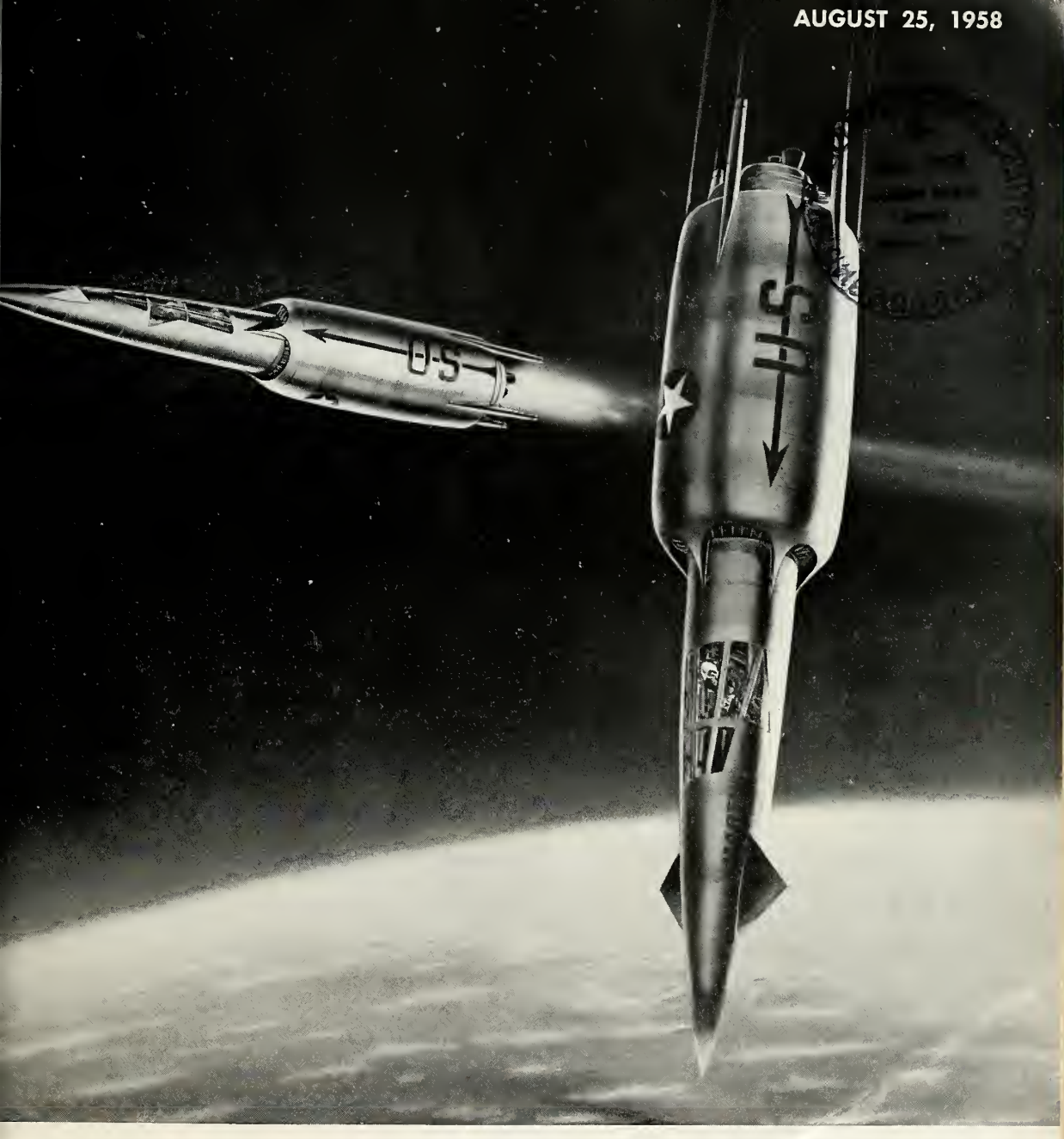
AUGUST 25, 1958



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Engineering and Electronics Edition

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THE PLASMA JET—

a case of research and advanced development

Development of a re-entry simulation facility for the Air Force *Titan* ICBM nose cone required a method for heating air to extremely high temperatures. A special type of electrical discharge, sometimes called a "plasma jet," was considered. Both *fundamental* research—to obtain a quantitative understanding of the arc properties and mechanism—and *applied* research in actual aerodynamic and materials testing were needed. Advanced development—the actual design and construction of improved test facilities—was also an inherent part of the problem.

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Research & Advanced Development

AUGUST 25, 1958
VOL. 4, NO. 8

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

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news

features

columns

departments

cover

Re-entry vehicle envisioned by the Martin Company would provide the stepping stone between satellites and manned space vehicles. The manned re-entry craft would use liquid engines and draw on presently-existing hardware. Martin, however, has never formally proposed to develop the vehicle. Artist: N. Stanilla; Designer: Michael Stoiko.

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TINY SAMPLING SWITCH — TREMENDOUS PERFORMANCE!

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The Moon—Or Bust

The moon—or bust—this is a phrase with much meaning. The Air Force made a nice try on August 17. It was as much of an accomplishment and as important to space flight as the Wright brothers' first flight was to air power. Indeed, the importance of lunar vehicles, in our struggle for military supremacy in the future, is as great as the Wright brothers airplane has been to the struggle for air supremacy in past years. Many lunar rockets may "bust" and fail. More significant, however, is the fact that *the nation itself may bust* if we don't move *ahead* in the race to the moon.

The full measure of tragedy in the Air Forces' first unsuccessful lunar attempt is not to be found in the blow-up of the vehicle itself, but in the political failure to grasp what the lunar program is all about.

For some mysterious reason, Administration officials are constantly telling the public that the lunar program is an all-scientific affair—under the auspices and for the benefit of the International Geophysical Year.

This is only half true. The significance of the lunar program is to be found in its military value. Must we continue to fool the public with half-true excuses in order to permit the military to plan ahead?

There can't be many U.S. citizens who don't know that our missile and space flight programs —and indeed, our way of life—are at stake.

The freedom-loving American is prepared to *back the military*. He is prepared to pay for any form of advanced research and for any kind of exploration that may lead to a stronger America. He doesn't accept the incomplete concept of "catching up with the Russians"—he wants to move ahead of them.

He has read about Russian lunar plans—he knows it is a matter of days or weeks before the Russians may win another big space victory. With the powerful rockets they must have used to launch their *Sputniks,* the Soviets have the definite and immediate capability to fire a payload of possibly over 1,000 pounds on a one-way trip to the moon. He knows the Russians plan to build bases on the moon. So why not tell the truth about our own lunar program?

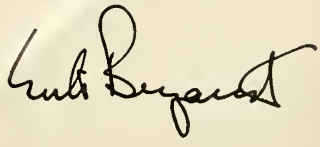
The simple truth is that our military are beginning to understand the strategic value of the moon. To say that the moon will not be of military importance in the future of mankind is to ignore the facts. Military experts say that if we consider the immense power and growth potential of these new weapons—guided missiles and space vehicles—it is clear beyond any question that the next few years can put humans in control of the moon. Considering the many factors that favor moon-launched versus earth-launched operations, it is also obvious that the question of dominance on the moon adds up—in a very positive fashion—to dominance on earth.

The most critical goal toward which Air Force major research and development efforts now are pointed is that of putting man into space: only through success in this endeavor can we command the high ground of space operations—the moon.

Very few Air Force officials and very few—if any—of our political leaders have shared this view until recently. If men like Air Force General Boushey and our rocket scientists could have joined forces and pushed their cases five or ten years ago—as Admiral Rickover's team did—the first manned moon trip might have been almost as far advanced today as is the atom-powered submarine.

Nevertheless, the Air Force and the Army are beginning to push ahead in their current lunar attempts. And they have our full support, because we believe the immediate psychological and the future strategic importance of the moon calls for an intensive, penetrating program. We also believe that the military aspects must be brought to the attention of the public as well. Certainly, Administration officials must begin to understand them.

If it is the destiny of mankind to live in a world dominated by cold-war co-existence, then we must remain the strongest. In addition to having the best Army, the best Navy and the best Air Force—we must be best in space. One way of advancing ahead toward this goal is to authorize, right now, a permanent *military* lunar program. It should be done by the military under ARPA and *not* under the camouflage of NASA.



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This motor, of advanced design, for various applications in missiles is only 3-15/16" x 3-15/16" x 7¼" in size, with the exception of mounting provisions and terminals, yet delivers 9½ HP intermittently @ 17,000 rpm. on 56 volts DC. It is designed without an output bearing so that it may be made an integral part of a pump, blower, compressor or other missile component. Type D-1026 will withstand an overspeed condition of no load and 66 volts terminal voltage. It is totally enclosed, explosion proof, and built for excessively high shock and vibration requirements.

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Output: 9½ HP @ 17,000 rpm intermittent duty

Volts: 56 volts DC

Weight: 12¼ lbs.

Dimensions: 3-15/16" x 3-15/16" x 7¼" (excluding mounting provisions and terminals)

Overspeed: Will withstand 66 volts terminal voltage and no load.

Features: Small size; advanced design; is totally enclosed, explosion proof, built for extreme shock and vibration requirements.

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INDUSTRY COUNTDOWN

HOW'S BUSINESS?

Net income of **Food Machinery and Chemical** for the quarter ended June 30th dropped to $5,002,807 from $5,181,169 in last year's quarter. Per share earnings were $1.45 vs. $1.51 for 1957's quarter . . . **Grumman Aircraft Engineering** published earnings of $1,030,804 for the six months ended June 30th, compared to $2,123,469 for same period in 1957. Earnings per sbare declined to 47 cents from 97 cents. The decline was accompanied by an increase in sales from $90,603,052 to $107,523,602; but Grumman blamed the drop on R&D costs on its new Gulfstream prop-jet transport . . . **Texas Instruments** has second-quarter sales of $21,710,250 and net earnings of $1,035,117 or 32 cents per share, to bring totals for six montbs to $42,189,584, $2,142,861 (66 cents per sbare). Figures were the best for any six month period in tbe company's bistory. Predicted earnings for 1958 are $1.40-$1.45, compared to $1.11 for 1957 . . . **Northrop Aircraft** declared a quarterly dividend of 40 cents a share . . . Net income for **Bendix Corp.** fell to $4,670,740, or 92 cents per share from $7,099,215 or $1.40 for the quarter ended June 30th. Sales were $155,278,951 compared with $194,706,859 for 1957, second quarter . . . **Ampex Corp.** jumped sales to $30,115,000, net income to $1,540,000; but dropped per share earnings to 90 cents for the 1958 period ending on April 30tb. Comparable figures for same period in 1957 were sales, $18,737,000, net income, $1,087,000, and per share, $1.51 . . . Earnings of **Sperry Rand** for the quarter ended June 30th were $3,920,271 (13 cents a share), off 60.9% from the same period in 1957. Revenue dropped only 1.5%, and backlog (military) is almost 75% bigher. 1957's figures for same period were net income, $10,922,075.

MERGERS

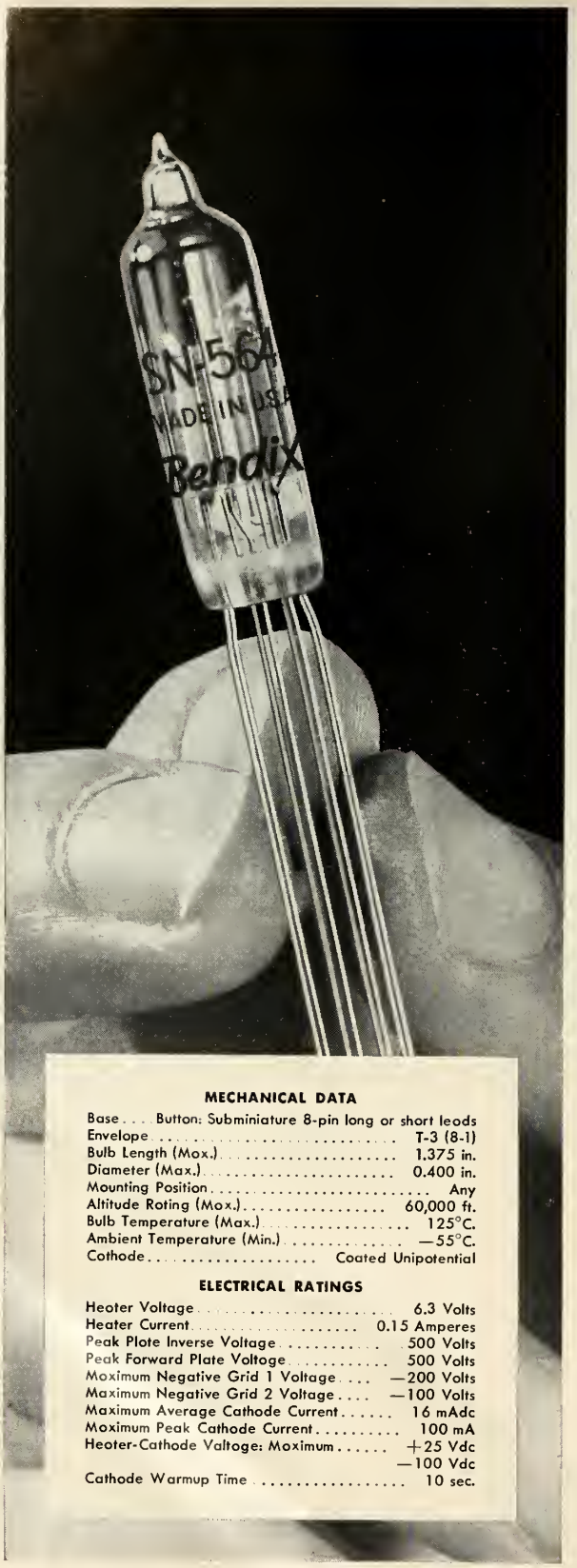
Litton Industries is losing no time in expanding recently-acquired **Airtron Inc.** First section of the expanding ferrite development and manufacturing program recently moved into a new 100,000 sq. ft. plant in Morris Plains, New Jersey. Tbe new facility will be in full operation by the first of the year and will employ 300 people at the outset . . . **Hercules Powder Co.** announced it will build a pilot plant to make nitrogen tetroxide at Hercules, California. Nitrogen tetroxide, now used in jet fuels, is expected to find greater use in tbe future in liquid-fueled rockets. Initial quantities from the new plant will be available in three to four months . . . **Ryan Aeronautical Co.** announced plans to hire 300 engineers, technicians and supporting personnel at its Electronics Division new San Diego site. Plans are also in the works to expand the division's new 30,000 sq. ft. plant, occupied last fall . . . **Lockheed Missile Systems** division named Robert M. Powell as manager of the newly-established base in Hawaii. Lockheed expects to have about 60 people in Hawaii by the end of tbe year.

