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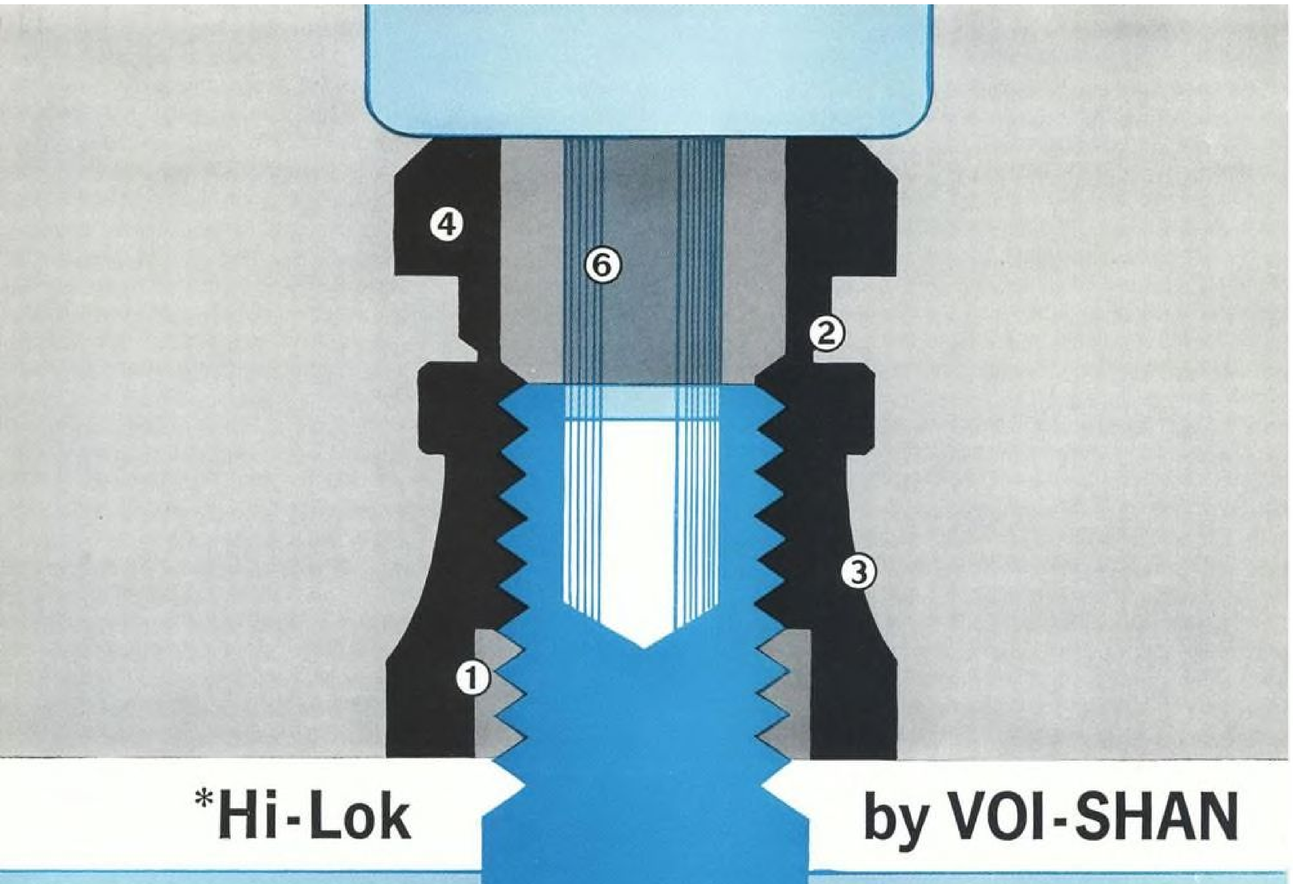
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October 22, 1962

Satellites Study Stars Obscured By Atmosphere

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*Hi-Lok by VOI-SHAN

Consistently controlled preload, minimum size and weight, plus speed of installation are outstanding advantages of the new Hi-Lok fastener now being produced by Voi-Shan. The Hi-Lok is the result of a design effort to provide an advanced fastener system incorporating as many desirable features as possible, with the greatest adaptability, in one product. Hi-Lok is driven from one side of the work, thereby saving in installation costs. Power tooling in use adds to time savings. Accurate, automatic torque control is incorporated by means of a closely controlled shear groove in the Hi-Lok collar. Available in a wide range of sizes and material combinations. The Hi-Lok is produced with the accepted Voi-Shan precision workmanship and quality control for maximum performance. Write for further details and specifications.

1 Grip coverage: 1/16 inch min. Counterbore absorbs material thickness variation.

2 Progressive tightening: Hi-Lok cannot over-torque. The driving section separates at pre-established torque level.

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4 Clearance: Hi-Lok pin head and collar diameters allow smaller wrench clearance. The "torque-off" hex-wrenching section projects to allow small tool accessibility.

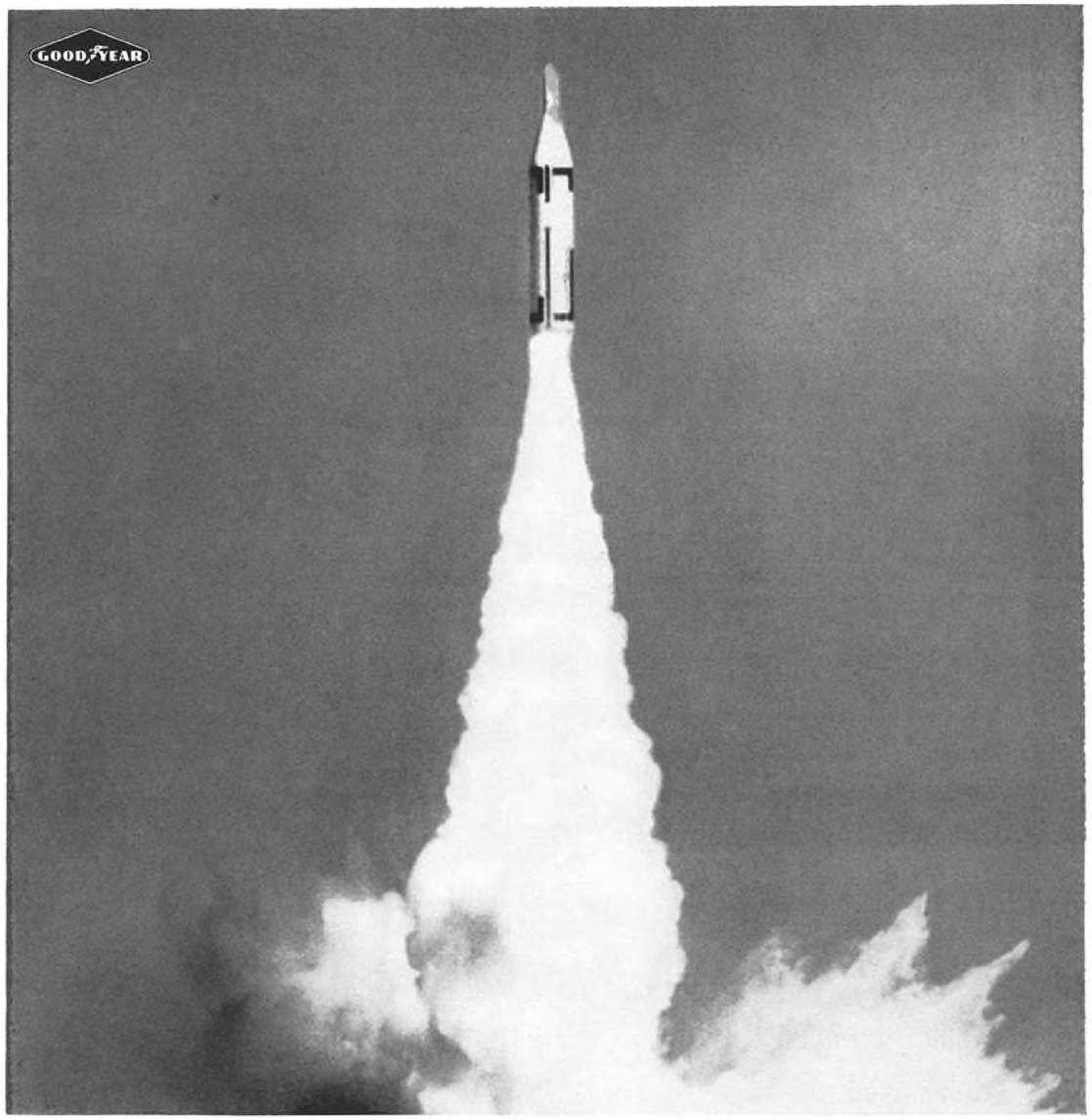
5 No recess in head: Improves aerodynamic qualities. 100° countersunk, close-tolerance, shear head style and sealing compound are used in wet wing assemblies.

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IDEA: Boost a missile's range and payload, too

Cutting inert motor weight is one of the fastest ways to increase a missile's range or payload. It's not easy . . . but it can be done. And 14 years ago, GAC–Goodyear Aircraft Corporation–started working on an idea that would do it.

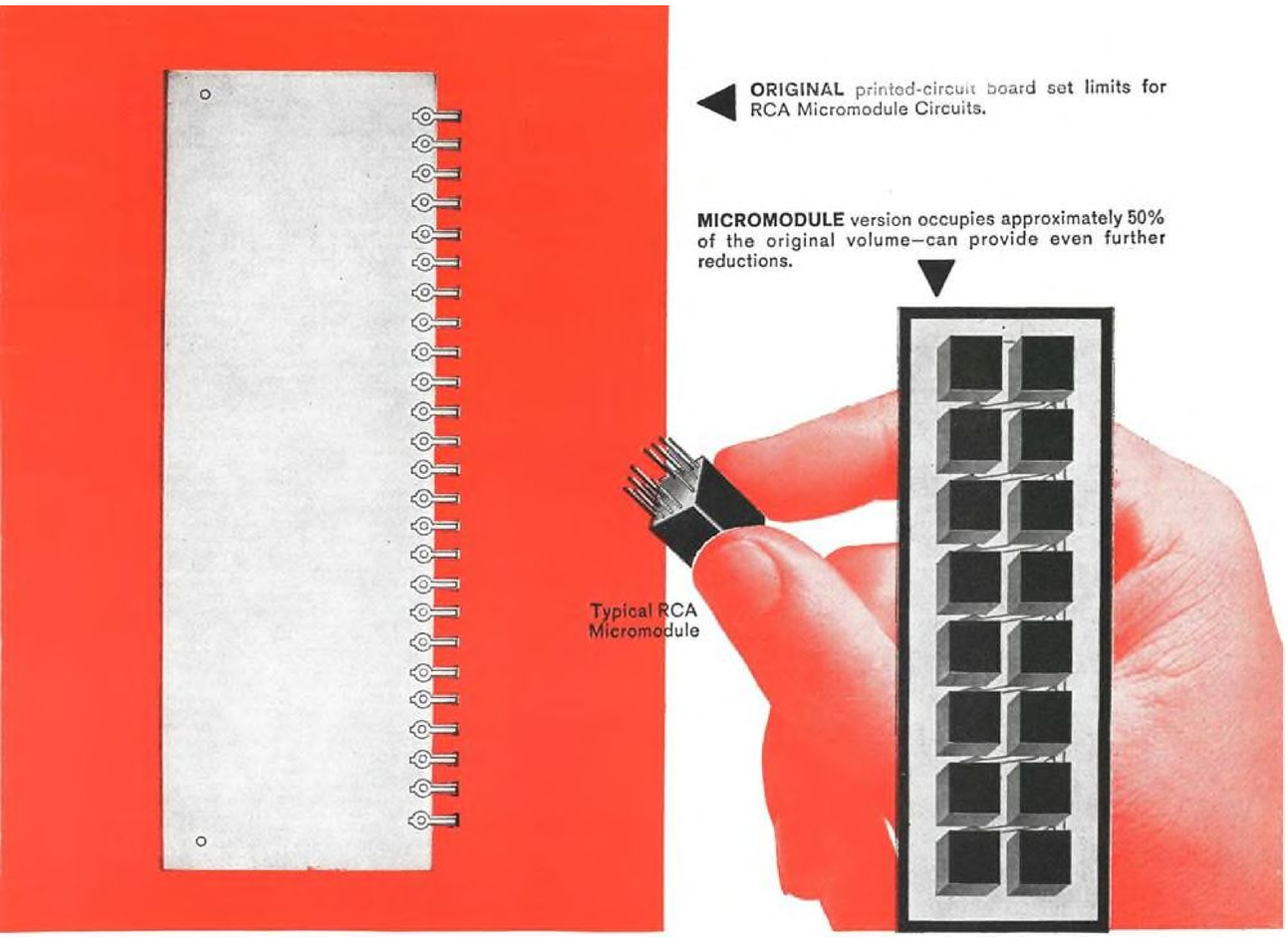
The idea: Filament winding–a technique brought to a fine art by GAC...a technique being used today by GAC to make Polaris first stage rocket motor cases.

