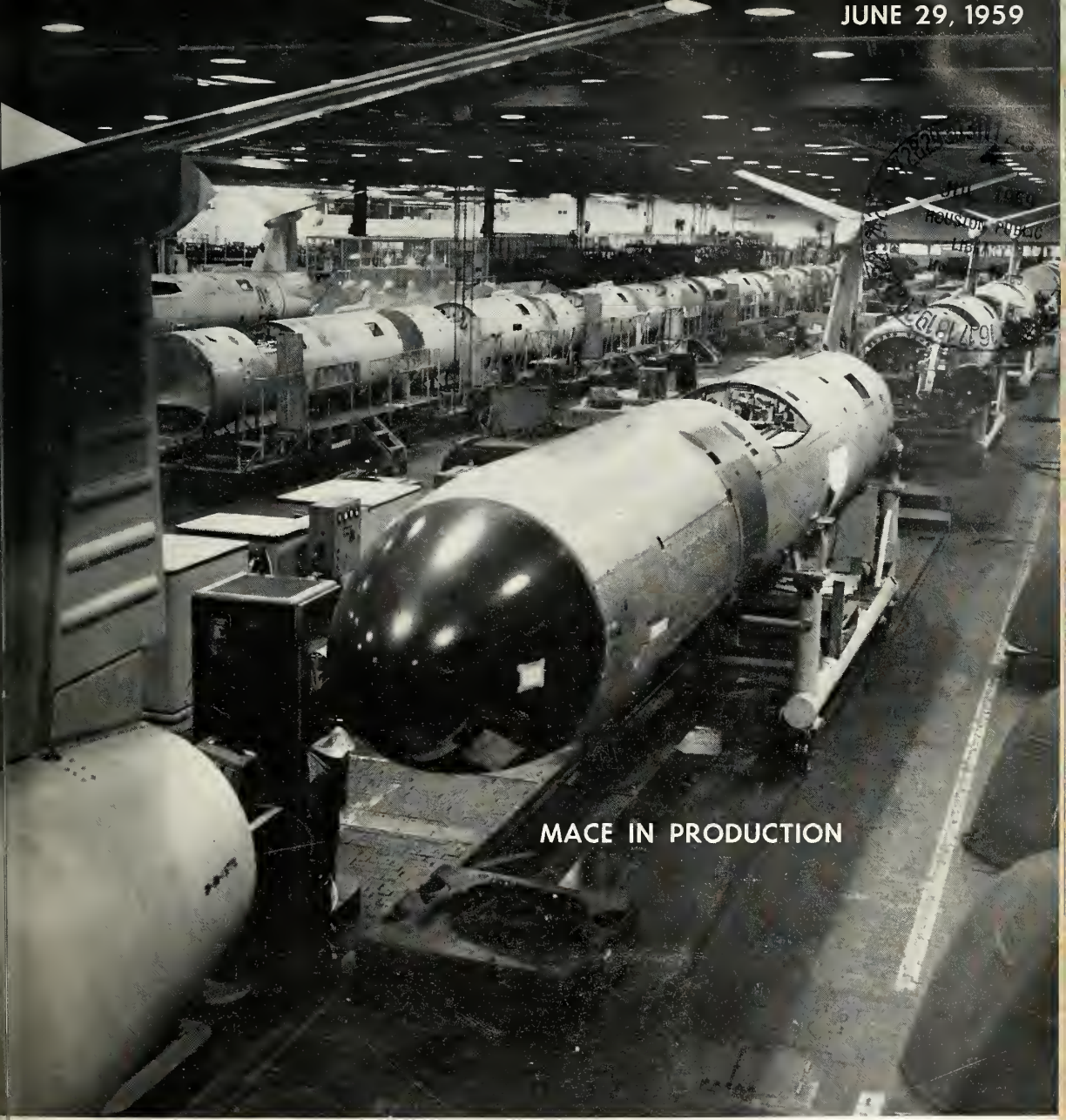
JUNE 29, 1959



MACE IN PRODUCTION

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

A Look at the Munitions Lobby .. 15
Handling 24-Megaton Thrust 16
Paris Show in Pictures 24

AN AMERICAN AVIATION PUBLICATION

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The requirements of accurately tanking missiles with propellants is but one of the areas of fuel management in which Servomechanisms, Inc. has demonstrated capability. *Propellant utilization* and *thrust control* are other areas in which SMI has developed highly accurate and precise measuring and control systems.

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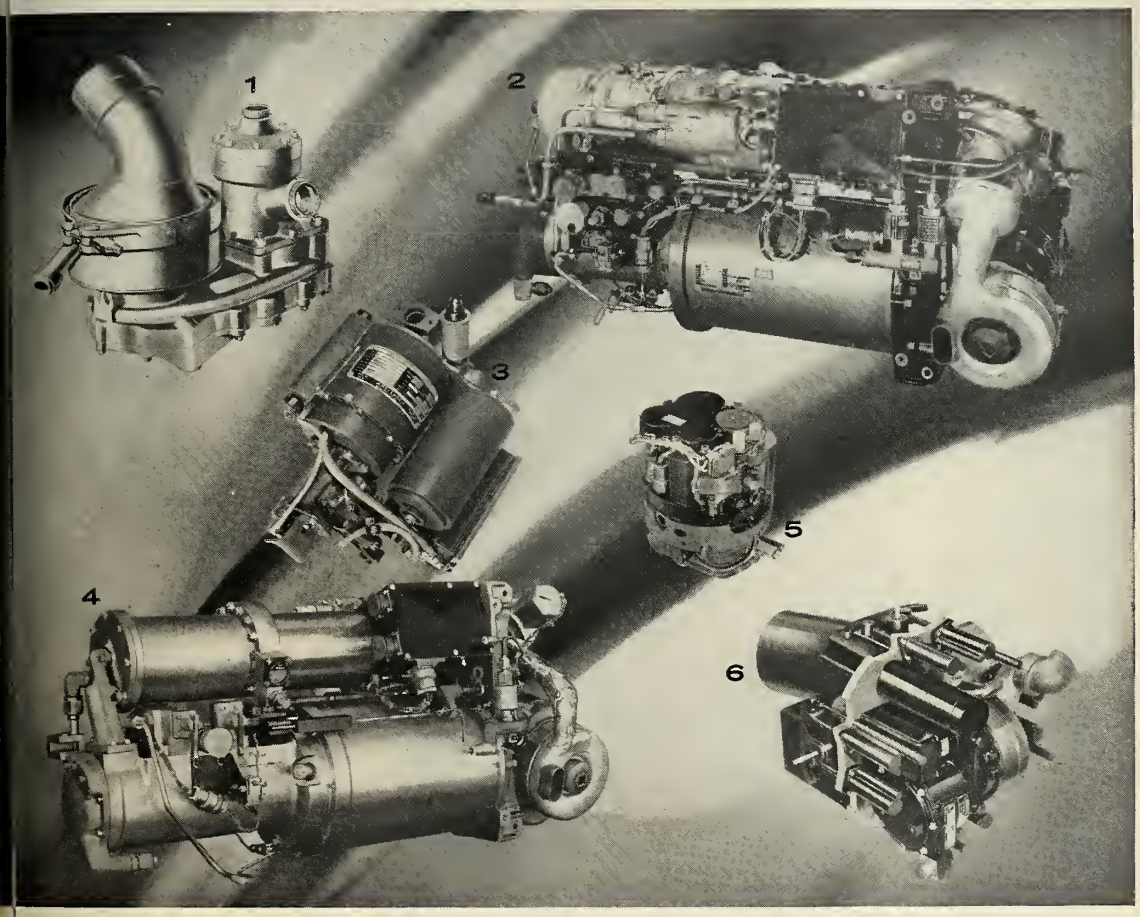

1. *Solid propellant—hydraulic output* 2. *Liquid propellant—hydraulic and electric output* 3. *Solid propellant—electric and mechanical drive output* 4. *Liquid propellant—hydraulic and electric output* 5. *Solid propellant—hydraulic and electric output* 6. *Solid propellant—hydraulic, electric and steering outputs*

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missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

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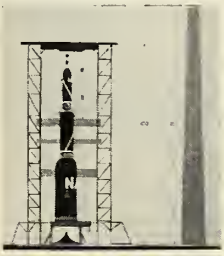
COVER: TM-76 *Mace* missiles on production line in The Martin Company's Baltimore Plant.



VEHICLE with thrust of 24 megatons might rival height of the Washington Monument (see p. 16).

COLLEGE students volunteers in experiment in Lockheed's simulated space cabin (see p. 22).

U.S. MISSILES dominated much of the scene at the big Paris Air show recently (see p. 24).

CHAIRMAN Overton Brooks claims his House Space Committee has broad jurisdiction (see p. 32).

on the countdown
split-second communication for split-second *action*

Launching today's highly complex missiles demands an unpre-dented degree of "team" cooperation. Hundreds of scientists, tech-cians and specialists must be kept constantly informed during all-important countdown. Instant action-getting voice communi-tions is the best answer.

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The Matter of the Munitions Lobby

Last week we mentioned on this page that the President had used the allusion "munitions lobby" in a press conference reference which might be taken generally to encompass the aerospace industry.

We must assume that Mr. Eisenhower had considered his remarks and was conscious of the implications of such a phrase coming from him in the White House. For the record, here is the question and the reply:

Question: "Mr. President, following upon that same question, several Senators said that lately you have spoken out rather sharply to them about what you have termed the munitions lobby, which you feel has been bringing some pressure on some of the Congressmen to try to change your defense program and plan. Could you comment on that?"

President Eisenhower: "Well, I don't know who has a right to carry outside the White House any remarks I have been making, and to make those remarks public property. That is supposed to be a little bit of a private place over there, although maybe not always. (Laughter). I don't think I have used that word . . . in public. I do say this: I may have, but I am not saying I didn't, but I don't believe I have. I do say this: But there is obviously political and financial considerations gets into this argument, rather than merely military ones, and that is produced when people have to advertise very strongly about a particular thing companies do—obviously, something besides the strict military needs of this country are becoming influenced decisions."

Writing in the New York Herald Tribune on the subject, Columnist Roscoe Drummond, himself a former Marshall plan official, commented:

"In talking about the pernicious influence of the 'munitions lobby,' President Eisenhower is raising a cry which will not soon be silenced.

"It will not be silenced until the facts are spread on the record—and the sooner the better. This is a serious complaint—that big defense contractors are bringing improper pressures to bear upon Congress and upon the Pentagon in deciding what weapons ought to be manufactured.

"This is the kind of issue which can become very political, very emotional and very distracting unless it is responsibly investigated. There will be a tendency to consider everybody guilty until proved innocent.

"I am not suggesting that the President's complaint is not a valid one. What I am suggesting is that Congress ought to investigate this matter promptly, calmly and with all deliberate speed—not drag it out."

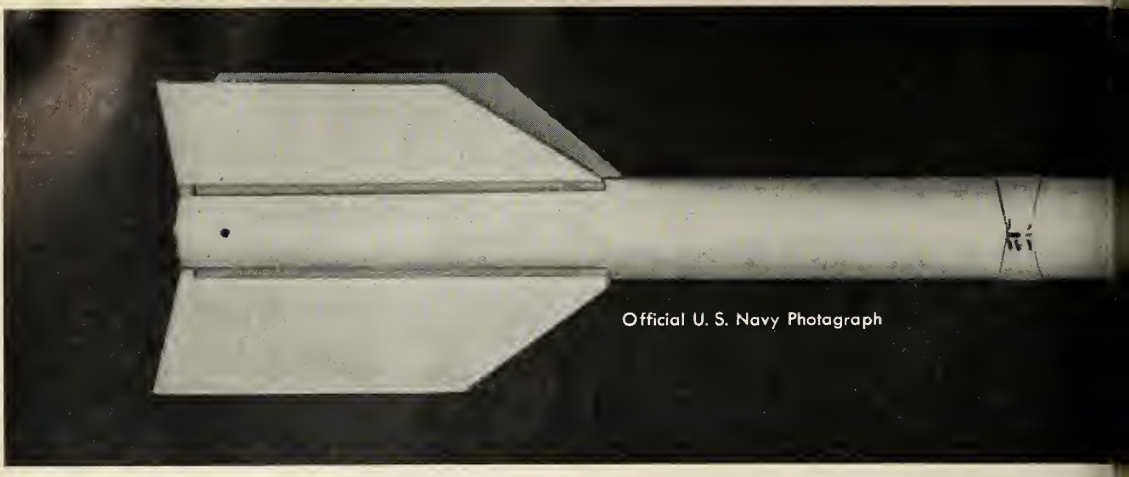
If the aircraft/missile/space industry is not seriously alarmed at this appellation—which carries with it all the connotations of warmongering, war profiteering, the German Krupp cartel—it should be. This is a term the enemies of our country would love to, and probably will, pick up and capitalize on to the fullest in propaganda aimed both at our friends and at the uncommitted nations of the world.

Actually, if there is a munitions lobby per se operating in Washingon it has been pretty ineffective. Congress has been walloping the whole aerospace industry right and left lately on every measure it has supported on Capitol Hill. But this is not the real point. The lobby label will hurt just about as much true or untrue.

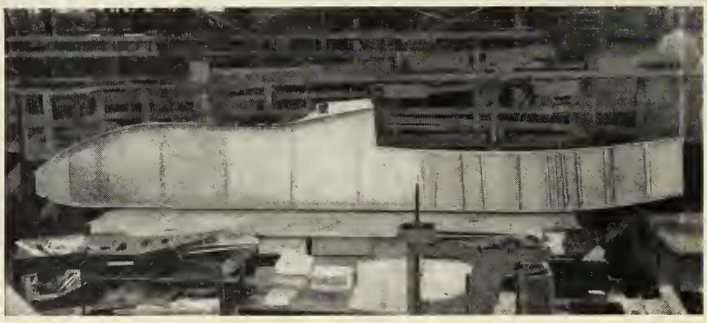
So let's indeed bring the matter out into the open. Congressman Hébert, chairman of the House Armed Services Investigating Subcommittee, opens hearings about July 6. The purpose of these hearings is to delve into the matter of the defense industry hiring retired military officers and why (see p. 15, this issue). This will bring a few headlines, but it is relatively unimportant to the greater question posed by the President's remarks: Does industry try to pressure Congress into approving purchase of weapons which may be obsolete, not needed, not the best, or unnecessarily expensive? Or, perhaps, in over-large quantities? Does this pressure extend to the military?

We would like to suggest that Congressman Hébert broaden his scope to bring the matter of the "munitions lobby" into the open where it can be examined. If it exists—beyond the scope of normal salesmanship—it would be far better to expose the sin and correct it. And if the term was misapplied that had better be understood, too, and quickly.

Clarke Newlon



Official U. S. Navy Photograph



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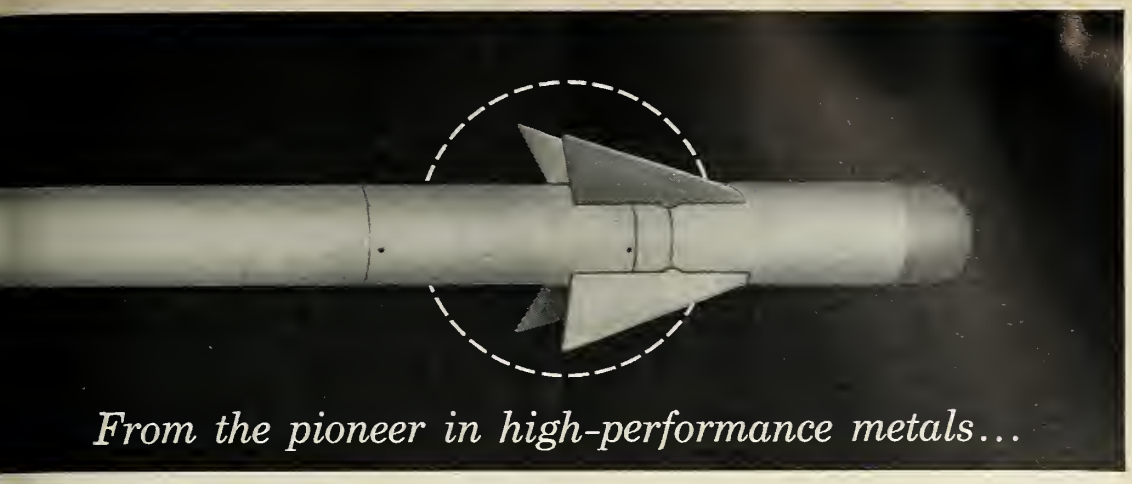

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TYPE 4130 ALLOY STEEL FINS FOR THE SIDEWINDER

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Republic 4130 offers exceptionally high strength-to-weight tios with the highest strength values. As seen at right, tensile rength in the heat-treated condition is over 230,000 psi after mpering at 400°F., with a Brinell Hardness of 460. Uniform sponse to heat treatment assures complete deep-hardening enetration.

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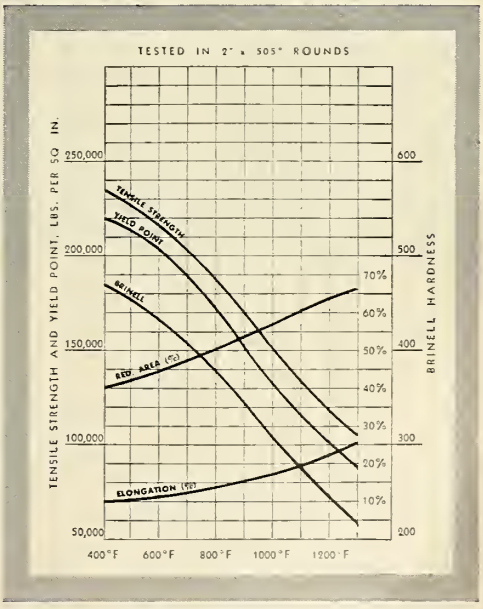

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STEEL

tainless Steel, and Alloy Steel

the missile week

washington countdown

IN THE PENTAGON

The Navy and Army . . .

are planning to turn the Western Pacific into a missile skeet-shooting range. Training shots from *Polaris* submarines are expected to be used as targets by the **Western Electric** *Nike-Zeus* test base being built on Kwajalein Atoll in the Marshall Islands.

• • •

The Air Force . . .

faces a possible drag-out fight over the continued development of the Mach 3 B-70 bomber and F-108 interceptor—offensive and defensive companions in future use of the ALBM. Reason: The two programs may cost as much as $20 billion.

• • •

ARPA is Working . . .

on two secret satellite programs. One is called *Samos*. The other is called *Somnium*. R&D on both is scheduled at the Pacific Missile Range.

• • •

Another new name . . .

to watch for is Project *Notus*. This is the ARPA code name for a whole series of communications satellite programs including *Courier* and a 24-hour satellite.

• • •

Some nuclear-power experts . . .

are saying that Project *Rover*—the program aimed at developing a nuclear-powered rocket—is headed in the wrong direction. They contend more money should be spent on developing propulsion from controlled nuclear explosions. *Rover*, based on heating a propellant with a nuclear reactor, claimed a successful first test firing June 20.

• • •

ICBM's fired by training crews . . .

at Vandenberg AFB, Calif., will be aimed at bulls-eyes located between the islands of Wake and Eniwetok and Wake and Midway. The bulls-eyes have a radius of 10 miles and are equipped with hydrophones for measuring the accuracy of firings. Range equipment has been in operation since last month.

• • •

New basic research program . . .

being started by ARPA in search of new and exotic materials for missiles, spacecraft and other defense needs is expected to cost $15 to $20 million in FY '60—possibly double that in FY '61. Details are still to be worked out.

ON CAPITOL HILL

Blistering new report . . .

can be expected soon from the House Inf mation Subcommittee. It will give details some 50 refusals by the Administration release unclassified information—mostly connection with defense matters. Operati of the Atlantic and Pacific Missile Ranges expected to be singled out.

• • •

Greater pressure for . . .

a tough freedom-of-information law may sult from the report. Many congressmen ready are considering a proposed fede public records bill. It would force officials defend keeping something secret rather th the current reverse practice.

• • •

No matter what . . .

the final congressional decision on the s called "master plan" for air defense, ba issues involved remain unsettled. Some of t questions still to be answered: What servi is in charge of air defense? What defer does the United States have against a Sov Mach 3 bomber or a nuclear-powered bomb armed with ALBMs? Is the U.S. AICBM pr gram moving fast enough?

AT NASA

John W. Crowley . . .

head of NASA's office of Aeronautical a Space Research, will retire at the end of t month. Taking his place will be Ira H. Abb Assistant Director of Research. Milton Ames, Chief of the Research Division, w take Abbot's position.

AROUND TOWN

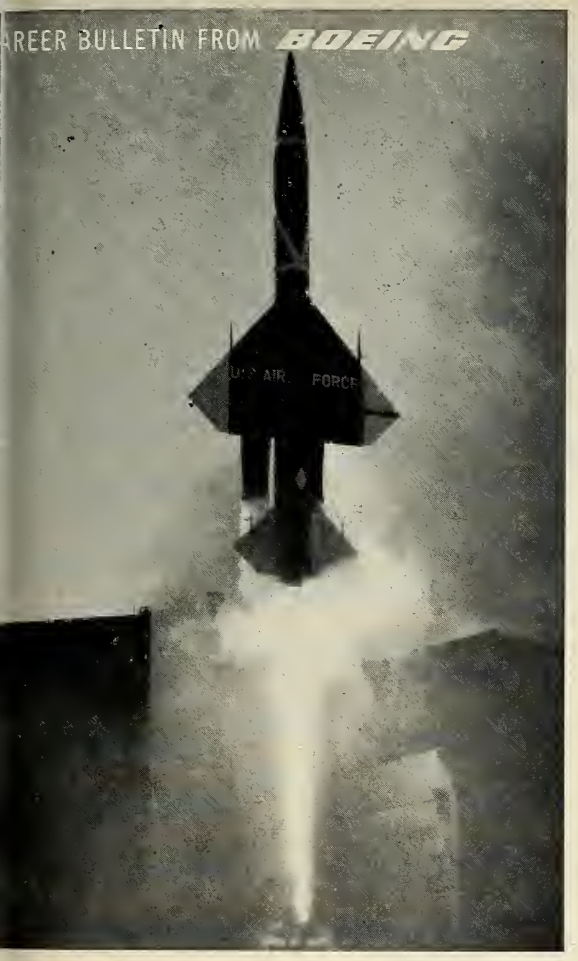
Some of the reports . . .

that are being passed as the "latest" in t nation's capitol:

. . . The advent of the **Boeing** *Minutem* and the era of ICBM-plenty will result in new blooming of U.S. isolationism.