PROJECTS

Douglas Aircraft will assemble the **Southwest Research Institute**-designed prefabricated all-weather shelter for the *Thor*. The missile rests borizontally until firing time, wben the shelter is rolled back on rails and the *Thor* is raised . . . And speaking of shelters, **Northrop Aircraft** is building a portable magnesium hangar for the *Snark* missile. Northrop claims that the hangar, built of magnesium for portability, is the largest structure of this material in the U.S. . . . **Because of the increased range** of the *Bomarc* 3, USAF will expand the Santa Rosa Gulf Coast Missile range out of Eglin AFB from 250 to 450 miles . . . **The Japanese Defense Agency** has established a Guided Missile Headquarters and two industry groups (**Mitsubishi** and **Fuji Precision Machinery**) are presently trying to work out a tie-up with a foreign missile manufacturer . . . In the solid propellant field, **Standard Oil of Indiana** announced that it was developing fuels for Air Force missiles that "utilize a thermo-plastic binder which permits holding the fuel at moderate temperatures into a desired shape or size." The fuel Standard is talking about will be used in an auxiliary power unit on the *Falcon*.

GOVERNMENT

On Capitol Hill, House Minority Whip Leslie Arends (R-Ill.) criticized the report on the government's research and development activity filed by the House Government Operations Committee. He labeled the report which contended, among other things, that scrimping on the part of the administration has impeded the development of advanced missiles; an attempt "to drag our eminently successful weapons programs into the dangerous arena of partisan politics" . . . **The nature of the reorganization** of ARDC is still uncertain, but the Air Council is studying the recommendations of the Stever committee and will soon submit its recommendations to General Tbomas White, USAF Chief of Staff. Action is expected to be taken sometime in the fall . . . **DOD has ordered** tbat tbe three existing major test ranges will be known in the future as the Atlantic Missile Test Range (formerly AFMTC), the White Sands Missile Range and the Pacific Missile Range (including Point Mugu and Point Arguello.) . . . **Office of Defense and Civil Mobilization** issued certificates of necessity for accelerated amortization to **Lockheed Missile Systems Division** ($1,065,000 with 60% write-off) and Martin Orlando ($105,115, also with 60%). Certificates are for missile testing facilities.



MECHANICAL DATA

Base	Button: Subminiature 8-pin long or short leads
Envelope	T-3 (8-1)
Bulb Length (Max.)	1.375 in.
Diameter (Max.)	0.400 in.
Mounting Position	Any
Altitude Rating (Max.)	60,000 ft.
Bulb Temperature (Max.)	125°C.
Ambient Temperature (Min.)	—55°C.
Cathode	Coated Unipotential

ELECTRICAL RATINGS

Heater Voltage	6.3 Volts
Heater Current	0.15 Amperes
Peak Plate Inverse Voltage	500 Volts
Peak Forward Plate Voltage	500 Volts
Maximum Negative Grid 1 Voltage	—200 Volts
Maximum Negative Grid 2 Voltage	—100 Volts
Maximum Average Cathode Current	16 mAdc
Maximum Peak Cathode Current	100 mA
Heater-Cathode Voltage: Maximum	+25 Vdc
	—100 Vdc
Cathode Warmup Time	10 sec.

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Much current interest centers on an SBP produced radome's ability to withstand under stress a high temperature jet stream for a substantial number of minutes. Yet this is only indicative of many new areas under relentless and costly attack by highly skilled Brunswick research and development teams.

New Brunswick materials and techniques are also available to answer your problems in design, fabrication and testing of aircraft components in metal honeycomb and conventional metalwork. Write: The Brunswick-Balke-Collender Co., Defense Products Div., 1700 Messler St., Muskegon, Michigan.

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Moon Shot "Major Accomplishment": Schriever

Air Force, Army Set To Continue Programs; Handling Of LOX May Have Caused Failure

an m/r staff report

CAPE CANAVERAL — Disappointed but not discouraged, the Air Force on September 14 will fire its second lunar probe vehicle—anticipating another failure but hoping for success.

The first probe vehicle, fired August 17 at 7:18 a.m. from this missile testing center, exploded 77 seconds after blastoff.

It reached an altitude of approximately 50,000 feet. Pieces of the 52-ton rocket rained into the Atlantic Ocean 10 miles offshore at a 60-ft. depth, and many were salvaged by Navy divers for study.

Maj. Gen. Bernard Schriever, commander of the Air Force Ballistic Missile Division, theorized that a pressure leak, or a broken fuel line might have caused the explosion. He termed it a "random failure" which should have no effect on future lunar probe plans. "The shot itself is a major accomplishment," Schriever said.

The Air Force has been authorized to conduct two more probe attempts; two have been authorized for the Army Ballistic Missile Agency, with a modified *Jupiter*.

The possibility exists that the first experimental vehicle may have been loxed too early, causing a freeze and possible rupture in the first-stage engine compartment. Newsmen and observers noted that the vehicle was being "loxed" three hours before launch time. The LOX was topped off three times before ignition.

(Preliminary checks of salvaged parts, m/r learned late last week, indicated a rupture of the lower bulkhead of the LOX TANK, about nine feet above the exhaust nozzle, or of tubing in that area. It was apparent that the "contrail" most observers thought they saw just before the missile failed was actually the result of escaping liquid oxygen.)

Gen. Schriever commented that the *Thor* has had a reliability of 80%. Of the last seven fired, six traveled to full burnout. Director Roy W. Johnson of the Advanced Research Projects Agency commented that "the attempt will go down in history, even though it failed, as the Kitty Hawk of the missile business."

• Quick action—The lunar probe project was one of quick organization. Part of the IGY program, it started on March 27 when Defense Secretary Neil H. McElroy ordered the Advanced Research Projects Agency to take program cognizance. In 12 days, ARPA ordered the Air Force Ballistic Missile Division of ARDC to conduct three lunar probes. The Army Ballistic Missile Agency was ordered to make two probes, and the Navy was assigned the task of developing a mechanical ground scanning system at its Ordnance Test Center, Inyokern, Calif.

The Air Force had emphasized that the *Thor* still is essentially an R&D vehicle and that the first flight test of all components probably would fail. Objectives of first test flight were:

To achieve proper powered flight performance from all three stages; to reach escape velocity from the earth's gravitational field; obtain data during the 250,000 mile flight; and finally, achieve trajectory control sufficient to place the payload in the vicinity (50,000 miles) of the Moon. Complete success depended on the perfect functioning of more than 300,000 complex and interdependent parts.

These are the questions which will be answered eventually through moon rocket research.

• Configuration, elements—The Air Force's lunar probe vehicle configuration had a total height of 88.1 ft. The first stage was a standard *Thor*, numbered 127, weighing more than 100,000 lb. and developing a thrust in excess of 150,000 lb. It had an 8-ft. diameter.

Second stage was powered by an Aerojet-General Corp. 1040 liquid-fueled engine of 7,500 lbs. thrust. This, configuration was changed with the addition of eight spin, or vernier rockets.

The third stage, developed by Allegany Ballistics Laboratory as part of the *Vanguard* series, but never used, had a 2,500 lb. thrust engine. This 400 lb. (weight) stage and its payload were covered by a nose fairing which was to have been jettisoned after first and

Four M/R editors were on the scene at Cape Canaveral to bring this story and pictures to readers. Editor Erik Bergaust; Associate Editor Norman L. Baker; Assistant Editors Donald E. Perry and Frank McGuire collaborated on this report.

ROY W. JOHNSON . . . "the attempt will go down in history with Kitty Hawk."

GEN. SCHRIEVER . . . "the fact . . . it got off is a major accomplishment."

MAJ. GEN. D. N. YATES . . . "we are . . . disappointed, but not discouraged."

MATING SEQUENCE for Moon Rocket. Here, second and third stages go together.

SECOND STAGE comes into position for joining with Primary Stage of *Thor*.

FINAL ADJUSTMENTS are completed on mated first and second stages of missile.

second stage separation occurred.

A Thiokol solid propellant terminal rocket of 3,000 lb. thrust was the basis of the payload package. The 83.8 lb. package contained 25 lb. of instrumentation weight, including batteries with a one-month life expectancy, a telemetry system and the NOTS photo-electric cell scanning device. Telemetry measurements would have included the measurement of the number of meteorite impacts, magnetic field, and the thrust-chamber pressure of the terminal rocket, giving evidence of whether or not it fired successfully in the planned 2.6 day flight.

• **Contractors**—West Coast industries played a prominent part in assisting Space Technology Laboratories of Los Angeles in the Air Force probe attempt. STL had over-all technical direction and systems engineering responsibility for the project, plus hardware responsibility for the second and third stages and the scientific payload of the vehicles.

Among principal subcontractors were: Atlantic Research Corp., Summit Industries, Pacific Automation Products, Rantec Corp., Western Electric, Reeves Instrument Corp., Radio Corp. of America, and Hallamore Electronics. A total of some 52 firms were involved.

Here is the contractual breakdown:

First Stage: Vehicle: Douglas aircraft *Thor* IRBM; Propulsion: Rocketdyne (first production engine by Neosho); frame, control, instrumentation and electrical systems, Douglas; Checkout, assembly, integration, Douglas.

Second stage: Propulsion system and tanks: Aerojet-General Corp.; Electrical, control, instrumentation, assembly and integration, spin rocket systems, STL.

Third stage: Rocket motor, Allegany Ballistics Laboratory; structure, electrical, assembly, integration and checkout, STL.

Terminal vehicle—Overall responsibility, STL; scanner and transmitter, Naval Ordnance Test Center, Inyokern; Thiokol Rocket Motor.

Major ground stations which would have been used for tracking are at Cape Canaveral; Singapore; Hawaii; the Manchester, England radio telescope antenna, and the Lincoln Laboratory, Millstone, N.H.

Nine naval minitrack stations were to have assisted. Data received was to have been transmitted on a special teletype circuit to the AFBMD Communications Center, where a staff of 40 people, headed by Lt. Col. Donald Latham and Dr. G. E. Mueller of STL, would make evaluations.

Mars, Venus: Next on U.S. Schedule?

CAPE CANAVERAL—ARPA director Roy W. Johnson confirmed at a press conference here that the U.S. will undertake a program for sending probes to Mars and Venus. Johnson said the program will be conducted by NASA. He did not elaborate and did not offer any details.

Missile experts visiting here for the first lunar shoot said the Mars and Venus probes probably will use IRBM boosters and be similar to the current Air Force and Army lunar vehicles. A check with NACA indicates "Mars and Venus probes are being considered," but that a program will not get underway until after NASA has been fully established.

DOD and Air Force have been flooded with Mars and Venus probe proposals. One official said the U.S. program for probes to the planets "is being hampered by politics, in that the agency that is to take charge has not been set up yet." Another official speculated it will take as long as one full year before NASA will authorize a program "although Mars probes could be incorporated as a follow-up series of the current lunar probe programs."

Army's Dr. Ernst Stuhlinger previously told m/r a Mars probe would differ from a lunar probe in payload design. Batteries must be designed to trigger the instruments after the vehicle has traveled for some 259 days. "This means more reliable and somewhat more complex instrumentation, but we know how to do it and we can do it now," he pointed out.

Newest *Explorer*, No. 5 Readied For Launching

Next space probe attempt will be *Explorer* V, in countdown as m/r went to press. Launching time is scheduled for 2 AM, Thursday, August 21st. *Explorer* V is the second of two satellites authorized last May to probe the intense radiation band discovered by earlier satellites. According to Army sources, it will be identical to *Explorer* IV and will carry the same instrumentation, designed by Dr. James Van Allen of the U. of Iowa.

However, any mishap in launching that results in a faulty orbit such as that of *Explorer* III would probably be welcomed by scientists. This might make it possible to determine the upper limit of the x-ray band, because a faulty orbit would likely have a vastly higher apogee than an ideal orbit.

While Army preparations were concluding, on a nearby pad the next *Vanguard* vehicle was being prepared for launching. This *Vanguard* will carry the "Weather Eye" infra-red scanning system.

Doolittle Named Chairman Space Tech. Laboratories

The Ramo-Wooldridge Corporation has announced that, effective January 1, General James H. Doolittle will become Chairman of the Board of Directors of the Space Technology Laboratories. Previously a division of Ramo-Wooldridge, the Laboratories on January 1st will become a separate corporation with an independent Board of Directors.

Space Technology Laboratories is the Ramo-Wooldridge division that has over-all scientific responsibility for the Air Force's *Thor, Atlas, Titan,* and *Minuteman* missile programs.

General Doolittle, who is now serving in a number of government advisory posts, including chairmanship of NACA and chairmanship of the Air Force's Scientific Advisory Board, will continue as a member of the Board of Directors of Shell Oil Company, but he will retire as vice-president of that organization at the end of the year, it was announced.

Ford Instrument to Design No-Gimbal Guide System

The Weapons Guidance Laboratory at Wright Air Development Center has awarded a contract for the development of a radically new type of inertial guidance system to the Ford Instrument Company division of Sperry Rand, it was announced recently.

The Phase I portion of the contract is for the study and preliminary design of a "No-Gimbal Pure Inertial Guidance System." This is a system which uses gyros fixed to the vehicle frame and computes deviations of the vehicle to give an unvarying space-fixed base to the measuring accelerometers.

Ford Instrument has been working on this type of system for some years, but found that the state of the analog computer art in the past precluded a successful system. The system now under development will undoubtedly use a digital computer to convert gyro-sensed deviations to proper orientation signals for the accelerometers.

