AUGUST 18, 1958

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

News and Business Edition

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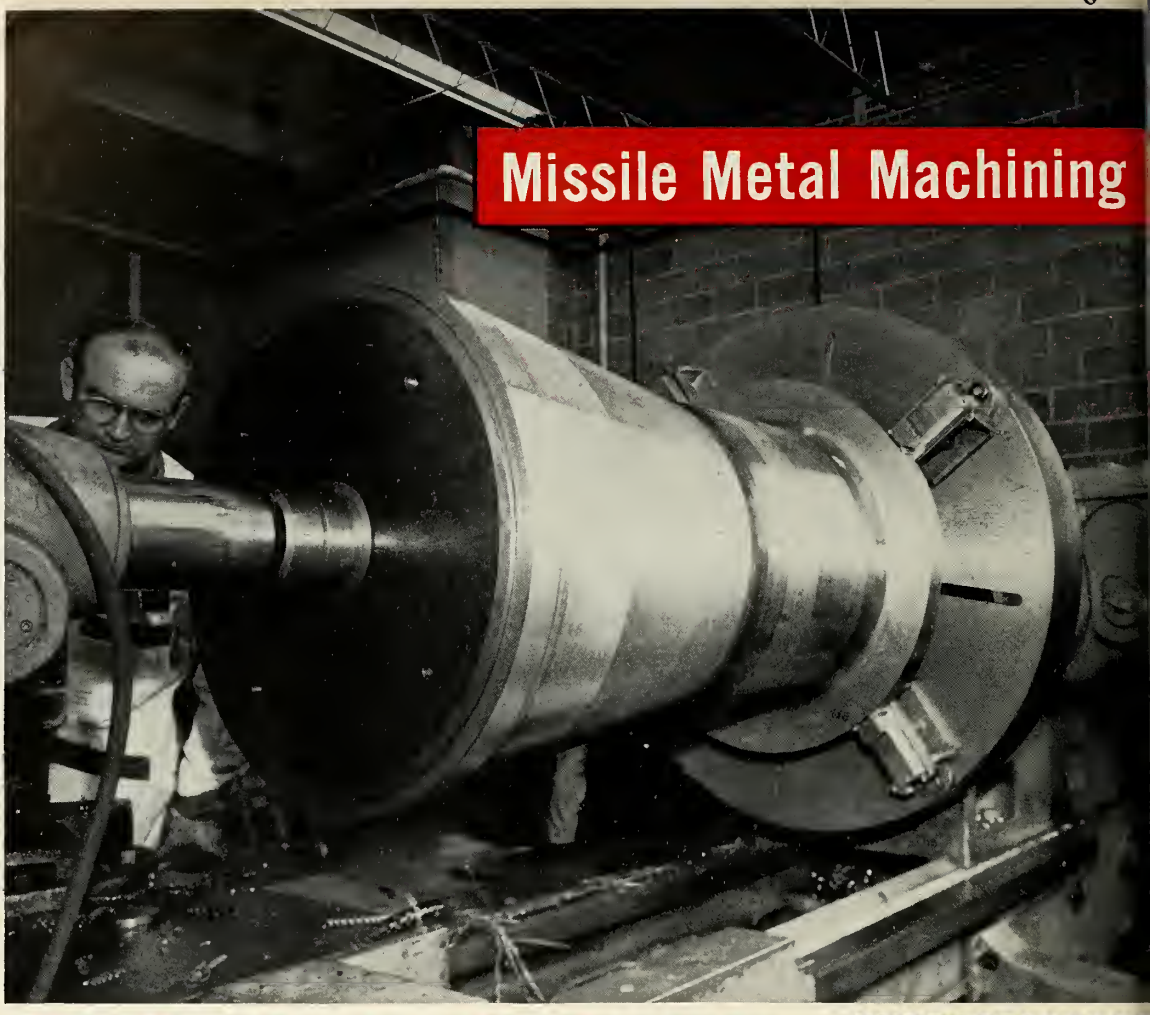

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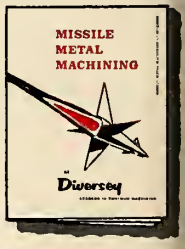

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AUGUST 18, 1958
VOL. 4, NO. 7

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

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editorial viewpoint . . .

Awaiting Presidential action is the appointment to one of the most important posts in U.S. military history: the Director, Research and Engineering, Department of Defense.

This new job, made possible under the newly-signed Reorganization Act, places emphasis—at long last—upon efficient management of weapons research. On this rests progress, and perhaps survival.

Research—a multi-billion dollar Defense Department endeavor this year—long has been without effective business management in the military establishment. Each service has managed its own program and costly duplication of effort and actual hardware often has been the result. Top-level decisions, particularly in space research—had they been made earlier and with greater wisdom—would have put this nation on top as the world's leader in astronautics, instead of relegating it to a secondary position.

It will take years to reorganize Defense Department R&D, but a lasting foundation can be quickly acted upon if the right man is appointed by the President. A record such as that demonstrated by Roy W. Johnson of the Advanced Research Projects Agency, should be the criteria for selection of a research and engineering chief.

Seldom has there been such quick decision-making by a DOD agency as ARPA has managed. This has been salutary, even though we haven't agreed wholeheartedly with some of the decisions. As a case in point, in the phenomenally short time of 12 days, ARPA executed orders to all branches of the services, making possible the early testing of our lunar probe project.

With the same speed and vigor, the agency, in just a few months, has developed an apparently sound and workable space program, where before there was virtually nothing. The credit goes to Johnson—whose contribution has been leadership.

Let's face the fact that the majority of the duties of the new Director, Research and Engineering, will be in space technology, and logical broadening of ARPA's basic function. The man selected must have this kind of background.

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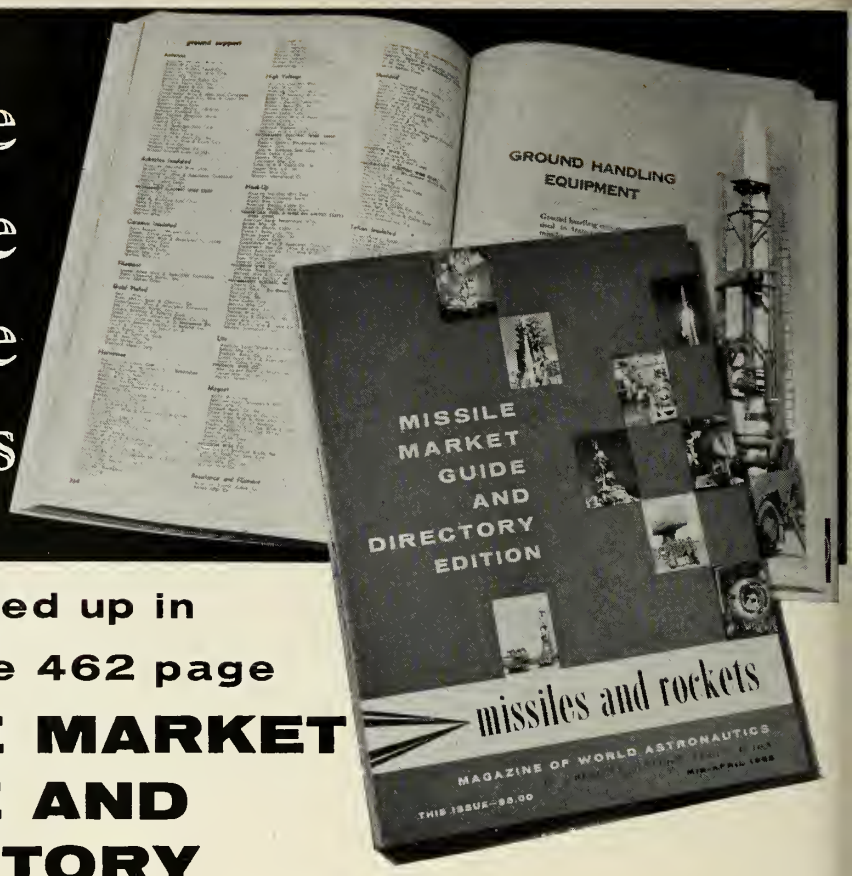
All scientific eyes are on the moon this week, as first attempts to reach that satellite move toward actuality at Cape Canaveral. (See page 32).

Here is the Missile Business



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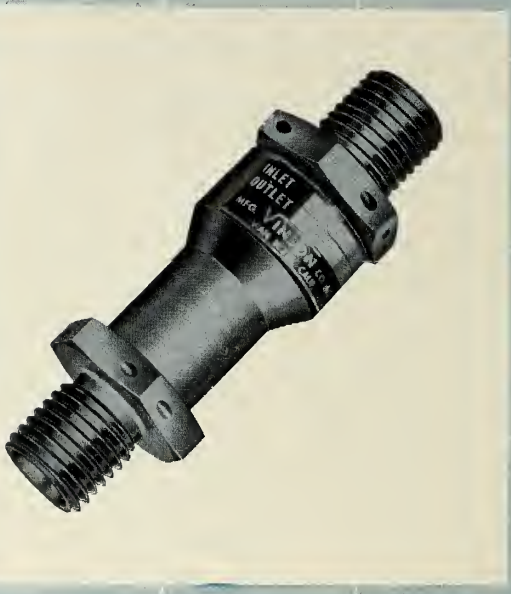

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INDUSTRY COUNTDOWN

GOVERNMENT

Passage by the House of a six-month extension of the Renegotiation Act should clear the way for Senate confirmation. The Senate traditionally declines to touch the bill until after House action . . . **DOD Secretary McElroy** reported looking for a "new face" for the post of Director of Research, Engineering . . . **The $39.6 billion DOD money bill** carries an amendment barring the use of 1959 funds for the construction of missile test facilities until existing installations are used to the "fullest practical" extent. The amendment grew from a controversy over reports that Holloman AFB facilities were being liquidated while duplicate facilities were being constructed by private contractors . . . **The Senate Committee on government operations** has reported favorably on a bill (S.3224) to increase from $1,000 to $2,500 the present open-market limitation for procurement without formal advertising and to provide other benefits to small business.

PROJECTS

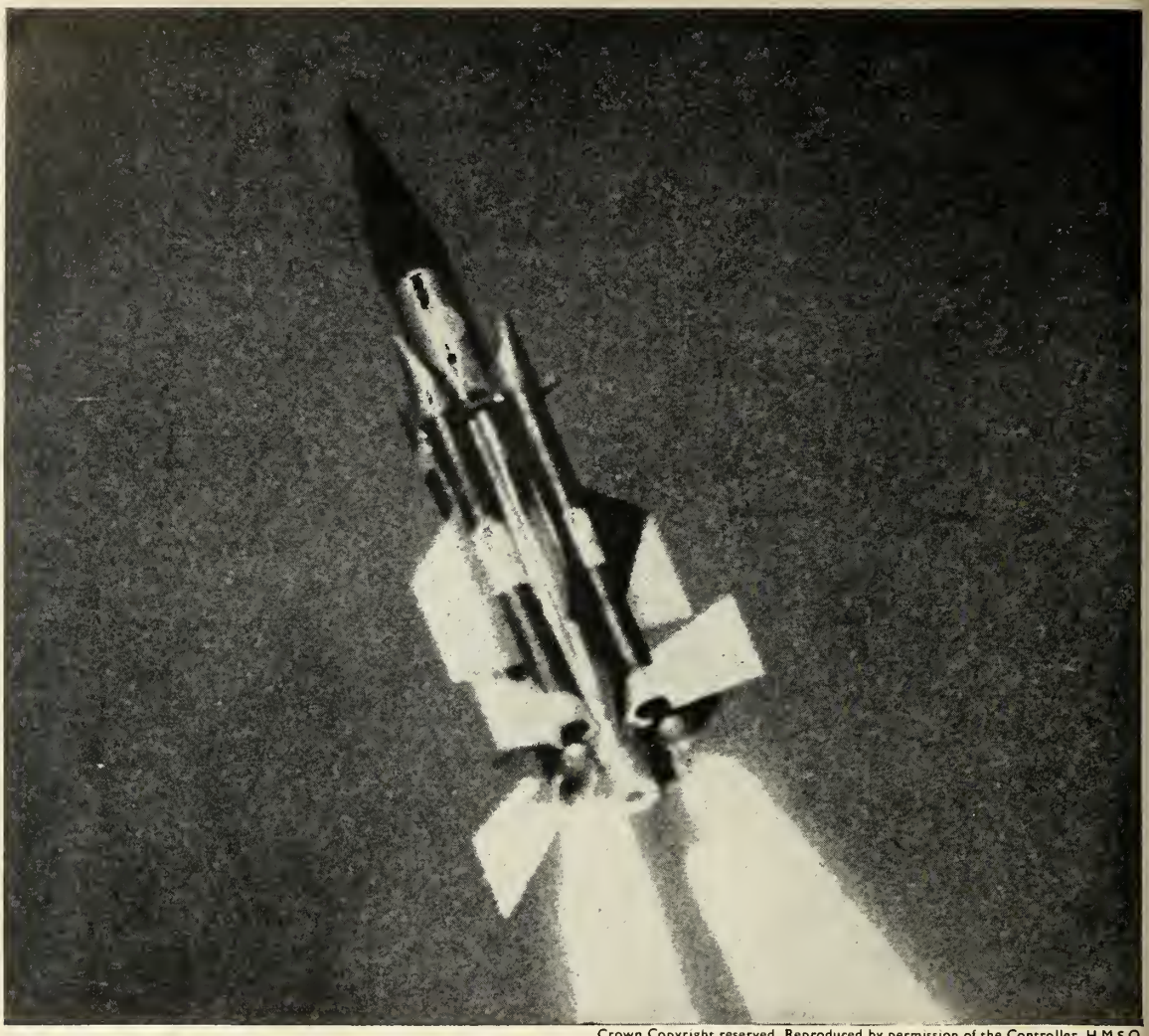
Nortronics Division of Northrop Aircraft working on a project for WADC involving "extremely advanced navigational techniques" . . . **General Electric's** J85 engine, to be used in the *Green Quail* decoy missile, passed its 15-hour preliminary flight rating test . . . **Use of heavy forgings** for big missiles being studied by AMC with some answers due in about six months . . . **Dr. Albert Hall,** Martin-Denver's head of *Titan* project, says industry must pour more of its own money back into research and not depend on the military when government policies are not clear . . . **Marquardt's XRJ59 ramjet engine,** slated for advanced version of the *Bomarc,* ran on test stand for equivalent time of three trips around the world at 70,000 ft. altitude . . . **Thiokol Chemical** planning to offer common stock to share-holders on basis of one new share for every 12 held . . . **Beech Aircraft Corp.** is running a sizeable advanced research program at its Boulder, Colo. division. Work concerns satellites, missiles and spacecraft . . . **The Army is studying** the feasibility of on-site firings of *Nike-Ajax* and *Nike-Hercules* missiles from several U.S. installations to demonstrate publicly how the systems operate. The announcement emphasized that warheads are "so constructed that they will explode only in flight" . . . **Chance Vought Aircraft** released figures on the growth of its electronics department; 20 men in 1951, 342 in 1956 and 400 in 1957. The company now manufactures about 5% of the electronics equipment going into its products.

