JANUARY 5, 1959

# missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

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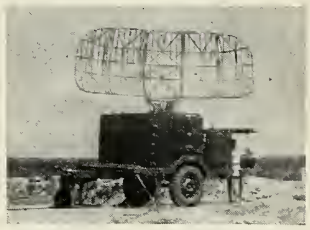
# missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

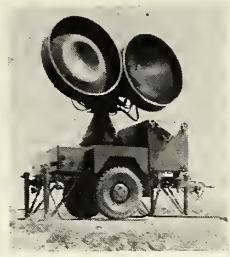

**COVER:** New U.S. radio telescope will bring star clusters like this closer. Story on p. 14.

## JANUARY 5 HEADLINES





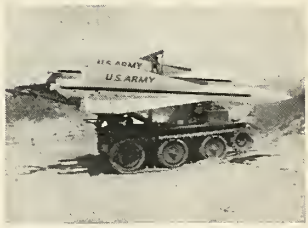
**THE *Hawk*** defends against low-level attack. This is acquisition radar of Raytheon system.



**HIGHLY MOBILE** ground equipment allows *Hawk* units to keep up with fast moving troops.

## MISSILE ELECTRONICS






**TRACTOR DRIVEN** Army missile loaders can quickly transfer three *Hawks* simultaneously.

## DEPARTMENTS



**RAYTHEON** has been awarded an additional $5 million for *Hawk* engineering.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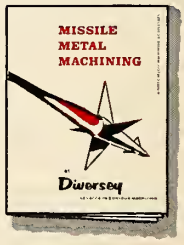


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**FROM NOSE TO NOZZLE, FROM FIN TO FIN, CONTOUR TURNED PARTS—WITH PRECISION BUILT IN**

# In My Opinion . . .

. . . there's no doubt that industry has made great advances in the last two years in the field of big engines. And there's no doubt that NASA's program for a big single-chamber million-and-half pound engine will be carried out successfully. But engine designers are facing intricate problems in propellant flow systems. An example of the difficulties is illustrated by Rocketdyne's efforts to scale up the current 160,000-pound thrust power plant. By simply modifying the combustion chamber it was possible to jack the thrust up to 300,000 pounds although a special pressure system had to be devised that would not be practical in a flight system. Rocketdyne is still working on a turboprop flow system for this new engine.

The estimated development time for the new million-and-half pound single-chamber rocket—from four to six years—clearly indicates the urgent need for continuing the parallel ARPA program for the clustered million-and-half unit—which may be ready for static test 11 months from now and flyable less than two years from now.

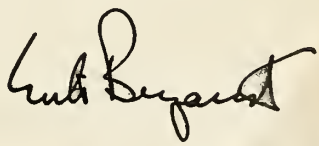
Certain "break-throughs" in the area of clustering big liquid engines have been reported and reliable sources have confirmed that both component tests and wind tunnel tests have proven the soundness of this engineering approach. The big eight-unit clustered powerplant may be employed for a variety of military and scientific space vehicles, and—in many cases—will present an even better approach to getting heavier payloads into space since the individual engines may be dropped en route like individual stages in a conventional step rocket. The soundness of this technique certainly was demonstrated in the recent *Atlas* satellite shoot. Also, the discarded units may be recovered if necessary.

It is obvious that the research and engineering which industry and government agencies now are putting into big engine development points to a new trend: there will be a need for both clustered units and single-chamber units. And we have the know-how to do both jobs.

The fact that the one program is the responsibility of ARPA and the other is carried out by NASA doesn't necessarily mean that the clustered unit will be used for military vehicles exclusively and the other one for "peaceful" or scientific missions. The important thing is that we fully understand that there is an established requirement for the two powerplants.

In view of this fact we consider it rather discouraging that certain "experts" in Washington and elsewhere are putting the pressure on to kill the ARPA engine program. It is difficult to grasp how supposedly intelligent planners at times can be so nearsighted, so completely ignorant of the logic in a sound engineering approach. ARPA deserves the most extensive and wholehearted backing in this program. Already its planners have demonstrated good and sound judgment. It was ARPA that got our lunar program off the ground in less than two weeks. It was ARPA that undertook the *Atlas* satellite program.

Let ARPA complete the big cluster job—and let's keep political bickering away from the research and engineering required to put us ahead in the space race.



# washington countdown

**Top priority has been given . . .**
to Air Force's WS-199 *Bold Orion* (m/r, Dec. 1, p.11) following recent successful launches of the Lockheed and Martin versions. AF wants an available air launched IRBM of 1,000 mile range within two years for adaption to more B52G and B58 bombers. Budgeting of aircraft to handle the missile should approximate $2 billion in FY 1960.

**Russian ICBM guidance . . .**
apparently is terrific, according to a report made to President Eisenhower by RAND Corp. During next 18 months, Soviets reportedly will have 300 ICBMs of 50 per cent reliability with half that number able to land within three miles of target. First full range *Atlas* shot reportedly had a 30 mile impact area.

**The triple firing . . .**
at Cape Canaveral—*Polaris, Thor* and *Atlas*—which was scheduled for the tag end of 1958 will be the last ballistic launchings over the Atlantic Range for some time. The substitution of ballistic computers plus holiday-absent technicians is responsible for delay.

**Standing space committee . . .**
memberships will be announced soon. These will be the first standing committees on space and science. Sen. Lyndon Johnson undoubtedly will head the Senate committee. Reps. Paul Kilday of Texas and Overton Brooks of Louisiana are still leading contenders for chairman of the House committee. Johnson recently announced appointment of Kenneth E. BeLieu as staff director of the Senate group.

**Soviet military buildup . . .**
will continue during 1959. Although USSR military budget is reduced to $24 billion, a new $18 billion industrial expansion fund is expected to provide additional funds for space and nuclear research. The Soviet "visible military budget," while some $13 billion less than the U.S., still approximates the U.S. budget in purchasing power.

**AIA's report for 1958 . . .**
stresses that the industry made radical changes in organizations to supply the demands of the new space era. The report notes that companies previously known only as airframe manufacturers have become leaders in propulsion, guidance and atomic energy applications. Sales for the aircraft and missile industry were estimated at $11.8 billion, approximately the same as in 1957, with sharp reductions in the production of military aircraft offset by increased expenditures for missiles and space vehicles. AIA predicts that barring a national emergency, 1959 expenditures for aircraft and missiles will remain about the same.

**Small businesses' . . .**
slice of the defense melon should be larger than the 3.7 percent of total prime contract dollars they got in 1958, according to the Senate Small Business Committee. The committee rejected the Pentagon argument that the decline was due to changeovers to items small business cannot provide, and pointed out that defense "procurement procedures . . . militated against small business."

**A recent poll . . .**
indicates that one out of every three Americans either do not know what satellites are, or have never heard of them. Taken eight months after Russia successfully orbited *Sputnik I*, the University of Michigan Survey Research Center poll reported that one out of every two Americans consider satellites as either a scientific achievement or as an element of Soviet competition; one in five view satellites in terms of future potentials, such as space platforms or tickets to the moon; and one in three were either misinformed or uninformed.

**50,000 pound thrust tests . . .**
were carried out in static trials of the Navy's packaged liquid rocket, as reported last week in m/r. The air-to-air tests were of a much smaller power plant using a *Sparrow III* missile. Reaction Motors Division of Thiokol is developing the engine under the Guardian program.

Circuit Development Group Leader Ralph Wolcott (left) considers future changes in computer output unit for bombing—navigational systems.

*Ground-floor opportunities in*

# COMPLETELY INTEGRATED B-70 WEAPON SYSTEMS *at* IBM

Project Engineer Robert J. Cantwell (left) uses a system of gimbals to describe navigational problems in the analysis of a new system design.

Staff Engineer William Howard (center) reviews gearing accuracy requirements of test equipment with electronic circuit designers.

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# industry countdown

**Latest *Snark* contract . . .**

may well be the last for the giant intercontinental pilotless bomber if the current downgrading of air-breathing missiles, as the results of budgetary considerations, continues. First to go was the *Goose* decoy and the *Regulus II*. Next to get the economy axe may be the *Matador*, leaving only the *Snark* as a major air-breathing missile system. New *Snark* award of $50 million will cover production of the missile through December 1960. The production figure, for operational weapons plus spare parts and ground support equipment, includes a $20 million letter contract awarded last September.

**Bomarc terminal guidance . . .**

systems, the most expensive single item aboard the missile, has received additional production funds in a new $10 million contract awarded by Boeing to the Air Arm Division of Westinghouse Electric Corp. This brings the total value of *Bomarc* guidance systems contracts to Westinghouse to approximately $60 million. Existing contracts will run target seeker production through 1960. Westinghouse is also developing the target seeker guidance system for the advanced *Bomarc*-B 400-mile area defense missile.

**Battlefield surveillance . . .**

by unmanned missiles is the goal of a development program by the Army and Republic Aviation. Designed to replace the faithful Grasshopper light aircraft for gathering information of enemy positions and movements, a drone which is a later generation RCAT (aircraft target missile) is in the final stages of development at Republic. The drone, known as the *Swallow* SD-4, is launched by small rocket motors and is sustained in flight with a turbojet engine. Republic's Signal Corps development contract is valued at $25 million.

**Surveys of *Minuteman* transport . . .**

equipment and types have been conducted by the Air Force, Boeing and consultants in a logistical investigation of the system. Teams have covered a broad area of the central United States evaluating roads, bridges and railroads in an effort to determine the types of equipment best suited to the prevailing conditions of the transportation medium.

**Combat-proven *Sidewinder* . . .**

already proven to be a highly accurate weapon system, will get an improved guidance unit. A $1.86 million contract from Bureau of Ordnance to Motorola Military Electronics Division calls for development of the new system. Work will be performed at Motorola's Western Military Electronics Center in Phoenix.

**Guggenheim Foundation seeks . . .**

outstanding students to receive Fellowships for graduate study in astronautics, rockets, jet propulsion and flight structures. Eighteen to twenty Fellowships will be given for study during 1959-60 at the Daniel and Florence Guggenheim Jet Propulsion Centers at Princeton University and California Institute of Technology.

**NASA's MIS capsule . . .**

prime contractor will be selected next month, probably receiving a development contract before the first of February. First man-in-space capsule is expected to be carried aloft in the nose of an *Atlas* D missile with the first animal test flights with this configuration anticipated by the end of 1959. Earlier flights will use *Thor* and *Jupiter* for transporting animals on ballistic flights from Cape Canaveral and Vandenberg AFB (similar to flight of monkey Gordo in *Jupiter*).

