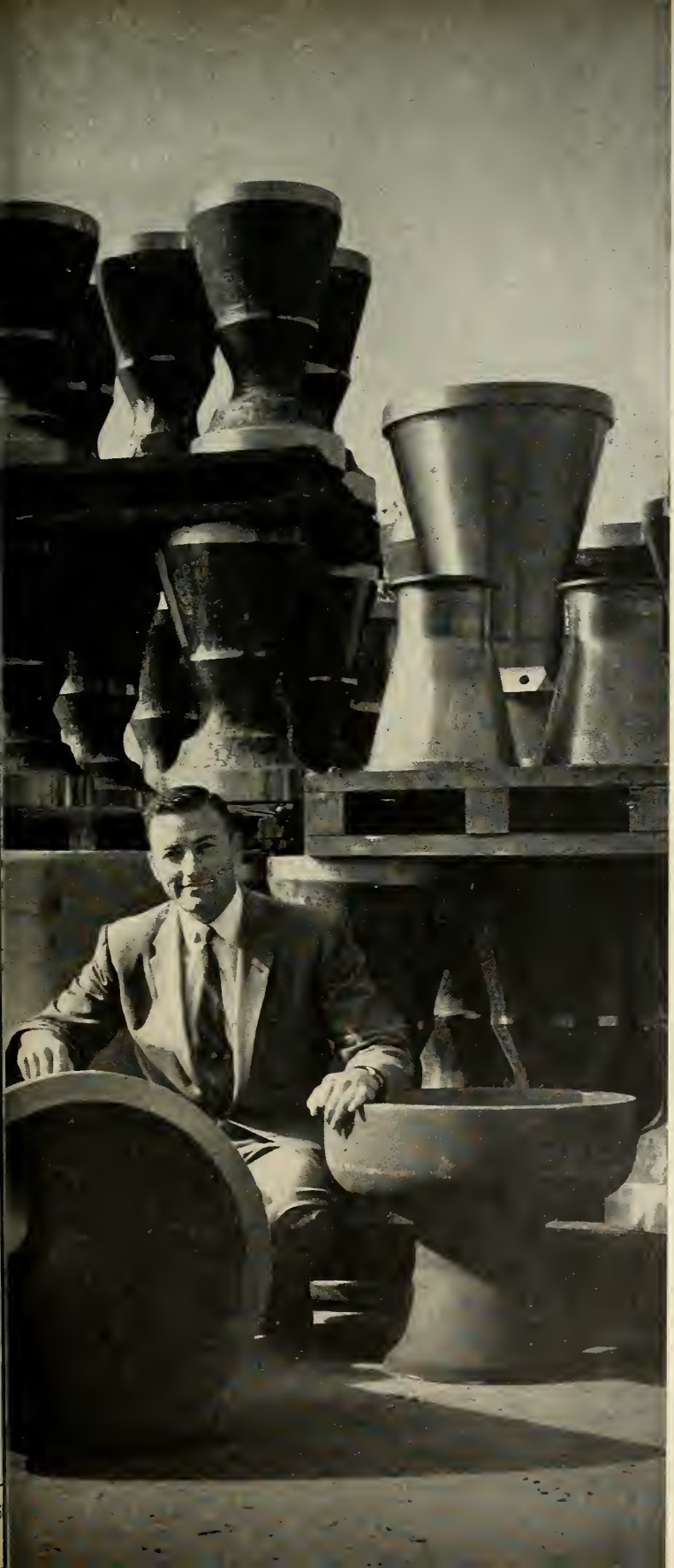
1) Materials acceptable for use in liquid oxygen systems and areas subject to liquid oxygen spillage. (See table below).
2) Materials acceptable for limited use in areas of liquid oxygen spillage.
3) Materials rejected for use in liquid oxygen systems or in areas of liquid oxygen spillage.

Acceptability was based on one detonation in 40 impacts or none in 20 impacts. The intensity of the detonations was very audible in all cases. Those of lower magnitude were similar to the sharp crack of a .22 caliber shell, while those of greater magnitude sounded like a .50 caliber shell. The latter was obtained on most petroleum products.

The work was reported by D. E. Clippinger and G. J. Morris of the Materials & Design Support Department. For listing of unacceptable materials plus specs on acceptable materials, contact Martin directly.

Materials Accepted for Use

Material	Use
Fluorocarbon Grease No. 3&4&5	Lubricant & Anti-Seize Compound
LOX lubricant (graphite & halogenated biphenyl)	Lubricant & Anti-Seize
Fluorocarbon Oil	Lubricant
Moly Disulfide Powder (MIL-L-7866)	Lubricant
Solid film lube, sprayable, air dry	Lubricant
Ceramic impreg. polytetrafluoroethylene gasket	Gasket
MIL-H-5606A Hydraulic fluid (Unoxidized & unfiltered)	Hydraulic oil to 250°F
Pure polytetrafluoroethylene	Gasket, insulation, potting molds, connectors
Polytetrafluoroethylene water base compound. MCI-20201	High pressure thread compound to 6,000 psi
Polyethylene sheet MCI-15014	Chemically inert material
Wire, Wrapped & Extruded, fluoroethylene, NAS 703	High temperature wire insulation



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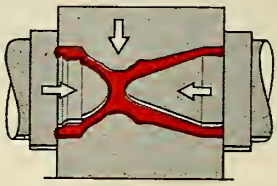
CAMERON ONE PIECE FORGED MISSILE NOZZLES

1. Have no welds
2. Require less machining
3. Are lower in cost

A better nozzle for less money has put Cameron way ahead in production of these important missile parts. Cameron's exclusive split-die forging process makes this possible. Each nozzle is forged from a single heated billet of specified steel. This steel is produced in Cameron's own melt shop under the closest possible control. From these perfect billets our specially designed split-die presses forge a near final shape.



Movement of the three elements in the split-die process.

No welds are required and machining is greatly simplified—grain structures are perfect.

Missile nozzles produced by this method are supplied as finished forgings ready for economical machining or completely machined to specification. At every single phase of manufacture, each nozzle is checked by the most modern methods used today.

The Cameron split-die process has successfully solved many unusual forging problems in a wide variety of end uses. Some of these include critical airframe members, jet engine components, propeller blades and hubs, atomic reactor valves and many high pressure controls for the oil industry.

Cameron has extended the great advantage of ferrous forged members to include shapes impossible to produce heretofore. Present production of missile nozzles includes diameters to 28″ with large open sections and elongated double conical thin sections to 36″ in length. In weight our forgings range to 8,000 lbs. and our high quality alloys satisfy many unusual demands. If you need forgings in this group and, of course, if you need nozzles, call, write or come by . . .

Cameron

IRON WORKS, Inc.

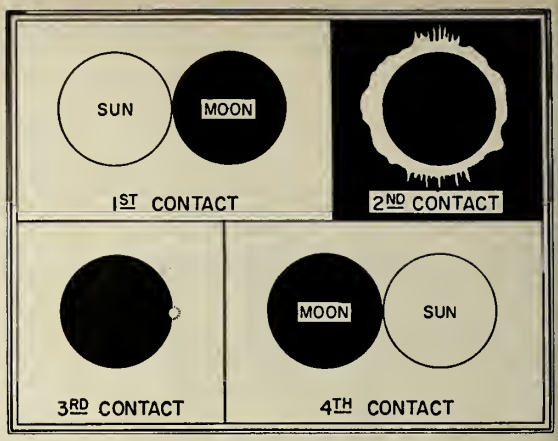
SPECIAL PRODUCTS DEPARTMENT

P. O. Box 1212, Houston, Texas

Rockets Seek Data on Eclipse Phenomena

Nike-Asp series, fired from ship in mid-Pacific, may add to information on X-rays, other data affecting Earth

by Raymond M. Nolan



As m/r went to press, a group of American astronomers and physicists were cruising the Pacific Ocean near the island of Pukapuka in the Danger Islands, waiting to fire six or possibly eight *Nike-Asp* rockets before, during and after the Columbus Day (Oct. 12) eclipse.

The men are members of a Naval Research Laboratory team headed by Drs. H. Friedman, T. A. Chubb, and J. C. Lindsay. They are studying the distribution of ionizing sources on the sun's disc and in the corona by direct measurement from the rocket.

NRL planned to fire a series of six to eight rockets during the eclipse—two during the period of totality and the rest during the partial eclipse before and after totality. Each rocket was equipped with detectors for soft X-rays, harder X-rays and Lyman-Alpha ultraviolet radiation. Data recorded during the rocket flights was to be telemetered to receivers aboard the USS Point Defiance (LSD-31).

The task was made harder because Pukapuka is so small that the rockets had to be fired from the ship in order to keep from interfering with or disturbing the measurements of other equipment situated on land.

• **Flight trajectory**—The 210 lb. *Asps*, built by Cooper Development Corp. of California, were to be boosted to about one mile by *Nike* boosters. Then they were expected to coast for 13 seconds before ignition and climb to the target altitude of from 150 to 180 miles. These were to be the first *Nike-Asp* firings from shipboard, with each *Asp* in flight for about seven to eight minutes—about five minutes of which was above the absorbing ionosphere.

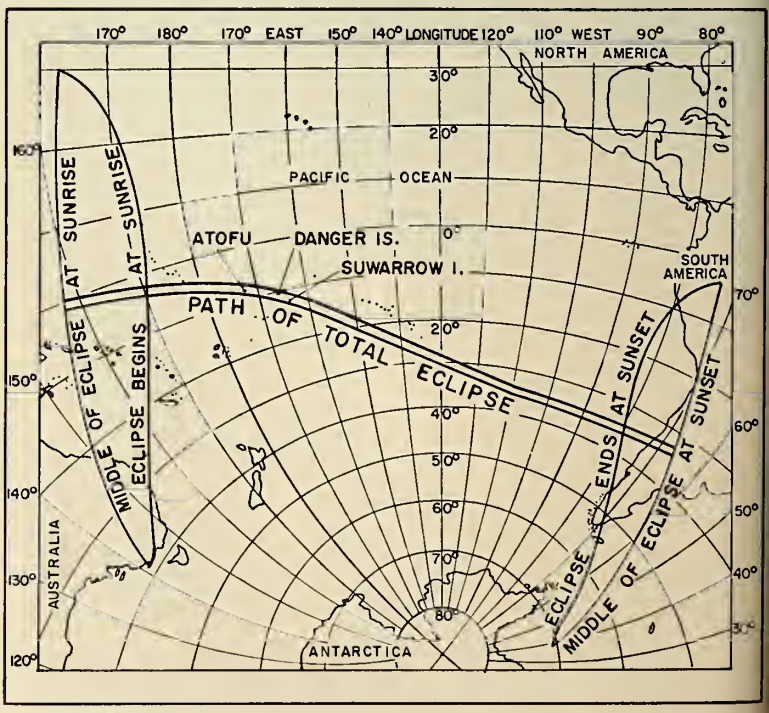
Totality of the eclipse is about four minutes—during which most of the phenomena occurs. Plans were to have two *Asps* in the air throughout totality.

Launchings were to be made in quick succession between first and second contact (see above sketch), just before second contact, and between third and fourth contact.

• **Origin of X-rays?** Measurement of X-ray radiation by the rockets when they are well above the ionosphere, might enable scientists to determine whether the X-rays, which produce the ionosphere, are the result of the so-called green clouds on the sun.

The green patches—created when particles from the sun reach high velocities circumventing sunspots and bombard iron atoms in the corona—may be the source of the ionizing X-rays, although no proof exists. The NRL team, with rocket measurements, and cooperating teams taking photographs of the sun during the eclipse, will attempt to determine if the rays really do come from the green clouds.

Other institutions participating in the expedition are the Central Radio Propagation Laboratory of the National Bureau of Standards; University of Wisconsin; California Academy of Sciences; U.S. Naval Radiological Defense Laboratory; Sacramento Peak Observatory; and the High Altitude Observatory of the University of Colorado, under AF sponsorship.



PATH OF TOTALITY of eclipse of October 12, 1958 and location of observation sites.

Need Forces U.S. To Face Engineer Shortage

Demands of missile technology bring greater pressure for solution; some action started, but slow results

by Erica Cromley

There are 85 times as many jobs for scientists and technicians in the United States today as there were 80 years ago. But there are only five times as many workers in the total labor force.

Although an increasingly larger percentage of the work force goes into science and engineering, the scientific-manpower supply, hit hard during the Korean war, continues to be short.

An increasingly large percentage of newspaper "help-wanted" columns are appealing for skilled help. On one recent Sunday, the N.Y. TIMES ran 728 individual ads by missile, aircraft and electronic companies for engineers and scientists, the majority listing multiple openings. Of these, 253 were for electronic engineers. Salaries listed ranged between $9,000 and $15,000, with a few going to $25,000.

The scramble for top-drawer technicians from comparatively slim available supplies has forced industry to bid up pay rates, add fancy fringe benefits, resort to "body snatching" from one company to another. It has brought pressure on government and education to find answers.

While some existing U.S. government programs were stepped up and budgets increased after *Sputnik* was launched a year ago, the only dramatic, significant action by the government was the National Defense Education Act of 1958—and that had rough going. In place of the nearly $100 million for scholarships, Congress compromised on student loans, although in the past such available loan money has had comparatively few takers.

Industry also has been stepping up its own training and education-aid programs for some years.