MERGERS, EXPANSIONS, CHANGES

Chance Vought Aircraft to expedite anti-submarine warfare with group headed by Vice Admiral Harry Sanders (Ret.). Company intends to draw on past experience, including *Regulus* missiles . . . **Consolidated Electrodynamics Corp.** established an International Department within the existing Marketing Department . . . **Douglas Aircraft Company** to build one of world's highest speed wind tunnel centers, including trisonic, supersonic and hypersonic facilities . . . **Texas Instrument Inc.** opened a sales office at 317 Town and Country Village, Palo Alto, Calif. . . . **Sequoia Wire and Cable** acquired Hall-Scott Electronics, Burbank, for entry into the missile wire and cable field . . . **Temco Aircraft** to add 52,500 sq. ft. to the 100,000 sq. ft. Engineering Center, completed in 1957 at Garland, Texas . . . **The Calidyne Co. and Ling Electronics** joined forces in the manufacture, sales and service of vibration test systems . . . **Aeroquip Corp.** opened a new 10,000 sq. ft. plant in Dallas, Texas for extension of its hose and coupling capability . . . **American Potash & Chemical Corp.** enlarged its Washington office and assigned James S. Murray as director . . . **Olin Mathieson Corp.** joined two French firms and Aluminium Ltd. in setting up FRIA Compagnie Internationale pour la Production de l'Alumine, a $135 million corporation formed to develop bauxite deposits in French Guinea.

HOW'S BUSINESS?

Lear Inc. reported consolidated net earnings for the six months ending June 30 of $630,000, or 27 cents per share, compared with 14 cents per share for like period in 1957. Total net earnings for 1957 were $859,000 or 36 cents per share . . . **Sales totaling** $860,753,438—highest level ever attained for a first six-months period in the company's history—were reported by Boeing Airplane Company. Net earnings were $19,572,367, a 2.27% return on sales equivalent to $2.78 per share. Comparable figures for 1957 were $651,890,419 and $16,502,200 respectively . . . **Dow Chemical Company** had earnings in the year ending May 31 of $1.78 per share, down from $2.17 for the preceding year . . . **Giannini & Co.** report shows sales down to $5,296,190 for six months ending June 30 from $5,558,387 in 1957 but earnings of $203,139 or 58 cents per share unchanged. Present backlog totals $4,200,000 . . . **Fruehauf Trailer's** Missile Products division increased sales for first six months to $11,485,634 from $7,576,650 in first six months of 1957, while total company sales dropped $95,978,031 compared to $115,309,305 in like period of 1957 . . . **General Dynamics Corp.** increased sales for the quarter ending June 30 to $403,327,266 up from $400,953,042 in 1957's first quarter. However, net income fell to $10,179,601 from 1957's $10,937,347.



NOW—THUNDERBIRDS FOR THE R.A.F

The English Electric Thunderbird, already in production for the Army, has now been ordered for the R.A.F. It is the only ground-to-air guided missile in production for both Services.

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WASHINGTON COUNTDOWN

• **MEN ARE KEY TO REORGANIZATION**—Now that the President has signed the Defense Department Reorganization bill (see p. 17) Washingtonians are watching closely for names of men who'll be appointed to fill key posts. It'll be these men that will get reorganization off the ground—or fail to make the program work. An example is the choice for Director of Research and Engineering. Assistant Secretary Paul Foot apparently isn't interested. ARPA Director Roy W. Johnson is being wooed, because of his proven management ability. Surprisingly, there are many actual applications from other men apparently eager to take on this mammoth headache.

• **JOINT EFFORT**—The Pentagon is convinced that the 1 to 1½-million-pound-thrust rocket engine will be a joint effort by the Defense Department and the new NASA—not exclusively a NASA job, as the House space committee was recently informed. Most important reason: the President has ordered the two-way effort, although this hasn't been announced officially, and probably won't be until he names the members of the important NASA space council. Second reason: NASA has a long way to go before it has the research capacity that will be necessary.

• **INCIDENTALLY**—The President has also ordered Defense department to take charge of space communications, navigation and meteorology. That seems to leave NASA with little control over anything.

• **REBUTTAL**—Apparently answering statements before the House Ways and Means committee—which last week extended the renegotiation act for another six months (m/r, August 11, page 16)—Navy issued a statement that aircraft overhaul, repair and modernization is being carried out "on a substantial scale" by private contractors. Said RAdm. Robert E. Dixon, chief of the Bureau of Aeronautics: Navy would like to take full advantage of private service shops, but dispersal of units to such shops could impair readiness of the fleet.

• **CANAVERAL STILL TOPS**—DOD has no plans to replace Canaveral or other existing test facilities with the huge Pacific Missile Range. The West Coast range will be used principally for testing operational weapons, and on occasion for special satellite launchings and other special projects. But that won't be started for about a year.

• **POLITICS IN MISSILES**—The upcoming political campaigns—already beginning to roll—will have a lot to do with missiles. You can read that easily into the by-play in committee hearings on the space bill, the budget and small-business problems. All sides of the political line are trying to make a record on the subject—some Congressmen by showing their willingness to approve much greater funds than have been asked; others by evincing interest in the problems of small business; the Administration by a show of attempt at careful money management. Right in the middle are the armed services, who can't satisfy anybody in this kind of an atmosphere. Since politics is not a game, but a way of life in Washington, you can expect to see constant investigations, criticisms—and perhaps even a little praise—from now until November.

• **WHO MOVES MISSILES?**—Many missile men may not know this—but the best qualified agency for moving missiles from factory to firing site are furniture movers, with their years of experience in attempting to preserve the housewife's pet china. And thereby hangs a tale of savings to Uncle Sam. Seems the furniture movers—who walk into a plant, package the missile and deliver it to the site—and Aircraft Industry Association's Transportation Committee got together recently, hammered out a new rate. Savings to U.S., on *Bomarc* alone (according to figures compiled by Boeing) will be at least $100,000 every six months.

Army R&D Looks To Major Primes

Responsibility For Quality and Delivery on Schedule Lies with Top Missile Contractors, says Gen. Trudeau

by William O. Miller

As missiles become more and more important in the arsenal of the Army, responsibility for developing the supporting research and development programs must be given to those capable of handling it.

So said Lt. Gen. A. G. Trudeau, in an interview with m/r last week.

He went on to emphasize the dependence of Army R&D on the major prime contractor, who must organize the efforts of hundreds or even thousands of sub-contractors, to make sure that schedules and production standards are met.

"There is absolutely no doubt that the Army, as well as all other military services, will increase its implementation of missiles of all types," explained the Army Chief of Research and Development.

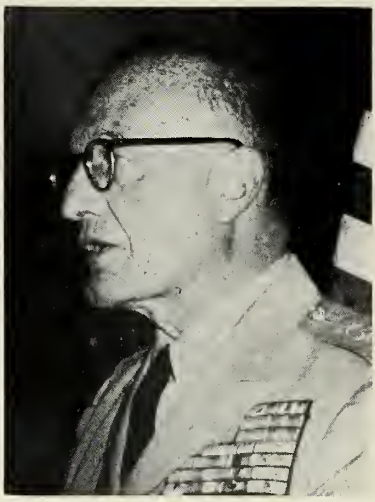
"However, if we are to have research of the scope and depth so vital to this highly complex area, we must have a massing of the scientific and technical skills of industry.

Gen. Trudeau said that many American industries, large and small, will play parts in the expanding effort. "But the responsibility for delivery on time of the quality components and materials by subcontractors must be assumed by the prime contractors," he added.

"This is the only way we can operate. We cannot get involved with the tremendous detail involved in making thousands of parts for a missile. We must decentralize this operation, holding the prime contractor responsible for the final job."

In this respect, the R&D chief was repeating the philosophy of the Army which calls for decentralization throughout its own R&D organization. Gen. Trudeau, for instance, as Chief of Army R&D, holds the chiefs of each Army technical service responsible for R&D operations in their respective areas.

At the same time, Gen. Trudeau did not discount the importance of the subcontractor. He pointed out that it takes only one malfunction of one part of a missile to cause a misfire. And the prime contractor must look to subcontractors to insure high standards in the thousands of different parts the subcontractors fabricate.



Lt. Gen. Arthur G. Trudeau

• **Congress criticizes**—The comments were made as the House Committee on Government Operations sent to lawmakers a report strongly critical of the research and development efforts within the Department of Defense, excepting the three individual military services.

Referring specifically to ARPA, the Director of Guided Missiles and the Assistant Secretary of Defense for Research and Engineering, the committee called for a reorganization by the Secretary of Defense within his office to integrate control under the Director of Research and Engineering, as provided by the Defense Department Reorganization Act (see also p. 5).

The report charged that "funds requested by executive officials for military research and development have been allowed to fall seriously, at the very time costs have risen sharply and weapons have become more and more complex."

The committee recommended a study as soon as possible by a firm of management consultants, and made the following specific recommendations:

(1) Reorganization to establish clear lines of authority running to the Director of Research and Engineering.

(2) Eliminate layers of review and minimize detailed reviews of project operations.

(3) DOD and Bureau of the Budget must recognize and carry out intention of Congress that R&D funds be made available so as to insure advancement of military programs at optimum rates. Fiscal operations should be geared to promote research and development, and not to hamper it, and DOD should review present methods of contracting for R&D services "with a view toward developing distinctive contract procedures and terms suitable for R&D rather than handling such contracts in the same manner as those for production and procurement of material and supplies."

(4) The Assistant Secretary of Defense (R&D) or his successor should participate actively in all stages of budgetary process and have a small budget under his direct control to expend in positive basic or applied research activity.

(5) In the new organization, the Secretary of Defense should insure establishment of the military R&D program on the basis of the nation's need, in a framework of appropriations and fiscal controls which will advance research progress rather than impede it.

(6) A definite policy should be established in DOD to insure orderly retrenchment of scientific projects when retrenchment is unavoidable; and approved projects making good progress should not be suddenly terminated. Full use should be made, when possible, of highly skilled technical teams and costly facilities, rather than allowing them to break up because of "shortsighted and poor planning, managing and funding."

Concluding recommendations included need for recognition of the fact that "wise management of research and early development may require parallel efforts in order to reach the best choices in weaponry." This policy, the committee continued, would have to be worked out so that the desired end be clearly understood.

The report said that "undoubtedly inter-service rivalries and confusion of roles and missions" brought on unnecessary and expensive duplication up to and including production. However, the report said "there is every reason to engage in as much research as possible, even to encourage directed competition along parallel lines of endeavor."

The committee urged strong discipline in decision-making at the proper time. "Each stage from research through development calls for an appraisal and a decision which makes for improvement to determine whether a research project merits continuation into the development stage, and when it should

move into the production stage."

"Public opinion and Congress must insist," the report said, "that the President authorize the Department of Defense to fund and carry out the type and size of military research and development program those directly charged with our military affairs believe is necessary for the security of our nation."

• **Army R&D**—Under the Secretary of the Army and his Chief of Research and Development (Dr. William H. Martin) Army research and development is headed by Gen. Trudeau. He is responsible for design of new items and provisions of developmental and design models for test and evaluation.

The Assistant Secretary of the Army for Logistics is involved in R&D insofar as contracting for development, provision of funds in support of the program, and the functions and operations of the Army's seven technical services.

All general staff agencies have an interest in R&D and are represented on the Army R&D Review Board.

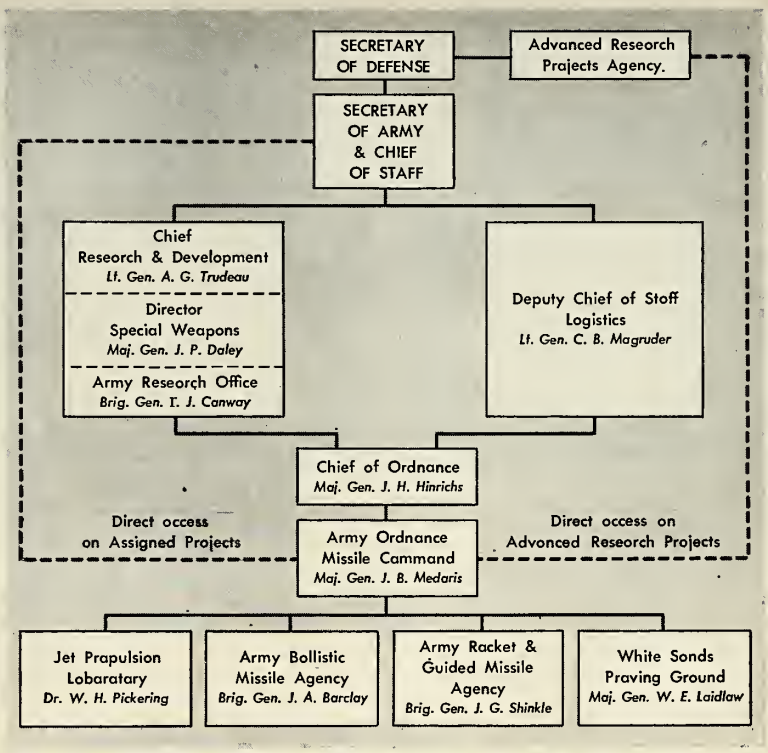
• **Wide spectrum**—The responsibility of the Chief of Research and Development for the Army covers a wide spectrum and his activities are closely coordinated with all Army Staff elements. His duties cover planning, coordinating, directing and supervising all research and development.

As indicated by the chart, Gen. Trudeau deals directly with the technical staffs and services. On the other hand, personnel and money for research and development activities of the technical services are allotted to the Army Deputy Chief of Staff for Logistics, Lt. Gen. C. B. Magruder. Gen. Magruder, in close cooperation with Gen. Trudeau, makes such funds available to the technical services at the request of the Chief of R&D.

The Advanced Research Projects Agency of the Department of Defense has direct access to the Army Ordnance Missile Command on assigned special priority projects, such as satellites and lunar probes.

The one other exception to normal chain of command channeling is a two-way channel between the Secretary of the Army and his Chief of Staff and the Army Ordnance Missile Command on assigned special priority projects.

The Chief of Ordnance, through whom the Deputy Chief of Staff for Logistics and the Chief of Research and Development normally have access to the Army Ordnance Missile Command and its divisions, is but one of the Army's seven technical services. The others are: transportation corps, medical corps, Quartermaster corps, Signal corps, and Chemical corps.



BASIC ORGANIZATION of Army's Research and Development Offices.

• **ARO setup**—Directly under Gen. Trudeau, the Army Research Office was established in March of this year. Its mission, under Brig. Gen. T. J. Conway, is to promote and coordinate Army research effort in physical, engineering, geophysical, biological, medical and the social sciences. In addition, it coordinates the efforts of the technical services which direct actual research projects in their individual fields.

Contractors interested in submitting proposals in the research and development fields normally make contact first with a field agency of the appropriate technical service. For instance, a firm interested in missile R&D would contact one of the 14 Ordnance Districts.

