DECEMBER 28, 1959

NAVY'S ARGUELLO–
CANYONS FOR MISSILES

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

AN AMERICAN AVIATION PUBLICATION

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COVER: Navy's Point Arguello facilities have numerous advantages, including these rugged canyons providing safety, secrecy for launchings. A special report starts on p. 13.

MARTIN'S *Titan* management program has been changed to meet Air Force criticism, though not at the service's orders. For a report on this development, see p. 11.

FULLY wrapped thrust chamber at Rocketdyne's plant during R&D of fibreglass wrapping technique. Method has cut the weight of *Atlas* engines 25%. See story on p. 18.

TRIGATRON shown here reveals actual dumping of current and exploding of wire as performed in lab by Electro-Optical Systems, Inc. Turn to p. 20.

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

32,000 copies of this issue printed

DECEMBER 28 HEADLINES

MISSILE SUPPORT

U.S. Reg. Pdg.

ASTRONAUTICS ENGINEERING

U.S. Reg. Pdg.

ASTRIONICS

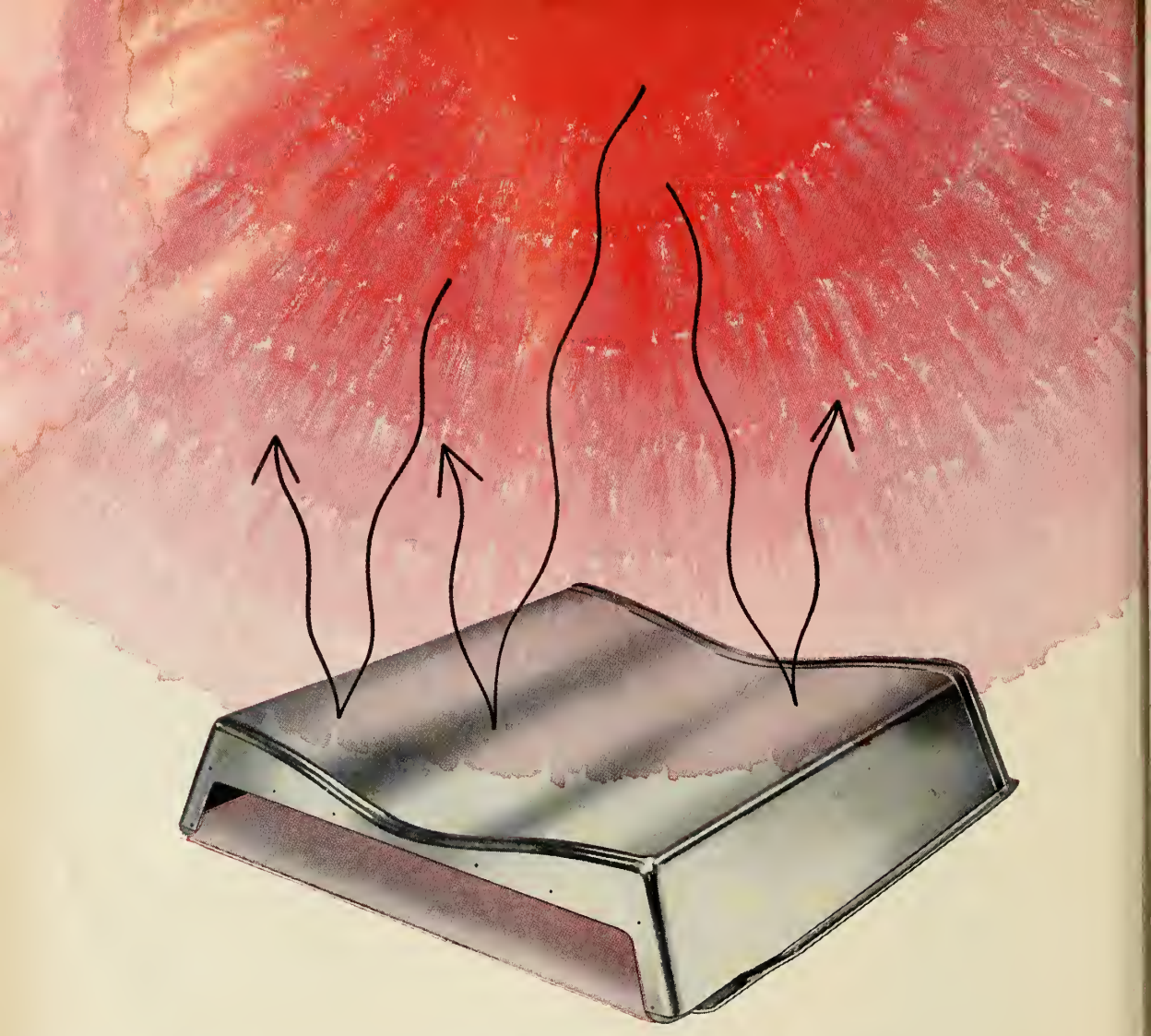
NEW MISSILE PRODUCTS

SPECIAL SECTION

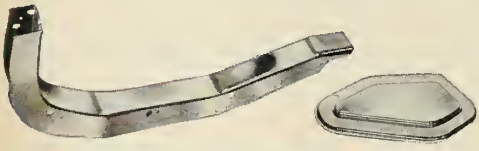
THE MISSILE WEEK

U.S. Reg. Pdg.

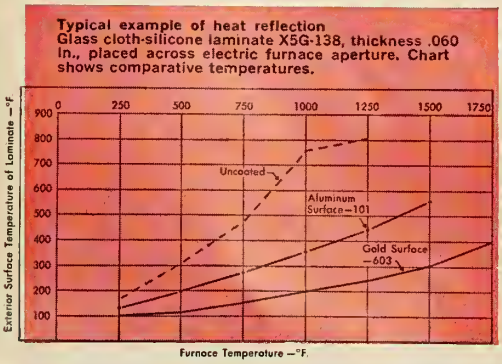
DEPARTMENTS



Now, reflect up to 1750°F radiant heat from SWEDLOW metallized laminates



Typical example of heat reflection
Glass cloth-silicone laminate X5G-138, thickness .060 in., placed across electric furnace aperture. Chart shows comparative temperatures.



Compound shapes—minimum weight and bulk—highly efficient reflectivity—distinguish these materials and solve the problem of resistance to elevated temperatures.

Swedlow's solution for light weight heat protection problems uses a ba of fiberglass fillers. To these are added any of an impressive variety silicone, phenolic, epoxy, TAC polyester or polyester binders to meet specif service conditions. The resulting high-strength laminate is furnished flat molded to any contour desired. Metallic coatings then further increase he reflectivity and resistance. Swedlow-pioneered Type -101 aluminum coatin is now in wide use for the 200°F to 1400°F range. The more recently deve oped Type -603 gold now raises the limit to approximately 1750°F.

Swedlow research is continuing the development of many combinations f the growing variety of aircraft, missile and electronic applications. To lear how these new materials can help solve your heat problems, contact th Swedlow plant nearest you. Or send for new literature—"Radiant He Reflective Laminates." Please refer to Dept. 21.

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Washington Countdown

IN THE PENTAGON

Dyna-Soar space gliders . . .

probably will be first launched for unpowered but manned flight tests in late 1962, according to present planning. The **Boeing** spacecraft will be dropped from B-52 jet bombers at Edwards AFB, Calif.

• • •

Dyna-Soar R&D money . . .

in the FY 1961 budget is the critical factor in the current schedule. Nearly $100 million is needed for the first stage of the big Air Force program.

• • •

Seagoing missile training . . .

for the crews of carriers and cruisers is being conducted on the coastal leg of the Pacific Missile Range. MORT—Missile Operation Readiness Testing—has been made standard program at PMR for all carriers headed for the Far East.

• • •

Missiles to the Far East . . .

are in the Army's plans for next year. Shipments to U.S. troops are expected to include **Martin** *Lacrosses* and **Raytheon** *Hawks*.

• • •

Project *Tackle* . . .

is the code name for a second polar orbiting communications satellite under development by the Air Force. It will be part of a worldwide communications satellite system that includes *Decree*, a 24-hour satellite, and *Steer*, another polar orbiter.

• • •

Reconnaissance by rocket . . .

is getting a close and very interested look by the Navy. The Navy wants a satellite or rocket that can provide "fast look" reconnaissance information for a task force at sea. Many think camera-armed rockets are a better bet than satellites for the job.

AT NASA

The new firing date . . .

for the sun-orbiting *Thor-Able IV* is about mid-January—possibly Jan. 15. **STL** hopes to have licked by then the transmitter difficulties and other payload troubles which forced cancellation of the shot this month.

A space shot sleeper . . .

using the new *Thor-Delta* may be in the works. The powerful **STL** *Thor-Delta* might be used to put a 100-pound satellite into orbit around the moon in case a planned *Atlas-Able* moon shot is permanently scratched.

• • •

Trouble for *Nova* . . .

may be on the way. NASA officials have been called on by the White House to present a run-down on the program to develop a 1.5-million-pound-thrust, single-chamber booster. The White House also has told NASA to be prepared to justify the $2-billion program.

ON CAPITOL HILL

Favorable reaction . . .

from congressmen has greeted NASA's proposed changes in the patent provisions of the National Space Act. The changes would put the agency's patent provisions more in line with those that prevail at the Pentagon—except in the field of nuclear research, where they would be similar to those of the Atomic Energy Commission.

• • •

The big missile-space battle . . .

between Congress and the Administration over the budget is considered to have been officially opened by Senate Democratic Leader Lyndon Johnson's Wright dinner speech. Johnson raised two verbal standards to rally his forces:

. . . "We cannot concede outer space to the Russians and hold leadership on earth."

. . . "We cannot indulge in the luxury of budget clerks gambling with our destiny."

ALONG EMBASSY ROW

Britain's *Black Knight* IRBM . . .

is reported to have soared to a 447-mile apogee in a recent test launching at Australia's Woomera Missile Range. The nose cone was recovered beyond Mount Eba in southern Australia.

• • •

Missile defense problems . . .

are being studied by the United States and Canada at Valcartier. A giant 14-inch hypersonic launcher is being used to launch nose cones at 7000-feet a second. The U.S. Army-built launcher is expected to double this speed when fully developed.

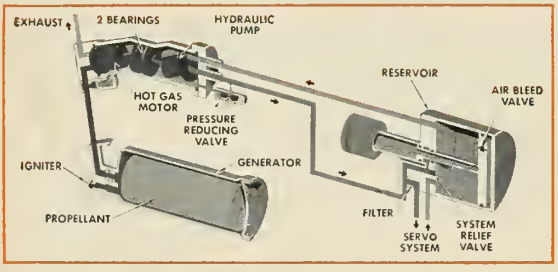
FLIGHT HARDWARE...NOW

VICKERS HOT GAS AUXILIARY POWER SYSTEMS

for missiles and spacecraft

CONCEPT

Vickers piston motors — as used in virtually all existing commercial and military aircraft — are now modified to operate efficiently on propellant-generated hot gas, or bleed gas from the main propulsion system. Minimum weight is achieved by mounting the hot gas motor "shaft-to-shaft" with a Vickers piston hydraulic pump in a common housing. The motorpump, a simple gas generator, hydraulic reservoir, filter, and relief valve are integrally mounted to form a complete Auxiliary Power System in a compact package.



DEVELOPMENT

Production line Vickers hydraulic motors have been operating on hot gas for over 2 years. Units have run on gases as hot as 2300°F without modification.

The present flight hardware was built and tested after an intensive prototype development effort. Test program motorpumps have accumulated over 100 runs each for 1 minute of operation cycle. Since the current development program is aimed at meeting known APS requirements, no limits have been established on the operating cycle duration for this type of equipment.

CONCLUSIONS

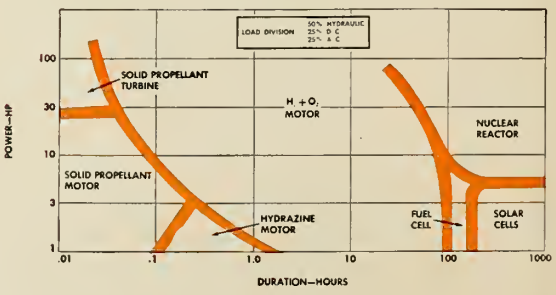
Performance and reliability goals for this concept have been met successfully. A complete hot gas APS package in the 2 - 8 horsepower range, shown above, is available within 90 days. Customer specifications for these and larger systems are invited. Write for Bulletin A-5223B.

APPLICATIONS

Because of the increasing scope of APS applications, Vickers conducted a series of studies to establish criteria for APS selection. Recent study results (published in March, 1959) indicate that for short duration operation, hot gas motors offer the best weight advantage in the 1 to 30 hp range. See curve below.

Attractive reliability and early delivery resulting from extensive use of proven hardware may extend the application of these systems to an even greater range of second and third generation missiles and spacecraft. Additional advantages include: low speed equipment (up to 10,000 rpm), convenient ground checkout, growth potential, and no alert time required.

OPTIMUM WEIGHT NON-PROPULSIVE POWER SYSTEMS



AERO HYDRAULICS DIVISION
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division of:
SPERRY RAND CORPORATION

Industry Countdown

MANUFACTURING

Germany will cooperate . . .

in the development of the 100-mile-range **English Electric** *Blue Water*. The solid-fueled surface-to-surface missile will be used by the British and German armies, and probably by other NATO nations.

• • •

High-powered anti-tank . . .

missiles tested by the Swiss—**Nord**'s *SS-10* and **Contraves'** *Mosquito*—are both reported to have ruptured 285 mm steel plate. The Swiss are conducting tests to determine the final shell configuration of their Pz 58 tank.

• • •

Sintered 50-50 moly . . .

and tungsten alloy as well as unalloyed tungsten are being extruded (at 4:1 ratio) by **Harvey Aluminum** at a Wright Air Development Division facility . . . **Atlas Corp.** estimates nonmilitary usage of uranium will exceed present domestic production (18,000 tons of uranium oxide per year) by 1973 and present U.S. reserves will be gone by 1982. AEC is buying about 36,000 tons a year from all sources for military uses, and—according to Atlas—expects this to increase in 1962-66.

• • •

January is red-letter . . .

month for contractors in the missile support and logistics area. The Air Force AMC is holding a series of three requirements symposiums. The first will be held Jan. 13-14 at New York City, the second Jan. 18-19 at Chicago and the third Jan. 21-22 at Los Angeles. NSIA, EIA and AIA, respectively, are making the arrangements.

PROPULSION

Titan non-cryogenic . . .

storable program will receive $200,000 funding by Air Force in FY 1961. Substitution of storables for cryogenics is planned for the seventh of the 11 *Titan* squadrons to be built in the next three years.

• • •

Two-step propulsion . . .

system of the IR guided surface-to-air *Redeye* "bazooka-type" missile will be developed by **Atlantic Research Corp.** The company has a $400,000 subcontract from **Convair/Pomona.**

A .67KS-600 retro rocket . . .

which successfully separated the data capsule from *Discoverer VII* nose cone had been in storage more than nine months. **Aerojet-General** says reliability of the retro was proven in advance by test-firing similar units which had been on the shelf the same length of time.

ASTRIONICS

There's disagreement . . .

among the experts on the value of NASA's passive balloon communications satellite. For one thing, many believe a sphere to be about the poorest possible shape for efficient reflection of radio beams.

• • •

Jump of 15 to 20%

in electronic test instrument production—giving it at least a $350-million volume in 1960—is predicted by **Technical Information Corp.** One-fifth of the increase is expected to be in power supplies.

• • •

Reliability conference . . .

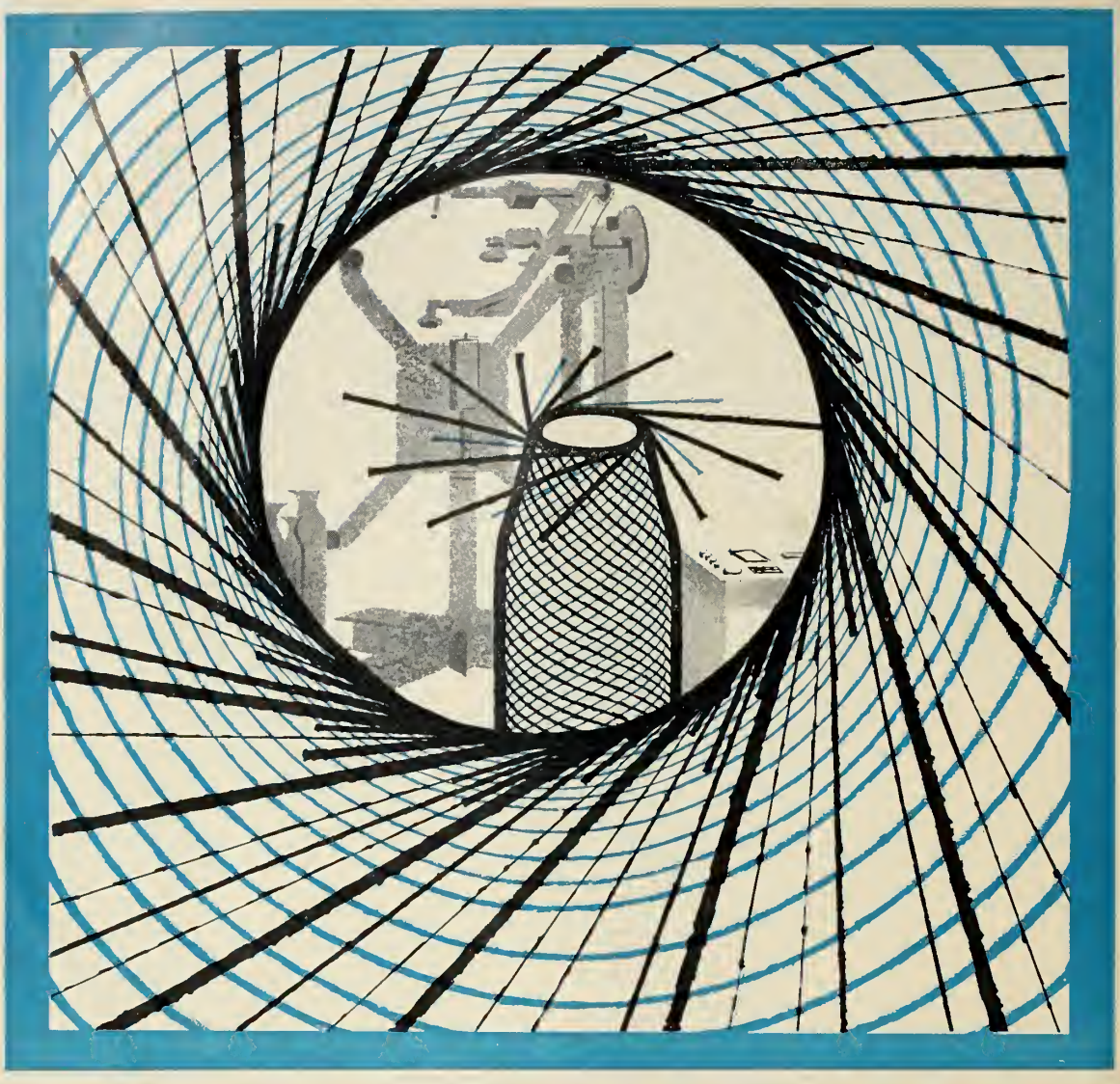
sponsored by AIEE, IRE, EIA and ASQC will be held in Washington Jan. 11-13.

WE HEAR THAT—

Boeing and Martin . . .

will hand the Air Force's Wright Air Development Division a list of *Dyna-Soar* subcontractors shortly after New Year's. If WADD okays the list, announcement of those selected could come within a month . . . **RCA** is said to have pinpointed AFMTC telemetry range ship locations so exactly that they could replace land-based installations . . . The winner of the competition to reactivate and operate the Army's Kansas Ordnance Plant at Parsons, Kan., is **Grand Central Rocket Co.**, which will manage the production of missile motors in the 5000 lb. to 10,000 lb. class . . . **Aerotest Laboratories Inc.** is starting up a multimillion-dollar advanced propulsion division . . . and during November, 10 rockets were launched by the West Germans at Kuxhaven in experimental "rocket mail" tests. Each rocket carried 500 letters.

More About the Missile Week on Page 43



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Get more information on how SBP can serve you. Write or call: The Brunswick-Balke-Collender Company, Defense Products Division Sales Manager, 1700 Messler Street, Muskegon, Michigan—today!

BRUNSWICK

MAKES YOUR IDEAS *WORK*

Martin Realigns to Push *Titan*

Firm will tighten liaison between divisions; change not ordered by AF

by William J. Coughlin

DENVER—**Martin Company** is planning corporate administrative changes intended, in part, to meet Air Force criticism of its management of the *Titan* missile program.

Major shift will be one designed to tighten liaison between the company's operating divisions. This is intended to meet Air Force complaints that administration of the *Titan* program is, in effect, spread among three separate company divisions—Denver Division, Cocoa Division and Activation Division.

But reports circulating in the industry that the Air Force has ordered top-level management shifts in the Martin Company are emphatically denied both by company officials and the Air Force.

"No one now or in the past has been removed from a position at Air Force insistence," a company spokesman emphasizes.

• **False reports**—The Martin Company is concerned deeply over false reports concerning the *Titan* program now being circulated in the industry. It has retained the New York public relations firm of Ruder and Finn to handle its relations with the financial press.

Officials at Martin's Denver Division, from Vice-President and General Manager H. W. Merrill on down, freely admit that in the crash program to get the *Titan* operational, some administrative snags have developed. Top Air Force officials also concede that some of the difficulties lie at their own door.