• **Outlook dark**—There is today a sufficient number of run-of-the-mill technicians and engineers; a shortage of top-notch, creative men—both those with broad, well-rounded engineering backgrounds and those in certain specialties. However, indications are that in a few years industry may find both top and bottom rungers in short supply.

The Scientific Manpower Commission reports an "acute shortage" in these fields: electronics and electrical engineering, mechanical engineering, physics and mathematics; a "moderate shortage" of chemical engineers and chemists.

The U.S. Employment Service's Professional Service, a "last resort" for industrial recruitment, recently reported 1,700 openings for electronic and electrical engineers, 1,650 for mechanical engineers. This is considered only a small fraction of the total demand, since the vast bulk of industrial hiring is done through the companies' own personnel recruitment programs and through professional societies.

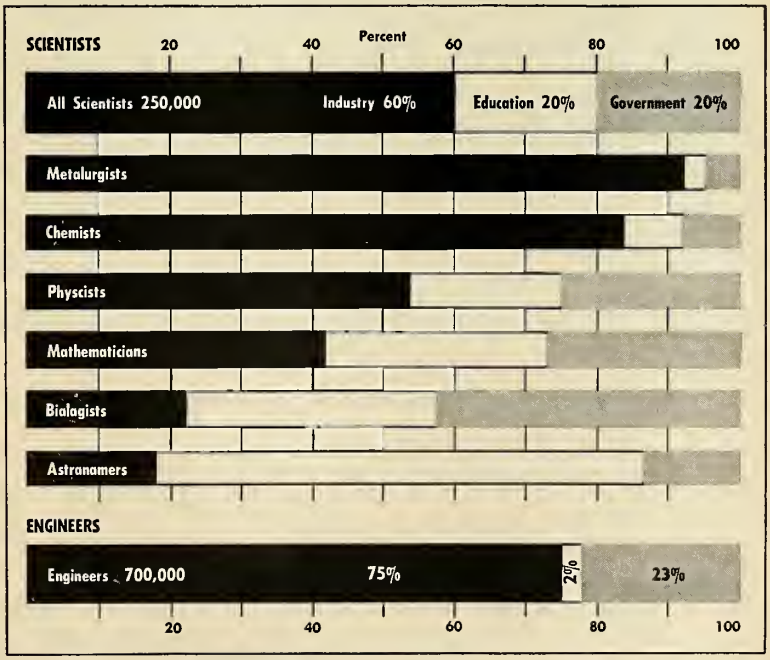
• **Getting worse**—Although the engineering ranks swell each year, the President's Committee on Scientists and Engineers predicts continuing problems for the next ten years. Skilled help needs will increase because the population is increasing at the rate of 3 million a year, the standard of living is expected to go up, and continuation of the cold war means continuation of sharp economic competition.

While the demand goes up, the problem will be compounded by the lower reservoir of young manpower brought on by the skimpy birth rate of the depression. This "lean generation," now being graduated, will not begin to fill the skilled-labor gaps. By 1965, there will be 700,000 fewer men between age 25 and 34 than there are today.

U.S. problem is one of education

In the *Sputnik*-spurred reappraisal of its educational system, the world's most technically advanced nation can find small comfort for the future:

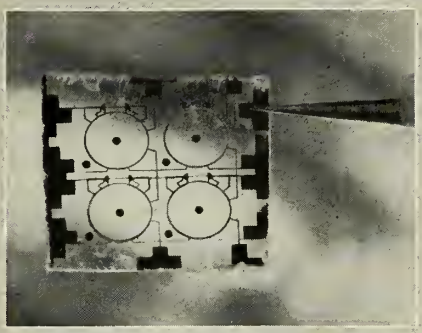
We graduate 34,000 engineers annually to Russia's 80,000. Soviet secondary school students get five times more hours of science and math than required for entrance to a top-notch American college. Fifty-three percent of a Russian student's school year is devoted to science, while a recent survey shows that less than 1/3 of our high school praduates had taken one



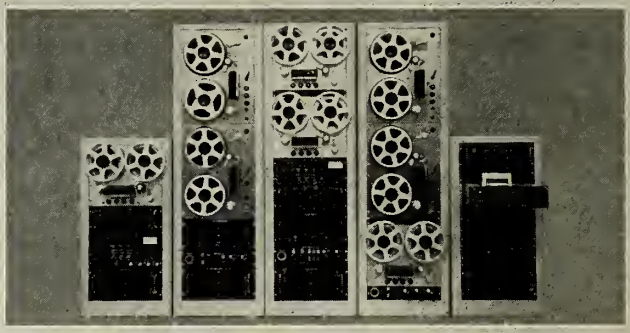
MAJORITY FIND EMPLOYMENT in industry in most engineering fields.

Horn fed parabolic reflector antenna for airborne applications.

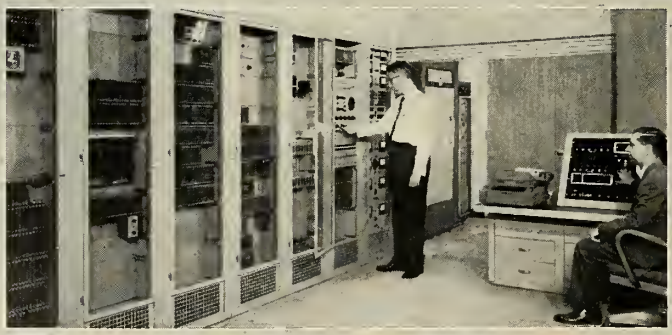
Charged aluminum particle suspended and controlled in a vacuum chamber by an oscillating electric field.



The Persistor gives promise of cryogenic computer memories with a capacity of 1,000,000 bits per cubic foot and access times of 1/30 microsecond.



Ground based data handling equipment for processing analog and digital reconnaissance information.



Data conversion system for digitizing and processing telemetered missile test data.

Electron micrograph of impact produced on aluminum coated glass by a 1 micron diameter particle traveling at 7,000 feet per second.

Pictorial **PROGRESS REPORT**

The photographs above illustrate some of the recent research, development, and manufacturing activities at Ramo-Wooldridge. Work is in progress on a wide variety of projects, and positions are available for scientists and engineers in the following fields:

- Digital Computers and Control Systems
- Communications and Navigation Systems
- Guided Missile Research and Development
- Infrared Systems
- Electronic Countermeasures
- Electronic Instrumentation and Test Equipment
- Basic Electronic and Aeronautical Research

The Ramo-Wooldridge Corporation

LOS ANGELES 45, CALIFORNIA

...engineer shortage

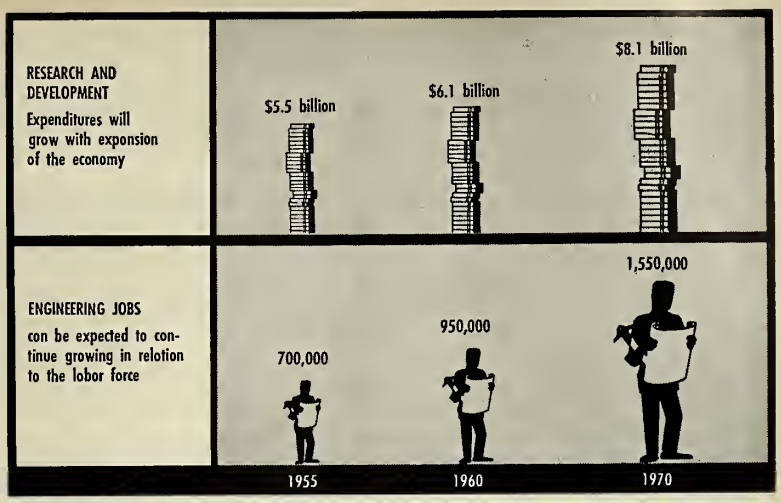
year of chemistry, about ¼ had a year of physics and only one in 15 had taken advanced mathematics.

Foreign language study is compulsory in Soviet schools while only 14% of our students study a modern foreign language (of which 13% is French and Spanish). Only 16% of the engineers with a bachelor degree go on to a master's; only 5% to a doctorate.

The U.S. now faces a shortage of nearly 1,000 engineering teachers, with 9,500 new teachers required by 1966.

A report issued by the Rockefeller Brothers Fund warns: "By 1969, high schools will be deluged with 50 to 70% more students than they can now accommodate; by 1975 our colleges and universities will face at least a doubling and in some cases a tripling of present enrollments."

One possible leak between the high school desk and the engineering table was found in a national survey showing that almost half of the top 1/3 of graduating classes does not go on to college. (The Science Manpower Project of Columbia University, in a study of New Jersey high schools, found that about 1/3 of the top-quarter students named a career in science or engineering as their first choice.)



R&D Funds will increase by almost 50%, engineering jobs will more than double by 1970.

• **Pinning down the problem**—The House and Senate education committees this past session held hearings and collected data that together covered 3,671 pages, before writing an aid-to-education bill. Witnesses represented industry, education, government.

Although there was some disagreement on solutions, there was general agreement on the problems:

Industry's need for top-flight people in science and engineering would require more qualified teachers; The tapping and training of students with interest and intelligence; The stimulation of interest during the early high school years; The better utilization of currently employed engineers and scientists, plus additional training; More comprehensive math and science courses with higher standards required of students.

• **Sifting out solutions**—There were 26 education-aid bills introduced in Congress this year. Although some industry associations opposed it, much support was given the Administration's proposal for federal scholarships to top-flight students aiming for scientific and engineering careers. As originally written, the bill called for expenditures of over $800 million, covering a period of five years, including $97.5 for scholarships.

The National Defense Education Act, shorn of scholarships, authorized expenditures of $294.5 million in loans, out of a total $880 million to be spent over a four-year period. The National Association of Manufacturers, testifying against the bill, protested that student loan money has been going begging.

(A 1955 survey showed that of $14 million in various loan funds available to students, only $5.3 million was used. However, federal loans are given with more liberal terms than most—3% interest, with ten years to pay starting one year after graduation.)

NAM was one of many organizations which argued that while there is a shortage of *highly competent personnel*, "there is now no convincing evidence that an actual over-all shortage of scientists and engineers exists."

The Aircraft Industries Association also stressed that the need for top-flight people is more urgent than swelling the engineering ranks generally.

New laws may be some help

In addition to loans, the new education-aid law provides money for fellowships, guidance and counseling, new equipment, foreign language development, grants to states for supervisory services, research or modern education aids, a science information service and area vocational education programs.

Although this is the most comprehensive and ambitious Federal education project in the nation's history, it is considered by some educators to fall far short of what is required. Although general sentiment at HEW is "satisfaction" with this first step, one official said: "We needed a mountain and got a knoll."

The Office of Education plans to come to Congress again next year with another proposal for federal scholarships.

One other post-*Sputnik* government move in education was to triple the National Science Foundation's education budget to $62-million, of which about 20% goes for advanced scholar training and 60% for training of science teachers.

Several new programs have been started, including summer study courses for graduate teaching assistants and experiments with new approaches to science training.

• **Existing programs**—Although steps taken by the government fall far short of the drastic action predicted after *Sputnik*, industry and government's existing programs to ease the scientific manpower shortage have been picking up momentum.

• The Scientific Manpower Commission and the Engineering Manpower Commission of Engineers Joint Council, both formed in June 1950, have coordinated their activities to promote careers in their fields and to better utilize available manpower.

The commissions support efforts to recruit and train good high school teachers, encourage study of math in

high school and make manpower surveys.

• President's Committee on Scientists and Engineers. Organized in March 1956, the function of this group was to bring together influential private organizations of industry, labor, education, and professional societies to "foster the development of more highly qualified technological manpower." The committee, whose tenure ends in December, has been stimulating local action groups in communities to interest children in taking math and science and to improve those courses available. It spurs such scientific youth activities as junior science clubs, student science fairs and science day camps.

• Health, Education and Welfare. The Education Office assists in student counseling, conducts research studies, surveys various phases of science education, and makes available brochures and pamphlets such as bibliographies of new books in the scientific fields.

• **Industry participation**—Although no dramatic new programs have emerged lately, industry has been taking a much more active role in the last ten years to increase the quantity and quality of the high-grade help it needs.

Last year corporate donations to higher education were over $150 million. Other forms of industrial support include financial assistance to teachers, contributions of teaching aids and supplies, consulting services.

A NAM survey of its members showed that industry participation is on the upswing. Among 600 companies replying to a 1955 survey, 50% were cooperating with the science and mathematics departments of the local high schools; the following year it had jumped to 76%.

Some corporations pay the tuition of their young engineers and scientists who are working toward advance degrees and will allow them to devote a certain percentage of their on-job time to work on research of their own choosing.

An Aircraft Industries Association survey showed that for the 1956 school year, 23 aircraft and missile companies spent $480,000 for college scholarships and were planning to spend almost twice that much for 1957; $13.7 million was spent for formal classroom technical training over and above the "on-the-job-training" programs. AIA firms conduct over 1,500 courses for supervisors, engineers and technicians, costing the industries over $13 million in manhours alone, in addition to the cost of instructors and facilities. Most of these companies are planning expansion of their training facilities.

Future looks a little better

The U.S. Office of Education in its first survey of junior-year students by field of study, estimates that there will be one-third as many science and math degrees awarded next June as in June 1957.