To assist prospective contractors, Army R&D has prepared a booklet titled "CONTRACTORS GUIDE," available on request to the Technical Liaison Office, Office of the Chief of Research and Development, Department of the Army, Washington 25, D.C.

General Trudeau said that he has a number of recommendations and proposals he will submit to the Secretary of the Army for transmittal to the Secretary of Defense, when called for, as the reorganization of the Department of Defense progresses. He said there are a number of reorganizational changes being considered for the Army rescarch and development program, but that nothing can be done until the Department of Defense outlines its own plans.

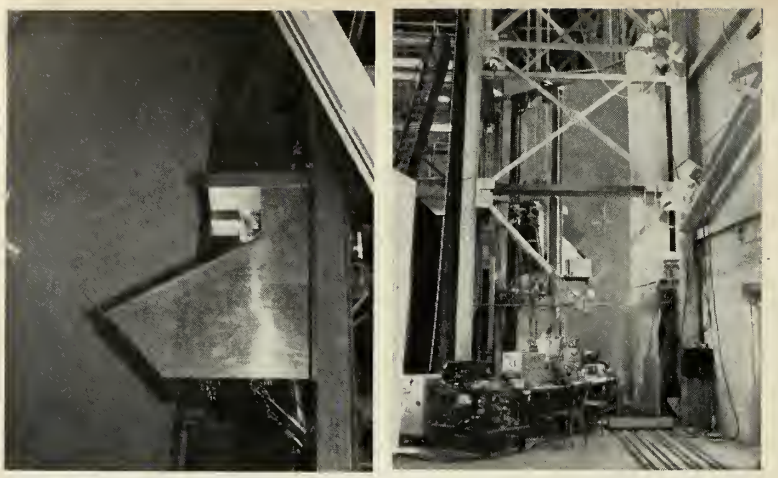
DOD Reorganization Law, Effects Seen Gradual

The controversial Defense Reorganization Act became law last week when the President signed the bill which included a number of compromises and fell short of what the Administration had sought.

The act: places directly under the Secretary of Defense and the Joint Chiefs of Staff the direction of strategic planning and the unified combat commands; it does call for an increase in the working agency of the JCOS; and it does provide for the creation of a new Director of Defense Research-Engineering.

The act does not, as sought by the Administration: give the Secretary of Defense greater control over military appropriations; provide some of the powers wanted for the Joint Staff; and it does not give to the executive department some of the control Congress has of Pentagon policymaking.

In any event, implementation of the act will be gradual, most observers think. It will take six to 12 months before real effects are felt.



RELATIVELY INEXPENSIVE NACA motion simulator in operation at Langley Field, Va., provides damping and stability testing data for space vehicle re-entry.

NACA Probes Vehicle Re-entry

Time-Cycle for Manned Flight Cut At Small Cost

by Donald E. Perry

LANGLEY FIELD, VA.—Motion simulator tests, started two years ago at NACA's Flight Research Laboratory here, have shortened the time cycle for the National Aeronautics and Space Administration's manned space flight program, which begins in earnest this year with a $30 million budget.

And, amazingly enough, simulator research has cost only a few thousand dollars, thanks to the ingenuity of NACA personnel.

By using an *Atlas* booster, NASA scientists are confident they can put a manned vehicle in orbit within two years. Payload weight would be on the order of 2,100 or 2,200 pounds; and during entry the vehicle would decelerate at 10 g's, well within the endurance capability of the pilot.

Orbit would be at approximately 120 nautical miles and the vehicle would be stabilized to prevent tumbling. Initial flights would be limited to just a few passes around the earth, facilitating recovery. Present plans call for using a parachute at 25,000 feet altitude, which would bring the vehicle and its passenger gently back to earth.

Within the next 11 months, NASA will spend $6.5 million for development and construction of model and full-scale capsules for centrifuge, static and flight experiments. Instrumentation for models and full-scale flight capsules will cost another $4 million. *Atlas* boosters for five model and two capsule-scale flights, some containing small animals, will cost at least another $19.5 million.

A vital part of this program's success depends on the work of the Flight Research Laboratory. Research is now underway to determine whether it is possible to stabilize a simulator for the small deviations a pilot will encounter during re-entry, taking into consideration that large deviations should never arise because of built-in design characteristics of the vehicle. Studies also are being made on the effect of these motions on the pilot.

Langley tests have shown that if the right shape is chosen for the space vehicle, its motion will be well damped. The frequency of the damping motion should be one cycle per second, within the airplane order of damping frequency—and should not become troublesome to the pilot. (Damping is the diminishing amplitude of an oscillation, due to friction or similar cause.)

In order to use simulators properly, NASA must determine first what characteristics should be built into them, for a simulator's usefulness is measured in terms of safety and economy. The safety aspect is obvious. In space flight, the penalty for equipment failure, pilot error, or wrong choice would be catastrophic. Economically, 10 or 15 satellite launchings to achieve results possible with simulators would be staggering in cost.

At Langley, research engineers Porter Brown and Harold I. Johnson, believe that motion is one of the most important requirements for a space flight simulator.

The problem of supplying a space vehicle pilot with a "feel" force will be no different in space than in air, NACA said, and electronics should easily provide artificial stabilization of control forces.

In space, the vehicle will be sluggish like a bomber, and the pilot will have to provide a force of 200 to 400 pounds for each inch of control stick motion. Langley has acquired data as high as 250 pounds for each inch of stick motion.

Johson and Brown have built and instrumented a NAP Chair—Normal Acceleration and Pitch—to acquire entry data. It is capable of duplicating the vertical and pitching motions of space vehicles within the limits of disturbances likely to be encountered.

A chair holding the pilot moves on eight foot rails and can furnish up to two G's. The pilot must control his descent motion within plus or minus five feet. A slide projector mounted to the chair projects a sighting image on a screen in front of the pilot. A small red ball strung on fine wires is his target.

Total cost of the simulator is a little over $10,000. Brown and Johnson estimate they saved $30,000 in analog equipment by designing an electro-mechanical system.

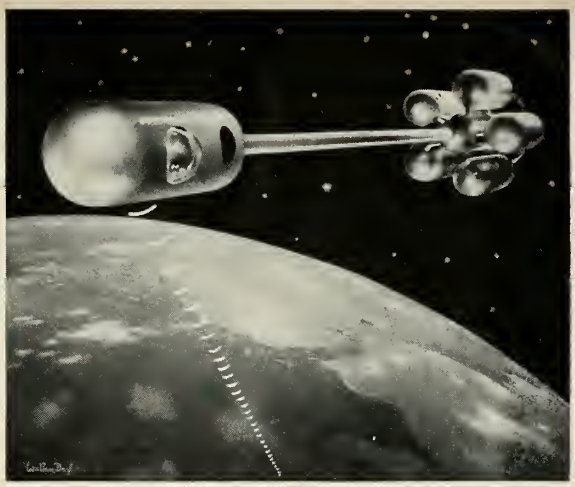
• **All instrumentation** was designed specifically by NASA technicians. An EPT unit (Evens per unit of time) gives a quantitative measure of the pilot's performance in chasing the ball, with or without damping effects. A skin resistance unit tests physiological reactions of the pilot when he is faced with awkward control situations and high G forces.

The nerve center of the system is a differential transformer that furnishes dynamic motions. When the pilot moves his stick, this in turn actuates the rotor of an identical differential transformer. One differential transformer follows the other's position. The dynamics of motion are determined on a small disk, the intertia of which simulates the inertia of the vehicles XY axis.

On the disk are various electrical hysteresis dampers, which simulate the aerodynamic dampening of the vehicle. The strength, or tendency of the differential transformers to remain synchronized, is determined by applied voltage. This tendency simulates the stability of the vehicle. Movements of the disk are synonymous to the angle of attack and normal acceleration.

Further research should provide the answers to what types of control stick —center, sidearms, hydraulics—the pilot should have. Extension of the simulator's track to 60 feet can give additional G force, and provide data on whether a pilot could regain control if lost.

TEST INSTRUMENTS Bulova's rugged Tachometer Tester for all jet and reciprocating systems meets MIL-T-945A requirements—is accurate to 0.1% with engines on or off. Simple to operate and maintain, this field unit also serves in maintenance depots. Precise Bulova testers include the dual purpose Torqmeter—a dynamometer or calibrated torque source



RECONNAISSANCE SYSTEMS Bulova-developed miniaturized sensor packages, geared to specific tactical missions, feed combat surveillance data to Bulova analysis and display systems. Camera, infra-red, TV and radar techniques, combined and integrated, aid decision-making on land and in space. Satellite applications? Unlimited!

Bulova's capability helps to solve today's most challenging problems

To conceive, develop and manufacture a broad range of advanced electronic and electro-mechanical devices...this is the Bulova capability.

Meeting the needs of defense and industry is an unusually creative group of scientists, engineers and technicians, backed by 80 years' experience in precision production.

BULOVA
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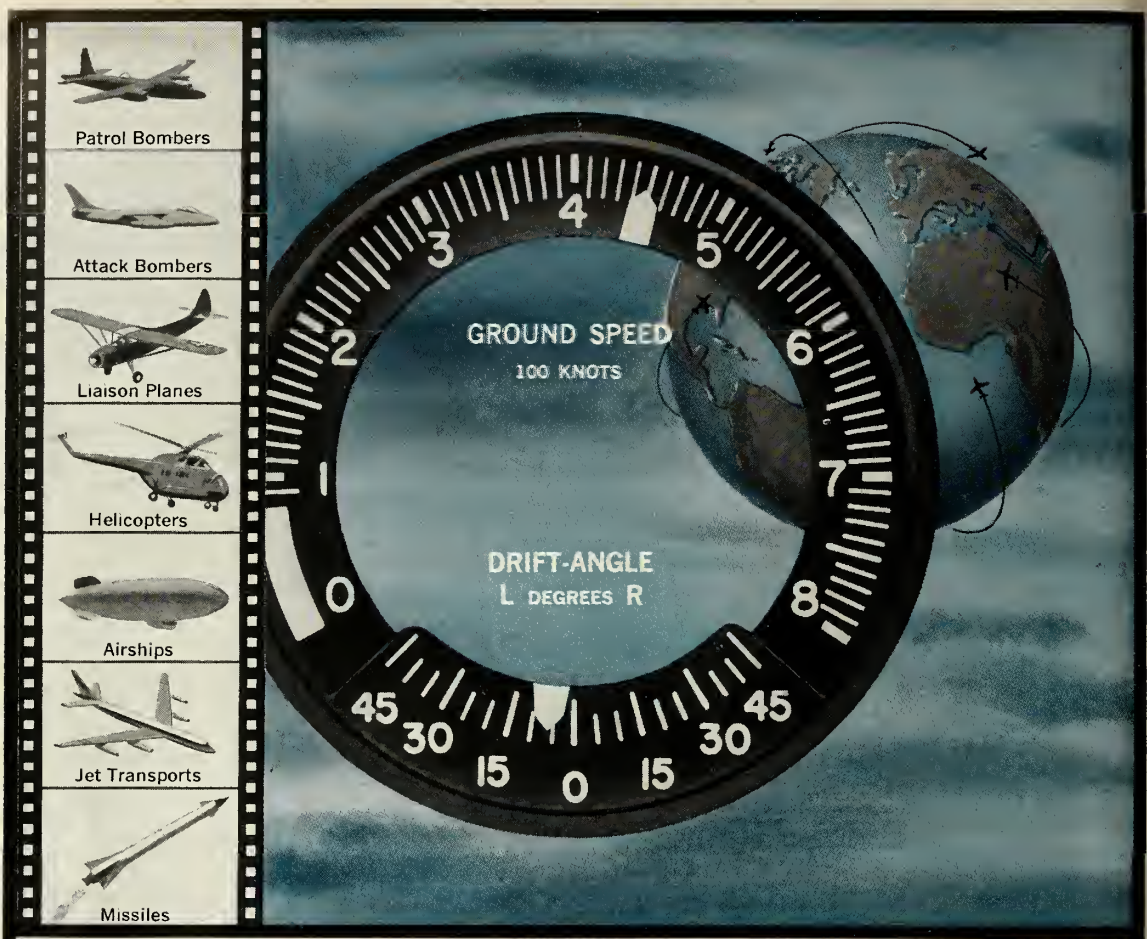
With dynamic imagination, Bulova's capability has invaded the often uncharted technological areas to originate many modern-day miracles in miniaturized systems and components.

Here is a proven capability ready to assist you from concept to mass production. For full information, write Department G.I.S.-2.

BULOVA RESEARCH AND DEVELOPMENT LABORATORIES, INC.
BULOVA PARK — JACKSON HEIGHTS — NEW YORK

INFRA-RED COMPONENTS Bulova's advanced IR projects include mosaic cells that will automatically filter out unwanted wave lengths and picture targets clearly against any background. Bulova infra-red R&D covers lead selenide and lead sulfide cells, missile seeker cells, reticles, filters and thermistor bolometers...for defense and industry.

INFRA-RED SYSTEMS Bulova's IR illuminators put unseen spotlights on night objectives. Bulova's development capability extends to fire control systems that detect, track and automatically lock on target. Designed for accuracy and simplicity, these high resolution units will serve our nation's land, sea and air forces.



WHY RYAN CONTINUOUS WAVE RADAR IS BEST FOR DOPPLER NAVIGATION

Through its pioneering work with the Navy and Army, Ryan has demonstrated that continuous wave radar is the best Doppler navigation system for every military and commercial application.

Ryan RANAV* systems are the only CW Doppler navigators in production. They have major advantages for aircraft navigation, ground speed measurement, missile guidance, and helicopter hovering. For example, RANAV is:

LIGHTEST—Ryan Doppler navigators are lightest, saving many precious pounds of weight, because CW radar requires less power for comparable performance and eliminates the need for many components required by pulse radars. RANAV also features a unique lightweight *non-gimballing* antenna system.

SIMPLEST—RANAV requires no IF (intermediate frequency) amplifiers or automatic frequency control circuits. Only one microwave generator is used and the systems have less tubes and components.

MOST COMPACT—Inherent simplicity of CW radar systems plus the ingenuity of RANAV design has enabled Ryan to take most advantage of subminiaturization and transistorization, creating compact systems with advanced modular units and etched circuitry.

MOST RELIABLE—RANAV continuous wave automatic navigators are most reliable because they are simple, rugged, and completely transistorized. RANAV also uses a long-life transmitter and it features a foolproof, non-wiggly (fixed) antenna with no moving parts and no adjustments.

*TRADE MARK

RYAN BUILDS BETTER

ELECTRONICS DIVISION

Ryan Aeronautical Company, San Diego, Calif.

Glennan Sees Management As NASA Key

an m/r staff report

CLEVELAND—T. Keith Glennan, nominated by President Eisenhower as administrator of the new National Aeronautics and Space Administration, admits he is not a space man by training, but basically an administrator of scientific research. The 52-year-old scientist-educator has been president of Case Institute of Technology since 1947.