**ARPA and NASA MIS programs . . .**

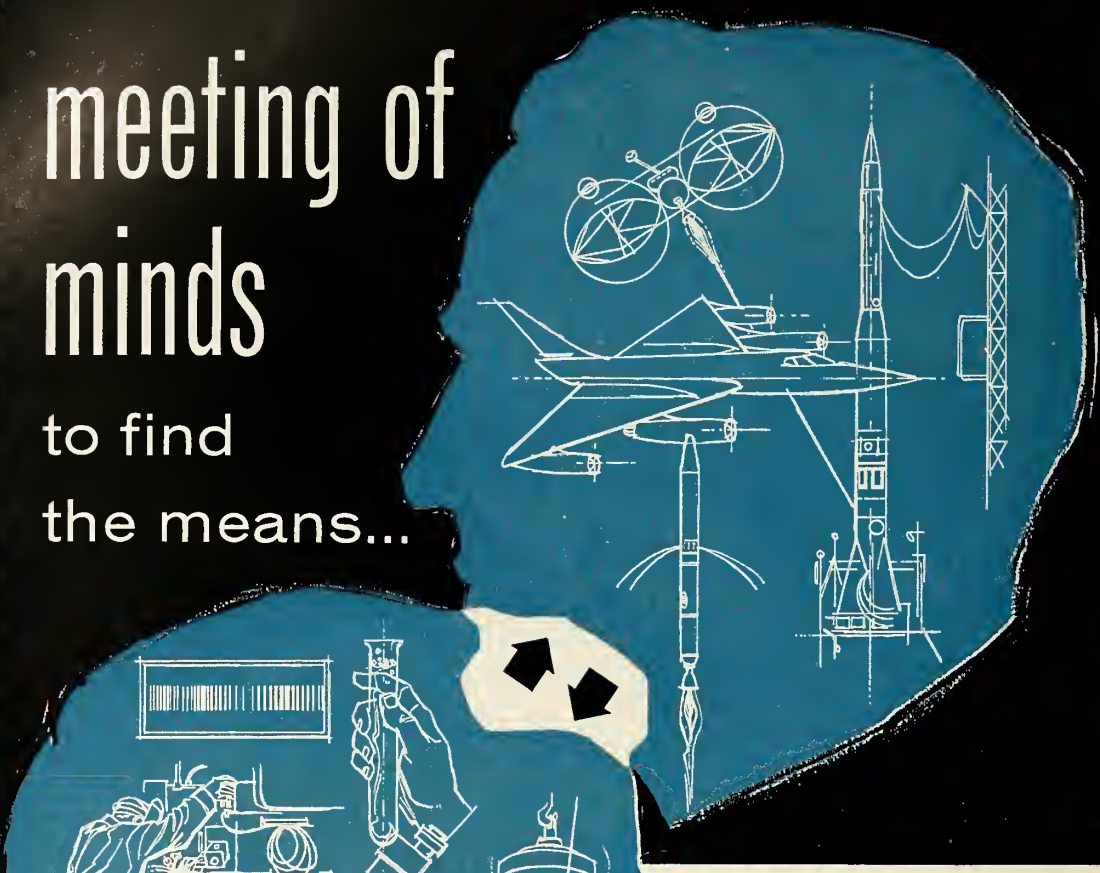
although dual coordinated efforts, are essentially two separate distinct projects. ARPA refers to its man-in-space program as Project *Discoverer* while NASA is now calling its efforts Project *Mercury*. ARPA will send animals into polar orbits from Vandenberg and attempt to recover them. First using *Thors* and later *Atlas* as boosters, project will also investigate feasibility of reconnaissance satellites. Meanwhile NASA's Dr. T. Keith Glennan has announced that success of Project *Mercury* is several years away. Dr. Glennan did not elaborate in detail whether the success of Project *Mercury* would be the first orbiting of man and recovery or whether he was referring to the establishment of manned permanent satellites. Roy Johnson, ARPA chief, stated meanwhile that Russia would probably beat us in placing man in space.

**Beryllium rolling mill . . .**

facilities will be expanded by the construction of new facilities to house additional cold strip mill equipment and to increase machining capacity for billet and slab milling at Brush Beryllium Co. in Cleveland.

# meeting of minds

## to find the means...



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missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Dr. James A Van Allen awarded AAS Space Flight Award for his experiments.

# Radiation Can Be Avoided

## Van Allen advocates polar launchings; proposes that two radiation belts be mapped by 100-pound payload satellite

**by Norman L. Baker**

WASHINGTON—Manned space flights can avoid the radiation belts which encircle the earth if flights originate from polar latitudes. This is the opinion of Dr. James A. Van Allen of the State University of Iowa whose instruments aboard U.S. space probes discovered the radiation belts.

Dr. Van Allen last week summarized 1958 satellite and space probe radiation experiments before the fifth annual meeting of the American Astronautical Society.

The meeting was held in conjunction with the 125th session of the American Association for the Advancement of Science. The AAAS meeting saw thousands of scientists attending some 300 sessions.

Dr. Van Allen, who was presented with the AAS Space Flight Award, reported that instruments aboard the *Pioneer III* lunar probe indicated that two belts—varying in length and thickness and in distance from the earth and from each other—exist in the earth's magnetic field. The belts extend for equal distances north and south of the equator, diminishing into insignificance in the polar regions.

Van Allen said that his mapped boundaries of the belts were based on data obtained from the *Pioneer III* instruments. He said more extensive experiments would be needed to substantiate these findings. The first belt is about 2,000 miles thick starting at 1,400 miles out. The second belt, approximately 4,000 miles thick begins at 8,000 miles.

The areas between the first belt and the earth and between the belts and beyond is considered relatively safe for prolonged space operations. No radiation problems will be encountered for flights below 500 miles altitude.

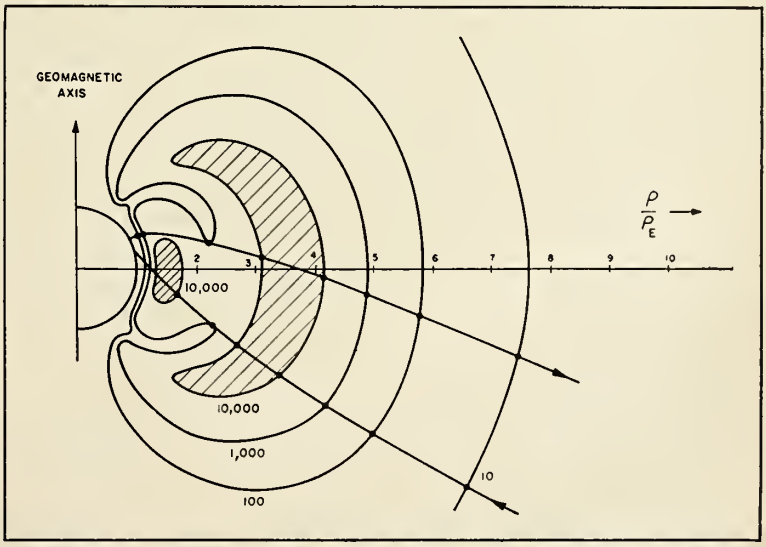
• **Best position**—Van Allen said the best position for extended manned satellite operations would be between the belts at approximately 6,000 miles altitude. In this region radiation was measured at .2 to .3 roentgens per hour. This 4,600-mile wide "radiation free" belt would be ideal for near-circular orbits.

Launch into such an orbit could be made from Vandenberg AFB or from Ft. Churchill, Canada in an northerly direction. Lunar or interplanetary flights could be made by launching directly out into space over the poles from either of these bases.

Each of the two distinct radiation zones are concentric with the earth's core and have identical intensity peaks. The hearts of maximum intensity—7,600 miles apart—the first at 2,400 miles out and the second at 10,000 miles—was measured at 25,600 counts per second.

The maximum intensity count is equivalent to about 10 roentgens per hour if particles are electrons and about 100 roentgens if protons. The type of particles have not definitely been determined. Van Allen thinks it highly unlikely the particles are protons and is firmly convinced, at least, that the particles in the outer rings are electrons. Dr. S. Fred Singer of the University of Maryland, has hypothesized (m/r, Sept. 1, p. 23) that the particles are protons.

The high intensity recordings mean




**CROSS-SECTIONS of the two radiation belts—shaded areas—plotted from measurements obtained during *Pioneer* probe of Dec. 6-7. Arrowed lines show the flight path of the payload. Dots represent intensity.**

that an unprotected man could not survive long after having received more than 45 hours exposure within either belt. Van Allen said that a space passenger could—in a fast dash—penetrate the belts without any undue hazard. Exposure in the 10 or 100 roentgen bands without shielding would have to be limited to one hour.

While the *Explorer* satellites (I, III and IV) discovered and measured the first radiation belt during their powered lifetimes, it was the instruments in *Pioneer III* that discovered the second radiation belt and measured accurately the varying intensity levels of each. The apogee of the *Explorer* satellites did not extend even to the center of the first band at 2,400 miles.

*Pioneer III* apparatus consisted basically of two small Geiger counters. The counters, one 2½ inches long and the other 1½ inches long were designed to measure intensity levels without distinguishing among the types of particles. The radiation instruments and the probe's radio transmitter provided continuous data for almost all of the 36-hour flight.

The larger Geiger counter was set to transmit intensity counting rates geared to three scaling factors—512, 8192 and 131,072 counts per second. The smaller was set to operate with less sensitivity on a different circuit in order to give a continuous check on the performance of the larger counter. The counters were manufactured by Anton Electronics Laboratories of Brooklyn. This firm also built the ionization chamber carried in the earlier Air Force lunar probe.

Although the *Pioneer* payload penetrated the two belts in the thickest portions above the equator, it did not intersect the bands in the polar latitudes. For this reason a cross sectional profile of the belts has been postulated assuming entrapment of the particles in the lines of force of the earth's magnetic field.

• **Map needed**—Dr. Van Allen proposed a global map of the two belts. This map can be obtained, he said, by orbiting radiation instruments in a highly elliptical polar orbit. The orbit of the radiation mapping satellite would have a perigee of 300 miles and an apogee of approximately 10 earth radii or 40,000 miles. After about one year of orbiting the earth the exact latitude limits of the bands and their cross sectional profiles would be known.