The Engineering and Scientific Manpower Newsletter has stressed that " . . . the major problem is no longer one of student recruitment, but of educational quality all along the line and the provision of adequate facilities and faculty for higher education in engineering and science."

The National Science Foundation in a recent report concludes: "Some notable progress has been made and some major accomplishments undertaken . . . this is not a single emergency but a continuing—possibly a permanent—one . . . we have only made a beginning: the major job is still to be done."

With consumer and defense needs rising while the nation faces a decrease in its young manpower supply, both industry and government are up against a challenge unique in the country's history. Automation will be only a partial answer. Until the electronics firms come up with a computer that can think creatively, the innovators will be at a premium and the Help-Wanted ads will continue to increase.

Although the number of PhD's in engineering remains low, the number of engineering enrollments has increased considerably. In September 1957, freshmen in engineering numbered 79,000 and total undergraduate enrollment for engineering degrees was 269,000, an increase of 7.2% over the previous year. This compares with an increase of 4.1% for all college enrollment.

The number of engineering bachelor degrees awarded increased 18.6% over the year before; masters degrees rose 10.8%, but the number of doctorates awarded declined 2.3%.

It is worth repeating the need: Although a year has passed since *Sputnik* I, we are still short 135,000 teachers—and the shortage is greatest in the fields of general science and mathematics. Teachers—as well as students—must be trained and brought into the field.

Missile Aids Escape Studies

SUPERSONIC, THREE-PRONGED *"CREE"* will enable Air Force engineers to study first stage parachutes for manned aircraft escape capsules, missiles and drones. Developed by Cook Laboratories under a ARDC contract for Wright Air Development Center. *Cree* will eject three parachutes backwards at altitudes between 30,000 and 150,000 feet at speeds from 1,520 to 3,040 mph. The three test missiles are mounted on a ground-to-air missile booster unit. Telemetry data received includes speed, altitude, temperature and other atmosphere information.

FORD INSTRUMENT CO.
DIVISION OF SPERRY RAND CORPORATION
Long Island City 1, New York

MISSILE SYSTEM CAPABILITIES

FORD INSTRUMENT

JUPITER JUPITER C REDSTONE

missile experience...

includes systems, subsystems and components for many of our country's most advanced missiles

Ford Instrument Co. is currently engaged in research, development, and production on a wide variety of missile projects. Notable among these are the complete inertial guidance and control systems for the Army REDSTONE and JUPITER missiles; many such components for the satellite-launching JUPITER C; launching and control order computers for the Navy's TERRIER and TARTAR missiles; Air Force missile projects, including a no-gimbal inertial system; and a wide variety of ground support and production test equipment.

Today, Ford Instrument has the experience, facilities, and capabilities to enable it to undertake complex missile contracts of every type from component or subsystem to complete weapons system. And, as a Division of Sperry Rand Corporation, Ford Instrument's own weapons skills are backed up by the resources of a vast and diversified organization of complete technical and financial responsibility.

TERRIER Missiles on U.S.S. Boston. Ford Instrument-built computers solve launching and control order problems for this beam-riding missile. U. S. Navy Photo.

U. S. Army JUPITER (left) and REDSTONE Missiles. Cover shows satellite-launching JUPITER C. The guidance and control systems for these ABMA missiles were developed and produced by the scientific team at the U. S. Army Ballistic Missile Agency and Ford Instrument Co. U. S. Army Photos.

More than four decades of military systems engineering insure operational equipment . . . whether systems, subsystems or components

FORD INSTRUMENT missile abilities

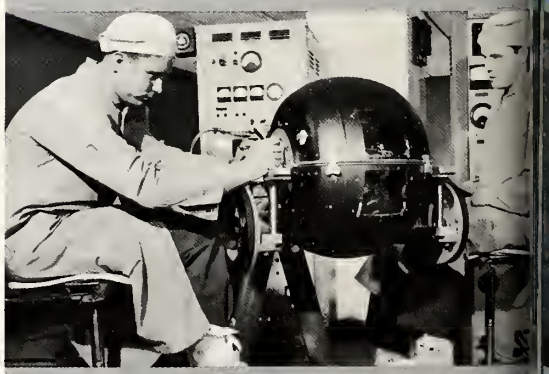
A unique combination of electronic, electrical and mechanical skills, devoted since 1915 almost exclusively to furtherance of military science, is the basic strength of Ford Instrument Co. Almost all of Ford Instrument's existence has been devoted to research, development and production of highly complex equipment, with laboratory precision and accuracy, yet able to withstand the rigors of military environments.

The proven reliability and extreme accuracy of the REDSTONE and JUPITER missiles, which employ guidance and control systems built by Ford Instrument—as well as the record of the JUPITER C —indicate clearly the company's capabilities in the area of guidance and control.

Another recent example of this type of work is Ford Instrument's design and manufacture of intricate warhead safety, fuzing and arming devices capable of withstanding the roughest environments. Few manufacturers are willing or able to undertake projects such as this and to carry them to completion. Ford Instrument has earned the reputation—which we are proud to acknowledge—of being able to do the "toughest jobs" in missile development and manufacture.

Contracting agencies or industries, with requisite security clearance and "need to know," are invited to examine further Ford Instrument abilities in difficult phases of missile research, development and production . . . whether for complete systems or specialized subsystems and components.

Warhead devices for missiles and other modern weapons. This precision warhead device (inset) made by Ford Instrument, successfully withstood atmospheric re-entry in the nose-cone of an Army JUPITER missile, shown here shortly after recovery from ocean.

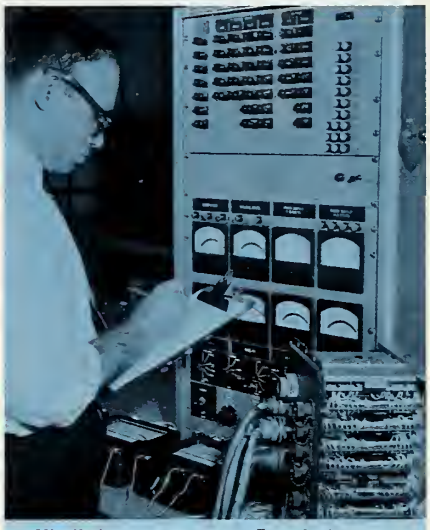


Stable platforms. Technicians here are performing test operations on a stable platform for the U. S. Army JUPITER Missile; these platforms are in quantity production at Ford Instrument.

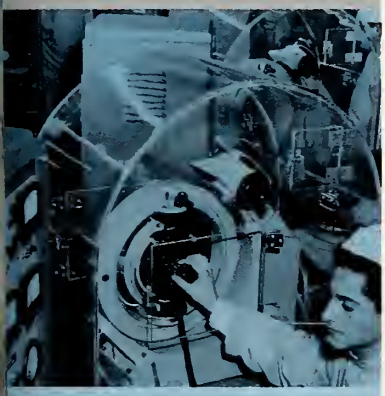
Launching and control order computers for TARTAR Missiles. Electronic and electromechanical portions of this all-transistorized modular computer are shown at left and right.

Actuators for jet vanes, air control-surfaces. This rotary actuator is driven by 1 hp d-c servo motor (shown in foreground with cable attached). Both motor and actuator are made by Ford Instrument.

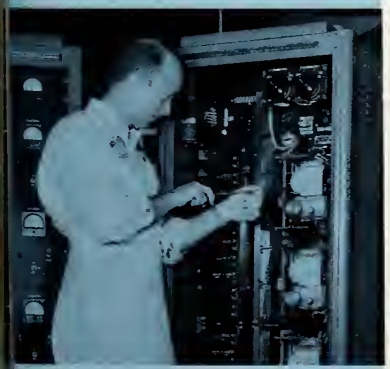
Missile-borne inverter. Vital missile component gets rigorous, precision performance checkout at console. All of the missile products delivered by Ford Instrument undergo full and complete testing procedures.



Missile-borne computers. Ford Instrument computer experience covers every phase of ballistic missile guidance and control. Typical is this control computer, shown during test, for U. S. Army JUPITER.



Specialized gyros and accelerometers. Ford Instrument pioneered in the quantity production of air-bearing gyroscopes and accelerometers. Air-bearing gyro here undergoes final test in special Ford-built test equipment.



Ground support equipment. Here pre-launch computer undergoes final adjustment. Modular techniques enabled this unit to be produced and delivered in less than 6 months.

current missile projects and equipment

SYSTEMS

- Inertial guidance and control systems and related ground support equipment
- No-gimbal pure integration inertial system
- Launching and control order computers
- Command guidance systems (for both missile and drone applications)
- Trajectory data system
- Missile velocity indicating system for test range applications
- Target locating system
- Radar target prediction and interpretation systems

SUBSYSTEMS (Missile-Borne)

- Safety, fuzing and arming devices
- Stable platforms
- Computers (control computers, guidance computers)
- Programming devices
- Inverter-regulators
- Transmitters

GROUND SUPPORT EQUIPMENT

Maintenance area, launch site and monitoring equipment, including:

- Impact prediction computer
- Aiming correction computer
- Pre-launch computers
- Test panels for computers and stable platforms
- Shipboard dynamic testers
- Monitor panels for guidance, stable platforms, alignment, and laying
- Test fixtures for a wide variety of components
- Combined sensor displays

PRODUCTION TEST EQUIPMENT

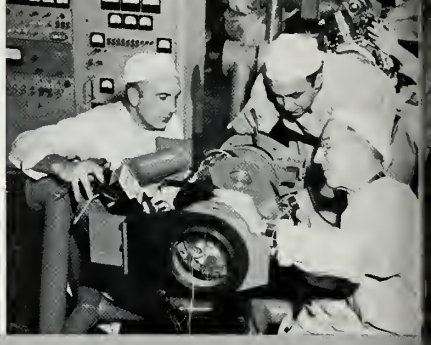
Systems and component test equipment including:

- Special environmental test units
- Quantity production test units
- Planetary test stands

SPECIALIZED COMPONENTS

- Gyroscopes
- Accelerometers
- Actuators
- Mechanical integrators
- Transistorized amplifiers
- Relay packages
- Computer modules, both analog and digital, for a variety of missile problems
- Timing devices
- Shipping and storage containers

Drafting. One of Ford Instrument's many drafting departments, where topflight design draftsmen and technicians support research and development and also produce production drawings.



Technicians perform final checks on stable platforms for U. S. Army REDSTONE Missile in ultra-clean assembly area.

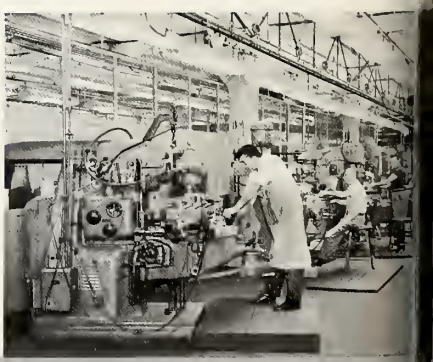
FORD INSTRUMENT

Extensive production and laboratory equipment implement engineering skill

Ford Instrument physical facilities make it one of the largest high-precision shops in the United States, fully equipped to handle every phase of development and production of complex missile systems. Initial studies, research, development, design, prototype construction and testing, final quantity production and quality control are expedited and facilitated by the most modern and highly developed equipment available for precision work.

Contracting agencies and industries possessing requisite security clearance are invited to make an on-the-spot inspection of Ford Instrument facilities.

Equatorial test stand, built by Ford Instrument for its own laboratory facilities, is used for conducting basic drift error research. This type of unit can also be built to contractor order.



Many hundred standard machine tools, a few of which are shown here, are available at Ford Instrument for missile applications, as well as a wide variety of special machine tools.

Missile-borne tape programmers being assembled. Continuous development in this field is under way at Ford.

Air-bearing gyro accelerometer is tested here in Ford designed and built special fixture.

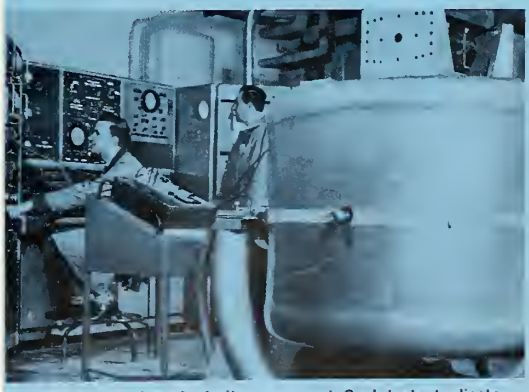
"Univac" computer is one of the general-purpose high-speed digital computers at Ford Instrument for engineering computations.

missile facilities

Typical of Ford Instrument Facilities:

- More than 30 laboratories for research, development and design in electronics, hydraulics, magnetics, mechanics and nucleonics, including fully equipped, ultra-clean gyro facilities.
- Advanced digital computing facilities with high-speed general purpose computers, including a Remington Rand "Univac." Ford Instrument scientists also have access to computing facilities of the Remington Rand Univac Division.
- An engineering shop, as large as many small manufacturing concerns, staffed by expert machinists and technicians, working under direct engineering supervision. The company also has fully staffed and equipped "short run" and prototype shops.
- Full production facilities—machine tools, shops, finishing and inspection facilities—for *large-scale* precision manufacture.
- A series of "clean rooms" for assembly of missile components. These rooms are dust-proof, temperature and humidity controlled areas with full environmental control procedures.
- Complete, elaborate environmental and other test facilities.