The Senate conducted hearings last week on confirming Dr. Glennan and Dr. Hugh L. Dryden, present director of the National Advisory Committee for Aeronautics, who was nominated by the President as Deputy Administrator. Dryden, 60, is a Democrat; Glennan, a Republican. The administrative post pays $22,500 annually; the deputy administrative post, $21,500 annually. If confirmed, Glennan plans to take over his new duties about September 1.

Commenting in an exclusive interview with m/r, Glennan said he would formulate his ideas when he takes over the job. However, he believes absorption of NACA by NASA will provide the new space agency with an excellent base of scientific and technical personnel on which to build.

"The line between military and civilian exploration of space is an uneven one," he commented, "but I am sure we can expect excellent cooperation from both."

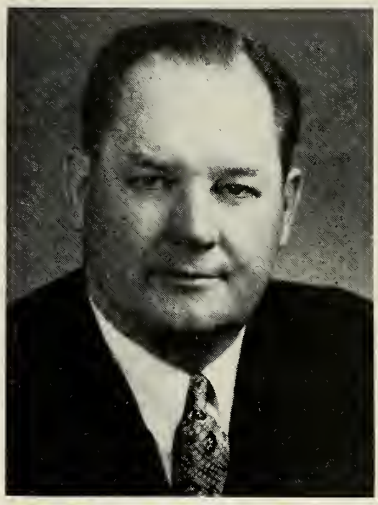
• **Soviet vs. U.S. progress**—Glennan said he is impressed by Russian scientific education. However, he said he deplores any criticism of American progress in space exploration since the time the Russians put the first satellite into orbit last fall.

"We've done a great deal, but we can't do it overnight," he pointed out.

Glennan has in mind a 15-day trip earlier this summer, when he visited Soviet colleges and universities. He said the Russians are making better use of the capitalist incentive system to encourage education than the Americans.

"They have developed a demand for education because it pays off," he remarked. He emphasized that a student "is paid according to the quality of his work," and there are three to six applicants for every scholarship.

• **Early days**—Born in Enderlin, N.D., Glennan grew up in Eau Claire, Wisconsin, and enrolled in an electrical engineering course at Yale. At midyear, he told the college board he was interested in people as well as machines, and broadened his courses to include liberal arts. He graduated cum laude with a degree in electrical engineering.



NEW SPACE BOSSES—Dr. T. Keith Glennan (left) will be administrator, and Dr. Hugh Dryden (right) deputy administrator of the new federal space agency.

Glennan is the son of a railroad dispatcher, and worked his way through college. At $35 a week, he spent two years in Europe supervising installation sound systems for Paramount, and then went to Hollywood as a studio manager. He later had a similar job at Goldwyn Studios. In World War II, Glennan was administrator and later director of the Navy's Underwater Sound Laboratory at New London, Conn. From there, he advanced to research and development work at the Ansco Corp., Binghamton, N.Y.

• **Progress of Case**—Glennan has built Case into one of the top-ranking engineering schools in the nation. During his eleven-year administration, Case was transformed from a primarily local institution into a school that Dr. Edward Teller ranked with the first four engineering schools in the nation.

During his tenure as president, Glennan spent two years as a member of the Atomic Energy Commission. His work has earned him various honors, including the medal for merit, the highest government award given a civilian. He also has been awarded honorary degrees in science and engineering from five universities and technical institutes.

Glennan is a member of the board of the National Science Foundation; chairman of the board of IDA (Institute for Defense Analysis); a member of the board of directors, Council on Financial Aid to Education; and a member of the General Advisory Committee of the AEC.

IDA holds a defense department contract for supplying scientific personnel. Advanced Research Projects Agency is staffed principally by IDA scientists. Presumably, Glennan will drop his IDA affiliation if confirmed.

Among his business affiliations, Glennan is a member of the board of the Cleveland Electric Illuminating Company; the Clevite Corporation; Standard Oil (Ohio); and the Harris-Intertype Corporation.

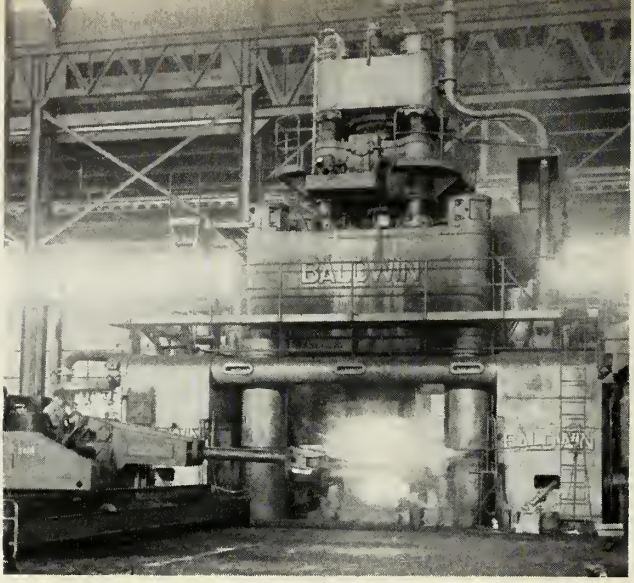
• **Dryden's qualifications**—Dr. Hugh Latimer Dryden, named as deputy administrator of NASA, is known as a conservative visionary.

Dryden was introduced to space by the late Dr. Joseph S. Ames, who later became chairman of NACA. At Johns Hopkins University Graduate School, Dryden was persuaded by Dr. Ames to undertake a study of fluid dynamics at the Bureau of Standards. In 1920, he was promoted to head the Bureau's aerodynamics section.

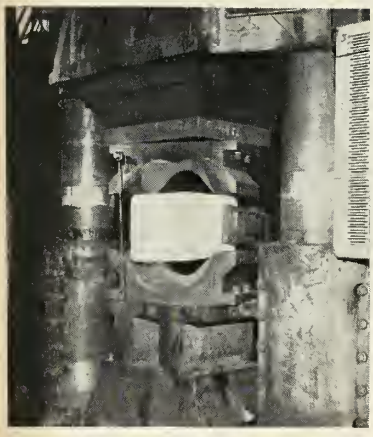
The Armed Forces used his services during World War II, as advisor on aeronautic and guided missile problems. In 1948, he received the Presidential Certificate of Merit.

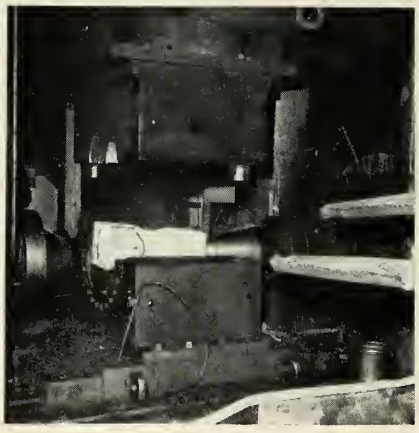
Toward the end of the war, as Deputy Scientific Director of the AAF Scientific Advisory Group, Dryden traveled through western Europe to study foreign aeronautic and missile weapon development. This work won him the Army's Medal of Freedom.

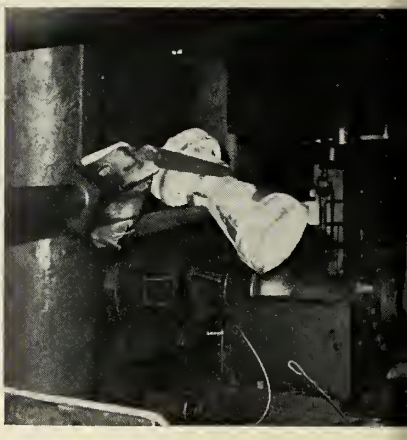
In 1947, Dryden went to work for NACA as Director of Aeronautical Research. Two years later, he was named director of the agency, a position he now holds.



Nozzles in Production

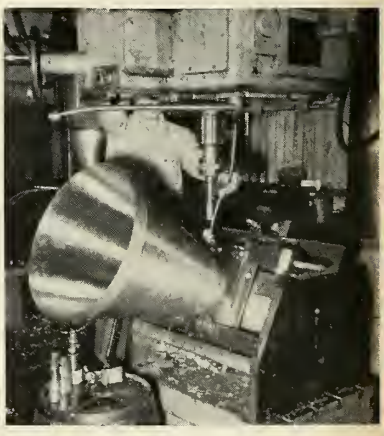




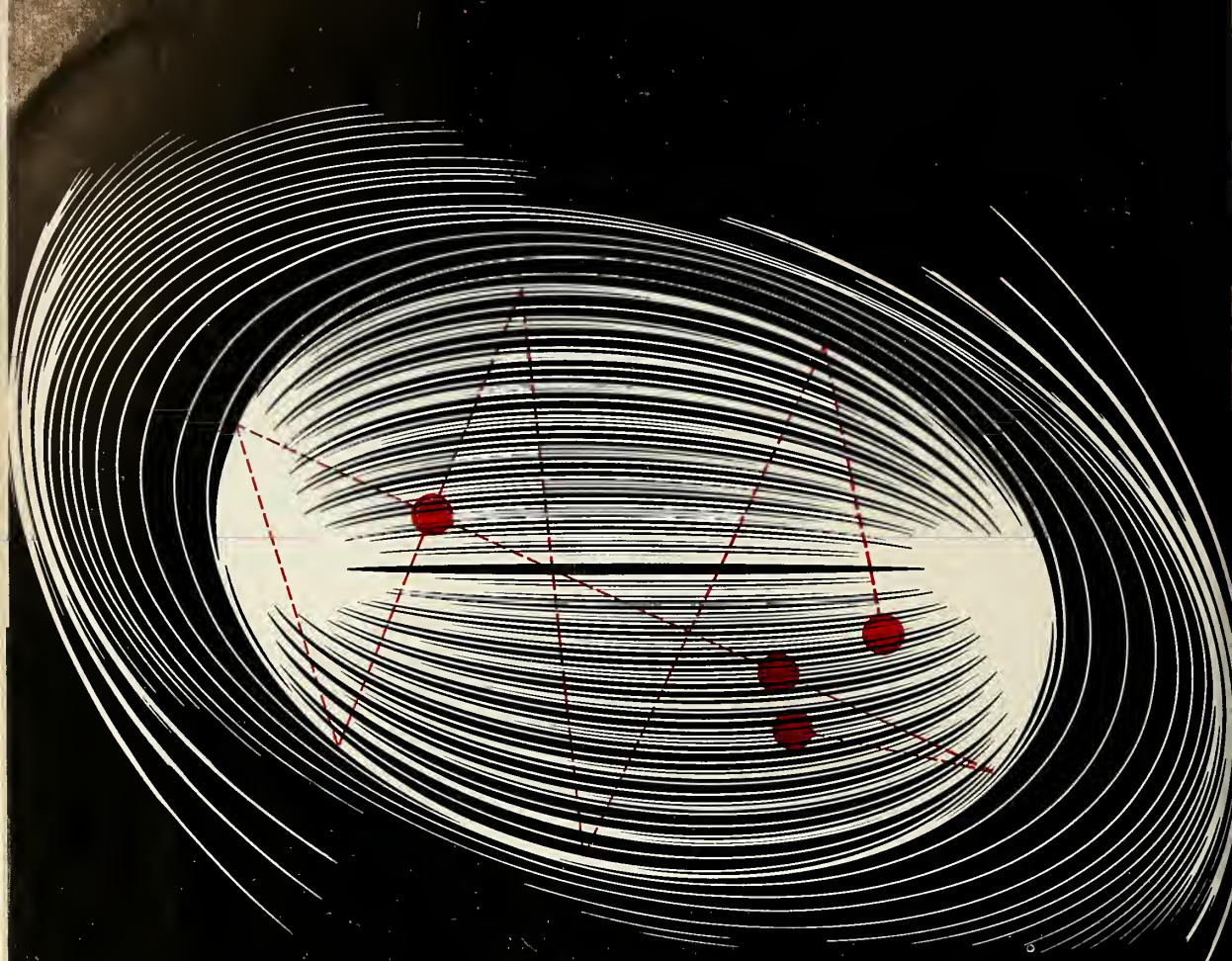


FORGING AND MACHINING are two of the primary operations in missile production, playing a proportionately bigger role than they normally do in aircraft manufacture. The pictures on these pages show the step-by-step life history of the birth of an *Honest John* nozzle. The only major step omitted is heat-treating. All work being done is at Cameron Iron Works, Houston, Texas. Cameron, basically a manufacturer of high-pressure, high-flow rate valves and fittings for the oilfield industry, is becoming progressively interested in missiles. Aside from considerable forging and machining on parts such as these nozzles, Cameron also has a special Navy-owned facility for making complete *Terrier* motor-casing assemblies.

THE GIANT PRESS used in forging these pieces is unique. With an 11,000-ton vertical ram and two 6,000-ton side rams, it forges the complex nozzle shape in one operation from billets requiring a minimum of pre-preparation. When removed from the press, only a small center plug of metal has to be punched out before the forging is ready for rough and finish machining. Note that for machining, both lathes and vertical boring mills are used. The tactical Douglas Aircraft *Honest John* ballistic missile is one of our higher production rate missiles. (Right) Press dies for forging **the nozzles.**



HONEST JOHN has atomic capabilities, is part of a completely air-transportable weapons system, and is now deployed with our forces both here and abroad. It is an Army development, and is supplemented in its role by *Little John* and *Lacrosse*. Here, a worn die-mold is being rebuilt, first by laying in metal with a welding torch, and then finish machining to size. The strip of pictures (above) shows the various steps in preforming, pressing, rough and finish machining and tapping. These nozzles (right) have now been heat treated, trued up, and are now ready to be crated for shipping. Though high precision is required in volume production, there is nothing essentially "tricky" about making nozzles this way.



SAGE SETS AN ELECTRONIC "BEAR TRAP"

BURROUGHS ELECTRONIC DATA PROCESSING EQUIPMENT STANDS WATCH FOR OUR CONTINENTAL AIR DEFENSE.

Problems of the awesome speeds and scope that confront our military defense systems can only be solved by the quick and uncanny accuracies of electronic computation, such as is found in our Semi-Automatic Ground Environment—SAGE, which is now becoming operational! As a result Burroughs radar data processing equipment fills important posts all along our peripheral continental approaches.

This major U. S. Air Force contract is one example of the widespread confidence in Burroughs Corporation's 70-year background of reliability and capability. It demonstrates Burroughs' new breadth in the development of electronic equipment and its continuing competence from research to final installation.

Burroughs Corporation

"NEW DIMENSIONS / in electronics and data processing systems"

west coast industry

by Fred S. Hunter

Small firms in the southern California area seem to be making headway in their campaign to obtain set-asides for small business on contracts let through the Air Force's Ballistic Missile Office. Defense Department procurement regulations spell out procedures for these set-asides for the benefit of small bidders, but up to now they have had little, if any, application in the ballistic missile program.

For one thing, the projects were classified and small firms had no way of finding out what work might be within their capabilities. Now they've discovered that the ballistic missile program is one of the most promising for their type of work. In response to their negotiations, Maj. Gen. Ben Funk, BMO chief, recently added a small business specialist to his staff to administer a set-asides program and to assist small shops in obtaining military work.