The elimination of stable platform gimbaling coupled with the reliability and repeatability of digital techniques promises a vastly simplified and much more reliable inertial reference and measuring system.

Congress Hits Procurement Practices

For the third time in five years, House investigators have dug into the procurement of launchers of air-borne rockets of the Air Force and Navy. In brief, the Committee on Government Operations found little it liked and specifically scored the Air Force and Navy procurement offices, and the Small Business Administration.

The committee, which in 1953 and 1954 (as the Investigating Sub-committee on Defense Activities) looked into the subject, termed planning for procurement "markedly poor," and said the imbalance between launchers and rockets now and for the past several years impairs the nation's aircraft firepower capabilities in the event of an emergency.

Military spokesmen declined comment on the report, released this week, but they admitted the situation was not good. One Air Force office said that present stocks of rocket launchers leave much to be desired, but that there are enough on hand to meet current requirements.

The Navy agreed improvement is needed in many areas, however, Navy officials disagreed with the Committee report that only 13,391 of the 19-round Aero 7D launchers had been shipped by mid-July. To date, the Navy has accepted delivery of some 18,000 for operational use, with the remaining 26,000 to be delivered by January, 1959.

The Committee said the congressional intent to help small business "is partly nullified by administrative procedures which permit subcontracting by small business to big business" and that "The Small Business Administration showed itself to be poorly informed and inconsistent with regard to positions taken within its own organization, when this matter was called to the agency's attention."

Among other matters, the Committee recommended that the Air Force and the Navy establish firm requirements, integrate procurement, and take steps to assure production sources adequate to fulfill these requirements.

Congressmen further urged that steps be taken, in cooperation with the Small Business Agency, to prevent subcontracting by small business to big business where procurement has been exclusively reserved for small business; prohibit 100% contracting unless clearly authorized in advance; and prohibit transfer of contract or subcontract for fees or commissions paid for such transfers.

Red Moon Stunt Seen Likely

Leroy Corcoran

SOVIET man-in-space capsule based on a drawing in "Red Star" newspaper.

As m/r went to press, speculation was that Red space scientists were preparing a moon probe or a man-in-space capsule program. Launching might coincide with the opening of the Ninth Congress of the International Astronautical Federation at Amsterdam, Holland, August 25-30.

Last year's congress in Barcelona was opened with the news of *Sputnik* I, and the hero of the congress was Dr. Leonid I. Sedov, who headed the four-man Russian delegation.

In an exclusive interview with m/r during the Congress (November 1957), the Red delegation outlined Russia's moon program:

The first Red moon rocket may carry a payload of approximately 500 pounds and be designed to either hit the moon or enter into an orbit around that satellite. The second lunar vehicle will be designed to retard its fall by means of reverse-thrust rockets, and plant itself and its instrumentation on the moon.

A third type of lunar probe will carry television equipment to relay back-to-earth closeups of the moon's surface. And a fourth type may carry a live passenger—animal or man—if the previous rockets and probes have been successful, and if the information gathered has been satisfactory enough to encourage manned trips into space.

The accompanying cross-sectional view of a capsule to put man into space (left) was recently shown in the Russian Army's newspaper RED STAR. The capsule, which is very similar to the one planned for use in the United States Army's Project Adam, contains: 1) air intake; 2) oxygen control panel; 3) oxygen and pressurization equipment; 4) carbon dioxide absorber; 5) electronic instruments; 6) radio receiver; 7) water supply; and 8) electric batteries.

Boeing's "Dyna-Soar" To Use Pinpoint

Goodyear Aircraft Division—already in the "Dyna-Soar" project as a member of the Martin-Bell team—last week was awarded a contract by the prime contractor of the competing team, Boeing Airplane Co. Under the contract, GAC will produce PINPOINT guidance systems. PINPOINT combines map-matching and inertial guidance principles.

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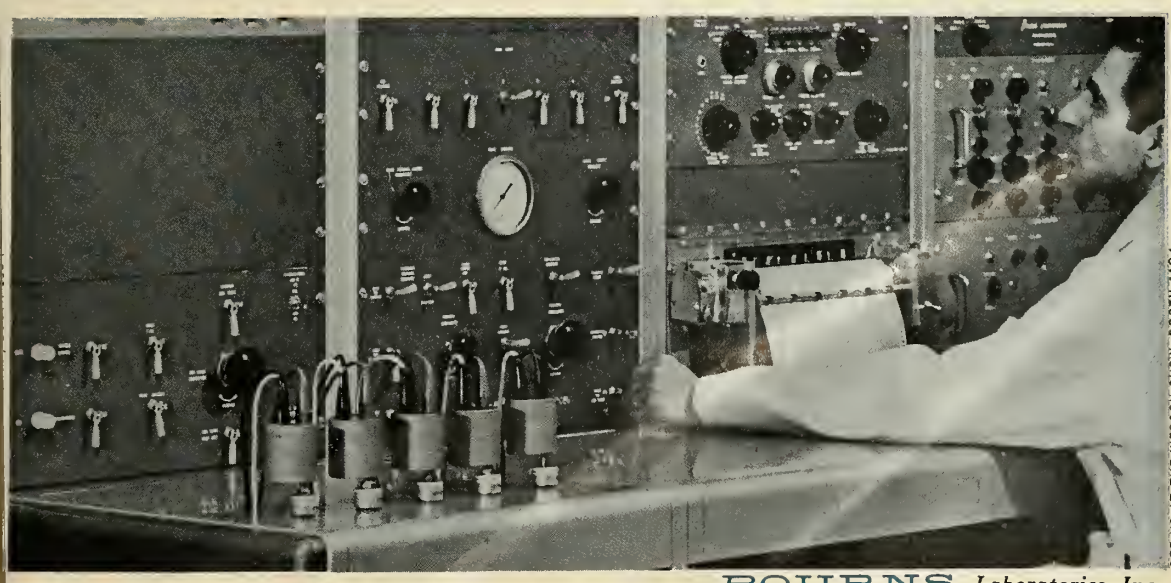

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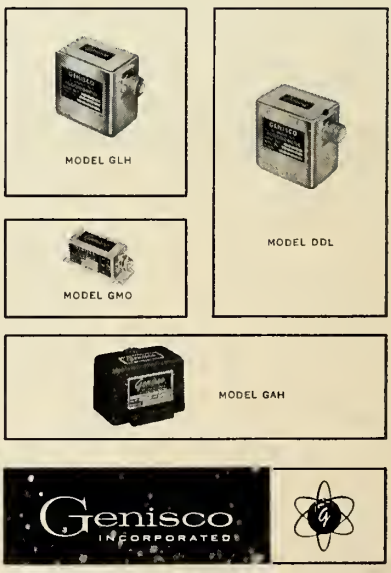

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when and where

SEPTEMBER

Summer Program, Problems of High-Powered Radar Design, Massachusetts Institute of Technology, Cambridge, Mass. (Security clearance required) Sept. 2-12.

1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass., Sept. 3-5.

American Rocket Society, Fall Meeting, Hotel Statler, Detroit, Mich., Sept. 15-18.

13th Annual Instrument Automation Conference, Convention Hall, Philadelphia, Pa., Sept. 15-19.

ASQC, 5th Annual San Francisco Bay Area Conference, Stanford University, Palo Alto, Calif., Sept. 19.

Professional Group on Telemetry and Remote Control, 1958 meeting, American Hotel, Bal Harbor, Miami Beach, Fla., Sept. 22-24.

Standards Engineers Society, Seventh Annual Meeting, Franklin Hotel, Philadelphia, Pa., Sept. 22-24.

Air Force Association, Airpower Showcase, Dallas, Texas, Sept. 25-28.

ASME Power Conference, Statler Hotel, Boston, Mass., Sept. 28-Oct. 1.

OCTOBER

Armour Research Foundation and Illinois Institute of Technology, Annual Noise Abatement Symposium, Hotel Sherman, Chicago, Ill., Oct. 9-10.

Fuels-AIME Conference, American Society of Mechanical Engineers, Old Point Comfort, Va., Oct. 9-10.

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

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

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

SAMA Laboratory Apparatus and Optical Sections' Midyear Meeting, Westchester Country Club, Rye, N.Y., Oct. 26-28.

1958 National Metal Exposition and Congress, American Society for Metals, Public Auditorium, Cleveland, Ohio, Oct. 27-31.

Institute of Radio Engineers East Coast Conference, Aeronautical & Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md., Oct. 27-28.

IRE, 1958 Electronic Devices Meeting, Shoreham Hotel, Washington, D.C., Oct. 30-31.

Vandenberg . .

With a Brand-New Name, Former Cooke AFB Gets Ready For a New Role

THE MOUTH of the flame deflector of the first *Thor* launching pad. The second pad of the two-pad complex can be seen in the background.

WORKMEN SNAKE propellant flow pipes into position on *Atlas* launching stand. Pipe will connect missile with storage tanks under stand. Pad shown is 90% complete.

FRAMED IN THE MAMMOTH lip of an *Atlas* flame deflector plate, workmen drill water flow holes for cooling the steel during hot firings. Water flow capacity—18,000 g/m.

pace Base, U.S.A.

By Norman L. Baker

VANDENBERG AFB, CALIF.—The United States' first and largest combined training-operational long range missile base has taken its first functional steps, while construction programs continue.

A contingent of 50 Royal Air Force personnel were enrolled as Vandenberg's first trainees on August 15. Slated to receive group training on the *Thor*, they will form the operational vanguard for the initial IRBM deliveries slated for the end of 1958. Earlier, the group received individual training in the fabrication and testing of the missile systems.

No time is being lost between facilities acceptance and the initiation of the training program. Two *Thor* launch complexes have been accepted by the Air Force and are currently being made ready for use. The first *Thor* training missile was delivered to the base Aug. 13, others will come during the first week of September, on the heels of *Atlas* trainers. One *Atlas* was delivered on July 1 to serve as a launch pad compatability checkout unit as well as a training tool.

• **Surpasses Canaveral**—Vandenberg (formerly Cooke AFB), will be the largest, most elaborate and fully equipped missile base in the United States when completed.

Within months, the broad expanse of the base's 64,000 acres will be crisscrossed with a dense array of launch pads for the entire arsenal of U.S. long range missiles.

In addition, there will be control centers, tank farms, assembly shops, classrooms, housing areas, an airfield, and ground tracking stations.

If any base, now or in the near future, deserves to be tagged "space port," it should be Vandenberg.

Air Force says that Vandenberg, at least for the time being, will serve only as a training and operational readiness base, and will not absorb any of Cape Canaveral's research and development testing program. Officials pointed out to m/r that Vandenberg's location (proximity to missile contractors in southern California and optimum launching capabilities) will make it ideal for a future R&D center.

• **Ideal location**—Almost the entire base is situated on Burton Mesa, a flat tableland—217 feet above sea level—nestled between two mountain ranges, sloping gradually to an isolated beach, sand dunes and brush. The nearest community, Lompoc, lies eight miles to the southeast. Only the Southern Pacific railroad, running north and south along the beach, invades the isolation of the area.

The launching pads are dispersed along the beach, jutting out into the ocean to provide an unobstructed missile flight lane.

If desired, missiles could be fired due south without endangering populated areas. This was the primary reason for the selection of Vandenberg as the take-off point for a polar-orbiting reconnaissance satellite. The orientation of the pads now under construction indicate that most flights will be made in a SW to SSW direction. (Any flights to the south will describe a path over the Navy's 20,000 acre Pt. Arguello Pacific Test Range, now under construction.)

As for security during launchings, "beachwatchers"—a headache for the AF at Cape Canaveral—are at a disadvantage at Vandenberg. The closest point where off-base observers could see a missile on the pad is more than 10 miles away. Only a railroad line, which had to be accepted with the base, could present a problem.

• **Launching pads**—The number of launching pads completed, under construction, and planned is of such magnitude as to make the Cape Canaveral personnel justifiably envious.

The pads are laid out in integrated complexes for control from central blockhouses. While at Cape Canaveral the pads are in a single line along the beach, at Vandenberg they are positioned along the beach and inland in what at first glance seems a haphazard pattern of two- and three-unit groups (see map, p. 23).

Missiles that will be launched from the base include *Thor, Jupiter, Atlas, Titan,* and *Bomarc.*

Pads for the *Thor* are the nearest to completion; seven are under construction, ranging from 85% to 100% complete (there are three *Thor* pads at Cape Canaveral). The first two, less the gantrys, were completed and accepted during July. The *Thor* pads are arranged in pairs, approximately 500 yards apart, with the control center blockhouse midway between them.

Six *Atlas* launching pads are under construction—three of these are 90% complete. The other three are weeks away—the first ground for these was broken in July. The *Atlas* pads are arranged in a triangle with a single blockhouse positioned in the center.

The *Thor* and *Atlas* positions are described as "soft" (located above ground level). Each pad is equipped with everything needed for individual operation: the *Atlas* pads, which have their missile mounting surfaces located flush with ground level, could handle two missile firings without re-supply.

In rooms below the *Atlas* stands, separated by a few feet of concrete, is the fueling system and liquid oxygen supply (28,000 gallons), nitrogen storage, electrical power units, and a crew safety area. The whole area is completely air-conditioned. The missile's rocket engine exhaust will be deflected by a 90 degree blast-plate, cooled by a water flow having a capacity of 18,000 gpm. The rocket's flame and deflector coolant will be carried away to the sea in deep ditches.

The *Atlas* pads will serve the dual

WELDER IS APPLYING finishing touches to the rails that will guide the huge servicing gantry handling the *Atlas*.