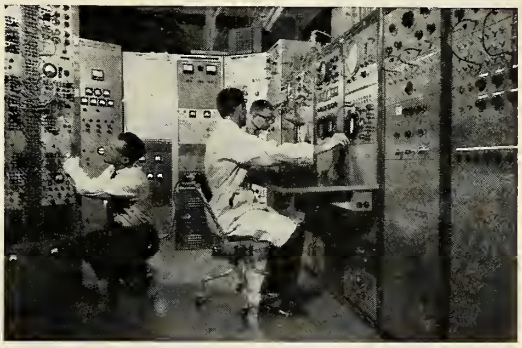
. . . Continuing Navy pressure for a gre er role in space will lead to a new int service fight over military missions.

. . . Efforts to reach advance East-W agreement on such issues as internationaliz tion of the moon are considered dead a any early resurrection is considered unlikel



BLAST-OFF of supersonic Boeing BOMARC, the nation's longest-range defense missile. Now in volume production for Air Force bases under construction. Other Boeing missile projects that offer engineers and scientists outstanding career opportunities include Minuteman, an advanced solid-propellant intercontinental ballistic missile system.

SPACE-AGE projects are expanding at Boeing. Above is human factors laboratory in which problems of providing environments and controls for space vehicle crews are investigated. Celestial mechanics, lunar orbital systems and interplanetary systems are other areas that offer long-range space-age career opportunities to qualified engineers and scientists.



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The T-38 Talon stands as the latest airborne evidence of Norair capability and production know-how. Norair's creative management further adds to the accomplishment by trimming production costs with methods that include PACE — the unique Performance And Cost Evaluation program; new and superior quality controls; and Norair-conceived, years-ahead production techniques.

NORAIR Hawthorne, California
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industry countdown

STRUCTURES

Dyna-Soar Goes to Boeing

This is the latest word which M/R has garnered from sources in AMC, ARDZ, and USAF headquarters.

Here are the believed facts.

Team headed by Boeing is the victor. Sources say—and this is confirmed by M/R—that announcement of awards is closely guarded secret.

DOD confirmed that a "blanket" press release has been made—listing both Martin and Boeing.

Look for General Motors . . .
to move much deeper into missiles in the next two or three years. GM's defense business has shrunk from 20% of its volume in 1953 to about 4.5% today. Recently upped from chief of the Cleveland tank division to director of GM's **Military Products Division,** Harold R. Boyer has been handed job of whipping GM's far-flung manufacturing interests into a "team" to bid on entire missile systems—though GM presently lacks a rocket propulsion division. New organization may be centered around **A.C. Sparkplug Division** which has *Titan* inertial guidance. Says Boyer, "Our approach is for the long haul." Is GM eyeing any particular system now to bid as a prime? "No," says Boyer, "we are preparing for the future." But he indicates GM is already gearing to expand its subcontract defense operations.

• • •

Proposed service-wide TIF . . .
(missile/aircraft support equipment technical information file) reaches a critical point at July 9-10 meeting in Penatgon. Ad hoc Army-Navy-Air Force study group will attempt to iron out a system for collecting data, printing and distributing the catalogue which would be patterned after the new AF TIF (M/R June 15, page 21). Agreement will be necessary before DOD will proceed to next step—evaluation and funding.

• • •

Small businesses . . .
looking for government R&D contracts must file a Form 449 with SBA by July 17 to be included in the agency's new directory. The directory is used by government purchasing agents and prime contractors and is also made available to private industry.

Ablating beryllium shields . . .
six feet in diameter and one inch thick are being fabricated by Alcoa for two of NASA's *Mercury* space capsules on 50,000-ton press. Material is being supplied by **Brush Beryllium.**

• • •

McDonnell's *Mercury* contract . . .
calls for fabricating 12 space capsules. If NASA puts a man in space on the first try, what happens to the remaining 11? Says Wilson H. Hunter of NASA's Lewis Laboratories, "we may use extra capsules to train a corps of spacemen."

PROPULSION

***Atlas* launching system . . .**
employs a brace of pneumatic release cylinders produced by **Western Design Division, U.S. Industries Inc.,** which exert holding force of 836,000 pounds when engines are fired. Force is reduced to 416,960 pounds within .35 seconds. As missile lifts, during next .4 seconds, holding pressure drops in each release cylinder to 7600 pounds and pistons move 4 inches. Pistons then ride free 42 inches before cylinders break away from missile by means of surface cam-actuated segment lock.

• • •

Officials of Thiokol's . . .
Longhorn Division at Marshall, Texas, report passage recently of the two millionth accident-free man hour by division's 1400 employes.

ELECTRONICS

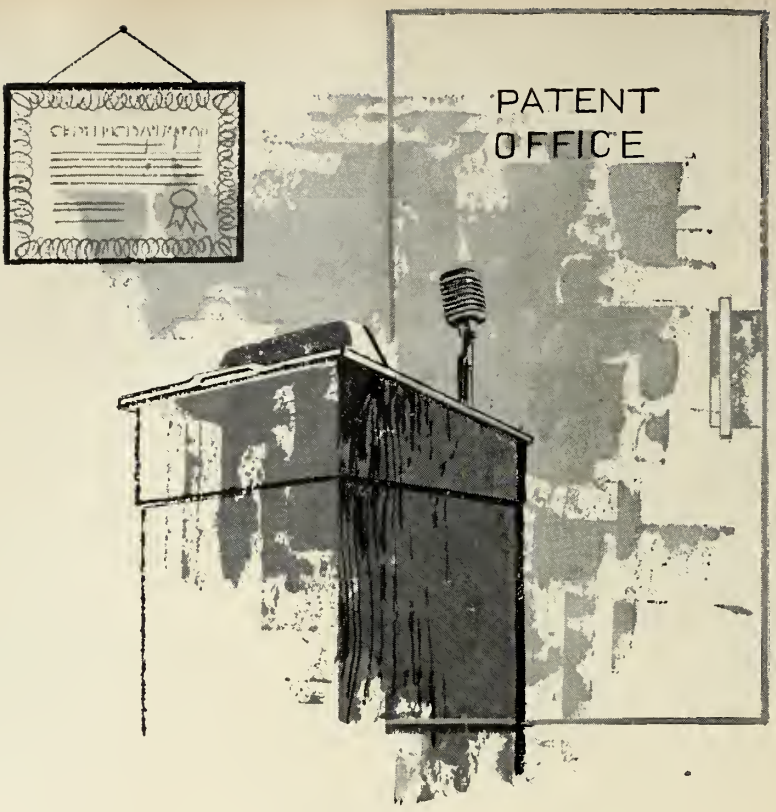
Under development . . .
by **Bell Laboratories,** an "improved" *Nike-Hercules* guidance system utilizing 68% parts common to *Hercules* and 32% new parts.

• • •

If and when *Nike-Zeus* . . .
is committed to production, guidance will be tested on **Chrysler** *Redstone* and *Jupiter* targets. Detroit missile makers believe a follow-on order for *Jupiters* is in the works and may be announced shortly.

ASTROPHYSICS

Huge Navy radio telescope . . .
being built at Green Bank, W.Va., theoretically will be able to peer 38 billion light years into space. Steel and aluminum dish weighing 20,000 tons will be more than 600 feet across; will have a 100-foot antenna in its center. Project (called Operation Big Dish) will cost $79 million.



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Can Congress Define 'Influence?'

by James Baar

WASHINGTON—Some 2500 years ago mart Greek named Plato and some his chums stood around Athens and d to answer the question: What is uence?

The House Armed Services Investi- ions Subcommittee will take another ck at the problem next month with red high-ranking military officers, ense contractors and the Pentagon he heart of the discussion.

The subcommittee—headed by Rep. Edward Hébert (D-La.)—began paring for the investigation more n a year ago in conjunction with rk on its current investigation into weapon system management con- t.

But the full-scale public hearings eduled to open about July 6 received ir present headline status from a nber of most recent developments:

• The bitter, drawn-out fight over *narc* and *Nike-Hercules*.

• President Eisenhower's "attack" "the munitions lobby."

• The House defeat by only one of a proposal by Rep. Alfred E. tangelo (D-N.Y.) aimed at barring ense contractors from employing ior military officers for five years r their retirement.

At this point, Chairman Carl Vin- (D-Ga.) of the House Armed vices Committee directed the Hébert committee to proceed promptly h its investigation. He said it should lude retired federal civilian officials well as ex-military officers.

Vinson, who has shown growing dis- asure with defense contractors, urged ctment of any remedial legislation t might be needed.

• **Flood of questionnaires**—The bert Subcommittee responded by ding thousands of questionnaires to nation's 100 top prime defense con- ctors who have 75% of the gov- ment's defense business. It then sent ilar thousands to some 600 prime tractors who have the other 25% to some 30 defense industry as- iations.

All were asked to have all retired itary officers on their payrolls above Army-Air Force rank of captain the Navy rank of lieutenant fill out forms. They also were asked to e all former Federal employes who n more than $10,000 a year and o have retired within the last five rs fill out special civilian forms.

In essence, the questionnaires ask: Just what do you do? And what are you getting for doing it?

They put it this way:

"State whether you have solicited or participated in any discussions, oral or written, concerning sale, use, adaptation, modification, improvement, suitability, development or research of any article, plan, process or program with any officer or employe of the Department of Defense at any time since your retirement, and at any place, on behalf of any company, organization or yourself."

"If your answer to the foregoing question . . . is 'yes', state the subject of such discussions, conversations or writings, identify the persons with whom the exchanges took place or the circumstances under which they occurred."

"What compensation or remuneration, direct or indirect, in money or anything of value, are you receiving or have you received for the service performed?"

• **What's taboo?**—Behind these questions are the already-enacted laws restricting both retired military and civilian officials in their dealings with the Federal government.

All military and civilian officials are banned for two years from selling to the Department of Defense. Moreover, retired military officers are prohibited forever to sell anything to their former service. And retired Navy and Marine officers must forfeit retirement pay at any time that they are engaged in defense selling. Penalties for violations range to a maximum of a year in jail and a $10,000 fine.

But the crux of the problem is: What is selling? And this comes back to the question: What is influence?

Santangelo, in arguing for his proposal, told the House: "prominent military figures in retirement can have a great influence over their former subordinates."

"Persons within the department who may be looking forward to possible employment within a certain organization after retirement can display partiality and favoritism without ever realizing it," he said.

"Contact at social and professional gatherings between active and retired officers can provide a perfectly natural setting for influence and favoritism."

Maybe so. But Defense Secretary Neil H. McElroy told a news conference the Defense Department is not aware of improper influence by retired military officers.

Also, he said "retired officers of our military services have done very good work in behalf of defense production." And he warned against loss of retired officers' "minds and their experience."

Rep. Samuel Stratton (D-N.Y.) warned the House during debate on the Santangelo proposal that by passing it "we would be throwing out the baby with the bath."

• **What will happen?**—The Hébert Subcommittee will analyze its questionnaires and add the results to considerable information already in its possession. Then it will call in the witnesses—almost certain to be mostly a parade of retired generals and admirals.

The investigators will try to determine not only whether retired military officers have attempted to influence military purchasing, but also:

• Were such attempts—if made—successful?

• Does a "munitions lobby" really exist? If so, who are its members? (Only about three dozen names connected with the defense industry appear on the list of hundreds of registered lobbyists.)

• If changes are needed, how can they be made without causing more harm than good?

Hébert has repeatedly promised a high-level investigation conducted in all fairness. But the pressures to turn it into a headline-making circus will be great.

Several Congressmen—none members of the Hébert Subcommittee—have already released long grab-bag lists of retired military officers employed by defense contractors. One list included a retired officer who heads his firm's plant hospital.

Also, take this sample of possible testimony for example:

Q: "Admiral (or General), did you have lunch April 1 with Admiral (or General) Jones, a key figure in the XYZ contract decision?"

A. "Yes, but we only talked about golf and baseball."

What might be made of this exchange in the glare of TV lights and headlines? But even worse, what fair judgment can be passed in such matters? Was influence exerted?

This is the problem the Hébert Subcommittee and the defense industry face.

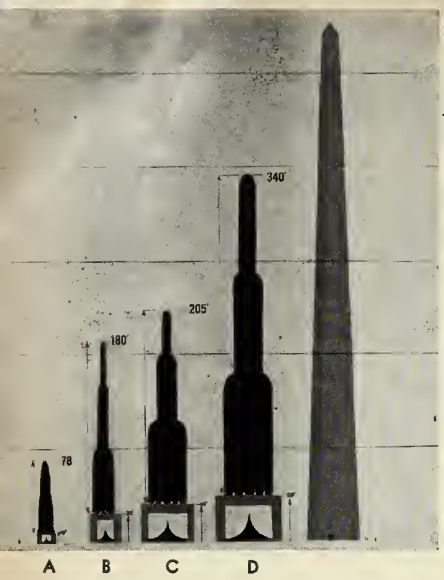


FIG. 1—Imaginary family of vehicles starting with *Atlas* compared with the 555-foot Washington Monument.

How to Handle 24-Megaton Thrust?

Special logistics will be needed for 1.5 million pounds-plus boosters

by Chauncey J. Hamlin Jr.*

LOS ANGELES—What are the support problems entailed in handling and launching a 24-million-pound-thrust rocket of the future?

The whole new generation of boosters of over 1.5 million pounds will involve special logistic requirements for transporting the rocket from the factory to launch site, erecting and completely preparing it for flight.

In setting forth some of these problems here, it is proposed to stimulate thinking on logistics in this large vehicle area and call to the attention of preliminary designers some of the problems associated with size. This discussion, moreover, will be confined to chemically fueled multi-meg rockets.

Since these systems will be very costly, every effort should be made to simplify ground handling problems. For instance, the cost of developing the prototype ground support equipment for the *Dyna-Soar* has been estimated at $60 million. As the size of the vehicles continues to increase, handling cost will go up proportionately.

One of the best ways to keep costs down is to consider handling and other logistic requirements as part of preliminary design. If planning in this area is started early in the game, simplified concepts of handling can be built into the system with appreciable dollar savings.

A 1.5-million-pound-thrust chemically fueled rocket powerplant is under development and will be available in the very near future. The development of engines with up to 20 million pounds of thrust is predicted in the early 1970's. Dan Kimball, president of Aerojet-General, makes a similar forecast in referring to rocket engines having "10 or 15 million pounds thrust."

• **Growing family**—To appreciate what these thrusts mean in terms of overall rocket size, consider Fig. which depicts a family of rocket-po ered vehicles, starting with the famil *Atlas* and increasing in size by m tiples of 4. This imaginary family, rived for the sake of size comparis is based on the following assumptio present state-of-the-art chemical fu with an impulse in the 250-260 s range at sea level, a mass ratio of 0 an initial acceleration of 0.3 g, and overall propellant specific gravity of

FIG. 2—Gantry with elevator would permit lifting upper stages and slid lower stages under them, structure rising as successive stages are install

*Corporate Development Planning Staff, North American Aviation, Inc.

en the thrust reaches 24,000,000 nds, the vehicle envelope approaches of the Washington Monument, a ewhat unbelievable structure.

What then are the principle new s of logistics facing the operator of a vehicle? First, there is the prob- of how to get a large booster from factory to the launch site. There severe limitations on current con- ional means of transportation by oad, highway or air transport. Size rictions of tunnels and highway passes make it obvious that any or structure with a diameter ter than 10.7 feet will require spe- handling.

A diameter somewhat in excess of feet can be transported over the on a trailer, but special permits special routing are required. Here here a look at handling problems y in the design phase will pay off. ecomes apparent that for conven- al transportation the design will re- e breaking the frame down into nents for shipment.

• **Where to build it?**—One alterna- of course, is fabrication at the ch site. Evaluation of the pros and of building block construction and of shipment versus construction he launch site should be made be- vehicle designs are finalized. ght penalties associated with mul- tank construction should be eval- d against the complexities of ch site fabrication. Fabrication at otely located launch sites such as e of those proposed for equatorial chings may prove far more costly he over-all program than the loss in performance associated with a booster built up of easily-transportable components.

For instance, an equatorial launch site where average temperatures are 80° and the relative humidity is between 80 and 90%, would require large air conditioned shops, would be far from normal industrial supplies and would require all of the necessary housing, etc., for the working force, which in itself would be difficult to recruit for such a location.

• **By water**—Another alternative exists where the frame manufacturing plant is located on a waterway and the bulky parts can be transported completely assembled by barge or ship, to a launching site that is also adjacent to port facilities. As a matter of fact, if taken into account during the initial planning phases, water transport of large boosters may easily determine the location of launch sites and manufacturing plants in a manner which could materially reduce the overall cost of a program.

Add to the ease of handling by marine methods the desirability of launching over water for safety considerations and launch sites adjacent to marine facilities appear highly desirable. In some recent studies of equatorial launch sites, the proposal has been made to utilize the highest ground available, often 2-3000 ft. above sea level for launch pads. I believe that a look into the future would relocate these to sea level at a great saving in cost.

• **400-ft. gantries?**—Having arrived at the launch site, the operator next faces the problem of erecting and servicing the rocket. To erect and service a 340-foot 24-million pound thrust vehicle standing on a 50-foot launching and flame deflector platform will require a gantry in excess of 400 feet high. The question immediately arises —is it practical to consider a structure this size? And if so, is it practical to move it away from the rocket for launching or will the ship have to be fired from within the structure?

In launchings from within the structure, exhaust flames can do extensive damage if vector control requires deflection of the jet onto the gantry. Wind drift during initial flight at low acceleration can endanger the rocket due to collision with the gantry. The complexity and cost of this system forces us to look for an easier way out.

• **Alternatives**—What avenues are there? One is to use a gantry with an elevator and, instead of stacking the upper stages upon the lower as is presently done, lifting them up and sliding the lower stages in beneath, so that the structure rises above the gantry as successive stages are installed (see Fig. 2). In this instance, the upper position of the elevator platform would only have to be high enough to permit the largest continuous section to be rolled into position beneath it.

Approaching the problem from a different angle, let us consider assembling the vehicle in a hole as shown in Fig. 3. The size and complexity of the gantry can be greatly reduced. By the time this rocket reaches the flight test stage, we shall have had a great deal of experience in launching missiles

3—Assembling vehicle in hole d cut gantry size complexity.

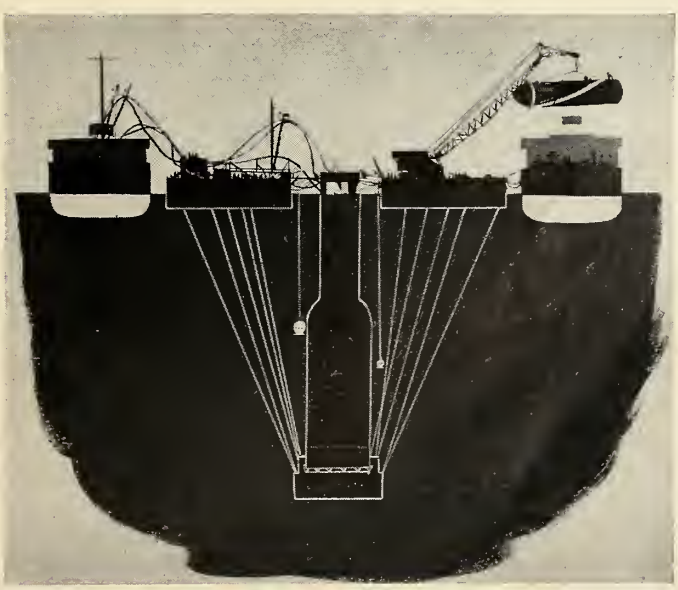


FIG. 4—Submerging missile in ocean is another possibility. As with the hole, the vehicle here could be raised to tbe surface for launching.

from holes in the ground, i.e. *Minuteman* and *Titan*. Of course, the complexity of constructing the hole and launching from it will have to be weighed against surface launching. After the rocket ship has been assembled in the hole, the possibility exists of raising it to the surface for launching if subsurface launching proves impractical.

Another scheme might be to submerge the missile in the ocean as shown in Fig. 4. Experience gained in underwater launching of the *Polaris* will provide many of the answers to submerged launching problems. Again, as in the case of the hole, the vehicle could be raised to the surface for launching.

It would appear at a first glance that the equipment associated with submerged or waterborne launching would be far less complex and costly than other types. Shipyard handling techniques already well-developed are available and the entire facility could be afloat. An added advantage of such a launching arrangement would be the ability to use it at many different locations, depending upon the mission of the flight, since it could be towed from one site to the next.

Another means of reducing the handling problem is to minimize the overall vehicle height by designing the stages to telescope into one another. Such a rocket would be rather squat with poor aerodynamic qualities, but these drawbacks might easily offset the cost and complexity of stacking one stage upon the other.

• **Two million gallons**—With the missile erected on the launching platform, cleaned, checked and ready for propellant loading, we are still faced with quite a problem in logistics insofar as our 24-million-pound-thrust giant is concerned. Approximately two million gallons of propellant must be pumped into the tanks. Servicing by conventional highway transport tank trucks would require the capacity of 666 such vehicles or 200 standard railroad tank cars. The problem of moving this equipment in and out of the launching area is immediately evident.

Again, a dock-side launch site appears superior, as propellants could be pumped directly from ocean-going tankers standing offshore. So far, only liquid propellant engines have been considered. If solids are to be used in these large vehicles, it would appear that they will probably have to be loaded at the launch site in much the same method as liquids, in order to simplify handling problems. High-capacity continuous mix processes will have to be developed for this purpose.

• **Boarding**—The problem of servicing the upper stages and putting the crews aboard in the case of rocket ships which are erected without the use of full-length gantries, or after the gantries have been removed, must be solved in an economical manner. The crew in particular should be boarded at the last possible moment, so that they are not subjected to extended periods of waiting.

One of the best ways to accomplish this for ships that are not too tall would be the use of cranes with lightweight aluminum booms. If height becomes excessive, helicopters with personnel platforms suspended by cable could be employed. It might even be possible to suspend a lightweight elevator sustained by means of captive balloons. (see Fig. 5).

In considering logistics for large rockets of the future, reliability of all phases of the equipment should claim first place—with overall system cost, a close rival. In general, the speed of launching preparations will not be an objective for nonmilitary missions—equipment can be kept unsophisticated and to a large degree, manually operated. Cost can always be kept to a minimum by using standard equipment when available. Design can always be simplified if a piece of equipment is not required to perform too many functions.

FIG. 5—Helicopters or balloons might be used for boarding crew members.

Medaris Gives His Basic Procurement Philosophy

DETROIT—An Army general r cently explained to the missile-spa industry the procurement philosop which governs the intelligent expen ture of some two billion dollars a nually in support of the Army's miss programs.