Rohr Aircraft Corp., which, with a payroll in excess of 15,000 employees has the distinction of being the biggest subcontractor in the aircraft industry, has moved into the missile field with an order from North American Aviation for support pylons for the GAM-77 (*Hound Dog*) air-to-surface missile. These pylons are to be mounted to the underside of Boeing B-52s. They'll be produced at Rohr's Riverside plant. The material will be a metal bond structure, selected because of its ability to "damp" vibration close to engines. During buildup, Rohr will supply tooling engineering service to NAA.

In a couple of years, 50% of the Douglas Aircraft Co.'s total volume of business will be in missiles, says Donald W. Douglas, Jr. With three major production articles—the IRBM *Thor,* the ground-to-air *Nike* and the air-to-air *Ding Dong*—Douglas already is the nation's biggest missile producer. The *Thor* is assembled at the home plant in Santa Monica; the *Nike* at Charlotte, N.C.; and the *Ding Dong* at Sacramento.

Interim facilities for the WS-117L reconnaissance satellite being developed for the Air Force by Lockheed, are scheduled for completion at Cooke Air Force Base September 4. The facilities include launch pad, gantry and instrument buildings. Basic technical equipment will be ready for preliminary systems testing in October. The WS-117L, it is reported, will be fired into orbit by an *Atlas* ICBM and circle the earth from pole to pole.

With a backlog of military orders in excess of $14 million, Packard-Bell is negotiating for a 100-acre electronics park in southern California to be used by its technical products division . . . **Hughes Aircraft Co.** is slated to move its semi-conductor division to Newport Beach into the plant formerly occupied by the Helipot division of Beckman Instruments . . . **Varian Associates** at Palo Alto are working on components for a magnetometer to be used in future satellites.

contract awards

LAST MINUTE AWARDS

Convair Astronautics Division of General Dynamics Corp. gave $100,000 to R/S Electronics Corp., Regan Industries, Inc., for manufacturing intermediate frequency amplifiers for use in the *Atlas* intercontinental ballistic missile.

Benrus Watch Company received $3-million for the manufacture of air-to-air guided missile launchers for the *Sidewinder* and *Sparrow* programs, and for electronic equipment to be utilized in the important air traffic safety program . . .

The Missile Division of North American Aviation, Downey, Calif., has awarded a contract to the Metal Products Division of Koppers Co., Inc., Baltimore, Md., for the design and construction of seven portable silencers.

ARMY

By Philadelphia Ordnance District:

Western Electric Co., Inc. received $33,900 for spare parts (*Nike* & M33 systems).

Air Products, Inc. received $2,179,200 for semi-trailer, liquid oxygen.

Leeds and Northrop Co. received $30,565 for recorder.

Princeton University received $35,000 for problems connected with differentiable and complex analytic structures.

Western Electric Co., Inc. received 7 contracts totalling $703,027 for *Nike* spare parts and components.

Douglas Aircraft Co., Inc. received 3 contracts totalling $185,539 for *Nike* spare parts and components.

University of Maryland received $53,000 for study of cosmic ray attitude sensing device.

The Franklin Institute of the State of Pennsylvania received $27,750 for emission of electrons from metals and induction of electrical conduction in crystals resulting from electron bombardment.

Atlas Powder Co. received $29,953 for design, and development of miniaturized hermetically sealed squib switches.

Douglas Aircraft Co., Inc., received 7 contracts totalling $895,872 for *Nike* spare parts and components.

Western Electric Co., Inc., received 7 contracts totalling $854,460 for *Nike* spare parts and components.

Applied Science Corp. of Princeton received $51,983 for study of telemetry data analysis technique.

RCA Service Co., Radio Corp. of America received $1,500,000 for multi-purpose missile system test equipment.

The Johns Hopkins University received $100,000 for research on the vulnerability of aircraft and missiles.

Duke University received $70,500 for basic research program of the ordnance corps and the mathematics research program of the Dept. of the Army.

By Signal Supply Agency:

Cutler-Hammer, Inc., Airborne Instruments Laboratory Div., Mineola, N.Y., received $95,700 for research and development work on microwave reactance amplifiers and harmonic generators for 12 months.

General Electric Co., Owensboro, Kentucky, received $476,640 for research and development for 3 years on subminiature electron tubes.

Hughes Aircraft Co., Cutler City, Calif., received $99,994 for research and development work to continue the study of atomic and spin resonances for microwave generation and amplification.

Lansdale Tube Co., Lansdale, Pa. received $59,521 for research and development work on silicon PNP alloy junction transistors.

Linfield Research Institute, McMinnville, Oregon, received $49,820 for research work on electrolytic mecromachine techniques of refractory metals for use in field mission electron devices.

Radio Corp. of America, Moorestown, N.J., received $47,372 for research study and investigation of the wind response characteristics and the estimated wind deviation of the *Little John* rocket.

By Purchasing and Contracting office, Research and Development Labs:

TURN SHIPPING DAYS TO PRODUCTION DAYS!

VIA AMERICAN AIRLINES AIRFREIGHT

America's Leading Airline

—your best assurance of careful handling, dependable on-time deliveries

Gain extra days for production with deliveries in hours by air. You save on overtime as well as packing and crating costs. For maximum speed and safety en route, specify American Airlines. With over 1000 flights daily, American offers direct one-carrier service to more key industrial areas than any other airline. Personnel—especially trained in the care of delicate instruments—offer the best assurance of expert handling and dependable on-time deliveries. Check your telephone book now for the number of the **AMERICAN AIRLINES AIRFREIGHT** office nearest you!

. . . contracts

American Optical Co., Buffalo, N.Y. received $49,610 for design and development of infrared binoculars.

General Mills, Inc., Minneapolis, Minn., received $94,892 for study, preliminary design of equipments and development of methods for automatic tracking theodolite.

Southwest Research Institute, San Antonio, Texas, received $68,670 for magnetic anomaly studies.

General Electric Co. Philadelphia, Pa., received $78,533 for study, preliminary design of equipments and development of methods for automatic tracking theodolite.

By Engineer Division, New England Corps of Engineers:

Kirkland Construction Co., Inc. Cambridge, Mass., received $1,480,794 for construction of missile master facilities.

Paino-La Cava Co. Inc., Lexington, Mass., received $1,691,615 for construction of additional pavements and minor structures for *Nike* batteries.

AIR FORCE

By Cmdr., HQ AMC, Wright-Patterson AFB:

Sperry Gyroscope Co., Sperry-Rand Corp., received $1,018,215 for APW-22 command guidance transponder sets, spare parts and reports for XQ-4A drones.

Avionics Div., Bell Aircraft Corp., received $500,000 for design, development of high-performance inertial navigator—the Hipernas II—and applicable spare parts, technical reports and engineering data.

Associated Missile Products Co., American Machine & Foundry Co., received $1,629,911 for AN/GPS-T4 radar target simulator trainer, engineering data and maintenance data.

David Clark Co., Inc., received $199,638 for full pressure altitude suits.

The Four Wheel Drive Auto Co. received $919,525 for prime mover for the TM 76A missile system. Semiconductor Div., Radio Corp. of America, received $100,000 for development of high temperature, semiconductor devices; $400,000 for production refinement of four types of semiconductor devices, transistors and diodes for engines controls for missiles, space vehicles.

American Machine & Foundry Co. received $48,714 for research services and reports on development of a set of physical vulnerability probability computers.

Air Mod Corp. received $528,297 for services and materials for conversion of USAF STRATCOMSYS centers from neutral to polar signaling.

(Leonard Anderson Associates, Inc. received $28,020 for production of motion picture entitled "Force for Space."

General Ceramics Corp. received $63,381 for development and manufacturing methods for production of miniaturized high voltage transformer terminal.

Applied Science Laboratories, Inc. received $154,936 for experimental hydrocarbon fuels, to be used in full-scale and engine tests etc.

A/C Spark Plug Div., General Motors Corp., received $1,162,658 for product improvement of the 107 inertial floated gyroscope to increasing its reliability and performance.

Electronic Systems Div., Sylvania Electric Products Inc., received $346,572 for ECM attachments to the AN/GPS-T2 radar simulator.

Patterson-Moos Div. of Universal Winding Co. received $98,053 for infrared gas detection cell.

Thiokol Chemical Corp., Utah Div., received $1,008,475 for M-16E-1 rocket engines in support of *Matador* missile program.

By Cambridge Research Center, ARDC:

The President and Directors of Georgetown College, Washington, D.C. received $45,000 for research directed toward application of photographic plates of artificial earth satellites for geodetic purposes.

Weston College, Weston, Mass., received $74,000 for research directed toward experimental determinations of ionospheric characteristics using satellite radio transmission.

Massachusetts Institute of Technology, Cambridge, Mass., received $150,000 for theoretical and experimental research in thermoelectricity.

Columbia University, New York, N.Y., received $30,000 for experimental and theoretical study of elastic wave propagation.

By HQ, Middletown Air Materiel Area:

Gas Industries Inc., Allentown, Pa., received $1,591,296 for liquid oxygen and liquid nitrogen.

British and U.S. Firms To Share Missile Data

Two leading British and American manufacturing companies recently announced that they would share technical knowledge and manufacturing techniques.

The companies are Armstrong Siddley Motors, Ltd. of London and Beaver Precision Products of Detroit. Beaver is a leading designer and manufacturer of precision actuating mechanisms used in production of missiles, aircraft, machine tools and instruments.

First Operational Firings Of *Regulus* Scheduled

First operational firings of *Regulus* II from a submarine are scheduled for some time in September off the Navy's Point Arguello facilities. Impact area will be in Utah.

The missile will be fired from the Grayback, which was re-designed during construction to accommodate *Regulus* II.

Demonstration firings already have been carried out, and test shots utilizing a weight load equal to the missile and employing solid propellant boosters have been conducted in San Francisco Bay. The firing next month will be the first shot with the missile approaching its full 1,000 mile range.

Pershing Subcontracts Show Program on Time

The naming of four major subcontractors for the solid propellant *Pershing* missile system by the prime contractor, Martin Company of Orlando, points up the varied and numerous companies engaged in the missile industry.

Bendix Eclipse-Pioneer Division, Teterboro, N.J., will build the inertial guidance system, stable platform and associated equipment. Bulova Watch Company, Long Island, N.Y. received the subcontract for the complete nuclear warhead field adaptation kit, including fuzing, safety and arming, checkout equipment, field handling and shipping containers, and power supply system, independent of the missile's auxiliary power.

Thiokol Chemical Corp., Huntsville, Ala. will design, develop and produce the *Pershing* propulsion system, using facilities at Redstone Arsenal in early stages. Thompson Products Accessories Division, Cleveland, Ohio, will make the transporter-erector-launcher.

The sub-contracts were awarded on a cost-plus fixed fee and will eventually cover four years. Best estimates for first production prototypes for tactical use is late 1962. First test firings probably will be scheduled in late 1960.

Missile Contracts Awarded Totaling $18 Million

Three contracts totaling $18 million have been awarded recently by the Army and Navy for missiles and missiles systems.

The Army awarded two contracts totaling $5.6 million to Hayes Aircraft Corp., Birmingham, Ala., for the *Jupiter* program. For production of ground service equipment, $2.3 million; for design and engineering services, $3.2 million.

Western Electric of New York City has received two contracts totaling $6.9 million from the Army for *Nike-Ajax* and *Nike-Hercules.* This work will be done in Winston Salem, N.C.; Whippany, N.J.; and Santa Monica, Calif.

The Navy has awarded a $5.5 million contract to Chance Vought for radar matching systems.

EIA Announces Increase Of Transistor Sales

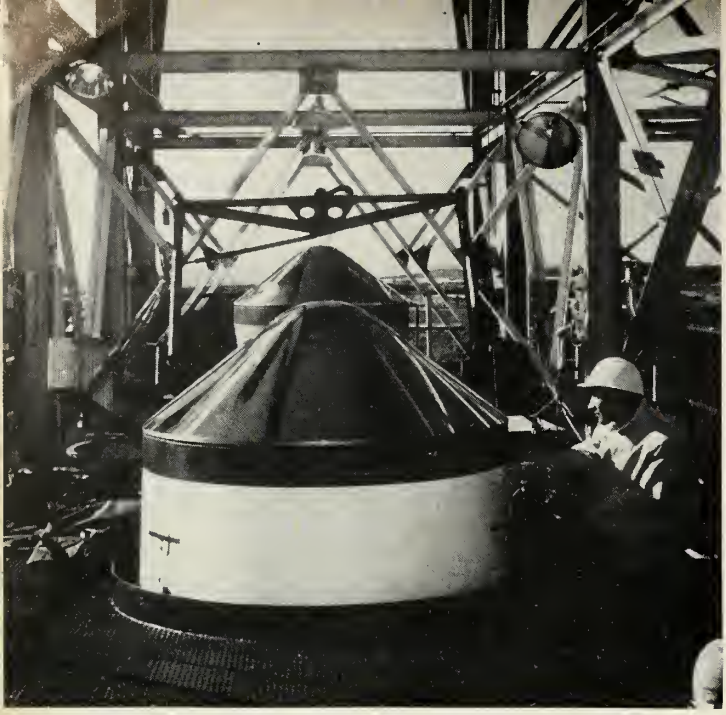
Factory sales of transistors increased in June over the May level, the Electronic Industries Association has announced. Cumulative sales of these semiconductor devices increased substantially during the first half of this year over the high level recorded by EIA during the 1957 period.

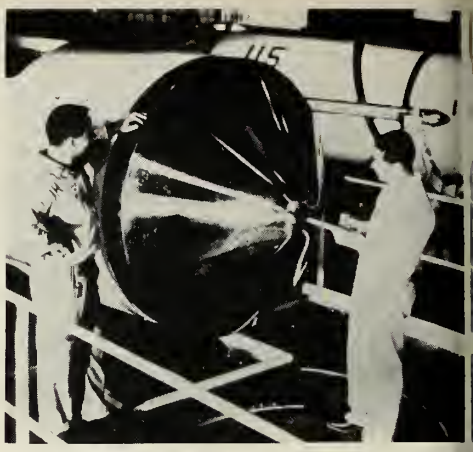
Factory sales of transistors in June totaled 3,558,094, with a dollar value of $8,232,343, compared with 2,999,198 valued at $7,250,824 sold in May, and 2,245,000 units valued at $6,121,000 sold in June a year ago.

Cumulative sales of transistors during the first six months of this year totaled 18,452,324, valued at $42,845,056, compared with 11,199,300 units valued at $31,249,000 sold during the first half of last year.

The following EIA chart shows factory sales of transistors in June and the first half of 1958:

	1958 Sales (units)	1957 Sales (units)
January	2,955,247	1,436,000
February	3,106,708	1,785,300
March	2,976,843	1,904,000
April	2,856,234	1,774,000
May	2,999,198	2,055,000
June	3,558,094	2,245,000
TOTAL	***18,452,324***	***11,199,300***





ENGINEERS MATE the nose cone to the missile at the Douglas hangar of the flight test center.