A recent re-evaluation of the *Titan* program conducted by **Space Technology Laboratories** and USAF's Ballistic Missile Division found the missile itself technically sound and blamed difficulties on management of the program. (M/R, Dec. 21, p. 43).

Result of the study apparently will be a closer working relationship between Martin and the Air Force to eliminate some of the management "bugs" which have plagued the project.

Explosive growth of Martin-Denver Division has brought it to almost 10,000 employees within a little more than three years. Growth that rapid usually brings some management problems with it, and Martin has been no exception.

"When you build that fast, obviously you get some deadwood," General Manager Merrill says. In one six-month period, for example, employment jumped from 5,000 to 7,500.

Despite rumors to the contrary, turnover in engineering personnel at the Denver plant has been somewhat below industry average; turnover in manufacturing personnel is somewhat higher than industry average, but not unusual for the area, Martin-Denver currently is hiring at a rate of about 200 a week for a net weekly increase of about 120.

Air Force criticism of *Titan* administration has brought both Martin management philosophy and management structure into the limelight.

The change to tighten relationships between corporate operating divisions is but one of a number which the Martin Company is making, or has made, under a dynamic concept of management. Under this, management structure shifts with program growth and requirements.

• **Eight Divisions**—Martin's corporate structure is broken down into eight operating divisions: Baltimore, Orlando, Denver, Cocoa, Rias, Nuclear, Space Flight and Activation.

Activation Division, the newest, was set up last June to activate the *Titan* weapon system in the field. This division is charged with administration and coordination of all activities concerned with construction of the *Titan* training complex at Vandenberg Air Force Base, California, and the operational base at Lowry Air Force Base, Denver. It will be responsible for operational readiness of all *Titan* launching bases.

Within the Denver Division, a major administrative shift saw responsibility for *Titan* ground support equipment hived off into a separate department and into a separate plant at nearby Littleton, Colo. This, known as the Electronics Division, is in charge of Assistant General Manager G. H. Teeter.

On Sept. 21, establishment of a separate test division within the Denver organization was announced, another major organizational change. Purpose was to bring all phases of *Titan* test operations in Denver under single-point control. George A. Rodney, former chief test pilot and head of the company's flight test operations in Baltimore, was named to head the new organization.

Rodney's department is responsible for conducting operating test runs on major subsystems and the complete missile prior to delivery to flight test at Canaveral or operational sites.

Since taking over his new post, Rodney has put strong emphasis on strengthening of test discipline.

It now takes about three weeks to run a *Titan* through the Denver test program, from the time it is received by the test division until it is shipped to Canaveral. Rodney expects this will be cut to 10 days by mid-year.

Martin's Cocoa Division has the responsibility for flight testing at the cape.

• **Missile Chaperon**—Last month, in another management shift, the company instituted a policy of appointing what it calls a "missile chaperon" for each *Titan* coming off the assembly line. This engineer is responsible administratively for his missile until launching.

Aside from the advantage of concentrating responsibility, intent is to have one man so familiar with the continuity of events on each missile that he will be in a position to make knowledgeable decisions concerning it whenever necessary.

Further downstream in the program as *Titan* testing becomes more commonplace and "bugs" are worked out, this function probably will be eliminated. But for the moment, it is an innovation which Martin believes will improve management of the test program.

Martin's management philosophy, as outlined by General Manager Merrill, puts the emphasis on men who have worked up from the production and engineering side of the organization. There aren't many Harvard Business School types in Denver Division management.

Robert N. Blakey, director of the manufacturing division, for example, joined Martin in 1942 as a process planning engineer. Finance Manager

T. P. Hudock came up through the ranks as a certified public accountant. Merrill himself joined the company's Baltimore Division in 1946 as an engineer in the pilotless aircraft section.

There are even engineers in the finance division. When someone from engineering wants to argue a need for more engineers, there is a man in finance who talks his language—which may or may not be to his advantage.

While an approach which leans heavily on engineers for management talent has many advantages, it is obvious it may also offer difficulties when a management survey team shows up and wants to talk about the paperwork.

Under this evolutionary concept, administrative structure shifts with the need. When the Denver Division first was set up, for example, the production control organization was kept a part of engineering—"almost a nonentity on an organization chart," is the way Blakey describes it.

Early in 1957, production control was split out and set up on its own. A factory manager was named with full responsibility for all aspects of factory operation, reporting directly to Blakey. At this time, all work in the Denver facility is related directly to the *Titan*.

This year, the manufacturing organization has changed again. The factory manager has been eliminated and the organization is set up on a functional and project basis. There is a single manager of detail fabrication and tooling for all projects. There also is a *Titan* project manager, with control of all activities peculiar to *Titan*, reporting to Blakey. Addition of each additional project will mean another project manager.

• **Revolutionary Process**—This is an evolutionary process which the company feels frequently has been misunderstood on the outside and pointed out as "another management shakeup at Martin."

Reports of frequent top-level shifts in Martin-Denver management are belied by the facts, a company spokesman points out. Merrill has been in his present post as vice president and general manager since April, 1957. *Titan* Program Director R. G. Swop has been at Denver since 1956 and with the project from the bid stage. Engineering Division Director A. C. Hall has been at Martin-Denver for two years. Blakey was appointed director of the manufacturing division in November, 1955.

Only change in the most recent Denver master organization chart is the naming of Kermith F. Wasmuth as quality control division director to replace H. P. Campbell, who was shifted to manager of the quality control department of the electronics division.

Under what the Air Force calls its "concurrency" concept, *Titan* is being designed and produced at the same time training and operational bases are being constructed.

• **$500-million program**—Some $500-million now has been committed to the *Titan* program. Martin does not yet have a production contract for the missile, but holds a contract for a research and development program which includes demonstration of initial operational capability, including the first base and missile assigned to it.

Total cost of the Denver facility has been about $52,500,000. Of this, some $25 million is Martin capital and the remainder Air Force funds. Generally speaking, the Martin investment covers the plant complex while Air Force funds have paid for the test area, tooling and equipment.

Martin management naturally is unhappy with the troubles which have grounded the *Titan* since last May. But there also is a feeling that too many people have forgotten initial troubles with the *Atlas* and other missiles. It is pointed out that *Titan* had four very successful firings in a row, that the missile has proved itself in flight and that troubles in the program all have been ground troubles, mostly non-recurring.

"We have had no trouble with the bird itself—none," a company official points out. Test objectives were, in fact, advanced as a result of the initial launchings.

There's little doubt that even one or two successful launchings will do much to take the pressure off Martin management. Whether these can be achieved before Congress begins probing the defense budget is another question. *Titan B7A*, now on the stand at Canaveral, may provide the answer.

Titan Scoreboard

A-1—Static missile. Used to check out cells and stands at Denver and Cape Canaveral.

A-2—Damaged on test stand when erector pulled off second stage.

A-3—Shipped to Cape in December, 1958. Automatic shutdown on firing when LOX line on pump failed. LOX froze hydraulic line on erector, crew was unable to get to second-stage systems to turn them off. A-3 returned to Denver.

A-4—Shipped to Cape in January, 1959. Hard start caused automatic shutdown. Returned to Denver.

A-3—Successful flight, February 6, 1959. Tested and back on Cape within 30 days of its return to Denver. All A-series objectives met on this first flight. Program objectives advanced.

A-5—Successful flight, February 25, 1959.

A-4—Successful flight, April 3, 1959.

A-6—Successful flight, May 4, 1959. Separation of two stages tested without second-stage firing. Solid rockets used to prove successful separation.

B-1—Eliminated from program.

B-2—Static missile. Damaged when sling broke at Denver plant. Repaired for static testing.

B-3—Exploded on Denver test stand, July 3. First stage mated with second stage of B-4. Stand damaged.

B-4—First stage blew up as result of LOX tank rupture, Denver test stand, May 15. Second stage mated with first stage of B-3, exploded on test stand, July 11. This resulted from engine fire and explosion with shrapnel from engine perforating tanks. Stand damaged.

B-5—Sequence testing and static firing conducted at Cape due to lack of available stands at Denver. Exploded on launch August 14, 1959. Holddown bolts blew prematurely, missile lifted with umbilicals still attached and automatic shutdown signal turned off engine. Missile fell back on pad from 12-ft. height and exploded. Stand damaged.

B-6—Helium line tore loose, holed first stage, Cape Canaveral.

B-7—Helium sphere pulled loose in tank during static test at Denver. Support leg attached to it holed second stage.

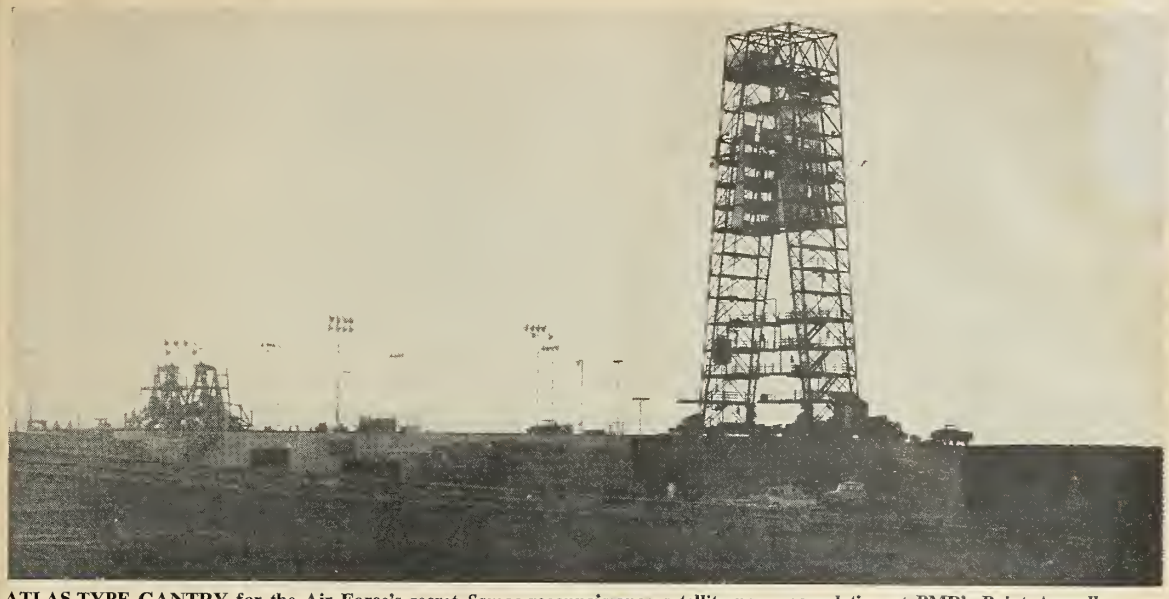
B-7—A-Second stage of B-6 mated with first stage of B-7. Now on stand at Canaveral for firing.

B-8—Failure to open valve during airlift from Denver to Cape Canaveral resulted in pressure differential which cracked tank.

B-9—Loading of LOX into cool tank resulted in negative pressure which caused tank to suck in and crack. Condition, never encountered before, later duplicated deliberately on Denver test stand. Information being disseminated to industry.

C-1—Static fired at Denver. Now being used for tests in connection with destruct package as result of C-2 explosion.

C-2—Destroyed Dec. 12, 1959, during launch at Canaveral when destruct system malfunctioned. Attributed to mechanical closing of electrical relay in destruct system, apparently due either to vibration or structural weakness.



ATLAS-TYPE GANTRY for the Air Force's secret *Samos* reconnaissance satellite nears completion at PMR's Point Arguello.

First pictures of Arguello facilities . . .

Navy Pushes for 'Perfect' Space Range

by James Baar and William E. Howard

(*This is the second in a series of special M/R reports.*)

POINT ARGUELLO, CALIF.—Less than a year ago, Rear Adm. Jack P. Monroe stood atop 2150-ft.-high Mt. Tranquillon looking out over Point Arguello's bunched hills and steep canyons to the Pacific. All around him there was furious activity.

Construction crews churned along the dark sage-covered ridges laying broad hardtop highways: to the north, the skeleton of a *Samos* gantry was taking shape against the sky; on the bulldozed crests of half a dozen hills, workmen swarmed around the white shells of buildings that would house basic instrumentation—radio transmitters, banks of telemetry equipment, radars and the main operations control center of the newly-created Pacific Missile Range which Monroe commands.

For the 55-year-old admiral, a top technical officer who began his career more than 30 years ago as a carrier pilot, it was a moment filled with both promise and uncertainty.

"Here is possibly our last opportunity to build a missile range from the ground up which will provide the necessary facilities for years to come," he said. Then, looking into the future, he added:

"These facilities must have a greater potential and be adaptable for any and all future space uses."

Today, as the heart of the PMR, Point Arguello is beginning to live up to its early promise. Through skillful planning and a tremendous expenditure of energy and money (about $200 million to date), parts of the facility are already operational.

Early next year, the first of two launching pads for the Air Force's polar-orbiting *Samos* reconnaissance satellite will be ready to receive its *Atlas* booster. *Samos* will be the first major space vehicle fired from the Point. The shot may take place in March or soon after.

The Navy also will use Arguello starting in 1960 to swing into full-scale tests of *Tepee*—its system designed to detect the launching of enemy ICBM's through high-frequency ionospheric backscatter. These tests could be tied in with the test program for the Army's *Nike-Zeus* anti-ICBM, which will be conducted from Kwajalein Atoll and Johnson Island on the western edge of the PMR.

In addition, the Atomic Energy Commission will begin its high-altitude radiation studies with *Tumbleweed* sounding rockets. And the Navy Research Lab will resume Project *Sunflare*—the launching of *Nike-Asps* to study solar phenomena.

Other programs now considered firm for the 1960-61 period include backup for **Martin** *Titan* firings from neighboring Vandenberg AFB and training of Marines in the use of anti-aircraft *Hawk* missiles.

What has PMR officials worried is whether from this point on, the range will be developed to its fullest potential for the nation's space program—or whether it will become a hodgepodge through budget restrictions and piecemeal additions.

Moreover the major factor influencing the future of PMR is the apparent decision of the Air Force to convert Vandenberg into a space R&D center (M/R Dec. 21 p. 10). As the chief potential user of PMR, the Air Force holds virtually all the cards—and a good share of the money—that

the range, the mission, the tools . . .

ADMINISTRATION BUILDING and related facilities near completion at Point Arguello. The 20,000-acre Point is the heart of the would-be $4-billion Pacific Missile Range.

will determine the range's future development.

• **Bobcats & duds**—The history of Arguello and the PMR begins in Dec. 7, 1957, with a piece of paper, a vision and a small, 13-year-old missile station at Point Mugu. Point Arguello itself was a 20,000-acre wilderness—and a somewhat dangerous one at that. Besides bobcats and mountain lions roaming through the scrub, the hills were mined with unexploded artillery shells, souvenirs from the World War II days when it was an impact area for the Army's Camp Cooke.

"Some of those duds were so sensitive a raindrop could have touched them off," a Navy officer said the other day. To clear work areas, more than 5000 acres had to be burned off and combed by demolition teams.

There were no buildings; the only roads were wheel ruts in the dirt. The chief occupants: hundreds of deer who still roam the area today watching man's elaborate preparations for leaving the planet.

• **Work plan**—Highway construction began almost immediately after Arguello was established and by last April, 15 months after its inception, more than 50 miles had been paved. (To fully service the facility, the Navy estimates another 50 miles are needed.) Work also proceeded on the first instrumentation facilities.

Prime contractor for Arguello's range support operations was given to **Federal Electric,** a subsidiary of **International Telephone and Telegraph Corp. Bendix Aviation** received the downrange instrumentation prime contract and **Texas Transportation** of Corpus Christi, Tex., the contract for providing logistic support at Kwajalein.

PMR, commissioned in March, 1958, was laid out into four sub ranges:

• An Inland Range extending from PMR headquarters at Point Mugu—90 miles south of Arguello—to Tonopah, Nev., and Dugway, Utah, eastward more than 400 miles.

• A Ballistic Range extending out into the Pacific north of Hawaii and Wake Island for impacting *Atlas* and *Thor* training shots from Vandenberg.

• A close-in Sea Test Range running 500 miles along the California coast and 250 miles out to sea where cruisers and carriers test their missiles.

• An Equatorial Range which won't come into being until a launching site is picked in the Pacific for the eastward launching of satellites into equatorial orbits.

NIKE-ASP **soars spaceward from Arguello to gather data on solar flares for Navy.**

Within a year after its creation, PMR Commander Monroe says, the range "developed a complete capability for handling any and all planned requirements. In fact, we were weeks ahead of schedule."

Operations actually began with the tracking of a *Thor* shot from Vandenberg on Dec. 8, 1958. But Arguello didn't get into the space business until last Feb. 28, when it provided backup tracking for the first polar-orbiting *Discoverer* satellite, also fired from Vandenberg.

• **Readying** *Samos*—Arguello today is comprised of islands of activity surrounded by acres of wild undergrowth. You reach the largest of these by driving up a paved one-time trail called Bear Creek Canyon Road. On the right as far as you can see stretch empty canyons. Beyond them lies the Pacific. Directly ahead stand the two *Samos* gantries.

One pad is more than 90% complete; the other about 70%. The prime contractor for both, under a $4.5-million contract, is **Wells-Benz Co.** of Phoenix, Ariz. **H. E. Robertson Co.** fabricated the 100-foot-tall railed gantries which stand on a high slope about 600 yards apart.

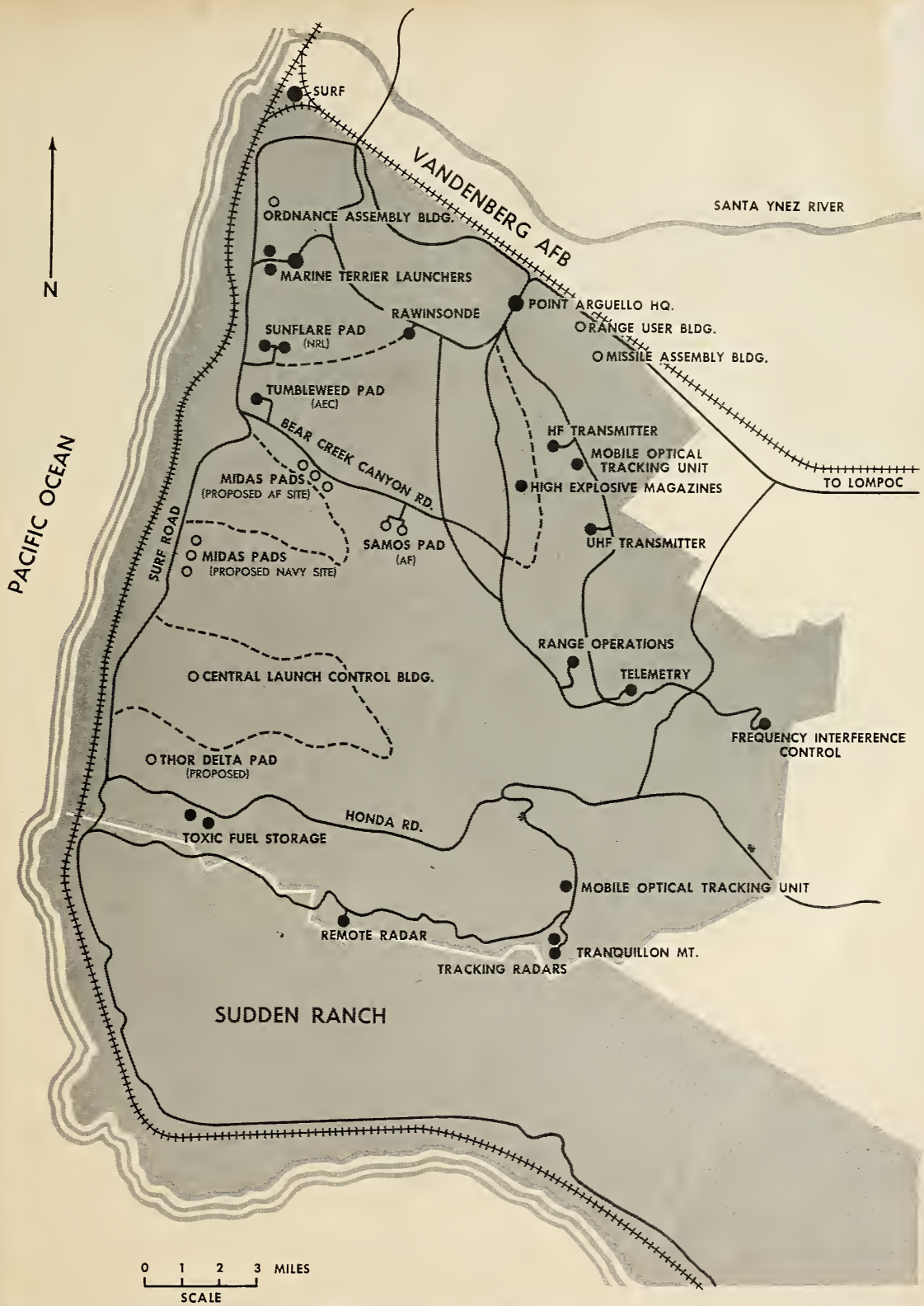
All instrumentation and other equipment already has been moved into place in the blockhouse that serves both pads. It is now being wired and checked out. Lights have already been installed around Pad No. 1 and the fueling system is in place.

Adjacent to the blockhouse, contractors have set up a village of dozens of trailers and prefabricated shacks—ready to be moved away within the next few months.