Van Allen's university team has written several proposals to NASA in past months emphasizing the necessity for the polar orbiting radiation satellite. The payload would consist of about 100 pounds of instruments comprised largely of radio batteries.

The payload could possibly be drastically reduced by substituting solar batteries instead of the planned mercury batteries.

After authorization from NASA—and the agency is interested—Van Allen said he would need from six to eight months to prepare the satellite. Booster vehicle for this "heavy" high-orbiting payload would probably be similar to the *Thor* configurations planned for the *Discoverer* program.

Dr. Hugh L. Dryden, NASA deputy administrator, who served, as the AAS Space Flight Award presentation speaker during the Society's honors night dinner, said that many radiation experiments have been planned for this year.

### Astronautics Tests

Dec. 23—*Atlas* launched for a perfect 4000-mile flight from Cape Canaveral. Efforts to recover the nose cone (no passenger) were unsuccessful. This was the 17th firing, and was test of guidance.

Dec. 24—*Bomarc* fired against a jet interceptor drone. Results of the test were not announced.

Dec. 23-24—*Titan* airlifted from Martin-Denver to replace the one that failed to lift off the pad on Dec. 20.

Dec. 30—*Polaris* fired from Canaveral. Destroyed after about 1½ minutes of flight. This 22nd test was first for both stages.

## Opposition Developing to President's Council

WASHINGTON—Strong opposition is developing on Capitol Hill against President Eisenhower's apparent attempt to avoid the establishment of a Cabinet-level science agency by setting up a new Federal Council of Science and Technology.

The President, on the advice of his Science Advisory Committee, recently approved the establishment of the new science council, which has no power, but will advise the President and government agencies on science matters. Many observers saw the President's action as a move to head off the creation of a science agency introduced and supported by Democrats during the last session of Congress.

Sen. Hubert H. Humphrey (D. Minn.) who was the author of a science agency bill during the last session, told m/r that he plans to introduce another bill which would integrate basic government science agencies such as the Atomic Energy Commission, the National Aeronautics and Space Administration, the National Bureau of Standards and the National Science Foundation under one department. Humphrey, chairman of the Senate Government Operations Committee's Reorganization Subcommittee, said he will hold early hearings on the bill.

Other Senators who may be expected to push for a new science agency are John L. McClellan (D. Ark.) and Ralph W. Yarborough (D. Tex.), co-sponsors of the Humphrey bill during the last session; and Sen. Estes Kefauver (D. Tenn.), who introduced a similar measure.

The fate of science agency legislation, of course, rests in the hands of Senate Majority Leader Lyndon Johnson (D. Tex.) and House Speaker Sam Rayburn (D. Tex.) who have not made their views publicly known.

The President's Science Advisory Committee also recommended that its chairman, Presidential Science Advisor Dr. James R. Killian Jr., be made head of the new council.

Although the Advisory Committee's report opposed the establishment of a science agency, the science council seems to be a step in that direction. Killian now attends meetings of the Cabinet and Security Council, and the groups to be represented on the Council would be those represented in a science agency.

Government scientists generally approved of the President's action. Dr. Hugh L. Dryden, Deputy Director of NASA, said he was opposed to the idea of setting up a separate science department. U.S. IGY Chairman Dr. Joseph Kaplan said he did not believe such an agency would solve the problem.

## Big Pine Telescope To Go in Operation Soon

WASHINGTON—Distant stars such as the globular cluster on this week's cover will be only a "stones throw away" when a new radio telescope observatory begins operations on the West Coast early this year.

The new observatory built by the Navy and the California Institute of Technology, is expected to have a reception range 15 times greater than any present observatories.

Constructed at a cost of $1.5 million at Big Pine, in Owens Valley 250 miles north of Los Angeles, the observatory will utilize two 90-foot diameter antennas. Early in the Spring the antennas—working in unison—will reach beyond mapped boundaries of the universe—to stars that transmitted their light and radio signals eons ago.

Light travels approximately 6 trillion miles in one year—which means that astronomers will now be able to map our universe out to about 180 million trillion miles.

# Congress Will Keep Eye on Space Program

**New space committees being formed in both houses; legislation likely to come in fields of patent rights, procurement, tax application and military procurement practices; industry ready to battle for new renegotiation act.**

**By Erica Cromley**

WASHINGTON—Formation of two new Congressional Space Committees, to join the already missile-conscious Armed Service and Appropriations Committees in a Democratic Congress, make it seem almost certain that the Eisenhower Administration's missile and space program will come up for legislative overhauling during this session.

After Congress convenes Jan. 7, the Mahan House Defense Appropriations Subcommittee probably will ask some searching questions on reliability studies and quality control of missile and other programs—questions directed at all services.

More quizzing will come at the budget hearings, especially if the administration follows its apparent plan to limit the country's space spending to less than a billion dollars. Overall budgets of both ARPA and NASA are set at about $500 million each, only part of which can be used for space. Under present ground rules the services won't budget for space projects per se.

As for new legislation, the following measures will have top priority in the defense and missile field:

Patent rights.

Procurement changes.

The Renegotiation Act.

Indemnification against missile accidents.

Pre-merger notification of major companies.

More uniform tax application.

No new "spectacular" legislation equal to last year's establishment of the National Aeronautics and Space Administration is expected, although there has been some Congressional interest in creation of a Department of Science.

The Administration is expected to submit a budget of about $40.5 billion. If Congress increases it, it probably will add funds for missiles, electronics and military space vehicle development.

• **Patent rights**—Although Congress is usually reluctant to amend legislation before it has had time to prove itself, agitation over patent restrictions written into the National Aeronautics and Space Administration Act may push legislators into early action. Under NASA contracts, patent rights may be taken by the space agency. Industry would like its space agency contracts to read like those of the Defense Department which grant commercial patent title while maintaining royalty-free use for the government.

Although the act provides for patent rights waivers, the big hurdle will be NASA's Inventions and Contributions Board which will have to rule on each case individually. There is no industry representation on the five-man board.

Said an Aircraft Industries Association spokesman: "It's going to be a mighty slim crop that survives the board. Board members are going to do a lot of soul searching before they waive the government's rights on an invention."

The patent provisions as they now stand, industry contends, will put a damper on incentive for new developments and, therefore, in the long run it is in the government's best interest to grant commercial rights.

• **Groups involved**—Organizations working on recommendations to ease the patent restrictions include the National Association of Manufacturers, the Aircraft Industries Association, National Security Industrial Association, Electronic Industries Association, and the American Patent Law Association.

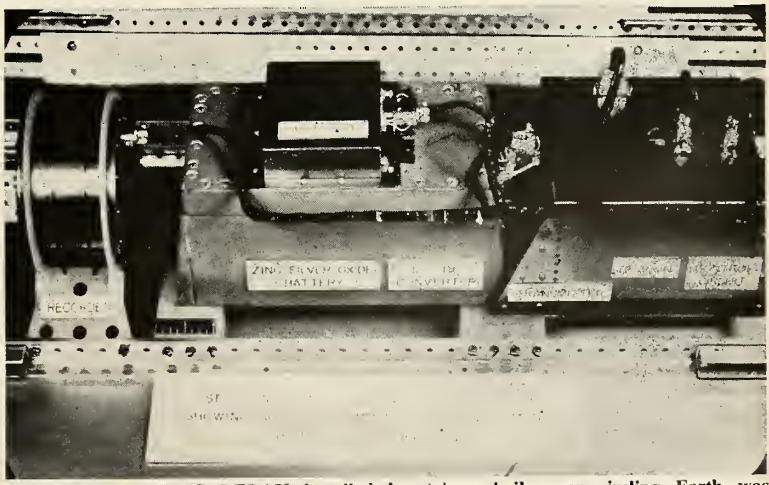
Members of the NAM's astronautics subcommittee met recently with representatives of the space agency and the Patent Office to state their case, and received a sympathetic hearing. According to an NAM spokesman, NASA has already issued instructions that patent restriction clauses will be written only into contracts involving research and development.

NASA is also drafting a regulation to exempt non-R&D contracts from the patent provisions of the act. Industry feels, however, that while this is a concession, very few patents are likely to develop out of supply contracts.

Industry also objects to the "patents oath" clause of the provisions requiring patent applications involving air or space-utility items to be accompanied by a statement "executed under oath" that these did not grow out of any space contract. "This," said Elmer Gorn, Assistant General Counsel for patent matters at Raytheon, "is a slap in the face at industry."

The provision gives the Commissioner of Patents broad power to demand the oath of any application "which appears" to him "to have sig-

## *Atlas Satellite's Payload*



**COMMUNICATIONS RELAY installed in *Atlas* missile now circling Earth was developed by Army Signal Corps in coordination with RCA and other firms. Total weight of equipment shown in cross section is about 150 pounds.**

nificant utility in the conduct of aeronautical and space activities." NASA is reported to be compiling a list of items for the commissioner's guidance.

Although the intent will be to keep this within reasonable bounds, industry feels that as the agency's field of interest grows, the list will likewise expand. Repeal of this policing power will have high priority when time is ripe for NASA act amendments.

• **Procurement**—A bill calling for major military procurement changes involving weapon system management and procurement will be re-introduced by Sen. Leverett Saltonstall (R-Mass.). Although the bill will be modified somewhat from that introduced in the last session, the main provisions are expected to remain. These include extension of the management system to all major weapons programs and would put responsibility for development of weapon under one head.

Included in the bill's provisions is a requirement that major prime contractors extend full subcontract opportunities to small business to increase its participation in subcontracting.

Another section of the bill provides exemption of incentive fixed-price contracts from renegotiation, but this is expected to end up as separate legislation.

It is expected that many provisions of this measure will be permissive rather than mandatory.

Details of the bill are now being worked out with Pentagon officials.

• **Renegotiation**—Industrial associations like the AIA have been working diligently on renegotiation proposals for presentation to the new Congress.

Industry feels that if substantial savings are made under incentive contracts, future incentive is lost if these are to be taken away in renegotiation proceedings. It is proposed that the Renegotiation Board be required to carry the burden of proof in establishing that cost savings did not result from the efficiency of the contractor if profit does not exceed 10%.