Maj. Gen. J. B. Medaris, comman ing general of the Army Ordnan Missile Command, addressed the se ond annual Industry Missile and Spa Conference here.

General Medaris' Command is r sponsible for 14 major missile systen including their ancillary equipme from the inception of the progra through production, fielding, supp and maintenance of the systems so lo as they remain operational.

• **Basic points**—The general su marized a one-hour presentation w "a few basic points of basic philosop that I consider far more essential th any matters of procedure:

1. "The procurement activity m support directly all of the work of parent organization, whether that wo be directed to development, to produ tion or to follow-on support of miss systems.

2. "All of our activities in procu ing goods and services must be bas on a firm, positive, and knowledgeal control of the work to be performed.

3. "In dealing with all segments industry and research activities, it our objective to be fair, but not to generous.

4. "The contractor selection, in th difficult area where only a minority our total needs can be so defined as permit standard sealed-competitive bi our selections must be founded on cold-blooded and objective apprai of the requirements to be met, of t realities of time and money requi ments, and of the capability and abo all the reputation for effective resu as applied to each contractor co sidered.

5. "By single and tightly coord ated management control, we must sure the maximum effective telesco ing of all of the finished activities volved in fielding a weapon syste keeping in mind that the effectiven of the system is strictly related to time of availability, and requires th the longer a program continues t higher the total cost."

Gen. Medaris added that "no w pon system development is worth c time or the taxpayers' money unless an end product we will have a syst that is effective when it hits the fi and for a reasonable period thereaft that is usable by the troops, and th is economical . . ."

Priority Rules Are Revised

by Betty Oswald

WASHINGTON—Manufacturers of ellites and intermediate and long-ge ballistic missiles will continue to a priority rating to get the equip-nt and materials they need to pro-ce in accordance with military sched-s.

The bottleneck-breaking priority X) is part of Defense Materials tem as it will be revised by the siness and Defense Services Ad-nistration shortly after July 1. The v rules will be effective in the third endar quarter which starts Oct. 1.

They will continue to provide ma-nery for distribution of steel, cop-and aluminum to defense contrac-s on a simplified basis. Nickel alloys d aluminum molten metal, foil and wder have been made controlled ma-ials.

Non-nickel bearing stainless steels ve also been made controlled ma-ials, but all steel castings, includ-stainless steel castings and nickel oy castings, have been deleted from list.

The decision to maintain and revise system followed conferences be-een Business and Defense Services lministration of the Commerce De-rtment, which administers the pro-m, and some seven industry groups cluding aircraft and electronics in-stry advisory committees. It was edicated on the belief that the ma-nery is needed to determine the use tterns of materials by defense con-ctors which help to set stockpile re-irements and the controls which uld be needed in the event of a ure mobilization program.

The system is also called necessary identify defense orders so that when ivery problems arise as a result of rtages, strikes or bottlenecks involv-materials or components, action n be taken to expedite deliveries. In 55, when defense contractors were ting more metal because of higher duction rates, some 8000 cases were ndled by the BDSA in efforts to get contractors what they needed. The rrent load amounts to about 4000 es annually—without counting the ormal expediting actions taken by my, Navy and Air Force under the hority provided by the Defense Ma-ials System.

• **Background**—DMS had its gen-s in the Controlled Materials Plan World War II and its revival, in dified form, in the Korean War. Basically, it's a method of distributing steel, copper and aluminum in mill forms and shapes to defense contractors and manufacturers of essential civilian goods. In a sense, it can be described as a rationing system.

However, experience has taught that it takes about a year to make the system work efficiently if statistical information is not available to show both the pattern of production of controlled materials and their consumption. After the Korean War, it was decided both by Government and industry that the system ought to be maintained on a modified and relaxed basis so that there would be no long time-lag in the event of another war or mobilization.

About six years have gone since the establishment of DMS, during which the Congress has continued the Defense Production Act on which the system is based. Relatively few changes have been made in DMS up to this point, although many have been suggested both by Government and industry.

• **Simplify and clarify**—Current changes are aimed at simplifying the rules without losing the priorities and statistical features of the system as well as the basic control machinery which could be made effective in the event of need. Second objective is to clarify certain gray areas and spell out the rules in black and white.

Among the major changes planned are a simplification of the definitions. Perhaps the most important of these changes makes construction and research projects a part of the Class A products, for which direct allotments of materials can be made. Industrial service operations are made Class B products, which are handled on the basis of automatic allotments.

Contractors will no longer be troubled with the problem of authorized production or construction schedules on which allotments were based. Under the new rules, the right of defense contractors to rate their orders and to an allotment of controlled materials flows from a rated order or contract or from a specific authorization.

Allotments of materials will be made under the new rules by the alloting agencies (Defense Department, Atomic Energy Commission, etc.). Prime consumers will no longer be permitted to make allotments to their subcontractors. Use of allotments, ratings or self-authorization by producers of Class A or Class B products having rated orders is mandatory except for purchase orders of $100 or less.

Purchasers of controlled materials are required to furnish suppliers with a prescribed statement that DMS rules must be followed in all cases where orders are placed for Class A or Class B products or authorized controlled materials orders.

Producers of Class A and Class B products extend their ratings to their suppliers.

• **Use of symbol**—As far as the bottleneck-breaking DX symbol is concerned, contractors are now required to use it and controlled materials producers are required to schedule the authorized controlled materials orders so identified without regard to lead-times or to set-asides set up under various production orders.

There will be a new schedule listing the authorized program identifications and alloting agencies. In addition, there will be a schedule containing a form for submitting a statement of controlled materials requirements when requested. However, unless there is a drastic change in current thinking, this request is not likely to be made very often.

BDSA is also trying to make the system more palatable for the controlled materials producers. Maintenance of the system is being described as a kind of insurance policy. The premium is represented by the cost of bookkeeping and related procedures involved.

William C. Truppner, Director of the Office of Industrial Mobilization, in summing up the decision to continue DMS, said that it was the intention of the Government to assure a top priority for ballistic missiles and satellites on the books of the controlled materials producers who are required to schedule orders for these programs, regardless of set-asides or leadtimes. However, an escape clause is provided which says: "Unless it is impracticable for him to make delivery within the required delivery month in which event he must accept such an order for the earliest practicable delivery date."

Generally speaking, the producers of materials prefer DMS as modified to a priority system. However, most of them believe that BDSA must do a better job of educating the contractors and distributors, so that the system works with a minimum of waste motion.

A Crisis in Range Instrumentation

AFMTC commander says more funds and effort must be expended to cure the rapidly widening time bottleneck

by Maj. Gen. Donald N. Yates
Commanding General, Patrick AFB

Mr. Chairman and members of the American Rocket Society—I wish to commend you on the organization of a Committee on Logistics and Operations. I think it is quite significant that the American Rocket Society now extends their concern over a broader area than just the research and development aspects of rocketry. One of the support areas of concern to the Committee on Logistics and Operations has a direct bearing on the success of the research and development program. This area needs attention and emphasis by the American Rocket Society and by the missiles and space vehicle community at large. The subject is the range instrumentation of the future.

The Air Force Missile Test Center has pointed with considerable pride to the fact that it has been able to grow and expand in pace with missile developments of the last ten years, particularly since the emphasis was placed on ballistic missiles during the last five years. The growth at the Atlantic Missile Range has been phenomenal, and we are proud that the vast majority of test data requirements have been met, on time, with instrumentation of the required precision and reliability.

With the spotlight logically enough resting on the missile programs themselves, it is only natural that supporting facilities, such as are provided by our range and its instrumentation, are too often taken for granted. It is a fact that for the past five years we have been driven into a frantic race with missile performance in our job to provide instrumentation of commensurate performance. We must match each masterful achievement in vehicle performance with an equivalent achievement in instrumentation performance.

• **Gaps to come**—Whereas our best instrumentation may suffice today, it falls far short of the requirements for the future. I see a gap forming which becomes wider upon close comparison of our future measurement requirements versus the state-of-the-art in data acquisition. For example, in electronic tracking we are being asked to improve our accuracy, not by a factor of two or three, but by one order of magnitude, to accommodate a second generation missile soon to be tested.

Explorations in space will bring about their own family of requirements which, a few years hence, will probably relegate today's space-tracking equipment to the class of primitive first attempts. There can be no question about the need for increased emphasis on instrumentation development. Our ability to advance in both ballistic missile and space work may, in fact, be determined by our achievements in the field of instrumentation development.

• **Past build-up**—When we began the build-up of the Atlantic missile range in 1950, we were able to draw upon the developments that had been achieved during World War II. With some improvements, the instrumentation equipment then available was adequate to meet the requirements imposed for the long-range cruise missiles and short-range ballistic missiles of that time period. Modified SCR-584 fire control radars, telemetry equipment constructed in accordance with RDB standards of 1947 and command co trol equipment used for drone conti during the late 40's, provided the ran with instrumentation that served well for a number of years.

The rapid build-up of our ICB programs beginning in late 1954 i posed significantly more stringent r quirements on instrumentation. The programs required far more accura position and velocity measuremen than had previously been necessa and at substantially greater slant ran distances. The telemetry requiremen increased in quantity, but fortunatel not very much in complexity. As wi the cruise missiles, it is still necessa to measure the actual impact locatic with great accuracy at distances of u to 4400 n.m. from the launching poin The limitations of our instrumentatic system to measure the actual impa location made it necessary to establis impact points adjacent to inhabite land masses. This, in turn, impose severe range safety problems and r quired the establishment of mo sophisticated range safety instrumenta tion.

In order to meet the requirement imposed by the ballistic missile pr grams, we exhausted the backlog th had been accumulated from our wa time developments. We were har pressed to meet many of the require ments of the ICBM programs. We wer oftentimes forced to use an assortmer of instrumentation systems obtaine from various sources to meet a singl requirement. In some cases, compro mises in missile test requirements wer made due to the exorbitant costs in curred by the use of these assorted an extensive systems.

• **Scraping the barrel**—We are no at the bottom of the barrel, so t speak, in instrumentation development We would like to initiate a majo development effort on a new trackin system during this fiscal year; however funding limitations have dictated tha

Editor's note—Due to the critical importance of adequate range instrumentation in the progress of our missile program, M/R feels this paper presented at the recent American Rocket Society meeting is of extreme interest to all in the missile business. General Yates points out the gaps in present instrumentation technique and equipment, the results of our inattention to the problem, and what must be done immediately to narrow the ever-widening gap.

must be deferred.

We must get this equipment developed and installed on the range if we are to meet presently known requirements. It is not difficult to foresee aeronautic systems of the future with more demanding requirements than can be met even with this new equipment.

• **Call for funds**—Based on the level of funding for instrumentation development during the past several years, we cannot hope to get the job done without a complete about-face. The funds expended on the Atlantic Missile Range for development of all instrumentation are a very small fraction of approximately the cost of the production missiles themselves. It is not unusual for the Range to be asked to evaluate a new guidance system that may have cost one hundred million dollars or more with an instrumentation system that has cost a few percent of what the guidance system cost. In most instances, the only solution has been to obtain funding assistance from the weapons systems people to buy, modify, and install "off the shelf" equipment on a crash basis to obtain marginal results.

The developer of instrumentation, in order to be effective, strives for two paramount goals in his product—maximum accuracy and one hundred per cent reliability. To properly evaluate vehicle performance, range instrumentation should be one order of magnitude better in accuracy than the performance parameters of the system under test. Certainly, we all agree that malfunction or impaired accuracy of instrumentation will invalidate a portion of the vehicle test objectives. To obtain the high degree of accuracy and reliability in instrumentation systems, sufficient funds are required: 1) to improve existing systems; and, 2) to develop systems based on new concepts.

The development of instrumentation to meet the exacting demands imposed on the test ranges is a slow and tedious process. Generally, we have found that it takes as long (and sometimes longer) to develop an instrumentation prototype as it does to develop new vehicle prototypes. When the missile contractor has his prototype complete, he is ready to test it. On the other hand, the range usually will require some production units of the developed instrumentation system to meet the test requirements of the new vehicle in addition to the prototype.

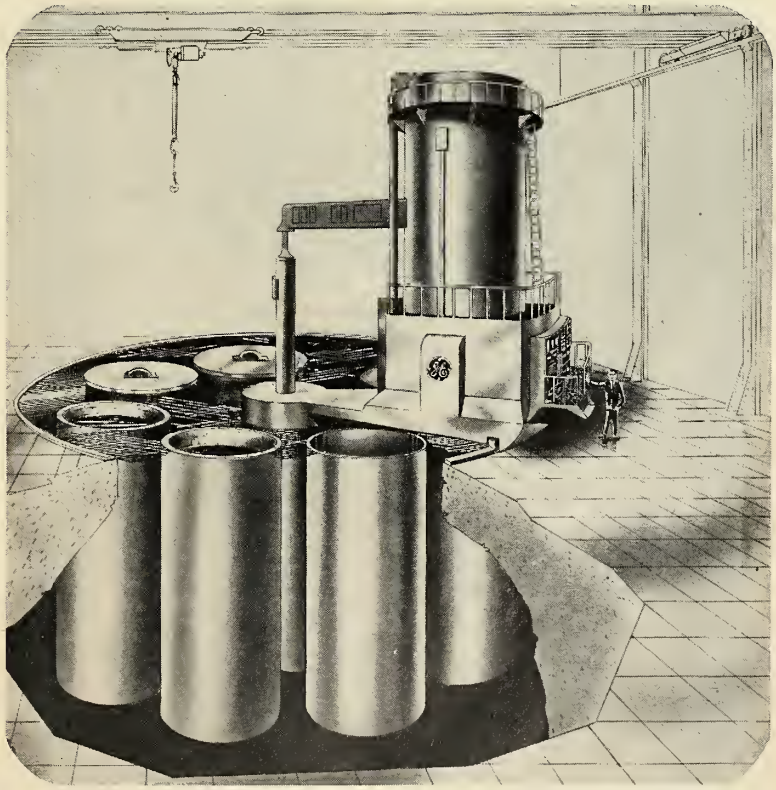
• **The bottleneck**—Thus, the "bottleneck," from a time aspect, is instrumentation. For example, several major instrumentation systems used to support the ballistic missile operations on the Atlantic Missile Range required an average of about four years for development. If you add to this the amount of time required for the budget cycle, plus the time required to check out and "de-bug" the system after it is installed, the average time from inception of the need to an operational use of a complex instrumentation system can be as great as five to six years.

A partial answer to the lead-time problem is to place the instrumentation developer where he can have continual cognizance of what the missile people are developing in the way of new vehicles. I recognize that such an approach is difficult to implement for a variety of reasons.

Systems contractors do not have a clear outline of test needs until the actual test stage is near. Consequently, they are reluctant to release the advance information we need to proceed with our development plans. A better solution from a Range viewpoint is to permit the development of new instrumentation to proceed, not on the basis of known missile requirements, but solely to advance the state-of-the-art against the trend of technical requirements as forecasted by our top missile and astronautic people. ARDC has an applied research program oriented toward such goals; however, these projects must compete with more glamorous end-item developments for their funds.

I doubt that there is any complete answer to the instrumentation development problems that the test ranges face today. Certainly, some breakthroughs are necessary in the state-of-the-art if we are to satisfy the data acquisition needs for future vehicles. The test ranges earnestly solicit the constructive suggestions and ideas of this Committee in the establishment of performance criteria for the next generation of instrumentation which will provide the desired test data for the next decade . . .

Heat Treatment for Solid Cases



PART OF A multi-million dollar expansion program at GE Evandale is this heat treating facility for solid rocket cases. Scheduled to be in operation in March, it will handle cases 10′ in diameter and 30′ long. It can be expanded to process cases 40′ in length. Evandale also will put into operation next year a hydro spinning machine believed to be the world's largest.

COLLEGE student volunteers in Lockheed's simulated space cabin.

Adapting Man to His Life in Space

by James Baar

WRIGHT-PATTERSON AFB, OHIO—The most complex part of any space craft will be man.

Today hundreds of scientists are working on projects costing millions of dollars in an attempt to better understand how this key part works—and how to make better use of it.

The complexity of the problems involved is tremendous. But the results are expected to pay off not only in helping man in the conquest of space but in widespread application to life on earth.

Much of this work is under the direction of the Aero-Medical Laboratory's Engineering Psychology Branch at Wright Air Development Center. Here are seven areas under study:

• Efficient work and rest periods—A million-dollar program being conducted by the Lockheed Aircraft Corp. at Marietta, Ga., aimed first at determining the most efficient way to break up the day for men aboard a space craft.

Volunteers perform assigned tasks in a specially constructed space cabin while extensive data on their reactions is collected by observers. The work-rest cycle will be varied from two hours on duty and two hours off to eight hours on and eight hours off.

• Ionized air—An investigation to determine the effects on astronauts of ionization of space cabin air caused by operation of electronic equipment.

Preliminary results show that positive ionization of the air causes crew members to suffer headaches, hay fever and asthmatic disorders. Some reports say positive ionization also causes feelings of depression. On the other hand, negative ionization appears to result in a feeling of well-being bordering on euphoria.

• Information handling—The collection of ever-greater amounts of data by electronic means has led to the problem of finding new ways to process and act upon it rapidly. This problem is expected to become particularly acute in manned satellites and space craft.

Researchers are attempting to come up with solutions based on simplified design of equipment.

• Magnetic fields—An investigation into the effect on astronauts of passage through magnetic fields of various intensities as well as proximity to magnetic fields possibly used to contain nuclear energy.

• Control Panels—Researchers are attempting to determine whether the time spent by a pilot looking at indicators on his instrument panel display area can be resolved into a patte

The goal would be replacement all indicators with one screen wh would flash readings in a similar p tern. This would save considera weight through miniaturization. P sibly time could be saved, too.

• Man as a "Black box'—An tempt to describe man in mathemati terms and hereby fit him into complex system of a space craft.

Researchers are operating on concept that of all the electronic "bl boxes" that make up a missile or sp craft, man is by far the most comp "black box" of all. The astronaut the Space Age is seen more and m as a manager and less and less as stick puller.

• Available light—In order to c serve precious electric power, or cause of inability to carry large pov sources, astronauts may face operati in very dimly lit space craft.

Researchers are attempting to termine whether lighting can be i proved by providing a series of 20 30 brighter flashes of light a seco rather than a continuous dim bea This would be the same as reduci the flicker of a normal fluorescent t about 70 to 80%.

• **Space work and ease**—The sp cabin at Marietta is 218 inches lo and 76 inches wide. Its height ran from 58 to 78 inches.

The front work area is divided i five compartments, each equipped w a chair and a control panel. The r rest area is equipped with bunks, ba room, small kitchen, a table and chai

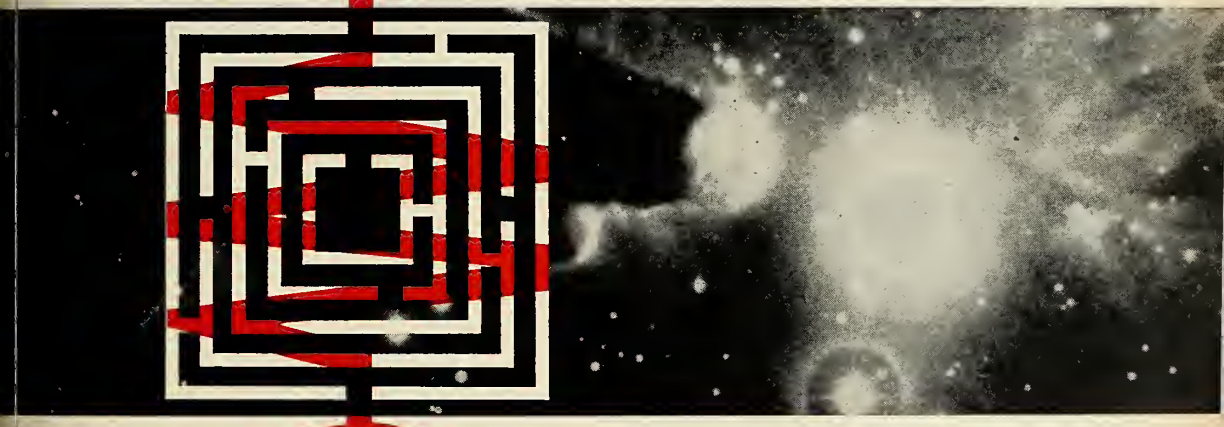
Occupants can be observed throu one-way mirrors and screens as well by closed-circuit TV cameras. El tronic equipment collects data on t occupants' heartbeat rates, breathi muscle tension and skin temperatur

The central panels provide sev tasks for crew members to accompl during work periods.

They must monitor three types scales and dials, solving mathemati problems, watching light patterns sir lar to radar and listening for a chan in an audio signal. Also, a series red lights must be turned off if th go on, and a series of green lights m be turned on if they go off.

Early experiments are expected concentrate on study of the work-r cycles. Crew members will not sleep the cabin but will bed down near Later experiments are expected to clude continuous confinement.

"This work-rest cycle will be a k thing in space," one scientist said. "T Navy's been working men four ho on and four off for generations. probably just superstition. But w knows? Maybe they're right."



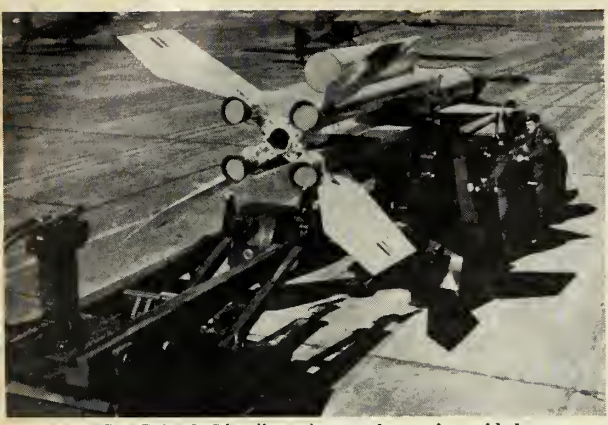
COMPUTATION FOR THE SPACE AGE

PEDITIONS INTO SPACE FOLLOW TRAILS BLAZED BY COMPUTATION SPECIALISTS. IN THIS HIGHLY PHISTICATED TECHNOLOGY, BURROUGHS CORPORATION'S DEMONSTRATED COMPETENCE RANGES FROM SI RESEARCH THROUGH PRODUCTION TO FIELD SERVICE AS PROVED BY PROJECTS SUCH AS THE AIR RCE ATLAS. BURROUGHS CORPORATION IS EQUIPPED BY ABILITY AND ATTITUDE TO FUNCTION AS AN MEMBER—A CLEARCUT RECOGNITION THAT EVEN IN THE REACHES OF OUTER SPACE, THE SHORTEST TNCE BETWEEN TWO POINTS IS SINGLENESS OF PURPOSE APPLIED TO MUTUAL OBJECTIVES.