The sprawling, almost-completed Range Operations Building stands on a hilltop about two miles farther inland. The Telemetry Building is nearby. Both are partly operational.

PMR data acquisition facilities are being expanded by the installation at Arguello of 20 **NEMS-Clarke** telemetry receivers. Some of these will be used for storage of data on magnetic tape while others will be used for both storage and display. The new equipment will supplement 15 FM-FM (AN/-UKR-5) telemetry receiving stations and three PDM-FM receiving stations located at Point Mugu and San Nicholas Island which lies just off the coast.

Data links are being set up so that



PRESENT AND PLANNED facilities give Point Arguello basic launch-tracking capability on which Navy hopes to build the world's greatest space range. Solid dots indicate existing facilities; others are proposed or under construction. Solid lines indicate improved roads and dotted lines show location of trails. Sudden Ranch is leased by Navy from private owner.

billions sought, only millions authorized . . .

ARGUELLO RANGE OPERATIONS are conducted from new sprawling building atop one of the Point's many hills.

telemetry can be displayed simultaneously at the Arguello Operations Building, Point Mugu and other range points.

Arguello's long-range tracking radars are being installed south of the Range Operations Building on top of Mt. Tranquillon—highest place on the Point. The instrumentation includes two of **RCA's** newest long-range radars—the FPS-16. Similar radars are being installed at Point Mugu.

Optical tracking equipment at Arguello as well as Point Mugu, San Nicholas Island and downrange sites includes **Askania** Model KTH tracking cinetheodolites. These permanent installations are supplemented by Askania KTH 41 transportable cinetheodolites and mobile optical tracking units.

Bowen RC-2 and CZR-1 acceleration cameras are installed on mobile mounts for measuring the acceleration of surface-launched missiles. Optical miss-distance equipment also is available downrange.

• **Ships for tracking**—PMR's land-based tracking facilities are further supplemented by three ships—the Joe E. Mann, Dalton Victory and Haiti Victory. A fourth ship will be added to the range radar fleet with the conversion of another Victory Class hull under a soon-to-be-let $10-million contract.

All three ships now in operation provide tracking facilities down-range. However, the Dalton and Haiti are primarily designed for recovery work and determining impact points of re-entry vehicles.

The PMR ships are supporting the *Discoverer* program along with the Air Force's attempt to recover re-entry capsules with "air snatch" nets attached to C-119's operating out of Hawaii.

The Navy says it is now offering as services to all range users:

• Area clearance, range control, range liaison (with users), ground safety, instrumentation, meteorology and photography.

• Administrative flight operations.

• Public works technical engineering, including limited design work, construction, alteration, repair, utilities and transportation service.

• Material procurement including supplies, travel, shipping, storage, technical classification disposal and clothing and small stores storage.

• Administrative, communication and telephone service.

• Security and fire protection services.

• Medical and dental services.

• Military discipline, legal, chaplain, service information office, recreational and educational services.

All flight operations, logistic support, community and recreation services—including payment of personnel—is done through Vandenberg for Arguello. Vandenberg also provides housing for the Point's 250 Navy personnel and 81 Marines. Because of over-firings, no living facilities are currently planned to be built at Arguello. Instead, a BOQ, enlisted men's barracks and 97 units of Capehart housing are being built at Vandenberg for the Navy.

• **Spotting the bullseye**—For the Marines who train twice yearly at Arguello with *Terrier*, PMR provides target drones, and recovers them. It will provide the same services for the Marines when they begin training with *Hawks* next year.

As backup to *Thor* and *Atlas* training shots from Vandenberg, Arguello is in charge of frequency interference control and well as supplying data reduction and information on warhead impact. *Sofar* and *Loran* are used for pin-pointing impacts in PMR's bullseyes north of Hawaii and north of Wake.

For the *Discoverer* program, Arguello predicts the area of impact for booster fallout, and will do the same for *Samos* in addition to the usual tracking and other services including data reduction.

Arguello is now completely in charge of range safety under the latest Air Force-Navy agreement covering R&D missile and space operations on the West Coast.

The agreement, reached recently amid the running Air Force-Navy struggle for the top role in West Coast space activities, turned over the destruct button to Arguello for all launchings into the PMR—except for *Atlas* and *Thor* training shots.

Arguello also is in charge of such safety and security matters as stopping Southern Pacific trains from running through the Arguello and Vandenberg.

• **Billboard space?**—One Navy wag has suggested that at least the security problem posed by the railroad might be profitably solved by building billboards along the entire right of way and selling space to missile manufacturers.

One of the main advantages that Arguello has to offer besides its various services is its location and its

rugged topography. Several canyons provide sites for launching pads from which missiles and space vehicles can be fired in secrecy and safety.

The nearest settled area of any size is 10 miles away at Lompoc. And the high canyon walls provide revetments that would protect other installations at the Point.

The Navy considers some of the canyons capable of housing launching pads large enough to handle boosters ranging from 6 million to 10 million pounds of thrust.

If Navy plans for building launching pads for giant boosters materialize, PMR would become the greatest space range in the world. The plans are part of the Navy's overall $4-billion program for PMR. The program calls for spending half of the money during the next four years; the rest during the following decade.

A key part of the plan calls for construction of huge launching pads on an island along the equator to make it possible to place multi-ton payloads into equatorial orbits. These include 24-hour stationary satellites and the assembly of space platforms which require a rendezvous orbit.

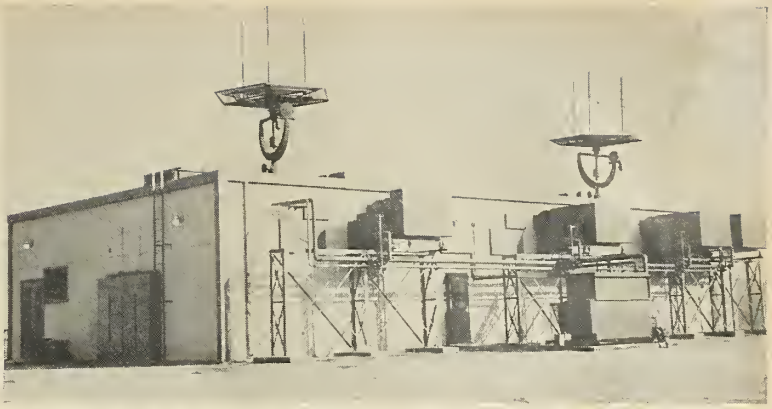
Another key phase calls for the construction of hard-line communications throughout the vast range. Some range officials consider this one of the range's most pressing needs, but they hold out little hope in the current tight-budget era of getting the some $750 million that would be needed to do the job.

Since the range's commissioning, only some $200 million has been authorized for its development—a small down payment on the overall plan. Funding is not expected to improve in FY 1961. The new budget is expected to provide less than $100 million for PMR.

This means that the Navy will continue to be a long way from achieving its goal of building a missile range that would provide the nation's space needs for years to come. Instead, budget restrictions are forcing the construction of the range piece by piece as expediency dictates.

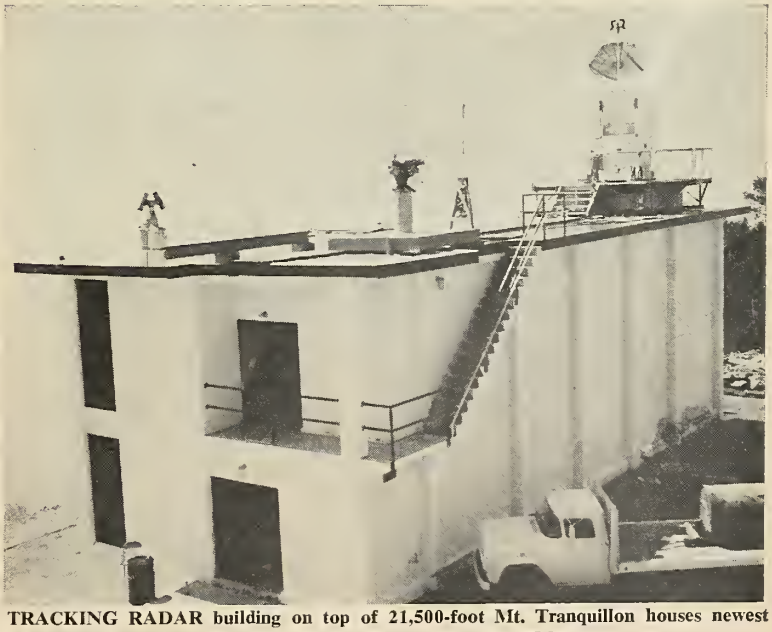
Officials in favor of the piecemeal approach under any circumstances argue that it prevents the Navy from installing "gold-plated toilets." Opponents argue that whatever economies might result from day-by-day development will be lost in the long run because a far less effective range will result.

To date the economizers are winning the day. The deer and mountain lions can be expected to abound in many parts of Arguello for some years to come.



TELEMETRY BUILDING is situated on a hilltop not far from Range Operations. Deer often graze nearby in empty canyons.

REMOTE RADAR building houses equipment for conducting surveillance of both sea and air to provide clearance for missile launchings.



TRACKING RADAR building on top of 21,500-foot Mt. Tranquillon houses newest long-range radars and other tracking instrumentation for PMR.

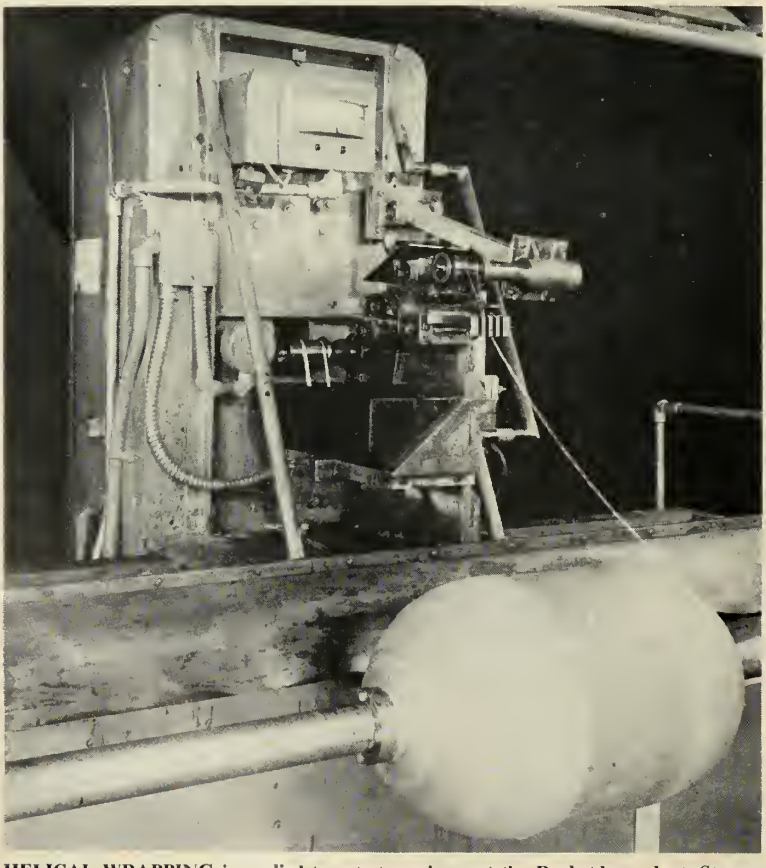
Fibreglass Wrapping Lightens *Atlas*

Rocketdyne achieves 25% savings in weight and cost of Atlas thrust chambers, and is developing the technique for use in solid powerplants as well

by Frank G. McGuire

CANOGA PARK, CALIF. — A new method of gaining strength and light weight for liquid-rocket engines, solid-rocket motors and pressure vessels is under advanced development at **Rocketdyne**, after being approved for *Atlas* production engines. Primarily a fibreglass wrapping process, the method has resulted in great weight, cost and time savings.

On the *Atlas* engines, 25% weight reductions have been achieved over the previous method of using steel restraining bands around the engine's combustion chamber. This saving, amounting to approximately 56 pounds, could be increased by further reducing the amount of winding used, a possibility considered quite feasible. Cost savings are also in the neighborhood of 25%.



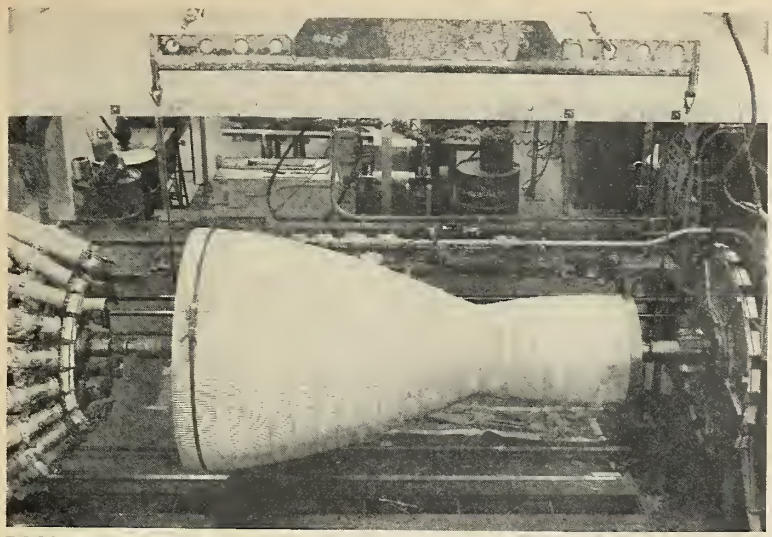
HELICAL WRAPPING is applied to a test specimen at the Rocketdyne plant. Stresses of 120,000 psi have been attained with the method as used for solid motors.

Ultimate yield stresses of 230,000 psi have been attained on the specimens of unidirectional winding similar to that used on the *Atlas* thrust chamber, and stresses of 120,000 psi are being attained with helical winding as used with solid-propellant motors and pressure vessels.

• **Time consuming**—Brazing and welding the steel bands to the combustion chamber was an operation consuming a couple of weeks. In contrast, the winding process can be completed, from initial preparation to final curing, in eight hours.

The process involves winding a glass filament roving, impregnated with an epoxy resin, around the combustion chamber, and introducing longitudinal sections of tape of similar material. The tape is loosely woven Roving with a minimum of cross filaments. (Roving is similar to a yarn thread, but without the twist. Neither a woven tape nor a twisted yarn is used because strength is reduced through weaving or twisting.)

Applied to the *Atlas* chamber in varying thicknesses, the material averages approximately $\frac{3}{16}''$ thick. Curing is accomplished in an oven at 200° to 300° for two hours. Experiments being contemplated would determine the feasibility of fabricating liquid-propellant chambers completely of fibreglass filament winding, with an erosion-resistant insert in the throat. Present methods still utilize the tubular



BOOSTER CHAMBER for *Atlas* waits in glass wrapping machine prior to the start of operations. Process was also used on *Thor, Jupiter* and *Navaho* during R&D work.

structure necessary for regenerative cooling.

On solid-propellant motors and other pressure vessels, a helical winding method is used, rather than the unidirectional winding of the *Atlas* chamber type. This makes it possible to hold in the head closure more efficiently. The helical winding, in figure 8 form, may achieve weight savings up to 50%.

• **Casings, too**—Entire solid-motor casings, complete with nozzle, can be wound, using a soluble jig or form which is removed before casting the propellant into the casing.

Any metal attachments necessary to operation may be wound into the filament with complete structural integrity. End closures on pressure vessels are wound into the filament and bonded with the resin. Failure at those joints is not a problem.

During winding, a firm jig is maintained within the chamber to prevent collapse of the coolant tubing under filament tension. Rocketdyne now has a winding machine at Neosho, for production engines, and a number at Canoga Park for R&D work.

The lathe-like circumferential winding machine at Canoga Park has the chamber rotating under a horizontally traversing arm which feeds epoxy-impregnated filaments onto the chamber at a predetermined rate. Rotation speed of the chamber is also controllable, permitting complete control over the amount of filaments applied on each pass of the traversing arm.

The helical winding machine is similar, with the added capability of having a controllable helix angle during application. On both machines, the filament is held on spools at the rear of the machine, then drawn through the impregnating resin before application to the form.

Preparation for winding the chambers involves sand-blasting the surface to be wound, then coating it with a resin to insure proper bonding of the filament winding to the tubes. After application of the filament, curing is accomplished. Physical size of the parts wound is limited only by size of the processing equipment.

Originating in 1954 as a development proejct, the filament winding process has been applied to *Thor, Jupiter, Atlas* and *Navaho* chambers during R&D development. However, *Atlas* is the only one that is now in full production.

Rocketdyne engineers foresee a greatly expanded use of filament winding, especially in rocket engine applications, and other fields. The day is also seen when liquid-rocket chambers as well as SPR nozzles will be fabricated solely of a reinforced plastic erosion-resistant liner that is filament-wound on the outside for strength.

ABMA Transfer Plan Is Readied for President

by an M/R Correspondent

HUNTSVILLE, ALA.—A proposed plan for transferring a major part of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration is expected to be laid before President Eisenhower before the month's end.

The plan, worked out by a joint Army-NASA task force in Huntsville and Washington, is expected to get a Department of Defense stamp of approval before it is handed to the President. While final details of the switch are being hammered out in Washington by NASA Administrator T. Keith Glennan and Maj. Gen. August Schomberg, commander-designate of the Army Ordnance Missile Command, general agreement on the transfer has been reached.

The President probably will present the transfer plan to Congress soon after that body reconvenes Jan. 6.

If all goes well, and Congress does not disapprove the transfer (approval is not required), actual transfer should be made in mid-March, with NASA in full operating control by the beginning of the new fiscal year.

Basically, the proposal calls for transfer of the 4300-man Development Operations Division of ABMA, headed by Dr. Wernher von Braun, to NASA —along with necessary physical facilities such as laboratories, office spaces and test stands, to enable NASA to meet on a self-sufficient basis its requirements for super-booster development.

ABMA will not be abolished as an agency of the Army, but will be continued to handle development of various military weapon systems as may be required. These would include the *Pershing* system, and the continued phase-out of *Jupiter* and *Redstone* missiles. It is possible, one source said, that other systems will be assigned to the agency. One proposal, for instance, calls for some of the systems being developed by the Army Rocket and Guided Missile Agency to be transferred to ABMA to "equalize the development load." ARGMA, now handling more than a dozen systems, would become primarily an air defense weapon system development agency, handling the *Nike-Zeus*, the *Nike-Hercules*, and smaller systems such as the *Redeye, Hawk* and *Mauler*.

• **Step-up likely**—If DOD approval is received, the net result probably will mean increased activity at Redstone, since both NASA and the Army would need additional personnel to remain self-sustaining.

Included in the transfer proposal, it was pointed out, are plans for "cross-buying" of services between the Army and NASA, to avoid needless duplication of effort.

It is in this area that details remain to be worked out—such as who will provide for NASA security, transportation, housekeeping and telephone service, since NASA has no such facilities at Huntsville. Also, the Army will have a continued need for some of its major facilities, such as the complex, multi-million-dollar computations laboratory, and its 15-story static-test stand (now modified for the *Saturn* booster), although not on a full-time basis.

I_{sp} May Be Upped by Wire Explosion

Company believes this propulsion method can provide more power than most proposed electrical systems offer; other uses seen in communication, attitude correction

PASADENA, CALIF. — Electrical explosions of fine wires may provide outer space vehicles with 2 to 10 times the specified impulse of present chemical propulsion systems.

This is only one of several applications proposed by **Electro-Optical Systems, Inc.**, out of a year-long basic research study of exploding wire techniques in fuze initiators and detonators conducted for U.S. Army Ordnance.

Such impulses conceivably could increase propulsion capabilities for space vehicles, particularly for missions from the atmosphere's outer edge to the moon. The system might also be used for satellite attitude correction. The company now feels that such a propulsion method can provide more thrust for the amount of power consumed than many currently proposed electrical propulsion systems.

Use of exploding wire phenomena to determine reaction characteristics of surfaces struck by hypervelocity objects would enable scientists to obtain high-speed impact data not presently obtainable. Vapor or plasma emanating from the exploding wire could be accelerated to 20-30 kilometers per second—a speed far greater than anything presently in laboratory use.

Other uses proposed by EOS include high-intensity light sources for communications purposes; utilization in studies of particle impact against various surface types; possible use as fusion for thermonuclear energy generation, and light for photochemical reaction.

THIS TRIGATRON reveals the actual dumping of current and exploding of wire as performed in the laboratory by Electro-Optical Systems, Inc.

• **Fast switching**—Key to the above applications lies in heat generated and the high amount of thrust producing energy obtained by fast switching of large amounts of current into the wires in millimicrosecond time. This technique has enabled EOS to place many times the material's vaporization energy into the wire.