• **Appropriations**—It is considered highly unlikely that Congress will tamper with the defense budget figure except to up it. Of the reported $40.5 billion plus (more likely $41 plus; see m/r December 22, p. 15), missiles and space equipment will take at least $6.8 billion. Missile production spending for Fiscal 1960 is expected to go up at least one billion over 1959 to $4.4 billion, with Research and Development to rise "slightly" over this year's $2.4 billion.

While missile spending has climbed annually, aircraft production money will drop under $7 billion for the first time in eight years.

• **Indemnification**—Missile industries would like up to $500 million indemnification in case of major rocket accidents because private insurance companies will not provide full coverage. Favorable Congressional action this year is a good possibility.

• **Taxes**—Congressional observers see little possibility of a reduction in the present 52% corporation tax rate which must be considered before June. Likely instead is a more uniform application of the tax base with a lifting of special deductions and an increase on certain "specially favored income."

# York Sees No Conflict Between ARPA and R&E

WASHINGTON—The Christmas Eve-appointed Dr. Herbert York told his first press conference that as the first Department of Defense Director of Research and Engineering he would:

1. Absorb the present office of the Director of Ballistic Missiles.

2. Act under his authority to supervise ARPA and to allocate projects in the R&E field.

3. Direct all R&E projects which the Secretary of Defense thought should have such central direction. (ARPA now controls the centralized direction of all military space projects.)

4. Supervise all research and engineering projects within the Department of Defense.

Although there are many areas in which the authority of the Director of Research and Engineering and the Director of the Advanced Research Projects Agency overlap, Dr. York said he saw no direct conflict between the two. Roy Johnson, ARPA, director, would, he said, continue to report directly to the Secretary of Defense as he, Dr. York does. He did not know whether or not William Holaday, missile boss, would continue with DOD. He suggested that reporters ask Holaday.

York repeated the recent remark of Deputy Defense Secretary Donald Quarles that ARPA is a "permanent" agency. ARPA would continue, he said, to take on specific military space jobs while the R&E office would supervise all R&E projects. There would have to be, he thought, very close cooperation between his office and Johnson's. Dr. York's new salary is $22,500 annually, a reported drop from his former pay under IDA. Johnson's annual salary is $19,000.

The Director of Research and Engineering replaces the old post of Assistant Secretary for Research and Engineering, most recently held by Paul D. Foote but vacant for some time. Dr. York announced that John B. Macauley, deputy assistant secretary, would stay on as deputy and that he expected to reorganize and utilize the present staff of about 200.

In addition he will absorb the present staff of Missile Director Holaday. Holaday, has been appointed chairman of NASA's Military Liaison Committee, a salaried position.

This absorption would come slowly, York said, in order not to interfere with the projects which Holaday's office already has underway. He expected the same deliberateness in the clarification of his working relationship with ARPA. Before his new appointment Dr. York was chief scientist of ARPA.

Dr. York's new agency, like ARPA, has the authority to contract with private firms' scientific organizations and other government agencies. Dr. York said he was somewhat familiar with the DOD budget for research and development and was prepared to go before Congress and defend it.

While he would supervise the service R&D projects, his office had no intention of taking over their budgets or separate authority, he said. He felt that among his main duties was to expedite all DOD research and to see that no areas were left out of the DOD program.

As an aside, Dr. York said he felt U.S. missile and space progress compared favorably to that of the Russians. The U.S. has lagged in the satellite and high propulsion fields, he said, but is now rapidly catching up.

The R&E position is known to have been refused by several prospects previously (perhaps by Dr. York himself). Queried as to why he had accepted, Dr. York said that he had seen no reason why he could and should not do the job.

"It was as simple as that," he said.

## letters

### Missile Fare

*To the Editor:*

Thought you might be interested in the agenda we whipped up for the Martin-Cocoa Management Club meeting.

Liquid fueling cut-off (bar closed); Start solid fueling (dinner); Man all stations (open meeting); Airborne guidance (invocation); Visitor control (introduction of guests); Identification of facilities (introduction of organizing committee); Prelaunch briefing (purpose of meeting); Data analysis—prior to launch (minutes).

Crew status report (membership report); Operating procedures briefing (constitution); Program identification (introduction of speaker); Ground guidance (main speaker); Hold for special briefing (award presentation); Selection of T.C. and crew (election of officers); Deactivate facilities activation (dissolve organization committee); Switch to automatic sequencing (adjourn); Blast off (the joint is closed).

Wade Epperson, Secretary

*(Ed. Note: Watch for fuel spillage)*

### We Stand Corrected

*To the Editor:*

I am referring to an article in your November 10 issue, entitled: "Cincinnati: Job Shop for Missile Industry." My main concern with the article is that it does not mention the Lodge & Shipley Company as contributing to the missile industry. Actually, Lodge & Shipley has contributed greatly both to the development of its Floturn process and Floturn machines, as well as in special lathes.

In this article there was a reference to the Cincinnati Testing and Research Laboratory and its Floturn process. The Cincinnati Testing and Research Laboratory has no connection with the Floturn process and had nothing to do with the production of the *Explorer* nose cone. The photograph of the nose cone in your article had a caption to the effect that the nose cone is a product of the Cincinnati Research Laboratory which, of course, is not true. Actually, the picture was taken in the Lodge & Shipley, Floturn Department, and it shows Mr. Dolle, President of Lodge & Shipley Company, holding an *Explorer* nose cone.

Arthur V. Baumann
Sales Promotion Manager
The Lodge & Shipley Company

*Editors Note: We regret the error and the oversight in not mentioning the fine work of the Lodge & Shipley Co.*

# west coast industry

**by Fred S. Hunter**

**Lockheed's Missile Systems Division** is making sure that it doesn't get fenced in as the California division did at Burbank. This is the reason for its recent land acquisitions at Sunnyvale, 16½ acres in one parcel, 154 in another, to add to the original 275-acre site. A building for a project is planned for the smaller parcel. There is nothing specific in mind for the 154 acres. This is insurance for the future. Lockheed's MSD also has an option on an additional 200 acres lying between the Sunnyvale plant and the Navy's Moffett Field for the same reason.

**You need room** when you expand in this business and you may need it fast. Four years ago—before Sunnyvale—Lockheed's MSD accounted for 1% of Lockheed's total business. Today it is 33%. In that same period of time the payroll has grown from less than 1000 to more than 14,000 and, increasing at the rate of 200 per week, will hit 15,000 by the end of the year. It is now the San Francisco Bay area's biggest employer. But it also has employes at 13 other locations, including the military test bases, such as Canaveral, White Sands and Vandenberg; tracking stations in Hawaii and Alaska; the engineering laboratory at Palo Alto; the testing site in the Santa Cruz Mountains, and personnel recruiting offices in Chicago and New York.

**It is interesting** to note that despite the big planning program at Sunnyvale, Lockheed has no intention of letting go of the sizeable facilities it leases from the City of Los Angeles at the Van Nuys Airport. This is the site of the *X-7* test vehicle and *Q-5* drone projects. MSD has moved a design group back into Van Nuys and is making some proposals from there. Lockheed's third quarter report, for example, makes guarded mention of a new ballistic concept (probably a version of WS-199B m/r, Dec. 1, p. 11) that has been proposed from the Van Nuys facility. The payroll at Van Nuys currently totals about 3300. It may dip a little, but it is being forecast to run within the 3000-3500 range in 1959.

**A further increase** of at least 50% in the specific impulse of chemical systems is attainable over the operational liquid rocket systems of today, Dr. Robert Thompson, Rocketdyne research manager, declares . . . Cohu Electronics booked its largest single TV sale to date in a $300,000 order from Douglas Aircraft Co. for a closed-circuit system to be used in observing rocket-engine tests at Vandenberg Air Force Base . . . Hoffman Electronics regards its accomplishment in mass production of high-efficiency solar cells as significant because of past hesitancy on the part of many research programs to use solar power due to uncertainty of production capability . . .

**"Never forget** that it is the powerplants that make the range and payload possible," Maj. Gen. Ben I. Funk, commander of the Air Materiel Command's Ballistic Missile Center, told a meeting of supervisors and department heads on the *Titan* project at Aerojet-General Corp. Gen. Funk disclosed that Aerojet contracts with the Air Force now total $252 million. The company has nearly 5000 persons employed on development, production and testing of the *Titan's* rocket engine at its liquid-rocket plant at Sacramento.

# SOLAR SAILING

EXPANDING THE FRONTIERS OF SPAC

**SOLAR SAILING:** Space travel with the aid of solar radiation pressure—an area of advanced research at Lockheed. Vehicle would employ a sail that would be raised and lowered in flight. The artist has depicted Magellan's ship "Trinidad" to symbolize man's great voyages of discovery.

**Lockheed Missile Systems Division** is engaged in all fields of missile and space technology—from concept to operation. Advanced research and development programs include—man in space; space communications; electronics; ionic propulsion; nuclear and solar propulsion; magnetohydrodynamics; computer development; oceanography; flight sciences; materials and processes; human engineering; electromagnetic wave propagation and radiation; and operations research and analysis.

The successful completion of programs such as these not only encompasses the sum of man's knowledge in many fields, but requires a bold and imaginative approach in areas where only theory now exists.

CHNOLOGY

The Missile Systems Division programs reach far into the future. It is a rewarding future which men of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, Dept. A-29, 962 W. El Camino Real, Sunnyvale, California, or 7701 Woodley Avenue, Van Nuys, California. For the convenience of those living in the East or Midwest, offices are maintained at Suite 745, 405 Lexington Avenue, New York 17, and at Suite 300, 840 N. Michigan Avenue, Chicago 11.

*"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."*

NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

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# IDA's 'Brain Factory' Guides Weapons Choices

## Five universities work with Pentagon to provide staff for secret projects

**by E. E. Halmos, Jr.**

WASHINGTON—A remarkable partnership between five top technical universities and the highest echelon of the U.S. military is today producing results that will have far-reaching effect on the future defense of the nation.

For the past two and a half years, the universities—banded into a nonprofit corporation—have been working on projects so secret that not more than a dozen men know the complete details. But the results coming out of this "brain factory" are the guiding principles on which the Department of Defense makes its decisions on weaponry for which the nation will spend its money, and on which the nation will risk its future.

As of now—working on "cost-reimbursement" contracts—the university group has contracts totalling about $3.6 million, from two agencies of the Defense Department. Some 225 people, 130 or more of whom are top-flight scientists, are on the payrolls.