Burroughs

Burroughs Corporation

"NEW DIMENSIONS / in computation for military systems"



BRITISH Bristol *Bloodhound* was shown in guided weapons enclosure. The trolley is used for transport and loading.

FRENCH Nord *SS-11* air-to-ground anti-tank bird atta to Sud Aviation helicopter. Photo by Réné Saint-Paul.

On Display at Paris Air Show

Pictures taken at the scene of the Continent's biggest Space Age exhibition

PARIS—British and American manufacturers vied with the French aircraft/missile industries at the 23rd Paris International Air Show—Europe's top international Space Age display.

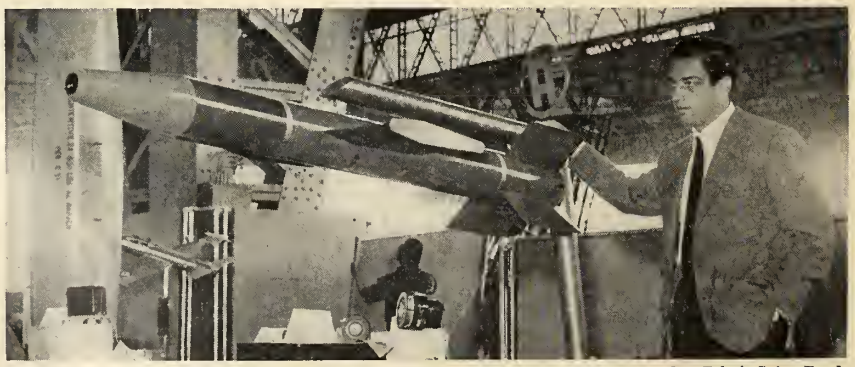
The French, who led in sheer numbers of exhibits, are emphasizing production rather than prototype missiles, such as the Nord *SS-10/11* SSM's.

Although they appear to be prospering, French manufacturers are troubled by labor unrest and a shortage of orders. Some observers feel that the French aircraft/missile industry must cooperate closely with its counterparts elsewhere in Europe. The French market alone is not enough.

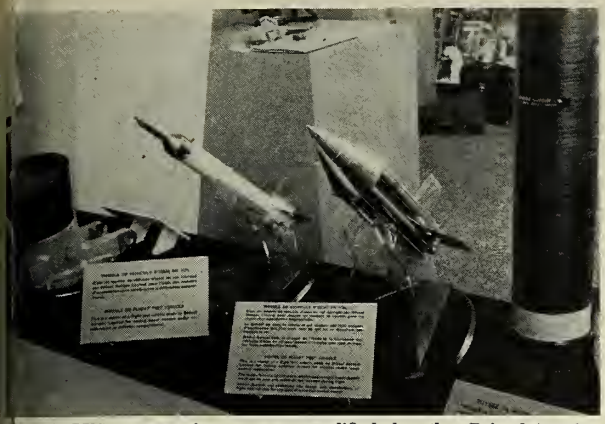
There has been considerable cooperation with the German and Italian industries, but cooperation with the British is regarded as the main key to broadening the scope of French manufacturers.

The British until recently showed little interest in wo ing with Continental aircraft/missile companies, except selling them license rights. But in recent months their tude has changed somewhat and they are now openly cussing how they can work with their continental ne bors to mutual advantage.

U.S. manufacturers, meantime, are increasingly in ested in the European market. The participation of Un Aircraft Corp., through its Pratt & Whitney subsidiary SNECMA activities is undoubtedly a sign of the times may well presage similar arrangements between other U and French companies.



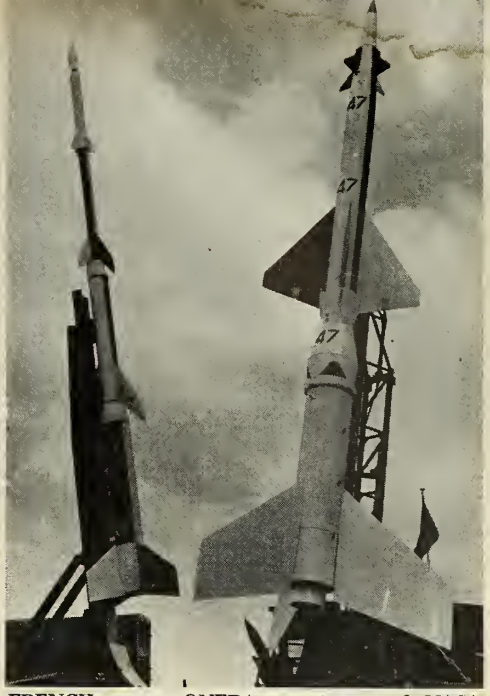
ITALIAN S.I.S.P.R.E. official looks at the company's *C-7* AAM. Photo by Réné Saint-Paul.



U.-BRITISH cooperation was exemplified by the Bristol-Aerojet stand with models of research vehicles. Photo by Réné Saint-Paul.

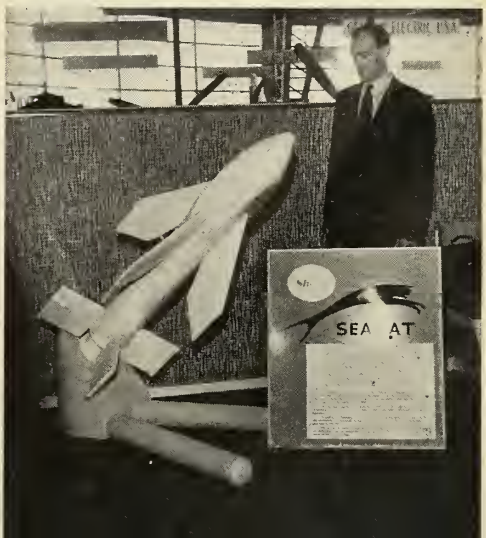
HUGHES Aircraft Co. exhibit featured *Falcon,* shown with Hughes official D. W. Harr. Photo by Réné Saint-Paul.

J. PRODUCTS dominated the missile park. They included *Redstone, Bomarc, Thor-Able, Nike-Ajax, Mace* and *Honest John.*

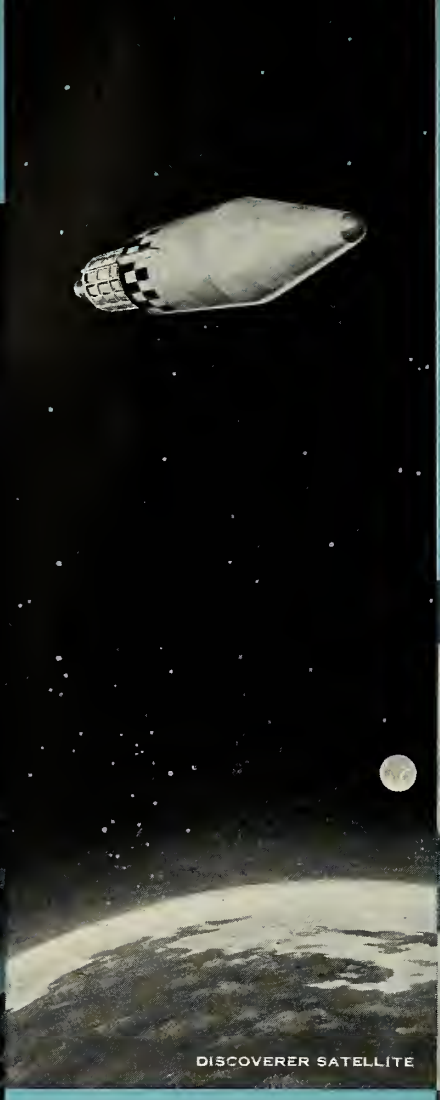


FRENCH agency ONERA, counterpart of NASA, developed these two test vehicles, one of them a four-stage Mach 7 exploration bird. Photo by Réné Saint-Paul.

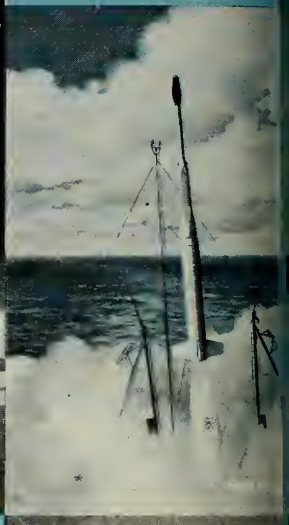
FIRST published firing picture of Short Brothers & Harland *Seacat* guided missile which will replace Royal Navy's 40 mm anti-aircraft guns. Bottom photo (by Réné Saint-Paul) shows *Seacat* unveiled at Paris.

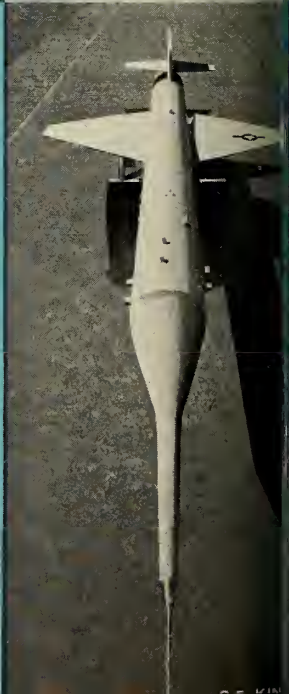


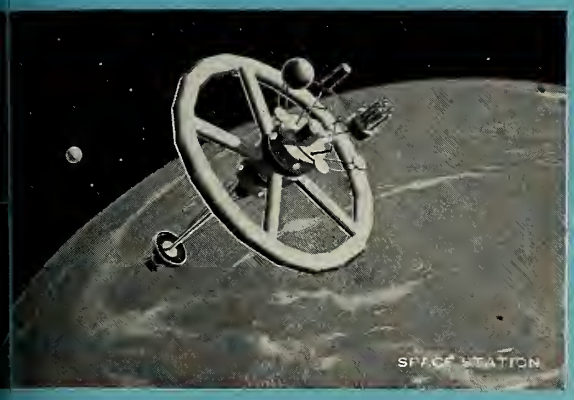
POLARIS FBM



DISCOVERER SATELLITE







EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

■

ADVANCED PROJECTS AT LOCKHEED

DISCOVERER SATELLITE—Designed and built by Lockheed Missiles and Space Division, the first of a series of DISCOVERER satellite launchings was successfully placed in orbit on February 28. Later satellites in the series will carry live animals and their recovery attempted. Valuable data will be obtained on space environment and recovery techniques of major importance to the nation's space program. The DISCOVERER is an Advanced Research Projects Agency program under the direction of the Air Force Ballistic Missile Division, with Lockheed as systems manager.

POLARIS FBM—Lockheed is missile systems manager for the Navy POLARIS Fleet Ballistic Missile, under the cognizance of the Special Projects Office of the Bureau of Ordnance. Submarine-launched, the POLARIS will travel through three mediums in a single flight: water, air and outer space. With three-quarters of the earth's surface being water, practically no target in the world is outside its range. The solid-propellant POLARIS was *designed with the future in mind*—an approach that the Navy states has cut nearly two years from the original timetable.

Q-5, KINGFISHER—Developed for the Air Force, and currently being manufactured for the Army, the Kingfisher is designed to simulate enemy attacks to test the efficiency of our various defensive weapon systems. It is equipped with extensive instrumentation to register "kills" without itself being destroyed and can be recovered by parachute and landing spike to be used again, with marked savings in cost.

X-7—Lockheed's X-7 recoverable ramjet-engine test vehicle, developed for the Air Force, has established speed and altitude records for air-breathing vehicles and is also recoverable for re-use following flight.

X-17—The nation's first successful reentry tests were conducted by the Air Force with the three-stage, Lockheed X-17 solid-propellant ballistic missile. The X-17 has pioneered many new techniques and the valuable experience gained from this program has facilitated development of other, inter-service projects, including the Navy POLARIS FBM. The Navy's history-making, 300-mile-high, Project Argus radiation explosions featured the X-17 as the vehicle.

SPACE STATION—An orbiting research facility, to serve as an advance base for space exploration, has been proposed in practical detail by Lockheed's research and development staff. The station would carry a 10-man crew. Prefabricated compartments for the rim of the wheel, the spokes, and the three hubs would be launched separately by means of ballistic missiles and guided into a cluster on the same orbit.

The successful completion of projects such as these requires a bold and imaginative approach to entirely new environments. Lockheed's programs reach far into the future. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, F-29, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

Lockheed / **MISSILES AND SPACE DIVISION**

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

BRITISH ASTRONAUTICS

- *More successful Seaslug trials*
- *Rolls-Royce building Rocketdyne motors*
- *Thunderbird comes into service with Army*

by G. V. E. Thompson

LONDON—Sir W. G. Armstrong Whitworth Aircraft Ltd., makers of the Royal Navy's ship-to-air guided missile, *Seaslug*, announced recently that it has been so successful in recent trials with live warheads that there is now no need for it to hit every practice jet target.

During trials in Australia, three rounds with live warheads were fired against jet targets. The first two destroyed their targets; so the third was programmed to miss by a predetermined distance, in order to preserve the instrumentation in its target. This firing was also completely successful.

The *Seaslug* system is designed to destroy any enemy bomber which evades the fighter defences of the Fleet. It consists of a supersonic weapon fired from a multiple launcher mounted on a ship. The target is first tracked by radar; when required, a missile is fired from the command center in the ship. If necessary, missiles can be fired as a salvo. With long-range radar it can engage bombers up to the maximum height at which modern aircraft can fly.

To launch and accelerate the missile to supersonic speed, four solid-propellant boosters are used. These are located at the forward end in a wrap-around arrangement, and the nozzle of each boost is slightly offset so that the exhaust sweeps clear of the missile and also imparts a roll to reduce dispersion. Until arrival in the launcher, the boosts are in an unarmed condition and unaffected by shock loads. Loading into the launcher automatically actuates launching levers on each boost, completing the firing circuits.

The boost period lasts only a few seconds; toward the end of this phase the main sustainer motor is ignited. This is a high-performance solid-propellant motor. The high drag of the boosts then causes them to move rearward relative to the missile body and disengage. The flight control equipment is then operative.

Power for the guidance and control equipment is provided by burning isopropyl nitrate under controlled conditions to produce a gas supply. This is cooled, filtered and used to drive a turboalternator and a hydraulic oil pump. The turboalternator supplies power for such units as the guidance receiver (which is sealed and pressurized with dry nitrogen), roll st lization gyroscopes, acceleromet telemetry equipment, etc. The pump provides fluid pressure to m the control surfaces as directed by guidance system.

ROLLS-ROYCE rocket engine, similar to those to be tested at Spadeadam, developed for the *Blue Streak* LRBM.

Four wings are attached to sustainer motor section in a crucif layout, and there are four control faces fitted to the control ring in same planes as the wings. In addi to bringing the missile on course accordance with information from guidance receiver, the control sys is designed to limit manoeuvers avoid overstressing the airframe to maintain performance with va tion of speed and altitude.

In service, the missile is fitted v a proximity fuze. However, the v head may be replaced by a telem head which can monitor the flight formance through 24 or 48 chan as required.

External electrical and air supp to the missile enter at the boat of the missile, which also includes sustainer nozzle and electrical con equipment.

Four ships of the "Hampsh class of guided missile destroyer now under construction for the R Navy, and will be fitted with *Seas* The operational ship should be i range of not less than 5000-6000 t The total space requirement for system is 8000 square feet. *Sea* moves from magazine to launcher rails controlled by hydraulic hand gear; during movement it is war up, and cooling air is fed to the e tronic equipment.

It is power-rammed into the lau er, where final air and electrical c nections are made prior to firing. ship is fitted with search, tracking

FIRING OF Armstrong Whitworth *Seaslug* from H.M.S. Girdle Ness, the Royal Navy trial ship which has launched it hundreds of times.

ctrol radar. The firing crew is far ller than the crew of a gun turret n major warship.

A complete range of handling and kaging equipment is available and ady in use at store ships and land cots. It includes a special container able of taking the complete boosted sile and equipped with anti-vibra- and shock-proof mountings. Al- atively, the missile can be broken n into six major packages, each in pecial waterproof container.

The Royal Navy's trial ship, I.S. Girdle Ness, has carried out y trials with *Seaslug* over the last years. Several hundred missiles ae already been fired, and many air- t targets destroyed not only by mis- fitted with warheads, but also in ral cases by direct hits from *Sea- lug* with telemetry sections instead varheads.

• **Scoreboard**—Very low angle fir- have been successful. On more one occasion, when a salvo of rounds has been fired, with only ort interval between them, the first destroyed the target and the sec- hit the largest remaining piece of kage.

Transfer of the fully boosted mis- from ship-to-ship at sea has been satisfactorily. Special automatic equipment for ship installation per- all the functions of the missile to ested simply and quickly at peri- intervals.

In addition to Armstrong Whit- 's, the other principal contractors the General Electric Co. Ltd. of and, and the Sperry Gyroscope Ltd. Other firms participating are I. Ltd., Imperial Chemical Indus- Ltd., Vickers Armstrongs Ltd., McMichael Ltd.

• **Rolls-Royce builds Rocketdyne motors**—Rolls-Royce Ltd., of Derby, England, are building rocket motors for the *Blue Streak* LRBM. They have been adapted and re-designed by R-R from designs of the Rocketdyne division of North American Aviation, with whom R-R have a licence agreement. In tests which have been carried out at the U.K. Ministry of Supply Rocket Propulsion Department at Westcott, the design performance was fully realized.

Rolls-Royce now has about 250 workers at their new rocket motor and missile test center at Spadeadam, high on the Cumberland fells. When the build-up is complete there will be 500. R-R are managing this site on behalf of the Ministry of Supply.

• **Thunderbird**—The English Electric *Thunderbird* will be the first British-made missile system to come into service in the British Army. Two heavy anti-aircraft regiments are to be converted into guided weapon anti-aircraft regiments and equipped with this weapon by the end of 1960. The first begins its training in June at the School of Anti-Aircraft Artillery at Manorbier, Pembrokeshire, Wales.

In peacetime, the establishment of a *Thunderbird* regiment will be about 700 men. It will have two batteries, each with four missile launchers and a total of 44 vehicles and trailers. The two regiments will thus have only 16 missile launchers in all, which indicates that this missile is not to be introduced on a large scale, but is merely intended to give Army units experience.

Air defence of Army bases in Great Britain is the responsibility of the RAF, which is already equipped with the fully operational Bristol *Bloodhound* A.A. missile. *Thunderbird* will be operated by the Army in overseas theatres. It has been designed to form a mobile missile system which will move with the Army in the field and protect it from aerial attack. Even more important will be its task of attacking the enemy's reconnaissance aircraft, hindering the use of his ground-to-ground missiles.

The two batteries of a regiment can operate independently. In addition to the four missile launchers, each battery is equipped with a tactical-control radar, a tracking and illuminating radar, a battery command post, a launch control post, and facilities for assembling the missiles in the field and giving them simple checkout tests. This equipment is based on standard service vehicles, and can be transported by air (with the exception of the large tactical-control radar vehicle).

• **Homing**—Like *Bloodhound*, *Thunderbird* uses semi-active homing guidance. Both missiles utilize the British Thomson-Houston Co.'s Sting-Ray ground-operated target-illuminating radar. However, *Thunderbird* carries guidance equipment made by the Marconi Wireless Telegraph Co., whereas *Bloodhound's* is made by Ferranti, Ltd.

When in the field, early warning of enemy approach would be given by the RAF warning system. The target would be picked up by the tactical-control radar as soon as it was within range and information given to the Sting Ray target illuminating radar. When this was locked on to the target, missiles could be launched to home on radar reflections from the target. As there is only one Sting Ray per battery, each battery can only attack one target at a time. This is considered satisfactory at present, as reconnaissance aircraft normally operate singly.

Under development since 1950, *Thunderbird* was originally powered by a liquid-propellant sustainer, but now uses solid propellants. Cruciform fixed wings and pivoted tail surfaces are fixed to the body and there are four jettisonable solid-propellant boosters.

A more advanced Mk. 2 *Thunderbird* is under development, and will have a greater range and a guidance system less vulnerable to countermeasures. The Mk. 2 missile will probably be introduced in greater numbers, and it seems likely that batteries will then be provided with several target-illuminating radar sets, so that more than one target can be attacked simultaneously. This advanced *Thunderbird* may be used by the RAF as well as the Army.

Explore new areas at IBM in

MATHEM

At IBM, creative mathematicians are discovering important, new applications of mathematics in tl electronic computer field. Long before actual construction of IBM's unique Magnetic Charact Sensing Machine, for example, mathematicians were at work on a mathematical model, testing both tl over-all design and the logic circuitry needed for character recognition. In another project, mathematicia employed large-scale computers to simulate, in a matter of weeks, eight years of engineering work whi have yet to begin. Currently under study are vehicular penetration problems involving thousands variables. Projects of this sort demand keen, discerning minds. If you have a flair for creative mathemati you're the man we want to talk to.

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RESEARCH MATHEMATICIAN: to investigate statistical problems in control system research on digital computer; to study control problems of analog to digital conversion, with particular reference to matrix problems; to apply experience with networks, statistics, or communications theory to problems in computer design; to solve problems involving switching theory, probability and information theory, and coding.

ATICS

APPLIED MATHEMATICIAN: to undertake assignments involving knowledge of feedback control theory, data systems theory, servomechanisms, information theory, statistical models, heat flow, circuitry, magnetics, probability.

MATHEMATICIAN-PROGRAMMER: to specify and program elements of a sophisticated automatic programming system. Must have considerable experience in automatic programming research.

OPERATIONAL PROGRAMMER: to develop computer program techniques for real-time military applications, using game theory and systems simulation.

OPERATIONS RESEARCH MATHEMATICIAN: to evaluate closed loop systems consisting of computers, radar displays, and inertial equipment; to simulate advanced weapons systems in order to evaluate alternate design concepts; to analyze and design electromechanical systems, studying targets, tactics, and operational effectiveness. Experience in applying advanced mathematical techniques to weapons systems analysis and evaluation. Knowledge of probability and linear programming techniques.

For details, write, outlining background and interests, to:
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reviews

HUMAN TOLERANCE TO PROLONGED FORWARD AND BACKWARD ACCELERATION, N. P. Clarke and S. Bondurant, Aero Medical Laboratory, Wright Air Development Center, USAF, 34 pp., $1, available from OTS, U.S. Department of Commerce, Washington 25, D.C.

Astronauts will be uncomfortable, but able to endure the short spurts of high acceleration necessary to put them into orbit by three-stage rocket, according to this Air Force study of the best body positions for entry into space and return.