Filament winding offers many advantages – strength, lightness, reliability and, most importantly, higher strength-weight ratios. Proof? The Polaris cases we make are as much as ⅓ lighter than steel cases of the same strength.

GAC can also wind nozzles, liquid propellant tanks, pressure vessels, ultra-large booster cases and similar products. If you need talent in these areas – or help with advanced systems and technology, aerospace support equipment, electronic subsystems, lightweight structures, or missile requirements–write: Goodyear Aircraft Corporation, Dept. 914AV, Akron 15, Ohio, or Litchfield Park, Arizona.

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...and backed by over 100,000,000 element hours of life-test experience

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RCA Minimodules—miniature packaged circuits utilizing conventional components and transistors—can be supplied in large volume, in the form you need. Consider RCA your packaging headquarters for miniaturized circuits utilizing transistors, rectifiers, diodes. Practically any component you require can be packaged to your specifications by RCA Engineers.

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AEROSPACE CALENDAR

Oct. 29—Fourth Annual Western Technical Conference, American Institute of Electrical Engineers, Biltmore Hotel, Los Angeles, Calif.

Oct. 29-30—Aerospace Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aerospace Division, Vickers, Inc.

Oct. 29-30—Meeting on Large Rockets, Institute of the Aerospace Sciences, El Dorado Inn, Sacramento, Calif.

Oct. 29-31—Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. Attendance limited; for information: Sinclaire M. Scala, General Chairman, Room M7023A, General Electric Co., MSD, Valley Forge Space Technology Center, Box 8555, Philadelphia 1, Pa. Co-sponsor: AFOSR.

Oct. 29-Nov. 1—58th Meeting National Aerospace Standards Committee, Aerospace Industries Assn., Ko Ko Motel, Cocoa Beach, Fla.

Oct. 29-Nov. 2—22nd National Convention, Society for Nondestructive Testing, Commodore Hotel, New York, N. Y.

Oct. 29-Nov. 2—World Metal Show & National Metal Congress, American Society for Metals, Coliseum and Hotel Biltmore, New York, N. Y.

Oct. 29-Nov. 2—International Symposium, "Basic Environmental Problems of Man in Space." UNESCO House, Paris, France. Sponsors: International Astronautical Federation; International Academy of Astronautics.

(Continued on page 7)

AVIATION WEEK and Space Technology

October 22, 1962

Vol. 77, No. 17

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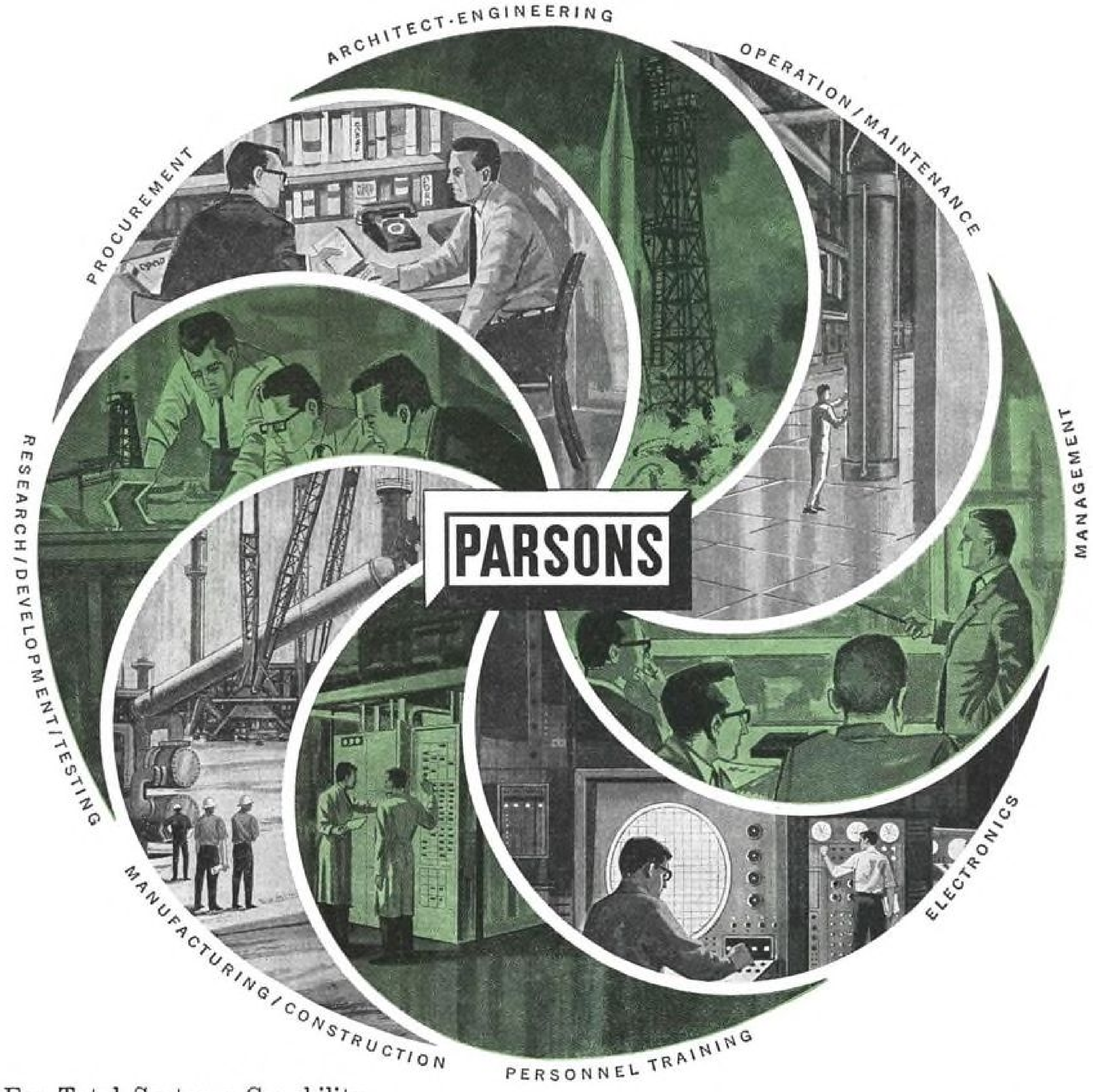
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AEROSPACE CALENDAR

(*Continued from page 5*)

Oct. 30—Supersonic Commercial Transport Metals Symposium, Metallurgical Society, Statler-Hilton Hotel, New York, N. Y.

Oct. 30-31—National Conference on Spaceborne Computer Engineering, IRE, Disneyland Hotel, Anaheim, Calif.

Oct. 30-Nov. 1—Eighth Tri-Service Conference, Armour Research Foundation, Chicago, Ill. Sponsors: U. S. Army, Navy and Air Force.

Oct. 31—Symposium: Oxidation of Tungsten and Other Refractory Metals, Statler Hilton Hotel, New York, N. Y. Sponsors: Metals and Ceramics Laboratory, Aeronautical Systems Division, Wright-Patterson AFB; Metallurgical Society.

Oct. 31-Nov. 3—Ninth Annual Symposium, American Vacuum Society, Statler Hilton Hotel, Los Angeles, Calif.

Nov. 1—Annual Meeting, General Aviation Safety Committee, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Nov. 1-2—Chemtronics Conference, American Society for Quality Control, Statler Hilton Hotel, New York, N. Y.

Nov. 1-2—Sixth National Conference, Product Engineering and Production, Institute of Radio Engineers, Jack Tar Hotel, San Francisco, Calif.

Nov. 2-3—Advanced Technology Symposium, American Society of Mechanical Engineers, University of New Mexico, Albuquerque, N. M., in cooperation with AFSWC-Kirtland AFB.

Nov. 4-7—14th Annual Conference on Engineering in Biology and Medicine, Conrad Hilton Hotel, Chicago, Ill. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Instrument Society of America.

Nov. 5-7—Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Tenn. Co-sponsors: Oak Ridge National Laboratory; NASA Manned Spacecraft Center; American Nuclear Society.

Nov. 5-7—Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Armory & Somerset Hotel, Boston, Mass.

Nov. 5-16—16th Air Transport Management Institute, School of Business Administration, The American University, Washington, D. C.

Nov. 7-8—Symposium on Lasers and Applications, Antenna Laboratory, Department of Electrical Engineering, Ohio State University, Columbus, Ohio.

Nov. 7-9—International Air Cargo Forum, Dinkler-Plaza Hotel, Atlanta, Ga. Sponsors: Institute of the Aerospace Sciences; Society of Automotive Engineers.

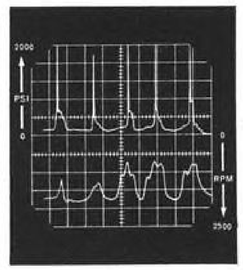
Nov. 12—Wings Club Annual Dinner, Americana Hotel, New York, N. Y.

Nov. 12-15—International Air Transport Assn.'s Sixth Public Relations Conference, Shoreham Hotel, Washington, D. C.

Nov. 12-15—Eighth Annual Conference on Magnetism and Magnetic Materials, Institute of Radio Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa.

Nov. 13-14—Retardation and Recovery Symposium, Imperial Motel, Dayton, Ohio. Sponsor: Aeronautical Systems Division's Flight Accessories Laboratory.