Giant centrifuge in special building at Ford Instrument can attain 60G's. Complete stable platforms—as well as components—are tested in this unit.



Vibration testing of missile component. Such tests duplicate inflight environments that components undergo when missiles are fired.

A special machine is used to mill irregular internal contours by an "electrical discharge" method, with extreme dimensional accuracy.

Technician grinds gyro part to a length within 20 millionths of an inch—typical of tolerances being met in missile work at Ford Instrument.

Engineering Shop. This shop makes breadboard models and other experimental products. It has much specialized equipment, e.g., toroidal coil winders, lapping equipment, in addition to standard machine tools.

Over four decades

of exacting weapons

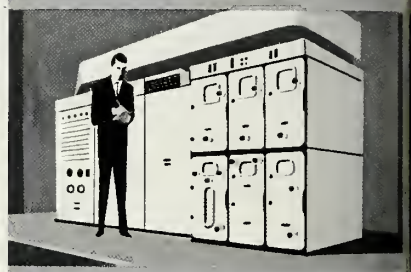
control systems

FORD INSTRUMENT related experience...

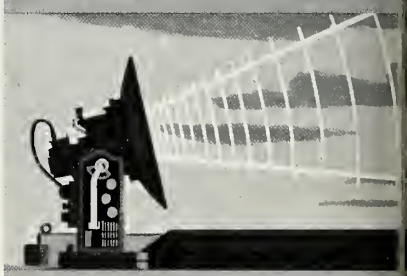
Ford Instrument Co. has been devoted to weapons control since its inception, originally pioneering computers and other automatic equipment for direction and control of naval gunfire. Today, Ford Instrument develops and produces equipment of wide variety for every branch of the armed forces and the U. S. Atomic Energy Commission, both directly and as a subcontractor through major manufacturers. The illustrations here give a small cross-section of the many hundreds of activities (other than missile) under way at Ford Instrument.

Ford Instrument welcomes inquiries from responsible contracting agencies in government or industry. Liaison engineers are available to discuss specialized requirements or to assist in generation of requirements for any service.

Navigation computers. Ford Instrument develops and produces automatic navigation systems for both U. S. Air Force and U. S. Army —for aircraft and surface vehicles.



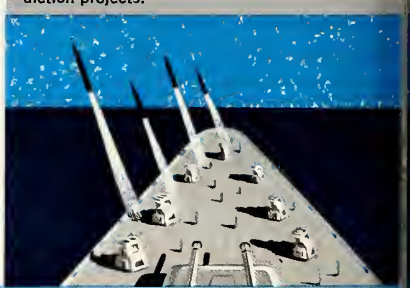
Special-purpose computers. Ford Instrument computers are in wide use in all branches of the armed forces.



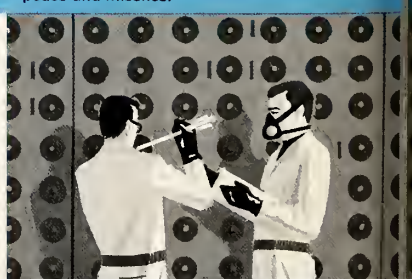
Telemetering and radar systems. A variety of projects at Ford Instrument range from "data-link" and other high frequency techniques—to radar intelligence interpretation and prediction projects.

Drone control. Battlefield surveillance aircraft are remotely controlled by Ford Instrument system (radar, transmitting, computing and plotting equipment).

Mission control systems. Latest results of operational research and linear programming theory are implemented by Ford Instrument techniques.



Rocket and gunfire control. Ford Instrument has developed and produced a tremendous variety of fire control equipment for naval and land-based guns and rockets, as well as torpedos and missiles.



Nuclear development. Ford Instrument nuclear activities include reactor designs, instrumentation, control systems (including studies of digital techniques in reactor control) and highly classified weapons projects.

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DIVISION OF SPERRY RAND CORPORATION

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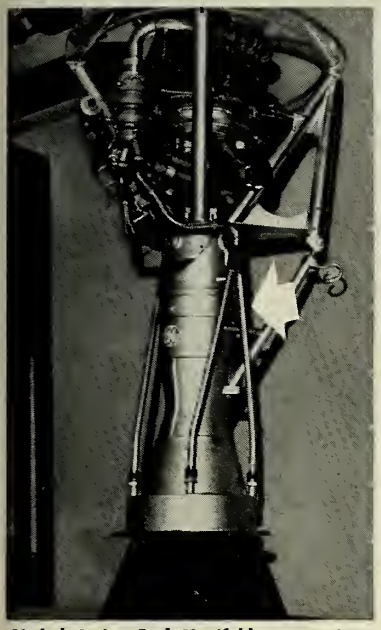

Gimbal Action Fuel Manifolds were developed by Aeroquip for the General Electric X-405 engine that powers the first stage of the Vanguard vehicle. Combination of Aeroquip 601 Lightweight Engine Hose and precision formed tubing solved the problem.

Hydraulic Lines for Portable Launcher used to send Nike-Cajun sounding rocket up from the Arctic Circle were made from Aeroquip Hose with Reusable Fittings. Aeroquip manufactures a full range of standard hose types for any fluid line application up to 10,000 psi.

Nitric Acid Transfer to Missiles was made safe with the development of Aeroquip 610 KEL-F Hose Lines with stainless steel fittings. Picture above shows KEL-F Hose being used for fueling the Navy Vanguard.

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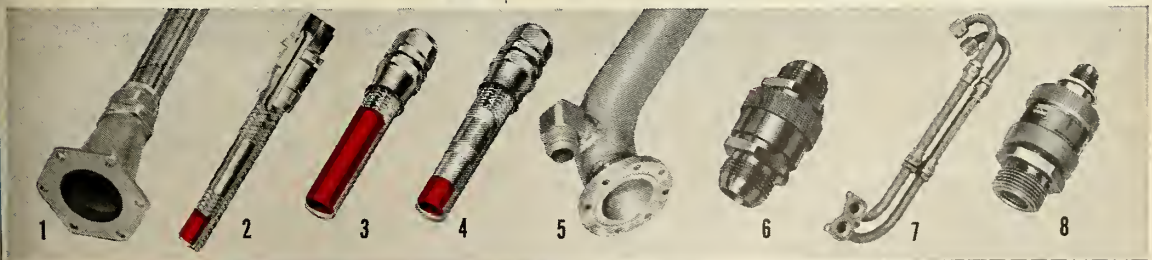

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Navy Not Discouraged Despite *Polaris* Failure

Despite the fact that the range safety officer had to destroy the *Polaris* test vehicle recently fired, the Navy is not discouraged.

"Reports that the missile corkscrewed all over the sky and was then destroyed are not accurate," a Navy spokesman said, "The missile behaved beautifully and was very stable."

"In fact," he continued, "this is the first time a solid propellant rocket of this size has been fired in such a perfect, stable, vertical flight. The trouble came from an extra motor, part of the test vehicle. This would not be part of an operational *Polaris*. It was supposed to angle the missile for flight over the Atlantic—it apparently went to sleep."

Rear Admiral W. F. Raborn, director of Special Projects, was reported "disappointed but not discouraged" by the partial success of the first full scale *Polaris*.

Meanwhile, the Navy is making improvements in the range safety precautions to preclude a recurrence of large pieces of the destructed missile falling in populated areas.

Nike-Zeus Testing Facilities Assigned

Central design agency for the test phase of the *Nike-Zeus* weapons system, as well as responsibility for the design of buildings, structures and utilities supporting the Army missile, is the Mobile, Ala. District of the Corps of Engineers. The facilities required are of varying complexities, and testing may be carried out under environmental conditions ranging from sub-arctic to tropical.

Soviets Invent Probe to Maintain *Sputnik* Stability

Soviet scientists have designed a probe for maintaining stable orientation of a satellite or rocket axis. In an article submitted to the JOURNAL of the Soviet Academy of Sciences, G. A. Leykin explains the functioning of this probe:

"In the case of an oriented body moving at supersonic speed in a highly rarefied medium, a probe of comparatively simple design seems possible. In this case, it is possible to make use of the fact that the thermal velocities of the particles in the medium, although their speed is much less in relation to the body, are still high and cause erosion of the corpuscular umbra. The higher the ambient temperature, the greater the erosion.

"The simplest probe of this type can be made in the form of a tube."

propulsion engineering

by Alfred J. Zaehringer

Monopropellant work areas at USNOTS, China Lake, are concerned with the thermal decomposition of Two-nitropropane and the pyrolysis of acetylene by free radicals. Two-nitropropane decomposes in a first-order reaction to give propylene, nitric oxide, and water—indicating that this monopropellant is underoxidized. Acetylene compounds have long been eyed as monopropellant materials. Big catch has been a lack of understanding in kinetics of decomposition and stability.

Design of supersonic expansion nozzles for chemically reacting gases requires thermodynamic systems analysis. Ohio State University finds isentropic gas exponents for reaction in nozzles radically different than from gamma—the ratio of specific heats. Caltech has also been working with fast chemical reactions in supersonic nozzles.

Shock wave experiments are being used by the Soviets to study the dynamic compressibility of metals at pressures of 400,000 to four million atmospheres. Extrapolation leads to compressibility curves to 40 to 400 million atmospheres.

More superperoxide work has been reported at Lomonosov University at Moscow. According to the Russians, hydrogen superperoxide breaks down into ordinary peroxide and oxygen and liberates some 68 kcal/mole of oxygen.

Titanium for solid rockets? Rem-Cru and Titanium Metals Corp. have been working on high-strength (160,000-200,000 psi), thin, weldable sheet titanium. The sheet alloy contains 4% aluminum, 3% molybdenum, and 1% vanadium—the rest is Ti. Good high temperature corrosion resistance is viewed. Both steel and aluminum alloys are now widely used for solid motors.

Boron polymers for solid propellants may be a distinct possibility. Pyrolysis of diborane can yield various fractions of boron hydrides, says American Potash & Chemical. Very little, however, is known about such polymers above $B_{10}H_{14}$. Such pyrolytic polymerization takes place at temperatures of 194-250°F and pressures of ½-1 atm.

Study of mixed, solid oxidants is being conducted at Picatinny Arsenal. Thermal studies of perchlorates and nitrates—at temperatures up to 325°C—could lead to improved physicals in one oxidant composite systems. Mixed oxidant solids aren't too popular in the U.S. On the other hand, the USSR is pushing hard on two and three oxidant solid systems in an effort to improve operations at both ends of the spectrum—phase changes at low temperatures and stability and decomposition at the near-ignition hot end.

Critical diameter for ammonium nitrate propellants has been confirmed by du Pont and University of Utah. Mixtures of AN and hydrocarbons can be exploded. This indicates the caution that the solid people will have to face in the scale-up of large AN booster rockets.

Water in missile fuels is a problem with the RP-1 petroleum based stocks. The problem is even greater than that experienced with ordinary jet fuels. Reasons: heavy distillate stocks are hydrophilic, have high densities that keep water from seperating out, and often water drops are kept emulsified by electrical charges. Result: at low temperature, the water freezes, changes viscosity of fuel, and sticking occurs in lines and orifices. One way out is to filter all fuel periodically. Present line of US ICBM's and IRBM's use this fuel.

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Missile Ground Support **MOBILITY**

NO JOB'S TOO TOUGH—WE DELIVER ON SCHEDULE

Take the case of the U.S. Air Force's (IRBM)—THOR missile project. FMC's design engineers developed the transporter-erector and launcher portion of the ground support equipment with Douglas Aircraft Company, Inc., prime contractor. The first units were engineered, manufactured and delivered in just eight months—2 months ahead of schedule.

FMC is not looking for "crash programs," but when the need arises, we go all out to meet deliveries. The delivery deadline for the THOR transporter-erector, launching base, and power-pack trailer was met because FMC handled the complete project—design, engineering, and production—with experienced people, at a single facility devoted exclusively to military equipment production. *Consult with FMC at the initial stage of project planning.* Contact us today for full information.

Creative Engineers: Find stimulating challenge at FMC's Ordnance Division.

Missile equipment takes to the air in Air Force's giant C-133 transport which flew FMC-built Thor ground support equipmen from West Coast to test site at Cape Canaveral, Florida. First load (upper) takes 65' launcher-erectar section. Launching base and power-pack trailer (above) were flown in a second shipment.

Putting Ideas to Work

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Ordnance Division

Missile Equipment Section 1-F

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missile business

by Donald E. Perry

Even though Air Force is buying missile spares on a relatively small scale compared to airplane spare procurement, it's still high-dollar purchasing.

Lt. Gen. C. S. Irvine, deputy chief of staff, materiel, points out in Air Force's 1959 budget estimate, missile spares represent 8.8% of the actual hardware portion cost.

Method of handling spares is contrary to past philosophy on airplanes. Air Force has no intention, according to Irvine, of placing missile spares in depots. Rather, the plan is not to have spare parts any place except where the operating missile is located. If a component goes bad, it will be returned to the manufacturer's plant. The intention of stocking package components from engines on down to smaller items will be done on "a strictly commercial-type operation," Irvine said, with the factory being the warehouse for spares.

It's interesting that Air Force, which is carrying $9.8 billion in spares (to be used in a four-year period), spends roughly 20% of spares acquired in a year, with 80% being the repairable type items which are returned to various systems.