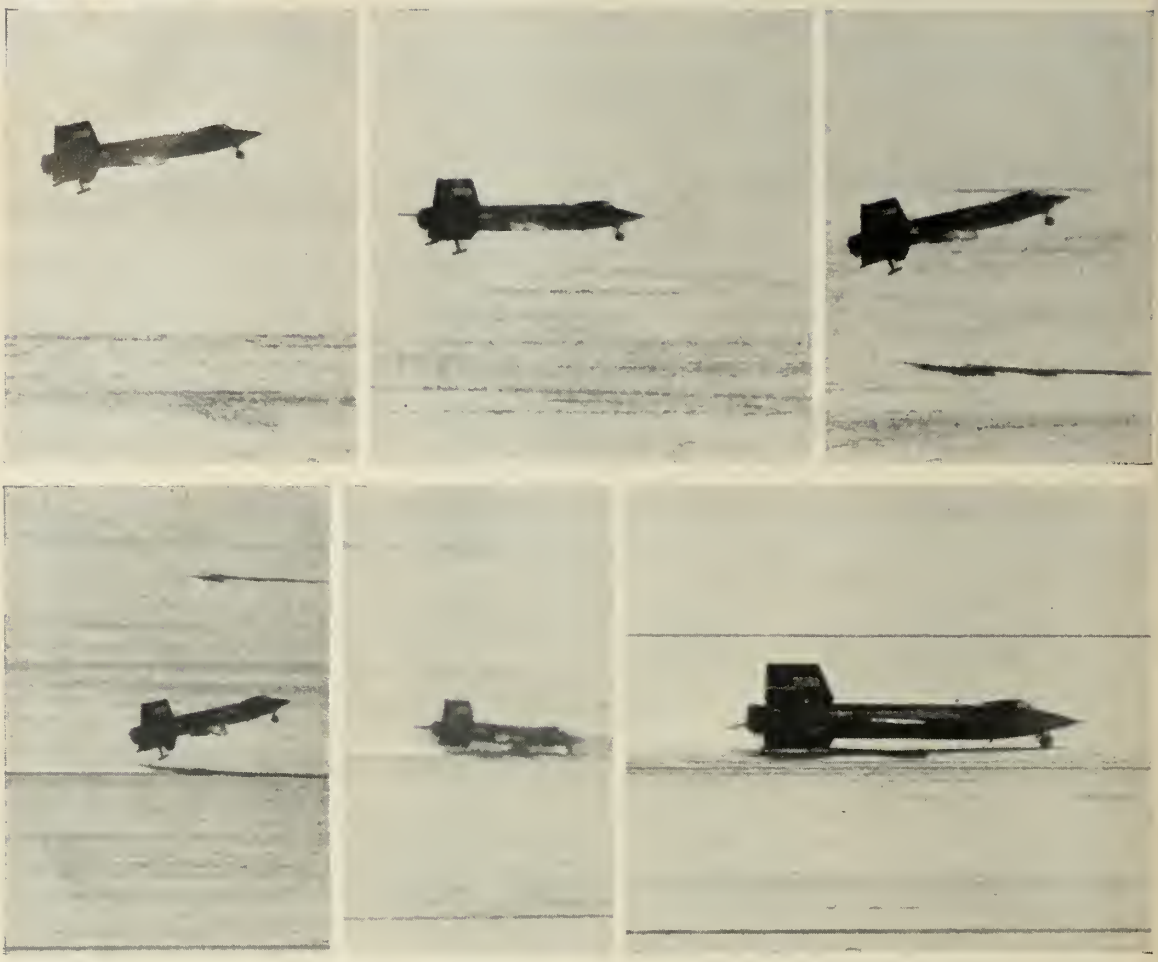
Temperatures up to 100,000°C and pressures in the megabar range have been obtained. Specific impulses of 1000 seconds have been achieved by exploding several wires at once, and a 1000-5000 second range appears possible.

The exploding wire technique at EOS is accomplished by charging electrical energy sources to many kilovolts and then suddenly switching current through the wire. Actual switching is triggered first by a hydrogen thyratron which activates a trigatron that actually dumps current into the wire by means of a triggered air spark gap.

Materials used in experiments include: aluminum, iron, copper, gold, silver, nickel, tungsten, molybdenum, tin, titanium, zinc, cadmium and bismuth. Test wires measure about one mil in diameter and ¼-in. in length. A capacitor of from 0.002 to 0.02 microfarads charged to 10-20 kilovolts is suddenly discharged into the wire where the entire circuit inductance is from 0.1 to 0.03 microhenrys. Voltage is switched across the wire in about seven millimicroseconds and the vapor process duration ranges from 50 to 100 millimicroseconds.

• **Dwell time**—Current dwell phenomena has been encountered in the wire explosion. Following the initial vaporization stage, current conduction is reduced to a low level. But voltage remains across the gap because vaporization is completed before the capacitor charge flows out completely. After a given time there is a resurge of

B.F.Goodrich



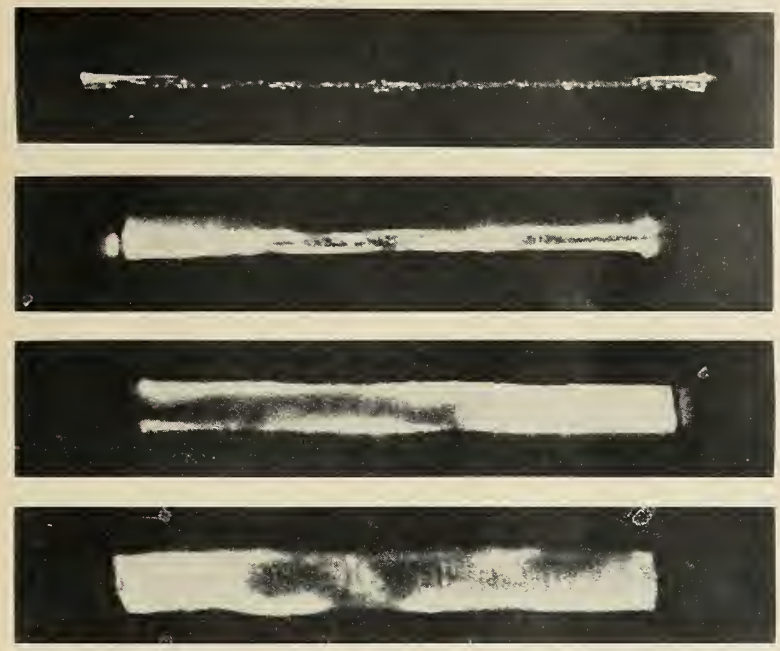
Fabric Tread Tires invented by B. F. Goodrich help land X-15

When the North American X-15 comes in for a landing, the B.F.Goodrich Fabric Tread Tires on its dual nose wheel touch down at about 200 mph. As X-15 comes to a stop, these special tires must withstand tremendous friction and heat build-up. Yet they can take this rugged pounding because nylon laminates are sandwiched right into the tread stock. These laminates reduce distortion under load, equalize modulus between tread and carcass and check "shock wave" formation.

The same construction now goes into BFG tires for today's newest commercial jets. For further information on these and a variety of B.F.Goodrich products you can use in space, in the air and on the ground, write to *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Co., Dept. MR-129, Akron, Ohio.*

Cross-section of BFG Fabric Tread Tire showing nylon laminates

B.F.Goodrich
aviation products



SERIES ILLUSTRATES reaction of exploding aluminum wire 3, 8, 32 and 45 millimicroseconds after induction of current. Wire was 1 mil in diameter, 3/16" long.

current conduction by the restrike of an arc.

Placing larger original voltages across the wire reduces dwell time to where it may also be merged into the initial current conduction phase.

Special instrumentation devices have played a large part in the EOS program. The company is believed to be one of the nation's first organizations to record simultaneous measurement of both voltage and current across the wire with a resolution of a billionth of a second. This has enabled the company to determine power input and wire resistance and has revealed a variety of characteristics of the particular material under study.

An EOS-developed Kerr Cell camera with an exposure time of 5 millimiscroseconds is used to photograph the explosion period and provide a record of light intensities and discharge products. Another development out of the wire experiments is a high frequency response current shunt which measures voltage drop across the wire. This advanced device replaces the classical shunt technique formerly used in such measurements. It is extremely applicable to high currents, is smaller than the previous device, simple to build and possesses low inductance and high frequency response.

The high intensity light source which may be obtained by exploding wire may prove ideal for space communications and searchlight operations within the atmosphere. Surface temperatures of 5000°C plus the superheated interior would give such a light source excellent visibility and long duration.

Other possible applications are detonation devices for fuzes and solid propellants, fuses for protection of capsulators, and special welding techniques.

20 Technical Sessions Set for IRE Convention

Los Angeles—Top Department of Defense research and development officials will be principal speakers at the IRE 1960 Winter Convention on Military Electronics here, February 3-5. They include James M. Bridges, Director of Electronics, DOD Research and Engineering; Lt. Gen. Arthur G. Trudeau, Chief of Army R&D; and Maj. Gen. O. J. Ritland, Commander of AFBMD.

Bridges will chair the convention's opening keynote session, General Trudeau will speak at the Wednesday luncheon meeting, and General Ritland will be the banquet speaker.

Papers of special interest to be presented in the 20 technical sessions include Project *Mercury* communications, re-entry problems, a portable atomic frequency standard, thin-film ferromagnetic modulators, redundancy, and range safety instrumentation at Vandenberg AFB.

Classified sessions will cover presentations on surveillance, reconnaissance, guidance and control and communications.

Other unclassified sessions will present four papers each on satellite system and subsystems, data handling, re-entry, reconnaissance, instrumentation, reliability, telemetry, guidance and control, communications, ranging and tracking, and components.

The keynote panel session will be devoted to the satellite as a transmission medium for global communications. Members of the panel are Paul Price, ARPA; Dr. John R. Pierce, **Bell Labs;** Dr. Hans Ziegler, Signal Corps R&D Lab; and Brig. Gen. John B. Bestic, AF Deputy Director of Communication Electronics.

North-Seeking Gyro Is Accurate within 5 Seconds

Santa Monica, Calif. — An extremely accurate North-Seeking Gyroscope with an accuracy of better than five seconds of arc is being developed by **Lear, Incorporated.**

The system has been under study, development and fabrication for the Army Ballistic Missile Agency for the past three years. The instrument was jointly developed by two divisions—the **Lear Astronics Division** here, and **Lear Electronic GmbH** in Munich, Germany.

The ±5 seconds of arc accuracy attained by the gyro has been reduced under certain favorable conditions. In a recent series of tests, the rms (root mean square) error was 3.55 seconds. The follow-up servo developed for use with the present gyro is capable of tracking the gyro with an accuracy of ±1 second of arc.

The present North-Seeking Gyro (NSG) was developed specifically as a prime azimuth reference for mobile ballistic missiles. To illustrate the order of accuracy involved: a 5-second azimuth error at launch would cause an off-target impact of about 800 feet over the full range of an ICBM, assuming no errors in the missile guidance system.

Critical azimuth adjustment becomes even more important when dealing with the vast distances of space. A moon probe, for example, could miss its impact point by 1.2 miles for each second of azimuth misalignment at launch.

• **Ten-year development**—Originally

developed in Germany for use in precisely determining true north for underground mine surveying, the device has been considerably refined; it is expected to prove useful in space vehicle applications and rapid all-weather surveys of missile launching sites, in addition to mining operations and geodetic surveying.

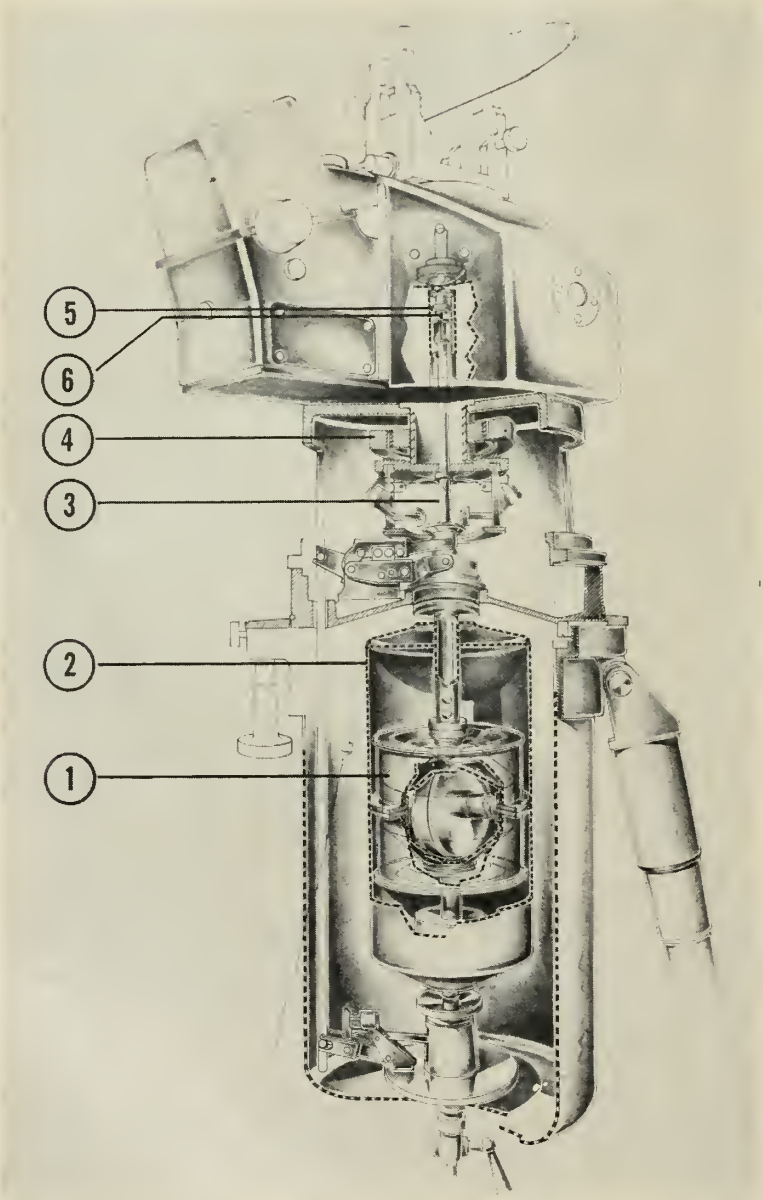
From the original instrument, which had an accuracy of ±1 minute of arc, to the present design took about 10 years of development work.

The underlying physical principle is the tendency of a pendulous gyro, suspended with its spin axis horizontal, to align the latter with the horizontal component of the earth's spin velocity. Consequently, the system locates true, rather than magnetic, north.

• **How it works**—As shown in the schematic diagram, the gyro element is suspended in an inner cylinder (1) filled with helium. This inner cylinder in turn in enclosed by an outer cylinder (2), which serves as structure and bearing support for the rotating inner cylinder. The gyro spin axis is initially roughly aligned with north with a magnetic compass. After the gyro is brought up to speed, it is uncaged by rotating the caging lever. The spin axis of the gyro then tends to align itself with the meridian.

Since the gyro is essentially undamped, it will oscillate around true north—the period of the oscillation being 13.5 minutes. The amplitude will vary, depending upon the position of the gyro at the time of uncaging. Power transfer to the gyro is accomplished by means of thin silver bands (3) whose torsional moments are negligible.

A precision electromechanical servo (4) tracks the oscillating gyro with an accuracy of one second of arc, and rotates the upper band clamp (5) in phase with the gyro, thus eliminating torsion effects of the steel suspension band (6). The volume between the inner and outer cylinders is filled with silicon oil, which partially floats the gyro and reduces the band tension.



SCHEMATIC DIAGRAM of Lear's North-Seeking Gyro (see text above). The basic principle involved enables the system to locate true, rather than magnetic, north.

Flame Sprayer Melts, Deposits Any Material

WESTBURY, N.Y.—**Metallizing Engineering Co. Inc.** has announced a hand metal spraying tool that can melt or vaporize any known material and deposit it on a surface.

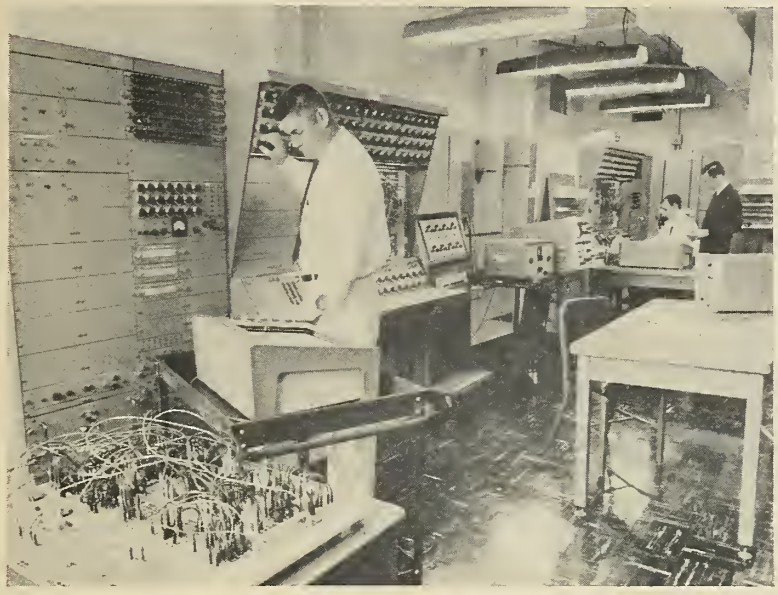
The tool is a plasma flame sprayer that utilizes a technique used hitherto to spray metals or metal oxides on rocket nozzles, nose cones and other equipment subject to extreme thermal conditions, such as crucibles for high-melting-point materials.

The flame sprayer will operate in a vacuum or in any atmosphere. It can operate up to 30,000°F, enough to melt the hardest materials, and spray them on to surfaces. Titanium, for instance, may be sprayed onto softer metal to give it a hard finish.

Physical and metallurgical properties of the coatings obtained are generally superior to conventional flame-sprayed coating, METCO President R. A. Axline reports.

Conventional flame-spraying techniques involve use of chemical fuel, such as oxy-acetylene, to melt materials to be sprayed. The plasma sprayer uses an electric arc to heat a relatively inert gas, such as nitrogen, into the plasma state, or so-called "fourth state of matter," at which it is highly ionized. The material to be sprayed is fed, in the form of rod or powder, into the plasma flame and shot onto the material.

Cost is about $10,000 for a hand sprayer and equipment, which includes a small computer—as big as a man—for equipment control.



Evaluators Save Time, Money

SYRACUSE, N.Y.—A new systems evaluator developed here by the **General Electric Co.**'s Defense Systems Department, is said to shorten electric system development by as much as 25 per cent.

The GEESE (GE Electronic System Evaluator) will enable design engineers to predict if a system will operate at top efficiency even before it goes into production, according to company engineers. The evaluator eliminates the need for costly intermediate hardware by simulating operation early in the development cycle.

GEESE, through the use of analog simulation techniques, can be used to simulate all types of radar and communication systems and to evaluate the effects of electronic countermeasures and mutual interference. It can generate and combine all types of r-f signals to determine the effects of imposed jamming and anti-jamming techniques, eliminating complex and expensive laboratory evaluation equipment.

The primary advantage claimed for the GEESE is its ability to vary system parameters simply and quickly and to record all transient and steady-state conditions with standard oscilloscopes. It includes a time scale up to one million to one so that r-f and i-f carriers can be recorded.

Almost any conceivable signal can be generated on the GEESE. Amplitude-, frequency-, and pulse-modulation techniques have been developed; doppler shift and noise have also been used in systems analysis. Signal frequency, phase, and amplitude can be controlled and their instantaneous effect on system performance observed. Other parameters—signal design, receiver gain, r-f and video, limit levels, detector characteristics, and age time constants—can be varied for investigation of simulated system operation.

The amplitude of return signals varies as a function of time, range, and antenna heading and can also be varied with potentiometer controls. Variations in signal strength are obtained with resolvers and multipliers.

Target size, as well as position, can be controlled. Jamming or interference signals are simulated in type, power, and frequency. All can be varied as functions of position and time.

The GEESE receiver uses an electronic multiplexer as a mixer. Various Filter networks can be used for the r-f and i-f section, their characteristics determined by potentiometer settings.

Programming is accomplished with modular building blocks. This feature, plus the almost unlimited number and variety of inputs and controls available, gives the system flexibility and application limited only by the analog equipment available.

Circle No. 225 on Subscriber Service Card.

Rubber Sleeve Insulators Protect Solid-Fuel Cases

Rubber sleeve insulators manufactured by **The Garlock Packing Company** are being used to insulate the outer case from the solid fuel of rockets and missiles. This insulation was used in the *Pioneer* moon rocket launched last fall.

The sleeve is made of a rubber compound developed by the Naval Research Laboratory. Without this insulation the intense heat and velocity of the propellant would burn through the motor casing, causing complete failure of the missile. The insulator is currently being used in the Navy's submarine-launched *Polaris* missile. Garlock has also developed similar insulators for the third-stage *Vanguard, Super Vanguard, Terrier, Super Tarter, Talos* Booster, the Air Force's *Minuteman* and certain outer space probe vehicles.

The company has also developed a filament-wound chamber to encase the insulator and propellant. The chamber must be able to withstand the tremendous pressures of the "controlled explosion" of the rocket engine.

Circle No. 226 on Subscriber Service Card.

Aluminum Alloy Patented

Navan Products Inc., invention marketing subsidiary of **North American Aviation,** has patented an aluminum alloy it says is used in the majority of aluminum castings in liquid-rocket engines that have powered the nation's successful major missiles.

The alloy, called "Tens-50," contains about 8% silicon, 0.5% magnesium, 0.2% beryllium and 0.15% titanium.

Circle No. 227 on Subscriber Service Card.

Gamma Spectrometer Unit Eliminates 'Dark Current'

A new gamma spectrometer system designed to eliminate the "dark current" defect common to conventional systems is offered by **Nuclear Measurements Corp.** It is said to offer better resolution over a wider range, and to provide greater precision in gamma spectroscopy than any other equipment now available.

Unlike conventional "sliding window" systems; the new system is a "sliding pulse" type, employing photomultiplier tubes, transistors and sensitive discriminators. The pulse is brought

In a number of highly stressed components subject to extreme high and low temperature fluctuations, *high-performance* titanium in the X-15 Research Vehicle will help take man higher and faster than he has ever been before.