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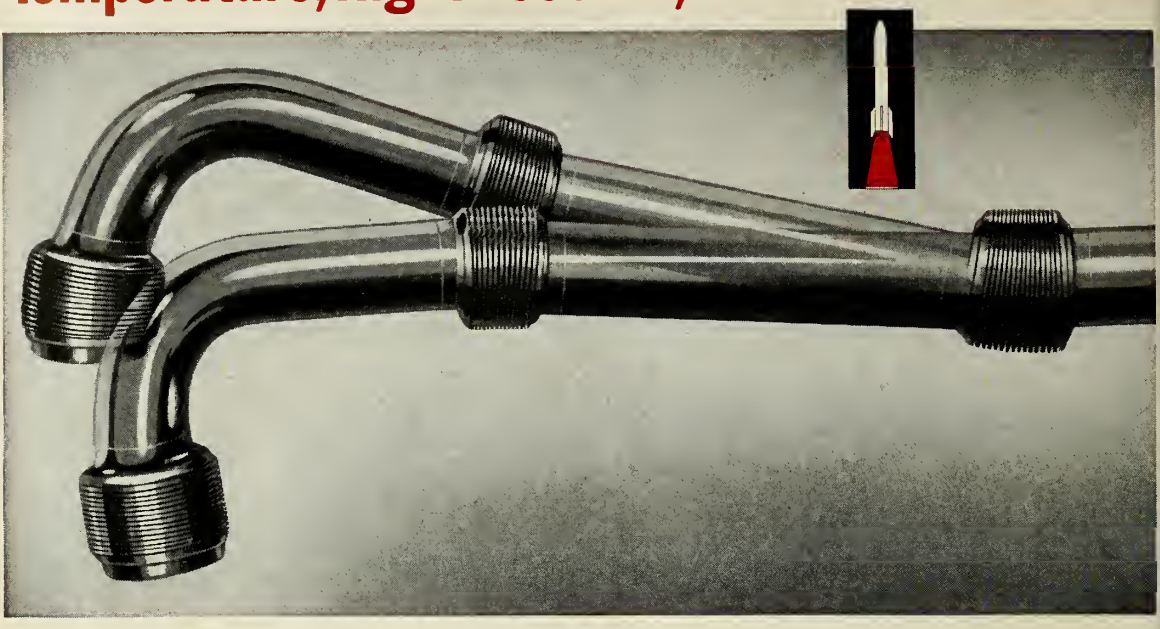

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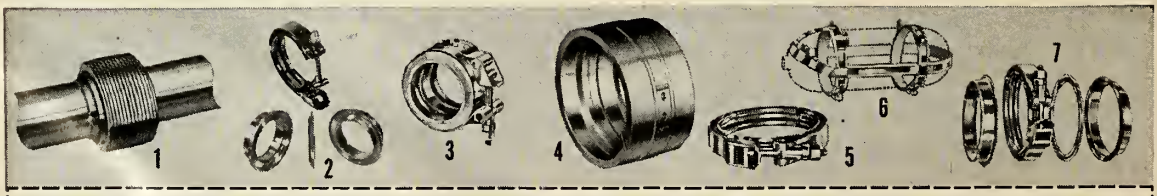

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purpose of training crews and as standby operational retaliation units. Land has been set-aside for future expansion of the *Atlas* program.

The *Thor* and *Atlas* pads are currently the only ones under construction. The sites for the *Titan* training and operational launch pads have been surveyed, on beach land north of the mesa, and may include about nine pads. Although the site has been selected for *Jupiter* units, the Air Force reported that no work has been started.

A short distance inland from the *Atlas* launch stands is the missile's guidance control system. The control building overlooks all the stands—a requirement for the radio inertial system. The guidance system consists of the control building, and two "legs" containing wave guide cables arranged in a cross shape.

• **Support facilities**—Located approximately seven miles east of the launching area are the barracks, mess halls, classrooms, and housing units for the Air Force personnel. Here, in what was Camp Cooke, the Army base of World War II, another large construction program is underway. About $10 million of the present $45 million construction contract will be utilized for houses, new buildings, and remodeling of old barracks. Total construction cost will exceed $100 million. Only about two-thirds of the old camp is being used (northern portion)—with no plans for the remainder.

New construction includes an *Atlas* and *Thor* assembly building (now completed), an 8,500-ft support runway and 1,430 three-to-four bedroom houses. Near the runway, a *Bomarc* surface-to-air missile base will be constructed for defense of the base.

Future missilemen on duty at Vandenberg will live under conditions not even dreamed of by service men of the past. The old, two-story 63-man Army barracks are being converted into 35-man units separated into two-man rooms. Floors are tiled and flush doors are used throughout. Bathrooms are completely modern, with individual stalls for showers and toilets.

There will be three 1,000-man mess halls with cafeteria-type service. Plans are being laid for a family-style service for the near future. A "hobby" garage where personnel can repair automobiles has been planned. For recreation, there will be swimming pools, a 1,000-man theatre (under construction), and a gymnasium (completed).

• **Training program**—All personnel training at Vandenberg will be in the

THE MISSILE launching location of Vandenberg AFB can be seen in the above map.

LAYOUT OF Vandenberg AFB showing location of missile launching pads.


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group training category, referred to as the Integrated Weapon Systems Training. Officers and airmen will first receive individual training on all the various missile components at contractor plants. This training, which varies from three weeks to six months, will include such areas as nose cone (arming, fusing, assembly), guidance (missile and ground station), fueling, LOX handling, rocket engine check out, launching, ground support, and general electronics.

Upon arrival at Vandenberg, individuals will be formed into integrated groups for the IWS training. Group crew training will take three to four months. The crew will be taught assemhly; handling; maintenance of the missile and its component parts; transporting and erecting; and finally, actual countdown and static-firing. After a few of the classes have completed the course, one class will be selected to carry through an actual flight operation.

Classes will be conducted on a mass lecture basis with an anticipated 2,000 to a class. A *Thor* squadron will contain 500 men, 65% of whom will be technical personnel. How many of the technical personnel of each squadron that will be trained at Vandenherg was not disclosed.

The Air Force hopes to start classes in individual training at Vandenberg as soon as it is feasible, although officials admit it will be impractical for many months to come.

Contractor-instructors will be employed for crew training until a sufficient number of Air Force personnel have been trained for the task. Many of the first students will be retained at Vandenberg to assist the contractors in the training program.

As the crews are trained, they will be dispatched to bases. At predetermined intervals, crews will be returned to the school for further actual flight shots. Crew training on the *Atlas* is not expected to get underway until the fall of 1959.

The 704th strategic Missile Wing, under the command of Col. William S. Radar, will conduct the IRBM and ICBM training program. This unit will also provide, operate and maintain instrumentation necessary for the missile training launches. The 704th is under the control of the 1st Missile Division, commanded by Maj. Gen. David Wade, formerly Chief of Staff, SAC Hdqs.

The division, with headquarters at Vandenherg, will incorporate under one central control all ballistic missiles designed for strategic operations. In addition to the 704th, the 706th Wing (*Atlas*) has been activated at Warren AFB, Wyo. The Air Force has identified three IRBM and two ICBM squadrons in various stages of the training program.

The 392nd (*Thor*) will be stationed at Vandenberg as training personnel; the 864th and 865th (*Jupiter*) are being trained by the Army at Redstone Arsenal as operational strategic missile squadrons. The 394th (*Atlas*) squadron will train crews at Vandenberg with the 576th (*Atlas*) programmed as the first operational crew.

• **Housing bottleneck**—Finding quarters for personnel and their dependents is currently a major problem. The Air Force is engaged in an accelerated housing development program, but the most conservative estimates indicate that it will be extremely inadequate.

A $11-million on-base Capehart development of 880 three and four bedroom individual homes was started in September 1957, with most units to be completed by this September. A second installation of 525 Capehart units at a cost of $7,765,913 was started July 1. Yet, there are over 700 Air Force personnel in need of homes for their dependents. To make matters worse, it is estimated that ahout 3,500 off-base houses will be needed for Air Force and contractor personnel by the end of 1959.

The Air Force admits freely that this housing can be obtained only hy an all-out effort hy the people of the communities of Lompoc and Santa Maria. Construction by these towns has so far been very gradual and marked with hesitancy. There is need for an education program—to convince the local populace that the Vandenherg base is not of a temporary nature—as was the case of Camp Cooke during World War II.

• **Flower seed center** — Lompoc, situated in the "Valley of Flowers," extends from the mountains to the sea, and has only 260 houses and approximately 20 two-floor apartments under construction. Present construction is limited within the town's limits. The Air Force, in an effort to offset part of the problem, has established a permanent house trailer camp on the hase.

Lompoc, the future Cocoa of California, with a population of 6,665, is looking forward to a tremendous growth—some believe it will hlossom into a city of 40-50,000 within the next few years. The annual income is approximately $9 million, with $5.5 million as a result of its wide range of agriculture. Industrial income is derived from earth processing plants.

Lompoc is only a short drive from fresh water lakes in the mountains on the east, to the ocean beaches on the west. There are eight county parks in the area, affording recreation for all summer sports. Climate conditions are excellent—average temperature 63 degrees, lowest average 52 degrees, combined with an average rainfall of 13.5 inches.

Santa Barbara is slightly over an hour's drive south; Los Angeles ahout 4 hours away.★

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FASTENERS FOR AIRBORNE WEAPONS SYSTEMS

Missile Electronics Growth Important to Florida Economy

by Donald E. Perry

TALLAHASSEE—Missile electronics research and manufacturing in Florida is not confined to the Cape Canaveral area—the whole playground state is now at work.

There is stepped-up activity all over the Sunshine state. It now has more than 100 electronics manufacturing firms, with total emplyoment of more than 10,000, and an annual payroll in excess of $40 million. In the past three years, electronics manufacturing has more than tripled in both the number of plants and total employment, and the Florida Development Commission estimates it is a $150 million-a-year industry.

Although the state's biggest plant, the 3,800-employee Martin Co. in Orlando, is turning out four major weapon systems; a three-engineer outfit in Melbourne—Missileonics—is hard at work designing and developing doppler systems for the big missile names at the Cape.

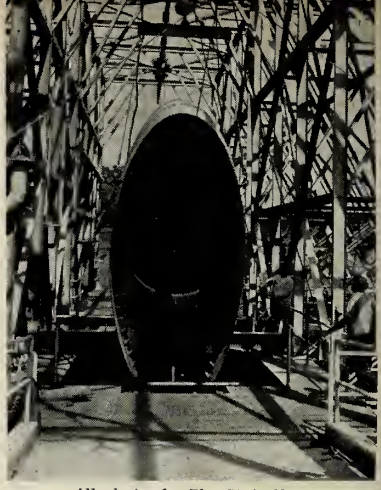
A map of Florida today shows the location of plants from Fort Walton Beach and Eglin Field in the west panhandle, down through the missile country of Orange and Brevard Counties, into the aviation centers around Fort Lauderdale, Orlando and Miami.

At Panama City, a Navy lab tries out electronic countermeasures against mines and torpedoes in the Gulf of Mexico. In Orlando, sonar research is carried out in the waters of a 35-foot crystal-clear lake for application to submarine missiles. At Miami, an engineer-group shipbuilding corporation is field-testing an electronic auto-pilot for hydrofoil boats.

Florida electronics manufacturing embraces every category of the industry. Electronics for aircraft is the major concern of 16 companies; marine communications, six; missile tracking and computing, 10; and industrial control and instrumentation, six. Other firms specialize in components.

Six plants are in the countermeasures field—including the Kett Technical Center infra-red laboratory at Pompano Beach and the fast-growing telemetry firm of Radiation, Inc. at Melbourne. Radiation, Inc., which several months ago set up an astrionics section, now reports it is the second largest part of the company.

• **Civilian contracts**—While about 80% of all Florida electronics activity is geared to defense contracts, many firms are producing items for civilian use, and others says they could convert to non-military production without too much difficulty. As an example, Centronix of Coca, while heavily involved in engineering work at the missile test center, is also making equipment for commercial radio stations and the Civil Aeronautics Administration.



All photos by Fla. State News Bureau

SONAR DOME is lowered into lake by Navy's Underwater Sound Reference Lab.

The Kett center, which opened in January, eventually will have a $2 million annual payroll. Studies underway in campus-like buildings on a 25-acre site include research on supersonic and transonic propellers and atomic reactor tools.

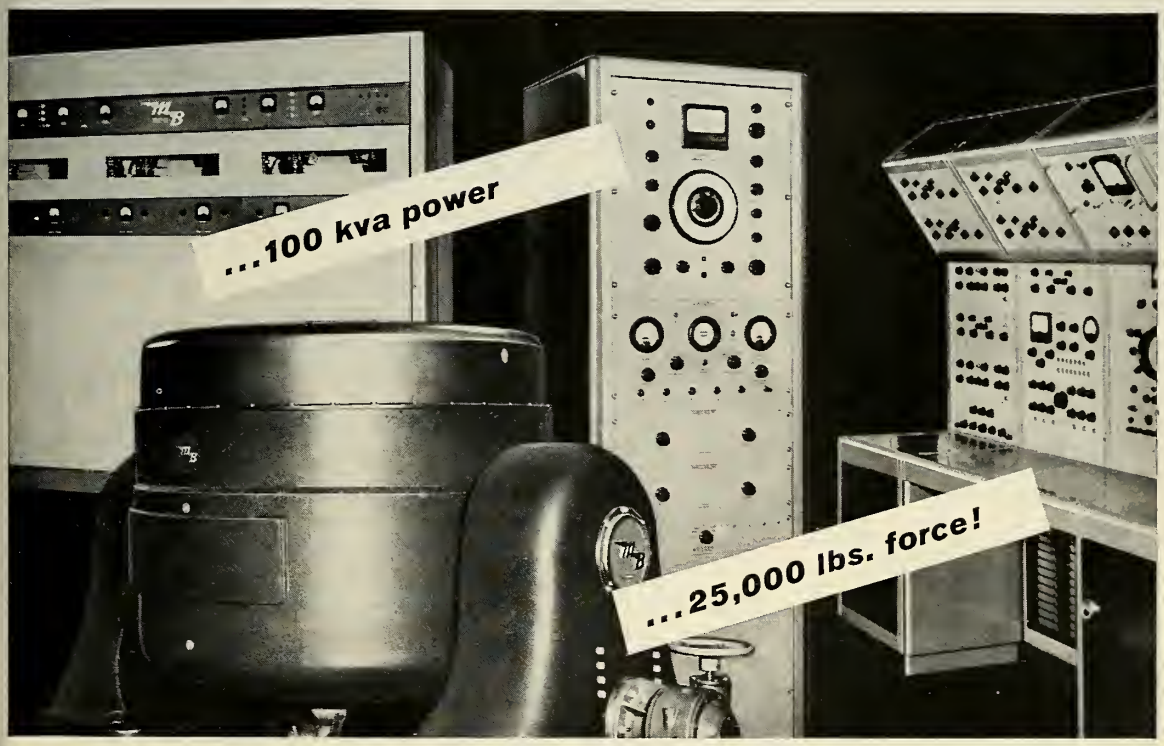
Electronics Communications' environmental laboratory at St. Petersburg deals with accelerations up to 75 Gs and altitudes up to 150,000 feet. The company also makes data link receivers, flap actuators, and electronic facsimile systems. Vice-president Tom F. Grieser pointed out that not only had his company added $5 million this year to its existing $12 million component contract for Hughes Aircraft Co., but that the company will start a new 150,000-square foot factory building by the end of this year. The firm already has two plants in the area.