In tests on WADC's human centrifuge, some subjects were able to withstand forward accelerations of simulated three-stage rocket flights of 8, 10, and 12 g. Rates of onset acceleration were calculated to give orbital velocity—18,000 miles per hour—at the end of the third stage.

The centrifuge was set to speed up at a rate of 0.5 g a second to constant accelerations between 2 and 12 g. Acceleration was maintained until loss of a critical facility—vision, breathing ability, or impairment of judgment or performance by pain.

The best body position for forward acceleration appeared to be with the head and trunk tilted 25 degrees forward and legs sharply bent. In this position, no blackout was observed and subjects were able to endure 12 g for 5 seconds, 10 g for 23 seconds, 8 g for one minute, and 4 g for 15 minutes. Ten-g tolerance was limited by impaired vision and extreme difficulty in breathing.

Tolerance to backward acceleration, with legs bent and head and trunk erect, was limited by considerable discomfort from the restraint system, leg pain, and difficult breathing. Twelve g was tolerated for about 4 seconds and 10 g for about 12.

PREPARATION OF STANDARDS AND TEST PROCEDURES FOR PRINTED CIRCUITS, C. A. Dodge, S. E. Graf and W. W. Hansen, Stanford Research Institute for Wright Air Development Center, USAF, 119 pp, $2.50, available from OTS, U.S. Department of Commerce, Washington 25, D.C.

Research and development which led to the preparation of military specifications for multiple-contact printed circuit connectors are described in this report.

At the start of the program, questionnaires concerning the field performance of printed circuit connectors and terminations and laboratory testing techniques were distributed to commercial firms. Significantly, replies indicated that failure rate for connectors was below 1%.

The laboratory phase involved evaluation of samples of multiple-contact connectors suitable for use in printed circuit assemblies. Specification limits were derived from performance and incorporated in two tentative military specifications.

Where existing methods of testing connectors were not adequate, new, more suitable techniques were developed. Properties most important for printed circuit connectors were established.

Chairman Seeks Broad R&D Power

Rep. Overton Brooks feels his House group should have jurisdiction over all non-military research and development bills, and sees this as step toward Department of Science

by Erica M. Karr

WASHINGTON—A quiet but highly significant revolution going on almost unnoticed in the House of Representatives may alter the route of many government scientific research and development programs. In the middle is mild-mannered, soft-spoken Congressman Overton Brooks, Chairman of the House Committee on Science and Astronautics, who reports: "I'm pleased with the way things are moving."

Brooks claims for his committee jurisdiction over *all* bills involving non-military research and development. In Brooks' opinion it includes looking into such non-space areas as cancer cures or how to grow a better potato crop. He says House Resolution 580, setting up the permanent committee and spelling out its jurisdiction, gives the group full rein over such areas.

But this is in sharp variance with the opinion of the House Parliamentarian who has been assigning the committee only such R&D bills as are space-related.

The controversy grew out of the vague wording of the resolution, now part of House Rule II. After defining the specific agencies to come under the committee's legislative authority, the resolution wound up with the nebulously-worded item (G) which states in its entirety: "scientific research and development."

Most government agencies' R&D projects are blanketed within package legislation and assigned to the committee that handles bills for the specific agency. Brooks is now actively campaigning to get the agencies to separate their R&D requests. "We talking to the departments now, but will take a while," he declares. Sev major agencies and numerous smal ones are involved in R&D projects.

Neither the parliamentarian's offi nor Brooks will admit there is a basic difference of opinion, and nc space R&D bills continue to fl through the old, established comm tees. But Brooks is optimistic that shift is just a question of time.

• **Science department?**—The Hou Space chairman, as one of the pri drafters of the resolution, sees the evitably-broadened scope of his co mittee as the first move in establis ment of a Department of Science. is very important right now to establi such a department," he says. But wh bills setting up a Federal super scien agency are going through the Congr

THE HANDS IN THE POT

Altogether 23 government departments and executive offices are involved in some phase of our missile and space program. The network extends down from the President through his Science Advisory Committee, the National Security Council, National Aeronautics and Space Council, and Federal Council for Science and Technology.

Active agencies involved are the Department of Defense and its substructures and the civilian National Aeronautics and Space Administration.

The 16 supporting agencies and their functions in the space picture are:

1. State Department—Assistance in the promotion of international scientific relations, space control policies.

2. Treasury Department—Cooperation in areas of aeronautics and flight safety, recovery and rescue.

3. Agriculture Department—Basic and applied research in agricultural products and their use, new sources of food, use of chemical byproducts, nutrition.

4. Labor Department—Information concerning available technical manpower, location of same, trends as to size and composition of labor force.

5. Interior Department—Research into geological principles. Experimental programs on minerals and fuels, metals technology and metallurgy. Basic research on saline water conversion and water purification.

6. Commerce Department—Research and development in physical sciences; advisory to other government agencies on basic scientific and technical problems. Special weather services to the "active agencies"; basic research in climatology. Basic and applied research in geodesy, mapping, etc.

7. Health, Education and Welfare Department—Research and training in medical sciences, human behavior, and collation of such data on international scale. Evaluation of educational trends and needs, research into improved educational methods.

8. Inter-Departmental Committee Scientific Research and Development Promotes exchange of R&D informati particularly regarding government pers nel. Advisory on the administration government laboratories.

9. Federal Aviation Administration Aeronautical development and testi Research into flight safety and allied te niques.

10. Smithsonian Institution—Assistar in tracking of space vehicles. Basic search in space sciences, cosmology, c mogony, etc.

11. National Science Foundation Widespread basic research support throu grants, contracts, scholarships, inforr tion exchange, participation in continu International Geophysical Cooperat program.

12. Atomic Energy Commission—Ba and supporting research in the nucl sciences, including propulsion elements the space program.

13. United States Information Age

:onal mill, chances for their passage iis session seem slim.

When the science department does lcome a reality, the Louisiana Conessman feels, it should have jurisdicton over both military and civilian sace projects, representing a $5.5 bilIn annual government investment. 'cience is science whether it is milit'y or not," according to Brooks.

If and when military and civilian sace programs are merged, presumably t: Space Committee will be more tin willing to blanket in the military l:D as well.

Brooks is hardly awed at the prosp:t of biting off all of the civilian F:D measures as they funnel through t: House. "We're eager beavers," he s's. "We'll take it."

• **Lack of coordination**—One of Books' primary motives in wanting all F:D channeled through his committee ishis conviction that the importance o research to the national welfare has n: been properly assessed, and that as leg as it is the victim of a "bits and pces" approach, rather than a coordated effort, the United States area wl fall short of its potential in the tchnological race.

As an example he points to the lack o information on the country's acadnic and industrial scientific endeavo. "We should have a census of scie'e," he says, "to answer such questins as 'How many scientists are there ir each field? Where are they? What is th'r educational background, their exprience? Is the John Doe Company hrding scientists? Is scientific manpwer being used most effectively? Hw many future scientists will be gduated from the schools each year?'

We ought to devise some system so we can tell at any time.

"The National Science Foundation has done some work on this, but—for one thing—the little company gets overlooked. We had a representative of one small company testify before the committee that they spend $50,000 a year on research. How many others there are can just be a guess. We need to have a better idea of what the private companies are doing in the way of R&D."

The Budget Bureau estimates that research and development is financed roughly 50% by government, 50% by industry. The Ford Motor Co. alone, Brooks points out, spends between $20 million and $25 million annually on research. With the hodge-podge of country-wide research projects, and no one knowing what others are doing, there is bound to be "wastage in scientific ability," says Brooks.

Just how far companies would be willing to go to divulge the details of their scientific efforts in a public census is another question.

• **Goal 10%**—Brooks feels that while the government's gradual upstepping of R&D funds is a step in the right direction, a quickening of the pace is in order. "I don't think we are spending enough."

The Fiscal Year 1960 budget calls for a total R&D slice of slightly over 7%. Brooks would like to see it hit 10%, calling this "a good ratio." He feels it would be a good investment—"Adequate research will save the country money in the long run."

To help push the day closer, Brooks has introduced a "tithe for science" bill which would in effect add 10% for basic research to all R&D money measures.

Before this session of Congress is over, the House Space Committee has on its agenda, in addition to the research tithe bill, probes into the progress of the million-and-a-half-pound-thrust single-chamber engine and 6.2-million-pound clustered engine, development of the *Zeus* anti-missile missile, recovery of satellites and missiles and Federal scholarships for students majoring in oceanography, a field Brooks thinks could stand much more attention.

Congressman Brooks, now in his 23rd year in Congress, has spent 22 of them sitting on the Armed Services Committee, and was in on the beginning of the military's entry onto the space scene. His background of some of the complexities of the problems involved is, therefore, at least as good, if not better, than those of his colleagues on Capitol Hill.

His enthusiasm for the new field is perhaps even greater.

—ervices for exchange of international sc ntific information.

4. Civil Aeronautics Board—Techni advice in accident investigation and sy ems of determining cause or source of ight failures.

5. National Academy of Sciences—Consel and research on space sciences thugh space science board. Coordinatio of U.S. activities in International Gophysical Year.

6. Federal Communications Commissio—Advice on spacecraft transmission fre encies; direction of scientific, technic and engineering programs related to de lopment of electronic communicatio techniques.

n addition, the Library of Congress, Ce ral Intelligence Agency, and Office of echnical Services of the Department of Commerce disseminate technical inforation and documents produced in oth countries, translated and sometimes mi ofilmed.

Vanguard Orbit Try Fails As Regulator Breaks Down

WASHINGTON—The ill-starred *Vanguard* project last week recorded its eighth failure in ten attempts to place a satellite into orbit.

The failure occurred in a second-stage pressure regulator, marking the fifth time that the vehicle's second stage has failed to function properly.

NASA scientists had hoped to launch into orbit a 22½-pound sphere that would have recorded the intensity of direct sunlight, sunlight reflected by the earth's cloud cover and show, and heat emitted by the earth.

The launching vehicle had been modified so that the payload and third stage parted on ground command after one full orbit.

The countdown was delayed two hours after the ignition system failed to operate on the first attempt. At 4:16 p.m. EDT Tuesday, the vehicle was finally launched, but NASA officials were not aware of the rocket's failure until two hours later when western U.S. tracking stations were unable to receive its signals.

The regulator, a stock factory item, allowed the rocket to come apart, keeping it from reaching the necessary 18,000 m.p.h.

• **Official word**—The NASA announcement said:

"The satellite did not respond to interrogation by the minitrack station at San Diego and therefore is presumed not in orbit. On the basis of data which have been received, it is indicated that there was some malfunction in the second stage. The exact nature of the difficulty will be determined from a further study of the data obtained."

This satellite, like *Explorer IV*, was launched towards the northeast from Cape Canaveral, which would have given it an orbit with about a 50 degree inclination from the equator.

Geomagnetic Equator To Be Measured by Ship

BERKELEY, CALIF.—Measurements of the earth's magnetic field are being made aboard the S.S. Mariposa with equipment from the University of California. The equipment will determine the amount of cosmic radiation reaching the earth along the ship's path.

Since the radiation is affected by the earth's magnetic field, an accurate picture of radiation intensity will provide data on geomagnetism. It is hoped that the experiment will locate the geomagnetic equator. It is the first of two or three voyages to be made in efforts to take readings of radiation over a portion of the earth's surface.

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AF Sees Improved System Management

Weapon System Project Offices are reportedly getting the job done more efficiently, although there's still the problem of just when production people should take over

by Betty Oswald

WASHINGTON—Who manages the Air Force weapon systems programs? The answer to this question depends on whom you talk to. It's the source of much of the current confusion on Capitol Hill over the operation of the AF's Weapon System Concept. Congressmen frequently charge that AF has delegated its responsibility to the contractors.

This just isn't so, according to authorities on the weapon system at Wright-Patterson AFB. As explained by Maj. Gen. W. A. Davis, recently designated as Director of Procurement and Production at Air Materiel Command: "Air Force retains control of the weapon system program while at the same time giving the prime or associate contractor sufficient latitude to accomplish his job. In this role, the Air Force must time-phase and integrate all actions of AF agencies as well as those of industry.

"Because of the magnitude of the job and the limited technical resources within the Air Force, there was no alternative but to turn to industry for assistance in performing a portion of our task. The Air Force has retained overall decision-making management prerogatives for weapon system management." An earlier article pointed out that the key to AF management rests with the Weapon System Project Office.

Executive responsibility for management of the weapon system rests in the first instance with the little-known office of Systems Management at Wright-Patterson. Part of ARDC, it manages programs through their development phase and until a decision is reached to produce for inventory.

Activity of this office does not include the ballistic missiles which are handled by the Ballistic Missile Division at Inglewood, Calif.

• 40 systems covered—However, the job is not a small one. It oversees jointly with AMC's Aeronautical Systems Center about 40 Weapon Systems Project Offices including such programs as *Dyna-Soar,* advanced space projects, the *X-15,* the air-to-ground missiles, and the air-to-air missiles.

In addition, its responsibility includes the electronic support offices for such programs as Air Weapons Control System 212L, which General Electric is developing for use overseas.

As of now, the Systems Management Office is headed by Maj. Gen. Victor H. Haugem, who will soon report to the Pentagon as Director of Planning for the Deputy Chief of the Air Staff (Development).

Basically, the office is divided into six parts, each of which is headed by a deputy. Divisions are for: research vehicles and advanced systems, elec-

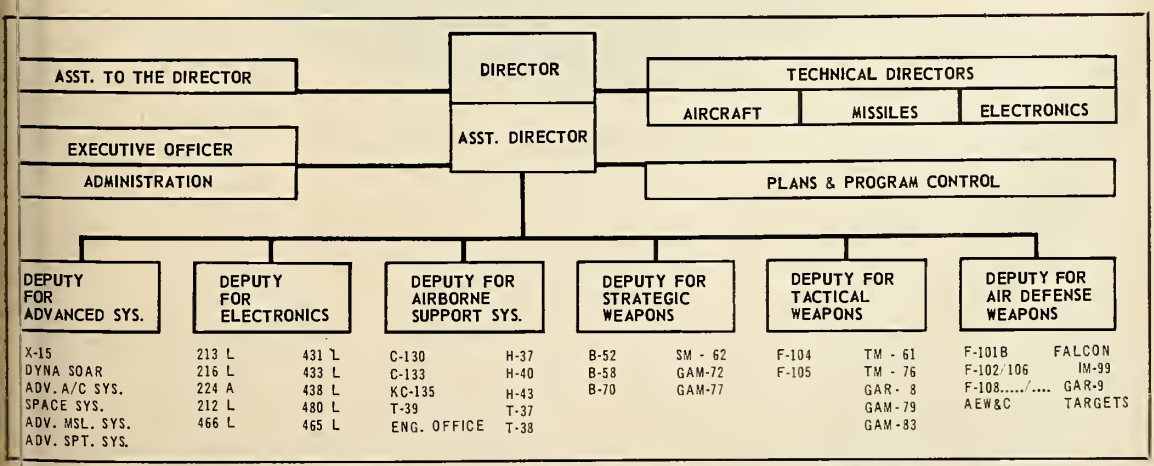

CHART of organization of the Air Force's Systems Management Office, a little-known but vital part of ARDC.

GLOBE-ILITY

Dawn in a
troubled harbor.
On the horizon,
units of a U. S. Navy
carrier task force.
Yesterday they were 700 miles away.
Today the lean ships and glinting jets are here to back up
U. S. policy. They came equipped to air-land Marines, win air
superiority, or trade nuclear blows.
Few bases are so formidable in so many ways.
None is better suited for guarding the
vast and scattered resources
which form the Free World's strength.

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ADVANCED WEAPONS | ASTRONAUTICS | ASW | ELECTRONICS | MISSILES AIRCRAFT | G | RANGE SYSTEMS

500TH CRUSADER DELIVERED TO FLEET

The jet fighter that introduced 1,000-plus-mph speed to carrier decks is now with the Navy – 500 strong. Chance Vought *Crusaders* are deployed with the Sixth and Seventh Fleets as day fighters and photoplanes. Another *Crusader* version – the F8U-2N – is being armed and equipped for near-Mach 2 combat in darkness or bad weather. It will join the Fleet next year.

With the *Crusader's* dynamic design, Vought engineers broke down barriers that have stymied carrier aircraft performance. In the same way, the Navy has tuned U. S. carrier design to the changing requirements of defense. Since World War II, these floating bases have been improved 50% in all-weather operation, 100% in aviation fuel capacity and 200% in ammunition storage.

It was a supersonic step forward when these high-performance carriers were modified by the *Crusader*. The transition was completed at low risk and cost. And these fastest of all Navy fighters have since proved reliable, serviceable and economical, too, in long periods of foreign duty that have included Quemoy and Lebanon.

Design and production of high-performance aircraft make up part of the broad spectrum of Chance Vought fields of activity. Other areas include: advanced weapons, astronautics, electronics, anti-submarine warfare, range systems management, commercial process control systems.

CHANCE VOUGHT DALLAS, TEXAS

tronics, airborne support systems, strategic weapons, tactical weapons and air defense weapons.

Technical direction is provided by three civilian directors—one for missiles (everything except ballistic missiles), a second for aircraft and the third for electronics.

• **Step by step**—First step in the complicated process is the development of a general operational requirement for a specified weapon or support system. This is prepared by Headquarters USAF. The requirement is analyzed by ARDC which makes contracts with industry for design studies.

Based on an analysis of these studies, ARDC submits a development plan to headquarters for approval. Approval of this plan gives ARDC a Development Directive.

At this point, the partnership between ARDC and AMC is set up with the start of source selection processes. These procedures are spelled out in Air Force Regulation 80-3, dated April 28, 1959.

Under the rules as spelled out, ARDC, AMC and the using command meet jointly to establish a System Source Selection Board. ARDC assigns a senior officer to act as the nonvoting chairman of each board and direct the proceedings.

These Boards are used in two situations. They may be required to choose a group of contractors from industry to submit proposals, or they may evaluate specific proposals from contractors.

Rules provide that after the contractor briefings and other actions needed to acquire information, the Board completes its evaluation and presents it to the commanders of ARDC, AMC and the using command. Each commander then makes his recommendation in writing to the Vice Chief of Staff. In order to prevent leaks, references to selected contractors are by letter code only, with the code for the occasion identified by the senior board members.

Final decision is, of course, up to the AF Chief of Staff, Gen. Thomas D. White, and Air Secretary James Douglas.

• **Shifting responsibility**—After the contractor is selected, the Weapon System Project Office is organized and staffed by the Directorate of Systems Management and AMC's Aeronautical Systems Center. Executive management responsibility for weapon system integration is given the Directorate of Systems Management.

What "executive management responsibility" means in this sense is team leadership during the development phase of a weapon system. Systems Management Office is responsible during the entire design and development cycle until a final decision to produce is made. At this point, executive management responsibility shifts to the Aeronautical Systems Center. However, the directorate keeps its people in the Weapon System Project Office, since it continues to be responsible for production engineering proposals, the product improvement program, the making of technical fixes and for safety and grounding orders.

Tools used by the directorate during the development phase are development engineering inspections, known as DEI's and Mockups. These are used in an effort to insure the technical adequacy of the work of the contractor and the integration of subsystems. Emphasis on this part of the program has been increased sharply because of the necessity to push a program through without waiting for flight tests.

During the development cycle, Weapon System Phasing Group is headed by a representative of the Directorate. The group, which is not an action body, is designed to assure that each of the functional elements of the Air Force involved are apprised of problem areas and of the actions which must be taken by each functional unit to provide a fully operational weapon on schedule.

When Executive Management Responsibility shifts to AMC, chairmanship of this group shifts to the Aeronautical Systems Center. Perhaps the toughest job which now exists is to determine when this responsibility should shift. So far, the shift of responsibility has been decided by mutual agreement of ARDC and AMC. If the agreement isn't reached, responsibility remains with the ARDC group. This in turn leads to the charge frequently made that research and development people in their search for perfection often create the most perfect obsolete weapon.

• **Stubborn problem**—In general, however, reports from Dayton indicate that the program is now working better—that the jointly manned weapon system project offices are getting a job done, now that the system permits greater action. Nevertheless, it is seemingly agreed that the really hard problem hasn't been solved yet. Simply stated, this is: "When does a weapon move out of its test and development phase to a point where production people should take over?"

The corollary problem is: "How much of a slow-up occurs production-wise as a result of the shift of executive management responsibility from one agency to another?" The answer to this last question depends entirely on how closely ARDC and AMC officers have been working together in the Weapon System Project Office.

$30 Billion Defense Spending Boost Urged

To put the United States on a par with Russia militarily, the Democratic Party's Advisory Committee says the nation must spend an extra $30 billion over the next four years—mostly on missiles. The committee charges that the country's defenses presently are in "disastrous" shape.

The committee recommends: doubling planned and actual rate of production of *Atlas* and *Titan;* stop-gap development of *Snark* and *Regulus II;* speed-up *Polaris* and *Minuteman;* continue high priority of *Nike-Zeus* development; give SAC 24-hour airborne capability; and increase jet tanker production.

Hits and Misses

A **Martin** *Bold Orion* two-stage ALBM prototype—the 11th—was fired successfully June 19 from a B-47 over Cape Canaveral. Rocket was programmed to travel several hundred miles . . . At Vandenberg AFB, a Royal Air Force crew launched a **Douglas** *Thor* June 16 and the missile had to be destroyed seconds after lift-off because of a "mechanical malfunction."

A supplemental appropriation of $485.3 million has been requested for NASA by President Eisenhower. The money bill follows an authorization for that amount already signed into law.

Waste of $1.4 million through a "lack of foresight and faulty planning" is the Senate Preparedness Subcommittee label hung on the Navy's decision to close down a new *Terrier* missile depot in Boston Harbor. Said the subcommittee: "Obviously it is not good business to construct a modern missile facility and then turn around and close it down. It is no wonder that the cost of national defense rises . . ."

Titan Base Contract

Ralph M. Parsons Co. has the $767,000 A&E contract to design a new $84 million *Titan* installation at Larson AFB, Wash.

The Martin Co. has set up an "activation division" under Vernon Rawlings to act as integrating contractor for construction and activation of *Titan* weapon systems in the field. The first job will be at Vandenberg, and will be under the direction of BMD.

OCBM has granted fast tax write certificates on 65% of $1.2 million **Lockheed** for missile R&D work Van Nuys, Sunnyvale, and Santa Cr to **Thiokol** on 60% of $600,000 rocket engine R&D at Denville, N and to **Boeing** on 75% of $1.5 mill for missile and space vehicle R&D.