The group calls itself, somewhat whimsically, IDA—Institute for Defense Analyses. And IDA is a girl the like of which never existed before, in the U.S., or anywhere else.

• **Genesis**—IDA has five actual parents, who, in April, 1956 became a nonprofit Delaware corporation in order to fill a need that was recognized when the late Defense Secretary James Forrestal created the Weapons System Evaluation Group (WSEG) as an interservice agency to provide the Joint Chiefs of Staff, himself and others with basic information for decisions on new weapons, or better uses for older ones.

Initial founders were the California Institute of Technology, Case Institute of Technology, Massachusetts Institute of Technology, Stanford University, and Tulane University.

Evidence of how closely associated these organizations have been with missiles and with space technology is the fact that both Dr. James R. Killian, Jr.—now scientific advisor to the President; and Dr. T. Keith Glennan—now head of the National Aeronautics and Space Administration—were at one time chairmen of IDA's board of directors.

A grant of $500,000 from the Ford Foundation put the new organization on a solid financial footing at once.

And the terms of the initial contract with DOD outlined a broad field of activity: "to provide personnel, facilities and material required for surveys of the effectiveness of various weapons systems; evaluation of new equipment in the light of military requirements; evaluation and analyses of military problems to predict the operational behavior of new materials and equipment.

"Development of new tactical doctrines to meet changing military requirements; studies and reports on the technical aspects of strategic planning; and analysis of actual combat reports, tactical and strategic plans, and field exercises . . . with a view to determining how existing weapons . . . could be more effectively employed."

• **Buildup**—That charge envisioned an unusual operation—a private group to pool the brains and know-how of the civilian scientific community of a nation with those of the military. And it took some unusual management techniques to build up the necessary staff.

One significant source of staff members are the universities themselves—not only the five founding organizations, but the academic community generally.

IDA pays special attention to the means for enabling university scientists to devote some part of their time to national security problems. Many of these people, of course, are already involved in on-campus military research projects, or service on government advisory committees.

But more particularly, IDA offers flexible and personalized arrangements for the university faculty member or research worker who is in a position to take a leave of absence for a term or a year—a person who does not feel able to accept a civil service appointment, yet wants to apply his time to problems in IDA's sphere of interest.

"It keeps bringing in fresh ideas, fresh viewpoints," comments President James McCormack. "We deal in brainpower, knowledge, ability to assess and analyze. We can't afford to stagnate."

Of IDA's 225 staff members, 150 are assigned to work with WSEG and the Joint Chiefs of Staff; and 47 work on projects for the Advanced Research Projects Agency.

In addition, a permanent staff of 25 military men, representing the three services, is assigned to WSEG, and works with institute scientists.

• **Assignments**—IDA gets its assignments either from WSEG or ARPA. An assignment, for example, may call for a comparison of two weapons systems being planned—or even in experimental stages. WSEG wants to know, for instance, whether it will be practical to manufacture the two systems.

### IDA Organization

The Institute for Defense Analyses has a formidable number of top scientists, educators and government leaders serving as officers or members of the board of trustees.

Maj. Gen. James McCormack, USAF (Ret.) is president, Dr. Albert G. Hill is vice-president and director of research. Paul V. Cusick is secretary-treasurer.

General McCormack, now with Massachusetts Institute of Technology, is chairman of the board of trustees. Other members are:

William A. M. Burden, public trustee.

Thomas W. Ford, Stanford University.

George W. Green, California Institute of Techology.

Dr. Rufus C. Harris, Tulane University.

Dr. Harlan Hatcher, University of Michigan.

Dr. Albert G. Hill, IDA.

Dr. John A. Hrones, Case Institute of Technology.

Marx Leva, public trustee.

Dr. Joseph C. Morris, Tulane.

Dr. Philip M. Morse, M.I.T.

Thomas P. Murtagh, Case.

Dr. James A. Perskins, public trustee.

Laurance S. Rockefeller, public trustee.

Dr. H. P. Robertson, California Institute of Technology.

Dr. Frederick E. Terman, Stanford.

Dr. Eric A. Walker, Pennsylvania State University.

or whether only one should be authorized; what will be required in the way of support activities; what the manufacturing limits will be; how much material and money will be involved; how much manpower; how soon either system could be ready for delivery of hardware; the feasibility of employing such a weapon—whether troops can handle, or specialists must be trained; what tactical uses could be made of the two—and many other matters.

IDA looks over this assignment, and agrees to handle it. (The Institute has occasionally returned such requests for further definition or other reasons). It then selects from its staff the best qualified man in the particular field, and appoints him as project officer.

And around this man, it assembles a team—assigning military men to provide necessary background and knowledge; and any specialists whose skills seem to fit into the requirement.

Now begins an intensive job of collecting all known data on the subject in hand, study of any tests, opinions and reports from any source; a search that may take investigators through libraries, military repositories, and company and laboratory records.

The information is gathered, evaluated by the project staff, put into final report form, and submitted to whichever agency has requested it. These reports have run from a folder of a few pages to mammoth documents running (with supplements) to 800 pages or more.

Some of them—under great urgency—have been produced in as little as two weeks. Most take longer, for careful study of all factors.

In any event, the results may never see the light of day, outside the most carefully guarded rooms in the Pentagon. It may be, however, that in some future year, some of the information may be made available to the interested public.

• **Results**—Because of the extremely sensitive nature of the work, it is difficult to report the exact nature of what IDA does.

However, in its second annual report, IDA pointed to its participation in the famous Gaither report, made public (in part) last year. IDA got into that picture in June, 1957, with a request from the National Security Council to support a special study group under the chairmanship of H. Rowan Gaither. This group was set up to explore the conditions and capabilities of the U.S. "Heartland" defense system, in the event of an all-out enemy attack.

Among the considerations were: U.S. retaliatory capacity, bearing in mind the fact that U.S. actions in continental defense would affect the actions and attitudes of its principal military allies and other nations with whom the United States has mutual commitments. Also to be considered was the fact that all branches of the U.S. government that would figure in national security are competitors for budgetary support.

Specifically, IDA was asked to recommend and assist in gathering the membership of the panel; insure the quality and technical support; assist in research, fact finding, synthesis and conclusion; and provide all necessary management and supporting service.

Other problems on which the organization has worked, or is working, include:

1) Studies of Air Defense: of the U.S. heartland; of special areas of particular interest overseas; of territories of allies; of U.S. ability to operate from overseas bases; of U.S. ability to launch retaliatory forces.

2) Studies of potentialities and hazards of atomic weapons: if used by the U.S. or against the U.S.; possible effects of radioactive fallout on enemies, on friendly nations, on the U.S. and its forces; relationships between nuclear capabilities and force structures, the logistical problems attendant on force deployment and mobility.

3) Studies of wars of less than all-out intensity: of the relationship between capability of all-out war and the conduct of lesser wars and diplomatic maneuver in the absence of active war—of achieving national objectives without resorting to war.

4) A study, with the North American Air Defense Command, to explore certain problems of defense against types of offensive attacks considered possible in specified time periods of the future.

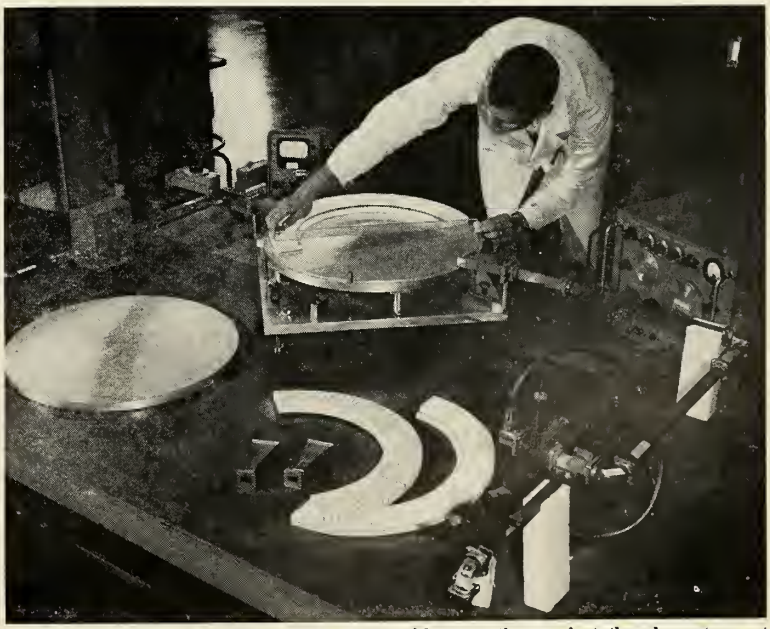
5) Service as a technical monitor for the Department of Defense in field tests of especially important new military systems.

• **Why it works**—IDA was formed after three separate government commissions (beginning with the Hoover commission which had recommended such a contract operation.) Its contracts and methods have been carefully scrutinized—and there has even been some Congressional criticism, mostly on the ground of high pay to scientists, and too great civilian participation in military matters.

However, no one has argued that the system doesn't work—and work well.

One reason is obvious. IDA can put its people to work without any service-connected prejudgments, is not in the position of having to defend any particular point of view. And it can call on the very best scientific brains in the United States to help solve its problems.