Three other electronics industries are on the West coast near St. Petersburg. Recently opened was the Sperry Microwave Electronics Division at Oldsmar on an 80-acre site.

General Electric, which plans to add 200 employees at its Pinellas Peninsula Plant, has been in operation for two years turning out classified devices for the Atomic Energy Commission. The $2.5 million Minneapolis-Honeywell plant, in the same area, has an inertial guidance engineering center which is the first installation in the country exclusively devoted to prototype and production work on hermetic integra-

ELECTRONICS research and manufacturing is not confined to the Cape Canaveral area.

MB develops largest vibration system!



THIS NEW, complete MB vibration test system is the largest in existence. It represents the most advanced equipment for high force, high frequency, high performance shake testing.

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UNDIVIDED RELIABILITY: Working with MB, you avail yourself of the longest experience in the field . . . the widest scope of test systems . . . the operational benefits of matched elements . . . the undivided responsibility for performance and service of the complete system . . . and the largest field service organization.

Send for Bulletin 470 which gives data on MB systems from 7000 to 25,000 pounds force. If you need less capacity, ask for Bulletin 435 (1750 to 5000 pounds force) or Bulletin 425 (1000 to 2500 pounds force).

largest producer of complete systems for vibration testing

MB manufacturing company 1055 State Street New Haven 11, Conn.

A Division of Textron Inc.

MINNEAPOLIS-HONEYWELL'S gyroscope and inertial guidance facility—surrounded by a moat to minimize vibration.

ting gyroscopes and accelerometers. Manager Melvin Fedders comments "we are still growing and adding to our staff."

Sperry also has an Electronic Tube Division at Gainesville, where klystron tubes have been produced since 1955. The plant soon will hire 200 more employees, and is moving part of its operation into a new 36,000 square foot building.

Biggest of the Melbourne area firms is Radiation, Inc., which started in 1950 with two engineers, Homer Denius and George Shaw. They staked a $25,000 bankroll on the chance that a combine of telementry and data system specialists could succeed in a state which had little related activity. Today, Radiation has 710 technicians and engineers; 135,000 square feet of floor space; two aircraft landing strips; and $8 million in contracts.

• **Smallest to biggest**—At the other end of the spectrum in Florida companies is Missileonics, with three engineers brain-storming in 6,000 square feet of abandoned hangar space at Melbourne airport. Here, president James Coapman, Frank Perkins, and William Thomas have designed and developed 12 vans of doppler beat systems now in use at the Cape, and have just come up with a 28 channel pulse amplitude modulation (PAM) telemetry decommutation system.

Jobs created by missile and electronics expansion have been a big factor in helping Florida to weather the national recession. Typical comments include:

THE TELEMETRY and data processing lab of Electro-Mechanical Research, Inc.

"Our total business in the last nine months is greater than all previous work since we started in 1955," according to William Rose, general manager of Milgo Electronic Corp. in Miami. Rose called the $1.7 million in contracts now being worked by his data system firm a "Cinderella story," and said company expanison was "two years" ahead of first plans.

Ben Moss, production manager for Orlando's Systems, Inc., a research and development firm, said, "We just got through doubling our space. This addition to the building was ahead of schedule and business seems ahead of last year."

Frederick Macklin, sales manager of Communications Company in Coral Gables, said "work has increased considerably, and we're working on two new radio equipment contracts for the Coast Guard and the Navy."

From Airpax Products, components manufacturer in Ft. Lauderdale which opened a new Seminole Division plant last year, came the comment: "We're ahead of last year and the prospects are very bright."

Actually, Florida led the entire country in manufacturing employment increases during 1957, both numerically and in percentage. Only five states showed increases for the year, with 40 states showing losses and three reporting no significant change at the present time.

Employment in eight of Florida's biggest companies increased by 1,695 in April, May, and June; and three firms reported their expansion programs were ahead of schedules that were previously planned.

U.S. Department of Labor figures show that the country as a whole had a 1957 decline of 4.9% in manufacturing employment, while Florida had a 5.5% increase for the same year in manufacturing.★

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MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O

58-18

ARTICULATE AND DEDICATED to his science, Dr. Strughold can hold any audience as he discusses his latest efforts.

Space Doctor Seeks Survival Solution

by Erica Cromley

"If industry were to come up with a workable space craft, man could now survive several weeks in space. The biochemical means exist."

This assertion was made recently by Dr. Hubertus Strughold, advisor for research at the Air Force's School of Aviation Medicine (SAM), and the man mainly responsible for the biologist's lead over the engineer in efforts to put man into space.

Although the closed ecolgical system which Dr. Strughold envisages is still some years away, a two or three-week space journey today would not require anything in the way of radical equipment. Canned food, oxygen tanks, chemical carbon dioxide absorbers and chemical waste disposers would meet essential biological requirements for short-term space voyages.

The closed cabin in which Airman Donald Farrell lived for a week, and which SAM obtained in 1954 largely through Dr. Strughold's efforts, was thus equipped.

Experiments conducted by Dr. Strughold, both in wartime Berlin as head of the Aeromedical Research Institute and later when he directed SAM's Division of Space Medicine at Randolph Air Force Base, Texas, show that man can stand the stresses of the extreme acceleration and deceleration going out of and re-entering the atmosphere.

"As early as World War II, we had shown that a man could survive 15 G's for two minutes, when he was vertical to the center of gravity (in the supine position)," Dr. Strughold said. (It has been estimated man will have to endure an average of about 5 G's for about three minutes to get into space.)

As research advisor to the school commandant, Dr. Strughold plans the long-range direction of SAM's experiments. About 60% of these are aimed at human survival in space. These efforts are expected to be stepped up further with completion of SAM's new $32 million facility at Brooks Air Force Base, Texas, several miles from the present site.

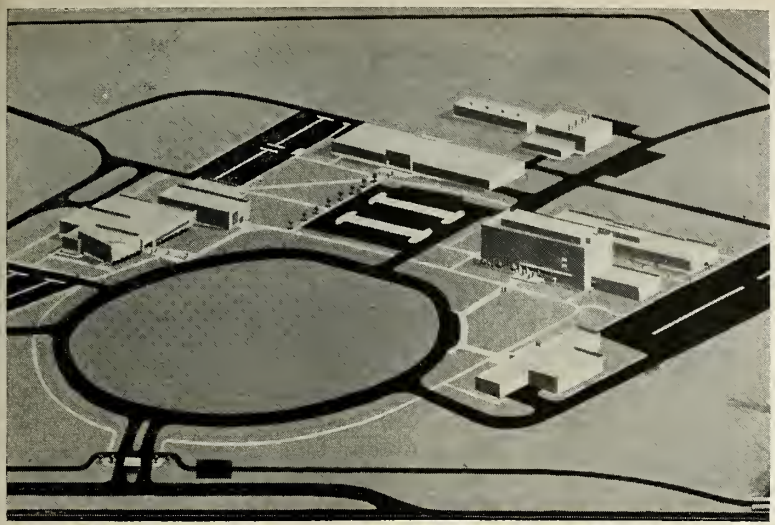
Part of the school's $3 million annual research funds will be used to perfect the closed ecological system. As a starter, Dr. Strughold had the lab technicians build a gas exchange system, in which algae produce the oxygen needed by four white mice—whose exhalations provide the carbon dioxide for the minute plants' photosynthesis.

The mice have survived for periods up to three weeks on the alga-produced oxygen, and could have continued in that atmosphere indefinitely, Dr. Strughold said. Next experiments will use urea as the alga nutrient, as a further step toward achievement of the closed system, which will make possible space trips of months and even years.

• **First space doctor**—Dr. Strughold's researches into the "how" of survival outside the atmosphere and the "what" of life on neighboring planets have paved the way for the new field of astrobiology, brought him international recognition and the first professorship of space medicine. This honor was given the 60-year-old ex-German scientist in March by the Air University, in recognition of his work in SAM's Space Medicine Division. He organized the Division in 1949 and headed it until his appointment as research advisor.

He has received so many awards—national and international—that after his acceptance of the Aero Medical Association's Theodore C. Lyster award last March—his second that month—a friend who congratulated him remarked: "Strugie, this is getting to be downright monotonous."

Recognition had been a long time coming. For many years, Strughold's work to free men from the confines



ARTIST'S CONCEPTION of the new School of Aviation Medicine, which will be located at Brooks Air Force Base, San Antonio, Texas.

of one planet met with the indifference and ridicule familiar to many pre-*Sputnik* space pioneers. However, he found this an advantage when he worked with freedom at the Berlin Aeromedical Research Institute.

• **Tapped by U.S.**—At war's end, Strughold was tapped by the Air Force for the directorship of the American Aeromedical Center at Heidelberg. "The Air Force had been greatly impressed by stories of Strughold's work and his textbook on aero-medical research," explained SAM's Commandant, Maj. Gen. Otis O. Benson, Jr.

Strughold and key members of his group who had escaped the Russian capture of Berlin undertook compilation of German wartime research. This was later published in two volumes as GERMAN AVIATION MEDICINE IN WORLD WAR II. After a thorough investigation, which cleared them of any complicity in war crimes, the group was invited in 1947 to continue their work in the U.S.

The first few years at SAM were not quite what the group had expected. They were not allowed to apply for American citizenship, they were unable to travel without difficulty, they were isolated from the community and they were employed at one pay grade below the equivalent rank of American scientists working for the government.

After taking out their first papers for U.S. citizenship, many of these specialists left the school for posts in universities and industry. Dr. Strughold, who attained citizenship in 1956, stayed with the school despite a number of attractive offers.

Actually Dr. Strughold's Americanization began in 1928, when he came to this country as a Fellow of the Rockefeller Foundation to conduct research in high altitude physiology at Western Reserve University and the University of Chicago.

"When I came back to Wuerzburg in 1929 to teach aviation medicine, my friends said I was not the same—I had become 'Amercanized'."

It was an American—Charles Lindbergh—who first aroused Strughold's interest in aviation medicine. After Lindbergh's transatlantic flight, Strughold began his altitude experiments at Wuerzberg's Physiological Institute, where he was assistant to the eminent Professor Max von Frey.

• **Scientist in action**—More often than not, Dr. Strughold is his own guinea pig. To study the effect of lowered oxygen pressure, he ascended to 12,000 feet in a balloon while recording his own physiological reactions.

Because contact lenses (more practical than glasses in flight operations) were uncomfortable, Dr. Strughold began a study of the ocular nerves. Using a blue dye which colored the nerve endings, he proved that the eye's pain receptors diminish in number from the center of the cornea out. (Lensmakers think it may be possible to construct a lens which rides between the nerve endings.) "The dye was painless," Strughold recalled, "but I went around with deep blue eyes for about two weeks."

While working on problems of weightlessness, he anesthesized his posterior to simulate the anti-gravity effect on the seated pilot. "Pilots really do fly by the seat of their pants," he concluded.

One of his main interests now is the progress of the tiny bits of life which inhabit the Mars jars in SAM's laboratories. First suggested in his book "THE RED AND GREEN PLANET," published in 1953, the experiments indicate that simple forms of life can exist in the somewhat hostile Martian environment where temperatures range from about 75°F. to –95°F.

The jars contain Martian-equivalent gases and soil from the Painted Desert. They have sustained many generations of bacteria, which draw nutriment and oxygen from their slim resources. Some microbes have survived seven months. The next step will show how moss and lichens respond to this treatment.

• **A spaceman dissected**—What kind of man is it whose universe is unlimited; who lives in a world of white mice, Mars jars, sealed space cabins, and compliant plants?

The professor-doctor is a mild-mannered man, whose reddish hair is turning gray. He speaks in a melodic German accent.

Testifying before the Senate Space Committee, Dr. Strughold replied in answer to a question of how he entered the field of space medicine: "I started with aviation medicine in 1927. Entering space medicine was nothing else but a matter of logic."

To his friends he has explained: "I studied everything for fun. When you have this attitude, you often discover things of great interest."

Dr. Strughold's day begins at 8 A.M., when he arrives at his office. He reads the morning mail and research reports, advises the lab on their problems, checks reports, consults with the Commandant, and meets with representatives of industry who are interested in setting up space medicine departments. (Martin Co. has one in the works, Ramo-Wooldridge is in the process and others are consulting with Dr. Strughold on ways and means.)

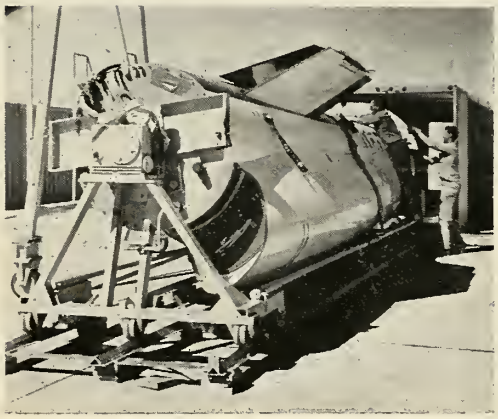
• **Science and space theories**—The Doctor's thoughts now dwell on the possibilities of plant adaptation. He has read of Russian experiments on cold-resistant plants, which show that plants which are bluish-green have the ability to absorb more heat rays than those found in temperate climates which are yellow-green. These reflect the long-wave rays which are heat carriers. "This helps regulate their temperature," Strughold pointed out.