Black Paint Job For *X-15* Re-entry

Jet-black, silicone-based paint us on **North American's** *X-15* resear plane, designed to withstand re-en temperatures in excess of 1000°F, expected to last through four or fi flights.

Ryan Aeronautical Co., now bla forming metal parts in an outdoor at San Diego, is building a new exp sive forming machine that will rese ble a deep diving bell. If it tests out expected, the next step will be pr duction-type equipment for operati in the factory, perhaps in a year two.

The Changing Scene

Acoustica Associates Inc., whi had 3 employes four years ago, h opened its fifth plant—a 50,000 squa foot building devoted exclusively to trasonics at Plainview, L.I. The co pany now has 425 employes . . . A n liquid epoxy resins plant with a 15 m lion pound annual capacity has be put on stream at Marietta, Ohio, **Union Carbide Plastic Co.** . . . In diversification move, **General Dynami** has acquired the 17 plants of **LaVer W. Hench & Associates** for "sever million dollars." The plants produci oxygen, hydrogen, argon and oth gases will be operated by GD's Liqu Carbonic Division . . . **Raytheon In** is building a new plant at Portsmout R.I., for its Navy ASW operation . . **Magma Products** of Santa Fe Spring Calif., has sold a 51% interest **Thompson Ramo Wooldridge.** Magn makes specialty chemical and electron products and holds an ARPA contrac . . . **Dynatronics** is moving to a ne plant at Orlando . . . Step-up in th hiring rate of all types of employes underway at the **Sperry Semiconducto Division** of **Sperry Rand** in Norwal Conn., as part of an accelerated e pansion program . . . **Dynamic Gear** building a $200,000 plant at Amit ville, N.Y. . . . and a plant with 28,0 square feet of space is under constru tion by the **Autonetics Division Nort American Aviation** at Downey, Calif for an environmental test laboratory.

A Rare Grouping

SPACE MEN garbed to receive earthly honors at Adelphi College's recent commencement from Dr. Paul Dawson Eddy (foreground), college president. Left to right: John P. Hagen, chief, *Vanguard* Div., NASA; Willy Ley, editor and author; Hugh L. Dryden, deputy administrator, NASA; Lt. Gen. Bernard A. Schriever, commander, USAF, ARDC; Dr. Wernher von Braun, director, Development Operations Div., ABMA; Hans H. Hueter, director, Systems Support Equipment Laboratory, ABMA; Lt. Gen. C. S. Irvine, (Ret.), former AF deputy chief of staff, Materiel. Honorary degrees: Doctor of Laws—Dryden and Von Braun; Doctor of Science—Schriever, Irvine, Hueter, Hagen; Doctor of Humane Letters—Ley. Von Braun spoke on "Education in the Space Age."

Big Push for Automatic Checkout

Fully transistorized systems are rapidly being developed—one is operational

by Charles D. LaFond

WASHINGTON—The big push is on ndustry to develop solid-state auto- ic checkout systems. The stagger- complexity and the vast number of erent missile weapon systems de- oped in recent years has spawned an ost equally large array of auto- ic checkout systems.

The initial testing, pre-launch or -flight testing of weapon systems forced the use of radically new hods and techniques, particularly ause of the constantly increasing d for greater speed and near 100% ability.

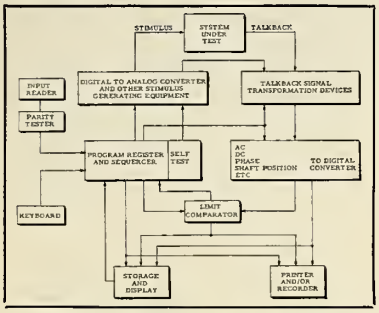
As a result of this increased com- xity, it is no longer feasible in view time, expense, and personnel train- problems to use highly skilled kers to perform the tests, evalua- , and adjustment of sub-systems systems. The need for completely omatic checkout devices and pro- ures was obvious several years ago , as a result, progress and develop- nt have been rapid. We are now in hase of transistorizing most of the re checkout systems.

Solid-state switching devices have hed a point where it is now practi- to design and construct completely matic checkout systems with much ter reliabilities. The new systems be considerably more flexible, rate at higher speeds, and provide er performance. Finally, mainte- ce will be faster and greatly simpli- because of the use of decks of ted circuit cards, overall modular struction and vastly improved self- king features.

An M/R survey of many of the ntry's leading producers of success- checkout systems has indicated the owing:

• Conventional systems for many lications certainly will not be made olescent by the higher speed tran- rized systems in development.

• Those manufacturers taking the e expedient course in developing conventional checkout systems now have an operational capability.



BLOCK DIAGRAM of a generalized solid-state automatic checkout system.

• Almost all manufacturers paralleled conventional systems development with an R&D effort at their own expense to design fully transistorized systems. To date, M/R has found only one—by Curtiss-Wright Corporation—that is operational. Others have developed prototypes and in some cases the military has proffered contracts to marry systems to missiles and aircraft.

• There exists an urgent need for a government requirement for designing future missile systems to accept automatic testing. The burden should not rest solely with designers of automatic checkout systems. (It should be noted that the cost of matching specialized individual test units with a weapon system is approximately 15 times that of automatic universal-type systems.)

• There also exists an urgent need for government standardization of automatic test procedures.

• Greatest stumbling block in developing very high-speed transistorized checkout systems has been in the state-of-the-art levels of the various major sub systems—computer technology is vastly more advanced than other units. In particular, one problem area has been the transient reaction time associated with switching matrices. In computerizing high-speed testing, the system must have high-speed programmable devices. Another thorn has been the access problem to meters—that is, the ranging and scaling by pulses in both stimulation and test equipments. Finally, development of a satisfactory programmable power supply has been slow.

• As might be expected, checkout system development has followed a pattern of self-standardization in general design and in functional subsystems. Real variance occurs in unit configurations only with final application.

• **Generalized system**—In general, information governing automatic test procedures is provided by paper or magnetic tapes, from punch cards or is manually directed into some kind of program register and sequencer. Some checkout systems use a supplementary wired patch board panel; with others, the patch board provides complete direction. To insure proper functioning of the primary information input, some type of parity check is made.

Information normally is stored to indicate not only the nature of the tests to be performed but certain tolerance limits of the response. A control of the timing sequence to perform various tests often is included. A central gating system frequently is provided to insure that tests are conducted in a sequence that cannot damage or destroy the system under test.

Finally, certain self-test procedures are included to check the operation of the checkout system itself. This usually includes some kind of a cutoff device which will stop the sequence of tests in case of a checkout-system failure until such time that the defective unit (or units) has been corrected.

Next week: the fully transistorized automatic checkout system developed by Curtiss-Wright Corp. will be presented. Its application to a Nike *system will be explored in detail.*

Input signals to the system under test are generated in several ways. A digital-to-analog converter is used to transform a digital value in a program register into either an ac or a dc voltage. At times, special signals, peculiar to the system under test, must be generated. At this time, the program register may be used to direct the appropriate signal. After feeding various stimuli into the system under test, response may have to be transformed before being converted into digital values.

Transducer outputs may require corrections for nonlinearities. Following this, a series of converters is used to convert the system response into digital form. These values can then be compared to the limit values in the program register and results can be displayed visually and printed.

Many systems also incorporate a manually operated phase. When in the manual mode of operation, the programming tape is not employed. This gives the system considerably more flexibility and enables it to be used in different phases of development or production in a missile weapon system program.

In most automatic checkout devices, there is of necessity a similarity in functional subsystems. To better understand how the typical checkout device is constructed, major subsystems are described below.

• Programmer—The programmer is the central element of a checkout system, providing storage for the various parameters and control information characterizing the test procedure. Information concerning one or a number of steps may be stored at one time. A large number of techniques for storing information are employed: transistorized flip flops, magnetic cores, magnetostrictive lines, or a combination of storage media may be appropriate.

• Stimulus generators—A multitude of stimulus-generating equipment may be employed, according to the nature of the tests being performed. In general, the application of stimuli, as indicated earlier, is directed by the programmer. Typical generators might be high-frequency units with various types of modulators, mechanical stimuli motors, temperature controlling equipment, pressure generators, rate and acceleration generators, etc.

• Signal transformers—The talkback signals often must be transformed before conversion to digital form. Transducer outputs, for example, may need to be amplified and linearized before conversion. Some r-f and power measurements may require an intermediate conversion before digital information can be derived.

• Analog-to-digital converters—As already indicated, analog-to-digital converters are provided. In addition, other types of converters must be used to convert to digital form the position of servos and synchros. Both mechanical and photoelectric encoders may be used.

• Comparators—Many means are available for comparing the magnitude of two digital numbers. One method is to scan the two numbers from the most significant end and note the first position in which the two differ. The number that has a one in that position is the larger but this assumes certain sign conventions.

Probably the most frequently used logic system is the method of subtracting one number from the other and observing the sign of the difference. The advantage of this method is the yield of the magnitude of the difference which may be necessary for display or recording.

In checking limits, both the upper and lower must be compared. The two operations can be performed sequentially by one device or simultaneously by separate converters. For very high speeds, completely parallel systems may be employed.

• Readout or display—Readout of checkout system can be in one or both of two forms, temporary or short term. Readout may be by warning lights, numerical display, or audible alarm. It may be permanent—such as printed tape, punched card or tape, or magnetic tape.

• Printer and/or recorder—A permanent record of the tests is normally required for future reference and further analysis. This calls for use of printers or recorders.

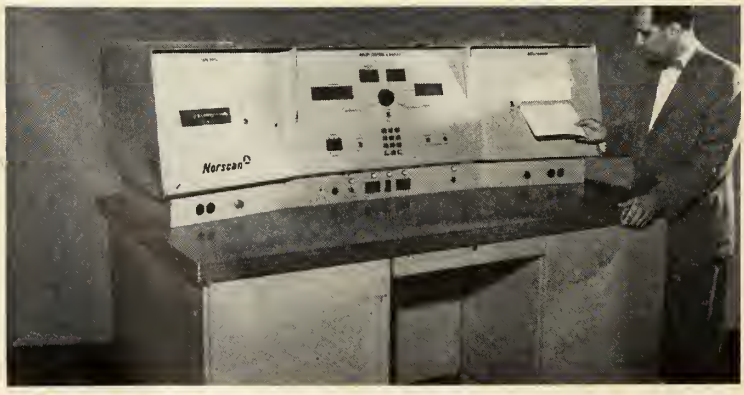
• Storage unit—If information is to be displayed and held at each step, or if it must be printed and recorded, some form of intermediate storage is necessary. Solid-state flip flops together with power amplifiers (required to activate displays) can be used for this purpose.

• Solid-state design—In the current state-of-the-art, almost all of the various checkout equipments described can be constructed using only solid-state active elements. There are a few exceptions, such as the r-f generators and talkback transformation devices.

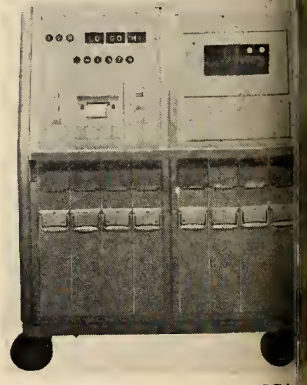
In designing the checkout system with solid-state components, the use of mechanical devices is minimized as much as possible. For example, dc amplifiers employ silicon transistors rather than mechanical devices for stabilization. In general, there is an optional use of either silicon or germanium transistors depending on the temperature requirements in the system. Magnetic elements such as shift registers and coincident current memories can be used, and magnetic regulation is employed in the system power supplies.

Packard-Bell Electronics Corporation, Los Angeles, has been designing and developing a number of units

Typical Fully Transistorized Checkout Systems



NORTHROP CORP., Nortronics, fully transistorized Norscan console (without stimuli-generating equipment) now in prototype form.



STROMBERG-CARLSON SCA using flexible functional module

eckout systems. In their design phi-ophy, they use etched circuitry as tensively as possible. In addition, ty employ the largest possible odules consistent with etched circuit thniques and with minimal spare part ventory requirements. Their reason: provides a significant increase in re-bility by minimizing the need for ring between boards. They also em-oy etched bus-board for interboard ring to eliminate individual wires.

Another problem area eliminated Packard-Bell is the use of positive tact connectors. For each module uiring individual interboard wiring, nnections are made physically and ctrically to the etched circuit, thus minating faulty contact difficulties en associated with etched board con-uction.

• **Trend index**—Along with the de-opment of solid-state checkout sys-ms, new concepts for the use of these vices are being incorporated. Curtiss-right Corporation of Santa Barbara, Calif., with their now-operational *Nike*-stem checkout equipment, and Nor-nics of Hawthorne Calif., with its ototype Norscan system, are both ilizing a "trend" or "confidence" ex. Employed in a similar manner, t idea is a step beyond that of more ntemporary go-no go type testing.

Nortronics has described its con-fence index as follows: The test read-t that is made is compared not only ainst established no-go limits but is ighed in relation with the reading de just prior to it. For example: uld a low voltage be fed into an plifier which doubles the voltage plitude, the comparative limits of t amplifier output are adjusted to npensate for the low input per-tting the amplifier gain to be on the h side, with a resulting acceptance o the two units because the summed ult is within the design limits. This comparison in Norscan will be accomplished by a processor which makes the necessary arithmetic computation.

If a no-go reading is obtained, the test equipment goes into a hold configuration and isolates the malfunction in the system under test to the next-lower level. If isolation to a still lower level is desired, it may be accomplished by using a mode selection capability incorporated in the test set. In this case, the operator can remove the subsystem causing the problem, connect into the test equipment individually, and perform more specific tests, or a different set of tests for that particular subsystem.

If a go indication is received, readout indicates to the operator just how good the go signal was. This data is provided in the form of a two-decimal digit presentation reading from 99 to zero.

In the initial phases of any developmental program, the system designer must establish the design center he is trying to achieve. He then arbitrarily establishes no-go limits. Until the test program has proven what these limits actually should be, the trend or confidence index is a means of utilizing past experience to indicate that a particular reading does or does not have too much effect on the accuracy or reliability of a particular system.

• **Exact limits**—The final values used in an index of this kind are derived by simulating a system in a computer (such as the IBM 704) and then by varying the parameters that are to be tested to determine their effect on the overall system. By this means, exact design limits can be established and variation effects of these parameters can be determined.

Each parameter is assigned a weighing factor. Then, as the system is tested and data recorded, a weighing factor is assigned to each one of the reading. Following the tests, a summation is made of all test limits with their weighing factor resulting in the two-decimal digit presentation.

Another important part of the original derivation of values in the index is the separate determination of values for reliability, accuracy and safety. These may be presented as three separate readings or may be combined in one overall index number.

• **Reliability**—Link Aviation Inc. of Binghamton, N.Y., believes that each specific system must be analyzed in detail before an intelligent definition of the checkout requirements can be specified. In general, design of any automatic checkout system requires primary compliance with system reliability as well as the fundamental concept of inherent versatility.

Systems must not only be simplified to permit maximum utilization by semi-skilled or unskilled personnel, but they must be capable of performing all tests necessary for the checkout of the system of subsystem and the various components in the subsystem. Thus the company believes that the more contemporary go-no go type checkout gear best meets these requirements.

But Link has indicated also that means should be provided for the generation of additional programs which may prove to be necessary. These would be performed by operators at the engineering level. With respect to reliability of the check out equipment, of necessity, it must be considerably better than that of the equipment under test. Link has stated the following requisites to be obtained with such high reliability:

1) System self-check should be accomplished as a requisite to any system test and should be executed from the most straightforward manner possible. The capability should be such that the self-check could be made by depressing a push button any time and without replacement of the tape or cards being used at the moment.

2) Redundancy bit checking should be included in the design of any checkout system in the manner which will interrupt the test routine when a discrepancy in coded signals is detected. Audible and visual alarms should be activated at the same time to provide suitable indication to the operator.

3) In some systems where considerable hazard is likely from the generation of faulty commands or where a dangerous situation can result from component failure in the checkout equipment, a policy of permissive progress should be employed. This requires the testing equipment to generate signals indicating successful completion of each command before the next information can be read and acted on.

RTH AMERICAN AVIATION, Autonetics, fully transistorized type GS-1 (C2-4A) includes simulation equipment. It is now in production.

Space Observatory in Three Years

NASA is spending $3.5 million to solve the remaining problems and bring a revolution in astronomy; 1.5 million pound thrust engine clusters are believed adequate

by Hal Gettings

WASHINGTON—Today's space research programs offer a golden opportunity to astronomy. We can now foresee—possibly within three years, according to Dr. Leo Goldberg, of the University of Michigan—astronomical telescopes on satellites orbiting the earth.

Eugene Root, Lockheed Aircraft, has predicted that during the next decade "astronomical observations from space vehicles will be an accomplished fact (and) will revolutionize conventional astronomy." He indicated that future astronomical techniques may bring the answer to the evolution of the universe.

According to Prof. Lovell, the British astronomer, satellite-borne radio telescopes will be able to look back billions of years to obtain information on the state of the universe as it existed then.

The earth's atmosphere and ionosphere act as a screen to most of the electromagnetic spectrum of radiation from celestial bodies. The establishment of space observatories will put man on the other side of this curtain —and reveal many of the secrets of the universe hidden from him today.

Artificial satellites and planets make possible a whole series of experiments and observations which are unique and lead to tests of the very foundations of physical theories. Space research introduces the element of controlled experimentation into what has always been fundamentally an observational science.

Much work has already been done; much remains to be done if the proposed three-year schedule is to be met.

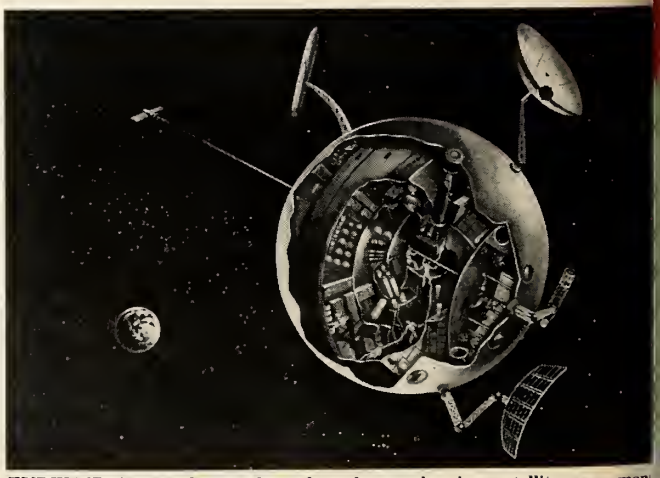
• **Step number one**—The first step has been taken with the spectroscopic photography of the sun's radiation in the light of Lyman—a line of hydrogen. This was done by a rocket camera fired to an altitude of 123 miles. A technique has also been developed to scan a selected spectrum and telemeter the observed intensities back to earth—a method leading itself to satellite observation. Work is currently being done on development of 8-inch and larger telescopes with necessary television equipment to transmit observations to ground stations.

Approximately $3.5 million has been budgeted by NASA for study and development of problems directly concerned with astronomical satell (performance requirements, protot telescopes, command-control and d handling and transmission, vehicle sign and construction).

• **Problems**—Many problems m be solved before successful space servatories can be established. Pr ably the major one is a vehicle capa of placing a payload of several th sand pounds in orbit. It is expec that the 1.5 million-pound thrust gine clusters now under developm and scheduled within the next t years can do the job.

A host of instrumentation proble must be solved before the observat becomes a reality.

The satellite telescope must only be stabilized so that it will pc



FURTHER in the future than the telescope-bearing satellites are man observatories like this 250,000-pound vehicle envisioned by Rocketdyne ar

curately in any desired direction in ace; the direction of pointing must o be controllable from the ground.

An adequate power supply must be ovided with reasonable long lifetime. e technique of using solar cells has en notably successful in the case of *nguard 1.* The same technique could used on an expanded scale to pro- ce 10-20 watts of power, which uld be satisfactory at present. Radio- ive sources and chemical fuel cells o offer promise.

Most of the problems connected h the storage of data and its trans- sion to earth have already been ved to an extent with earlier rocket l satellite experiments.

There still remains the extremely icult problem of designing optical tems and detectors that will operate h high efficiency for radiation of y short wave length.

• **Experiments**—The Space Science ard of the National Academy of ences and its ad hoc committees e been working to prepare an out- of what seem to be, at present, most important space experiments. y are aware, of course, that it is realistic nor even possible to list the many exciting astronomical ex- ments that could be performed n space vehicles. According to Dr. dberg, chairman of the Astronomy Radio Astronomy Committee, this ine is intended only to point out possibilities to potential investiga- who may realize the very great dity with which space technology dvancing.

• **The sun**—The sun is certainly an ct of very high priority for study. the only star whose detailed sur- features can be studied and its tion has a very direct and prac- influence upon our daily lives. Every advance made towards the understanding of the sun serves also to expand our knowledge of the other stars. Although a vast amount of knowledge has been accumulated about the sun, many of the most fundamental questions concerning its structure and activity are completely unanswered. Our knowledge is most deficient with respect to the outermost layers, the chromosphere and corona, both as regards the structure of these layers and the nature and origin of the often catastrophic disturbances that take place within them.

Many interesting experiments are being planned for the observation of X-rays and ultraviolet radiation from the sun. Perhaps the most urgent is the reconnaissance of the spectrum with scanning spectrometers. This experiment need not await the development of refined stabilization techniques since a great deal can be learned from analysis of radiation averaged over the whole disc of the sun. As soon as accurate pointing capability is acquired, small regions on the surface can be isolated for more detailed studies.

A second series of experiments would involve recording images of the entire sun in monochromatic radiation at ultraviolet and X-ray wavelengths. Similar monochromatic photographs made in visible light from the ground have already constituted a major source of information, particularly with respect to the transient disturbances.

An interesting byproduct of the solar spectrum studies would be the determination of the densities of the constituent atoms at altitudes above 200 kilometers in the earth's atmosphere.

The observation of radio waves at frequencies below about 20 mc, which are reflected back into space by the earth's ionosphere, are also of interest. Particular importance is attached to the solar radio bursts in the very low frequencies. The dynamic spectra of these bursts, which originate high up in the chromosphere and in the corona, have been observed to a low-frequency limit of 40 mc. The so-called type II and type III bursts, which begin at high frequencies and occur progressively later at the lower, have been interpreted as resulting from corpuscular streams propagated outward through the solar atmosphere at speeds varying from a few hundred to a few tens of thousands of kilometers per second.

• **Moon and planets**—Investigations of the moon and planets will be carried out with space probes and by actual exploration. The moon will be the first object for investigation, and the next few years will probably see a variety of experiments including:

1) Return of lunar surface samples to earth.

2) Measurement of density and composition of possible lunar atmosphere.