Republic Steel—a leading supplier of titanium, and the nation's largest producer of stainless and alloy steels—is supplying North American Aviation with Type 110A titanium for internal structures on the X-15 project.

Let us help you utilize *high-performance* metals to increase strength, resist heat, or trim weight. Write Republic Steel, Dept. MR-8591, 1441 Republic Building, Cleveland 1, Ohio.
Please indicate if you would like a titanium metallurgist to call.

REPUBLIC STEEL *Where Steels are*

FIRST POWERED FLIGHT of the North American X-15 come on September 21, 1959, over Edwords AFB. Corrying o full lood of fuel (note frost from liquid oxygen ot top and bottom of fuselage), the X-15 flew under power for 3.5 minutes ot speeds in excess of Moch 2.

REPUBLIC STAINLESS STEEL is used in leading edges of the Convoir 880's verticol fin ond horizontal stobilizer where onti-icing is occomplished through electrical heoting of the metol. Use of Republic ENDURO® Stoinless Steel increoses strength ond heot-resistonce, permits thinner, lighter goges. Types 301 ond 302 ore reodily formed into desired shopes by cold forming, drowing, ond bending operotions.

REPUBLIC'S NEW HIGH STRENGTH POWDER, TYPE HS6460

is ideol for sinterings of highly stressed components. Provides minimum tensile strength of 60,000 psi ot 6.4 density os sintered . . . 100,000 psi after heot treotment. Maximum of .004% shrinkoge from die size ot 6.4 density. Avoiloble in quontities up to ond including 12 tons or multiples. Con be used with existing operoting equipment.

REPUBLIC VACUUM-MELTED ALLOYS heot treoted to tensile strength levels of 270,000 to 300,000 psi ore produced in fifteen thousond-pound heots for missiles such os the Minutemon. Vocuum orc process minimizes segregotion ond center porosity. Nonmetollic inclusions ore reduced in number ond size. Tronsverse ductility ot high strength levels is olso greotly improved.

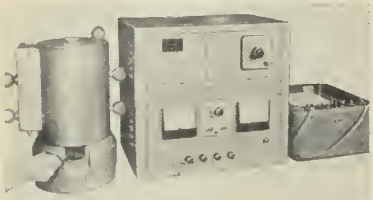
Made to Meet the Challenge of Acceleration

REPUBLIC STEEL

Circle No. 8 on Subscriber Service Card.

to the window rather than the window to the pulse.

Designated Model GSS-1, the system is built around two basic components —a combination linear count ratemeter and all-transistorized spectrometer cir-



cuit, and a probe assembly including spectrometer grade photomultiplier tube with 2″ x 2″ NaI scintillation crystal, coupled directly to an all-transistorized amplifier. Integrated with these are other units—a universal shield with sample slides, a decade type slave scaler, and a graphic recorder.

Circle No. 228 on Subscriber Service Card.

Low-cost Modified Epoxy Adhesive Is 100% Reactive

A 100% reactive, room-temperature curing epoxy adhesive, Bondmaster M685, has been formulated by the **Rubber and Asbestos Corp.**

In 6-drum lots, the mixed cost of M685 and its hardener is about $7.75 per gal. The modified epoxy adhesive is a free-flowing liquid (3000 to 7000 cps). Mixed weight, with hardener, is 9.6 lbs to the gallon. Pot life with Hardener CH-22 is 60-90 minutes; with Hardener CH-34 approximately 45 minutes, depending on the size of the container used.

At room temperature, the bonded assembly can be handled in 6-8 hours and develops 85% maximum strength in 14-24 hours. The formulation may be heat-cured in 10 minutes at 250°F.

Circle No. 229 on Subscriber Service Card.

Bonding Permits Hermetic Seals in Microwave Systems

Development of a group of modified fluorocarbons called Raibond which makes possible a stronger, more elastic bond between metal and plastic components of microwave transmission systems has been announced by **Radiation Applications, Inc.**

The product is said to permit the use of newly developed adhesives, with substantially increased low-temperature flexibility, in waveguide equipment. For this reason, the development may have a highly favorable impact on the performance of radio and radar devices in sub-freezing regions.

Raibond-modified fluorocarbons are employed as plugs in microwave guide "plumbing" systems designed to keep out water and dirt and to keep in either hydraulic fluid or pressurized gases. The fluorocarbons to which it has been applied are Kel-F and Teflon, produced, respectively, by **Minnesota Mining and Manufacturing Co.** and **E. I. DuPont de Nemours & Co., Inc.**

RAI engineers discovered that Teflon and Kel-F could be successfully bonded to metals with room temperature vulcanizing (RTV) silicone rubbers in place of the epoxies formerly used. The resulting bonds are flexible and pressure tight. In addition, Raibond retains all of the electrical characteristics of the original Teflon or Kel-F. This results in a higher efficiency of microwave transmission—marked by plumbing with a lower loss factor—than can be obtained with conventionally bonded Teflon.

In the past, problems arose with epoxy adhesives at extremely low temperatures (of the order of −100°F) because of the difference in thermal expansion and contraction between the plastics and metal of the waveguide.

Circle No. 230 on Subscriber Service Card.

Spin Stabilization Aids *Polaris*

A pneumatic spin stabilization system weighing less than three pounds has been developed by the **Solar Aircraft Co.** for use in controlling re-entry bodies of test vehicles in the development program for the U.S. Navy's *Polaris* ballistics missile.

The system was manufactured by Solar to specifications of **Lockheed Missiles and Space Division.** Lockheed is manager of the *Polaris* missile system.

A high pressure spin control system consists of a sealed tank about eight inches long charged with nitrogen and controlled by an explosive-actuated valve.

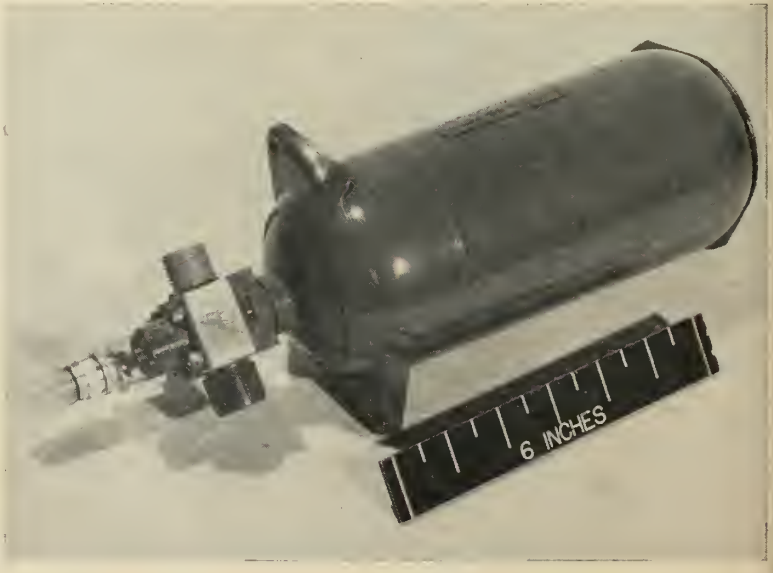
In operation, the actuator is fired by an electrical impulse. The resulting gas energy unloads a piston-supported metal diaphragm. The resulting gas energy unloads a piston-supported metal diaphragm. The internal nitrogen gas pressure then ruptures the diaphragm and the gas is discharged through two opposed valve openings at 3000 psia.

This emitted gas, from several of these small systems, provides stabilization for the missile's re-entry body. Solar engineers have incorporated an over-pressure thermal relief device into the system to prevent premature firing.

By hermetically sealing the nitrogen gas, the system is insensitive to environmental storage conditions with a minimum storage life of five years in the charged condition.

Burst tests of the system's tank, made of alloy steel with walls .050 inches thick, by Solar and an outside testing laboratory have consistently recorded a hoop bursting strength of a minimum of 280,000 psi and a maximum of 307,000 psi.

Circle No. 231 on Subscriber Service Card.



New Material Features Low Ablation Loss

A material with high heat-resistant properties has been developed by the **Cordo Chemical Corp.** Called Resin Bonded Quartz Sheet, it is a combination of reinforced plastics and ceramics.

Both of these materials have been used with varying success in the rocket and missiles field, but neither alone is the complete answer to the extremes of temperature encountered in these applications.

Resin Bonded Quartz Sheet has advantages over either plastics or ceramics alone. Aside from the obvious fact that it out performs other materials in current use, it is markedly lower in price and handles as well, if not better than such materials.

Finely divided particles of fused quartz are bonded together with already proven high temperature-resistant Cordo Pyropreg resin. A small percentage of glass or other fibers is included to give the resultant sheet good handling properties. The sheet assumes the black color of the Pyropreg resin and looks very much like a normal pre-impregnated fabric except that there is, of course, no cloth weave to be seen.

The Cordo Chemical Corporation recommends using this material as a facing on a laminate of standard Pyropreg reinforced plastic. Resin Bonded Quartz Sheet is not a structural material, and in the cured form has physical properties comparable to the resin itself. Its strength is ample for shielding properties but contributes little to the over-all structure.

The special property of low ablation loss under extreme conditions is attributable in large part to the use of quartz. The fused quartz particles used in Resin Bonded Quartz Sheet have an extremely low coefficient of thermal expansion. The melting point of this fused quartz is in excess of 3100°F., and the resultant liquid is extremely viscous so that it is not washed off the surface but tends to act as an insulator for the material which is not yet melted.

The low ablation loss feature is apparent. Five panels have been tested in the 5500°F blast of an O-H rocket motor for sixty seconds. Panels number one, three, and the unnumbered panel were dropped in cold water within a matter of seconds after the rocket motor was cut off. The panels which show cracks were not damaged during the test. This was mechanical damage in shipping the exposed panels.

Resin Bonded Quartz Sheet is avail-

propulsion engineering . . .

By JAY HOLMES

Nuclear propulsion and APU proposals . . .

are drawing bigger and bigger responses. Two dozen companies—many more than expected—attended a briefing this month on an Air Research & Development Command contract for design studies and development of a 300 kilowatt nuclear mechanical power system suitable for use in a space vehicle.

Such a power source could function as an auxiliary power system or deliver a service load drawn by an electrical propulsion device—such as ion or plasma. However, 300 KW would provide only a few pounds of thrust, even at top efficiency.

The nuclear industry is pleased with the development because it expects progress on electrical propulsion to pull far ahead of power sources available. The ARDC source will take at least five years to develop. Ion propulsion devices could be ready in two years.

Development cost of $50 million . . .

is a figure bandied about in industry. ARDC won't say, of course. Only a small fraction of the total is involved in the design study, the first phase. Bids on the design study, expected to take about a year, are due Feb. 1. With additional "examining" time needed for circulation of the second round of development phase bids, it is clear that work in earnest may not begin for almost two years.

ARDC, associated with the Atomic Energy Commission, is calling for a reactor power source based on rotating machinery. Thermionic conversion is out for the present. The Aeronautical Accessories Laboratory at Wright Air Development Center, Dayton, says the device may not be used in an actual vehicle. The prime objective of the work is to advance the state of technology.

Solid motors weighing 5-10,000 lbs. . . .

will be produced at the Kansas Ordnance Plant at Parsons by **Grand Central** if the Army gives the go-ahead. Architect-engineering studies, now in progress, will be completed late in 1960.

No specific projects are scheduled for Parsons; the Army sees the plant as a possible backup, in case of production slippage elsewhere. It will have a limited capacity but will be capable of expansion.

Too-detailed specifications . . .

are causing annoyance in several shops. Case makers fail to see why welds in solid rockets should be dressed down, when machining may introduce weaknesses. Others are irked at the need for machining case interiors—when the surface is immediately roughened by application of plastic inhibitor, painted on with a brush before the grain is cast.

Metal suppliers wonder why aeronautical specifications are put on some materials that never will get higher than the tailgate of a truck. On the other side, fabricators complain of poor quality metal furnished when they demand highest purity. Vendors guarantee that chemical impurities are below a specified level, but they neglect to mention one compound—DIRT.

Industry is giving horselaugh . . .

to an inexperienced casemaker who took ideas that an experienced company had presented on the first feasibility go-round, incorporated them in his production plan and filed the lowest bid. When he couldn't produce, he went running to originator for help. Result: the experienced company made a small profit and the chiseler lost his shirt.

Other chuckles are generated by a West Coast man who proposes wood-burning rockets. He would save money on the insulation too—by using wadded-up old newspapers.

able in thickness of from 10 to 20 mils and is 36" wide. Special thicknesses and widths can be special ordered. Roll length is normally 30 to 40 yards. The material can also be supplied in a diced form. It may be ordered from Cordo Molding Products, Inc., 230 Park Avenue, New York, New York, and their nation-wide representatives.

One of the most interesting features of this material is its price. Resin Bonded Quartz Sheet is actually priced lower than standard pre-impregnated glass fabric, which is several times lower than high silica materials such as Refrasil, and many, many times lower than pure quartz fabric reinforced materials.

Circle No. 232 on Subscriber Service Card.

New Literature

TRANSISTORS. A 16-page Brochure available from the **General Transistor Corp.**, describes its complete line of PNP and NPN transistors most widely used by original equipment manufacturers. Complete specifications are provided; characteristics given are minimum standards against which GT Transistors are 100% tested. A GT Transistor applications chart is included. Sections are devoted to: audio transistors (for audio amplifier and low speed computers); computer transistors (PNP and NPN for low to medium speed AC amplifier and medium current DC switching); high current computer transistors; photo transistors; bilateral transistors (NPN for core and drum memory addressing and chopper applications); drift transistors (PNP for DC computer applications); high voltage transistors (PNP and NPN for driving Nixie and Neon tubes); and silicon alloy junction transistors (PNP and NPN).

Circle No. 200 on Subscriber Service Card.

GYROS. A 62-page technical manual for subminiature rate gyroscopes has been prepared and published by **Sanders Associates, Inc.** The manual contains the basic principles of operation of this subminiature type gyro and covers the operating characteristics, standard types available, transformer pickoff, and use and design of packages of one-, two-, and three-axis sensors for rate and acceleration.

Circle No. 201 on Subscriber Service Card.

FASTENERS. An illustrated engineering data catalogue describing bolts, nuts, screws, dowels, etc., which can be used at elevated temperatures has been published by the **Mercury Air Parts Co.** Fabricated to AMS 5735 for 1300 degree to 1800 degree applications. Non magnetic and corrosion resistant.

Circle No. 202 on Subscriber Service Card.

west coast industry . . .

By FRANK G. McGUIRE

Distribution of trade union members throughout California has been determined by Irving Bernstein, associate director of UCLA's Institute of Industrial Relations. The state's past conception of San Francisco as a "union town" and Los Angeles as an "open-shop city" must be re-evaluated in light of actual distribution of unionists, says Bernstein. Trade union membership in the Los Angeles-Long Beach area is between 200,000 and 250,000 more than in the nine counties of the San Francisco Bay region.

Despite this shift from one large city to another, the UCLA study shows that unions have made their biggest gains in smaller urban communities, not in the big cities. This trend is most noticeable in southern California. Between 1954 and 1957, unions made their largest increase, percentagewise, in Imperial, Riverside and San Bernardino counties, followed by Santa Barbara-Ventura, Sacramento Valley, San Diego County, and Los Angeles-Long Beach.

San Diego may soon become the state's third major center of trade union strength, if its present rate of growth continues. Leadership in at least one respect has been retained by San Francisco-Oakland, because half of their total work force belongs to unions—a higher percentage than any other California city. The general decline of the Bay City as the state's union stronghold has been attributed to the decline of the maritime unions and the fast growth of such other organizations as the Teamsters.

United Research Corporation . . .

is moving into solid-propellant rocketry at a rapid pace. The briefing held November 10 at Edwards AFB on a large solid-propellant booster included **URC** in such company as **Thiokol, Rocketdyne, Aerojet, Grand Central, Hercules Powder,** and **Atlantic Research.** The recently-formed subsidiary of **United Aircraft Corp.** is expected to contribute mostly research to any such program, pending completion of its plants, but even this capability represents very rapid growth.

Convair will start construction . . .

of its $4-million Astronautics warehouse building, following failure of an opposing petition to block the project. The building will be used for offices (about 1/3) and storage of components. Completion is expected in the fall of 1960. The construction site is adjacent to the **Convair (Astronautics)** plant on Kearney Mesa.

Metal Control Laboratories . . .

has purchased **Pacific Testing Laboratories, Inc.** MCL, a Huntington Park, Calif., firm, will move the equipment and personnel of PTL from the Van Nuys location. Both firms specialize in testing and research.

Astral Electronics Inc. . . .

has received a $113,446 contract from AF for chemical, biological and radiological defense training sets. The contract is apparently the first of its type to be awarded by a government agency, and reflects a growing interest in the field.

University of California will research . . .

the process of mass transfer—the means by which the molecules of one chemical spread themselves out among the molecules of another—in order to determine its mechanics. The $125,200 grant will benefit rocket fuel development, and will aid in predicting how two materials will interact under certain conditions.

More politics than security . . .

pervades some aspects of the missile program. For example, the configuration of the *Nike-Zeus* is not classified, but is marked "for official use only" and kept from public view. The argument is that the configuration may soon undergo a complete change, and make the present bird a misleading representative of the program.

FROM LAGRANGIAN TO LIFT-OFF

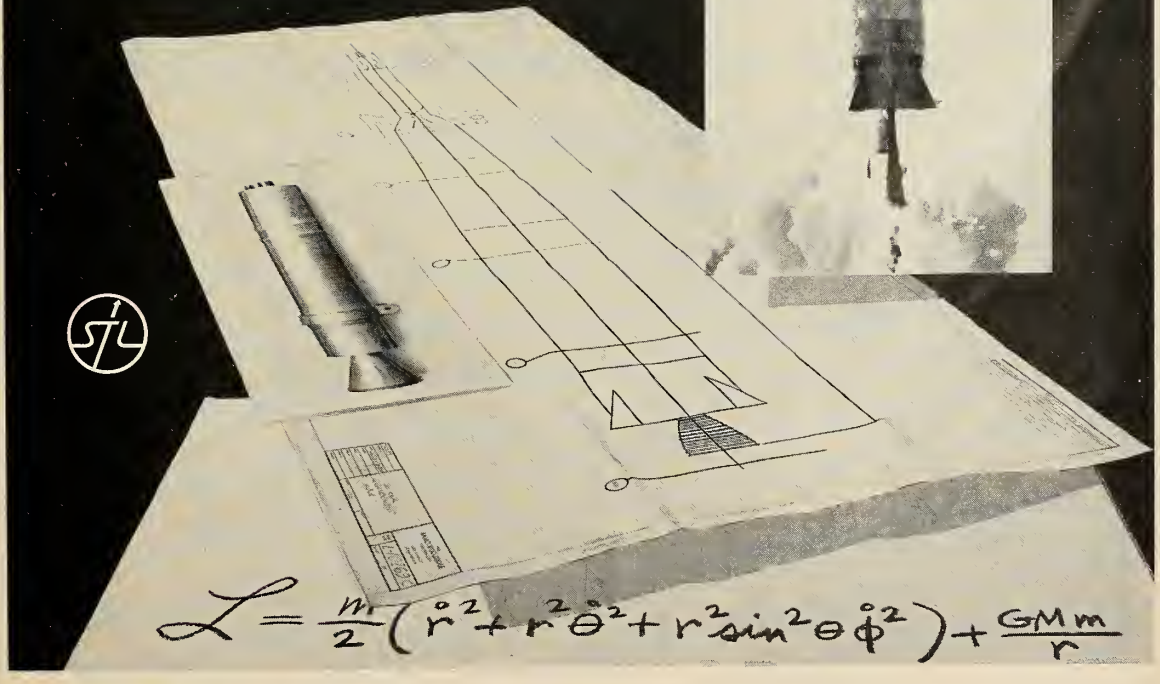
Sometimes forgotten during the thundering ascent of a space probe rocket are months of meticulous analysis, engineering and planning. The staff of Space Technology Laboratories is now engaged in a broad program of space research for the Air Force, the National Aeronautics and Space Administration and the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division. For space probe projects STL provides the total concept approach, including preliminary analysis, sub-system development, design, fabrication, testing, launch operations and data evaluation. The total task requires subtle original analysis in many fields as well as sound technical management.

The STL technical staff brings to this space research the talents which have provided system engineering and technical direction since 1954 to the Air Force Ballistic Missile Program. Major missile systems currently in this program are Atlas, Titan, Thor and Minuteman.

The scope of STL's responsibilities offers creative engineers, physicists and mathematicians unusual opportunities to see their ideas tested in working hardware. Inquiries are invited regarding staff openings in the areas of Advanced Systems Analysis, Rocket Propulsion, Space Flight Mechanics, Dynamics, Structural Analysis, and Aerodynamics.

Space Technology Laboratories, Inc.

P. O. Box 95004, Los Angeles 45, California



Missiles and Rockets Editorial Index

Readers are invited to save the following six-month index covering M/R issues of July 6, 1959 through Dec. 28, 1959. This index is a reference guide to major news and technical articles published in M/R during the last half of the year.

ASTRIONICS

Antennas

ANTENNAS: THERE'S A LIMIT IN SIZE; What's needed is the ability to manufacture dishes and maintain them in an exposed environment to the close tolerances required, by Hal Gettings, M/R Associate Editor, 8/10/59, p. 18.

Automatic Checkout

UNIVERSAL CHECKOUT CENTER IS URGED TO MATCH WEAPON ADVANCES; Packard Bell, with experience in Polaris, Thor and Falcon programs, believes the concept will reduce inventories and personnel and enhance portability, 10/5/59, p. 23.