He believes it is possible to adapt tropical plants to arctic conditions by moving them several latitudes each year and vice versa. "Life is adaptable," he says, "I don't see why not." Extension of this theory into extra-terrestrial life offers interesting possibilities.★

Packaging Missiles for Mobility

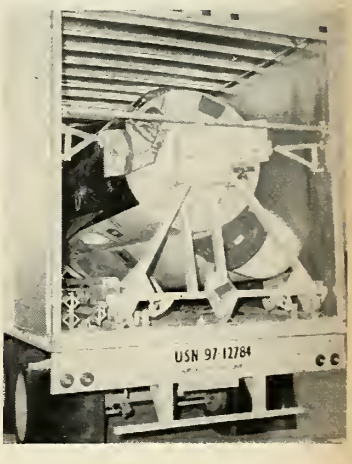
Removed from its highway transport van, the nose section is placed on a dolly for later joining with the after section. Nose boom is folded for mobility during shipment to test sites.

The missile after section is lowered into hanger trailer, and joined to forward section.



Regulus II completely unloaded from its highway transport container. The missile is shipped in a rotated position for better stowage and safety in the cargo van.

The rear section packaged and ready for shipment to site.



The Navy's *Regulus* II is one missile that is not dogged with the major logistical problem of mobility. currently plaguing other long range missile systems. This mobility is being demonstrated by transit of the *Regulus* by air and cargo van from the Chance Vought plant in Dallas, Texas, to test sites in California. (See pictures above.)

The missile is broken into two transit containers and moved to the test sites, supplementing the existing practice of flying the completed missile in C-124 Globemasters. For shipment by air, *Regulus* II is rotated about 45 degrees and, with the wings folded, is hauled into the fuselage intact.

A two-van overland shipping unit developed by Fruehauf Trailer is used to transport the missile by highway. Half of the missile goes in each of two containers which are lifted by crane onto truck trailers. Tracks for rolling the missile in and out of the containers are stowed inside each unit. As in shipment by air, *Regulus* II is rotated 45 degrees and its wings and vertical stabilizer folded for stowage.

Chance Vought developed the shipping container method of mobility several years ago for its *Regulus* I. The *Regulus* I was shipped complete in a single truck unit.

Air shipment of the *Regulus* II. With wings and vertical stabilizer folded and tail removed, the missile is rotated 45 degrees and pulled into the fuselage of an Air Force C-124.

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astrionics

by Raymond M. Nolan

With moon shots in the news these days, it's interesting to remember that the accuracies required for a successful trajectory to impact the moon need only be one-tenth those required for the design objective of *Vanguard*—initial orbital altitude of 300 miles with perigee of 200 miles and apogee of 1,400 miles.

And add this to design problems of the future: Dr. Ernst Stuhlinger of ABMA estimates that, for a proper functioning of a photonic propulsion system, photons of all the wavelengths generated in the conversion system must be reflected and collimated by a mirror with a reflectivity factor of at least 0.999999999. If the photons are created within a container, its walls must have a transmissivity of the same order of magnitude. With anything lower, the mirrors and walls would vaporize from the absorption of energy.

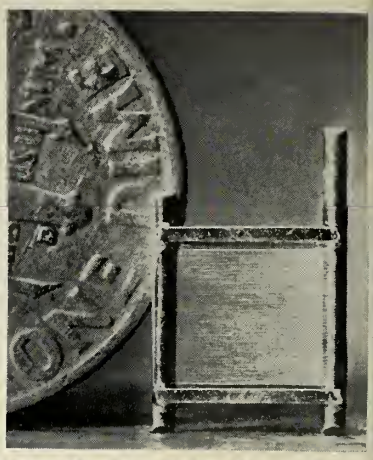
A further advance in inertial guidance seems to be on the threshold of laboratory operation. The electronics division of a large manufacturer claims to have a system which will operate without gyros or gyroscopic accelerometers. Its said to work on the compressibility of fluids.

Newest step forward in micro-miniaturization of electronic modules will probably come from Diamond Ordnance Fuze Laboratories. DOFL's "2D" approach, a two dimensional module with the third, or thickness dimension, as thin as possible, has already resulted in spectacular size reductions. One binary counter module occupies less than 1/150th of a cubic inch. Some of the techniques involved are caseless semi-conductors and scaled-down printed components. One future application reportedly is the Arma *Titan* and *Atlas* guidance and control system. Modules would be mounted on a circular board with a new type of delay line running around the periphery. Some average component sizes: 10K ohm resistor, 60 mils square, 1 mil thick; 0.01 ufd capacitor, 0.1 in. square by 8 mils thick.

Dr. Marcel Golay of Philco's Research Division coins the word "gystat" for the electrostatic gyros under development by the Control Systems Laboratory of the University of Illinois, Minneapolis-Honeywell, and General Electric, among others. The gystat uses a nearly spherical rotor suspended by pairs of supporting electrodes. Additional electrodes form capacitances with the rotor, and are used to sense the three position coordinates and the two orientation coordinates of the rotor. Two shallow zones are cut in the rotor to fix their axis as the one about which the rotor rotates stably, and to provide for differential capacitance changes as the axis of the rotor tilts.

Look for an announcement soon of the decision by a defense manufacturer to produce the wire-guided English Type 891 missile now being manufactured by Vickers Armstrong Ltd. The 891 is an anti-tank missile which is transported under the arm of its one-man crew and launched from the container. Because of rumored difficulties with the anti-tank *Dart*, the 891 might find a ready market until the *Dart* becomes reliable and operational.

A unique "hands-off" partnership is being practiced between the Naval Ordnance Laboratory and Goodyear Aircraft in the *Subroc* program. In areas where either the contractor or the service agency has a decided design advantage, the other partner does not attempt further development on its own. For instance, NOL expects to incorporate a number of new twists already uncovered in the *Polaris* program—Goodyear will accept NOL's design philosophy and attempt no work of its own in these areas except to convert concepts to hardware.



Grid-Frame Tube Seen As Major Electronic Advance

The frame grid tube, a recent significant advance in tube design, is now being mass produced by Amperex Electronic Corp., Hicksville, L.I.

The frame grid construction makes it possible to use extremely fine wire for the grid and achieve the closest approximation now practical to the physicist's "ideal" grid.

This ideal is an infinitely thin conducting plane which offers no resistance to the passage of electrons, except those due to its electrostatic potential. The frame grid construction also results in vastly increased gain-bandwidth product, transconductance and insensitivity to microphonics—all of which make feasible the design and manufacture of more compact and reliable tubes.

What the frame grid is and does may best be understood by comparing it with a conventional grid. In conventional grid construction, molybdenum grid wire is wound helically around two metal supporting rods in which grooves are cut to hold the grid wire in place; the grooves being closed under pressure after the winding is completed.

In this type of construction the grid wire performs both a mechanical and an electronic function. It physically supports the metal rods, and together with two mica spacers, holds them apart at the correct distance. However, this "correct" distance is difficult to maintain because the mica spacers cannot be manufactured to sufficiently close tolerances and the wires, being under tension during the manufacturing process, deform somewhat when released.

• **Construction**—In frame grid construction, the grid wires have only an

electronic function, the mechanical being fulfilled by a sturdy self-supporting frame consisting of two molybdenum centerless ground rods connected by four spot-welded molybdenum strips.

The rods, which can be manufactured to within a tolerance of 0.005 millimeters, determine the clearance between the turns of wire on opposite sides of the frame. This clearance and its accuracy largely determines the grid-cathode spacing, which in turn determines gain-bandwidth product and transconductance.

Very thin tungsten wire, 0.0075 millimeters in diameter, is tightly wound around the frame. The winding tension is about 60% of the tensile strength of the wire. This high tension makes is possible to position the grid wires more accurately and have them maintain their position throughout the life of the tube.

There are several reasons why the frame grid improves performance and reliability. In a vacuum tube, the grid-to-cathode spacing is of prime importance in determining the gain-bandwidth product; the closer the spacing, the higher the product. With the frame grid construction, grid-to-cathode spacing can be reduced to 0.05 millimeters, resulting in a doubling of the gain-bandwith.

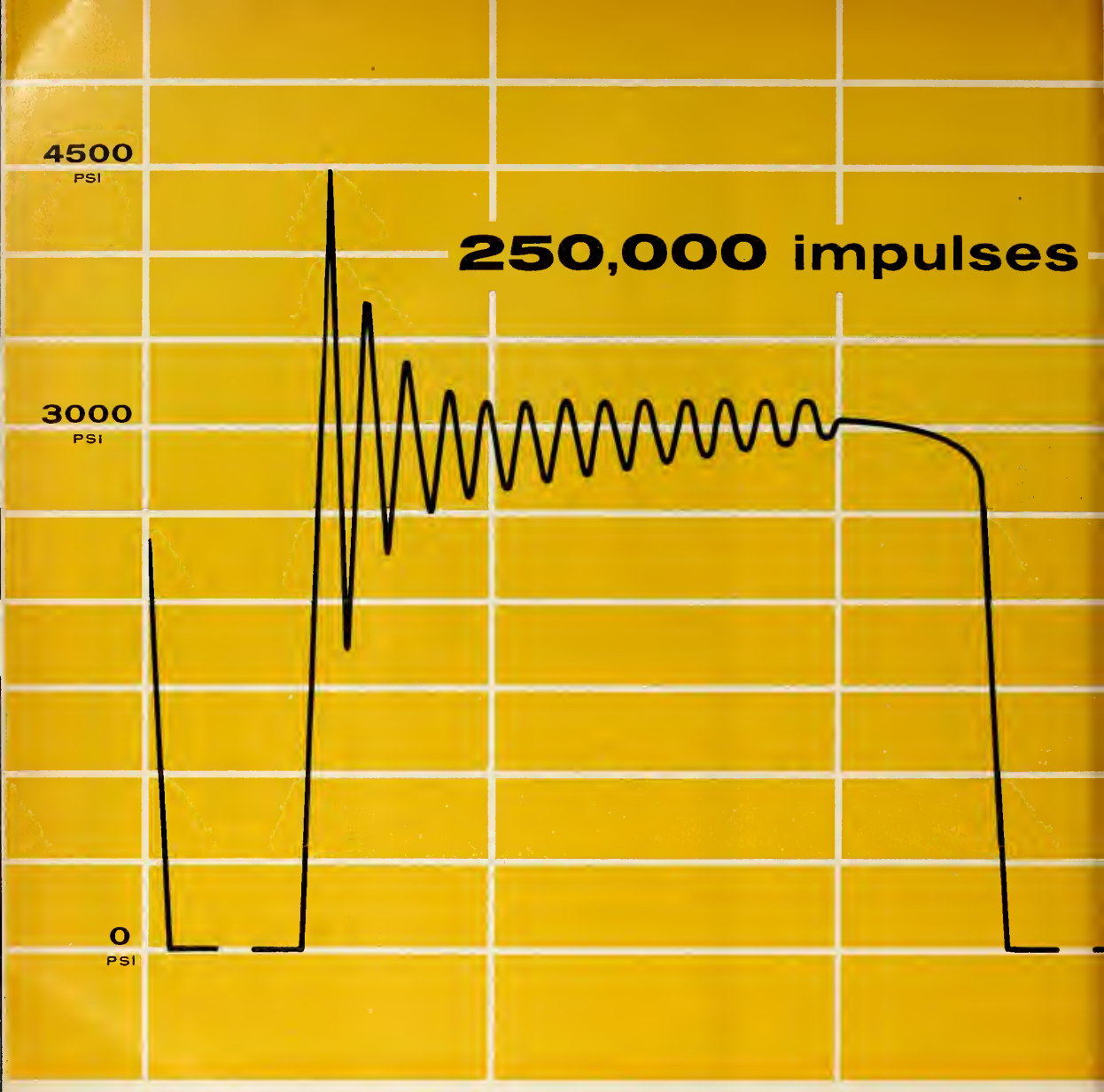
Another factor increasing the efficiency of frame grid tubes is the excellent heat dissipation properties of the frame grid structure. The relatively large mass of the frame structure dissipates heat faster than a conventional grid.

The frame grid construction also achieves greater reliability because there is less spread in characteristics before and during use. Variations during manufacturing are at a minimum, because the frame grid structure is such that accurate automatic tooling can be used to produce the high degree of conformity necessary for consistent electrical characteristics. The rigidity of the frame grid structure also makes the tube insensitive to microphonics.

Instrument Behavior Study Under High Speeds

The behavior of instruments for measuring and controlling the flight and re-entry of aircraft, space vehicles, and missiles at hypersonic speeds and at extremely high altitudes is one of the problems currently under study by NACA's Lewis Flight Propulsion Laboratory in Cleveland, Ohio.

To study and analyze instrument behavior under these conditions, Lewis



Resistoflex Corporation announces new 250,000-cycle impulse test standards—for 3000 psi Fluoroflex®-T (Teflon®) hose for hydraulic service at 400° F. These Resistoflex standards replace usual industry standards of 100,000 cycles. Reports of completed tests available on request.

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FPL built a special wind tunnel capable of simulating flight speeds in the range from Mach 2 (twice the speed of sound) up to Mach 8, and altitudes on the order of 75 miles.

Experimental designs of air-speed probes and devices for pressure, temperature, velocity, and altitude determination are placed in this tunnel, where their performance under simulated hypersonic flight conditions can be carefully observed.

Performance requirements of this new wind tunnel called for a pumping system of very large volumetric capacity, capable of meeting a specified speed curve over a range of pressures from .05 to 200 microns, and with a maximum air-flow rate of about 44,000 c.f.m. at a pressure of 3 microns.

To meet these requirements, engineers of Lewis FPL selected a specially-designed Stokes high vacuum pumping system, consisting of five 16-inch "Ring-Jet" oil-vapor type booster pumps, with associated valves and fittings. A Stokes (graphic) panel, with schematic representation of all controls, was also supplied.

TI Opens Sales Office In San Francisco Area

Texas Instruments Inc. has recently opened a new sales office for its Semiconductor-Components division in Palo Alto. California.

The office will enable TI to serve its customers better in the expanding San Francisco bay area electronics market. This is the fourth TI office located in the Western states, with regional headquarters in Los Angeles.

The Palo Alto office will be managed by George Pantaze, who has been engaged in a marketing capacity with the TI Semiconductor-Components division in the Western region for two years. His territory includes northern California and Nevada.