## *Protection for Radar Antennas*



**RADOMES THAT provide radar antennas with protection against the elements must be highly transparent to radar waves. Here, a Stanford Research Institute engineer determines electrical characteristics of new high-strength radome walls. The equipment shown permits the use of a narrow strip of the radome to simulate a large, flat radome panel.**

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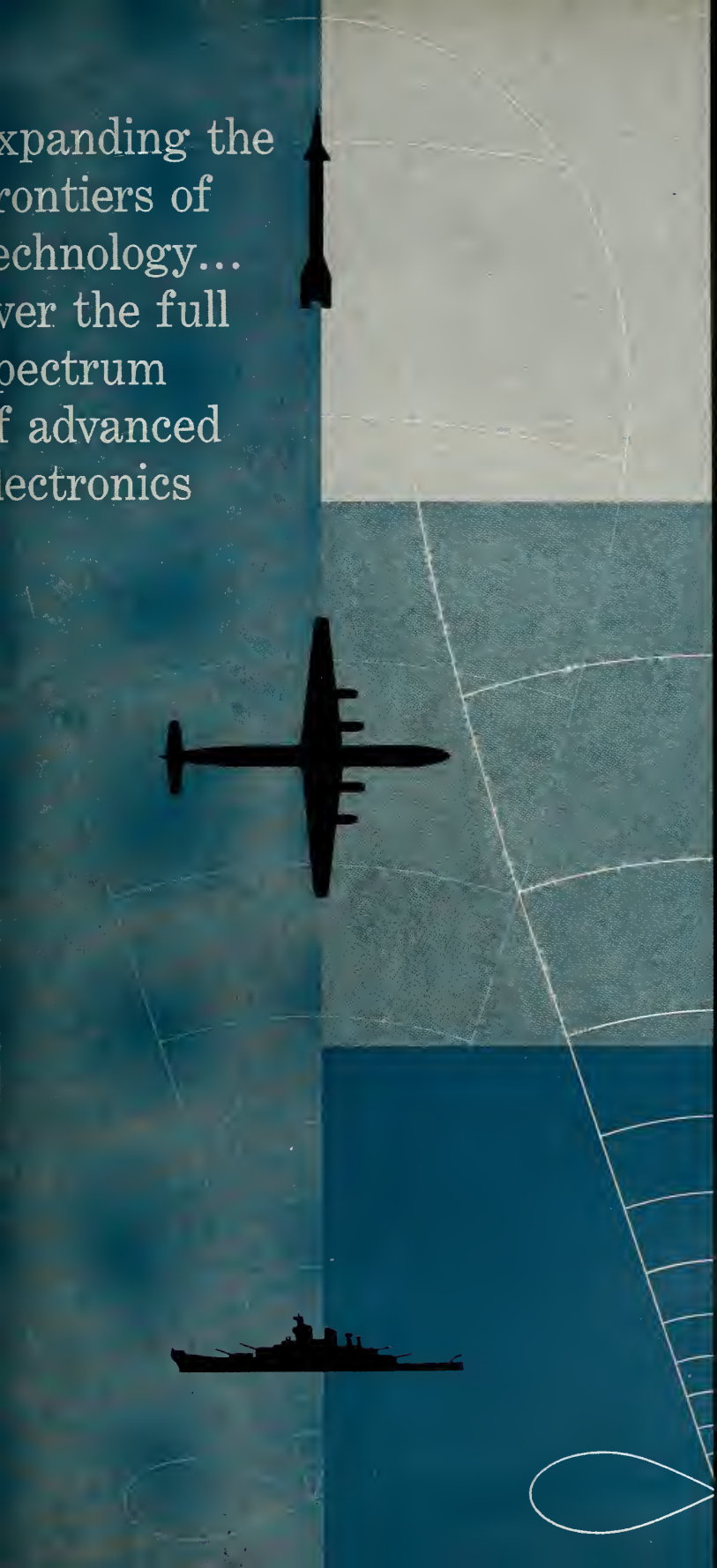

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# propulsion engineering

by Alfred J. Zaehringer

**Neutrons and ions** for rocket propulsion are being researched at the University of Heidelberg. A fission reactor using beta particles given off by cesium-137 is used. The particles are sent through two hyperbolic quadropole magnets. Beta particle jets of about 40 mm long have been produced.

**Photon propulsion systems** may evolve from present plasma jet work. This seems to be implied by Dr. Eugen Saenger who extrapolates present work to the point where temperatures will reach 400,000°K with high plasma pressures. Photon rockets would make possible flight speeds of about a million kilometers per hour.

**Critical mass** for U-238, U-235, or Pu-239 is several inches in diameter and weighs 35-65 pounds. This was given in an older Russian report surveying nuclear propulsion for rockets, ramjets, and turbojets. Thus, atomic fuel costs for an airborne reactor system would be $250-500 million at present U-235 costs.

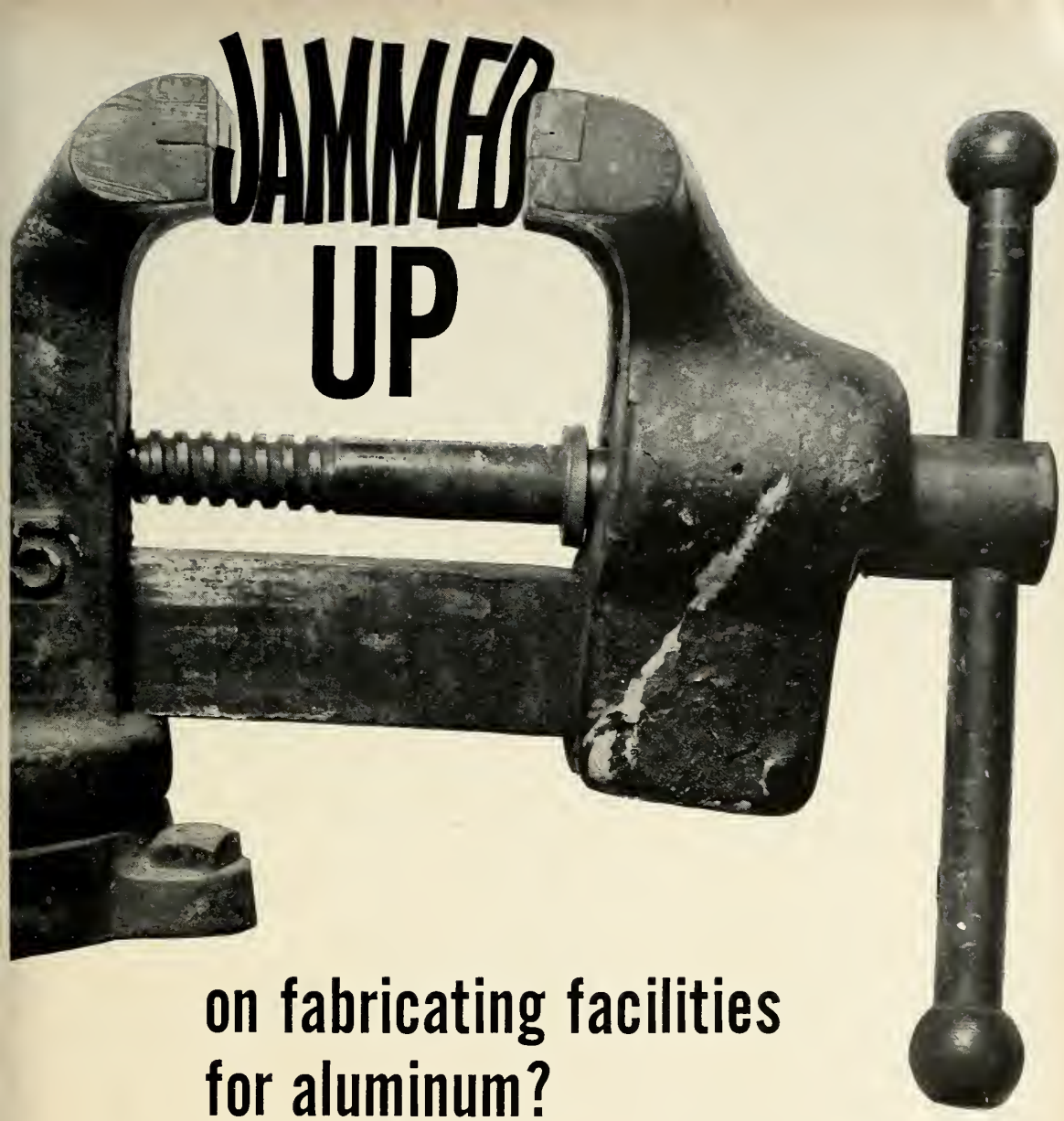
**Propellant systems favored** by the Soviets are: oxygen and ozone for oxidizers, and the light metals and metallo-organics for fuels. Hydrogen figures big in high performance upper stages and for nuclear rockets. Apparently fluorine does not have high favor because of handling difficulties.

**Shaped-charge atomic explosions** may figure in rocket propulsion systems being investigated by Los Alamos Scientific Laboratory. Current feeling is that each directed atomic explosion (say a fraction of a kiloton) would give several times more thrust per propellant weight than the reactor-working fluid system such as being tested on *Rover* rocket.

**Atomic oxygen may drive** the Air Force *Hare* missile. Catalytic surfaces within the missile would allow the free oxygen atoms to recombine to form molecular oxygen. Energy available from such a reaction is $10^{-6}$ calories per cc of air at an altitude of 100 km. Proposed speed of *Hare* on oxygen drive would be about 1330 feet per second.

**New fuel-binder possibilities** are pouring out of the chemical industry. Minnesota Mining & Manufacturing (recently awarded an ARPA solid propellant contract) has introduced an epoxy extender and plasticizer for solid propellant use. American Petrochemical has a new flexible polyester on the market which may improve present brittle binders. Atlas Powder came out with a polyether urethane while DuPont uses PMDA and an epoxidized plasticizer to produce a rigid vinyl from castable plastisols. Finally, Monsanto introduced Mod-Epox, a cost/viscosity modifier for epoxy resins.

**Handling and shipping practices** have been outlined for HiCal-3 by Callery Chemical, indicating production status. Shipment will be made in one ton chlorine cylinders (190 gal) and LPG cylinder (53 gal). ICC classification is Class B Poison with permissible shipment by rail freight or truck. While the company is making available samples of diborane, the solid decaborane may be available in 1959. Amine boranes and trialkyl boranes are being produced now.

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# Lear Designs Guidance For Manned Satellite

## Broad features appear feasible in system for integrating accelerometers and retrofitting 'Bootstrap' gyros

LOS ANGELES—Design of an inertial guidance system for use in a manned orbital cislunar satellite is underway at Lear Astronics, a division of Lear, Inc., Santa Monica, Calif.

Broad system features have been proven feasible and a technological evaluation has been made. Synthesis of system elements and total system performance appraisals are not yet complete.

Astronics has not revealed hardware details, but its gyro and platform technique reportedly involves advanced and unorthodox gimbal configurations.

Designed for integrating accelerometers, the system is adaptable also to possible retrofit of Astronics' "bootstrap" gyros—a concept still under study.

• **Reduce drift rate**—The bootstrap term describes gyros equipped with a means of detecting drift rate rather than total drift. Once drift rate has been established, it can be zeroed out of the system. The technique may prove capable of reducing drift rates in existing gyros by factors as high as 10 to 100. Applicable to ordinary gyros, the concept can reduce component costs relative to accuracy demands. Rotating bearing, flotation and other ultra-precise requirements can be eliminated. Tests indicate a probable value of less than 0.01° per hour average free drift can be achieved.