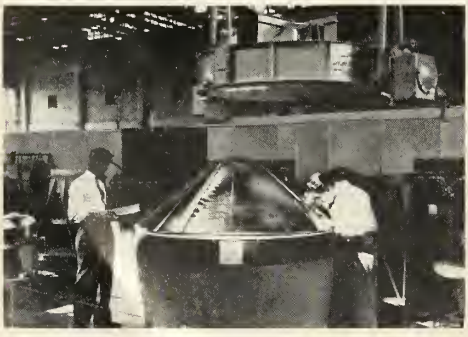
←

FLIGHT TEST PERSONNEL maintain a constant watch while readying a *Thor* nose cone for a test.

Nose Cones: The Blunt Approach

Within the last few days, the Air Force has made public revealing photos of the nose cones developed and fabricated by the General Electric Co. An outstanding disclosure made simultaneously was the announcement that the entire *Thor* program was developed around a nose cone which could be used not only for the *Thor* IRBM, but also for the *Atlas* ICBM.

Utilizing the heat sink principle, final designs show a broad, blunt shield that is designed to provide the high drag needed to combat the high temperatures of re-entry velocities.



EVERY CONE arriving at the Cape receives a "pit-plotting" inspection for possible shipping damage.

AIR FORCE CREWMEN match a missile nose cone to a simulated *Thor* instrument section at General Electric's Ordnance Systems.

Name the Ground Support Job

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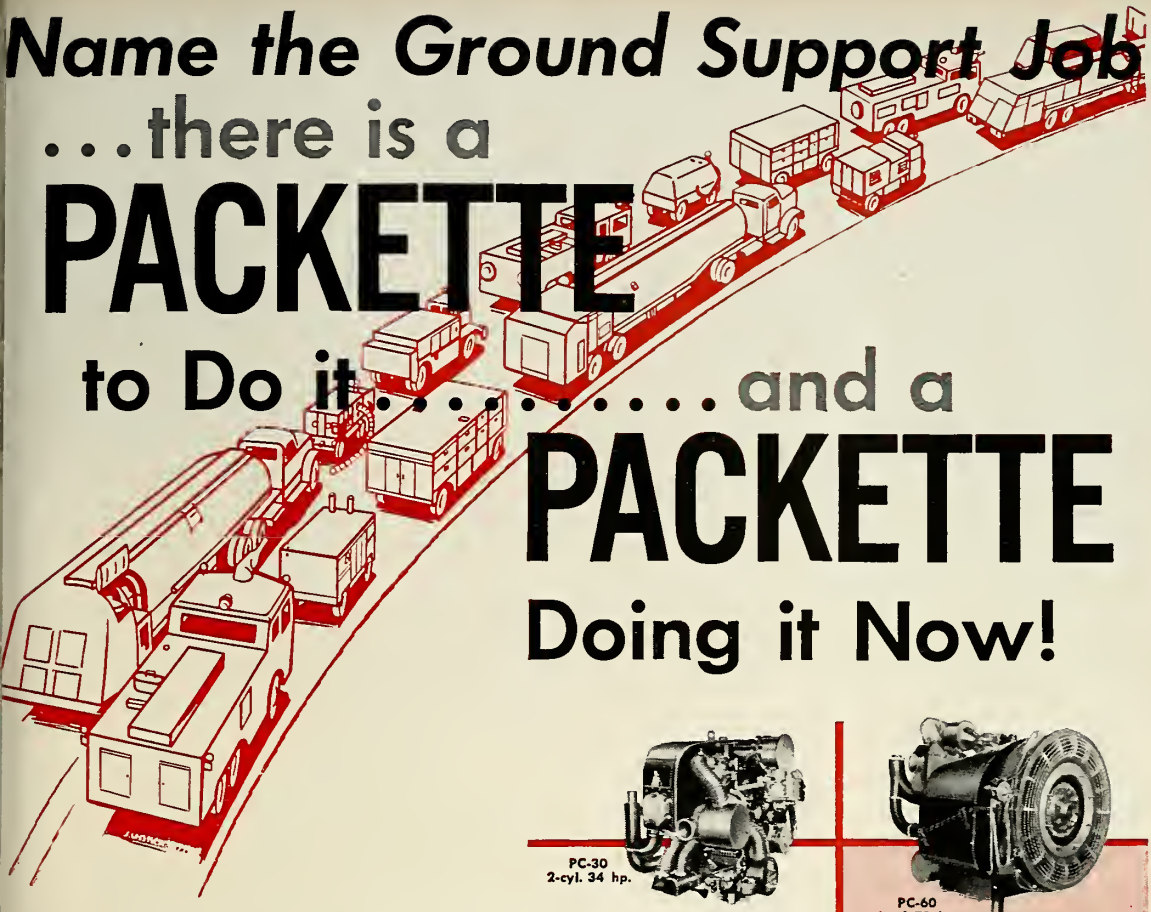

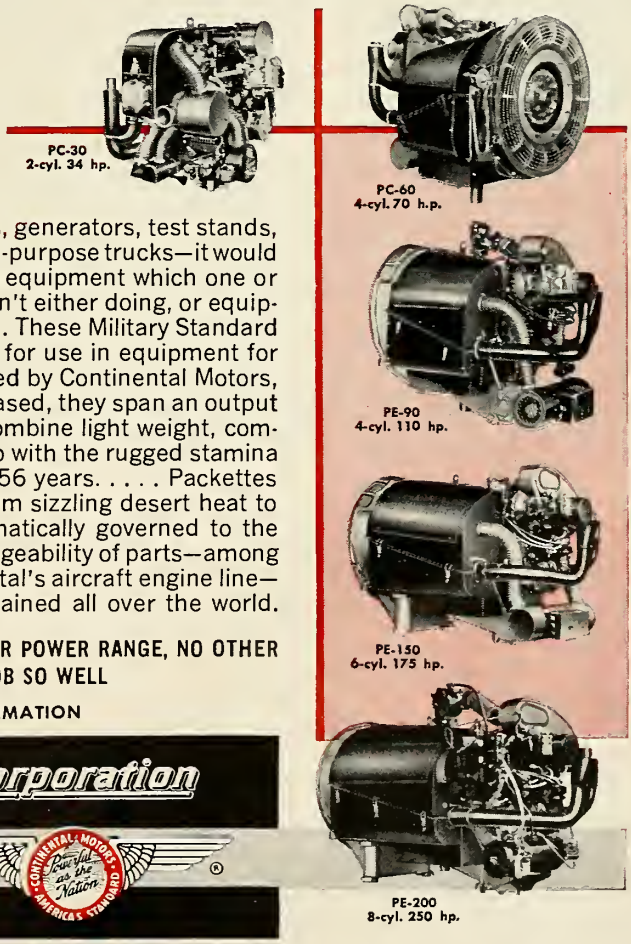

Air conditioners, crash trucks, compressors, generators, test stands, refuelers, heaters, blowers, Rollagons, multi-purpose trucks—it would be hard to name a type of ground support equipment which one or another of the five Continental Packettes isn't either doing, or equipped to do, better than any other engine. . . . . These Military Standard power plants (Mil. E-6449-A) are approved for use in equipment for all branches of the Armed Forces. Developed by Continental Motors, on whose aircraft engine models they are based, they span an output range from 30 to 250 horsepower. They combine light weight, compactness, and ease of servicing and upkeep with the rugged stamina for which Continental has been known for 56 years. . . . . Packettes are built to operate in any temperature from sizzling desert heat to 65 below zero, power output being automatically governed to the load. They feature unusually wide interchangeability of parts—among themselves and among models in Continental's aircraft engine line—and complete supplies of parts are maintained all over the world.

In short, IF THE APPLICATION FALLS WITHIN THEIR POWER RANGE, NO OTHER POWER PLANT WILL DO THE JOB SO WELL

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5836-A

AMERICAN BOSCH ARMA CORPORATION

propulsion engineering

by Alfred J. Zaehringer

Tank car shipment of LOX and other liquefied gases may be near. Linde Co. is to make available new insulation techniques, cryogenic pumps, and know-how to build railway tank cars. Could mean more and cheaper LOX for blossoming rocket test work.

Pre-mixed bipropellants? Ohio State University has successfully fired pre-mixed gaseous hydrogen and oxygen in a test rocket engine at pressures of 200-300 psi. Mixtures ranged from fuel rich to stoichiometric. Small amount of oxygen, however, is needed to keep flame from propagating back to storage tank. Such techniques may eventually make possible a practical monopropellant liquid rocket. Ohio State is also believed to have conducted tests of fuels in liquid oxygen and non-hypergolics in nitric acid.

Look to Phillips Petroleum to enter the liquid monopropellant picture. Phillips is already working on an Air Force research contract and sees single and two component possibilities. The single component approach may be a pure liquid such as a nitrated or halogenated organic. The two component system dissolves a solid in a liquid (viz., ammonium nitrate in ammonia) or a liquid in a liquid (viz., nitropropane in nitric acid). Others working on liquid monopropellants: Aerojet; American Rocket; Experiment, Inc.; Food Machinery; Hughes Aircraft; JPL; NARTS; Reaction Motors; Stauffer; Sundstrand; and Wyandotte Chemicals.

Aluminum alkyls are currently under test at Rocketdyne's Santa Susana rocket complex. Great concern, however, is over toxicity in large concentrations for prolonged periods. Possible use: ignition aid additive for hydrocarbon, alcohol, and amine fuels with LOX. Big problem is still auto-ignition in air.

Radiation effects on combustion at high altitudes could lead to problems. Two high energy radiation belts have been discovered by rocket soundings at about 12 and 26 miles. Batelle has found that radiation can break down boundary films in combustion gases and could cause combustion instability in turbojets, ramjets, and rockets. Air Force is quite concerned.

Free radicals are still too free. A recent AFOSR-Aerojet meeting in Los Angeles revealed more complications in understanding the instability of free radicals. In NBS work with free nitrogen at solid nitrogen temperatures, three basic reactions were found: transitions between metastable states, interaction between free atom and nearby molecule, and coupling beween free atom impurities and nitrogen molecules. Result: nobody has yet come near a laboratory stabilization method.

More ammonium perchlorate for solids is shaping up. HEF, Inc. is starting construction on its multi-million pound-per-year AP plant at Columbus, Miss. Lithium perchlorate will also be made, though on a small scale. HEF is a joint venture of Hooker Electrochemical and Foote Mineral.

Air-quenchable tool steels with ultimate tensiles of near 300,000 psi for high-strength, thin-walled solid motors are near, say Solar Aircraft engineers. Coatings on cheaper steels may also be important.

Nozzles for solid rockets are the critical factor, also. A big breakthrough is needed to drastically reduce weights on present heavy nozzles, particularly on high-thrust, long burning time units. Cooling is rough when burning time gets over 30 seconds. Nozzles, already critical on *Polaris*, will need new approach on *Minuteman*.

Cavitation detector for liquid propellants has been developed by AiResearch. For use in missile ground test systems or flight test vehicles, the detector can sense bubbles 50 mils in diameter in a 6 inch diameter line. It can also detect foreign particles such as sand.

National Guard Units To Take Over *Nike* Sites

National Guard Units will take over operation of *Nike* guided missile sites around Los Angeles in September, the Army has announced. This will inaugurate a program for operation of air defense missiles by Guardsmen.

For the first time, the Army identified states other than California where National Guardsmen will take over operation of some anti-aircraft guided missile installations. They are:

Connecticut, Illinois, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Washington, Wisconsin, and Washington, D.C.

The California Guards's 720th anti-aircraft missile battalion will take over four *Nike* sites in the Los Angeles area.

Redstone Probably Used In Nuclear Test Blast

A *Redstone* probably was used in the recent Johnson Island test of the explosion of a nuclear warhead in space.

Part of the Atomic Energy Commission's Hardtack series of nuclear tests in the Pacific, the blast was the first exploratory effort to determine how a nuclear explosion works at high altitude. The warhead reportedly exploded at an altitude of about 100 miles.

Nuclear explosions in space are being researched for their applicability in the nation's anti-ballistic missile defense system. It is believed, by some scientists, that high-energy neutrons generated by an atomic blast could travel great distances in space and could trigger an incoming ICBM while it is on its ballistic flight path.

Reduced Costs Seen For Satellites In Space

The costs of putting satellites into space may be reduced soon, according to Dr. H. J. Stewart, division chief, design and power plants department, Jet Propulsion Laboratories. Speaking at the recent Third Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Dr. Stewart pointed out that it now takes 3,000 lbs. of starting equipment to put one pound of satellite aloft.

"With even low level technology, we shall soon be able to bring the ratio down to 100 to 1 and perhaps as low as 25 to 1," he predicted. Much of the data necessary for solving space age problems will be furnished by photographic instrumentation systems, Dr. Stewart declared.

Navaho System Guides *Nautilus* Exploit

The recent trip of the atomic submarine *Nautilus* under the polar ice cap pointed up a fact of major importance: the ship was guided by a system developed for a defunct missile—the Air Force *Navaho*. Thus, despite cancellation of the weapon, its guidance system has been converted to other defense uses.

The system that guided the *Nautilus* was the pure inertial guidance system originally developed for *Navaho* by the Autonetics division of North American Aircraft.

It contsists of a platform stabilized by three liquid-floated gyros and mounting three pendulous integrating accelerometers. The accelerometers sense deviations from a predetermined course, in three dimensions, and their signals are fed into computers which determine the corrections to be applied to the submarine. When the submarine is again on course, a null results in the accelerometer error signal output and no corrective signals issue from the computers.

• **Four days**—The outstanding fact of this announcement is that the inertial system operated for four days, although most inertial systems for ballistic missiles are required to work for not much more than 30 minutes.

This means that a system such as the *Navaho* could be used for moon flights without the addition of stellar correction, as is needed in the *Snark*. Designers will be able to insert the flight program into the guidance system on the ground, confident that the moon vehicle will correct itself for gyro.

Officials at North American have confirmed that the company is also manufacturing similar systems for nuclear submarines now under construction in the *Polaris* program. How this will fit in with the Sperry SINS (Shipboard Inertial Navigation System) was not announced, but it is known that the SINS depends on occasional stellar correction for pinpoint position.

It might be that the North American system will be used for general navigation and the Sperry system for actual missile firing. This is borne out by the fact that the SINS actually sets the azimuth of the *Polaris*.

The guidance system is not the only element of the *Navaho* that is contributing to the defense effort. North American is the engine partner on the Boeing Dyna-soar team, and it is reported that the 400,000 lb. booster used on the *Navaho* might be the main propulsive force used to get the Dyna-soar off the ground.

Project Manager For *Minuteman* Announced

Appointment of Jesse Y. Bowman as Autonetics Project Manager for the USAF *Minuteman* missile's guidance and control system has been announced.

Selection of Autonetics, a division of North American Aviation, Inc., to develop the *Minuteman* missile's guidance and control system was announced recently by the Air Force.