Irvine said if missile programs stabilize, it may be necessary as in the case of *Thor* running out of production, for Air Force to buy life-of-type spares to finish out the remaining *Thors*.

Department of Defense will spend $2 billion more in FY 1959 than in 1958, but the cash outlay for missiles and aircraft will be about $30 million less. Total expenditure planned is $40.9 billion, compared with $39 billion. Expenditures for aircraft and missiles will be $10.9, compared with $11.2.

A Senate Small Business subcommittee estimates that smaller firms will receive less than two percent of $5 billion to be spent on prime missile contracts this year. After hearings earlier this year (m/r, June, 1958, p. 80), action was demanded from every service to improve procurement. Lack of adequate item specifications, and Pentagon practices of buying one item from one source, was cited by the subcommittee.

With industry in a decided business upturn from recession earlier this year, there is a growing tendency, even in the missile market, to go slow in rehiring or adding new workers. Many business leaders feel a cautious approach is necessary because there is no unanimity that the upturn is solid. This mainly applies to production workers, but there's still a demand—and a great one—for experienced technical help, with personnel requisitions stacking up high.

Expansions—Standard Steel Corporation of Los Angeles has opened a new $500,000 facility for alloy engineering and fabrication, principally for "vacuum-bottle-type" low temperature rocket-fuel tanks . . . **Martin-Orlando** is adding a $442,000 personnel office to its plant, and an additional 35,000 square feet of floor space. Expansion was apparently made necessary with receipt of prime responsibility for *Pershing* system . . . **Control Data Corporation,** Minneapolis electronics firm, has moved into new general offices and opened a new computer research and development facility . . . **Ampex Corporation,** San Francisco manufacturer of video and audio tape records, has leased an additional 63,000 square feet of floor space for engineering expansion . . . **Johns-Manville Corp.** has proposed a merger with **L.O.F. Glass Fibers Co.** on the basis of one share of its common stock for two and one-half shares of the other's stock . . . Construction has started on a 76,000-square-foot addition to **Sylvania Electric Products** electronic defense laboratory, Mountain View, Calif. . . . Fast tax writeoffs have been approved for major companies with heavy missile commitments. **The Martin Co.'s Denver Division** got four certificates covering research, development and testing of missiles, for $252,298, $577,000, $74,992 and $560,000.

contract awards

LAST MINUTE AWARDS

Republic Aviation Corp. has received $464,000 for intermediate range and intercontinental ballistic missile components.

NAVY

New York University, New York, N.Y., received $40,000 for research on the quantum theory of fields using group-theoretical and functional-theoretical methods.

Ferranti Electric, Inc., Hempstead, N.Y., received $50,000 for investigation of the feasibility of extending present delay line techniques into areas compatible with underwater acoustics.

American Institute of Biological Sciences, Washington, D.C., received $30,000 for symposium on ecological problems related to confinement in the true submersible or sealed space cabin.

Hydel, Inc., Cambridge, Mass., received $30,000 for research leading to a design and construction of a full scale high density writing and reading photographic storage device.

Aerojet-General Corp., Azusa, Calif., received $134,360 for Aerobee-Hi rockets.

ARMY

By Purchasing and Contracting Div., White Sands Missile Range, N. Mex.:

Delta Steel Bldgs. Co., Dallas, Texas, received $32,328 for Igor Tower, Malpais Spring, White Sands Missile Range, N. Mex.

Douglas-Aircraft Co., Inc., Santa Monica, Calif., received $128,326 for Blue Streak and emergency repair parts for tbe *Nike* system; $50,625 for repair parts for the *Nike* system.

AIR FORCE

by Headquarters, Air Force Office of Scientific Research, Air Research and Development command:

Bell Aircraft Corp., Buffalo 5, N.Y., received $115,734 for continuation of "Program of Exploratory Research Concerning Observation of Burning Propellants in Rocket Engines."

Ohio State University Research Foundation, Columbus 10, Ohio, received $48,775 for research on "Value Acts and Situational Variables in Organizational Behavior."

Cornell University, Ithaca, N.Y., received $54,816 for continuation of research on "Theoretical and Experimental Investigations in High-Speed Aerodynamics."

University of Maryland, College Park, Md., received $32,000 for continuation of research on the theory of scattering.

Boston University, Boston 15, Mass., received $28,343 for research on chemical properties of "active nitrogen."

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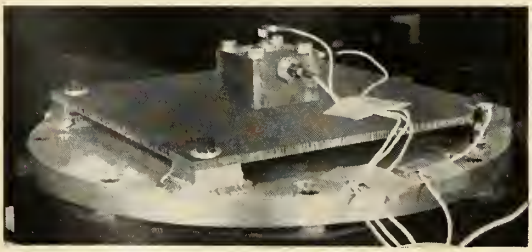

HIGH FREQUENCY VIBRATION TESTS prove resistance of Aeranca structures ta sustained G loads.

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New concepts in air weapon systems . . . both manned and missile . . . generate critical stress factors that exceed the limitations of conventional structures. New concepts in structures, therefore, are a fundamental need to advance air weapon technology.

Stainless steel brazed honeycomb structures produced by Aeronca are meeting many of the "impossible" specifications inherent in High Mach performance. This is no mere coincidence. Aeronca has pioneered in developing high-temperature honeycomb fabrications. As a result, we are one of very few companies capable of producing these specialized structures in quantity.

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Global Group Seeks To Perpetuate IGY Work

WASHINGTON—One of the more important actions at the recent meeting of the Bureau of the International Council of Scientific Unions (ICSU) here was the formation of a global scientific committee to devise means to perpetuate the cooperation in space research that has marked the International Geophysical Year.

The new committee, approved unanimously with West Germany absenting, will be known as the Committee on Space Research. It will consist of about 15 members with the United States and the USSR both members of the five-man executive committee.

As its main objective, it is charged with the duty of submitting to the next meeting (about a year from now) of the executive board of ICSU, a plan for coordinating space research and the exchange of information resulting from the research. An additional phase of work for the committee will be keeping an eye on programs for space control in the United Nations and elsewhere.

Members for the committee were chosen from nations launching satellites and those with other major rocket programs. Other members were picked from the nine international scientific unions taking part in space research and from three additional nations engaged in tracking or other aspects of space science. The three nations will be chosen on a rotating basis, indicating that the committee will last beyond the end-of-1959 date authorized.

In his opening remarks to the delegation, Lloyd V. Berkner of the United States, president of the Internation Council, said that "with the closing of the IGY, the basic question is raised whether international collaboration in space scientific research should be continued under the auspices of ICSU. Consequently, ICSU asked its members for their views on creating an ICSU committee on Space Research (COSPAR) to continue collaboration in planning of space research under ICSU following the IGY.

"The response has been favorable and the Executive board has authorized organization of COSPAR for the next year to aid in development of plans for space research on an international base of free scientific activity, and to report to the Executive board at its next meeting those measures needed for further international collaboration in space research."

All of this probably means that the equivalent of an IGY may exist for many years to come. The ICSU, under whose stimulus and sponsorship the IGY has been organized and conducted, works to accomplish its mission by coordinating the activities of its 13 member International Unions. It is non-governmental and seeks to operate outside the realm of individual politics.

One of COSPARS first moves will be to absorb CETEX, the Committee on Contamination by Extra-Terrestial Exploration, which specifies the conditions of landing on other planets that would keep contamination to acceptable levels. Another aim will be inducing nations capable of launching satellites, moon probes, or other spacecraft to reserve part of their payload for scientific experiments by other nations.

AIL Forms Department For Space Technology

NEW YORK—Airborne Instruments Laboratory—electronics division of Cutler-Hammer, Inc.—has formed a new department to handle activities in the space technology field.

AIL for some time has been working on a series of ARDC contracts calling for highly advanced electronic systems for the nation's space program. These contracts have now been grouped into a single activity under the name Project STAR (Space Technology and Advanced Research), and all work will be concentrated within department.

About 225 persons—more than 100 of them engineers, scientists and mathematicians—are working for the project, which will be headed by Winfield E. Fromm. Emphasis is on analysis of the operational problem, system design of both space and ground equipment, and reliability.

In outlining the program, Fromm said:

"Overcoming the known problems is a staggering assignment, but perhaps even more staggering are the problems posed by the unknown and the unique nature of space itself. We will have to develop sensitive equipment which will have to perform under the intense bombardment of cosmic rays and other forms of radiation, together with equipment that will contain bearing lubricants which will not evaporate in the vacuum of space.

We plan on developing instruments with parts that will not overheat when there is no atmosphere to help dissipate the heat generated in the equipment.

"Then there is the intriguing problem of equipment which will combat weightlessness. As the circling speed of the space vehicle balances out the pull of gravity, tiny bits of dust and other foreign particles, which ordinarily would remain harmlessly at the bottom or on surfaces of the equipment, will begin floating weightlessly about—each piece a drifting derelict, a potential trouble-maker in every precision mechanical and electronic assembly exposed to it."

Defense Electronics Buying Sets Record

Defense electronics procurement during fiscal year 1958 ended last June 30, totaled $4.050 billion and is considered by the Electronic Industries Association to be the largest amount spent by the military for electronics in a single year.

Based on its formula to extract that portion of military spending for electronics from all major defense procurement categories, EIA reports total expenditures in the fourth quarter (April, May, June) to be $1.187 billion, a considerable increase over third quarter buying of $969.5 million, and over the $967.5 million spent by the Armed Services for military electronics gear in the second quarter of FY 1958.

Cumulative spending for electronics by the Defense Department during the 12-month period, added to such expenditures since fiscal year 1951, shows military electronics procurement near the $23 billion level—or $22.807 billion—based on the EIA figures.

Intended primarily to be used to depict trends, and subject to later revision, the EIA computation shows the following electronic figures (in millions of dollars for fiscal year 1958).

Budget Category	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
Aircraft	$340	$346.0	$359.0	$401	$1,446.0
Ships-Harbor Craft	23	25.0	24.0	27	99.0
Combat Vehicles	1	—.2	—.1	1	1.7
Support Vehicles	1	.7	.6	2	4.3
Missiles	273	299.0	319.0	377	1,268.0
Elec. & Comm.	204	214.0	183.0	274	875.0
Research & Dev.	73	74.0	75.0	96	318.0
Miscellaneous	11	9.0	9.0	9	38.0
TOTAL (FY 1958)	$926	$967.5	$969.5	$1,187	$4,050.0
TOTAL (FY 1957)	$637	$876.0	$938.0	$1,055	$3,560.0

RYAN FIREBEES TEST AMERICA'S AIR DEFENSE IN FIRST WEAPONS MEET TO USE JET TARGETS

Ryan Firebees are the exclusive flying "bull's-eyes" for the Air Force Project "William Tell"—first weapons meet to use free-flying jet targets. 100 Firebee jet drones will test the pilots, planes, and missiles of America's air defense system under the most realistic "combat" conditions ever achieved.

Firebees will not only draw the fire of the nation's crack Air Force pilots: they will score the results in mid-air with a new electronics system. A running record of hits, misses, and near-misses will be instantly transmitted from Firebees to scorekeepers on the ground. Other Firebees will photograph missiles boring in—or streaking away if they don't score a "hit."

Pitted against the Firebees in this world-wide weapons meet will be the top Air Defense Command squadrons, flying Convair F-102, Northrop F-89J and North American F-86L interceptors. They will fire deadly Falcon guided missiles, and Genie and "Mighty Mouse" rockets.

Only the Firebee—the most advanced target drone—has the high performance, reliability, and extended duration needed for realistic weapons evaluation. In service with the Air Force, Navy, and Army, Firebees are flying in greater numbers and for more hours than any other jet target drone.

The Firebee is another outstanding example of Ryan skill in blending aerodynamics, propulsion, and electronics knowledge to produce a superior product.

RYAN BUILDS BETTER

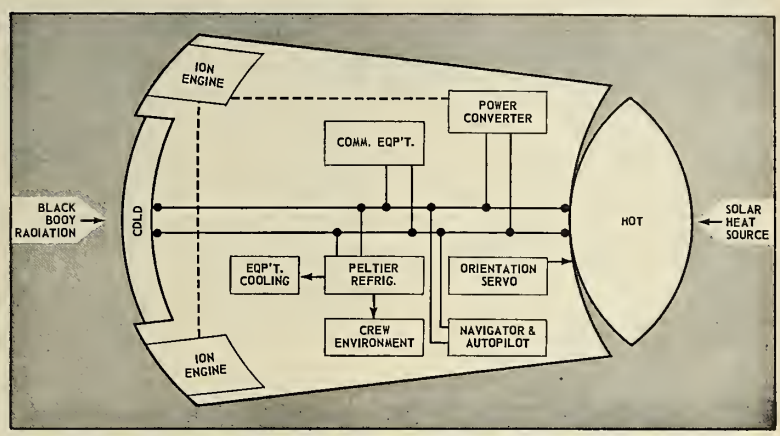
AIRCRAFT · POWER PLANTS · ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

Sun to Cool Spaceship Electronic Components

Solar Discs, developed by Northrop, could also power satellites by using well-known refrigeration principle.

by Raymond M. Nolan



NORTRONIC'S PROPOSED space ship would contain the various elements shown here.

The sun is to be used for cooling infrared sensors and other electronic components in a method now under development by the Nortronics division of Northrop Aircraft.