Topp Develops Two New Missile Flight Devices

Based on the principle of measured radioactivity, two new missile flight test devices have been developed by Topp Mfg. Co., a division of Topp Industries, Inc.

The first unit, a missile distance indicator (MDI), consists of two basic components—a gamma ray radioactive source and a radiation detector.

The radioactive source, for placement in the missile, is contained in a small screw weighing less than one ounce. The detector, installed in a target drone, counts the amount of radio-

activity in the drone as it rises to a maximum with the missile's approach and then decreases as the missile leaves the target area. The maximum value of the counting rate is then a measure of the distance between the missile and the target.

A feature of the system is that the detector output can be recorded internally in the target for later recovery, or it may be telemetered to a ground station. Output may also be used to actuate a triggering device in a go-no-go system to fire a smoke bomb, flare or other signaling device if the missile passes within a predetermined range.

The radioactive source aids in missile recovery when conventional portable scintillometer equipment is installed in a search plane. It is possible to locate impact sites within one-quarter mile of the radiation source. But, if the missile is buried in the earth upon impact, the source location is then obtained by hand-carrying detection equipment to the site.

Recovery of the radioactive source permits re-use during its entire half-life. Source material may be varied in composition and activation for control of miss distance, operating range, and useful life. Depending upon the application, such materials as cobalt 57, cobalt 60, gold 197, gold 198 and iron 26 may be used. Half-life may be from a few seconds to many years.

Gamma rays from the source material will not effect electronic or mechanical equipment in the missile, nor induce radioactivity in surrounding materials, the company says. Source operation is not effected by heat, acceleration forces, vibrations or low atmospheric pressures.

The scintillation-type detector has a completely transistorized power supply and pulse shaping network. If a battery pack is used, the unit has a life of 10 hours and weighs six lbs. If missile power is used, the 7½-in.-long and 4-in-diameter detector package is reduced to three lbs. Any 28-volt D.X. source may be used with the detector's built-in converter. Temperature ranges for detector operation are from —40°F to 150°F.

The system has an adjustable operational range of miss distances from 2 to 300 feet for relative speeds between the target and missile of Mach 0.5 to Mach 3.0.

Topp's second device for missiles is a 1-lb. material erosion rate instrument (MERI) for installation in a missile nose-cone. The device is designed for continuous telemetry of material erosion rate data back to ground stations.

The basic unit measures 1-3/8"x3-3/8"x5", and may be installed in the instrumentation compartment with a detector probe mounted next to the inside surface of the missile skin. An activated plug is fitted on the outer skin, at the probe's location, and is impregnated with a radioactive tracer element.

When skin material erodes, radioactive emanation from the wall section decreases. Measurement of the radiation level provides direct measurement of skin thickness to determine the erosion rate.

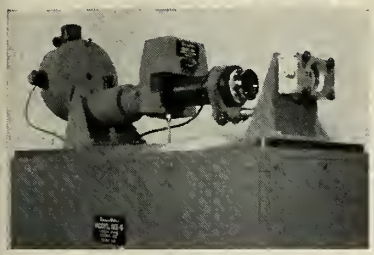
As with the miss distance indicator, the unit can be used with various radioactive materials and a variety of source strengths.

Indian Head Delivers *Talos* Missile Boosters

The Naval Powder Factory at Indian Head, Maryland, has started delivery of rocket boosters for the *Talos* missile, according to Captain G. T. Atkins, USN, Commanding Officer.

This solid propellant rocket, which provides take-off power for *Talos*, is one of the largest solid propellant units in production. It was designed by Allegheny Ballistics Laboratory, operated by Hercules Powder Company, under the direction of the Navy Bureau of Ordnance.

Research Tool Developed For Photo-Instrument Use



A new research tool for the photo-instrumentation study of self-luminous transient events has been announced by Beckman & Whitley, Inc. The new Model 194 Continuous-Writing Streak Camera produces a documentation designating a plot of space in one direction versus time in a 90-degree direction.

The instrument mounts on its own base and control housing. Standard 35-mm film, arranged for daylight loading and unloading, is used. The image is swept on this film by a rotating triangular mirror driven by a high-speed turbine. Several types of these drives are available. The fastest—ranging from 200 to 5500 revolutions per second—is driven by helium gas.

This arrangement produces a maximum writing rate of approximately 8 millimeters per microsecond, a total writing time at top speed of 58 microseconds, and a maximum time resolution, using a 0.004-in. wide slit image and film having a resolution of 75 lines per millimeter, of 2.5 x 10^{-8}.

Circle No. 239 on Subscriber Service Card.

Cartridge Actuated Cutters Slice Cables Safely

Due to high speed, lightweight cartridge actuated cable cutters are now available that can sever current-carrying cables in a highly explosive atmosphere without hazard.

According to Pitman-Dunn Laboratories, a division of Frankford Arsenal, the 1¼ pound, 5 7/8" cartridge actuated device will cut a ¾" diameter bundle of cables in 4/1000 of a second. The cable cutter is triggered by application of a pulse of high pressure gas from an initiator in the system. A portion of the body is threaded and fitted with two locknuts, to permit mounting the cable cutter in a bulkhead. The yoke portion of the cutter swivels in the body of the device, to permit rotation of the yoke to suit the lay of the cable.

Circle No. 225 on Subscriber Service Card.

Gaseal Permits Access To Sealed Equipment

Gaseal, a new, re-usable, leak-tight seal permitting easy access to and resealing of hermetically sealed equipment, is now available from General Hermetic Sealing Corp. Made of seamless, thin-wall metal tubing internally pressurized at 1000 psi, the resilient Gaseal protects systems, subsystems and components from gases and liquids over a wide range of temperatures and under extreme environmental conditions.

Faster service and maintenance of equipment are possible since they may be taken apart and resealed many times, using the same Gaseal. Opening and resealing can be done in less time than required for solder-sealed devices. No heat, special tools or special skills are needed to install or service units.

Circle No. 226 on Subscriber Service Card.

letters

Credit for MMPR Forms

To the Editor:

We are writing in reference to the article entitled "U.S. Readies Missile Makers' Planning Forms" (m/r, August 4, p. 12).

We would like to bring to your attention the fact that these forms were not developed solely by Stanford Research Institute. Chronologically speaking, we came in at the tail end of their development, about a year ago—subsequent to at least three and a half years of effort by the three services.

About a year ago, our contracting officer in the Industrial Division of what is now ARGMA was appointed as the Army's representative to the Joint Services Committee working on these missile manufacturer's forms. At this point, the scope of our already existing contract with ARGMA was broadened to include support work for the Army's representative on this committee.

Thus, to correct the statement on page 13, the MMPR forms were developed by the three services, with support from Stanford Research Institute's Economics Division in the latter stages, under a contract with ARGMA's Industrial Division.

Paul Foreman
Operations Analyst
Stanford Research Institute
Washington, D.C.

Everyone concerned is given due credit—Ed.

Encyclopedia Reprints Due

To the Editor:

. . . We wish to have 250 copies . . . which we will distribute to Air Force units for training purposes.

Lt. Col. R. C. Freeman, USAF
Chief, Plans & Development Div.
Directorate of Airmunitions
Ogden Air Materiel Area, Utah

To the Editor:

Your "Guided Missile Encyclopedia" (m/r, July 28) is extremely comprehensive and contains a wealth of information. Congratulations on an excellent job. I hope you will be able to consider our request for twenty-five copies.

Bernard C. Victory
Advertising Manager
Craig Systems, Inc.
Lawrence, Massachusetts

To the Editor:

The encyclopedia . . . is the best thing I've seen on the subject and a perfect educational piece for a newcomer, like ourselves, to the market. We would like reprints . . . to route throughout our organization.

R. G. Gamble
Advertising Planner
Cummins Engine Co., Inc.
Columbus, Indiana

To the Editor:

It is our intention to order 15[illegible] copies of the reprint of the "Guided Missile Encyclopedia" . . .

F. E. Fitzgerald
Chief Librarian
The National War College
Washington, D.C.

To the Editor:

We used the "Guided Missile Encyclopedia" from last year's issue with great benefit . . . we think you have done a wonderful job on what you have been able to get together for this year.

S. H. McAloney
Director, Public Relations
Ford Instrument Co.,
Div. of Sperry Rand Corp.
Long Island City, N.Y.

To the Editor:

The "Guided Missile Encyclopedia" was extremely interesting and is very

NEW limit switchless actuators

Reduce weight and cost 25% below conventional design

A reduction in actuator cost and weight up to 25 per cent, with similar maintenance savings, has been achieved through the advance design of AiResearch electro-mechanical Limit Switchless Actuators for aircraft and missiles.

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Limit switches are eliminated by two methods: 1) use of continuous stall high temperature motors, 2) use of high temperature motors with thermal protectors which permit maximum *on* time in the duty cycle.

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B *Seat Actuator, LOCKHEED F-104*
C *Rotor Blade Trim Actuator*
D *Elevator Actuator, TEMCO XKDT-1 Target*
E *2-Motor Trim Actuator, REPUBLIC F-105*
F *General Purpose Linear Actuator*
G *Dual Purpose Feel Trim Actuator, AVRO CF-105*
H *Rudder Trim, AVRO CF-105*
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closely related to our business. This information would prove to be very excellent reference material in our Engineering Department and would also serve to familiarize our junior engineers with the current missile families . . .

L. M. Bachman
Project Supervisor
Thiokol Chemical Corp.,
Reaction Motors Div.

The demand for copies of the Encyclopedia has been so great that we are now preparing a complete reprint . . . which will be ready for distribution at the cost of $1.00 per copy. Any requests for reprints should go to Lawrence Brettner, Circulation Director—Ed.

World Astronautics?

To the Editor:

Congratulations to m/r on becoming a weekly.

I always enjoy reading your magazine and find it a mine of information. I wish, however, that you could find space for news of activity outside America, for although only a limited amount of hardware is actually constructed in other countries, it is quite impossible for the U.S. to cover the whole field of spaceflight. There are many avenues which can and should be explored in other countries.

We in the United Kingdom have long advocated that our country should undertake a spaceflight program in those fields where we could make a useful contribution, and where a dovetailing of activity with the American program would yield mutual benefits.

There is now a strong possibility that the United Kingdom will enter the spaceflight field, even at this late date —with many sidelong glances at its overall financial position. In point of fact, the resources available with the inclusion of Commonwealth scientists are very great, and a significant contribution could be made if official quarters were influenced in this direction.

At a recent Youth Conference, H.R.H. Duke of Edinburgh said, "I personally cannot believe that the British people or the people of the Commonwealth will be content to sit by and watch others explore the Universe around us".

Certainly, the occasion will be unique if, at a time when new and exciting frontiers are opening up for mankind, our country chooses to remain aloof from a job of exploration.

L. J. Carter, Secretary
British Interplanetary Soc.

We anticipated Mr. Carter's letter in m/r, August 18 (p. 33) in an article entitled "Britain, Red China Enter Satellite Race." We mentioned the fact that increasing reports are circulating concerning the possibility of the Red Chinese launching artificial earth satellites. For this reason, The British Interplanetary Society is strongly pressing for establishment of a British space flight program, to offset the propaganda onslaught which would result. British government sources have confirmed hopes of using large powerplants as satellite-launching vehicles—Ed.

We Erred

To the Editor:

In "New Missile Products" (m/r, May, p. 86), appears a product release with a picture from the Aero Research Instrument Co. In the last sentence of the release, it is stated that "the missile use has been at altitudes of at least 2 x 10 feet, and has survived entry." This quote is incorrect, of course.

The addition of the superscript number "5" behind "10" makes a considerable difference.

L. Scadrom
Aero Research Instrument Co.
Chicago, Ill.

We stand corrected—Ed.

contract awards

LAST MINUTE AWARDS

System Development Corp. got an AMC contract of $29.8 million in connection with Air Defense Command's SAGE computer program.

Metal Products Division of Kippers Co., Inc. was awarded a contract from North American Aviation's Missile Division for design and construction of seven portable silencers for use in testing the GAM-77 Hound Dog.

McDonnell Aircraft received a $5.8 million AF order for production of GAM-72 Quail missile, bringing total Quail money so far to $41.3 million.

Four Wheel Co. received $1.5 million for trans-launcher bogies, part of the Mace missile system.

NAVY

By Bureau of Ships:

Celanese Corp. of America, New York, N.Y. received $65,519 for fluid, hydraulic power transmission safety type.

Anaconda Wire and Cable Co., Hastings-on-Hudson, N.Y., received $73,500 for developing an ultra-high temperature magnet wire suitable for continuous service with repeated cycling within temperature range.

Allen B. DuMont Laboratories, Inc. of Clifton, N.J. received $800,000 for design and development of a special short wavelength radar set.

By Officer in charge of construction, Budocks Contracts, San Francisco:

S. G. Limuaco & Co., Inc., received $63,950 for construction of storage, base rocket assembly.

By Bureau of Ordnance:

Ford Instrument Co., division of Sperry Rand, received $7.4 million for the production of computers for the Tartar missile.

AIR FORCE

By HQ AFOSR, ARDC:

Polytechnic Inst. of Brooklyn, Brooklyn, N.Y. received $90,000 for continuation of research on "three-dimensional supersonic and hypersonic flow problems."

Brown University, Providence, R.I. received $55,600 for research on radiation effects in solids.

University of Maryland, College Park, Md., received $25,725 for continuation of research in micro-wave magnetic spectroscopy of free atoms and free radicals.

Purdue Research Foundation, Lafayette, Ind., received $41,920 for continuation of study of nuclear structure and interactions.

University of Utah received $102,192 for research on "high velocity impact studies."

University of Maryland, College Park, Md., received $62,750 for continuation of research in solid state theory.

University of Minnesota, Minneapolis, received $59,950 for continuation of research on experimental and theoretical research of honey-comb sandwich structures.

Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y. received $125,876 for continuation of research on hypersonic flow by means of the shock tunnel.

University of Minnesota received $116,859 for continuation of research on theoretical and experimental studies of mass transfer cooling.

By HQ, Cambridge Research Center, ARDC:

University of New Hampshire received $75,000 for research directed toward experimental determinations of ionospheric characteristics using satellite radio transmission.