(*Continued on page 9*)

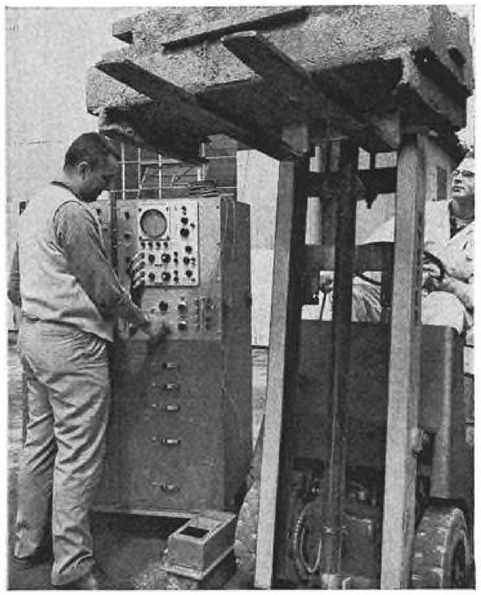


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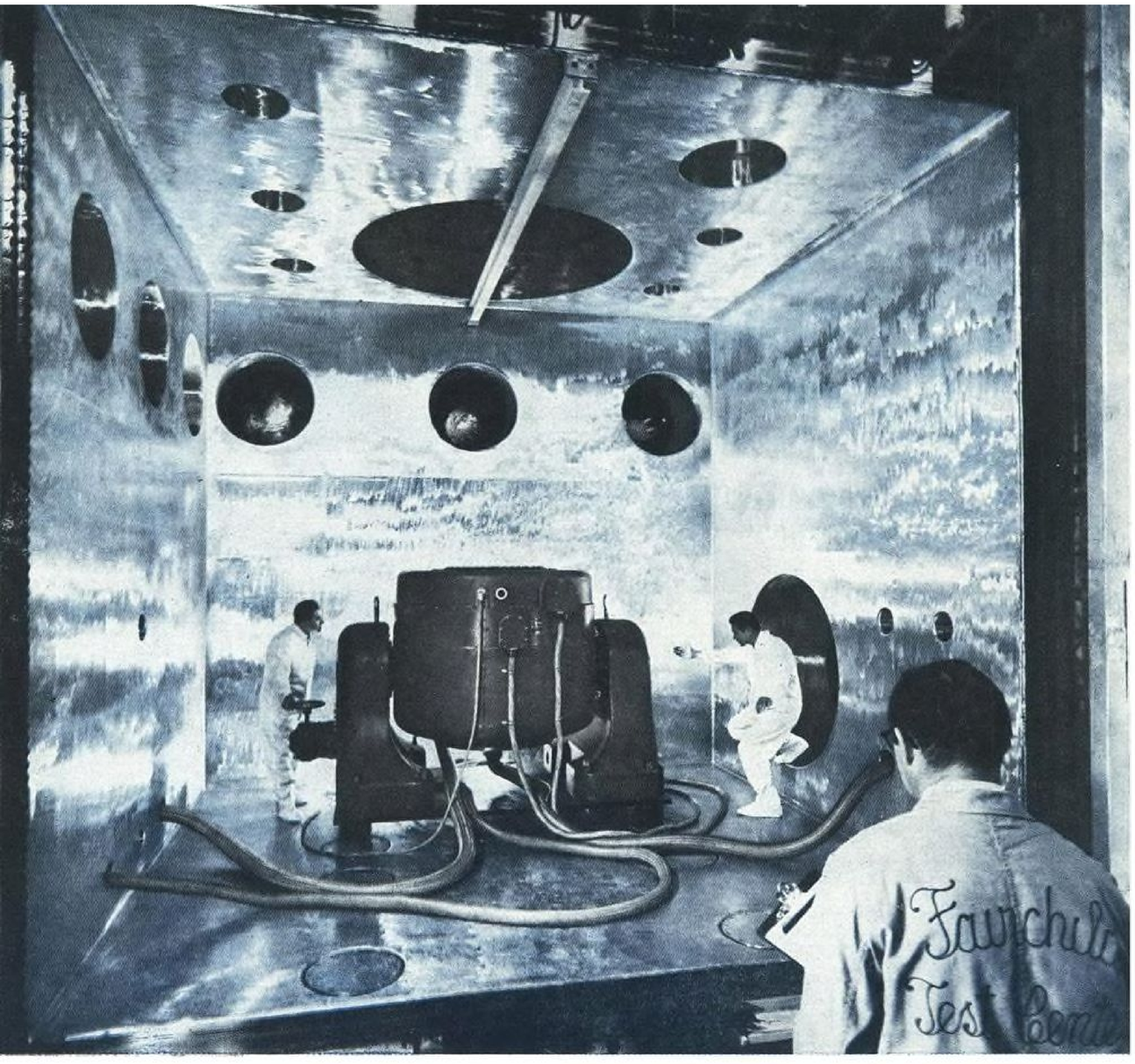
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AEROSPACE CALENDAR

(*Continued from page 7*)

Nov. 13-15—National Symposium: Materials Compatibility and Contamination Control Processes, Society of Aerospace Material and Process Engineers, Hollywood-Roosevelt Hotel, Hollywood, Calif.

Nov. 13-18—17th Annual Meeting and Space Flight Exposition, American Rocket Society, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 14-16—17th Annual Meeting Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D. C. Host: United States Navy.

Nov. 16-17—Second Canadian Institute of Radio Engineers Symposium on Communications, Queen Elizabeth Hotel, Montreal, Canada.

Nov. 19-20—Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Continental, Kansas City, Mo.

Nov. 26-27—Western States Section Meeting, The Combustion Institute, Aerojet-General Corp., Sacramento, Calif.

Nov. 26-29—Annual Coordinated Meetings: American Nuclear Society, Atomic Industrial Forum, and joint AtomFair, Sheraton-Park and Shoreham Hotels, Washington, D. C.

Nov. 27-29—40th Meeting, Aviation Distributors and Manufacturers Assn., The Kenilworth, Miami Beach, Fla.

Nov. 27-29—Fall Meeting, Radio Technical Commission for Aeronautics, Marriott Motor Hotel, Washington, D. C.

Nov. 28-30—1962 Ultrasonics Symposium, Institute of Radio Engineers, Columbia University, New York, N. Y.

Dec. 4-6—Fall Joint Computer Conference, Sheraton Hotel, Philadelphia, Pa. Sponsors: American Federation of Information Processing Societies; IRE.

Dec. 6-7—Vehicular Communications Conference, IRE, Disneyland Motel, Los Angeles.

Dec. 10-12—Conference on VTOL Aircraft, New York Academy of Sciences, Henry Hudson Hotel, New York, N. Y.

Dec. 17-18—Symposium: Structural Dynamics Under High Impulse Loading, Wright-Patterson AFB, Ohio. Co-sponsors: Air Force Office of Scientific Research (Mechanics Division); Aeronautical Systems Division.

Dec. 26-31—Space Physics Meeting, American Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.

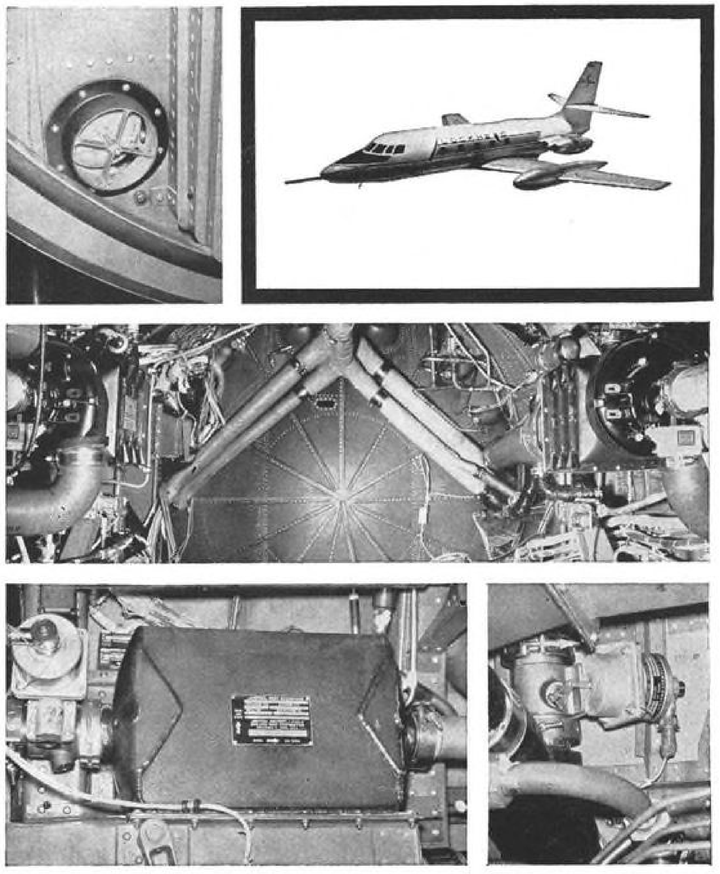
Jan. 8-10—Millimeter and Submillimeter Conference, Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.

Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y.

Jan. 22-24—Ninth National Symposium on Reliability and Quality Control, Sheraton-Palace Hotel, San Francisco, Calif.

Jan. 30-Feb. 1—Fourth Annual Solid Propellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and The Franklin Institute, Philadelphia.

Jan. 30-Feb. 1—National Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.