3) Study of composition and structure of surface and interior of the moon.

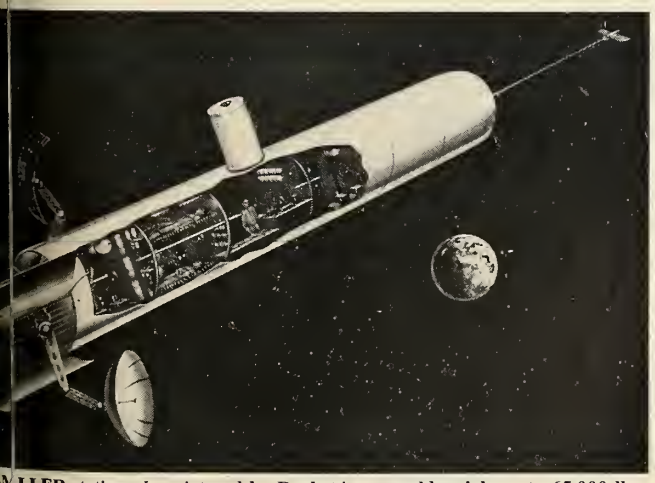
4) Measurement of lunar magnetic fields.

5) Investigation of presence or absence of dormant life spores.

The planets may also be explored from satellites and space probes with packages of instruments to obtain pictures with different wave lengths of radiation and for the detection of numerous phenomena such as magnetic fields, planetary ionospheres, lighting flashes, aurorae, etc. It has also been proposed that radar pulse probes be used to display the surface roughness of planets.

The success of many of the planetary probe experiments will depend rather critically on the amount of power available for the transmission of information back to earth. For example, it would be useless to send a space probe close to Mars to televise its surface unless the resolving power of the image received is smaller than about 25 miles; otherwise just as good or better results can be achieved with a 50-inch telescope mounted in a high-altitude balloon.

In the very immediate future the most profitable investigations of planets from the vicinity of the earth will probably be carried out by balloons rather than satellites. Considerable work in this area is continuing under Office of Naval Research projects "Stratoscope," "Skyhook," and "Stratolab." Commander Malcolm Ross, with Dr. Strong of the University of Maryland,



LLER station also pictured by Rocketdyne would weigh up to 65,000 lbs., ering a launching booster vehicle with about 6 million pounds of thrust.

feels that much more can be done with this program and that balloons should be used for all observatory work below 150,000 feet. As in many other programs, money has been the limiting factor.

• **Stars and nebulae**—Satellite investigations of the stars, nebulae, and interstellar medium and external galaxies are at least an order of magnitude more difficult experimentally than those dealing with the sun, because of the relative faintness of the sources and the stringent requirements for accurate guidance and control. Furthermore, astrophysical measurements from rockets have to date been limited almost entirely to solar spectroscopy and, therefore, the galactic experiments are not so well defined as the solar experiments. For these reasons, galactic and extra-galactic research from satellites will probably proceed in two stages. It is extremely important as a first step that the ultraviolet radiation from night sky be mapped quickly, even relatively low angular and spectral olutions. A start has already been n with rockets by the Naval Rese Laboratory.

A number of astronomers proposed experiments for compre sive sky surveys designed to yield m urements of the radiation density number of wave lengths and with ing degrees of angular and spe scopic resolution. If the wave len are properly chosen, valuable infor tion can be obtained on the phy state of interstellar matter, on the u violet energy distribution of bright, stars, and on the relative contribut to the integrated radiation backgr of starlight, galactic light, extra-gal nebulae and zodiacal light.

After the sky surveys, the next s of galactic investigation would c with the establishment of accur controlled telescopes in satellites has been estimated that it will be sible within three years to mou telescope on a stabilized platform sufficient control and pointing accu to permit the imaging of indivi stars. Two groups are already at w on the design and development such telescopes.

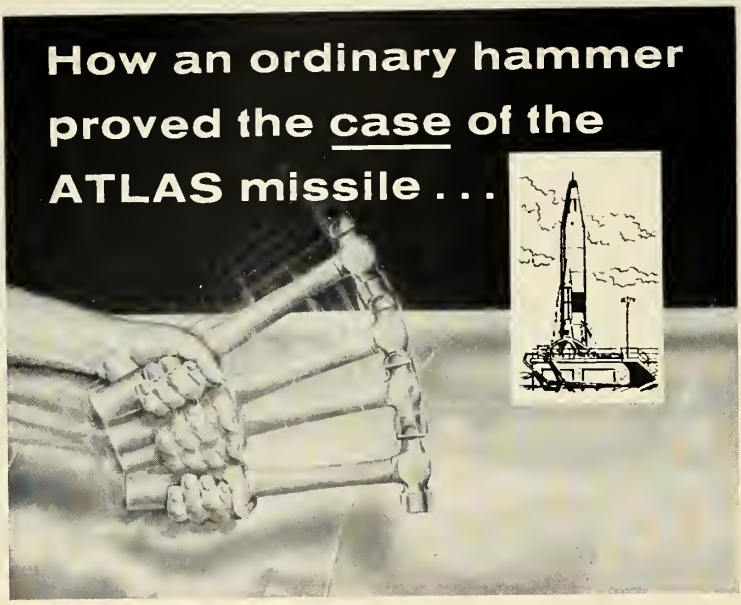
The first few years of sate astronomy will probably be devote the astrophysical analysis of ultrav radiation. This is an area where loons cannot be used since the u violet frequencies are absorbed ozone and photochemical reactions low 150,000 feet.

As the technology of instrume tion advances, it may be expected there will be important application the field of astronometry—the pre measurement of the positions and tions of the stars.

• **Solutions**—Three sources of nificant systematic errors would eliminated by a telescope mou above the atmosphere: imperfect tr parency and seeing and atmosph dispersion. Images would be sm and fainter stars would be reached. additional great advantage would the attainment of high optical resol power in the ultraviolet. Condit would be particularly favorable for serving faint white dwarf stars, whe single or components of binary st

A survey for binary stars am "single" stars would be more p trating than from the bottom of atmosphere. In particular, it shoul easier to discover faint companion s and possible planetary compani The possibility of discovering m faint red dwarf stars would also enhanced in the absence of atmosph absorption in the red and infr regions of the spectrum.

How an ordinary hammer proved the case of the ATLAS missile . . .



The body of the missile, essentially one big fuel tank, is similar in principle to an inflated football. Convair-Astronautics broke new ground in missile design by developing a super-strong structure with a comparatively thin stainless steel skin to keep weight to a minimum. This stainless steel skin is so thin that the interior has to be pressurized to preserve the shape of the body as propellants are consumed in flight, or when the missile is being transported on the ground.

Some critics, however, thought the body was too fragile—"You could dent it with a hammer." So, recently, when the Scientific Advisory Board, engaged in a re-evaluation of all missile programs, arrived at Convair-Astronautics to take a reading on the ATLAS, they found that Convair had thoughtfully placed a number of hammers within easy reach of a finished missile. "Go ahead, bash it," invited Convair. The SAB members swung lustily. *Not a dent was registered*, for, although the walls are thin, the stainless has a minimum tensile strength of 200,000 psi.

This stainless steel skin material, supplied by Washington Steel, required extremely close control of mechanical properties and gauge tolerance which are regularly produced through Washington Steel's long experience with precision rolling equipment.

Stainless Steel—the Space Age Metal

Washington Steel Corporation

6-H Woodland Avenue
Washington, Pa.

Report from West Germany

The following dispatches were sent m West Germany by M/R's executive tor, now touring Europe.

by Clarke Newlon

RAMSTEIN, GERMANY, Hq. 4th Allied ctical Air Force—Russia has "hun- ds" of 700-mile ballistic missiles facing stern Europe, according to intelligence orts which reach Maj. Gen. Gabriel llon Disosway, commander here. They not in the satellite nations but are bile, some of them poised on rail cars, l can be moved at a moment's notice.

These are in addition to IL-10 Beast ck planes, Mig 15s, 17s, and 19s, 28 jet bombers and Yak-25 all-weather rceptors. The planes are all missile riers, and although the IL-28 poses the atest strategic atomic threat, nearly all st be assumed to be nuclear-capable— are the ballistic missiles.

Facing some 3000 Soviet and satellite mbat aircraft, Gen. Disosway, a native Pomona, Calif., has 1500 U.S. and nch combat planes, but figures those s are not too great. Also under his op- tional direction is a brigade of *Nike- rcules* air defense missiles operated by Army, but carefully coordinated under 4th ATAF defense plan. Air bases at hn, Bitberg and Sembach have the -mile air-breathing, nuclear warhead rtin *Matador* at the present but will n change over to the more modern *ce,* which requires no ground guidance.

Russian and satellite ground forces are pped with 20-mile air-breathing mis- . All in all the West faces a Soviet at of probably 20,000 combat air- t (150 heavy bombers, 1000 medium mbers and the rest fighter planes) plus divisions of ground forces, plus also tever longer-range missiles Russia may e. It takes, incidentally, about 15 min- for a Soviet bomber to reach Ram- from the edge of the Iron Curtain.

Contrary to published reports, Gen. sway did not say that the U.S. nned" to move three U.S. fighter bases France (Etain, Toul and Chaumont) use the French would not permit the ge of nuclear warheads. He did say his headquarters, which includes three bases, "had plans" to move and prepared to move.

Also on the military-political front, he that his C-130 cargo carriers had run high-altitude missions into Berlin, one March and one in April, contrary to et edicts, and that he thought the should run them regularly to prepare an airlift if one is necessary. The Russian fighters mildly harassed the first flight, did not bother the second.

He added: That Germany would be too close for IRBM's. (The German minister of defense once remarked: "You don't put artillery in the foxholes of the ground forces"). That 700-mile ballistic missiles for NATO nations would be most welcome, especially since the *Mace* program has been knocked back $100 million by the House. That the F-102, of which he has thus far one squadron stationed at Bitberg, will carry both the *GAR-1* and the *GAR-11 Falcon*. The *GAR-1* is conventional but the *GAR-11* packs a nuclear punch.

Germany Would Make *Hawks* Under License

ERDING, GERMANY, Hqs. Luftwaffen Gruppe Sud—West Germany is not working on a defense against the ballistic missile because it believes this is a NATO problem but German industry is working on a radar defense against low-flying aircraft and has made some progress, according to Brigadier Johannes Steinhoff, deputy chief of staff for operations, Ministry of Defense.

At this headquarters of the German Air Force Group South, the Luftwaffe ace whose face is badly scarred from a Messerschmidt jet flameout and crash near the close of World War II, said:

The German government is working to lift the restrictions of building missiles (now limited to two meters in length and 30 centimeters in diameter) so that Germany can manufacture the Raytheon *Hawk* under license: that Messerschmidt, Heinkel and Dornier have formed a combine to manufacture the Lockheed F-104 in Bavaria. Germany will buy 66 F-104's direct from the Lockheed plant, plus 20 two-seat trainers. They plan to manufacture about 250 in southern Germany. The Air Force controls all air defense, even including ack-ack, and will operate the three *Nike-Ajax, Nike-Hercules* battalions it will get from the U.S. These units have already been trained in the States and the first battalion (*Nike-Ajax*) will be operational in the spring.

That one German unit is already in training for the *Matador;* that the French Fouga-Magister trainer will replace the U.S. T-6 and that the Italian built (Fiat) G-91 will replace the U.S. Republic F-84 as an interim combat fighter plane until the F-104 enters GAF service, probably in 1961-62.

That under Germany's depot system, the GAF does only about 20% of its maintenance with the other 80% being farmed out to industry. That the GAF gets its equipment from three sources: grant aid from U.S., purchase from USAF and purchase direct from the U.S. manufacturers. Germany will shortly begin paying most of its own way, one of the reasons the GAF is holding up a decision on purchasing the Republic F-105. It is too expensive to buy and maintain. This deal is not completely cold, however, and some arrangement might be worked out, including European pool manufacture.

There are about 40,000 total personnel in the GAR now. It is expected to have about 100,000 with 20-22 wings, half tactical and half defense, by 1963-64. All units will be committed to NATO.

French Atomic Complaints

LAHR, GERMANY, Hq. First Commandement Aerien Tactique (C.A.TAC) —The French ban on atomic storage for missiles and aircraft also extends to French NATO units stationed in Germany, Maj. Gen. Raymond Brohon, commander, said here. The urbane French officer, who flew with the RAF during World War II and who spent four years in the Pentagon on the NATO Standing Group, also somewhat bitterly echoed the words of his chief, Gen. deGaulle, regarding the U.S. restrictions on atomic information exchange.

"You are refusing to give your allies what is known to your enemies," he said.

He also thought that France, when able to produce its own atomic bomb, might carry out testing (in the Sahara desert, perhaps) regardless of any agreement which might be entered into by Russia, the U.S., and Great Britain.

General Brohon also felt:

That using the F-84 (an old lady) by his forces for the next two or three years would be a waste of the human element. (His pilots are too well trained for that). That he would like the F-104; that he now has 1.2 pilots for each plane and wants the NATO standard of 1.5.

That C.A. TAC will soon have four batteries of *Nike-Ajax* air defense missiles. He has no roles and missions problem. All are controlled by the Air Force although he had to request personnel from the French army to man three of the batteries. That in spite of the fact some of his French NATO units are deployed in Algeria, C.A. TAC maintains 10% of its force on 15-minute alert during non-working hours—more, of course, during the working day.

—reviews—

HYPERSONIC FLOW THEORY, Wallace D. Hayes and Ronald F. Probstein, 464 pp., $11.50.

What started as an 80-page review paper has grown into a formula-packed, amply illustrated book on the fundamentals and present state of knowledge of hypersonic flow theory. It is aimed at research workers and students as a text in graduate courses and serves as an introduction not only to HFT but also to modern approaches in theoretical aerodynamics in general. However, a course in gas dynamics or compressible fluid theory is prerequisite.

Subjects covered include small disturbance theory, constant-density solutions, theory of thin shock layers, other methods for blunt-body flows, other methods for locally supersonic flows, viscous flows, viscous interactions, and free molecule and rarefied gas flows.

TARGET FOR TOMMOROW, Dr. I. M. Levitt, Fleet Publishing Co., New York, 328 pp., $4.95.

Dr. Levitt, director of the Fels Planetarium of Franklin Institute and contributing editor of M/R, starts with what is and then essays to predict what's next in the unfolding of man's space goals. Beginning with an analysis of rocket and satellite development to date, the book's orbit takes in conquest of the moon, life on other planets, man-made space stations and satellite weather bureaus and analyzes the technical problems involved in space pioneering. Although the presentation is solidly grounded in scientific fact, Dr. Levitt writes clearly, simply and colorfully, painting an excellent backdrop for the coming space drama.

DECIMAL CLASSIFICATION OF ASTRONAUTICS, The Council of the International Astronautical Federation (IAF), available from H. H. Koelle, Chief, Future Projects Design Branch, Development Operations Division, Army Ballistic Missile Agency, Huntsville, Ala.

If you've had trouble—as most people do—in locating astronautics material in your filing system, this classification system could be an invaluable aid.

The classification was adopted by IAF to give astronautical scientists a tool for filing of references, technical papers, preprints and working material in a simple and logical frame of reference. It is specifically tailored for small research institutes, working groups, small specialized libraries, individual departments or laboratories in large companies and, specifically, for the individual scientist and engineer who is interested in keeping up to date in the general field of astronautics and its applications on a broad basis.

west coast industry . . .

By FRED S. HUNTER

A good many secondary power people feel this has been a neglected phase of missile development. "It gets third class treatment," said one. "It's just a component to be put together with bits and pieces we have on hand." Secondary power, of course, is a critical factor—the auxiliary power system caused most of the delay in reaching the free fall stage on the *X-15*—but while it may not have received top recognition in the early stages of missile development, it's moving up the scale now.

Aerojet-General Corp. has designed and . . .

produced an auxiliary power unit for the *Titan* ICBM. It is a hydrazine liquid propellant unit, which feeds into a gas generator, thence to a turbine. It has a dry weight of 95 pounds and develops approximately 30 shaft horsepower. In tests conducted to check the temperature danger level for the first shaft bearing, which takes most of the heat load, Aerojet has operated the unit continuously for one hour and 15 minutes without any noticeable temperature rise. In operation, it has achieved a variation of one fourth of 1% plus or minus in frequency and voltage variation in demonstrating a requirement of 1% plus or minus. This unit is scheduled for installation in lot G of the *Titan*. In the final analysis, however, it is still more likely that operational *Titans* will use batteries for secondary power.

Batteries have won the battle . . .

for secondary power for the *Atlas* ICBM. Wet cell batteries are used in the *Atlas* to drive a Bendix AC inverter. After spending something in the area of $20 million, Convair-Astronautics halted expenditure of further funds for Sundstrand's development of a monopropellant power system for the *Atlas*. Sunstrand had come into the *Atlas* secondary power picture through its purchase of the American Machine & Foundry Co.'s Pacoima division. Latter had been working on a bipropellant system for the *Atlas*. Sunstrand changed to monopropellant after it took over. Convair is buying silver salt batteries from Yardney Electric, The Eagle-Picher Co., the Cook Co. in Denver and AMF. It wants a battery with indefinite shelf life.

The DC-3 of the target drone field . . .

might be a good way to describe the OQ-19. The Radioplane division of Northrop Corp. has been turning out OQ-19's since 1946. It is nearing production of its 50,000th target drone and the end is not yet in sight. Currently, it is in production of more than 2150 OQ-19's for the Air Force. This contract, including spares, comes close to $6 million and deliveries run through November. For the Army Signal Corps it is building 612 SD-1 surveillance drones, and these are reworked OQ-19's. Currently being flight tested at El Paso is the new RP-78, designed for improved altitude and higher speed performance. It employs the OQ-19 control system.

Employment increase from 10,000 to 12,000 . . .

is projected at the Autonetics division of North American Aviation in the next 12 months. Among the bigger Autonetics programs is guidance for the *Minuteman*, the forthcoming solid-propellant ICBM. But the big show on *Minuteman* right now is the mobility program. This stems from the Strategic Air Command, which recognized the need for mobile launching for the *Minuteman* to supplement the underground launching sites originally planned.

Most indications are that about one third of the *Minuteman* striking force will be mobile by rail, truck, barge or what have you. New contracts are ahead, and they may be among the biggest expenditures of the entire *Minuteman* program (M/R, June 1, p. 19).

The Navy may have a requirement . . .

for a turbofan engine in the 9000 to 12,000-pound-thrust area for the missile carrier in the *Eagle* project.

SENTER

Maj. Gen. William O. Senter, director of Procurement and Production at Headquarters, Air Materiel Command, for the past two years, will leave Wright - Patterson AFB for an assignment in Washington, D.C.

Maj. Gen. Waymond A. Davis was promoted to that rank from brigadier general to succeed Senter. Davis was AMC's deputy for production. Also announced was appointment of **Col. Henry MacDonald,** AF *Jupiter* Liaison Officer at Huntsville, Ala., as AMC's dep-

DAVIS

for production.

Gen. Senter will become assistant dep chief of staff, materiel, at Headrters, USAF.

Earlier, announcement had been made Davis would become director of ls and Programs. According to AMC, e orders have now been revoked, and ouncement of the officer to fill this tion will be made later.

The Director of Procurement and Proion at AMC is responsible for comon of Air Force purchases which age close to $10 billion a year.

The Lockheed Electronics and Avionics sion (LEAD) has filled two major neering management positions.

Paul F. Pearce was named manager of ect engineering and **Gunnar Wenner**e will head product development. e ce joined LEAD with an extensive a ground in managing the design and e lopment of electronic systems. Wenerg's electrical engineering career s 17 years including a decade in varieengineering management capacities at e.

Callery Chemical Co.'s newly established West Coast office, part of an expansion of its Defense Products Department, will be headed by **Dr. Robert G. Brault.** With Callery since 1954, Brault formerly was supervisor of subcontract research and coordinator of

BRAULT

nig-energy fuel projects at the firm's Re arch and Development Laboratories n allery, Pa.

"Determination to consolidate an important position for itself in the field of missile weapons systems, and to become a major subcontractor for U.S. missile work," is behind organization of a new missiles and systems division and appointment of **Robert D. Richmond** as vice-president of Canadair, according to the company. Richmond, formerly chief engineer of special weapons, will head the new division.

This move follows eight months after termination of Canadair's *Sparrow* missile program.

The new division, Canadair says, is set up to be "strongly competitive with United States sub-contract firms and thereby gain a share of contracts which are made available to Canadian companies under the production sharing arrangements which exist between the two countries."

William C. Benson, newly named project engineer, ground support equipment, for Solar Aircraft Co., came to the firm from Beech Aircraft Corp., where he was manager of support equipment sales. His appointment is part of a program to "bolster Solar's capabilities in the growing area of ground support and handling equipment."

BENSON

George E. Smith who has a 20-year background in manned aircraft, pilotless bombers and ballistic missiles, has been named general manager of The Martin Co.'s Cocoa Division at Cape Canaveral, Fla. Smith succeeds **G. T. Willey,** recently named vice president and general manager of Martin's Orlando Division.

SMITH

Smith will direct the company's test operations and related activities at the Atlantic missile range.

Maj. Gen. E. Blair Garland, USAF ret., will join Philco Corp.'s Government & Industrial division as manager of a new military communications group.

This special technical unit will handle Philco's 19-million-dollar AIRCOM (international communication system) modernization contract from the Air Force and similar contracts.

Philco also named **Henry E. Hockeimer** as AIRCOM project director. New AIRCOM staff members are **Donald B. Clyman,** administration and services manager; **Morton L. Long,** engineering manager, and **John Pell,** installation manager.

Martin E. Dykeman will direct a program to broaden applications of glass, ceramics and Pyroceram materials in aircraft and missiles for Corning Glass Works' New Products division.

DYKEMAN

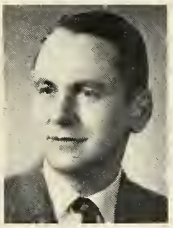
The aircraft and missiles group formerly concentrated almost exclusively on materials and process development.

Dykeman has been with Corning Glass Works for 19 years, most recently as a sales engineer handling optical products such as glass infrared missile domes.

German scientist **Dr. Herbert Kromer** is Varian Associates' latest addition to the Central Research team organized last year under **Dr. Louis Malter.**

Krömer will be senior research scientist. His nine years of experience in the semiconductor field both in the United States and abroad include several years as a research physicist in the semiconductor group at RCA laboratories, Princeton, N.J.

Appointment of **David Y. Keim** as chief engineer-Military Products of Stromberg-Carlson's Electronics Division has been announced. Keim previously was Engineering Department head, Microwave and Electronic Equipment, Sperry Gyroscope Co.