The cooling would be a byproduct of a solar-powered space vehicle, using principles of physics to develop electricity. Basic elements of the system will be a solar disc to provide power and a Peltier refrigerator to furnish the cooling.

Nortronics' space ship would use the sun to heat a disc, which would in turn be connected electrically to another element to radiate heat into space. The difference in temperatures would produce electricity, which would then power ion engines and operate other equipment in the vehicle. One piece of equipment would be a Peltier refrigerator which can cool without using refrigerants, and has no moving parts.

The principle that is used both to power the engines and to provide the cooling is known as the Peltier effect —one of several phenomena that occur when a current is passed across the junction of two dissimilar metals, or when different temperatures exist in the two metals.

• **How it cools**—The theory on which this effect is based uses the analogy that electrons are a more or less ideal gas. One result is that an electron gas may be subjected to a refrigeration cycle, where in heat is extracted from a reservoir at low temperature by a refrigerant which rejects it at a higher temperature.

Peltier discovered the phenomenon on which this analogy is based in 1834, when he observed that a voltage applied to a circuit consisting of two dissimilar materials resulted in the absorption of heat at one junction of the circuit and the emission of heat at the other junction. This—the Peltier effect—produces the cooling in the Nortronics device. A converse application where two materials are kept at radically different temperatures results in the generation of electricity.

M. B. Grier, Nortronics Project Engineer, in a paper entitled, "Thermoelectricity, New Horizons for Missiles," describes the development of tiny refrigeration devices which use the Peltier effect and speculates on the uses of the effect for powering satellites and other vehicles.

The tiny electronic refrigerator, capable of inducing a 50° (or more) temperature drop in sensitive electronic components, was developed by engineers in Nortronic's Advanced Planning Department. Two units have been delivered to the Navy for evaluation. The present refrigerators use conventional power sources, but future units for satellites or space ships will use power generated by a solar disc, also under laboratory evaluation at Nortronics.

• **Where to use it**—Grier points to the present method of cooling infrared sensors by liquid nitrogen as a good example of a spot where a Peltier refrigerator could be substituted.

The liquid nitrogen method is effective, but requires considerable space and has a definitely limited period of operation. For a satellite application requiring long-time "on" periods for the infrared sensor, he believes that Peltier cooling is the answer.

The refrigerator-photosensor shown in the accompanying illustration is mounted in an aluminized evacuated envelope. The refrigerator-cell assembly is mounted on thermally massive copper support discs, which in turn feed through an insulating support disc. The supports are equipped with cooling fins and lugs for fastening leads. The photodetector is a lead sulfide cell which is fastened to the cold junction.

The required driving voltage is about 250 millivolts at 10 amps, or 2.5 watts. Power for intermittent operation is a zinc-silver oxide secondary cell which furnishes approximately one volt with very high current for relatively long durations. A silicon rectifier could be used for continuous operation.

• **Solar receiver**—The solar disc (see block diagram) visualized by Nortronics engineers would take the form of an eyeball-shaped solar energy collector, servoed to continuously face the sun without moving the vehicle. The black-body radiator on the other end of the craft would be recessed slightly so that its acceptance angle for rays of the sun would be minimized.

The temperature differential which would exist would produce electrical energy. With this power, the vehicles would be propelled and would have self-contained power and cooling for communications equipment. A power converter would provide the voltages

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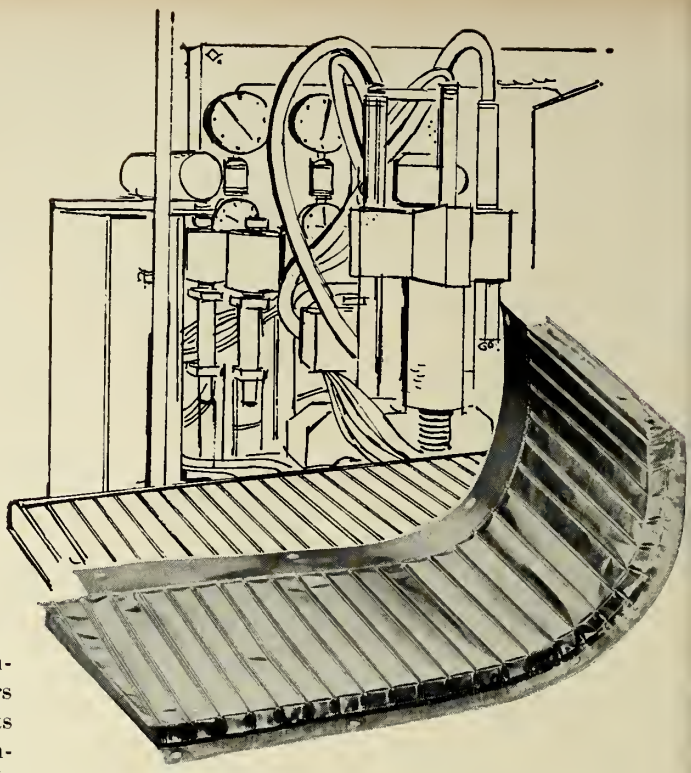
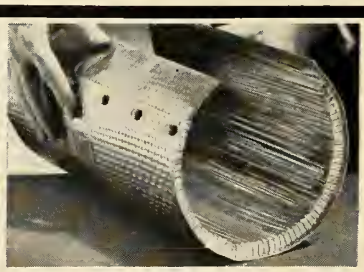


Leaders in the aircraft and rocket industries look to L·O·F Glass Fibers Company for the new developments in both thermal and acoustical insulating components, because this is the *only company in the glass fiber field* that performs all of the following:

starts with the sand . . . turns it into glass . . . draws it into fibers . . . forms them to specification . . . covers them with metal or plastic in custom fabrication.

L·O·F Glass Fibers Company fabricates insulation for thermal applications (up to 3000°F.) and a wide range of acoustical applications, including: de-icer duct insulation, tail-pipe and afterburner insulation, turbine case insulation, engine parts insulation, hot-air duct insulation, cabin-heater duct insulation, cabin insulation, structural insulation and bleed-air duct insulation.

Insulation blanket made with ½ inch of Micro-Quartz felt withstands the searing heat of a 2000°F. flame.



Wrap-around blanket, encased in stainless steel, shields hot-air duct at 600°F. Insulation will not pack, settle or crumble.

New Micro-Fail tape, made from Micra-Quartz felt faced with aluminum, protects parts too small for molded or shaped insulation.

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. . . sun to cool components

necessary for the ion engines.

One further use of the Peltier refrigerator would be in maintaining the proper crew environment if the ship should be manned. Cooling for comfort and dehumidification for moisture recuperation would be possible through the use of a portion of the electrical power generated by the solar disc.

Of course, there are serious limitations to the use of this effect for propulsion and high-power equipment.

One of the greatest would be the size of the "hot" part of the disc. Another would be the stability required so that the disc would face the sun at all times. However, Nortronics engineers feel that these are no greater than problems which face all designers of space vehicles.

• **Potential uses** — According to Grier, the Peltier refrigerator principle has a vast potential for both military and commercial applications.

It is possible, he says, to cascade Peltier units to obtain unusually high levels of refrigeration. This might provide the heat-sink method now being sought by almost all electronics designers where the extensive use of semiconductors and their serious drawback of thermal runaway poses a tough problem.

Transistor engineers feel that they can design almost any type and size of electronic device if something can be done about the heat dissipation problem, but most of the solutions now in use or under investigation use some type or another of metal heat sink. This just about nullifies the size and weight saving gained by the use of semiconductors.

One application which could benefit from Peltier cooling would be the high-power, low-weight static inverter presently on many drawing boards.

Static inverters do exist, but do not produce the power levels required by many of the larger guidance systems. It has been estimated that the inertial guidance and control system on an IRBM or ICBM requires about 2000 VA of well-regulated, 400-cycle, 110-volt power.

Most of these systems use standard motor-generator sets with large regulators to achieve the power they require, but problems such as size, weight and the interaction between gyros and the rotating inverter make a transistorized power supply look attractive.

The main drawback to this method, however, is heat dissipation. With Peltier units for cooling, energized from their own power source, the large static inverter could become a possibility. This, coupled with other electronic cooling, would result in significant weight reductions in guidance systems, either for the big missiles or for space vehicles.

PELTIER refrigerator used to cool infrared sensor.

• **Direct electricity?** Among the more promising of the applications for the thermoelectric generation of power is the possibility of converting directly from nuclear energy to electricity without intervening moving parts. To accomplish this, a heat producing isotope such as PO 210 may be chosen as the energy source which easily emits radiation such as beta or alpha particles.

In connection with this, it is interesting to note the testimony before Congress of Col. Jack Armstrong, Deputy Chief, Aircraft Reactors Branch, Division of Reactor Development, Atomic Energy Commission.

Col. Armstrong said, "SNAP III (Secondary Nuclear Auxiliary Power) is a very new one to us. We ran across some work that is being supported by the Navy and we took advantage of this. Its work is with Westinghouse, I think, as a result of some Russian work.

"We are trying to utilize this to provide an extremely light, an extremely small source of power for something like the *Vanguard*, or something of that type, and this is only three watts of electrical energy for six months and will probably weigh not over 10 pounds . . . This is a mixed valence oxide. These little pellets you see here, I have actually seen demonstrated. You put fins on one end to cool them, you apply heat to the other end and electrical energy flows out . . . That little gadget is about 8% efficient, but they feel that efficiencies can be increased up to 15% and, perhaps, to 25%.

"If this pans out, we would then use polonium as a radio isotope for a heat source on one side, and then we would have a very close approximation of conversion of atomic energy into electrical energy."

• **Smaller converters?** But even before some of the more advanced uses of thermo-electricity are in use, devices might be developed which take advantage of the Peltier effect. Currently the most direct method of conversion of electric energy from solar power is by means of the silicon solar cell. Such cells are currently yielding efficiencies of the order of from 8 to 14% and are light and highly reliable. Efficiency is reduced with increasing temperature, tests have shown.

However, Grier says that work at the Nortronics Laboratories indicates that it is possible to construct a thermoelectric solar converter which is comparable in efficiency with the silicon solar cell under free space conditions. The thermoelectric converters could be used with concentrators to increase their efficiency, resulting in increased utilization of power from the sun.

Many companies in the missile business are investigating the Peltier effect for application to their advanced projects, but most report that the main impediment to design so far has been the materials used to form the junction. Early experiments used iron and constantin, but power requirements were high and cooling capacity was low. Nortronics is reluctant to name the materials used in their units but a good guess would be Bismuth-Tellurium and alloys of Zinc-Antimony and Bismuth-Antimony.

Two companies investigating Peltier refrigeration are General Electric and Westinghouse, indicating that these units might some day appear in home refrigeration and air-conditioning units. The twin drawbacks of rare materials and high power consumption are the areas in which these companies are most interested. Solving either, or both of them, would constitute a real breakthrough in science, with immediate applications in the military and commercial fields.

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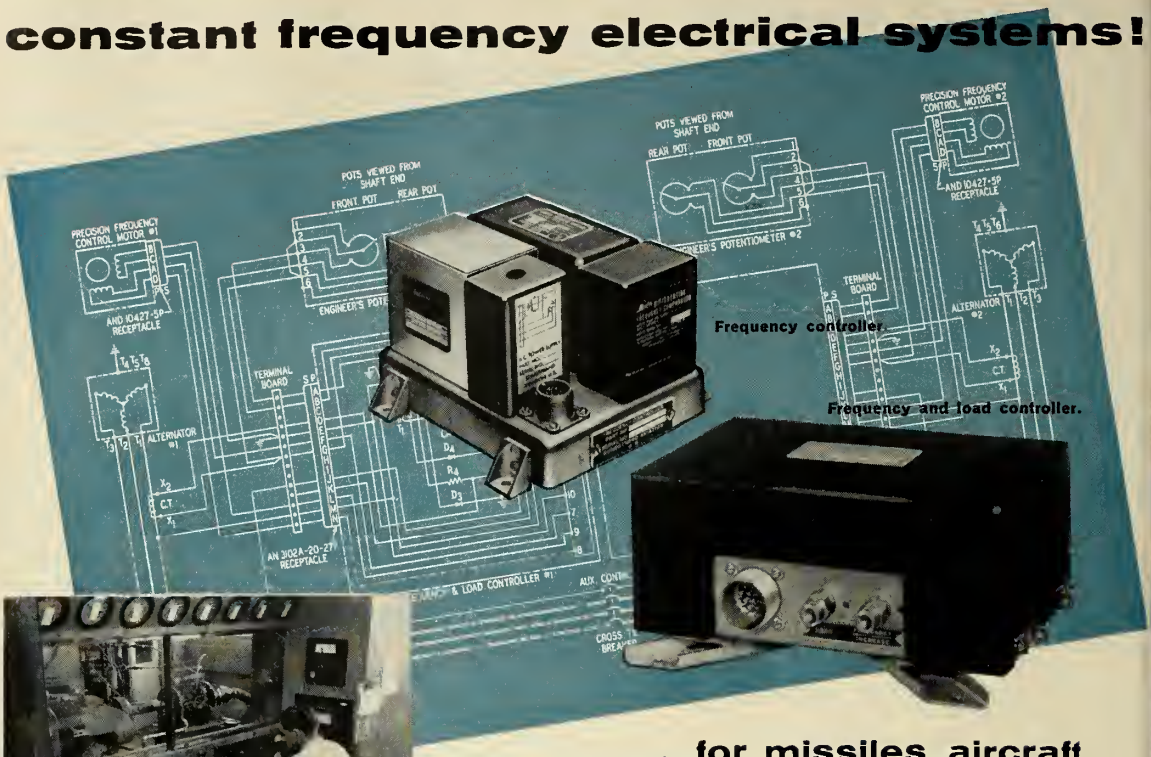

Operator's console for one of the constant speed drive test stands at Sundstrand Aviation.