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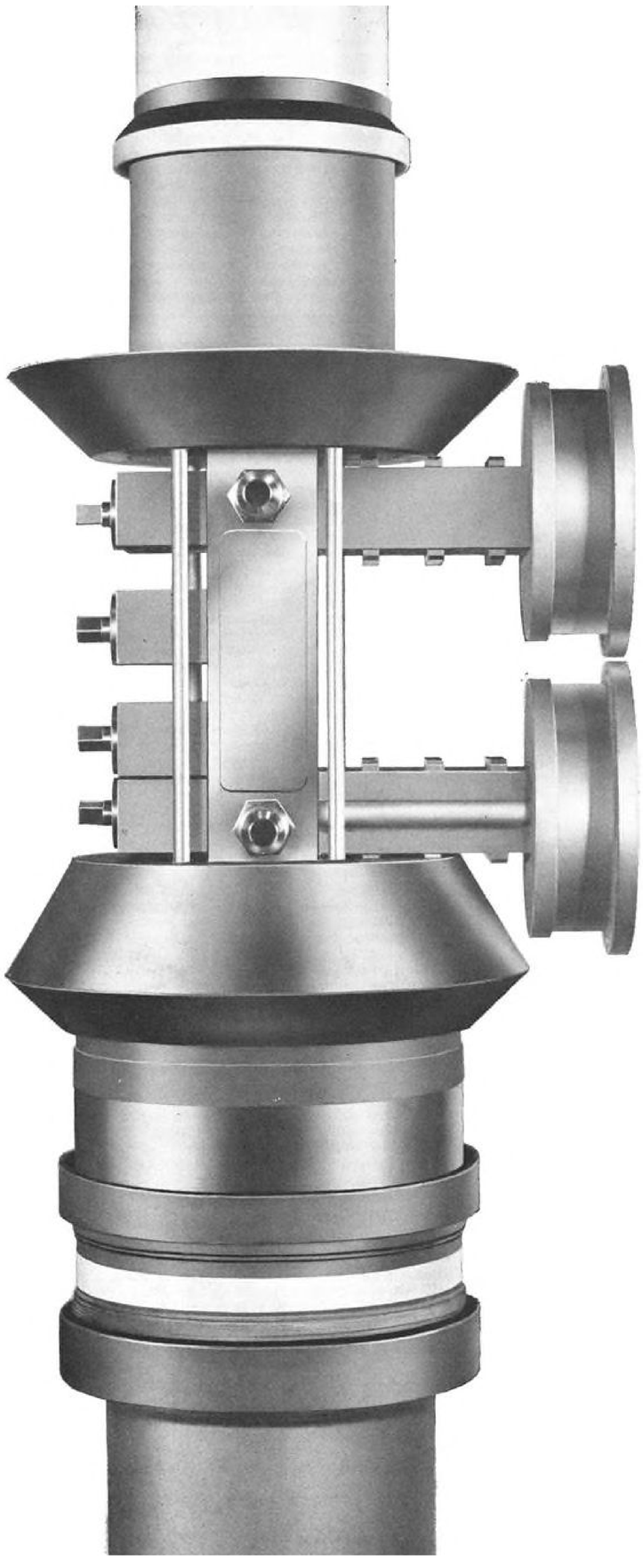
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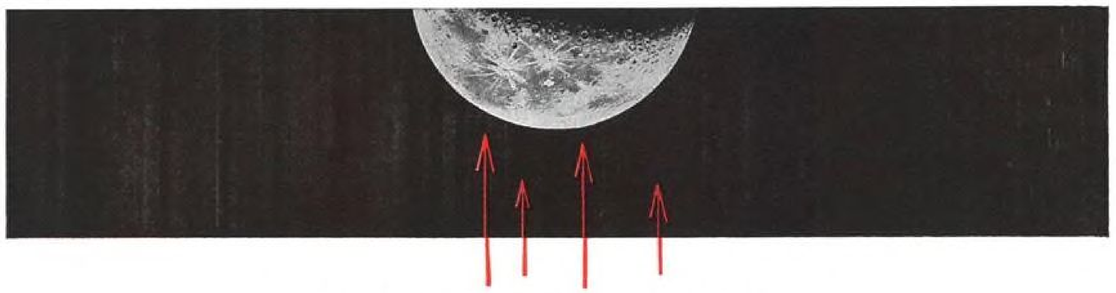
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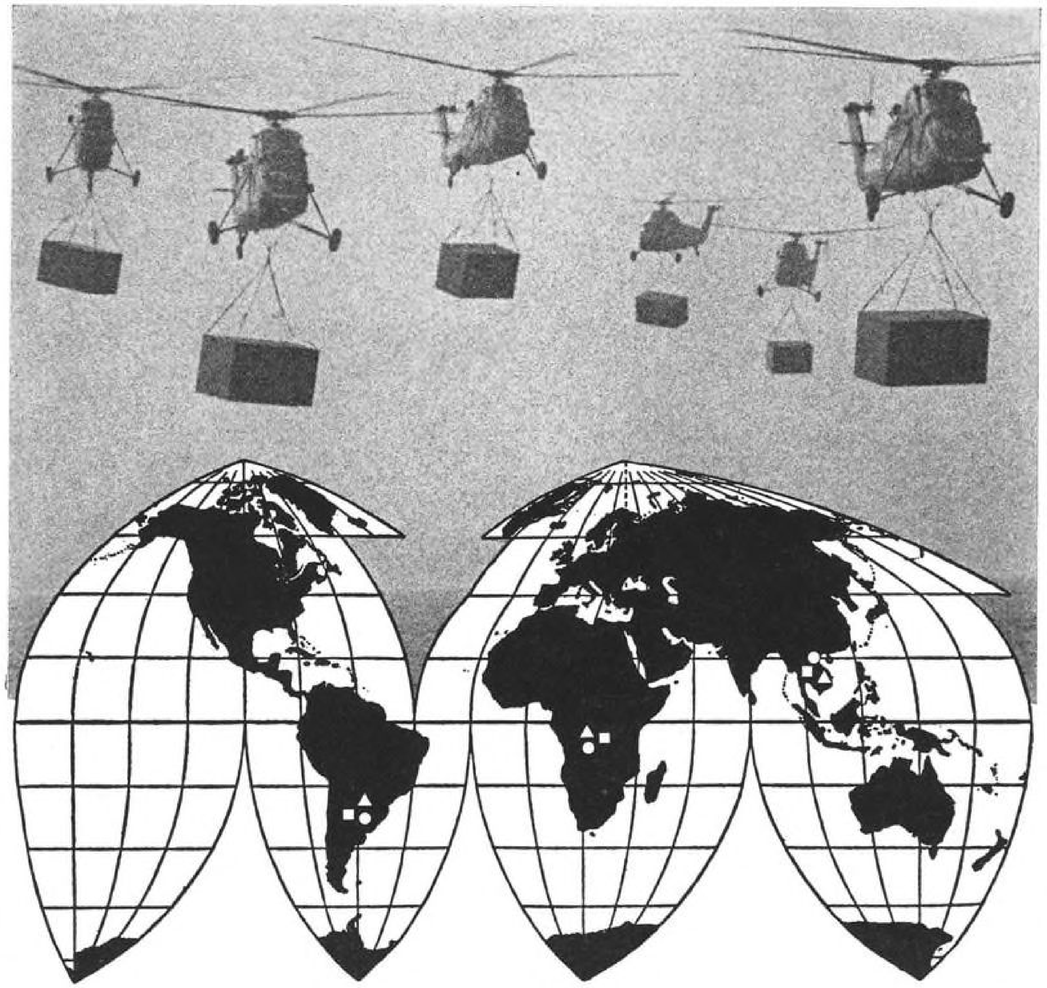
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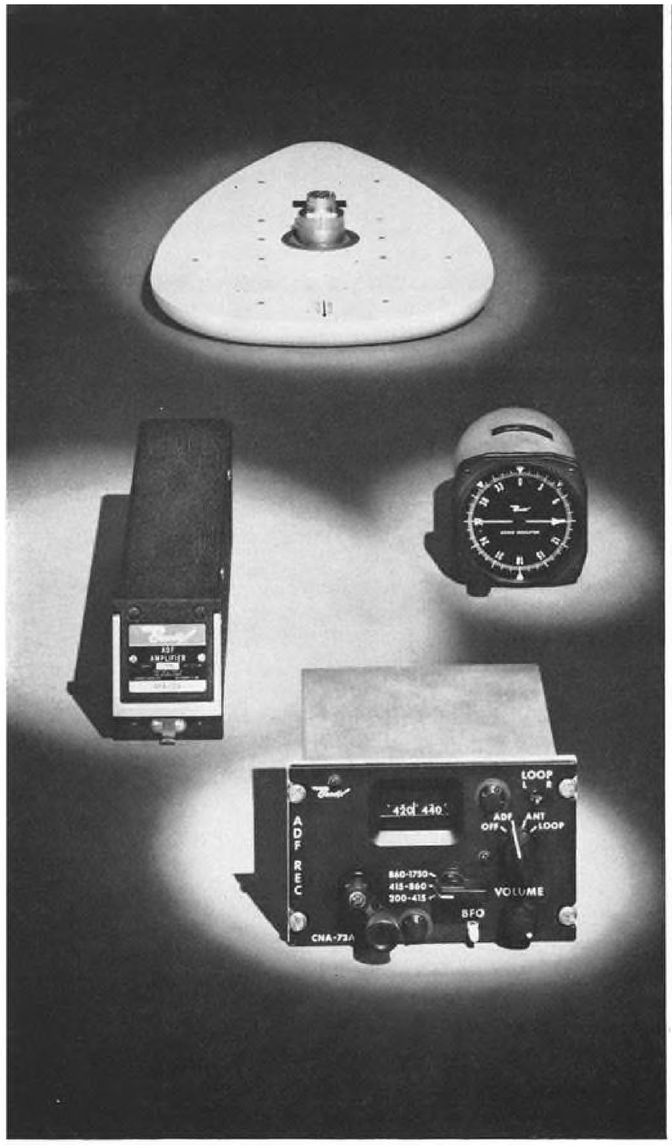


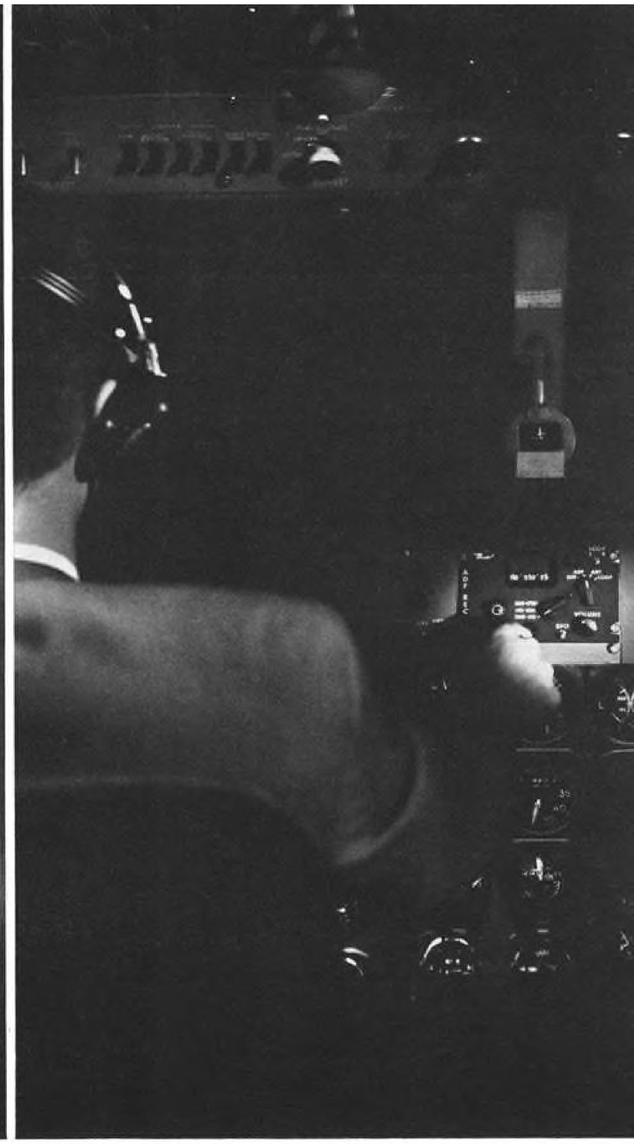


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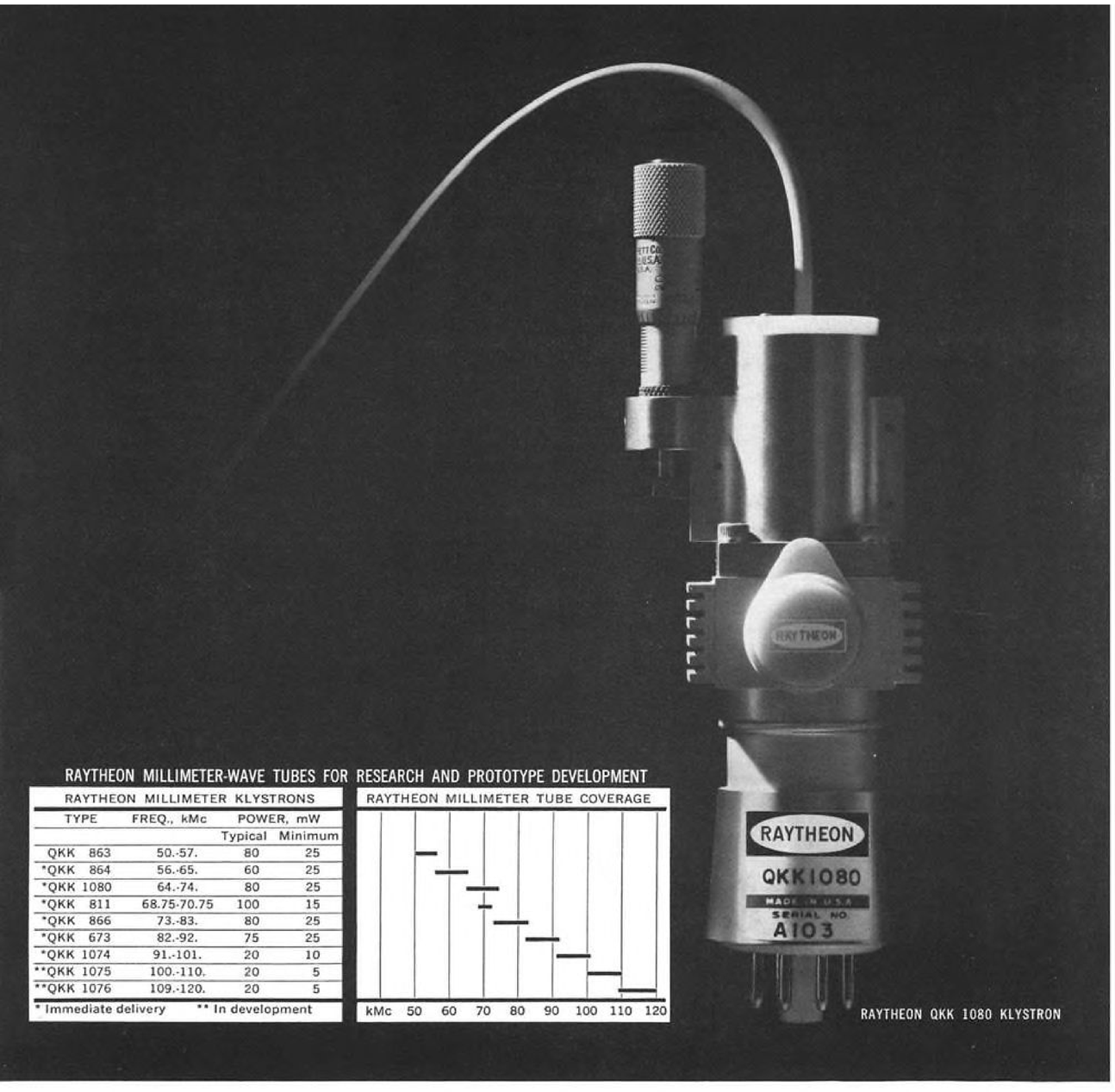
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COVER: Kaman Aircraft Corp.'s K-1125, currently being flown on demonstration flights for Department of Defense and military officials in Washington, D. C., features single boom empennage, cabin space for 12 troops or 3,000 lb. of cargo and instrument flight capability (AW Oct. 8, p. 102). Designated Huskie 3, the helicopter is powered by twin Boeing YT60-10 turbine engines which drive the twin rotors. (See p. 81 for additional photos and details.)