A CLOSE-UP OF TWO AUTOMATIC CHECKOUT SYSTEMS; Curtiss-Wright's DEMON and Nortronics' NORSCAN are fully transistorized, modularly constructed and completely self-checking, by Charles D. LaFond, M/R Associate Editor, 7/6/59, p. 33.

Communications

DEVICES COULD HANDLE 300 MILLION WORDS/SEC; 12/7/59, p. 26.

EXPLORER VI MAY SOLVE PUZZLE OF REPETITIOUS RADIO SIGNALS; 11/9/59, p. 24.

PROMISE OF NEW 'DECISION THRESHOLD COMPUTER'; Simple device performs well in NATO scatter stations and is expected to find application in telemetry, especially over long distances, by Charles D. LaFond, M/R Associate Editor, 8/24/59, p. 18.

Components

EYELETS VS. PLATED-THRU HOLES IN PRINTED CIRCUITRY; A report on a comprehensive test in which all located failures were in eyeletted phenolic boards, by Barnard C. Alzua, Jr., 7/27/59, p. 37.

Control Systems

RCA SYSTEM DESIGNED TO RELIEVE INTERFERENCE TROUBLES; 8/31/59, p. 32.

PROMISE OF A NEW 'DECISION THRESHOLD COMPUTER'; Simple device performs well in NATO scatter stations and is expected to find application in telemetry, especially over long distances, by Charles D. LaFond, M/R Associate Editor, 8/24/59, p. 18.

Data Processing

DEVICES COULD HANDLE 300 MILLION WORDS/SEC; 12/7/59, p. 26.

SAGE GUIDES INTERCEPTOR MISSILES; An exclusive account of a computer's role in meeting air attack, by Lawrence R. Jeffery, 9/21/59, p. 56.

Data Recording

TINY RECORDER SURVIVES MISSILE FLIGHT, DUNKING; Ampex unit performs perfectly when retrieved after flight in AF missile nose cone and nine days in the Atlantic, 11/30/59, p. 31.

DATA HANDLING SYSTEM MAY BOOST USE OF DIGITAL TAPE; This 100-lb. Datalab recorder with total capacity of 2.4 billion bits is touted as having great potential for space exploration, 10/5/59, p. 19.

VIDEOTAPE SUCCESSFULLY USED TO RECORD RADAR SIGNALS; Army's Signal Missile Support Agency finds great advantage in immediate playback capability for trajectory evaluation, 9/28/59, p. 24.

MAGNETIC TAPE RECORDING SALES BOOMING; This year should see 700,000 units sold but most promising future applications will be in astronautics for photo-reconnaissance, by Robinette E. McCabe, 8/3/59, p. 34.

Electronic Cooling

IR INDUSTRY IS SOLVING ITS COOLING PROBLEM; IR-Detector cells are behind the state-of-the-art of cells, but R&D is closing the gap with better hardware and advanced methods, by Charles D. LaFond, M/R Associate Editor, 11/2/59, p. 16.

HUGHES RESEARCH REVEALS ADVANCES IN INFRARED DETECTION; Shielding technique doubles IR search and tracking range; cooling methods treble detectivity of IR cells, 9/28/59, p. 19.

NEW TECHNIQUES AID ELECTRONICS COOLING; Basic methods of heat dissipation in components are the same but the applications can vary. Here are principal methods, by Hal Gettings and Charles D. LaFond, M/R Associate Editors, 8/3/59, p. 38.

ELECTRONICS COOLING — MULTIMILLION-DOLLAR STEPCHILD; The demand for cooling units is growing. An M/R staff survey shows how the challenge is being met. First of two stories, by Hal Gettings and Charles D. LaFond, M/R Associate Editors, 7/27/59, p. 34.

Energy Conversion

Isp MAY BE UPPED BY WIRE EXPLOSIONS; Company believes this propulsion can provide more power than most proposed electrical systems offer; other uses seen in communication, attitude correction, 12/28/59, p. 20.

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REFRACTORY METALS RESEARCH IS INTENSIFIED; Hundreds of firms are pressing R&D on the heat-resistant metals that hold answers to many of the toughest missile/space problems, by S. David Pursglove, 8/31/59, p. 13.

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TUNGSTEN SHAPES NOW ON HAND; by John C. Redmond, 11/23/59, p. 39.

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RESOLUTION IN ELECTROLYTIC MACHINING; Anocut engineers develop cavity sink device to meet metal working challenge of Space Age. A report on this and other recent advances, by John F. Judge, M/R Associate Editor, 11/2/59, p. 29.

METHOD FOUND FOR STRUCTURAL MOLYBDENUM WELDING; Finn Aeronautical Division achieves unheard-of ductility and arouses enthusiasm in industry and government, by John F. Judge, M/R Associate Editor, 10/26/59, p. 40.

BREAKTHROUGH IN HEAT TREAT PROMISES HUGE STRENGTH GAINS; Barrett process gives ultimate metal tensile strength 10% to 60% higher with improved ductility; company expects one-million psi in 18 months, by Frank G. McGuire, 9/28/59, p. 10.

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REYNOLDS NEW ALUMINUM BACK-UP FOR ALUMINUM WELDING; 7/20/59, p. 107.

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FUTURE TEMPERATURE PROBLEMS; by Harry A. Campbell, 11/23/59, p. 32.

MATERIALS WILL HAVE TO OUTDO THEMSELVES; by Dr. George J. Mills, 11/23/59, p. 27.

MISSILE 'INNARDS' MUST TAKE SPACE RIGORS; by Frank McGinnis, 11/23/59, p. 26.

NO MAGIC MATERIALS IN SIGHT; by John L. McDaniel, 11/23/59, p. 31.

PUSHING UP I_{sp} BRINGS FRESH PROBLEMS; by Dr. Morris A. Steinberg, 11/23/59, p. 28.

ROCKETS MUST BE LIGHTER, MORE RELIABLE; by L. L. Gilbert, 11/23/59, p. 21.

STRUCTURAL MATERIALS FACE TOUGH DEMANDS; by A. A. Watts, 11/23/59, p. 19.

THE GROWING ROLE OF MATERIALS ENGINEER; by N. J. Hoffman and D. E. Roda, 11/23/59, p. 22.

NBS PRESSES RESEARCH ON DIELECTRICS; A broad study, partly funded by the Pentagon is aimed at obtaining better measurements and materials, 10/19/59, p. 37.

EMERSON'S PROLIFIC E&A DIVISION; Company compiles an enviable record in missile work and comes up with startling developments for the future while bucking "decentralization" trend, by Charles D. LaFond, M/R Associate Editor, 8/31/59, p. 28.

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AID FROM SILICONE RUBBERS; by Robert Treat Jr., 11/23/59, p. 48.

DEMAND GROWS FOR ASTROLITE; by W. E. Benke, 11/23/59, p. 48.

FILAMENT WINDING FOR CASES; by Richard E. Young, 11/23/59, p. 49.

MORE AND VARIED USES SEEN; by John H. Lux, 11/23/59, p. 46.

NEW IDEAL FOR THERMAL BARRIER; by J. C. Siegle and P. H. Settlage, 11/23/59, p. 46.

OLD ITEMS FIND SPACE USES; by F. William Jahns, Jr., 11/23/59, p. 48.

PHENOLICS GAIN IN MISSILE USES; by Minert E. Hull, 11/23/59, p. 51.

RE-ENTRY VEHICLES USE ABLATION PLASTICS; by L. R. McCreight, 11/23/59, p. 43.

STRENGTH LEVELS TO DOUBLE; by Howard Meinke, 11/23/59, p. 52.

VERSATILE LAMINATED PLASTICS; by Dr. Carlisle M. Thacker, 11/23/59, p. 49.

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FIBER GLASS TOUGHENED TEFLON; by Titeflex, Inc., 11/23/59, p. 52.

SWAGE FITTED TEFLON TUBES; by R. C. Ramé, 11/23/59, p. 52.

MISSILES, SATELLITES AND RESEARCH VEHICLES

SECOND EDITION OF M/R ASTROLOG; Latest status report on all U.S. missiles, rockets and space vehicles, plus a new listing of all satellites, U.S. and Russian, now in orbit by M/R Staff, 11/9/59, p. 25.

FIRST EDITION OF M/R ASTROLOG; For the reader's convenience, an easy-reference status report on all space vehicles and missiles, by M/R Staff, 9/7/59, p. 25.

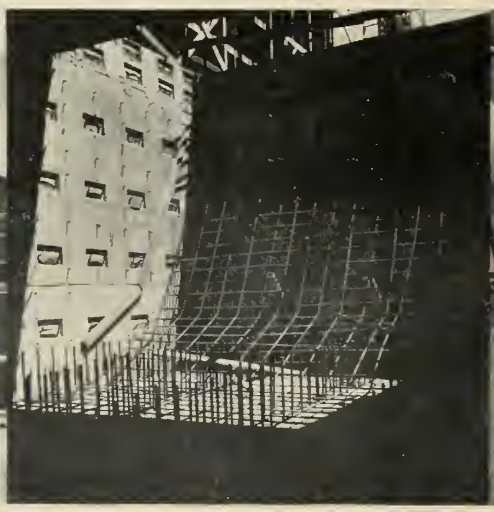
ANNUAL MISSILE ENCYCLOPEDIA; A comprehensive illustrated listing of U.S., Allied and Soviet missiles, by M/R Staff, 7/20/59, p. 137.

Missiles

THE AIR FORCE REAPPRAISES THE TITAN PROGRAM; The Ballistic Missile Division reportedly has concluded the missile is basically sound and has place in defense plans; upshot may be thorough congressional investigation of entire ICBM picture, by William J. Coughlin, M/R Los Angeles Bureau Chief, 12/21/59, p. 43.

Somewhere east of Laramie, on one of Wyoming's plains, you'll find the strangest government housing project ever built. Six concrete and steel buildings are being constructed to house Atlas missiles. The site is one of the operational intercontinental missile bases to be operated by the Strategic Air Command. This base is being constructed on the surface. Follow-on bases will burrow deep into the earth. In all these systems, the Air Force puts much emphasis into ground support equipment. Virtually all of the material can be purchased from one firm — United States Steel. Whether it's carbon

The U. S. Army Corps of Engineers is constructing this operational intercontinental missile base in Wyoming. In front of the partially completed Launch and Service Buildings are Col. Sidney T. Martin, in charge of construction, and Maurice K. Graber, a construction engineer for the Corps.



This is the inside of the blast pit of one of the launcher buildings. In all six of these buildings there are 1,040 tons of structural steel, 1,950 tons of reinforcing steel, over 48,000 tons of concrete aggregate, blocks and cement, and 8,040 tons of mechanical steel items.

Fuel lines and process piping are Stainless Ste and operate at pressures up to 15,000 psi. The pipes a kept almost surgically clean to prevent contaminati of fuel and subsequent malfunction. Vapor degreasir and chemical cleaning processes are used on the pipe

steel, high-strength low-alloy steel, ultra high-strength alloy steels, Stainless Steel, steel fence, electrical cable, cement or wire rope, United States Steel maintains the technical services to assist in solving any problem on materials for ground support. When a ground support program goes to the drawing board, consult with

USS United States Steel

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The Atlas is powered by a cluster of liquid propellant rocket engines that burn liquid oxygen and RP-1, a kerosene-like hydrocarbon fuel. 192 pressure tanks fabricated from alloy or Stainless Steel plate at this site store liquid and gases—liquid oxygen and nitrogen and helium gases which are used to inject the fuels into the missiles.

IROQUOIS PACKS SIX SS-11's; by an M R Correspondent, 12/14/59, p. 29.

NAVY SEEKS ANTI-MISSILE BIRDS; by James Baar, M/R Associate Editor, 12/14/59, p. 40.

MISSILE NEWS IN RECENT PICTURES; 11/9/59, p. 35.

TRIPLE-THREAT TALOS FOR ANTI-AIR, BOMBARDMENT, AICBM; The new Talos will be able to hit planes 100 miles away; Super Talos may be the seaborne defense for U.S. mainland; by James Baar, M/R Associate Editor, 9/21/59, p. 24.

THE ABLE TO DELTA SUCCESS STORY; A history of the progress of the Aerojet-General system from four failures in the Vanguard program to a perfect batting average with Thor-Able, by Frank McGuire, M/R Associate Editor, 8/24/59, p. 22.

REDEYE AND BULLPUP; Bazooka-type missile details released; Martin ASM becomes operational in Atlantic Fleet, by James Baar, M/R Associate Editor, 8/3/59, p. 12.

NAVY'S CORVUS HAS FIRST SUCCESSFUL FLIGHT; 7/27/59, p. 43.

HAWK AND LACROSSE ARE ADDED TO ARMY'S ARSENAL; Artillery units are organized in Texas to train in their use, by M/R Staff, 7/6/59, p. 28.

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AIR FORCE SWINGS BACK INTO SPACE WITH AWARD OF ADVANCED DYNA-SOAR PROGRAM; by James Baar, M/R Associate Editor, 11/16/59, p. 49.

LANDING ACCIDENT TO DELAY X-15 PLANS; 11/16/59, p. 11.

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BACKGROUND ON THE POSTPONED THOR-ABLE PROBE; NASA's planned sun orbiter, Thor-Able IV, could stay within tracking range until May, expanding communication know-how and providing new information on solar system, 12/21/59, p. 17.

EXPLORER VI MAY SOLVE PUZZLE OF REPETITIOUS RADIO SIGNALS; 11/9/59, p. 24.

NEC HEARS REPORTS ON EXPLORERS VI, VII; by an M/R Correspondent, 10/26/59, p. 34.

EXPLORER VII GOES INTO POSSIBLE 20-YEAR ORBIT; 10/19/59, p. 16.

NASA PLANS TO LAUNCH A SATELLITE NEAR VENUS; Thor-Able shot would be trackable beyond 50 million miles and could help restore U.S. prestige, by C. Paul Means, M/R Associate Editor, 10/19/59, p. 33.

TRANSIT STILL DUE TO BE FIRST MILITARY SPACE SYSTEM; Despite last month's launching failure, the ARPA-Navy project is proceeding on schedule calling for prototypes in orbit by early 1961; money problems could still bring delays, by James Baar, M/R Associate Editor, 10/12/59, p. 16.

VANGUARD CONTRIBUTED GREATLY TO SPACE TECHNOLOGY; The nation's first designed space vehicle was a greater success than failures indicated and its components are used in most newer spacecraft, by C. Paul Means, M/R Associate Editor, 9/28/59, p. 35.

NASA MAY TRY MOON ORBIT IN OCTOBER; Space agency to use Atlas-Able vehicle which was earlier scheduled for Venus probe, by C. Paul Means, M/R Associate Editor, 8/24/59, p. 33.

EXPLORER VI GIVES NASA NEW TRACKING CAPABILITY; Solar-celled power unit slated for deep space probe, 8/17/59, p. 46.

PROJECT TEPEE MAY UNDERCUT NEED FOR BMEWS; 8/17/59, p. 45.

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EVEN WITH GOLD, SCOUT 'POOR'; 12/21/59, p. 18.

VEGA OUT, HOPES PINNED ON CENTAUR; Delay in schedule thought to be primary reason for cancellation and reshuffling; the Air Force's Atlas-Agena will be used as an interim vehicle, by C. Paul Means, M/R Associate Editor, 12/21/59, p. 15.

Undersea Warfare

SOVIET SUBS BIGGER THREAT THAN ICBM'S; Intelligence reports assume Reds converting to nuclear and deep diving boats armed with Komet III IR&M, Red China now third biggest submarine builder, by James Baar, M/R Associate Editor, 8/10/59, p. 32.

TORPEDOES—NEGLECTED FACTOR IN ASW; Between wars we forget about them but they'll have to be vastly more sophisticated and reliable if they are to be equal to their mission in coping with missile submarine threat, by Hal Gettings, M/R Associate Editor, 8/10/59, p. 30.

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HOW TO PICK LIQUID TANK MATERIALS; An Army expert outlines how compatibility and strength vary as prime factors, 10/19/59, p. 35.

ICBM FACILITIES WILL COST $550 MILLION IN FY60; An account of requirements in the top U.S. design and construction program, by Lt. Col. Charles B. Alexander, Jr., USAF and Fred E. Ressegieu, 9/21/59, p. 46.

MANAGEMENT—MAJOR SUPPORT PROBLEM; editorial, 9/21/59, p. 122.

SUPPORT MARKET MAY TOTAL $40 BILLION BY 1967; Hardened ICBM bases and Polaris submarines are setting the pace for expansion. A complete forecast for 1960-61, by William E. Howard, M/R Associate Editor, 9/21/59, p. 21.

SOLARIS WILL SALVAGE MISSILES FROM THE DEEP; Low-cost system being developed by Vitro Laboratories should find wide range of uses, including eventual work in charting ocean bottom, by William E. Howard, M/R Associate Editor, 8/31/59, p. 16.

AIR-SUPPORT SPACE PLATFORM ADVOCATED; 8/10/59, p. 36.

MISSILE SUPPORT: THE BIGGER PROBLEMS COMING WITH LARGER VEHICLES; Army Corps of Engineers has the responsibility for solving most of the engineering difficulties ahead, an interview with Maj. Gen. E. C. Itschner, Chief of Engineers, 7/20/59, p. 48.

Launching Facilities

ARGUELLO, PAST, PRESENT AND FUTURE; Details of PMR's Point Arguello facility, including first published pictures, by James Baar and William E. Howard, M/R Associate Editors, 12/28/59, p. 13.

AF, NAVY FIGHT FOR TOP WEST COAST LAUNCHING ROLE; The Air Force wants to use Atlas pads at Vandenberg for polar-orbit launchings which would cross Navy's Pacific Missile Range facility at Point Arguello; Navy is already bothered by Vandenberg's effect on PMR. A special report by James Baar and William E. Howard, M/R Associate Editors, 12/21/59, p. 10.

NAVY PUSHES FOR BIG FLEET OF POLARIS CRUISERS; It urges eventual deployment of hundreds of IRBM's on some 24 cruisers, to supplement subs and SAC; new Polaris surface force might include battleships, by James Baar, M/R Associate Editor, 11/16/59, p. 13.

LAUNCHING—WHERE ICBM'S ARE WEAK; A "mix" of hard, mobile and dispersed sites is needed for protection from enemy missiles; a new "hard" Titan base is being designed, by Warren R. Stumpe, 10/26/59, p. 21.

ARMY ESTABLISHING MISSILE SUPPORT BASE IN FRANCE; by Anthony Vandyk, M/R Geneva Bureau Chief, 9/21/59, p. 81.

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FIBREGLASS WRAPPING LIGHTENS ATLAS: Rocketdyne achieves 25% savings in weight and cost of Atlas thrust chambers, and is developing the technique for use in solid powerplants as well, by Frank G. McGuire, M/R Associate Editor, 12/28/59, p. 18.

FLAME SPRAYER MELTS, DEPOSITS ANY MATERIAL; 12/28/59, p. 24.

PACKAGING INFLUENCES MSE CONCEPTS; "Packs" are boosting reliability and cutting costs, by Edsel F. Moffitt, 9/21/59, p. 49.

NEW IMPETUS IS GIVEN TO DRIVE FOR RELIABILITY; Military services plan to step up use of off-the-shelf components; NASA will stretch out firing schedules in effort to raise its batting average, by Jay Holmes, M/R Associate Editor, 9/14/59, p. 28.

COMPONENTS RELIABILITY: WHAT'S NEEDED?; editorial, 7/13/59, p. 50.

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CURTISS-WRIGHT DEVELOPS AN EXPENDABLE DRONE; by Frank McGuire, M/G Associate Editor, 12/21/59, p. 28.

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PICTURE STORY OF TESTING AT ARDC'S TULLAHOMA WIND TUNNEL FACILITY; 12/21/59, p. 24.

BIG STATIC TEST STAND COMPLETED AT NOTS; 12/7/59, p. 21.

MISSILE MEET TESTS U.S. AIR DEFENSE; Near-combat conditions during William Tell II show at Tyndall AFB show value of weapons mix, but results don't reflect what would happen against real attacking planes carrying electronic counter-measures, by James Baar, M/R Associate Editor, 11/2/59, p. 14.

NAVY SAVES MONEY ON MISSILE TESTS; Weapon's Laboratory's short-cuts in testing and evaluating programs yield economies of millions of dollars and months of development time, by Hal Gettings, M/R Associate Editor, 11/2/59, p. 20.

AUTOMATIC TEST EQUIPMENT SOLVES LOGISTIC NIGHTMARE; Potential market is nearly one-half billion dollars, by George A. Peck, 9/21/59, p. 53.

WHO SHOULD DESIGN AND BUILD TEST STANDS AND GANTRYS? Big steel fabricators dispute role of missile makers in constructing rocket stands, by M/R Staff, 9/21/59, p. 40.

Test Ranges

PMR PLANS TO SPEND $256 MILLION; The nation's largest missile and space vehicle range includes only base from which polar launches can be made, will be heavily used by services and NASA, by M/R Staff, 9/21/59, p. 73.

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MINUTEMAN HANDLING MUST BE DELICATE; by Jay Holmes, M/R Associate Editor, 9/21/59, p. 45.

'ARTICULATION' SOLVES TALOS HANDLING PROBLEMS; High-speed movement from magazine to launching deck is engineered by an articulated rack driving huge hoist, by R. A. Burt, 9/21/59, p. 26.

SUPPORT VEHICLE REQUIREMENTS ARE TRICKY; Experts stress early design to meet complicated needs; a wide variety of vehicle combinations are available, by John J. MacRostie, 7/27/59, p. 17.