The inertial system incorporates vertical reference data; allowances for flight profile pertrubations; a platform-computer configuration with integrity of solution in any order of powered vs. free-fall flight; and platform configuration which maintains verticality without gyro precessing in the high rates of angular progression around an orbit.

Other provisions include elimination of possible adverse effects on gyro accuracy with thrust application following a zero acceleration period, and possible mixed system performance with star tracking and ground link data inputs.

Trajectory information incorporates position in three coordinates and the three components of velocity. Prediction and correction of trajectory is accomplished by computer/platform configuration which predicts the point where penetration is to be initiated based on existing initial conditions and no rocket power. The information is used also for correction data specifying thrust requirements for intercept of desired space point.

Monopropellant or dry gas rockets would be used for attitude control. Silvercell batteries would supply basic DC power. Conversion to AC is planned by use of Lear-developed, lightweight plasmotors.

The plasmotor consists of a tube containing an ionized gas which conducts an electrical current at intervals determined by the irradiation rate provided by a nuclear source. When the gas ionization reaches saturation, a pulse is released. Said to maintain highly accurate AC frequencies, a several hundred watt unit is about the size of a standard receiving tube.

Final system configuration would be tied closely to space cockpit design program of the company's Grand Rapids Division. The studies stress information presentation and amount of data actually required by a crew.

• **Another project**—The year-old Astronics division is working also on an Air Force-funded project for a learning rate integrating gyro-autopilot —an outgrowth of previous MIT auto-

### *Ford Instrument Cited*

**AN AWARD for outstanding service to the Army Ordnance Missile Command and the Army Ballistic Missile Agency was presented recently to Ford Instrument Company, a division of Sperry Rand Corp. Col. Calvin Heath of ABMA's Industrial Division makes the presentation to Charles S. Rockwell, president of Ford Instrument. On left is L. S. Brown, manager of Ford's Missile Division on right is Harry Vickers, president of Sperry Rand Corporation.**

# FIREBEE...THE HIT OF PROJECT WILLIAM TELL

"I'LL NEVER WANT TO FIRE AT TOWED TARGETS AGAIN!" That's the typical reaction of Air Force interceptor pilots after they fired at Ryan Firebee jet targets during the recent "Project William Tell" Weapons Meet. 78 Firebees, launched off the Florida coast, brought combat realism to the 10-day meet. Acting as "enemy" jet bombers, the free-flying Firebees streaked in at over 500 mph, from 14,000 to 42,000 feet, and flew an average of 31 minutes each. Air Force pilots, crews, and weapons systems met this realistic test with the most impressive teamwork and skill ever displayed at a weapons meet.

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**Ryan Aeronautical Company, San Diego, Calif.**

pilot development.

In essence, such a servomechanism is capable of remembering what it has done in relation to a vehicle and compares what it is doing now to a past or ideal performance.

Applied to guidance systems, the concept may make it possible to design flight controls which select their own sub-routines and are capable of sensing whether such actions are correct or not.

Missile or space exploration aspects of the device would be in unmanned probes to unknown planets such as Venus. Astronics engineers say that a probe with a learning curve and judgment comparable to human may be available in about 10 years.

Astronics has been organized to meet requirements of future advanced projects. Functioning as Lear's systems division, it utilizes the team concept to integrate capabilities of other divisions and/or other equipment companies.

Where team efforts are warranted, a systems management office and a systems planning and study organization dubbed SPARC (Systems Planning for Advance Requirements Center) has been established. Management plan includes all Lear divisions, establishing a central agency for guidance and control system activities.

But, the division is not letting time slip by. The SPARC group has been operating for some time in predictions of future guidance and control system requirements. Subsystem needs have been studied as to what can or cannot be produced by Lear divisions, and Astronics has made a number of proposals jointly with organizations outside the corporate family.

## Two New Reports Issued on Electronics

WASHINGTON—The Office of Technical Service, U.S. Department of Commerce has released a USAF report on a new way to protect electronic equipment against shock and vibration and a Navy report on the change in resistivity of high polymers during isothermal polymerization.

The Air Force report, titled "New medium for the protection of electronic equipment against shock and vibration," is PB 151005 and costs $2.75 from OTS. It describes the medium as a multi-layer grid of 3/32-inch Teflon rods embedded in a matrix of silicone rubber. High internal damping, believed to be produced by friction of the Teflon-rubber interfaces, is the salient feature of the new medium. Maximum

transmissibility obtained at 0.010-inch input double amplitude was 2.1, considerably smaller than that specified in current military specs. Materials in the new medium withstood temperatures from –85 to 482 F.

"The change in electrical resistivity of some high polymers during isothermal polymerization" is the Navy report title. OTS number is PB 131582 and price is 75 cents. It describes a technique for the study of the rate of polymerization, under isothermal conditions, for typical encapsulating resins. Polymerization of epoxy, polyester and styrene resins was monitored electrically.

The plots suggest that relative rates of reaction could be conveniently obtained if a correlation between extent of polymerization and electrical resistivity were known for the particular resins studied. Results are presented for commercially available resins.

## GE Scientists Describe Nuclear Power Package

DETROIT—E. Schnetzer and W. R. Corliss, scientists at the General Electric Flight Propulsion Lab, have outlined a one megawatt nuclear power package for an ion rocket.

At a recent meeting here of nuclear scientists and engineers, they reported that with cesium propellant, the 1 MW could produce 3.6 lb. of thrust at an $I_{sp}$ of 9600 sec. Thrust to gross weight ratios of $1.8 \times 10^{-4}$ were stated to be available for typical vehicles. A closed cycle system, available by 1965, would use an induction alternator.

The 1 MW power package, to be launched from a rocket or glide-type vehicle, would be about 80 feet long and have a diameter of 8 feet. A ceramic core, helium-cooled reactor produces 7.8 MW of heat. A 12-stage molybdenum turbine, consuming 4.3 lb./sec. of 2600 R helium, drives a 41-stage compressor and 400-cycle induction alternator at 24,000 RPM.

Waste heat is rejected in a packaged, three-wing, 16,800 sq. ft. radiator with an inlet temperature of 1818 R and an outlet temperature of 675 R. The specific weight of the power package is 11 lb./kw. Total weight, without shadow shielding, is 11,000 lb. Hermetically sealed parts might operate for 10,000 hours of unattended operation.

Estimated lifetime of the ceramic fuel elements represent an extrapolation of the present state of the art. Techniques for preserving the integrity of the radiator in the presence of high meteoroid fluxes remain to be developed.

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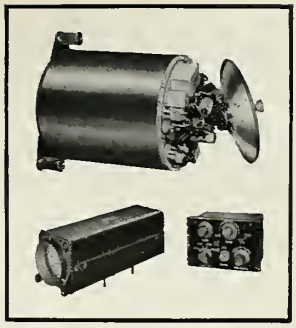

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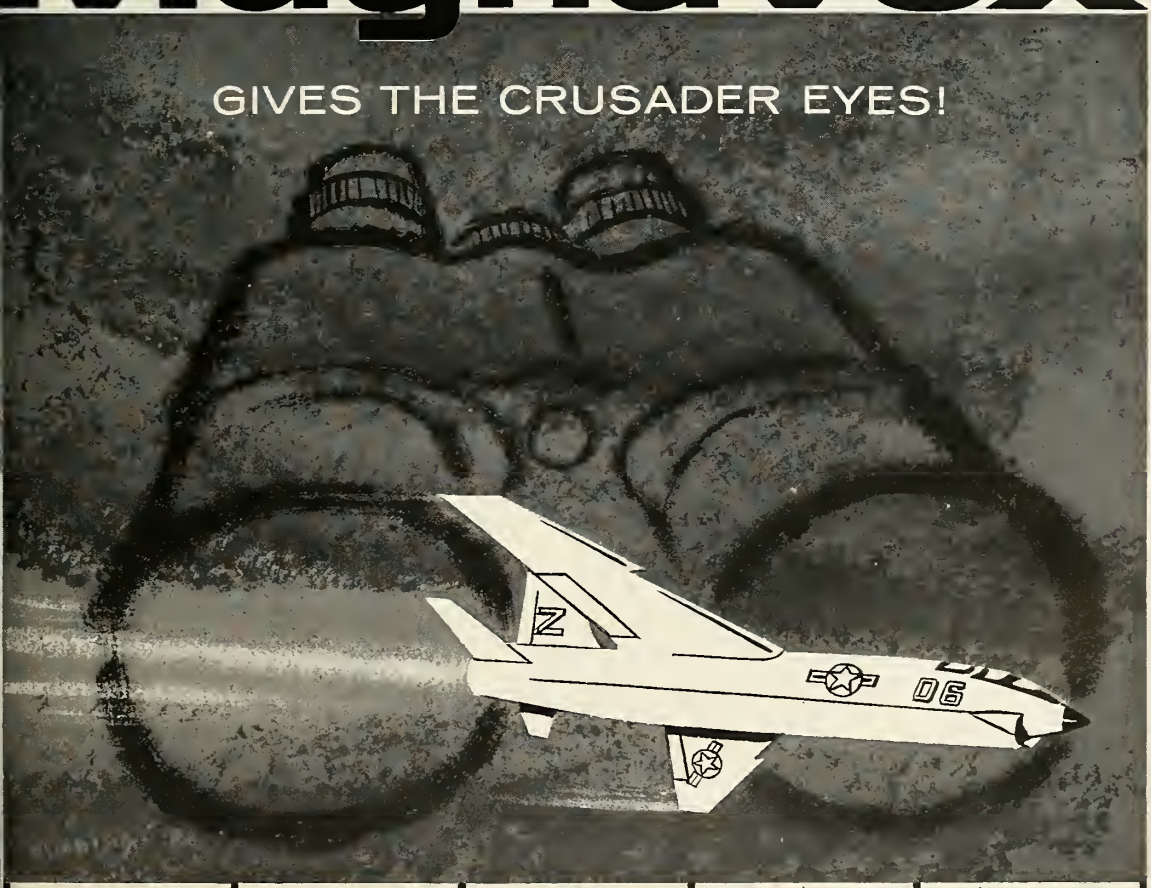


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## How Lockheed helps conserve defense dollars:

# The missile with 9 lives

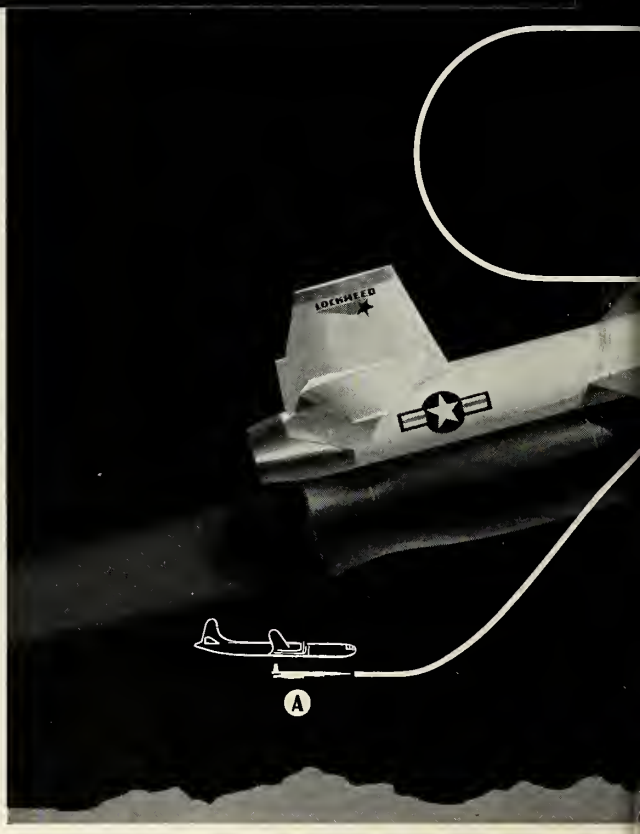
**The U.S. Army's** new Q-5 *Kingfisher* was designed by Lockheed's Missile Systems Division to provide our mighty arsenal of ground-to-air missiles with a realistic test of marksmanship—against high-altitude targets moving at supersonic speeds over 1500 miles-per-hour.

The *Kingfisher* is 38-feet long, 20-inches in diameter, has a 10-foot wingspan and weighs more than 7600 pounds. As it flashes across the skies it electronically simulates any desired size and type of "enemy" plane or air-breathing missile.

The *Kingfisher's* electronic Firing Error Indicator instantly and accurately tells ground controllers whether missiles fired at it are "hits" or "misses"—and automatically evaluates each missile's angle-of-attack, miss-distance, and other highly important technical data.

Undamaged by "hits" scored on its electronic image, the Q-5 *Kingfisher* is parachute recovered after each flight.

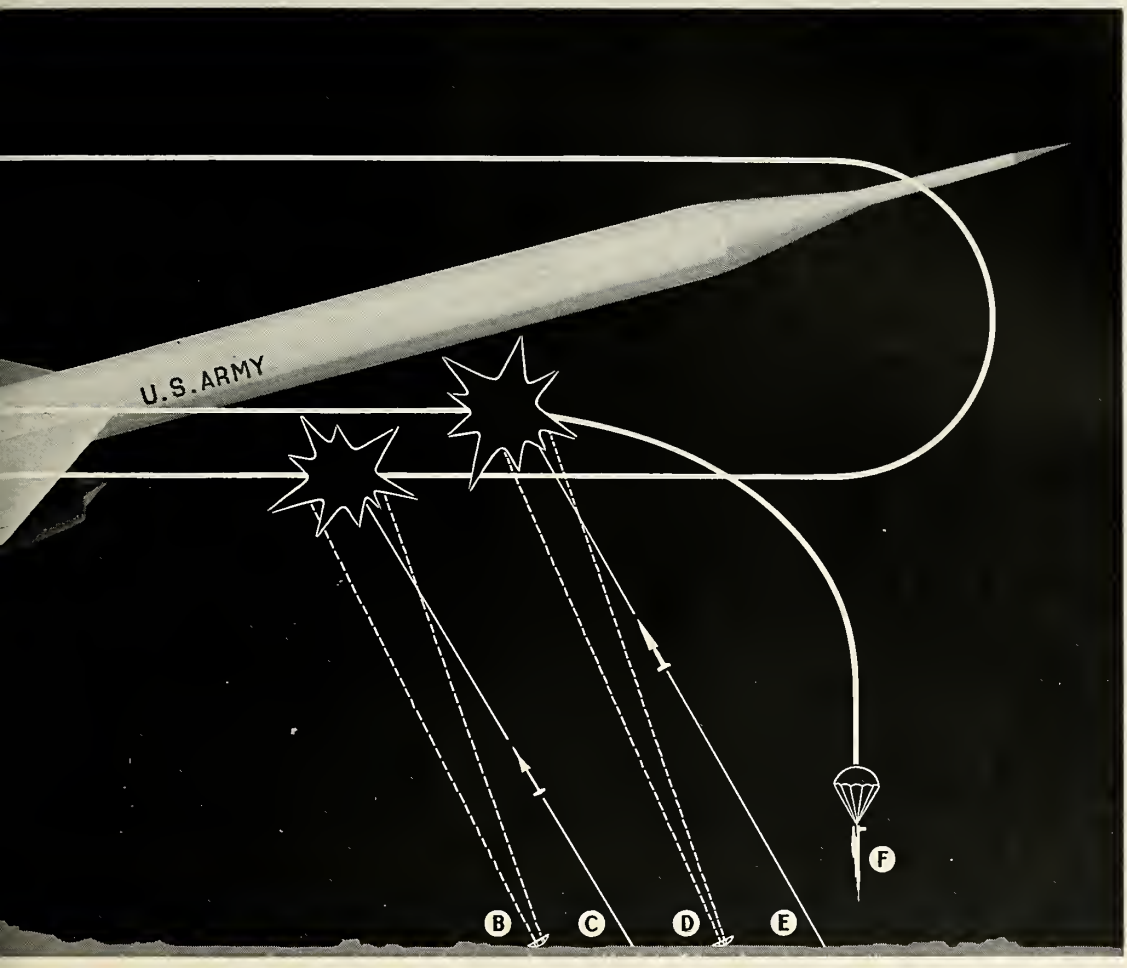
This Lockheed-developed "missile with 9 lives" will enable the U.S. Army to achieve hitherto impossible proficiency in missile marksmanship against supersonic targets—at a saving to taxpayers of approximately half a million dollars on each recovery flight.




**Q-5 is dropped** by plane at 35,000 feet ((A) in diagram). Then its twin rockets ignite, propel it to speeds required to operate its ramjet engine.

**Q-5 is detected as "enemy"** by ground radar (B), and its speed, altitude, and course are fed into fire-control computer of Nike battery.

**Missiles fired at Q-5** are like t used in wartime—but lack h explosive warheads. Nike missil scores "hit" on Q-5's electronic in





**Above: Entering oval flight pattern,** Q-5 attains speeds over 1500 mph. Second ground radar **(D)** and missile-launching battery **(E)** practice their marksmanship until Q-5 *Kingfisher's* fuel supply is exhausted.

**Left: Landing on its nose-spike** in a remote, uninhabited area, after floating down by parachute **(F)**, the Q-5 is recovered by U.S. Army ground crews—to be refueled and refitted for future flights.

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

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## Advertiser's Index



## when and where

### JANUARY

**Fifth National Symposium on Reliability and Quality Control in Electronics,** Bellevue-Stratford Hotel, Philadelphia, Jan. 12-14.

**Southwest Electronic Exhibit,** Arizona State Fairgrounds, Phoenix, Jan. 21-23.

**Institute of the Aeronautical Sciences,** 27th Annual Meeting, Sheraton-Astor Hotel, New York, Honors Night Dinner, Jan. 27, Jan. 26-29.

**Fifth Annual Radar Symposium** (classified), Rockham Bldg., University of Michigan, Ann Arbor, Jan. 27-29.

**Society of Plastics Engineers,** 15th Annual Technical Conference, Hotel Commodore, New York, Jan. 27-30.

**Armour Research Foundation,** Fifth Annual Midwest Welding Conference, Illinois Institute of Technology, Chicago, Jan. 28-29.

### FEBRUARY

**14th Annual Technical and Management Conference,** Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago, Feb. 3-5.

**1959 Engineering Exposition,** Balboa Park, San Diego, Feb. 26-March 1.

### MARCH

**IRE, AIEE and Association for Computing Machinery,** 1959 Western Joint Computer Conference, Fairmont Hotel, San Francisco, March 3-5.

**Institute of the Aeronautical Sciences,** Flight Propulsion Meeting (classified), Hotel Carter, Cleveland, March 5-6.

**Western Space Age Conference and Exhibit.** For information: Domestic Trade Dept., Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles, March 5-7.

**Gas Turbine Division of the American Society of Mechanical Engineers,** Turbine in Action, Cincinnati, March 8-11.

**American Society for Metals,** 11th Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, March 16-20.

**The American Rocket Society,** 1959 Sectional Meeting, Daytona Plaza Hotel, Daytona Beach, Fla., March 23-25.

**Institute of Radio Engineers,** National Convention, Coliseum and Waldorf-Astoria Hotel, New York, March 23-26.

**Polytechnic Institute** of Brooklyn's Ninth International Symposium, Auditorium, Engineering Societies Bldg., New York, March 31-Apr. 2.

**Society of Automotive Engineers,** National Aeronautic Meeting, Hotel Commodore, New York, March 31-Apr. 3.

### APRIL

**1959 Nuclear Congress,** Municipal Auditorium, Cleveland. For information: Engineers Joint Council, 29 West 39th St., New York, Apr. 5-10.

**American Welding Society,** 1959 Welding Show and 40th Annual Convention, International Amphitheatre and Hotel Sherman, Chicago, Apr. 7-10.

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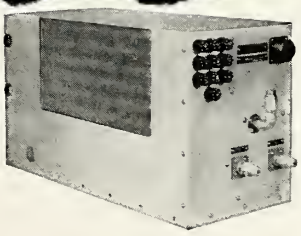

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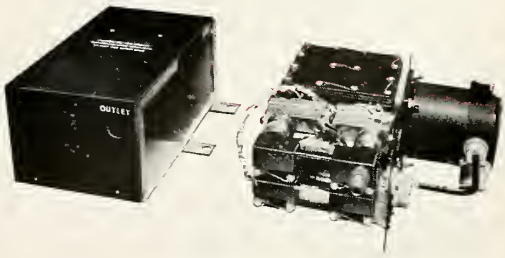


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