PICTURE CREDITS

Cover—P. B. Sperry, Kaman Aircraft Corp.; 27, 61—Aviation Week; 29—U. S. Navy; 30—Vertol; 39—Delta; 54, 55, 57—NASA; 59—USAF; 67—Airborne Instruments Laboratory; 70—North American Electronics; 72—Westinghouse; 78—Ron Appelbe; 81—Kaman; 84—Sikorsky; 92, 93—Goodyear; 95—General Dynamics/Astronautics; 97—U. S. Army; 98—Rolls-Royce; 102—(top & center) Cessna, (bottom)—E. J. Bulban; 103—(top) E. J. Bulban, (bottom)—Cessna; 107—R. J. Enstrom Corp.; 111—Piper Aircraft.



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EDITORIAL

Two Disturbing Trends

There are two disturbing trends appearing on the Washington scene that, if allowed to develop much further, will seriously imperil the ability of this nation to defend itself against any foe. The first is the widening rift between the top civilian secretariat in the Pentagon and the professional military leaders, and the second is the increasing weight of the political factor in what should be primarily technical decisions in contract awards for development of new weapon systems.

Almost any new Administration commences its Pentagon experience with a sharp clash between its top level civilian appointees in the Defense Dept. and the professional military men. This in itself is not unhealthy. In the past, this has always boiled down to a working relationship wherein both parties learned a good deal from the other's talents and experiences. This has not been the case with the current civilian leadership in the Pentagon. The initial rift, no worse than in previous administrations, has widened and deepened with the passing of the last two years until now it is an almost unbridgeable chasm that seriously threatens the functioning of our entire defense capability. The present civilian leadership in the Pentagon has an intellectual arrogance, military ignorance and a supercilious contempt for professional military men that surpasses anything in post-war history.

Military Professionals Ignored

There is an increasing tendency not only to make major policy decisions without any input from the professional, combat-hardened military operators, but also to execute purely military functions such as troop movements and tactical maneuvers without even letting the commanders involved know what is going on. When amateurs attempt to play soldier, the results can be disastrous.

The law of this land requires civilian control of the military and nobody that we know is questioning the wisdom of this policy. But what is disturbing many close observers of the Pentagon scene, as well as many of the players on its stage, is the increasing lack of any practical working liaison between these civilian leaders and the chiefs of military services. Just as it would be fatal to allow military leaders to set national policy, so is it also fatal to make military decisions aimed at executing national policy without the benefit of any solid professional military experience. And no matter how much it may be glossed over with official soothing syrup, this mutual contempt between the military and civilian leaders in the Pentagon exists and is opening a fatal crack in our entire defense posture.

The civilians, although their conduct has been unnecessarily arrogant, are not entirely to blame for this sad situation. For years, the military professionals rudely rebuffed any attempts to make them subordinate their inter-service rivalries at the highest levels where the stakes of rank and power were the greatest. They played the game for the color of their respective service uniforms and exhibited little inclination to resolve decisions on major military policy. They preferred to concentrate on building mutually exclusive military empires that served themselves better than the national welfare. The failure of the Joint Chiefs of Staff to make vital military decisions during the past decade created a vacuum into which civilian control has flowed far beyond its proper limits.

But regardless of which side is right or wrong, the national defense of this country cannot function with a bitter civilian-military split any more than it could with a tri-service split. It is high time that higher authority—and in this case nobody less than the President himself can do the job—exerted the authority required to get all of the warring camps in the Pentagon back to working in the national interest.

Expanding Political Factor

Politics have always had an influence in government spending and indeed they should. Politics are an integral part of the nation's business, not something that only becomes important when major elections loom. Other considerations being equal, a judicious distribution of the federal spending of the taxpayers' dollars can contribute to a healthy and expanding economy. However, during the past year the political factor in defense and space contracting has been multiplied to the point where it may already be outweighing the technical and management skills needed to produce the required weapon and space systems. If this trend continues, it can only lead to the production of shoddy weapons and flimsy space systems which will drain the national resources without producing any useful results.

We may be able to survive the results of poorly built schools, cracking highways and the other standard results of public works contracted for solely on political considerations. But we cannot survive the production of inferior and unreliable weapons that will be the inevitable product of this same philosophy. There is also a new trend in the announcement of defense awards that borders on chicanery. These announcements are so sparse in facts and detail and are distorted so badly as they grind through the political mill that they create a deliberately false impression of how much defense business is really going to any particular area. Some of the so-called defense contract awards, when announced by congressmen and senators, are cleverly designed to withhold the whole truth without actually lying, while a false and temporary optimism is generated just long enough to tide some embattled office seeker through a critical campaign.

This nation faces far too serious a menace all around the globe to be able to defend itself adequately with policies no more enlightened than ward politics or civil strife in the Pentagon.

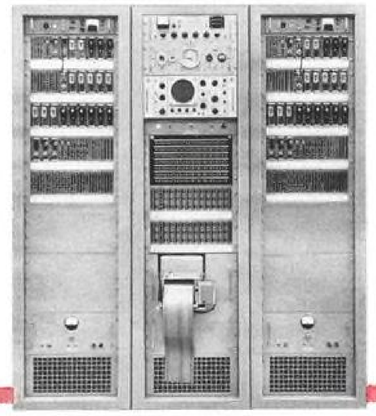
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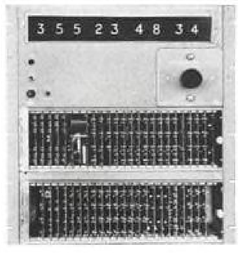
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Model 6190 Up to 8 serial time codes simultaneously... standard pulse rates... decimal display ... stability to 1 part in 10^8.

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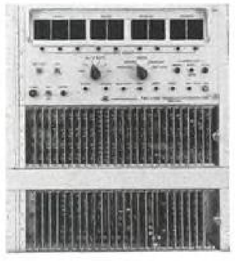
Model 6220 UNIVERSAL... translates all serial time codes to decimal display... parallel BCD output. Tape Search and Control Units (Models 6224, 6225, 6226) available for universal automatic tape search.

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10

WHO'S WHERE

In the Front Office

Dr. Norman F. Parker, executive vice president-administration, Autonetics, a division of North American Aviation, Inc., Downey, Calif. **S. Frederick Eyestone** succeeds Dr. Parker as executive vice president-operations.

Wayne D. Hudson, vice president and general manager, Nashville Division, Avco Corp., Nashville, Tenn.

A. Georges Fayet, president, Union Aeromaritime de Transport (UAT), French private carrier.

Dr. Harper Q. North, vice president-research and development, Thompson Ramo Wooldridge, Inc., Cleveland, Ohio, succeeding **Dr. Ralph P. Johnson,** resigning.

Herbert A. Finke, a vice president, Varian Associates, Palo Alto, Calif. Mr. Finke continues as general manager, Bomac Division.

George G. Hoberg, president, Monitor Systems, Inc., Ft. Washington, Pa., a subsidiary of Epsco, Inc., and **Thomas J. Cowgill,** vice president-sales.

William H. Graham, president, North Electric Co., Galion, Ohio, succeeding **William Tucker,** resigned.

Dr. Werner R. Kirchner, a vice president, Aerojet-General Corp., Sacramento, Calif., and assistant manager of the Liquid Rocket Plant.

Robert O. Case, Jr., vice president-engineering and marketing, Tamar Electronics Industries, Inc., Anaheim, Calif. Also: **Rulon G. Shelley,** vice president and general manager, Tamar Electronics Division, Gardena, Calif.

Robert P. Sumberg, manager of Avco Corp.'s Lawrence (Mass.) facility. Mr. Sumberg continues as vice president and controller of the Research and Advanced Development Division.

Julius R. Pascuzzo, vice president and general manager, General Instrument Corp.'s Radio Receptor Division, Hicksville, N. Y.

Franklin R. Dean, senior vice president for operations, Computer Control Company, Inc., Framingham, Mass.

Charles N. Oursler, assistant to the executive vice president and treasurer, American Airlines, Inc. Mr. Oursler continues as vice president of corporate planning.

William J. Waymack, Jr., secretary, and **Earl S. Sowers,** treasurer, Flight Research, Inc., Richmond, Va.

Honors and Elections

William Bresnick, an Air Traffic Control supervisor at the Boston (Mass.) Air Route Traffic Control Center, has been elected president of the Air Traffic Control Assn.

Donald McCracken, now with the Columbus Division of North American Aviation, received the Society of Experimental Test Pilots' Iven C. Kincheloe Award, which is presented to the outstanding test pilot of the year, for his development flying of the F4H while an experimental test pilot for McDonnell Aircraft Corp. Named Honorary Fellows of the Society: **Maj. Gen. Benjamin D. Foulois (USAF, Ret.)** and **Igor Ivan Sikorsky.**

(*Continued on page 114*)

INDUSTRY OBSERVER

► Scramjet (supersonic combustion ramjet) concept now appears to be favored over upper-air collection and liquefaction schemes such as the Marquardt Lace (AW Nov. 6, 1961, p. 59) or other cycles lumped under the generic term "aerospace plane." Current interest centers on using the Scramjet powerplant to accelerate a vehicle from low flight speed and altitude to orbital velocities at extreme altitudes. Specific impulse—thrust developed per pound of fuel burned per second—is about 4,000 at the hypersonic Mach numbers considered for Scramjet operations.

► Ryan Aeronautical is proposing a modified Fairchild C-123, using the Ryan system of boundary-layer control, for transport service with counter-insurgency forces. Proposal was made to Project Coin (counter-insurgency) management at Eglin AFB, Fla. Ryan BLC system uses both blowing and suction techniques (AW May 21, p. 87).

► Electric and magnetic fields have been used successfully in tests to change aerodynamic parameters at supersonic and hypersonic speeds where aerodynamic flow energy has been transformed partially into electromagnetic radiation. Air Force Systems Command's Aeronautical Systems Division is performing research in this area; Avco, Grumman and other industrial organizations are working on specific problems. Possible results include alleviation of aerodynamic heating, reduction of high-temperature corrosion, fluid orientation during weightlessness, variation of drag distribution for flight control of a vehicle, and reduction of required propulsion force.

► Cornell Aeronautical Laboratory has started work on a low-density shock tube which should be capable of shock velocities approaching 40,000 fps. Initial expenditure for the tube was approved recently by CAL.