TRANSPORTING BIG BOOSTERS BY WATER; Plant-to-pad logistics is essential preliminary design consideration for multimegaton rockets; land and air movement is restricted, 11/16/59, p. 28.

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I_{SP} MAY BE UPPED BY WIRE EXPLOSIONS; Company believes this propulsion method can provide more power than most proposed electrical systems offer; other uses seen in communication, attitude correction, 12/28/59, p. 20.

ION ROCKET SEEN USEFUL FOR SHIFTING ORBITS; NASA experts suggest low-I_{sp} devices for switch from 300-mile to 24-hour level, 10/26/59, p. 19.

ION ROCKETS LEAD IN 'EXOTIC' PROPULSION; Reported at the only open session of Second Symposium on Advanced Propulsion Concepts, jointly sponsored by Avco-Everett Research Laboratory and AF Office of Scientific Research. Papers are abstracted, 10/12/59, p. 28.

COST, HANDLING PROBLEMS KNOCK OUT BORON PROGRAM; Production curtailed after $200 million R&D expense, 8/17/59, p. 48.

ELECTRIC PROPULSION: MUCH THEORETICAL WORK IS STARTED; Although experiments are still in early stages, results so far are encouraging, by Ernst Stuhlinger, 7/20/59, p. 83.

Cryogenics

LINDE DEVELOPS A 'SUPER' INSULATION; Report on a new advance in cryogenic insulating materials, together with a guide to practical comparison of systems, by John F. Judge, M/R Associate Editor, 10/19/59, p. 28.

PRE-COOLING CRYOGENICS TO ELIMINATE COUNTDOWN? Survey of cryogenics support includes suggestion for retractable cooling jacket to prevent boiloff, by James A. Snyder, 9/21/59, p. 35.

NATION'S LIQUID HYDROGEN OUTPUT RISES; Industry-government cooperation is building large tonnage plants for the "ultimate" chemical fuel—until recently a laboratory curiosity, by Jay Holmes, M/R Associate Editor, 8/17/59, p. 21.

CENTAUR ENGINE BEGINS FULL SCALE TESTS; Scheduling calls for P&W to deliver first operational liquid hydrogen engine to Convair in 1960, by C. Paul Means, M/R Associate Editor, 8/3/59, p. 20.

WHERE ARE WE GOING IN FUEL HANDLING? The cryogenic engineer still must be a jack-of-all-trades with industry having to gear up for multi-million pound thrust boosters, by S. David Pursglove, 8/3/59, p. 28.

THE BRIGHT OUTLOOK FOR CRYOGENICS; Other systems are in the works, but the advantages of cryogenics will make them the most efficient for years to come, by Frank G. McGuire, M/R Associate Editor, 7/6/59, p. 21.

General

TEMPLE STUDIES HIGH TEMPERATURE FLAMES; A report on the intensive investigations conducted by the university's research institute with a rocket facility which could lead to high-energy breakthroughs, by William L. Doyle, 12/14/59, p. 17.

SERVOVALVES NEED FRESH APPROACH ON TEMPERATURE; Moog Valve believes 1000°F reachable by using acceleration switching servos, by Jay Holmes, M/R Associate Editor, 8/10/59, p. 34.

HOPE SUSTAINS RESEARCH INTO MONOPROPELLANTS; Interest continues despite the strange fuels' many disadvantages; "near-miracle" is hoped for, by S. David Pursglove, 7/27/59, p. 28.

CONTROL, GUIDANCE AND NAVIGATION: PROPULSION IMPOSES DESIGN; Inventiveness is needed most in prime problem areas of components hardware, by S. S. Edwards, W. C. Griffith and J. I. Osborne, 7/20/59, p. 63.

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AEROJET PUSHING HYBRID LIQUID-SOLID ENGINES; 10/26/59, p. 20.

Igniters

THE DEMAND FOR NON-PYROTECHNIC IGNITERS; Electric, torch, hot spot, catalytic, and hypergolic systems have many uses in repetitive starts. Part II of a two-part survey, by Frank McGuire, M/R Associate Editor, 10/12/59, p. 20.

IGNITION KEEPS PACE WITH CHALLENGES; Trend is toward hypergolics for restarts and pyrotechnics for single-shots—both may be passed up in future systems. Part I of a two-part series, by Frank McGuire, M/R Associate Editor, 10/5/59, p. 30.

Liquid

WILL TITAN SWITCH TO STORABLE FUELS? How the pre-packaged liquid systems concept is profiting from advances in storable fuels and oxidizers; encapsulation techniques may be applicable, by John F. Judge, M/R Associate Editor, 11/16/59, p. 24.

LIQUID ENGINES: EMPHASIS REMAINS ON POWER, SIMPLIFICATION AND RELIABILITY; Cheaper oxygen-jet fuels will be dominant for some time because of tremendous consumption of rockets being designed, by Roy Healy, 7/20/59, p. 53.

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TORPEDOES—NEGLECTED FACTOR IN ASW; Between wars we forget about them but they'll have to be vastly more sophisticated and reliable if they are to be equal to their mission in coping with missile submarine threat, by Hal Gettings, M/R Associate Editor, 8/10/59, p. 30.

Solids

AIR FORCE PUSHES FOR BIG SOLID BOOSTERS; Industry is expecting a decision soon on a feasibility contract for developing a one-million pound thrust rocket, by Jay Holmes, M/R Associate Editor, 11/30/59, p. 21.

SOLID FUEL TECHNOLOGY PROGRESS REPORT; Reliable propellants in operation give I_{sp} ranging from 240 to 250 sec.; new gains occur steadily; ARPA expects 20-30 sec. quantum jump from Project Principia, by Jay Holmes, M/R Associate Editor, 11/2/59, p. 24.

NO FUTURE FOR SOLIDS IN SPACE SHIPS; American Chemical Society hears that solids lack momentum needed for large vehicles. Convention also views advances in plastics, elastomers and polyurethanes, by John F. Judge, M/R Associate Editor, 9/28/59, p. 33.

BETTER METHOD DEVELOPED TO MEASURE SOLID CHANGES; Scientists at Stanford Research Institute have announced the development of an improved method of measuring creep and stress relaxation in solid propellants, by M/R Staff, 9/7/59, p. 15.

DOUBLE-BASE SOLIDS REMAIN STANDARD; Despite inroads by polyurethanes, a major part of the solid-fuel program relies on double-base composition. A report from the Naval Propellant Plant at Indian Head, Md., by Jay Holmes, M/R Associate Editor, 9/7/59, p. 16.

ARPA OBLIGATING $18 MILLION FOR SOLIDS RESEARCH; by Betty Oswald, M/R Associate Editor, 8/3/59, p. 14.

SOLIDS MANUFACTURERS LOOK TO FUTURE WITH CONFIDENCE; With problems being overcome, the role of solid fuels—already important in military applications—is expected to grow greatly, by Frank G. McGuire, M/R Associate Editor, 7/27/59, p. 31.

SPACE MEDICINE

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SOVIETS LAUNCH AND RECOVER TWO DOGS AND A RABBIT; by M/R Staff, 7/13/59, p. 45.

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SOVIETS PREDICT TWO-COUPLE MOON ORBIT BY SPRING; German newspaper also quotes Red scientists as saying plans call for a two-man earth orbit by the end of this year; moon trip would coincide with Eisenhower visit, 10/26/59, p. 18.

THE FIRST MAN ON THE MOON; editorial, 9/7/59, p. 50.

THE CASE FOR MANNED LUNAR FLIGHT; A pair of NASA officials, speaking for themselves, argue that man can do more at less cost than instruments; they propose detailed plans, 8/31/59, p. 24.

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TIME DRAWS NEAR FOR PAINFUL NIKE-ZEUS DECISION; Cold War strategy will dictate the White House choice of going ahead with the multi-billion-dollar AICBM program, trying to find a cheaper substitute, or doing without anti-missile defense, by James Baar, M/R Associate Editor, 10/26/59, p. 18.

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DEFENSE STOCKPILE HITS PEAK, by Heather MacKinnon, M/R Editorial Assistant, 11/23/59, p. 71.

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——more about the missile week——

• **Washington**—Sen. Lyndon B. Johnson accused President Eisenhower of failing to provide the leadership necessary to win the space race. The Senate Democratic leader said that unless the President decides immediately to make the U.S. competitive, Congress will have to act in the next session. He said failure to act decisively in space is a "form of unilateral disarmament."

• **Cape Canaveral**—The Air Force successfully tested an *Atlas* Dec. 18 with a "dry engine" start in which water and associated piping was eliminated from the bird as an ignition stabilizing agent. Starting thrust was smaller and the ICBM went full-range—6325 statute miles.

• **Tuscon, Ariz.**—The **Douglas Aircraft**-operated *Thor* IRBM school closed shop after training a total of 1863 Royal Air Force and USAF officers and enlisted men in 19 months. The 1300 RAF trainees are now manning 60 *Thors* (4 squadrons) around the clock at operational sites in Britain.

• **Bristol, Pa.**—An 80-ton "Transrector" for handling rocket engines up to 35 ft. in length, 85 in. in diameter and weighing 80,000 lbs. has been delivered to **Thiokol Chemical Corp.** by **The Siegler Corp.'s** Hufford Division. It is believed to be the largest piece of mobile support equipment of its kind and probably will be used for the first stage of *Minuteman.*

• **Los Angeles**—President Robert S. Bell of **Packard Bell Electronics Corp.** urges establishment of "Q" awards by industry to jack up quality and quantity of U.S. production to win the "war of workmanship." Said Bell, who is establishing the awards in his plants: "we are individually and collectively at war. It is a war against foreign ideology and technology and against our own complacency . . ."

• **Los Angeles**—The BMD's 659th Test Wing, created to back up the Air Force's *Discoverer* satellite program, is expected to take over responsibility for the launch, instrumentation and recovery of AF *Samos* reconnaissance satellites when the program starts next year. This unit would be in addition to—and perhaps conflict with—similar services offered by the Navy's Pacific Missile Range (M/R, Dec. 14, p. 10). *Samos* will be launched from Point Arguello, Calif., primary facility of the PMR.

• **Bethpage, N.Y.**—Grumman Aircraft Engineering Corp. is making a three-month study of the feasibility of using nuclear propulsion to extend the range of a low level attack missile. The study is at Grumman's initiative under a $1-a-year contract with the Bureau of Naval Weapons. Walter Scott, Grumman Chief of Preliminary Design, said his group has been studying application of reactors to ramjets for about a year.

• **Washington**—The electronics industry share of the military hardware market rose to $4.5 billion in 1959, 33% of the total, despite a general leveling off of total defense procurement. The figure is expected to increase fairly substantially next year, Electronic Industries Association said in a year-end statement. Hardware for non-military space applications approached $100 million in 1959. EIA reported overall electronics sales of $9.2 billion in 1959, projected $10.35 billion for 1960, and forecast $20 billion a year by 1970.

NASA Launches *Javelin* To Measure Galactic Noise

WALLOPS ISLAND, VA.—The National Aeronautics and Space Administration on Dec. 22 launched a four-stage *Javelin* sounding rocket to an altitude of 560 miles to measure the intensity of galactic noise.

NASA scientists also hoped that the launch would determine how well the fourth-stage *X-248* rocket would perform in a vacuum.

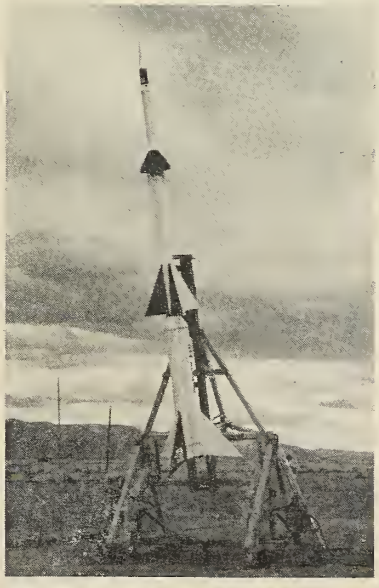
The rocket's 480-pound payload contained a three-megacycle radio receiver which telemetered galactic radio signals back to earth. Because galactic noises are absorbed by the ionosphere, it is necessary to measure them when they are encountered at altitudes above 450 miles.

Data on the performance of the *X-248* rocket was telemetered to stations located at Wallops, Cape Hatteras, and Cape Canaveral.

The *Javelin* is a combination of an *Honest John,* two *Nikes,* and the *X-248.* Its weight at takeoff was approximately 7000 pounds.

The payload came down in the Atlantic Ocean about 600 miles from Wallops Island.

Record Breaker



THREE-STAGE missile built by Curtiss-Wright for tests in Boeing's *Dyna-Soar* program hit 6000 mph in Dec. 16 firing at Holloman AFB—new high for ground launch.

Million-lb.-thrust Booster Project Reported Under Way

LOS ANGELES—**United Research Corp.** reportedly has begun a project to build a one-million-pound-thrust solid propellant booster with its own funds.

Reliable sources said the company will complete the project relatively quickly, to have the booster ready when a requirement is established.

Questioned by M/R, company officials said they were "not at liberty to discuss the report," but did not deny it.

Vacuum Cadmium Plating Process Is Made Available

NEWTON, MASS.—Custom vacuum cadmium plating services are now available in the East and Midwest.

NRC Equipment Corp., developer of the process, says **Poly-Kote, Inc.,** North Attleboro, Mass., and **Electro-Vac Division** of **Radio Cores, Inc.,** Melrose Park, Ill., are now authorized to use it.

The process makes it possible to protect high-tensile steel missile parts against corrosion without subjecting them to hydrogen embrittlement.

SAC Receives Its First *Hound Dog*

DOWNEY, CALIF.—Gen. Thomas S. Power, Commanding General, Strategic Air Command, took delivery of the first production model of **North American Aviation's** GAM-77 *Hound Dog* air-to-surface missile at the company's missile division here.

General Power said the *Hound Dog*, slated to become operational with SAC by next spring, is a megaton class weapon and can carry the H-bomb. "Its accuracy is measured in feet rather than the usual accuracy of missiles which is measured in miles," he added.

SAC's basic requirement for the *Hound Dog*, which will be used in **Boeing** B-52G aircraft, is to enhance the capacity of its manned bombers, General Power said.

He pointed out that the *Hound Dog* will be used to attack enemy defenses by launching it beyond the range of early warning radar, but he declined to discuss the missile's range other than to say that it was "several hundred" miles. The *Hound Dog's* **Autonetics**-produced inertial autonavigation system is said to be immune to enemy decoying or jamming. It is also possible for the B-52 navigator to select missile cruise altitude to target or change the target after the missile is airborne.

Additional advantages of the missile were noted. The J-52 engine can provide the mother ship with additional thrust and its inertial guidance system can be used to supplement the bomber's navigational equipment.

The B-52 can carry two *Hound Dogs* in addition to its H-bomb warload.

NAA's Missile Division was awarded an R&D contract for *Hound Dog* in August 1957. Initial production contract was announced in November, 1958. First powered flight of the missile was in April, 1959. The missile is currently undergoing flight testing at Eglin AFB, Fla.

General Power told a press conference in Los Angeles that "There is a definite requirement for the B-70 as a successor for the B-52." He said also that he expects there will be sufficient money in the new defense budget for development of the *ALBM* (air-launched ballistic missile). *Hound Dog* also is "adequately funded," he added.

Third Test for Nike-Zeus

EARLY TEST model of *Nike-Zeus* **anti-missile missile, of this type, was fired by Army at White Sands Missile Range, N.M., on Dec. 16. First stage fired properly, and second stage separated, but second-stage sustainer motor apparently did not ignite.**

NASA Boosts Spending For *Mercury* Tracking

WASHINGTON—A report released by the Senate Space Committee last week reveals that NASA will spend $31.4 million more than originally planned for the Project *Mercury* world-wide tracking network in Fiscal 1959-60.

Present indications are that the network's total cost will be somewhere around $75-80 million—about $50 million more than was estimated in the winning bid.

NASA came up with the extra $31.4 million, according to the report, by transferring $15 million from Project *Mercury* R&D funds, and by finding $16.4 million elsewhere in the space agency's tight budget.

Three major reasons given by informed sources for the increased cost are rising prices, unrealistic initial estimates, and expansion of the network.

Principal expansion was the addition of a tracking station to be built in Central America, which gives the network the capability of bringing the manned capsule down after only one orbit.

According to a recent speech by NASA General Counsel John A. Johnson, total cost of the *Mercury* program has now increased from the original estimate of $250 million to $350 million.

The space administration is expected to make up some of this shortage in the Fiscal 1961 budget.

Underfunding and time lags reportedly have already delayed the *Mercury* program until 1962. Further delays could create an age problem which could eliminate the older astronauts now training under the program.

contracts

NASA

$175,000—**Donner Scientific Co.**, Concord, Calif., for production of an altitude sensor, accelerometers and accelerometer switches for use in Project *Mercury*. Subcontract from **McDonnell Aircraft.**

NAVY

$4,000,000—**Hazeltine Corp.**, Little Neck, N.Y., for 32,000 sonobuoys and repair kits.

$3,335,533—**General Electric's** Light Military Electronics Dept., for sonobuoys.

$500,000—**Solar Aircraft Co.**, for research, development and production of a new lightweight rocket nozzle and rocket motor cases for the *Polaris* missile. Subcontract from **Aerojet-General Corp.**

AIR FORCE

$5,000,000—**Worthington Corp.**, Harrison, N.J., for air conditioning, diesel engines, generators, compressors and a wide range of instrumentation equipment for the *Titan* bases being built near Denver.

$78,976—**Aero-Test Equipment Co., Inc.**, Dallas, for low-pressure high-altitude test chamber (six-man capacity) plus spare parts and reproducible copy.

$65,985—**Kearfott Co. Inc.**, Little Falls, N.J., for 543 three-inch repeater indicators to be used in airborne weather radar systems.

$59,740—**Dynamic Research, Inc.**, Los Angeles, for nitrogen recharger for use in nitrogen conversion system in support of the *133A* program.

$59,505—**California Institute of Technology**, Pasadena, for research on "Growth of Boundary Layers in Plasma Accelerators."

$45,915—**University of Minnesota**, Minneapolis, for research on "Microwave Studies of Semiconductor Crystals."

$40,646—**Beckman & Whitley, Inc.**, San Carlos, Calif., for synchronized framing camera with control units and turbine.

$40,310—**Radiation, Inc.**, Melbourne, Fla., for non-personal modification and repair PCM data handling equipment on *Minuteman* project.

$36,600—**University of California**, Berkeley, for continuation of research on "Effects of Internal Stress and Microstructures on the Physical Properties of Model Ceramic Systems."

$36,100—**University of Maryland**, College Park, for continuation of research on "Foundations of Scattering Theory and Applications to Physical Problems."

$33,139—**Collins Radio Co.**, Dallas, for spare replacement modules for microwave system.

$25,200—**Sanborn Co.**, Waltham, Mass., for hot wire recorder and recorder system for use in support of Project *WS-133A*.

$25,125—**Northrop Corp., Norair Div.**, Hawthorne, Calif., for reproducible copy applicable to *SM62A*.

$25,000—**Ohio State University Research Foundation**, Columbus, for research on "Magnetic Resonance and Spin Relaxation of Ions in Solution, Complex Molecules and Free Radicals."

ARMY

$8,911,904—**Radio Corp. of America** for improved missile measurement equipment for a missile tracking ship.

$3,765,417—**Raytheon Co.**, Waltham, Mass., for engineering services for the *Hawk* missile system.

$984,279—**Raytheon Co.**, for engineering services in connection with the *Hawk* missile.

$876,927—**Raytheon Co.**, for *Hawk* missile repair parts.

$825,000—California Institute of Technology, Pasadena, for research and development re guided missiles.

$423,794—**Nichols-Southern Div. Luba Consolidated Industries, Inc.**, Baton Rouge, La., for construction of propellant inspection building for *Minuteman*.

$400,000—**Atlantic Research Corp.**, Alexandria, Va., for developing an anti-aircraft guided missile known as *Redeye*.

$225,000—**Sperry Rand Corp.**, Sperry Utah Engineering Laboratory Div., for repair parts for *Sergeant* guided missile system.

$129,836—**AiResearch Manufacturing Co.**, Los Angeles, for *Nike-Hercules* replenishment repair parts.

$129,561—**Douglas Aircraft Co. Inc.**, Santa Monica, for field change kits and repair parts.

$126,167—**Raytheon Co.**, for services for production engineering of shroud, fin and windshield for XM-28 and XM-29.

$117,610—**Lockheed Missiles & Space Div.**, for basic research on a new technique for harnessing solar energy.

$99,625—**Continental Technical Services, Inc.**, for services in connection with design, development and testing of rocket motors, airframes, launchers, guidance systems and related equipment.

$96,064—**Douglas Aircraft Co., Inc.**, Santa Monica, for repair parts for *Nike* system.

$94,958—**General Electric Co.**, Pittsfield, Mass., for development of a cryogenic gyro.

$65,232—**Texas Instruments, Inc., Semi-conductor Div.**, for solar cells and assemblies.

$63,175—**Hoover Awning and Manufacturing Co.**, Miami, for radome cover.

$47,660—**Texas Instrument, Inc.**, Dallas, for unmounted silicon solar cells.

$46,556—**Permanent Filter Corp.**, for *Nike* repair parts.

$42,361—Research Institute of Temple University, Philadelphia, Pa., for development and fabrication of a liquid propellant evaluator.

$40,740—**Western Electric Co.**, New York City, for *Nike* spare parts and components.