U.S. Navy

STEERING UNDER ICE, with data supplied by missile guidance system, are Lt. S. N. Jenks (left), navigator, and Cmdr. W. R. Anderson.

LONG distance firing controls, as . . .

SAGE Guidance Is Teamed With *Bomarc*

The first computer for SAGE (Semi-Automatic Ground Environment) an Air Force detection and communication system designed for coordinated defense against air attack, has been teamed with the *Bomarc* surface-to-air missile in a successful long distance test.

The SAGE computer, located in Kingston, N.Y., was used to fire and guide the interception of *Bomarc* from the long-range test site at Cape Canaveral, Fla. The Kingston-controlled test was set up to determine the compatibility of the *Bomarc* control and guidance and the SAGE computing system. The Air Force reported the successful completion of a planned near-miss interception by the missile with an airplane target drone over the Atlantic.

The earlier *Bomarc* test missions were controlled from a Boeing-designed ground guidance center at Patrick AFB. Last month the Kingston SAGE center began monitoring the Florida controlled launchings.

The distance between the *Bomarc* launching site and the SAGE system is of little importance. A telephone communications system connects the computer with the radar which searches for the missile's target, and the surface-to-air transmitting station at the missile site. "Instructions" are transmitted through an IBM card system between radar, computer and missile without human intervention.

The SAGE system of ground control will make it unnecessary for each missile base to have its own control center. When fully operational, there will be about 30 SAGE direction centers.

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WESCON to Highlight Three Special Sessions

With more than 900 exhibit booths and 42 technical sessions scheduled, the 1958 Western Electronic Show and Convention (WESCON) will open August 19, in Los Angeles, Calif., sponsored by the 7th Region, IRE, and the West Coast Electronic Manufacturing Association.

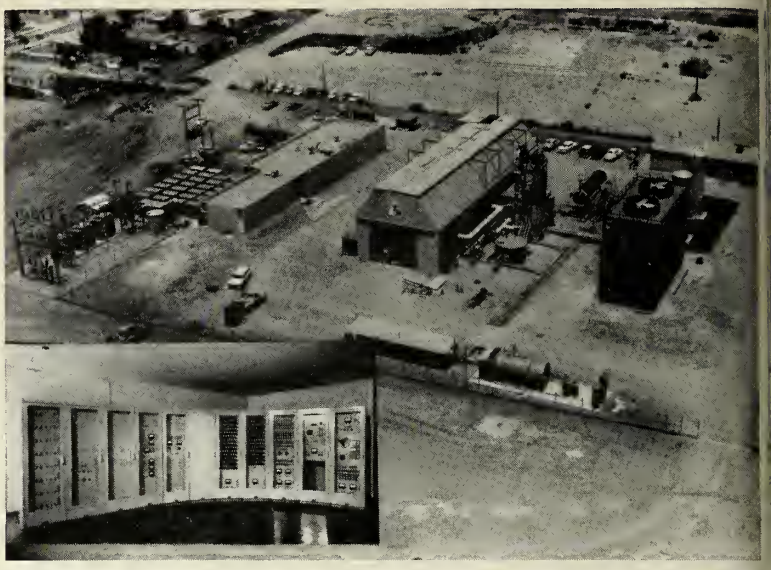
In addition to the standard presentations, three special sessions are scheduled. One, "Industry Looks at Fusion Power," will consist of a panel discussion with Robert Hughey, AEC, as moderator. Speakers will be Henry Hurwitz, General Electric Co.; Samuel Cunningham, General Atomics Corp.; and William J. Lange, Westinghouse Electric Corp.

The second special session, "Biological Measurement in Space Travel," will be moderated by Dr. Robert Tschirigi, UCLA. Panel members will be Brig. Gen. Don Flickinger, special assistant for bio-astronautics, ARDC, Washington, D.C.; Dr. Blaine H. Levedahl, assistant professor of zoology, UCLA; Dr. Albert Walter Heatherington, technical advisor, Human Factors Div., ARDC, Baltimore; Miss F. Van Der Wal, technical staff, Ramo-Wooldridge; and Frank W. Lehan, consultant to Space Technology Laboratory, Ramo-Wooldridge.

Arrangements are made for still another special session, "Project Management—Airframe or Electronics." This timely and controversial subject will be presented in panel form, moderated by Col. Edward N. Hall, USAF Ballistic Missile Division, Inglewood, Calif. Speakers will include George Stoner, weapons system project manager, Boeing Airplane Co.; Oscar Simpson, manager, Western Development Laboratory, Philco Corp.; and Richard L. Shetler, manager, Missile Guidance, Defense Electronics Div., General Electric, Syracuse. Sponsored by the IRE professional group on engineering management, the panel is "charged" with clarifying the positions of the airframe and electronics industries.

Eight field trips are being offered to delegates. These include a visit to Litton Industries; Thompson Products in Inglewood; Helipot Corp. and Altec-Lansing; March AFB; Beckman Systems Div. and Hallamore Electronics; Hughes Standards Laboratory; and a tour through an Air Force RC-121D Lockheed Super Constellation AEW aircraft at Burbank.

• **Technical sessions**—In the technical sessions, heavy accent will be placed on reliability, microwave theory and techniques, and solid-state electronic components.



ENGINEERS ATTENDING Western Electronic Show and Convention at Los Angeles, Aug. 19-22, will make a field trip to the Thompson Products missile systems ground test facility in Inglewood. Inset shows a laboratory section capable of handling 800 channels of information on electronic data processing and acqusition systems.

The reliability sessions include a panel discussion, "Contract Implications of Military Electronics Reliability Requirements," moderated by E. J. Nucci, Office of Assistant Secretary of Defense.

In a paper, "Design Techniques for Upgrading the Reliability of Weapon Systems During Flight-Readiness Checkout," Melvin Patterson, Radioplane, will point out that system contractors have been slow to recognize the importance of design refinement in electronic support equipment. Powell will also emphasize the need for checkouts that project future performance, rather than present.

Reliability specifications and related acceptance tests must be better understood by those who use the test results, says Cliff Ryerson, RCA, Camden, who will speak on "The Confidence That Can Be Placed on Various Reliability Tests." Ryerson will explain such specs as Mil Standard 105 tables, and sequential sampling techniques.

Some conventional methods for determining reliability are inadequate in terms of improvement vs. the engineering effort expanded, declares James H. S. Chin, Sperry Gyroscope Co. Chin will describe the new technique of group redundancy and its relation to product improvement, in terms of engineering effort.

• **Microwave theory**—The 10 papers on microwave theory and techniques will include "Mode Conversion Filters," by E. A. Marcatili, Bell Telephone Labs; "Properties of the H-Guide for Microwave and Millimeter Waves," by F. J. Tischer, Ohio State University; "Power Handling Capacity of Slab Lines," by G. Badoyannis, Sperry Gyroscope Co.; "RF Circuits for a Voltabe-Turnable Magnetron," by W. J. Gemulla, Electronic Defense Laboratory; "An S-Band Two-Phase Demodulator," by Robert B. Wilds, Sylvania Electric Products, Inc.; "Solution of Some Microwave Problems By an Analog Computer," by Donald M. Byck, EAI Computation Center, and Allen Norris, Varian Associates.

New artificial dielectrics are needed for construction of large-scale microwave lenses such as a Luneberg lens, according to Ming-Kuei Hu and David K. Cheng, Syracuse University. The units should be lightweight, isotropic artificial dielectrics with a controllable refractive index.

The speakers will suggest such a device, which is a random arrangement of a large number of artificially made lightweight elements in the form of two concentric spherical shells. The outer shell is a dielectric material, and the inner shell is made essentially of conducting material. The proposed dielectrics are believed to be favorable with other known types in homogenity, bandwidth, loss and cost.

When men push off for Space, they will need the absolute accuracy of inertial and stellar-inertial guidance systems to navigate in the trackless void. Working with the Air Force, Autonetics has spent 12 years bringing both to their present high state of development. Autonetics made America's first successful flight test of an inertial guidance system in 1950. Since then, more than 800 successful flight tests have demonstrated the reliability of a series of ever-improved systems. Today Autonetics has the basic know-how and hardware America needs for Space navigation.

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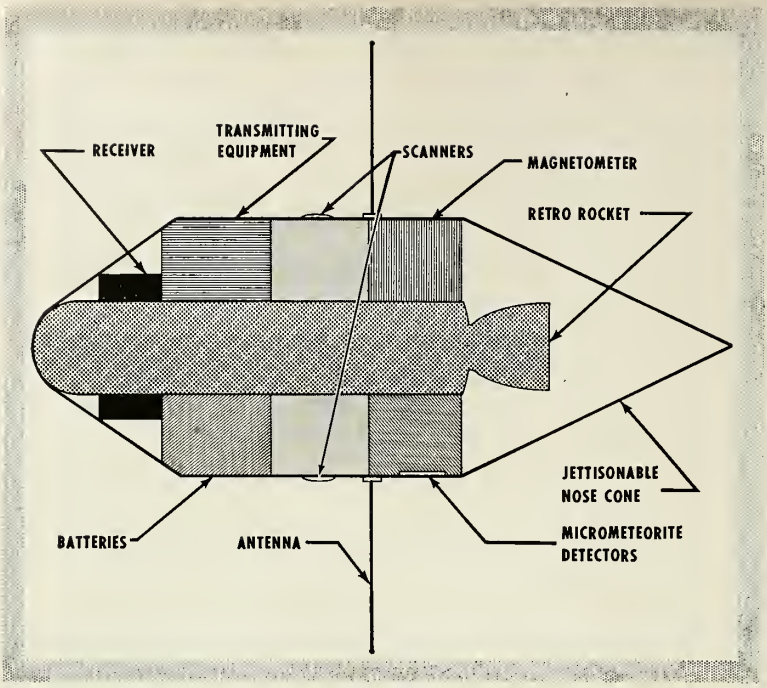


PROBE COMPONENT of Air Force's Lunar shot might look like this sketch, drawn by m/r's staff artist. Cross section indicates "doughnut" shape of probe.

Moon Probe Readied For Launch

by Raymond M. Nolan

Despite the fact that the Lunar Probe attempt (in countdown as m/r went to press) is labeled a "scientific experiment" with no military significance, the Advanced Research Projects Agency and the Department of Defense have been extremely chary of releasing any details.

This much is known:

The first Lunar Probe vehicle is a *Thor-Able* combination with a *Thor* IRBM as the first stage, a radically modified *Vanguard* second stage, and a high-energy solid propellant third stage.

On top of this is the probe, described by ARPA's chief, Roy Johnson, as "doughnut-shaped," but more probably resembling the cross-section sketch shown here. The probe will contain a retro rocket (forward firing) to slow it down when it is in proximity to the moon. It will also attempt to place it in orbit on the moon.

Instrumentation for the photography the Air Force hopes to accomplish includes:

- one or more photo-electric scanners,
- a vidicon tube to record the scan,
- radio equipment and batteries to beam the information back to earth,
- a magnetometer to check the magnetic field of the moon (if any)
- a micrometeorite detector.

Transmission will probably be accomplished by four whip antennas working on a frequency around 2250 Mc/s.

• **Transmission**—Several approaches could be used for scanning, if the shot is successful. One picture could be taken as the probe made its first, and possibly its only orbit, and then play back to earth slowly over a period of two hours. Or a number of pictures could be taken, with playback occurring between pictures.

The probable size and weight of the probe indicate that transmitting equipment will have a power level of 3 to 10 watts in the power stage of the transmitter, with about 30 to 40% effective radiation off the antenna. Tracking stations will include the radio telescope in Manchester, England, and stations in San Diego, Hawaii, Singapore, and Cape Canaveral.

• **Firing sequence**—If things proceed according to schedule, the sequence will go something like this:

As the countdown ends, the *Thor-Able* will be fired on a vertical trajectory and tilt to its proper pitch angle during the powered phase of its first stage.

When the first stage burns out and separates, the remaining stages will coast for a short time, and then the second stage will ignite (presumably any deviations from a proper course will be corrected by equipment in the second stage.)

The second stage will burn out and separate, leaving the third stage and probe traveling at 18,000 mph.

Another coasting period will ensue, and then the third stage will ignite, providing the additional boost needed to achieve 25,000 mph.

Finally, the long, unpowered, unguided flight of a little more than two and one-half days.

As the probe nears the moon, a scientist at a post in Hawaii will touch a button to ignite the retro rocket, slowing the probe down to a velocity which will allow it to be captured by the moon's gravitational field. If this is successful, the probe will go into orbit. How long it remains, or where it goes after orbiting one or more times, is anybody's guess.

• **Fifty-fifty**—ARPA Chief Scientist Herbert York estimates the chances of the Lunar Probe going into orbit at something around 50%; of missing the moon entirely and continuing on into space, about 25%. ARPA Chief Roy Johnson uses a little different figure and guesses success to have a "1 in 10" chance.

This probe will be the first of three attempts by the Air Force and will precede the Army's projected two attempts by a couple of months. Reports are that the Army is presently by-passing its lunar probe program in favor of more *Explorers* to investigate the band of intense radiation uncovered by the first earth satellites.

When the Army does fire its probe, the first stage of the *Juno* II vehicle will be the *Jupiter* IRBM, with upper stages identical to the *Explorer Jupiter-C* (or *Juno* I) vehicles.

These consist of a circle of 12 scaled-down *Sergeant* missiles as a second stage, surrounding a cluster of three scaled-down *Sergeants* as a third stage, and supporting a single scaled-down *Sergeant* as the fourth stage.

Unlike the *Thor-Able* which will assume its attitude in the air, *Juno* II will be trained in azimuth on the ground and fired in the optimum direction. Its probe will be a single-pass affair, designed to take one picture and transmit it back to earth. No additional instrumentation will be carried.

After the picture is taken and sent back, the probe, its batteries dead, will take an unknown course.

Britain, Red China Enter Satellite Race

by Frank G. McGuire

Increasing reports are circulating in Western countries concerning the possibility of the Red Chinese launching artificial earth satellites.

The president of the Chinese Academy of Sciences, Mr. Kuo Mo-Jo, has stated that "China's scientists are determined to get China's artificial earth satellite into the sky at an early date."

Observers here and in Great Britain are inclined to regard the statement with some respect, noting that the political advantages of such a launching would be tremendous. Scientists in Great Britain are advocating the launching of a British satellite, to offset the propaganda onslaught which would result.

Soviet technicians and launching vehicles would likely be used in the operations, and perhaps the only part of the feat which would really come from the Soviet-bloc countries would be the instrumentation of the satellite itself.

For this reason, The British Interplanetary Society is strongly pressing for establishment of a British space flight program. Government sources in London have confirmed that there are hopes of using some of Great Britain's larger powerplants as satellite-launching vehicles. Those under consideration include the *Black Knight* and *Blue Streak* rocket engines.