► Expansion of the bomb impact detector system to include more than the present array of 99 strategic target areas is under study within USAF. System uses three detection stations in each target area to give instant notice and position of a nuclear detonation nearby. USAF rents the system from Western Union Telegraph Co. for Norad; annual rental is $4 million. Air Force also paid initial installation cost of $750,000.

► Optical maser (laser) radar, recently used by Massachusetts Institute of Technology scientists to bounce a high-intensity light pulse off the moon, soon will be used to make measurements of the stratospheric aerosol and the dust cloud about the earth.

►Athena will be the USAF's name for the NASA-developed Trailblazer research rocket built by Atlantic Research Corp. Until now, USAF has called it Space Test Vehicle. NASA has used Trailblazer for re-entry heating and re-entry radar signature studies in flights from Wallops Island, Va.

► NASA's Manned Space Flight Center is inviting proposals, due Nov. 5, for an electronic or mechanical attitude-sensing device to be used on space vehicles with rocket landing systems. Device probably is for the Apollo lunar-landing vehicle.

► Two separate capsules, planned as possible payloads for the five Ranger spacecraft just added to the lunar exploration program (AW Sept. 3, p. 17), have been proposed by Ford's Aeronutronic Division. One would carry a photographic system with a very slow scan rate to make detailed close pictures of the lunar surface. The other would carry several accelerometers, wired to the Aeronutronic spherical payload, which would be thrown onto the surface after impact of the sphere to measure hardness and other characteristics. Each capsule would have a 1-ft. diameter and weigh 92 lb., the same size and weight as the capsules flown on Rangers 4 and 5.

► Bell X-14C is designation of a proposed close-support aircraft, modified from the X-14 VTOL test vehicle. Modification includes a third lightweight, off-the-shelf engine in addition to the two General Electric J85 turbojets providing vectored thrust. Bell is also proposing the X-14A, which has been flying for five years, as a trainer for VTOL test pilots.

SILICOLOGY

REPORTING ON:

An Application of Silicone Technology

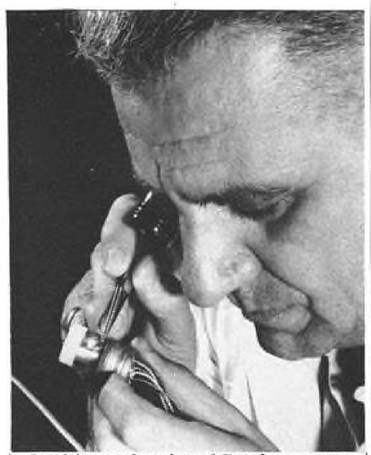
A gyro puts a missile on a pinpoint . . . and a silicone fluid smooths the way

The highly critical area of missile guidance provides an example of how UNION CARBIDE Silicone Fluids can meet your own precise specifications. In the Hawk I ground-to-air missile, flight control depends largely on the miniature rate gyroscopes strapped to the airframe. This location results in a built-in problem of unwanted vibration. And since the targets can be anywhere from treetop height to ten miles up, this problem is complicated by the range of temperatures through which the missile passes.

Since the guidance system must remain stable throughout, the gyros require a torsional vibration damper. Raytheon Company, manufacturer of both the missiles and their gyros, uses UNION CARBIDE's Silicone Fluid L-45, 1415 centistoke. A film of this fluid between the gyro's gimbal and external case prevents excessive resonance at frequencies near the gyro's natural resonant frequency. In this way, the gyro's response characteristic is shaped as desired in the frequency range of interest without affecting static response. And since L-45 maintains its viscosity over a broad temperature range, it functions with dependable uniformity.



Target for this missile may be treetop height or ten miles up. Silicone Fluids keep its gyro functioning despite extremes of vibration and temperature.



Precision engineering of Raytheon gyroscopes for guided missiles include a vibration-dampening silicone fluid that retains its fluidity below −55°F.

FITTING YOUR NEEDS

This excellent viscosity-temperature characteristic of L-45 is a primary reason for its usefulness as a torsional vibration damper in these missiles. For example, it provides these properties:

Coefficient of thermal expansion
9.7×10^{-4} cc/cc/°C.

Viscosity-Temperature Coefficient 0.62

$$\left(1-\frac{V(210°F.)}{V(100°F.)}\right)$$

In addition, it has a flash point over 600°F. and a pour point below −55°F. But this is only one application for silicone fluids, and UNION CARBIDE is capable of supplying formulations that will meet any specifications set for any job where these materials will work. Your own requirements may be just as severe as those involved in missile guidance; if so, you'll do well to talk to UNION CARBIDE.

THE KEY: PRECISE FORMULATION

The L-45 series of silicone fluids is available in a wide range of viscosities. Heat exchange devices, electrical systems, hydraulic systems, liquid springs, and other mechanisms are utilizing silicone fluids that are precisely engineered to the task. In their formulation and production, UNION CARBIDE maintains a rigid quality control program to provide the uniform performance properties on which you can depend.

SEE YOUR SILICONES MAN

With its pioneering background in silicones technology, UNION CARBIDE is constantly achieving new breakthroughs in these versatile materials. Your UNION CARBIDE Silicones Man, supported by extensive resources of technical capacities, is an authority in his field. Get in touch with him to learn what is being done in silicones today. Or, for further information, send us the coupon below.

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Washington Roundup

U.S.-U.K. R&D Plan

U.S. probably will finance half of a proposed $20-million British military research and development program for 1963 as a result of the recent conferences here between Defense Secretary Robert McNamara and his British counterpart, Peter Thorneycroft. Bulk of the money—$15 million—would be spent on development of the Bristol-Siddeley BS.100 vectored-thrust turbojet with plenum chamber burning. Final U.S. decision to back the BS.100 will be made after a demonstration of the plenum chamber burning and evaluation of this program, scheduled to be made later this fall. Pentagon currently has no military requirement for this engine but it is the powerplant for the Hawker P.1154, British entry in the NATO VTOL fighter competition.

Thorneycroft failed to get a McNamara commitment to support British vertical and short takeoff transport development under the OR 351 requirement. Conference also considered a plan for joint Anglo-American research and development program submitted by John Rubel, assistant secretary of defense for research and engineering, and Sir Solly Zuckerman, chief scientist of the British Defense Ministry, who accompanied Thorneycroft to Washington. Proposed program calls for an annual meeting between the Pentagon and British Defense Ministry research and development officials to finance programs jointly where one country appears to have a clear technical lead in a particular field under a "principle of complementarity." Aim would be to eliminate duplicate programs where they seemed "unnecessary or undesirable."

Vanishing Venus Shots

Inconsistency is still the order of the day in the government's release of information on Soviet space shots. National Aeronautics and Space Administration has resumed publication of the biweekly Satellite Situation Report, after missing two issues while high councils debated how much information it should contain.

Some minor changes—most of them helpful—have been made. But the report omits any mention of Russia's Cosmos 9 satellite and its unsuccessful Sept. 1 attempt to send a probe to Venus. It lists tracking information on Russia's unsuccessful Aug. 25 Venus probe attempt, but doesn't say what the purpose of the shot was. Russia itself announced orbital details on the Cosmos shot, and NASA Administrator James Webb recently released, with considerable fanfare, details on the two Russian Venus failures (see p. 27). The official explanation is that the report contains everything passed on to NASA by North American Air Defense Command's Spadats tracking center, subject to a clearance policy established by Asst. Secretary of Defense for Public Affairs Arthur Sylvester—and the Cosmos and Venus data were not included.

Forward Thinking

Defense Dept. policy pinch on what Air Force officials are allowed to say about space apparently is tighter than ever. Air Force has begun requiring headquarters approval for Air Force participation in symposiums and conferences, regardless of subject matter or who else is participating. But when "non-Defense Dept. personnel in industry or government" are attending and the meeting will involve "forward thinking" affecting the Air Force, approval of the Office of the Secretary of Defense must be obtained.

Some Pentagon security officer has finally admitted what everyone who has dealt with clearance of information has known for a long time. An aerospace company recently submitted for clearance a picture that had been cleared once before, many years ago, along with a proposed written history of a phase of the company's work. But the Defense Dept. now does not like to clear photos of missile interiors or components. The history was approved but the picture was stamped: "Publication is objected to on grounds of military security." The word "security" had been crossed out, and the word "policy" was written in its place.

Another RS-70 Study

Joint Chiefs of Staff have been asked by Defense Dept. to institute a study of Air Force's need for the North American RS-70. Congress voted extra funds for the aircraft earlier this year and Defense Secretary McNamara agreed then to have Air Force make a further study. He has never made public the conclusion of USAF's review, in spite of congressional criticism.

Army Maj. Gen. Andrew J. Goodpaster, who was staff secretary to President Eisenhower, is moving from the command of the 8th Army Division to become special assistant to Chairman of the Joint Chiefs of Staff Gen. Maxwell Taylor.

Workers of Cuba's Fumigation Trade Union were praised at a recent national meeting of aviation workers for their "titanic" job of assembling five Soviet-built An-2 crop-dusting aircraft in less than 10 days. This was the second lot of An-2s delivered to Cuba. The first five were assembled by Soviet technicians. Cuban mechanics and technicians were trained on the first five aircraft for a six-month period before they assembled the second batch.

—Washington Staff

Lunar Briefing Set for Top Science Aides

Moon base, supply system on White House agenda; both projects to require supplemental appropriation.

By Edward H. Kolcum

Washington—President's Science Advisory Committee was scheduled to be briefed late last week on the long-range U. S. plan for establishing a permanent manned lunar base and on the immediate project for a supply system that will be an integral part of both the Apollo manned lunar landing project and the lunar base program.

Neither the lunar base nor the supply system is funded, but National Aeronautics and Space Administration will request a substantial supplemental Fiscal 1963 appropriation for the supply system and for the Apollo lunar excursion module soon after Congress reconvenes in January (AW Sept. 3, p. 16). The lunar base project probably will remain in the study phase for several years.

Briefing on the programs was to be conducted by NASA, and although this was not on the formal agenda, the agency has been preparing for about six weeks to go into an exhaustive justification of why it selected the lunar orbit rendezvous technique for Apollo.

Although it has not previously been reported, President Kennedy requested and was given a briefing at the White House on the lunar orbit rendezvous technique by NASA several weeks ago, and he apparently concurs in the decision to use this technique.

Industry has been concerned in recent weeks that Dr. Jerome B. Wiesner's opposition to the selected approach is delaying the Apollo program—a delay reflected in NASA's failure to announce the development contractor for the lunar excursion bug by the Oct. 15 target date, which had already slipped from an original date of Oct. 1.

Wiesner, who is President Kennedy's science adviser and chairman of the Science Advisory Committee, has sidestepped opportunities to express his views publicly on NASA's choice for the mission since he called the lunar orbit rendezvous approach "no good" while Marshall Space Flight Center Director Wernher von Braun was explaining the technique to the President at Huntsville, Ala. (AW Sept. 17, p. 26). The President's request for a more complete briefing followed this incident.

Industry concern was caused by Wiesner's refusal to amplify his Huntsville remark—he told a public gathering recently that he gives his opinions only to the President—and by the fact that the White House has not disclosed the recent briefing to the President. Concern was compounded because the bug contractor had not been announced by late last week, and because some members of the scientific committee (see box) have opposed the emphasis being given to manned space flight.

One Administration official told AVIATION WEEK that no matter how strongly Wiesner and the committee feel about the NASA decision to use lunar orbit rendezvous, "they would have one hell of a time changing it."

The science advisory group was briefed on lunar orbit rendezvous at a meeting at NASA's Marshall Space Flight Center last August, shortly after NASA announced its decision to use this technique (AW July 9, p. 25). An observer at the meeting said no opposition to the decision was expressed at this time.