Sundstrand controlled-speed variable-displacement hydraulic motor with alternator—for use with Sundstrand hydraulic pump to provide controlled frequency electrical power.

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IRE Makes Cash Awards For Six Technical Papers

Six cash prizes—$250.00 each—were awarded for outstanding technical papers given in Miami during the recent National Telemetering Symposium sponsored by the Professional group on Telemetry and Remote Control of the Institute of Radio Engineers.

The prize-winning papers are (in order presented at Symposium):

A transistor-driven Magnetic-Core Memory Using Non-Coincident Current Techniques, by R. L. Koppel, Lockheed Missile Systems Division.

A Transistorized Calibrator for Missile Telemetry, by Olin B. King, Army Ballistic Missile Agency.

Phase-Locked Demodulation in Telemetry Receivers, by D. D. McRae, Radiation, Inc.

New Design Philosophies in Dynamic Data Handling Systems, by Jerome J. Dover, Ampex Corporation.

Automatic Control of Power in a Scatter Communications System, by George S. Axelby and Eugene F. Osborne, Westinghouse Electric Corp.

Advanced Space Instrumentation Techniques, by R. V. Werner, Cubic Corporation.

All of the above papers are included in the proceedings from the meeting, obtainable from IRE's Professional Group on Telemetry and Remote Control.

In his paper on "A Transistorized Calibrator for Missile Telemetry," Olin B. King of ABMA described a transistorized in-flight calibrator developed for use with the *Jupiter* missile, and briefly discussed the requirements for in-flight calibration. The paper also outlined the history of calibration equipment used on the *Jupiter* as well as on the *Redstone*.

GE Continues Streamlining of Defense Electronics

Syracuse—A Defense Systems of General Electric Co. has been established by Dr. George L. Haller, general manager. This is the second major change in the division's structure in recent weeks. The first change involved dividing the Missile and Ordnance Systems Department into two separate operating units, the Missile and Space Vehicle Department and the Ordnance Department (m/r Sept. 22, p. 42).

The new department, Dr. Haller said will enable GE to focus top defense systems management and technical talent on fullfillment of advanced defense system requirements of the Army, Navy, and 2nd Air Force. The centralized systems organization is intended to respond to urgent Department of Defense requirements.

Richard L. Shelter will head the organization. Shelter was manager of GE's Missile Guidance Section in Syracuse heading design and development of the *Atlas* guidance system.

Dr. Haller announced the appointment of Hillard W. Paige as general Manager of the newly formed Missile and Space Vehicle Department in Philadelphia. Paige was manager of GE's Nose Cone Section.

ITT Consolidates Two Electronics Divisions

The consolidation of two of its divisions—both in the electronics manufacturing field—has been announced by International Telephone and Telegraph Corporation.

The two divisions are Federal Telephone and Radio Company of Clifton, N.J., and Farnsworth Electronics Co., of Fort Wayne, Indiana. Headquarters will be at Clifton, with manufacturing operations maintained at both places.

Fred M. Farwell, executive vice-president of ITT's United States group, said "The move is another step in ITT's organization program for its American companies. Both have had close similarity in their products and capabilities, and their markets have coincided to a considerable extent."

Delbert L. Mills, President of Federal Telephone and Radio, will head the single management of the new division. Vernon L. Haage vice-president of Farnsworth missile test equipment section has been named general manager of the Fort Wayne operation.

Reader Interest Surveys to be Taken for m/r

In line with m/r's policy of continuous improvement of editorial content, AMERICAN AVIATION PUBLICATIONS has retained Eastman Editorial Research Service.

This nationally known organization will make continuing, comprehensive studies to determine reader interest in editorial content.

Appraisal will be based on personal interviews with representative subscribers who will be asked for opinions on each department, news and features articles. This will be evaluated by m/r editors whose aim will be to give you the best in your field of interest. Meanwhile, m/r welcomes, as always, the expression of views through letters of our readers.

Manpower Search Keys Telemetry Meet

The National Symposium on Telemetry in Miami again showed that high-level manpower is the most sought-after commodity in the electronics field. Technical papers, panel meetings, exhibits, and "shop talk" are all important, but the most emphasis is still put on "body-snatching" schemes.

Favorite topics at the meeting were salaries, lucrative fringe benefits, fat retirement plans, long vacations, stock option plans, profit-sharing incentive deals, and other subjects that might lure men—other companys' scientists and engineers—into the fold. And the favorite meeting spots were the plush suites or hospitality rooms run by the body-snatchers.

Except for a small number of companies heavily involved in major missile programs, recruiting was confined to a search for experienced specialists. This pattern was set at the Institute of Radio Engineers National Convention in New York last spring. There, company officials agreed that high-level talent was hard to come by, but that inducements besides salary might be of some help.

There are mixed feelings on this type of proselytizing. The unhappy employee is all for it, while the employer with a heavy work schedule ahead of him cannot afford much in the line of personnel shifts. One of the employers put it this way: "After every convention, my company cringes waiting to see who it lost or hired."

The matter was also of great concern to the symposium committee. Chairman of Public Relations, C. H. Hoeppner of Radiation Inc., stated it in the follows words: "This thing is getting bad enough to actually impede the national defense. A great number of top-notch people only remain with a company for a relative short period of time, and just as they are about to get their feet wet, some other company comes in and hires them away."

There is, however, one bright side to the picture. The *most* desirable men are already comfortably slotted in top spots with their present employers, and are loathe to leave, even for attractive incentive offers.

Space Reconnaissance

The development of a dynamic analyzer to improve the reliability of reconnaissance equipment aboard a space vehicle was disclosed today by the Air Research and Development Command (ARDC). This prototype model tests camera systems under simulated flight conditions. A production model is slated for completion by early 1960.

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Making major breakthroughs in brazing stainless sandwich

Two radically new process developments by Temco Engineering may well revolutionize the entire concept of fabricating stainless steel honeycomb structures. One is "Temcombing," Temco's *continuous process* of stainless sandwich fabrication. The other is a simplified "Two-Phase" method for brazing stainless honeycomb structures. Patents now are being applied for on both of these processes.

Conventional, time-consuming batch brazing methods seem primitive compared with Temcombing. Panels of virtually unlimited size now are feasible in place of small, batch-made panels, thus reducing weight and critical tolerance errors. After lay-up, finished Temcomb panels can be turned out at rates up to 18 inches per minute, and at considerably *lower costs than by batch methods.*

Temco's exclusive Two-Phase resistance brazing method eliminates the need for furnace operations. For complex shapes, the Two-Phase process is the fastest and most advanced developed to date.

Advanced weapons systems, probing beyond Mach 3, demand whole new domains of materials and reliability. Temco engineering capabilities are meeting these demands with new developments and fabrication techniques in stainless steel, titanium, and other high-temperature materials. Pioneering in design, tooling and production for tomorrow's spacecraft industry is part of Temco's complete systems capabilities — all ready to meet *your* challenge.

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TOMORROW'S NEED IS TODAY'S CHALLENGE AT..

Second Moon Probe Geared To Measure Radiation Belt

Optimum Time For Launching Air Force Vehicle—Early Morning, Oct. 11-13

An air of cautious optimism prevailed in Air Force circles as the second *Thor-Able* vehicle was readied at the Cape Canaveral range for another attempt at a lunar probe.

Unlike the first stage of its predecessor—a standard USAF *Thor*—the *Thor* set up for this second attempt was stock hardware, but a vehicle which has been the object of every refinement and double-check possible. Insofar as thrust, fuel and guidance are concerned no changes were indicated. No details were released offically on the instrumentation, prior to the shoot.

However, Dr. Herbert F. York, chief scientist for ARPA—the managerial agency for the last lunar probe—recently said the lunar probe was being reinstrumented to measure the van Allen radiation belt detected by *Explorer* I. Due to the critical payload weight limitations (about 32 pounds), possibly the magnetometer, which would measure the magnetic fields of the earth and the moon; or the scanner which was to provide a picture of the back side of the moon, would be eliminated to permit incorporation of the scintillometer which would measure the radiation.

Because of the intensity of the radiation indicated by *Explorer* I, as much as five pounds of lead shielding could be required to protect the instruments and reduce radiation penetration to a tolerable recording level.

In view of the possibility that the payload might impact the moon—one chance in four at best—this vehicle and those used in later lunar probes were sterilized to prevent any contamination of the moon.

No definite announcement was scheduled prior to the actual attempt, but the optimum times for the shoot were known to be the early morning hours of October 11-13.

Caution—lightly seasoned with optimism—would better describe the general atmosphere at the Florida base as military and civilian technicians and scientists worked feverishly to ready the vehicle.

Maj. Gen. Donald Yates, commanding officer of the Atlantic Missile Test Range, said steps have been taken to remedy the malfunction which caused the first lunar probe vehicle to blow up 77 seconds after it lifted off the pad August 17.

The attempt, coming so soon after transfer of the project from the military to the National Aeronautics and Science Administration, meant that essentially there could be little difference in the overall handling of the attempt.

Third and final Air Force attempt to get off a lunar shot will be made on or about November 8, at which time AF technicians feel they will have accomplished a complete check-out.

NASA Begins Operation With Some Areas Vague

As an organization, the newly-created National Aeronautics and Space Administration apparently is off to a good start, with the naming of top management personnel and the assignment of particular space projects.

But in the "gray areas" of military vs. civil responsibilities, many projects still await Presidential decision. By executive order, Department of Defense has transferred to NASA:

1. Project Vanguard team witb about 150 persons, including Dr. John P. Hagen, director. This transfer was forecast several weeks ago by m/r.

2. The four remaining lunar probes (two Air Force, two Army), plus three satellite projects assigned to Army Ballistic Missile Agency. This includes two inflatable spheres—one 12' in diameter, the other 100' in diameter—and a cosmic ray satellite. These transfers also were forecast by m/r.

The order switched from the military (principally Advanced Research Projects Agency) a total of $117 million, bringing NASA's budget to $301 million, with about $250 million programmed for space projects.

NASA also got research programs in such areas as nuclear rocket engines, high-performance fuel (fluorine, hydrogen, etc.), and responsibility for developing a one million pound thrust single chamber engine.

Still to be decided are program responsibility—military or NASA—for a 1.5 million pound thrust engine using *Jupiter* clusters; and cognizance over navigation, communication and weather satellites. "Men in Space" programs will be joint endeavors.

• **Key men named**—Five days after NASA took over responsibilities of NACA, Administrator T. Keith Glennan announced key appointments. With the exception of three persons, all were elevated from existing NACA personnel.

The new appointees included Albert W. Siepert as director of business administration, Homer E. Newell, Jr., as assistant director for advanced technology; and Abraham Hyatt, assistant director of propulsion. Siepert was executive officer, National Institutes of Health. Newell was program coordinator for Vanguard project; and Hyatt was chief scientist, research and analysis office of Bureau of Aeronautics.

Also named as directors and reporting to Glennan were Dr. Abe Silverstein, director of space flight development (from associate director at Lewis Research Center); John W. Crowley, Jr., director of aeronautical and space research (from NACA associate director for research).

Dr. John F. Victory, executive secretary of NACA, was named an assistant to the administrator.

when and where

ASME, Lubrication-ASLE Conference, Statler Hotel, Los Angeles, Calif., Oct. 14-16.

The British Interplanetary Society, Space Medicine Symposium, The Great Hall, BMA House, Tavistock Square, London, W.C.1, Oct. 16-17.

URSI, IRE, USA National Committee Joint Meeting, Pennsylvania State University, University Park, Penna., Oct. 20-22.

Association of the United States Army, 1958 annual meeting, Sheraton-Park Hotel, Washington, D.C., Oct. 20-22.

Sixth Annual USAF Weapons Competition, Interceptor Phase, Air Defense Command, Tyndall AFB, Fla., Oct. 20-30.

Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif., Oct. 22-24.

Fourth Annual Symposium on Aviation Medicine, Miramar Hotel, Santa Monica, Calif., Oct. 22-24.

Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif., Oct. 22-24.

IRE, 1958 National Simulation Conference, Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Texas, Oct. 23-25.

BURROUGHS "VEST POCKET CREW" PACKS A TRIPLE WALLOP

AIRBORNE DIGITAL ELECTRONIC COMPUTER WILL "TAKE OVER" FOR PILOT, NAVIGATOR AND BOMBARDIER ON NAVY'S NEWEST JET BOMBERS. The crowded quarters of carrier-based aircraft leave little room for electronic "brains"—a scant few cubic feet in the case of the Navy's requirement for its AN/ASB-8 program: a package computer capable of target-approach pilotage, navigation and precision bombardment. And that's just what Burroughs, working closely with the Naval Ordnance Test Station, China Lake, is doing—cutting a roomful of equipment down to size. Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan.