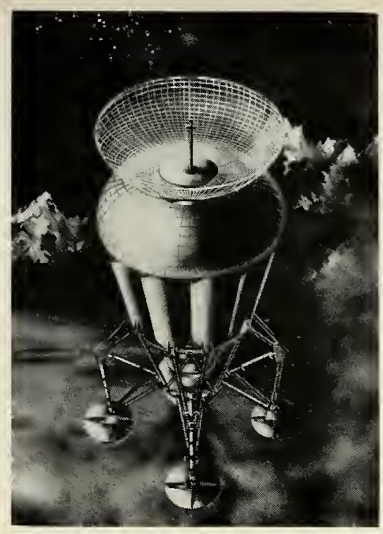
The B.I.S. has pointed out that despite the fact that minimum orbital satellites were proposed by its members as early as 1951, there still is no real program in existence to launch a satellite as soon as possible.

Prof. A. C. B. Lovell, director of the radio-astronomy station at Jodrell Bank, said the United States has plans to "sell space" in its satellites to underdeveloped countries.

Although admitting that it would be "ludicrous" for Great Britain to attempt a space flight program of the magnitude of either the U.S. or the Soviet Union, the British Interplanetary Society proposes that work be carried on beyond the present *Skylark* upper-atmosphere research program and current missile projects.

The B.I.S. maintains that the question that remains unanswered is—"How long can we afford to ignore space research without seriously harming our scientific stature and without seriously impeding new avenues of research which will become increasingly vital to us in the future?"

At a recent youth conference, the 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."

Titan Guidance System Contract for *Atlas* OK'd

The Air Force is expected to use all-inertial guidance for the *Atlas* intercontinental ballistic missile. This will mean a substantial contract increase for the Arma Division of American Bosch Arma Corp., Garden City, New York, Charles W. Perelle, president, recently announced.

According to Maj. Gen. Bernard A. Schriever, commander of the Ballistic Missile Division, progress made in the development of an all-inertial guidance system for the ICBM by Arma, will result in its earlier introduction into the *Atlas* program than was originally planned.

Opposition Voiced to Missile Planning Reports

The aircraft industry has expressed opposition to the Missile Manufacturers Planning Reports, under consideration by the Bureau of the Budget. (See m/r, August 4, p. 12) Industry spokesmen cited serveral major reasons for their opposition to the forms:

- There are already reports in existence which satisfy "better or equally well" the administrative needs stated by the military services.
- The detailed data required by the MMPR forms is often unavailable.
- The forms would result in duplication of information already supplied on forms AMPR, Program Progress Reporting, WDD56-1, and others.
- It is unfair to ask industry to revise its internal reporting systems merely to satisfy government requirements.
- The use of manhours as a measure of effort is not common to all industries in the missile field.
- It is impossible to develop instructions and definitions which allow for the variation between company methods of operation, and yet provide reliability.
- Considering the variations in company accounting systems throughout the industry in aircraft, electronic, automotive, machinery, and others, much of the information required by the MMPR forms could only be estimated.

Aircraft industry spokesmen also cited various "unresolved areas" left by the MMPR forms: applicability (reporting other than production-status missiles); reporting indirect manhours; reporting by segment; breakdowns into fabrication, subassembly, test, spares, etc.; weight breakdown; reporting of manhours instead of dollars; understandable definitions.

ALMOST INSTANTANEOUS ACCELERATION to 18 Gs is achieved by this Lockheed X-7 missile as it blasts two feet along the rails of this specially designed "G-Shooter" at Halloman AF base. The X-7, used to test ramjets for the Air Force, is the fastest and highest flying air-breathing missile in the free world. Performance details are still classified.

missile people in the news

Charles J. Wiley has been appointed market development manager of Callery Chemical Company. He will be responsible for market activities of chemical products under research and development at Callery, it was announced by the company recently.

William A. Cuddy will head the liquid propellant combustion section in the contract research department of Wyandotte Chemicals' Research and Engineering Division. Cuddy has been a member of Wyandotte's research staff since 1950.

Maxwell C. Scott has been named assistant manager of Buffalo operations for Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc. Scott, who had been manager of the New Amherst Engineering Laboratory, will make his headquarters at the Electronic Systems Plant in Buffalo.

James L. Anast, Technical Director of the Airways Modernization Board, Washington, D.C., will join Lear, Inc. as assistant to the president for technical planning. He will advise the president on advanced engineering and product planning and will maintain liaison on advanced technical matters between the company, customers and government organizations.

Dr. W. T. von der Nuell, former director of DVL Institute for Turbomachinery in Berlin and onetime member of the German Academy of Aeronautical Sciences, has been appointed chairman of a corporate five-man research board, established by The Garrett Corp. The board will review and direct research activity and maintain long-range studies of component system requirements in space. Other board members are: **Dr. John Mason, A. P. Kelley, Hans Egli** and **J. E. Chapman.**

Robert R. Pierce will manage the Corrosion Engineering Products department of Pennsalt Chemicals Corp. He has been with the company for 17 years, working in plant, technical service and sales management.

Rear Admiral James E. Leeper, USN (Ret.) has been named vice president for the Washington area of the Philco Corp. Since his naval retirement in 1956, he has been special representative, TechRep Division of Philco.

Air Materiel Command's Directorate of Procurement and Production has announced a number of re-assignments of officers. New assignments result from retirement of **Col. H. G. Spillinger,** chief, production engineering staff division; **Col. E. H. Wilson,** chief, areonautical equipment division; **Col. John N. Dick,** chief, manufacturing methods branch; **Col. C. L. Munroe,** chief, industrial resources division; and **John W. Schwinn,** assistant to director of procurement and production.

Col. R. O. Mitterling will succeed Col. Spillinger, **Col. M. C. Smith** will succeed Col. Wilson, **Col. Preston L. Hill** will take over Col. Dick's position.

Col. J. L. Zoeckler has been assigned as deputy chief, ballistic missile office, Inglewood, Calif. He will be followed as assistant deputy director for weapons systems by **Col. L. F. Tanberg,** former chief of airlines, maintenance and service contracts division, who will be succeeded by **Col. E. N. Odell.**

Col. T. J. Kennedy takes over the newly-created post as special assistant for industrial equipment to the deputy director of production. **Col. W. R. Carter** is new assistant deputy director of production, resigning his position as chief, production management staff division.

Six Weapons Systems Procurement Offices will receive new chiefs: **Col. E. F. O'Conner,** B-52, will be succeeded by **Col. S. A. Dallas; Col. W. E. Chambers** will take over as chief F-108 from **Col. B. C. Downs; Col. H. M. Harlow** will be new chief of F-102/F-106 in place of **Lt. Col. H. G. Reed.**

Col. P. J. Guhl will succeed **Col. Pirruccello** as chief of transport WSPO and, in turn, will be replaced by **Col. C. E. Moore** as chief of facilities branch of the industrial resources division.

Col O'Conner will go to the Air War College, **Col. Downs** goes to the Directorate's electronic defense systems division at New York. Chief, resources branch will be filled by **Lt. Col. Joe McNeil. Col. R. H. Cobb** will succeed **Lt. Col. R. J. Hagreen** as chief, tactical missiles. **Lt. Col. A. D. Hoover** is succeeded by **Col. B. F. Kelly.**

Jerome E. Becker has joined Kaynar Mfg. Co. Inc. as sales engineer to represent the Kaylock line of self-locking aircraft nuts. His appointment announces the establishment of additional sales and service coverage in the Southern California area.

H. W. Bissell has been appointed to the newly-established position of personnel division manager of Lockheed Missile Systems division. He will assume his new post at the Sunnyvale plant, the company announced.

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

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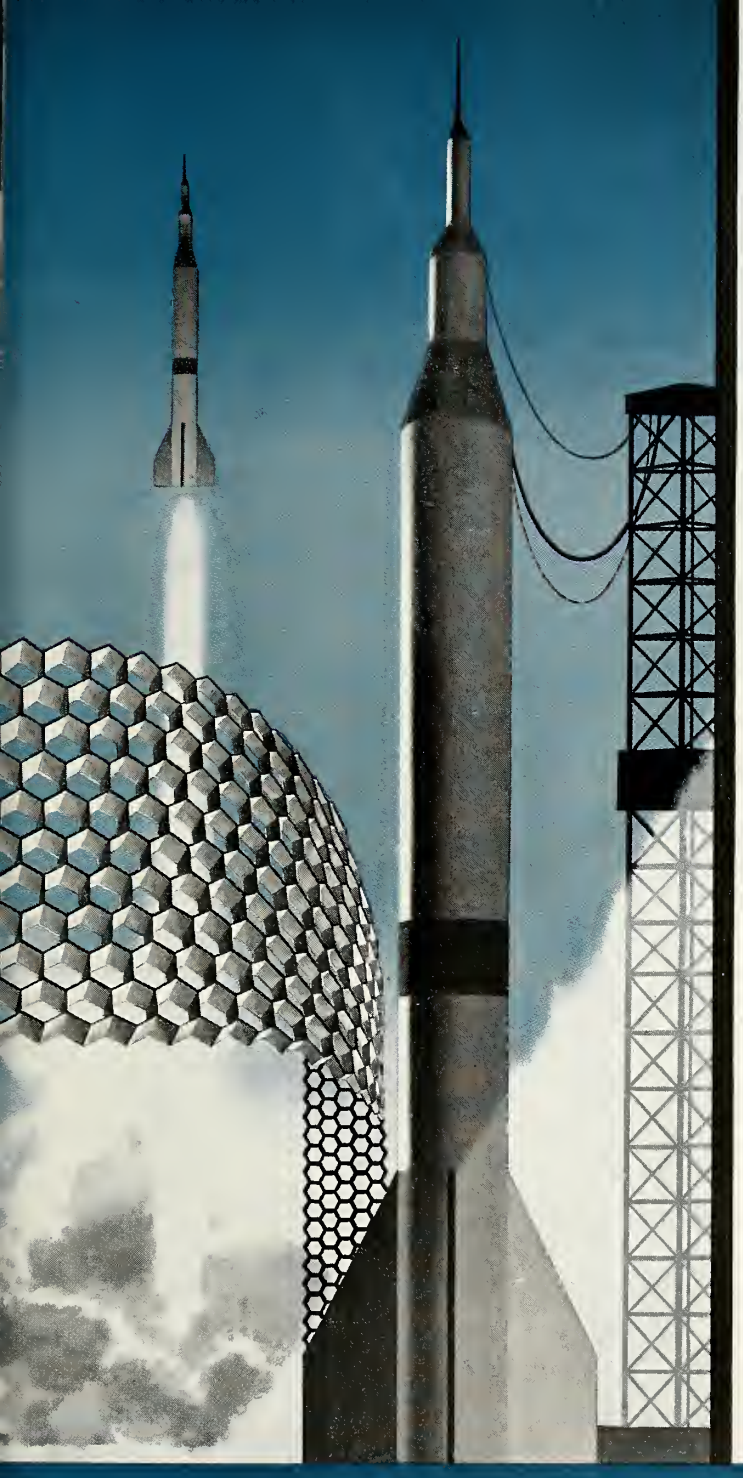


Steel structures for space... from Crosley

Today's missiles require materials that are lighter, stronger and more heat resistant. Such requirements make Avco-Crosley a leading contender for building missile frames and structures.

Avco-Crosley is a pioneer in the development of stainless-steel honeycomb, a structural material that is cutting deep into the "thermal barrier" that so long has limited the speed at which planes and missiles travel through the air.

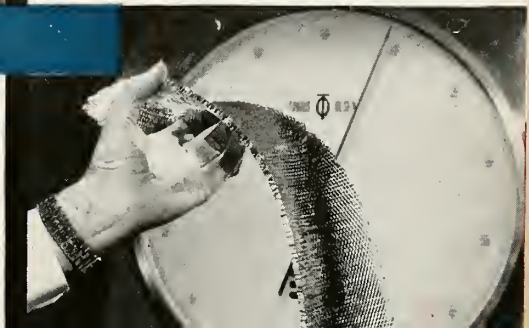
Using stainless-steel honeycomb, it is now possible to build structures with great heat tolerance and high strength/weight ratio: with the strength of solid steel, yet weighing only one-tenth as much.

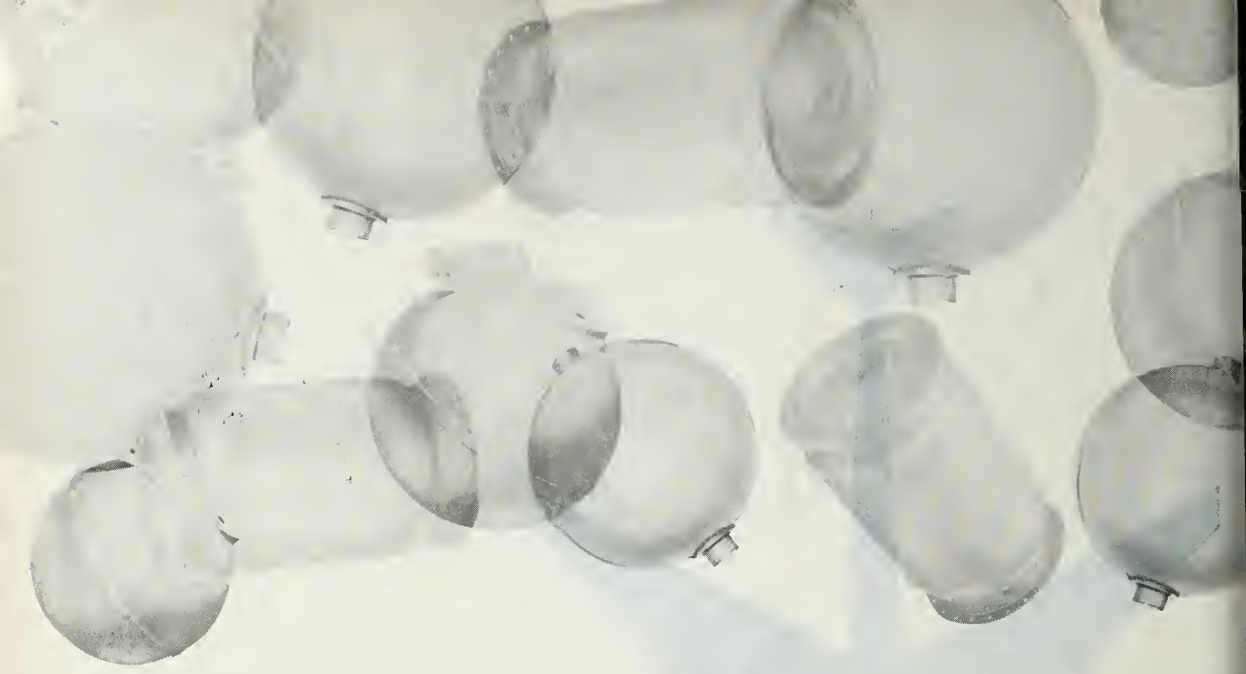
Together with its associated Avco divisions, the Crosley Division now provides facilities and personnel for:

- *Weapon systems management, from initial concept to production.*
- *Research, development and engineering design of: missile nose cones, air frames, electronics, control systems, telemetering, automatic test and support equipment, ground handling equipment and logistics.*
- *Production and manufacturing for missile and aircraft systems.*

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

Avco // Crosley





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