It was against this background that the NASA team, headed by Dr. Robert C. Seamans, Jr., associate administrator, was to brief the advisory committee last week. There was some expectation that the contractor for the lunar excursion module, who had been selected by NASA on Oct. 12, would be named immediately after the meeting. NASA said there is no technical reason for the delay in the announcement, but it would not comment on political implications (AW Oct. 1, p. 15). However, the great concern that existed in NASA three weeks ago over Wiesner's opposition apparently has been erased.

There is no united position in NASA on the need for immediate development of the lunar supply system as a critical requisite for the Apollo program itself, but the agency feels the system should be developed concurrently with Apollo so that it will be available in time for the lunar base.

NASA recently awarded $300,000 for three-month study contracts to Space Technology Laboratories, Northrop Corp. and Grumman Aircraft Engineering Corp. for the supply system (AW Sept. 10, p. 35), but the agency did not request hardware money for this project in the Fiscal 1963 budget requests. Although the system is of a lower priority than the bug, the agency would like at least $50 million in supplemental funds for each in order to start hardware programs this fiscal year.

The lunar base at this time is considered a long-range concept which will follow Apollo by several years. Although the concept is still nebulous, NASA is thinking generally of a base to sustain a crew of 18 to 20 for about a year.

Supply system integral parts are:

- **Spacecraft bus weighing 9,000 lb.** adaptable to a Saturn C-1B and able to carry a 1,500-lb. useful payload of supplies and instruments to the moon. The bus would have a growth potential to 90,000 lb., with a 20,000-lb. payload. This would be launched by a Saturn C-5.
- **Payloads for both vehicles,** ranging from crew shelters to bulldozers.
- **Propulsion stages,** including a new third stage for the Saturn C-1B, and landing stages for both 9,000-lb. and 90,000-lb. buses.

Science Advisory Group

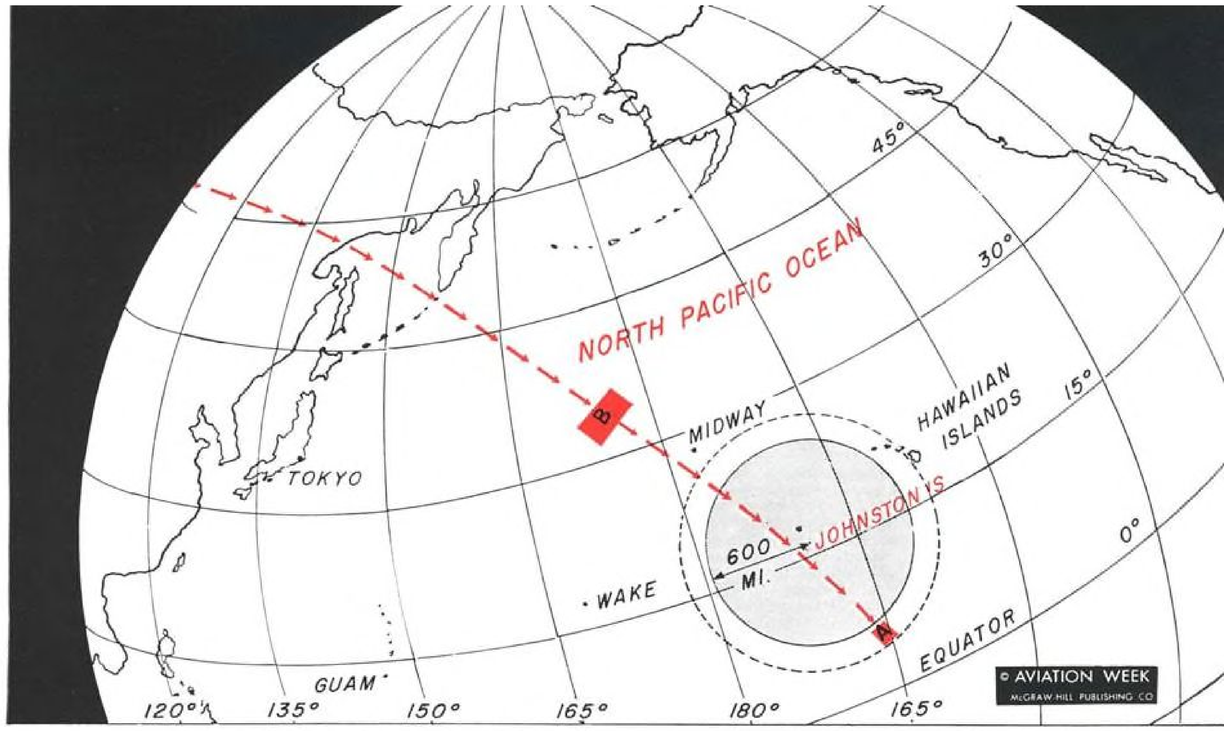
Washington—President's Science Advisory Committee, with Dr. Jerome B. Wiesner as chairman, consists of 16 permanent members and four consultants-at-large. In addition to Wiesner, permanent members are Drs. Frederick Seitz, John Bardeen, Robert F. Loeb, Alvin M. Wienberg, George B. Kistiakowsky, Wolfgang Panofsky, Harvey Brooks, Donald F. Harnig, John W. Tukey, Paul M. Doty, Jerrold R. Zacharias, Frank Press, Edwin R. Gilliland, Colin M. Macleod, Richard L. Garwin and Edward M. Purcell.

Consultants are Drs. James R. Killian, Jr., Edwin H. Land, James B. Fisk and I. I. Rabi.

Houston Award to IBM

Washington — International Business Machines Corp. has been selected to provide the real-time data processing complex for National Aeronautics and Space Administration's Gemini and Apollo integrated mission control center in Houston. This is one of two prime contracts for the control center. The other is systems integration (AW Sept. 24, p. 41).

First phase of the IBM contract, expected to cost $1 million, involves planning and program preparation for Gemini rendezvous flights. Total contract calls for establishment of an interim computer facility, establishing the requirements for a permanent computer facility, establishing the programs for all Gemini and Apollo missions, and computer installation, checkout, operation, maintenance. Systems integration contractor, not yet selected, will design, build and support the permanent control facilities.



CONFLICT between U. S. and Soviet test firings in the Pacific is indicated on map. Johnston Island test area (circular in shape) extends 600 naut. mi. at the surface, increases to 810 naut. mi. at 40,000 ft. (broken line). Rectangular areas in color—B and A—represent Soviet impact zones. Note that Zone A is in Johnston Island high-altitude restricted area and is where Russians have already begun rocket firing.

Soviet Space Activity Reaches New Peak

By Evert Clark

Washington—Soviet Russia is engaged in the most active series of space launchings since its program began five years ago. In seven months, it has successfully launched 10 unmanned scientific satellites, put Vostoks 3 and 4 into "group flight," failed in two attempts to send probes to Venus and begun tests of what it calls "new variations" of a multi-stage booster.

Cosmos 10 was launched Oct. 16, seven months to the day after the launching of Cosmos 1. On Oct. 16 and Oct. 17, Russia also fired test rockets about 7,500 mi. from its mainland to an area in the Pacific Ocean adjacent to the test area around Johnston Island which is used by the U. S. for high altitude nuclear explosions (see map).

The U. S. was scheduled to attempt another high altitude test from the island late last week after a Thor booster malfunctioned on Oct. 16 and caused the fourth failure in five attempts. The Atomic Energy Commission said Russia's rocket tests were not expected to interfere with the U. S. launchings.

Meanwhile, the Upsala Seismological Institute of Upsala, Sweden, announced that Soviet Russia has detonated nuclear devices with yields that total 400 megatons—twice the force of all those detonated by the U. S., Britain and France combined. In 15 recent tests, Russia has detonated weapons with a force of 230 megatons, an average of more than 15 megatons each, the institute said.

Four days before Russia announced the new series of rocket tests, it announced that a joint exercise of the Soviet Northern Fleet's rocket and air forces in the Barents and Kara seas had been extended until Nov. 10.

The rocket launchings into the Pacific may extend until Nov. 30 and will conform "with the plan of scientific research and experimental designing work for the further conquest of outer space," Russia said.

Three previous series of rocket test firings into the Pacific have been conducted by Russia. The first consisted of two shots, on Jan. 20 and Jan. 21, 1960. They were followed on May 15 of that year by the first flight test of a five-ton spacecraft—the predecessor of Vostok 1. This flight was unsuccessful, and Russia said the spacecraft had carried only "a dummy cosmonaut" as a passenger.

The second series also consisted of two shots, on July 5 and July 31, 1960. These were followed on Aug. 19 by the second five-ton spacecraft, from which two dogs were successfully recovered; and by two failures—on Oct. 10 and Oct. 14, 1960—in attempts to send probes to Mars.

Before the third series of tests occurred, Russia made three more known tests of the Vostok type of spacecraft and then successfully orbited Cosmonauts Yuri Gagarin in April, 1961, and Gherman Titov in August of that year in Vostoks 1 and 2. It also put two seven-ton spaceships into earth parking orbits in attempts to launch smaller probes to Venus. One shot was partially successful.

Following the first two Vostok flights, Russia conducted the most extensive series of rocket tests—eight shots, spread through September and October of last

Avco-Potez Venture

Paris—Jointly owned Franco-American aircraft engine company has been formed by private French aircraft and engine builder Henry Potez and Avco Corp.

Headquarters of new company, called Potez-Avco S. A., will be in the Paris area. Potez will build Avco's Lycoming piston engines for the European market and Lycoming turbine engines for world markets other than the U. S. and Canada. The two companies expect jointly to invest about $2.5 million over the next three years in the new company. The move parallels a recent agreement between U.K.'s Rolls-Royce and Continental Motors.

year. These are believed to have been aimed at proving a 1.2-million lb. thrust booster and its guidance capability.

Russia has never revealed weights of its Cosmos satellites, but estimates have ranged as high as 8.5 tons (AW Aug. 20, p. 28). Soviet broadcasts to East Germany at the time of last year's rocket tests said that Russia might soon launch spaceships weighing 16,000 to 20,000 lb. and carrying "entire space teams in flights around the earth or around the moon" (AW Sept. 25, 1961, p. 353). One broadcast said the spacecraft also could be used as "ships for the building of large, permanent space stations."

Cosmos 10 was the fourth Cosmos satellite to be launched at an inclination of about 65 deg. to the equator. The others have been Cosmos 4, last Apr. 26; Cosmos 7, last July 28—a few days before Vostoks 3 and 4 were launched at that same inclination—and Cosmos 9, launched last Sept. 27.

The six other Cosmos satellites have been launched at an inclination of 49 deg., an angle which Russia had never used before this series began. When the series was announced last March (AW Mar. 26, p. 24), Russia said the satellites would be launched from different cosmodromes.

This may mean that those launched at the 49 deg. inclination are fired from a different location than those launched at 65 deg.

Cosmos 10 had an initial apogee of 235 mi., perigee of 130 mi. and period of 90.2 min., roughly the same orbital parameters as Cosmos 9. Russia has described the Cosmos series as scientific satellites aimed at collecting physical data in space near the earth, in preparation for more manned flights near earth and to the moon and planets.

They have been launched on an average of one every three weeks. Even without the new rocket tests, the two Venus attempts and the flights of Vostoks 3 and 4, the Cosmos series would have made 1962 by far the most active Soviet space year.

Russia launched two satellites late in 1957 and only one in 1958. It launched three Lunik probes in 1959 but no earth satellites. In 1960, it launched three Vostok-type spaceships and the two Mars probes and conducted four rocket tests into the Pacific.

In 1961, it launched four Vostok-type satellites and attempted two shots at Venus. But in the seven months of 1962 from Mar. 16 until last week, it had launched 12 satellites, attempted two Venus probes and begun the new rocket test series. These figures include launchings that Russia has announced plus four failures that Russia did not announce but that the U.S. revealed (AW Sept. 10, p. 34).