ARMY

By Engineer District, Los Angeles, Corps of Engineers:

Utah Construction Co. Paul Hardeman, Inc., and Manhattan Construction Co. of Oklahoma, San Francisco, Calif. received $5,985,231 for launch complex 65-2 at Cooke AFB.

Price-McNemar Construction Co., Van Nuys, Calif. received $213,500 for Nike improvement program part C at special AAA sites in Los Angeles and Orange Counties, California.

By New York Ordnance District:

Pioneer Chemical Co., Inc., Long Island City, N.Y., received $64,080 for starting mixture, guided missile.

By Los Angeles Ordnance District:

Firestone Tire & Rubber Co. received $2,423,653 for surface-to-surface guided missile.

Douglas Aircraft Co., Inc., Santa Monica, Calif. received $113,225 for launching area items, and also $28,631 for blue streak and emergency repair parts for the Nike system.

North American Aviation, Inc., Canoga Park, Calif., received 2 contracts totaling $180,000 for rocket engines.

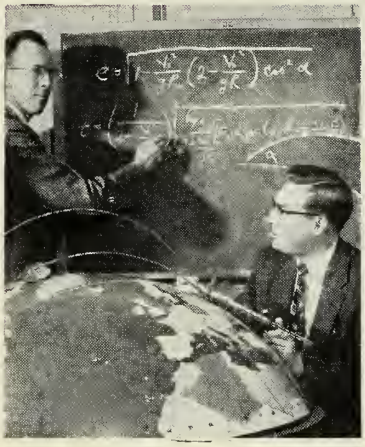
General Electric Co., Phoenix, Arizona, received $149,285 for digital computation facility operation.

By Corps of Engineers, Omaha District:

George A. Fuller Co., Los Angeles, Calif. received $11,762,420 for construction of launch facilities and utilities.

MISSILE DETECTION SYSTEMS SECTION OF GENERAL ELECTRIC AUGMENTING SYSTEMS MANAGEMENT GROUP

Responsible for Development and Design of Long-Range Detection Systems



As far back as 1950, G-E engineers and scientists began to investigate ballistic missile detection problems. This study program was part of the long-term investment in electronics research undertaken by General Electric... *an investment that is a major factor in the selection of G. E. for such contracts as the $100,000,000 plus responsibility for high-power, long-range surveillance radar... BMEWS.*

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An indication of the way research and development at Republic spans practically the entire field of engineering and scientific endeavor is this partial list of current programs: investigations in magnetohydrodynamics, exotic structural materials, nuclear applications to flight... development of new concepts in hypersonic aircraft, re-entry configurations... new procedures and instrumentation to flight-test missiles, aircraft, satellites and space vehicles.

HOW CAN HEAT TREATMENT BOOST STRENGTH OF MOLYBDENUM ALLOY?

One answer is suggested by this 10,000 X electron micrograph showing precipitated low-temperature-stable phase finely dispersed in matrix material. Grown from atomic size by heat treatment, precipitate induces lattice strains in matrix, imparting high strength properties.

▶ RESEARCH

FLUID DYNAMICS OF ORBITAL SPEEDS IN RAREFIED ATMOSPHERE—AE who can conduct basic research and translate results into practical applications to hypervelocities of upper atmosphere flight. Strong background in aeronautical R&D with theoretical base essential. Advanced degree preferred.

PRELIMINARY DESIGN FOR MISSILE & SPACE PROJECTS—AE with background in 2 or more of these areas: propulsion, aerodynamics, stability & control, trajectory calculation, wind tunnel testing. *Must be able to perform Parametric Studies.* Advanced degree preferred.

OPTICAL & INFRARED TECHNIQUES—as applied to reconnaissance systems development, MS, Physics.

OPERATIONAL ANALYSIS, RECONNAISSANCE & DETECTION SYSTEMS—Experience needed in aircraft or missile technology in electronics, or vehicle performance, or armament, or structures, or applied math. MS in engineering, physics or math.

▶ FLIGHT TEST

ANALYSIS—Power plant performance; stability & control characteristics; other flight test data. AE or ME, 3-7 years relative experience.

DATA REDUCTION—BS or equivalent experience oscillographic data reduction & semi-automatic data reducing equipment.

INSTRUMENTATION—Planning & arranging installation of such systems as: FT photopanel, oscillographic, T/M & magnetic tape recording. Sr Engineer, EE (3-5 years relative experience); Jr Engineer, EE or applied electronic-physics.

ELECTRONIC SYSTEMS—Planning & directing specific FT projects. EE's—3 to 5 years in A/C systems. AE's familiar A/C plus 3-5 years flight test experience. Some Jr EE positions.

DESIGN—EE's or equivalent with 7-10 years wiring design experience. AE able to design instrumentation installations. Familiar with optics, mechanics, high speed photography.

FLIGHT TEST ASSIGNMENT PROGRAMMING—(Also test evaluation; liaison) AE or EE with 3-5 years A/C systems experience. Able to coordinate overall flight test results. Pilot experience desirable but not essential.

AE or ME with 3-5 years flight test experience. Familiar with instrumentation, data analysis, system testing & mission planning.

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FLUTTER & VIBRATION—Determination of flutter and dynamic loads for high-speed aircraft. Design and testing of flutter models. Positions at different levels. MS-Engineering, Math or Physics with minimum of 8 years experience. BS-Minimum 6 years experience in flutter and dynamic loads.

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ANALOG COMPUTATION—Computation work and the analysis of systems for diversity of upper atmosphere applications. MS or PhD in Physics or Applied Mathematics or Engineering. Minimum 2 years analog experience.

DIGITAL COMPUTER PROGRAMMING—Design and develop Management Control Systems for solution on IBM 704. Program engineering problems involved in aircraft, missile and space vehicle projects. System analysts and programmers. Minimum 2 years programming experience on IBM 704 Computer.

DYNAMICS ANALYSIS—Analysis of radar and guidance systems, servos, analog computers and related areas. Supervisor: EE with 3-5 years experience (Electrical or Electronic).

Also openings for Senior, Principal and Group Engineers. EE's with 2 to 3 years experience.

SYSTEMS ANALYSIS—Analysis of electro-mechanical, electro-hydraulic and mechanical systems for aircraft and missiles. Positions at different levels. ME's with 3-5 years experience.

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Mr. J. M. Murray
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Detroit 31, Michigan

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To guide a Research and Development group in the design and application of electronic gathering and reduction systems. Required: B.S. or M.S. in E.E., plus 5 years electronics experience in telemeter applications of flight test instrumentation data.

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To design various active and self-contained missile guidance systems, and to design and develop radar beacons. Required: E.E., or Physics Degree, plus 2 or more years experience.

Current Vought hardware includes the F8U jet fighter series and the Regulus guided missiles. Among projects under way are Dyna Soar, ASW studies, spacecraft, other advanced weapons programs. To investigate the key openings described above, qualified engineers are invited to write to C. A. Besio, Supervisor, Engineering Personnel, Dept. P-9.

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H PRESSURE GAS PUMP. A new pressure liquified gas pump, which sures only 36 inches overall, but luces pressures up to 10,000 psi flows to 10 gpm, has been deped. The pump is said to be ideally d for trailer mounted oxygen or gen recharges, booster stations, or ade systems. In its portable conration it weighs 400 pounds. Dyic Research Inc.

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VO MOTOR. As a basic actuating ce for AC automatic control and inmentation systems, the Motordyne 1034 subminiature servo motor has rsable operations, high torque-toia ratio, outstanding dynamic reise, and dependable operation for cision airborne applications. Motore, Inc.

le No. 229 on Subscriber Service Card.

GNETIC CLUTCHES. A line of minre magnetic clutches specially de-ed for military or commercial con- applications has been announced. ignated as Series 1500, these clutches available in double-ended models with servo or flange type mount- surfaces. MagneTec Corp.

le No. 230 on Subscriber Service Card.

CELEROMETER. Friction is said to eliminated in a new A-C linear acrometer, assuring low threshold and standing reliability. Designated the neywell, Type LA-600, the unit con- of a non-pendulous seismic mass pported on a frictionless spring sus-sion, and incorporates an a-c varie reluctance type pick-off. Minneapo-Honeywell Co.

cle No. 231 on Subscriber Service Card.

NG LIFE PERFORMANCE. A subniature ceramic capacitor, said to e high reliability over a broad temrature range, and a microminiature y design for maximum vibration and ck resistance, have been announced. ecomputing Corporation.

cle No. 232 on Subscriber Service Card.

SIGNAL TRANSFORMER. A miniature toroidal signal transformer for low-level applications where the user requires high impedance, low phase shift, and minimum pickup, is now available. Arnold Magnetics Corp.

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THERMAL-INDICATOR. The indicator provides a rapid and direct means for accurately measuring temperature. The meter is calibrated in degrees C, and gives a direct reading of the temperature sensed by the Thermal-ribbon. Minco Products, Inc.

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SWITCHING TRANSISTORS. A new line of germanium high frequency transistors has been announced. To be marketed under EIA numbers 2N425, 2N426, 2N427, and 2N428, the new product line features the standard TO-9 package, and is designed to meet or exceed the electrical and mechanical requirements of MIL-T-19500A. Semiconductors Products Division, Motorola, Inc.

Circle No. 235 on Subscriber Service Card.

ACID VALVE. A type of valve designed for use with helium and Jp-4 fuel vapor in an atmosphere of inhibited red fuming nitric acid, has been placed on the market. The solenoid operated shut-off valve is leak-proof and operates at a maximum of 1 amp. and 28 volts DC. Randall Engineering Corp.

Circle No. 236 on Subscriber Service Card.

POTENTIOMETER. A new rectilinear potentiometer said to meet environmental specifications of MIL-R-19, has been announced. The compact trimming resistor measures only 1¼" in length. DeJur-Amsco Corp.

Circle No. 237 on Subscriber Service Card.

CORE WINDER. This newly-developed semi automatic machine winds transformer cores in completely variable lengths, to a maximum of 10" in multiples of three. George Stevens Mfg. Co., Inc.

Circle No. 238 on Subscriber Service Card.

MISSILES AND ROCKETS

AUGUST 25, 1958

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MISSILE LITERATURE

LIQUATITE DATA. How and where Electri-Flex Liquatite—the liquid tight flexible wiring conduit—protects important wiring circuits from oil, chemicals, water, corrosive fumes and vapors, grease, dirt, salt air and spray, coolants, abrasives, etc., is described in a new two-page data and specification sheet.
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BLIND RIVETS. An eight-page catalogue shows typical design applications of Defco-Seal Blind Rivets, and a three-page evaluation report on these new, positive-sealing fasteners. Catalogue includes application notes, specifications and driving sequence instructions on the rivet, which is designed for application where positive sealing is required.
Circle No. 201 on Subscriber Service Card.

PRECISION STAMPED GEAR. The Fastex Division of Illinois Tool Works has published a 20-page booklet illustrating typical examples of precision stamped gears and listing major applications, size limits, materials and finishes.
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GAUGE SAVER. Automatic shut-off valves for overload protection of gauges and instruments in hydraulic and pneumatic systems are described in a sheet issued by the Sprague Engineering Corp. Six models offer pressure ranges from 10 to 10,000 psi.
Circle No. 203 on Subscriber Service Card.

COMPUTER DESIGN. New design techniques to accomplish substantial savings throughout engineering development programs for electronic digital computers are described in a booklet published by Control Data Corporation, Minneapolis computer and control firm.
Circle No. 204 on Subscriber Service Card.

ELECTRONIC RESEARCH. Andersen Laboratories, Inc. has issued a four-page bulletin describing its facilities for research, design and manufacture of specialized high quality ultrasonic solid delay lines.
Circle No. 205 on Subscriber Service Card.

TEST INSTRUMENTATION. A new bulletin, W1831, has been released by the Bristol Company as a guide for equipment builders and specifying engineers, outlining Bristol indicating, recording, programming, and controlling instruments for environmental test equipment.
Circle No. 206 on Subscriber Service Card.

SELF-SEALING FASTENERS. A four-page, two-color folder, available from Automatic and Precision Manufacturing Co., describes and illustrates a line of high-pressure self-sealing Seelskrews, Seelbolts and Seelrivits (all registered tradenames) for industrial and military use. The fasteners are said to seal out dust fumes and moisture and wera signed for vibration resistance in cri sealing applications.
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STABILIZED SERVOMECHANISM. importance of gain variations, which the only parameters over which the signer has control long after the res the system design has been frozen illustrated in a booklet issued by Servo Corporation of America. A gra ical representation of the effects of changes at various points in an ou rate stabilized servomechanism is vided in Paper CP-58-13.
Circle No. 208 on Subscriber Service C

POROUS METAL BEARINGS. The b chure presents detailed information DU, U.S. Gasket Company's high-p formance, self-lubricated bearing ma rial. It describes the advantages of new T.F.E. fluorocarbon resin, lead, ous bronze, steel composite, in typica well as unusual bearing applications.
Circle No. 209 on Subscriber Service C

RELAYS. Universal Relay Corporat has issued a new 16-page illustra folder featuring a wide assortment relays, steppers, solenoids, rectifiers related components. Items shown carried in stock in production quantit
Circle No. 210 on Subscriber Service C

PRODUCTION FACILITIES. New il trated 12-page brochure published The M. W. Kellogg Company contain complete listing of the company's p duction facilities for missile and roc programs. It describes in detail extens machining and fabricating shops other equipment and experienca the company offers.
Circle No. 211 on Subscriber Service C

BLAST-ETCH MARKING. Recently co pleted bulletins 146-C25 and 146-C describe Matthews complete line "Airgrit" Blast-Etch Marking Machin from standard stationary models to p able and inspection type units.
Circle No. 212 on Subscriber Service C

THERMISTOR PROBES. Nine speci designed thermistor probe assemb are described in detail in a naw fo page brochure issued by Fenwal El tronics, Inc. Each assembly is identif by its most common application, has complete dimensions and mount arrangements.
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BALL SELECTOR CHART. The Hartf Steel Ball Co. has prepared a ha chart showing the relative corrosion sistance properties of various ball ma rials under extreme conditions of te perature and varied chemical exposu
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