$29,989—**Townsend Engineered Products**, Santa Ana, Calif., for design and development of a suppression kit.

$27,793—**Stanford Research Institute**, Menlo Park, Calif., for measurement of radioactive isomers produced by gamma rays.

$27,278—**General Electric Co., Defense Div.**, Light Military Electronics Dept., for research and development on thermocouple energy converters.

Sheldon L. Feld has been named applications engineer at Yardney Electric Corp., manufacturers of silvercel and silcad batteries.


FELD

With the firm since 1956, Feld was formerly a project engineer in design and development. Prior to joining Yardney he was associated with the Dexter Chemical Corp. and Charles Pfizer, Inc.

United Research Inc., has announced the election of **Dr. A. B. Van Rennes** as vice president in charge of its technical division. Among his responsibilities will be direction of fundamental research and development programs in instrumentation, including programs for the measurement of meteorological variables and fuel contamination.


VAN RENNES

Dr. Van Rennes comes to United from the research laboratories division of Bendix Aviation Corp., where he was supervisor of the nuclear technology group.

During the past eight years, Dr. Van Rennes has been a consultant to various industrial and government groups, and has published a variety of papers on nuclear instrumentation techniques and on nuclear reactor kinetics, control and instrumentation.

Rear Adm. Mell A. Peterson (USN ret.), formerly commander of the Naval Ordnance Laboratory, Silver Spring, Md., has been named executive vice president and a director of Bulova Research & Development Laboratories, Inc. In the Navy for 29 years, Peterson specialized in research and development administration and industrial control.


PETERSON

Rear Adm. A. B. Metsger (USN ret.), has been appointed assistant to the president of The Marquardt Corp. He will help to plan and coordinate the company's technical efforts aimed toward application of Marquardt's capabilities and facilities to new products and services.

During his 28 years of active service, Metsger served as deputy chief of Naval Research from 1956 to 1959, and was director of the Guided Missiles Division of the Bureau of Aeronautics from 1952 to 1956. He also headed the fighter branch of BuAer and managed more than 12 major jet fighter development programs. And he was responsible for initiating the Fleet Ballistic Missile Program, now *Polaris*.


METSGER

Reuben Thorson and **John P. Gallagher** have been elected directors of The Hallicrafters Co., electronics development and manufacturing firm.

Thorson is general partner and chairman of the policy committee of Paine, Webber, Jackson & Curtis, investment brokers. He is also a director of Growth Industry Shares, Inc., Wilson-Jones Co., Illinois Mid-Continent Life Insurance Co., Booth Fisheries Corp. and United Electric Coal Co.

Gallagher is a partner and member of

the executive committee of Booz, Allen & Hamilton, and is the coordinating partner of the firm's central region.

Analab Instrument Corp. has announced the appointments of **Theodore Lasar, Philip G. Schifflin** and **Edwin J. Sommers** as senior engineers.

Lasar formerly was a senior engineer with Allen B. Du Mont Laboratories. Prior to that he was with the Weston Electrical Corp. and Bendix Aviation Co.

Schifflin formerly was a research administration coordinator with Du Mont Laboratories, where he directed the operations of the commercial engineering department model shop and was a production engineer in the research and development department engaged in missile test equipment.

Sommers, responsible for the mechanical design engineering, was formerly with Emerson Radio and Phonograph Co. as a senior engineer. Earlier he was with Western Electric Co., engaged in test equipment design.

Alfred Sansonetti has been named to the newly created post of vice president-manufacturing for Avien, Inc., designer and manufacturer of instrumentation systems in temperature control, fluid flow measurement, automatic checkout equipment and propulsion system instrumentation. He was formerly manager of the company.

Before he joined the firm in 1956, Sansonetti was assistant general manager of Airborne Accessories Corp. and was also associated with the General Electric Co.

Douglas Aircraft Co. has announced the appointment of **Edward F. Spraitz** as assistant Washington representative for space programs. He will coordinate company space activities with all government agencies. He has been a member of the Washington office for the past three years.

Before coming to Douglas, Spraitz held key engineering posts with the National Bureau of Standards and the Naval Ordnance Laboratory.

Roylyn Inc., manufacturer of aircraft, missile and industrial components and quick disconnect couplings, has announced appointment of **Richard B. Hubbard** as vice president, and of **Benjamin N. Ohannesian** as production manager. In addition, Hubbard has been elected to the board of directors.

Hubbard formerly was affiliated with Pacific Airmotive Corp. as vice president and assistant to the president; with ACF Industries as president of its Erco division; with Specialties, Inc., as vice president.

Ohannesian was previously with Clary Dynamics where he served as supervisor of production and material control, works manager of the aircraft division, operations manager of the automatic controls division and director of manufacturing.

Joseph H. Hannigan, formerly sales engineer with The Gabriel Co., has been chosen director of radar and infrared communications, technical liaison division of The National Co. Inc.

Hannigan comes to National with a number of years' engineering experience including planning, designing and installation of countermeasures, guided missile radar control, remote control equipment, radiation warning systems, and infrared devices. He was also a consultant in nuclear power instrumentation and control.

John F. Probst has been elected president of South Bend Lathe, Inc., a subsidiary of American Steel Foundries, succeeding **Russel E. Frushour** who is retiring. Frushour, president of the company since 1939, will remain a director as well as a consultant.

Probst joined South Bend in 1946, was elected assistant vice president in 1955, and vice president in 1959. He is also a director of the company.

Richard S. Anderson will become secretary-treasurer, replacing **Maurice Howard,** who is retiring.

Public Be Blamed

To the Editor:

In your Dec. 7 editorial, you state that there are indications that the public does not agree with the Administration's lack of concern (over losing the space race). I am wondering if this is truly a "lack of concern" or just pondering over how to get the public's support and/or how "loose" the strings should be *if* the money were appropriated, and at the expense of what.

The public has been lulled into a state of apathy for the last 25 years, with the politicians promising Mr. John Q anything he wants for his vote. Mr. John Q now wants to have his cake and eat it too. The labor unions, operating on the same basis, insist that their members have a sizeable raise every year. Much money appropriated has been literally dumped in the river . . .

So, I am wondering just who is to blame. I believe it's the public themselves—for permitting themselves to be lulled into apathy in the first place; secondly, for voting for politicans who had nothing to offer except a promise to the people to "give" them anything they "wanted"; and finally, for demanding—or maybe I should say refusing to give up—certain wartime spending for fear they might have to tighten their belts for a few months. It is a well known fact that when an air base or a defense plant is to be closed the people start clamoring and write their Congressmen, the pressure starts—and soon the plant is not only kept open but expanded. Small bureaus are built up within local, state and federal governments, and many defense business contractors—whose survival depends entirely, or nearly so, on government defense contracts that are almost entirely wasteful and cost billions of tax money.

. . . I hardly believe Los Angeles would be a fair poll of the U.S.A. (concern over losses in the space race). Even if it were, I would be willing to bet 10 to 1 that if wages were frozen and taxes raised $50 per person you would lose 4 out of 5 of your votes . . .

K. U. Benjamin
Shelley Electric Inc.
P. O. Box 2239
Wichita 1, Kan.

Anti-Second Law

To the Editor:

I read with considerable interest the article in the Nov. 16 M/R concerning 182% thermal efficiencies.

Some years ago I submitted a group of papers to various Washington agencies concerning energy, matter, and *anti-second law devices.* The only reply I could evoke from these worthies was much laughter. It is refreshing, therefore, to see in print the idea that "basic truths" might need to be re-examined. Several years ago the term "anti-second law" was in the same classification as certain four-letter words. I am sure that in the future the term will become quite respectable.

Without doubt the Russian device is merely a heat pump, but the next device, or the one after that, may indeed exceed second-law efficiencies. The Russians certainly have shown enough imagination to make this possible.

Robert E. Span
Registered Engineer
P.O. Box 157
Ligonier, Pa.

U.S. Bonds for Space?

To the Editor:

Regarding your editorial of Dec. 7 about public concern over the U.S. space effort, may I quote from your Nov. 30 issue ("Who Says There's A Space Race?"): "The space program costs less than ten dollars per year per U.S. adult or roughly one evening's entertainment per year."

Why not government SPACE BONDS in various denominations to allow U.S. citizens so disposed to contribute one or two "evenings' entertainment per year" to their country's *bigger space effort?*

Arthur A. Wiese
753 Utah St.
Toledo 5, Ohio

ATOMIC RADIATION, part II. RCA Service Company, a division of the Radio Corp. of America. Order from Government Services (210-1), RCA Service Company, Camden 8, N.J. 110 pp. $2.65.

The practical aspects of radiation protection is covered in a book intended primarily as a practical guide for industrial, military, and research installations engaged in nuclear energy activities.

Discussed are such subjects as monitoring techniques and instruments, radiation exposure control, decontamination, radioactive material transport and waste disposal.

SHORTWAVE PROPAGATION, Stanley Leinwoll. John F. Rider Publisher Inc. 160 pp. $3.90.

This book presents the basic principles of shortwave radio propagation, and how it is used in long distance radio communication.

Following the exploration of basic phenomena, the author deals with ionospheric variations attributable to sunspot cycles as well as abnormal causes which have so often disrupted man's ability to communicate by electro-magnetic waves. He explains the preparation of maximum usable frequency (MUF) charts and how to use them.

A chapter is devoted to the explanation of the correlation between the seasons and the most satisfactory frequency within the 3 to 30 mc range which are usable for interglobal communication.

The book is suited to the radio amateur who is concerned with global communication on shortwaves. It is also recommended to Armed Forces users of the radio-frequency spectrum.

ENERGY DISSIPATION BY FAST ELECTRONS, L. V. Spencer, National Bureau of Standards. Order from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 70 pp. $.45.

Presented is one of a series of reports on radiation physics data being prepared with the support of the Office of Naval Research and the Atomic Energy Commission. Tabulations are given of the energy dissipated by fast electrons at different distances from monoenergetic electron sources, for plane perpendicular and point isotropic sources.

Tabulations are designed to answer the following type of problem: If electrons of kinetic energy E_o are produced at a point or on a plane in a material with atomic number Z, the electrons will travel away from their point of origin, dissipating energy to the material as they go. When each electron has given up its initial energy, what is the spatial distribution of the energy transferred to the surrounding material?

Results are given for E_o, varying in approximately logarithmic intervals from 0.025 to 10 Mev, for carbon, aluminum, copper, tin, lead, air, and polystyrene.

—when and where—

DECEMBER

American Chemical Society, Industrial and Engineering Chemistry Division, 1959 Christmas Symposiums on "Mechanisms of Inter facial Reaction," Shriver Hall, Johns Hopkins University, Baltimore, Dec. 28-29.

JANUARY

Gas Dynamics, Colloquium, Electrostatic Propulsion, University of Michigan, Jan. 7.

Sixth National Symposium on Reliability and Quality Control in Electronics IRE, EIA, AIEE, ASQC, Statler-Hilton Hotel, Washington, D.C., Jan. 11-13.

First International Space Science Symposium, and COSPAR Plenary Session, sponsored hy COSPAR, Nice, France, Jan. 11-16.

Society of Plastics Engineers, 16th Annual Technical Conference, Conrad Hilton Hotel, Chicago, Jan. 12-16.

Gas Dynamics Colloquium, Shock Tube Research, University of Michigan, Ann Arbor, Jan. 14.

American Astronautical Society, Sixth Annual Meeting, Statler-Hilton Hotel, New York City, Jan. 18-21.

American Management Association, Special Research and Development Conference, "Capitalizing on Technology," Roosevelt Hotel, New York City, Jan. 20-22.

Gas Dynamics Colloquium, Structure of Strong Normal Shockwaves, Northwestern University, Evanston, Ill., Jan. 21.

Institute of the Aeronautical Sciences, 28th Annual Meeting, Hotel Astor, New York City, Jan. 25-28.

Second Annual Symposium on High Speed Testing, sponsored hy Plas-Tech Equipment Corporation, Somerset Hotel, Boston, Jan. 27.

Gas Dynamics Colloquium, Research in Rarified Gas Dynamics, Northwestern University, Jan. 28.

Seventh Annual Western Spectroscopy Conference, Asilomar, Pacific Grove, Calif., Jan. 28-29.

Amercan Rocket Society, Solid Propellants Conference, Princeton University, Princeton, N.J., Jan. 28-29.

FEBRUARY

Chemical Institute of Canada, Toronto Section, Symposium on Gas Chromatography, Seaway Hotel, Toronto, Ont., Feb. 1.

Instrument Society of America, Houston Section, Instrument-Automation Conferences & Exhibit, Rice Hotel & Sam Houston Coliseum, Houston, Feb. 1-4.

Sixth Annual Midwest Welding Conference, sponsored hy Armour Research Foundation of Illinois, Institute of Technology; Chicago Section, American Welding Society, Illinois Tech Chemistry Bldg., Chicago, Feb. 3-4.

Institute of Radio Engineers, Professional Group on Military Electronics, Biltmore Hotel, Los Angeles, Feb. 3-5.

Seventh Annual Solid-State Circuits Conference, sponsored hy Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania, Philadelphia, Feb. 10-12.

First National Symposium on Nondestructive Testing of Aircraft and Missile Components, sponsored hy Southwest Section, Society for Nondestructive Testing; Southwest Research Institute, Hilton Hotel, San Antonio, Tex., Feb. 16-18.

AIEE Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Feb. 18-19.

ADVERTISER'S INDEX

Anybody Want a Moral Victory?

NASA maintains that the U.S. space program has produced more scientific results than the Russian program, that the Soviet achievements were simply more spectacular.

This seems a little like the old business of claiming a moral victory for the home team because it played a clean game while the opposition got a little rough and won 54 to 3.

We would feel somewhat better about this kind of rationalization if we could see a clear pattern in the American program; if some one person in authority (and who is in authority?) would say:

"This is what we want to do and this is how we are going to do it."

If we would lay out a program of desired achievements—and back it up with enough money and merchandise to insure that one mishap or one miscalculation does not bring the program to a halt and make us look foolish in the eyes of the world.

Such a program might make us, the country and the world more inclined to believe, as NASA declares, that our way is best; that in the long run we will push forward over a broad front; that the space satellites and spacecraft of the 1970's and '80's will carry more American than Soviet flags.

At the moment we are not convinced. Neither, we fear, are the American people or the world.

Let the People Know

While NASA is organizing its command for an assault on the broad front of the space program, as it says, we think it might be a good idea if NASA officials would explain to the public—as they must explain to Congress very shortly—the reason for two big space boosters which will materialize at about the same time.

Project *Saturn* is the clustering of eight Rocketdyne engines to produce 1½ millions pounds of thrust. Slipping badly from lack of money, the *Saturn* will probably be fired in 1963, come to full strength in 1964.

Simultaneously, Rocketdyne is perfecting a single rocket engine of 1½ million pounds thrust (the F-1) which is due to become operational at about the same time.

By naming Maj. Gen. Don Ostrander, USAF, as head of the NASA booster program and placing him in charge of the Von Braun group at ABMA, NASA has in effect put the *Saturn* and the F-1 programs in the same workshop.

A great many knowledgeable people in the space field question the necessity of both the *Saturn* and the F-1 programs; specifically, they question the necessity of the *Saturn,* which has been variously described as a great white hope and as a big clinker.

They speculate: is the billion-dollar *Saturn* continued as a back-up for the F-1? Is it a parallel program for different purposes? Is it an exercise to give us experience in clustering engines because we will eventually want to cluster the F-1 into a 6-8-million-pound-thrust *Nova*? Is it just something to keep the ABMA team busy for a while?

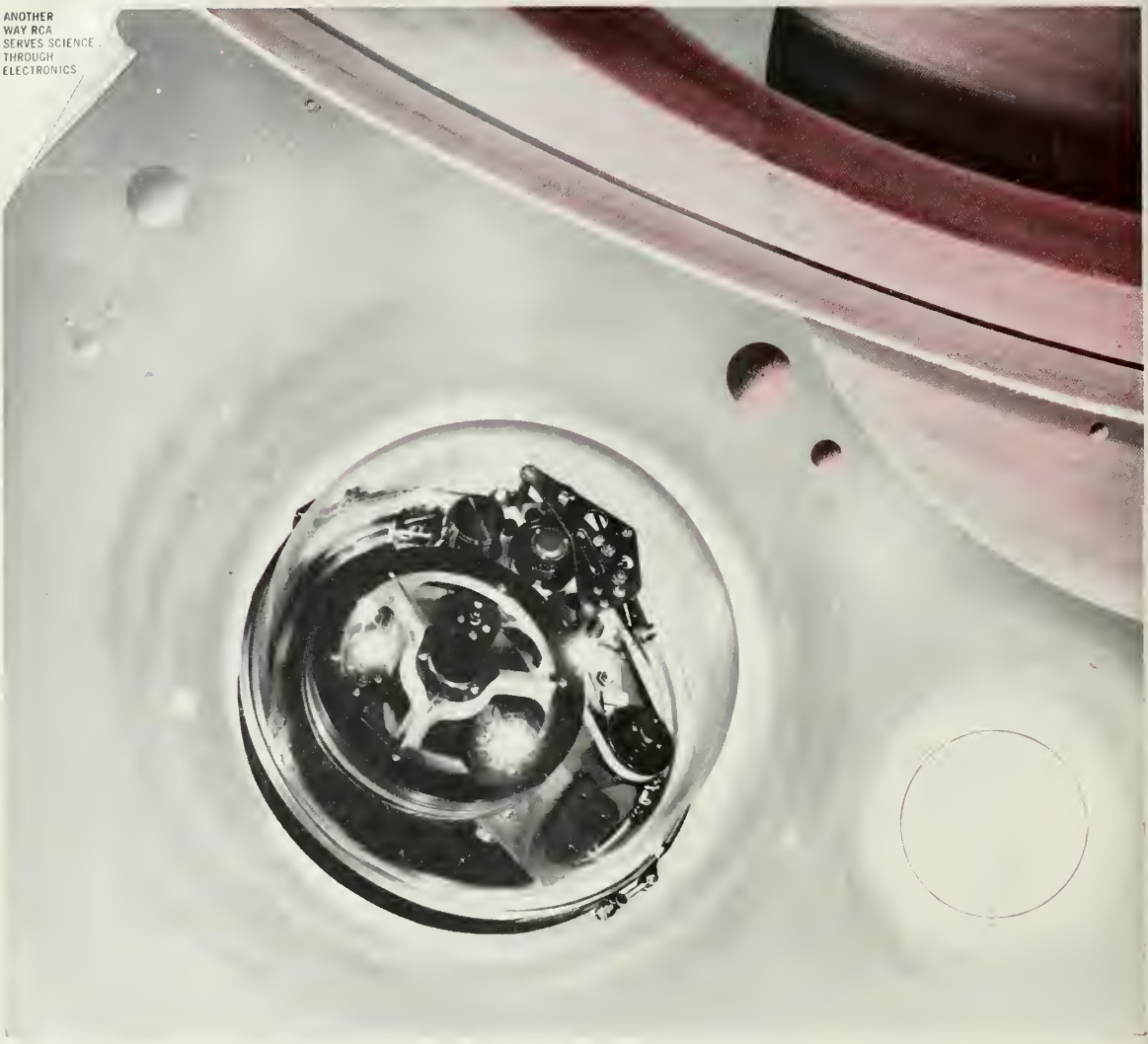
NASA must have its reasons for both programs. We strongly believe that they should be presented to the public even before they are spelled out in great detail to answer the searching questions of Congress.

CLARKE NEWLON

AC Seeks and Solves the Significant—Because of GM's large contribution in the international race for technological superiority, AC accepts a challenge. AC Research is on a scientific quest for solutions to significant problems . . . for accomplishments even more advanced than AChiever inertial guidance for Titan. / We call this creative challenge . . . AC QUESTMANSHIP. It's an exciting quest for new ideas, components and systems . . . to advance AC's many projects in guidance, navigation, control and detection. / Right now Dr. Joseph F. Shea, AC's Director of Advanced Systems Research and Development, is drawing a group of competent men around him to build "the greatest R & D organization in the industry." And Dr. Shea adds strong support to the fact that AC offers "an excellent working atmosphere for a scientist or engineer who wishes to produce and progress." / You may qualify for our specially selected staff... if you have a B.S., M.S. or Ph.D. in the electronics, electrical or mechanical fields, plus related experience. If you are a "seeker and solver," write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

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

ANOTHER
WAY RCA
SERVES SCIENCE
THROUGH
ELECTRONICS



Systems Development for Space Technology:

Magnetic Tape Recorders

Develop a tape recorder capable of handling video signals, but light and compact enough to fit in a satellite. Design for minimum power drain. Make the unit rugged to stand up under launching stresses and operate unattended for the life of the satellite.

From requirements such as these, Astro-Electronic Products Division developed the video tape recorder pictured above.

The entire unit, including electronic circuits, weighs less than nine pounds. It is designed to accept video signals from a satellite TV camera and deliver at its output a frequency-modulated carrier suitable for input to a transmitter. Weight and power drain in the tape transport are reduced without sacrificing tape motion stability. Normal braking methods are eliminated in favor of a constant-tension spring coupling between reels which keeps tape tension constant. The entire system is designed to operate normally in the vacuum of space.

Video or digital data tape recorders are typical of the many specialized systems developed at AEP to spearhead man's advance into space. Whether your problems involve electronic instruments, mechanical sub-systems, entire satellite systems, or the supporting ground control equipment, AEP can help you find the answer.

Watch for Camera Systems for space applications...another AEP capability

ASTRO-ELECTRONIC PRODUCTS DIVISION

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