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Four or More U.S. Missiles Arm Forces Facing Red China

Atomic Weapons Included in Available Arsenal

special report to m/r

TAIPEI—American forces in the Formosa area have as varied a supply of missiles and rockets as any power in the Far East, ally or enemy.

First missiles to appear on Taiwan were the subsonic *Matadors,* which the United States brought in last year. American experts set up bases along the 250-mile western coastline of Formosa, facing Communist China, and the *Matadors* have been operational for some time. This ground-to-ground missile should prove extremely effective if the Communists attempt invasion of this island fortress.

The Reds have been complaining bitterly about the Nationalist use of the heat-seeking air-to-air *Sidewinder,* which has proved so successful in recent jet air battles between Nationalist Sabre-jets and Red-built Mig 17's flown by Chinese Reds.

The *Sidewinder* is also used by the American 83rd-fighter Interceptor squadron from Hamilton Field, California, with its record holding F-104's. These aircraft were flown to Formosa aboard C-124's, and first aircraft equipped with *Sidewinders* were operational within 24-hours arrival.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF MISSILES AND ROCKETS, published weekly at Harrisburg, Pennsylvania, for October 13, 1958.

1. The names and addresses of the publisher, editor, executive editor, and business manager are: Publisher, Wayne W. Parrish, Washington, D.C.; Editor, Eric R. Bergaust, Washington, D.C.; Managing Editor, E. E. Halmos, Washington, D.C.; Business Manager, Leonard Eiserer, Washington, D.C.

2. The owner is: American Aviation Publications Inc., 1001 Vermont Ave. N.W., Washington 5, D.C. Stockholders owning 1% or more of total amount of stock: Wayne W. Parrish, Washington, D.C.; Leonard A. Eiserer, Washington, D.C.; Eric Bramley, Washington, D.C.; Jay Shuler, Springville, N.Y.; Robert R. Parrish, Chicago, Ill.; E. J. Stackpole, Harrisburg, Pa.; Fred S. Hunter, Los Angeles, Calif.; A. H. Stackpole, Harrisburg, Pa.; Erik Bergaust, Washington, D.C.

3. The known bondholders, mortgagees, and other security holders owning or holding 1% or more of total amount of bonds, mortgages, or other securities are: None.

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5. The average number of copies of each issue of this publication sold or distributed through the mails or otherwise to paid subscribers during the 12 months preceding the date shown above was: 23,347.

LEONARD EISERER,
(Signature of business manager)

Sworn to and subscribed before me this 3rd day of October, 1958.

HELEN M. DES PREZ,
Notary Public.
(My commission expires November 30, 1961)

• **Arrival of** *Nike*—Big news from Taipei, for both Communists and Nationalists, was the arrival of the *Nike-Hercules* missile on October 8.

The Vinnell Corporation has been in a crash program for weeks building launching pads above ground, as against normal subterranean installations. These pads will be turned over to American military men by October 15, and units should be operational by the end of the month.

Nike-Ajax, with its "powder and ball" warhead, was considered sufficient for this area at one time. However Washington changed this thinking and set up the atomic warhead *Nike-Hercules.* A second missile battalion, of the 71st Artillery Regiment, is on way from the United States to take over setting up and operating the *Nike* bases.

A big factor in the defense of Formosa is the Seventh Fleet, which the United States has committed to protect Taiwan and the Pescadores.

The 155-ship Fleet is well provided with many types of rockets and missiles. The cruisers "Los Angeles" and "Helena" have *Regulus* I, which can be fitted with an atomic warhead.

There are four aircraft carriers in the Fleet, three with attack missions and the fourth an anti-submarine unit.

Aircraft on these vessels undoubtedly have the infrared-eye *Sidewinder,* which seeks out the greatest heat source in its target and aims itself into the enemy aircraft's tailpipe.

American fighters and interceptors are also equipped with 2.75-millimeter *"Mighty Mouse"* rockets, which can be fired singly or in selective salvos.

There has been no information that either the Nationalist Chinese or Americans have the Hughes *Falcon* missile, although it is more efficient than the *Sidewinder.*

The Navy has advised that it doesn't have destroyer escort rockets which proved so effective in Korea—but indications are they'll be sent out if needed.

• **Atomic Factors**—There's a little known, but seriously considered factor in the use of *Nike-Hercules.* Washington officials feel that when a missile is fired at an approaching enemy plane, even such aircraft as are not damaged by the atomic explosion will be unable to return to base.

Experts say that enemy survivors of such a blast will be so frightened, they'll develop psychosomatic radiation sickness, self-induced by that very fear. First symptoms of radiation sickness are extreme dizziness and vomiting, which should make enemy crew members incapable of operation of their aircraft.

Vice Admiral Wallace Beakley, outgoing Commander of the Seventh Fleet, ruefully admitted he's called "Atomic Admiral and Warmonger" by Chinese Communists. But, in a recent interview, he stated that he is totally ready to go to the ultimate expense in combat—that is, totally ready if ordered to use atomic weapons.

These weapons are cheaper in the long run, he believes.

He disclosed that he has partially assembled atomic weapons aboard vessels of his Fleet, but considered them a precaution against fatal delays if the Formosa Straits should suddenly erupt into total war.

With *Mighty Mouse, Sidewinder, Regulus* I, *Matador* and *Nike-Hercules,* well deployed in the Taiwan area, our forces and forces of our Allies are well prepared to wage any type war which the Communists might choose.

Vitro, Koppers Sign "Joint Venture" Agreement

Officials of Vitro Corp. of America and Koppers Co. Inc. announced the signing of a Vitro-Koppers "joint venture" agreement that will enable the two companies to team in undertaking weapon systems work for the Department of Defense.

The Vitro-Koppers team will undertake all phases of weapon systems work from research and development through large-scale manufacture. The companies will seek contracts for missile ground support equipment, as well as for the design and production of complete weapon systems, according to a spokesman.

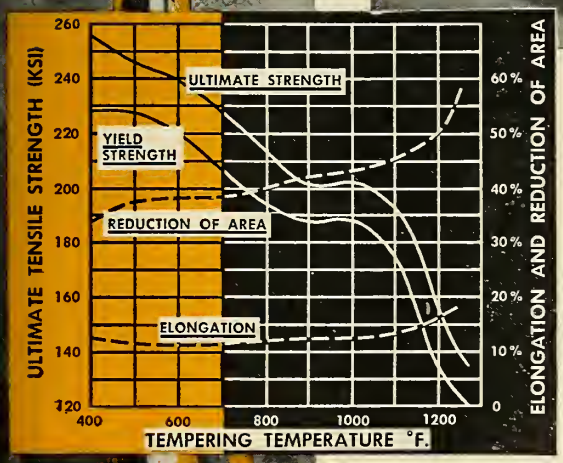
Koppers' Metal Products Division operates three manufacturing plants in the Baltimore area, in addition to a plant in Philadelphia.

Vitro owns the research and development facilities of Vitro Laboratories in Silver Spring, Md. and W. Orange, N.J.; the electronic production facilities of NEMS-Clark Co., Silver Spring, Md.; and the aircraft and armament production facilities of Thieblot Aircraft Co., Martinsburg, W. Va.

Newest advance in missile tankage

A. O. Smith flash-welded and fusion-welded units have exceptional strength . . . can be furnished in sizes and configurations to meet your designs exactly

Typical missile propellant tank as produced by A. O. Smith. Diameter is 40", length 28'. The highly stressed langitudinal welds in the "rall and weld" fabricatian methad can be flash-welded far higher strengths.



Materials are available which will produce properties indicated abave. Current lightweight, high-strength propellant tanks are being produced in the strength range indicated by the yellaw area af the chart.

Here's a new opportunity to gain wider design latitude. A. O. Smith can fabricate liquid or solid propellant tanks (cylindrical or spherical) and pressure tanks to practically any chamber size.

A. O. Smith has produced tanks with guaranteed minimum yield strengths of 190,000 psi. . . . wall thicknesses from .050"-.220" . . . diameters over 50" . . lengths to 28'. Proposed designs and recent fusion weld developments indicate minimum yield strengths of 210,000-225,000 psi are attainable in weld areas.

For details on the A. O. Smith facilities and capabilities available, write direct.

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A.O.Smith
CORPORATION

AERONAUTICAL DIVISION
Milwaukee 1, Wisconsin

A. O. Smith International S. A., Milwaukee 1, Wis., U. S. A.

West Coast Electronics Announce Job Shifts

Electronics companies in the San Francisco Bay area have announced a series of appointments and other executive changes.

Varian Associates have appointed **T. L. Allen** as manager of magnetometer products development, and **Richard M. Whitehorn** to the new position, research manager of radiation. **Dr. William J. McBride,** manager of the radiation division, said the creation of the research department is a planned step in the division's growth pattern.

Eitel-McCullough, Inc., San Carlos, has created a new post in the office of the president—assistant for management planning—and named **Jack Gilpin** to that post.

Robert Scal, vice president and general manager of R/S Electronics Corp., has announced a reorganization of its Palo Alto plant with creation of three operating divisions.

Scal heads the production division with responsibility for all manufacturing. R/S Electronics is a subsidiary of Regan Industries, Inc., San Bruno, manufacturer of amplifier-receiver systems for aircraft, missiles and radar.

Clinton O. Lindseth, formerly chief of the receiver section, heads the electronics division. **Wallace F. Burton,** formerly a senior project engineer in magnetic components, was appointed chief of the transformer division.

K. E. Hallikainen, president of Hallikainen Instruments, Berkeley, announced the appointment of **William F. Stairs** as production manager. Stairs previously was with Beckman Instruments and Tracerlab, Inc.

Roy Healy Heads Space Cluster Project

Rocketdyne has announced that **Roy Healy** is program manager on its contract to provide a space-mission propulsion cluster for the Army Ballistic Missile Agency. Healy also retains his duties as program manager for the U.S. Army *Jupiter* IRBM engine, the company announced.

The new system, scheduled for lunar probes and overseas operational use, will utilize a cluster of rocket motors like those of *Jupiter.*

Healy first became interested in rockets in the mid-20's and joined the American Society in 1935. He was twice elected ARS president—in 1942 and 1947. With the ARS Experimental Committee, Healy took part in pioneer work on oxygen-alcohol thrust chamber developments.

Sales

Burt L. Fielding has been appointed manager of engineering sales for the Electronic Systems Division of Dalmo Victor Company. Fielding will have responsibility for the division's sales functions, including customer liaison in cooperation with Dalmo Victor's director of sales, George Stewart. Fielding previously held the post of liaison engineer, with responsibility for military goods production at United Electro-Dynamics, Division of United Geophysical Corp.

Samuel Ochlis has been named sales manager of the Instrument and Equipment Division of Epsco, Inc., which designs and manufactures building blocks for large data handling systems. Prior to his new appointment, Ochlis was sales manager at Arthur C. Ruge Associates.

Industry

George Masurat was promoted to general superintendent of production for Philco Corp.'s Government and Industrial Division. In his new position, Masurat is responsible for production operations of the *Terrier* missile fuze, Transac computers, Signal Corps radio relay equipment and *Sidewinder* missile. Masurat has been with Philco since 1943.

Everett M. Patterson has been appointed vice president of Industrial and Defense Sales for the Bulova Watch Company, Inc. Patterson will continue to serve as president and director of the Bulova Research and Development Laboratories, Inc., posts he has held since September, 1957. Credited with many pioneering engineering achievements on jet engines and rocket propulsion control devices, Patterson was formerly affiliated with Bell Telephone Labs.

Advertising correspondence should be addressed to Advertising Sales Manager, Missiles and Rocket, 17 East 48th Street, New York 17, N.Y.

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advertiser's index

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- An unparalleled background in development and production of complex electronic and electromechanical systems, including guidance systems.
- Proven design capabilities along with extensive, low-cost manufacturing facilities—including stainless-steel contour honeycombing, metal bonding and chemical milling.
- Systems management that insures both speed and efficiency during every phase of a project.
- Experience. Crosley has and is proving itself on many projects, including some involving the *Falcon*, *Polaris* and *Titan* missiles; the MD-9 fire control system, research and development of the *Volscan* Air Traffic Control System, MPS-16 Height Finder Radar, missile and mortar fuzing, and structural components for missiles and supersonic aircraft.

Avco-Crosley Missile Capabilities

Complete facilities for research, development, and engineering design of: *nose cones, air frames, electronics control systems, telemetering, automatic test and support equipment, ground handling equipment and logistics.*

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For further information, write to: Vice President, Defense Products Marketing, Crosley Division, Avco Manufacturing Corporation, Cincinnati 25, Ohio.

hi-shear®

RIVETS

The U. S. Navy's guided-missile the Regulus II, built by Chance Vought Aircraft, is capable of delivering a nuclear warhead with "pin point accuracy" to targets over 1,000 miles distant at speeds in excess of Mach 2 and altitudes above 60,000 feet. Retaliatory weapons such as the Regulus II guarantee our national security.

Hi-Shear Rivets insure structural integrity in the Regulus by meeting the environmental conditions of high strength at elevated temperatures encountered during missile flight.

Regulus II

Research and development in Hi-Shear laboratories has continued to keep pace with advances in the missile industry by investigating new materials, methods and fastener design. Hi-Shear Rivets are now being manufactured in a full range of sizes and many materials, including:

- Titanium
- 17-4PH
- Inconel X
- M-252
- S-816
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- 5% Chrome Die Steels

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