KEIM

Dr. Earl L. Steele, a physicist expert in semiconductor devices, has been appointed assistant manager of the development laboratory for the semiconductor division of Hughes Aircraft Co.'s Products Group. Dr. Steele, formerly research chief for Motorola, Inc., is the author of many technical papers on diodes, transistors, and rectifiers, and is an editor of the IRE Transactions on electron devices.

CHERNIAK

George S. Cherniak has been appointed Director of Space Technology Laboratories, Inc.'s Flight Test Operations at the Atlantic Missile Range, Cape Canaveral. He was formerly head of STL's *Atlas* Project Office at the Cape.

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Graduate Electronics Engineer or Physicist to perform theoretical electronic system analysis and design of new projects in the missile and electronic system field. He will be responsible for analyzing the customer's requirements and establishing basic as well as overall design parameters to be followed throughout the development of the project. The System Design Engineer will consider the various operational aspects of the system, including environments as well as collateral and concurrent effectiveness when used with related systems.

GUIDANCE DESIGN

Graduate Electronics Engineer or Physicist to perform design and development of circuits and components necessary to the optimum functioning of missile guidance systems. He will design transistorized pulse and video circuits for use in missile and other electronic system projects. He will be responsible for developing applicable circuitry, working from specified and/or general requirements laid down by the particular system concept as dictated by the needs of the customer. The field of emphasis will be in the development of radar techniques.

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Aluminum welding problems? . . .

Air Reduction Company's new book on aluminum won't solve all your problems, but it'll point you in the right direction. The 116-page book covers all aspects from aluminum history and familiar welding problems to state-of-the-art and unusual problems that missile and aircraft people might encounter. Examples of the topics discussed: joining aluminum, the whys and why-nots; aluminum alloys, their classifications and characteristics; the basic welding processes, each covered in detail.

Equipment for aluminum welding . . .

is discussed in the book, also. Air Reduction's staff discusses manual and machine holders, automatic equipment and accessories for the Heliweld process; manual and automatic Aircomatic processes, and their accessories. The book also goes into power supplies for aluminum welding, discusses special products available, and ends on a safety note.

Plastics stable at 1000°F . . .

aren't here yet, but they're on the way, missilemen learned early in the month at Wright Air Development Center's symposium on high-temperature polymers. Missilemen also learned that the most promising polymers in this field, not surprisingly, are inorganics.

High-temperature plastics are experimental . . .

and they will remain strictly laboratory curiosities for some little time, the Air Force says. However, major advances have been made in the past year in this field that is only about four or five official years old. The Air Force, and other armed services, too, want poylmers that can be used as structural plastics, lubricants, hydraulic fluids, and adhesives. They must stand up under high temperature, pressure and friction.

Polymerized oxygen-aluminum . . .

is one of the most promising of the inorganic materials—the one that has come the farthest and is progressing most rapidly, the Air Force indicates. Aluminum-oxygen-based polymers are terrific at high temperatures, one scientist says. However, there's a catch: the fundamental polymer is terrific so far, but now scientists have to find satisfactory side groups which will make the polymer into a usable, finished material. Technically, the polymers are polyaluminoxanes.

New liquid oxygen truck . . .

is available from the Cambridge Company. It holds 2100 gallons, which the Lowell, Mass., firm equates to 234,000 ft.^{3}. The vacuum tank is jacketed with aluminum, cab is plastic.

Ammonium perchlorate output increases . . .

at Pennsalt Chemicals' Portland, Ore., plant as soon as expanded facilities under a $2 million budget jump materialize. Some new buildings already are underway, and Pennsalt says it has started ordering equipment. Company officials won't say how much the perchlorate production will increase, but hint it will be in the "thousands of tons." Sodium chlorate output also will be upped, about 25%.

New fuel cell "is practical" . . .

so says General Electric vp Guy Suits in describing the company's recently announced device. Suits says the cell operates at 60% and higher thermal efficiencies, produces low voltage direct current directly, with no moving parts, from hydrogen and oxygen. He calls it a simple, portable, lightweight, small-volume generator highly reliable for specialty missile and military applications.

Metal coatings process is updated . . .

by Alloyd Research Co. The company has modified and improved an old process for depositing coatings of molybdenum, chromium and tungsten from the vapor state. This makes possible tough, reliable coatings of these metals on intricate shapes.

contract awards

ARMY

2?00,000—**Morrison-Knudsen Co.**, Boise, I.ho, **Paul Hardeman, Inc.**, Los Angeles, Jinson, **Drake & Piper, Inc.**, Minneapo- l **Olson Construction Co.**, Lincoln, Neb., si **F. E. Young Construction Co.**, (joint viture) for construction of an additional r.e underground *Titan* launching sites a Lowry AFB, Colo.

3,0,000—**Douglas Aircraft Co.**, Santa Monica, Calif., for launching equipment.

31:00—**Diversified Builders, Inc.**, Cocoa, F., for construction of *Saturn* block-house at Patrick AFB, Fla.

5022—**American Telephone & Telegraph C. Western Electric Co.**, for *Nike* spare pts.

60·00—**Raytheon Manufacturing Co.**, Andver, Mass., for test equipment, mechanic inspection equipment, material handig equipment and production equipnt to support second generation *Hawk*.

9·00—**Rheem Manufacturing Co.**, Downey, Calif., for warhead.

8 46—**Western Electric Co., Inc.**, N.Y., f *Nike* spare parts and components (six-tn contracts).

9.50—**Reynolds Electrical & Engineering C Inc.**, El Paso, Tex., for *Nike-Zeus* nifications and additions (power portti).

5 76—**Douglas Aircraft Co., Inc.**, Charlce Ordnance Missile Plant, Charlotte, N., for *Nike* spare parts and compon ts.

3945—**MB Manufacturing Co.**, New Havi, Conn., for one item of vibrator test sem equipment for simulating shock a vibration to missile motors.

9,3—**Greenhut Construction Co.**, Pensaco, Fla., for construction of Model IV B lacher shelter for F/M launch facility aSanta Rosa Island, Eglin AFB, Fla.

6.5—**Hartley Boiler Works**, Montgomery, A., for construction of test tower in Bg. 4619 at Redstone Arsenal.

0,3—**Sierra Oxygen Co.**, Reno, Nev., for 94 cu. ft. of liquid oxygen.

3,7—**Gilfillan Bros., Inc.**, Los Angeles, fo repair parts.

6,9—**West Florida Electric Service Compny, Inc.**, Panama City, for installation of n engine generator set and associated wrk at the Anclote site portion of the Eln Gulf Test Range.

4,·—**Andy Electric Co.**, Andalusia, Ala., fo 500 KW engine generator installation fo Guided Missile Test Range, Site D-3 at Cape San Blas, Fla.

2,3—**Princeton University**, Princeton, N., for design and analysis of experim ts.

0,3—**Earl & Wright, Inc.**, San Francisco, fo preparation of concept plans and dgn for SAC missile facility.

3,5—**Bowen-McLaughlin-York, Inc.**, York, Pa for extension of vehicle engineering se ices.

3,5—**Polarad Electronics Corp.**, L.I., N.Y., fo a spectrum analyzer and microwave fle intensity meter.

3,2—**Raytheon Co.**, Newton, Mass., for elctron tubes.

5,6—**Ryan Aeronautical Co.**, San Diego, fo target missile.

NAVY

230—**Fred A. Haycox Co., Inc.**, Lynnhan, Va., for construction of guided miles school annex, Fleet Air Defense Trning Center, Dam Neck, Va.

90,3—**Sperry Gyroscope Co., Div. Sperry Rad Corp.**, Great Neck, L.I., N.Y., for spcial tools, jigs, fixtures and test equipnt for *Sparrow I* missiles.

31,2—**General Electric Co.**, Schenectady, N., for fabricating and furnishing self-adptive flight control system.

51.0—**Microwave Associates, Inc.**, Burlington, Mass., for research and development in the field of solid state microwave techniques (two contracts).

$96,789—**Lockheed Aircraft Corp., Missiles & Space Div.**, Sunnyvale, Calif., for research and development.

$53,946—**Philco Corp.**, Philadelphia, for high-resolution electronic viewing system.

$40,671—**Arthur D. Little, Inc.**, Cambridge, Mass., for research and development study of proof testing of missiles.

$36,891—**Temco Aircraft Corp.**, Dallas, for planning and conducting wind tunnel investigation program and formulating a method of determining aerodynamic loads.

AIR FORCE

The Ralph M. Parsons Company, Los Angeles, for architect-engineering services in connection with the fifth operational squadron base for the *Titan* weapon system at Larson AFB. Total value of the complete facility estimated at $48,000,000.

$38,900,000—**Airborne Instruments Laboratory, Div. Cutler-Hammer, Inc.**, Mineola, N.Y., for the development and design of airborne electronic equipment. (Other companies assisting with this project are: **Aerojet-General Corp.**, Azusa, Calif.; **Filtron Company, Inc.**, Flushing, N.Y.; **Haller, Raymond and Brown, Inc.**, State College, Pa.; **Raytheon Manufacturing Co.**, Santa Barbara, Calif.; **Sperry Gyroscope Co., Div. of Sperry Rand Co.**, Great Neck, N.Y.; **Sylvania Electronic Systems**, Waltham, Mass.; **Temco Corp.**, Greenville, Tex.).

$5,000,000—**Collins Radio Co.**, Cedar Rapids, Iowa, for construction of communications stations for the Strategic Air Command in California and Massachusetts.

$5,000,000—**Kollsman Instrnment Corp.**, for astro trackers plus associated tooling and test equipment for use with **North American's** *Hound Dog* weapon system.

Computer Equipment Corporation has received its largest contract for the development of an advanced space/time velocity data recording system. (Amount not disclosed.)

$915,222—**Aerovias Sud Americana, Inc.**, St. Petersburg, Fla., for the "rocket run," a coast-to-coast airlift of test missiles and engineering research personnel (awarded by MATS).

$500,000—**Cal-Tronics Corp., Div. of Acme Precision Products, Inc.**, for design and production of a group of automatic production diode testers.

$366,597—**Microwave Associates, Inc.**, Burlington, Mass., for study and investigation of design factors in high-powered gaseous discharge switches, research and development of a high-powered beacon magnetron and microwave tube (three contracts).

$150,000—**Texas Instruments Inc.**, for study of a major semiconductor substate device—the TI-developed ultraminiaturized semiconductor solid circuit.

$139,954—**Cornell Aeronautical Laboratory, Inc.**, Buffalo, for continuation of research on hypersonic flow by means of a shock tunnel.

$138,613—**Union Carbide Corp., Linde Co., Div.**, N.Y., for 33,920,000 cu. ft. of liquid oxygen.

$124,073—**The Houston-Fearless Corp.**, Los Angeles, for production of four camera systems and precision mounts.

$73,165—**Aerojet-General Corp.**, Azusa, Calif., for spare parts kit for AJ10-33 liquid rocket sled engine in support of project WS-133A.

$54,717—**Motorola, Inc., Western Military Electronics Center**, Phoenix, for subminiaturized receiver sets.

$50,760—**Technicolor Corp.**, Hollywood, Calif., for construction of a 70 MM continuous contract printer for the AFMTC Photographic Laboratory at Patrick AFB.

$45,690—**Aerojet-General Corp.**, Azusa, Calif., for nonpersonal services for relining thrust chambers in support of project WS-133A.

$32,000—**Miami Engineering Div. of Miami Shipbuilding Corp.**, for a mobile frequency control and analysis van for use in monitoring frequency interference during missile test operations at Atlantic missile range.

$25,706—**Southern Research Institute**, Birmingham, Ala., for research on infrared spectra of heterocyclic nitrogen compounds.

NASA

The civilian space agency announced that it awarded the following contracts during the month of May:

$7,500,000—**Convair Astronautics Div., General Dynamics, Inc.**, for eight two-stage *Vega* boosters plus an additional *Vega* for captive firing tests.

$5,000,000—**Jet Propulsion Laboratory**, for technical supervision of the *Vega* project, planning *Vega* interplanetary missions, and providing a third stage for *Vega*.

$4,400,000—**Air Force Research & Development Command's Ballistic Missile Div.**, for already authorized space probes. To be used toward firing of *Thor-Able* and *Atlas-Able* vehicles.

$1,000,000—**Army Ballistic Missile Agency**, for advanced research into four areas: (1) Propulsion and propellants (2) Guidance studies involving celestial mechanics of trajectories in lunar interplanetary misisons (3) investigation of thermal properties of materials in space re-entry research (4) effects of space environment on physical and chemical properties.

$660,000—**Aerojet-General Corp.**, for 20 sounding rockets (*Aerobee Junior* and *Aerobee-Hi* vehicles) which can send 150 pounds to 150 miles in ionospheric investigations to be fired from both Fort Churchill and Wallops.

$560,000—**Army Ordnance Missile Command**, for multi-frequency radio beacons to be used in earth satellites investigation of the ionosphere.

$350,000—**National Academy of Sciences**, for financing research associateship program by providing study grants at the graduate and post-doctorate levels.

$300,000—**Jet Propulsion Laboratory**, for research and development on improved tracking and receiving equipment for deep space missions.

$200,000—**Massachusetts Institute of Technology**, for assistance in making technical evaluations of facilities and instrumentation in tracking network for Project *Mercury*, the manned space flight program.

$180,000—**Bureau of Ordnance (Navy)**, for 16 third-stage *Delta* rocket motors, 12 of which would be used in the *Delta* launching vehicles. The remaining four to be mounted on *Sergeant* rockets for high-altitude firings from NASA's Wallops Space Flight Station (Va.) to check out sphere ejection and inflation.

$150,000—**Office of Army Surgeon General**, for medical aspects for the successful *Jupiter* shot in which monkeys Able and Baker were sent 300 miles in space and recovered safely.

$120,000—**New York University**, for study of general instability of stiffened circular cylinders.

$110,000—**Jet Propulsion Laboratory**, for a transmitter to be installed at Goldstone, Calif., tracking installation. The project calls for an orbiting 100 ft. inflatable plastic sphere off which radio signals would be bounced cross-country within the next year.

$110,000—**California Institute of Technology**, for basic studies of cylindrical and conical shells.

—when and where—

JULY

Tenth Annual Basic Statistical Quality Institute, University of Connecticut, Storrs, July 12-24.

Radio Technical Commission for Aeronautics and Los Angeles Section of the Institute of Radio Engineers, Third Biennial Joint Meeting, Ambassador Hotel, Los Angeles, July 16-17.

The American Rocket Society, Propellants and Combustion Committee, "Propellants, Thermodynamics and Handling Conference," Ohio Union, Ohio State University, Columbus, July 20-21.

Second Annual Institute on Missile Technology, Chief of Research and Development, U.S. Army, University of Connecticut, Storrs, July 26-Aug. 7.

The Denver Research Institute of the University of Denver, 6th Annual Symposium on Computers and Data Processing, Stanley Hotel, Estes Park, Colo., July 30-31.

AUGUST

Institution of Investigation of Biological Sciences, Sponsor: Air Force Office of Scientific Research, Aeromedical Div., World Health Organization and United Nations Educational Scientific and Cultural Organization, Montevideo, Uruguay, Aug. 2-7.

Association of the U.S. Army, Annual Meeting, Sheraton-Park Hotel, Washington, D.C., Aug. 3-5.

William Frederick Durand Centennial Conference, Problems of Hypersonic and Space Flight, Stanford University, Stanford, Calif., Aug. 5-7.

Institute of Radio Engineers' Professional Group on Ultrasonics Engineering, First National Ultrasonics Symposium, Stanford University, Stanford, Calif., Aug. 17.

Institute of Radio Engineers, Western Electronic Show & Convention, Cow Palace, San Francisco, Aug. 18-21.

American Rocket Society, Gas Dynamics Symposium, Northwestern University, Evanston, Ill., Aug. 24-26.

Institute of the Aeronautical Sciences' National Specialists Meeting, A Symposium on Anti-Submarine Warfare, (classified), San Diego, Aug. 24-26.

International Astronautical Federation, 10th Annual Congress, Church House, Westminster, London, Aug. 31-Sept. 5.

SEPTEMBER

Air Force Office of Scientific Research and General Electric Co.'s Missile and Space Vehicle Department, Conference on Physical Chemistry in Aerodynamics and Space Flight, University of Pennsylvania, Philadelphia, Sept. 1-2.

University of California, 1959 Cryogenic Engineering Conference, Berkeley, Sept. 2-4.

Air Force Association and Panorama; Send Reservations to AFA Housing Bureau, P. O. Box 1511, Miami Beach, Sept. 3-6.

Standards Engineering Society, Boston Section, Eighth Annual Meeting, Hotel Somerset, Boston, Sept. 21-22.

Instrument Society of America, Conference and Exhibit, Chicago, Sept. 21-25.

Industrial Nuclear Technology Conference, Sponsored by Armour Research Foundation of Illinois Institute of Technology, Nucleonics Magazine and Atomic Energy Commission, Morrison Hotel, Chicago, Sept. 22-24.

American Rocket Society, Solid Propellants Conference, Princeton University, Princeton, N.J., Sept. 24-25.

Institute of Radio Engineers, 1959 National Symposium on Telemetering, Civil Auditorium, San Francisco, 28-30.

OCTOBER

Society of Automotive Engineers, tional Aeronautics Meeting, Air Manufacturers Forum and Airc Engineering Display, The Ambass Hotel, Los Angeles, Oct. 5-10.

Electronics Industries Association Co ence, University of Pennsylvania, versity Park, Oct. 6-7.

Stanford Research Institute, First H Temperature Symposium, Asilo Conference Grounds, Monterey Pe sula, Calif., Oct. 6-9.

National Electronics Conference, S sored by American Institute of E trical Engineers, Illinois Institute Technology, Institute of Radio gineers, Northwestern University University of Illinois, Hotel Sherr Chicago, Oct. 12-14.

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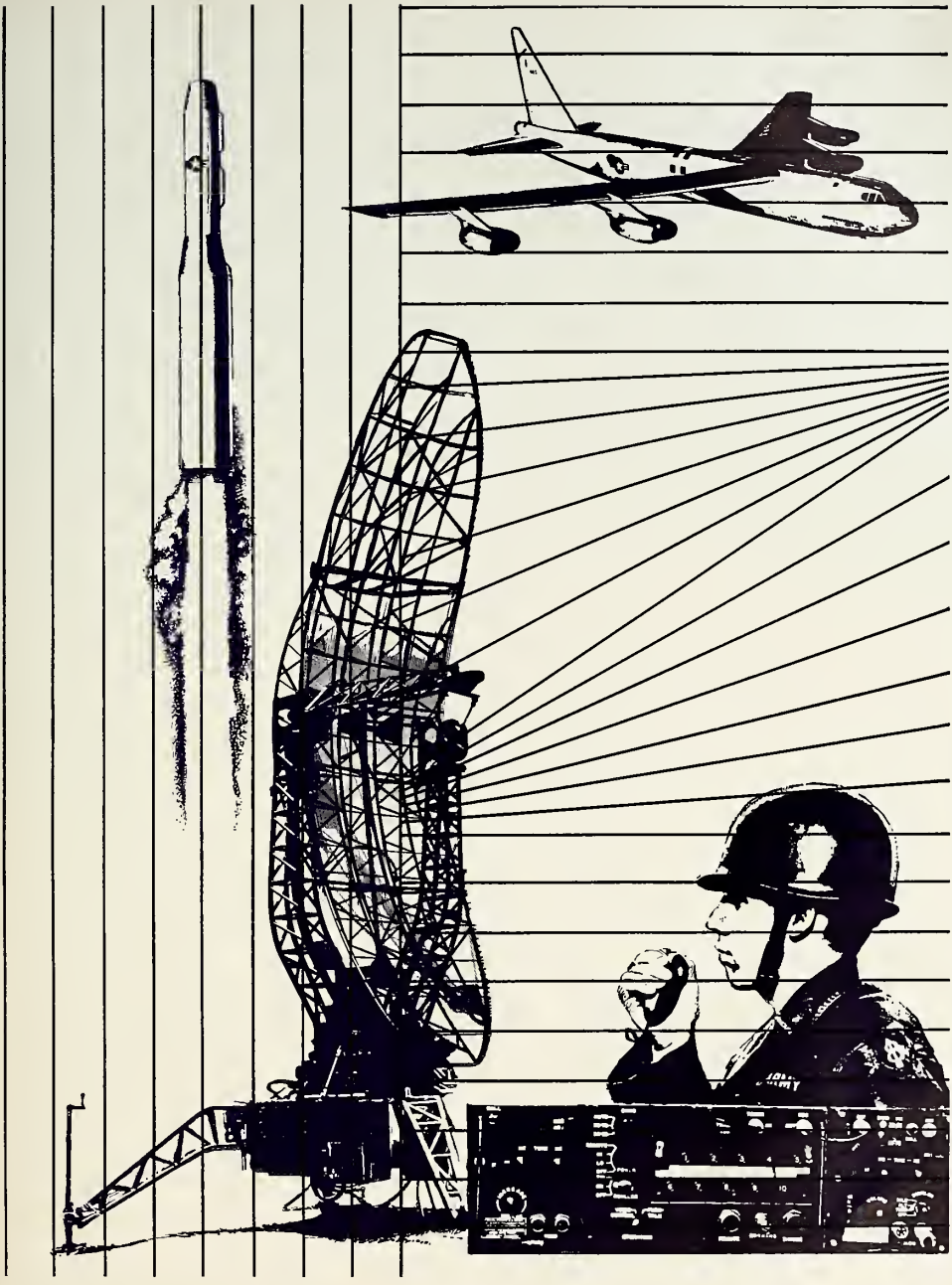

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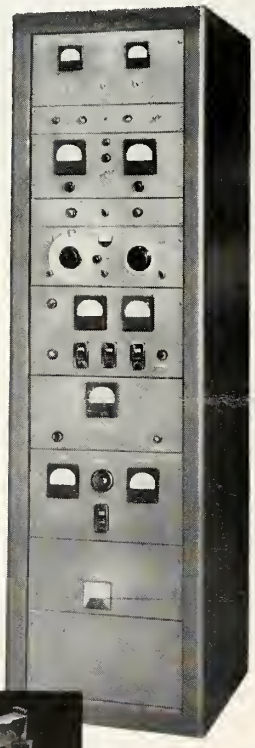

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RA-250	6-C	250	200	25
RA-500	A-88	500	600	100
RP-1/2	227	1,000	2,000	150
CP-3/4	219	3,000	4,000	500
CP-3/4	A-174	3,000	4,000	1,200
CP-5/6	A-174	5,000	6,000	1,500

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