In spite of the acceleration of the launching pace, Russia does not approach the U.S. in total numbers of space shots. Since Oct. 4, 1957, Russia has successfully launched 23 earth satellites, two lunar probes and two interplanetary probes. The U.S. has successfully launched 106 earth satellites and lunar and interplanetary probes since Jan. 31, 1958. Two of the U.S. interplanetary probes and one of Russia's were intended to be lunar probes but missed their target.

Failure of the fourth Thor booster in the U.S. nuclear test series apparently will not deter AEC from attempting a total of three high altitude detonations in addition to the July 9 shot which created an artificial radiation belt (AW Oct. 1, p. 24). The booster and its nuclear device, which was to have produced a yield of less than a megaton, were destroyed by the Joint Task Force 8 safety officer. There was no nuclear detonation, AEC said. Small radioactive fragments fell on Johnston Island but there were no injuries and no substantial effect on test operations was expected, AEC said. Destruction of a Thor on the launching pad earlier this year delayed tests for several weeks.

Three Soviet tracking ships on their way to the Soviet rocket target area were still about 100 mi. within the 600-naut.-mi. radius safety zone around Johnston Island when the Oct. 16 shot failed. After the first two rocket tests, Russia announced that the area south of Johnston Island would be free to sea and air traffic pending the announcement of further shots.

Differences Continue On Proprietary Data

Differences between industry and the Air Force over proprietary rights are "almost irreconcilable," according to Maj. Gen. W. Austin Davis, commander of the Air Force Ballistic Systems Division.

"Industry feels that the Air Force (primarily because of pressures to increase the competitive procurement of equipment and spares) borrows, begs or steals proprietary information from contractors," he said at the Aerospace Electrical-Electronic Exposition in Los Angeles last week.

"The Air Force, on the other hand, contends that having paid for development of an item or system, the government has bought the right to use the data concerning the item or system as it sees fit in the public interest, including competitive procurement," he said. Air Force feels that a contractor's true proprietary developments are recognized and protected and that tools are available to ensure this protection.

"The 'limited use' clause in a contract, for instance, stipulates that use of proprietary data covered by it will be limited to 'in-house' requirements," he said. "Also, when it is necessary for the Air Force to reprocure a commercial item proprietary to a company, we expect to pay a license fee for that right exactly as does any private citizen in the country."

ARS-IAS Merger

New York—Board of the American Rocket Society and the Council of the Institute of the Aerospace Sciences approved the plan for the merger of both societies last week.

Scheduled date for the merger, which still has to be approved by a membership vote, is Feb. 1, 1963. Ballots will go out to the members of both organizations at the end of this week.

In order for the merger to take place, more than 50% of the members of both societies have to cast a vote, and more than two-thirds of those votes must favor the merger.

Westinghouse Unites Atomic, Defense Units

All nuclear and electronic resources of Westinghouse Electric Corp. which are defense and space oriented were combined last week under a new Atomic, Defense and Space Group.

Charles H. Weaver, vice president and former head of the firm's Atomic Power Group, was named general manager of the new group, which reports to Executive Vice President John K. Hodnette. Commercial nuclear power work was transferred to the Electric Utility and Marine Group.

USAF Gen. Albert Boyd (ret.), former vice president and general manager of the Defense and Space Group, will serve as vice president for planning operations for the new group.

The reorganization combines Westinghouse's nuclear submarine powerplant and nuclear space work—such as that on the reactor for Nerva—with electronic work at the Defense Center in Baltimore, and at Aerospace Electrical Division, Lima, Ohio.

Other personnel changes include: Dr. John A. Hutcheson, formerly vice president-engineering and research, now vice president-technical operations for the new group; John W. Simpson, vice president and former general manager of the Atomic Power Divisions, now vice president-engineering and research; Dr. William E. Shoupp, formerly technical director, Astronuclear Laboratory, now general manager, Westinghouse Research Laboratories. Dr. Sidney Krasik, project manager for Nerva work, will continue to supervise that program but has also been named general manager, Astronuclear Laboratory.

Advanced Rendezvous Concepts Studied

Washington—Three study contracts to analyze and define basic problems involved in rendezvous of friendly spacecraft and optimum techniques for its accomplishment have been awarded by the National Aeronautics and Space Administration.

The six-month study contracts, ranging in value from $82,000 to $94,000, were awarded to Cornell Aeronautical Laboratory, Raytheon and Westinghouse Electric. Before the end of the current fiscal year, NASA expects to award a Phase Two hardware development contract, with competition thrown open to all qualified companies.

The new program, sponsored by the electronics and control directorate of NASA's Office of Advanced Technology, is aimed at developing advanced rendezvous technology which might find use in Apollo and subsequent spacecraft. It is not intended for use in the Gemini, whose rendezvous radar is under development by Westinghouse.

Although techniques coming out of the study possibly might be used in military rendezvous-for-inspection applications, the three NASA contractors have been told to assume that both spacecraft are cooperating in the operation, or at least that the target vehicle is not opposing the maneuver, as might be the case in military operations.

Selection of the contractors, chosen without a formal competition, was based largely on unsolicited proposals received from the companies plus their previous experience in airborne intercept and missile guidance, according to Dr. Albert J. Kelley, NASA's director of electronics and control.

In addition to supplying the rendezvous radar for Gemini (see p. 72), Westinghouse is building the radar used in the USAF's Satellite Inspector (Saint) as a subcontractor to Radio Corp. of America, and has long been a major supplier of airborne intercept radar to the Navy. Raytheon has specialized in Doppler radar for guidance of its Hawk surface-to-air missile and developed the guidance for the Sparrow 3 missile.

Cornell also has been involved in missile guidance development for the Lacrosse missile and in other programs. NASA also was anxious to have a nonproducer of hardware in the study phase since its views might be less oriented to existing equipment techniques.

Each of the three Phase One contractors will prepare two reports when its study is complete. One will deal with the definition of the basic rendezvous problem while the other will cover possible solutions expressed in analytical block-diagram form.

Copies of these reports will be distributed to all companies which are invited to bid for the subsequent phase of hardware development. Because the studies may develop techniques of military value, the reports probably will be classified, NASA has indicated. The principal emphasis in the analytical solution portion of the study will be on the sensors to be used, rather than the computer and thrust generating portions of the system. The three contractors also have been told to consider the requirements of lunar and planetary landings with the view to using rendezvous sensors as a radio altimeter or ground-speed sensor during such landings.

Dr. Kelley said that the rendezvous problem and its solution is the highest priority program in his directorate. Techniques and equipments planned for Gemini and Saint necessarily were adaptations of systems developed for aircraft interception because of time limitations.

Despite many similarities, there are important differences between intercepting an enemy bomber and rendezvous with a friendly spacecraft, Kelley pointed out. Where the former is a "hard-intercept," the latter is "soft" and more leisurely.

NASA concluded that a fresh look was needed at the basic rendezvous problem, freed from the restraints of meeting a specific operational date and using available technology.

The second half of the current six-month study programs is to provide a "complete definition of the subsystem parameter values and equipment characteristics that will provide an optimum solution to the [rendezvous] system problem," according to the civilian space agency.

"Consideration of the state-of-the-art should be withheld as long as possible," the work statement says. "Some time is saved when state-of-the-art limitations are evaluated and applied as they are encountered in the analysis, but valuable information may be lost [as a result]."

Any company that would like to conduct a similar study with its own funds and submit a report to NASA for consideration along with the three funded contractors is welcome to do so, Dr. Kelley said.



Seaplane Tested With Hydrofoil System for Navy

Edo Corp., College Park, N. Y., is testing a Grumman/Coast Guard JRF-5 amphibian fitted with a supercavitating hydrofoil system for Navy's BuWeps. Single high-speed foil is mounted between ventilating struts below the aircraft's center of gravity, and two skis extend forward from the nose to stabilize the plane during takeoffs and landings and to prevent diving, should the foil be damaged or destroyed.



FIRST FLIGHT PHOTO of the Boeing-Vertol CH-46A Sea Knight medium assault helicopter shows there is small external configuration change from the Vertol 107. Rear pylon is longer because of mounting of an auxiliary powerplant at the rear behind the main engines, and intake shapes are modified slightly because of duct heating and addition of a particle separation system. On the ground (left to right) are a Canadian Vertol 107 with large sponson tanks, an HC-1A development helicopter, three CH-47A (HC-1B) Chinook test ships and New York Airways fifth 107 now undergoing test flight.

Vertol Flys CH-46A Assault Helicopter

By William H. Gregory

Philadelphia—Boeing Vertol CH-46A Sea Knight medium assault helicopter for the Marine Corps made its official first flight here last week, a year from the contract signing but eight weeks behind its program schedule.

As reprogramed, Vertol plans to absorb the slippage and meet the original date for beginning of Board of Inspection and Survey trials at the Patuxent River Naval Air Test Center in June, 1963.

Demonstration aircraft, No. 2 of three off the line so far, had approximately 8 hr. flight test time prior to the display, half of which was flown with the folding blade system required for operation from aircraft carrier-type assault ships—LP-2s or LP-4s.

First helicopter off the line went into tie-down test and the third was sent to Republic Aviation Corp. as static test subcontractor. Flight test on the No. 2 helicopter has reached primary mission gross weight of 18,700 lb. and speeds of 100 kt. with the folding blades. Installation of the total automatic folding system circuity is not complete, so blade folding was demonstrated on a test stand and not on the aircraft.

Marine officers were not unduly concerned over the slippage since they felt Vertol's schedule was optimistic to begin with. They considered holding the official first flight demonstration—a program milestone in Navy-Marine aircraft procurement—a year from the contract signing as a significant achievement even though Vertol had the development knowledge of its Vertol 107 program to draw on.

The helicopter, designated HRB-1 by the Marines before Defense Dept. revised military aircraft designations, is procured through the Navy Bureau of Weapons and is the first helicopter BuWeps has bought from inception on fixed-price contract.

Vertol as a result has been faced with program definition problems in addition to a tight program schedule, especially in the area of technical manuals, whose contribution as a cost item is becoming more widely appreciated.

Weapons Readiness Analysis Program (WRAP) requirements also are a major definition problem because the CH-46A is the first helicopter to include this new Navy maintenance package system and is farther along in it than any of the four fixed-wing aircraft which also will use the system.

Basically, the WRAP system calls for providing various card-file maintenance instruction packages by the contractor designed for various unit levels. Each package is to contain step-by-step maintenance instructions for the particular command level involved and also will specify the manpower skills required in detail to carry out the instructions in the package.

Because of definition problems, Vertol has been faced with absorbing unforeseen short-term costs. Terms of the contract were designed, however, to provide for such costs over the long haul. Vertol agreed to share substantially in development costs when the program was awarded.

Slippages in the program have stemmed from two general causes: delay in release of drawings to production and delays in receipt and qualification of components and parts from subcontractors. An example is the redesign of part of the engine start system because of failure of a geared shaft to operate properly.

The Marine aircraft, designated the Vertol 107-2 in its commercial versions, has generally the same external configuration as the Vertol 107 twin-turbine helicopter in service with New York Airways. Powerplants are a pair of General Electric T58-8B free-turbine engines with a 30-min. military rating of 1,250 shp. and normal continuous rating of 1,050 shp. at 19,500 rpm. The -8B engines are the current production version, and incorporate an auxiliary sump for the No. 2 bearing that was added with the -8A version and in addition an automatic start control system and associated piping.

Folding of the blades, a major external change from the 107-1, is accomplished by addition of a second hinge at each rotor blade root which acts as a pivot point. An electric motor and actuator system developed by Curtiss Division of Curtiss-Wright Corp., Caldwell, N. J., is fitted in each hinge.

Each of the two three-blade tandem rotors must begin the cycle from a set position, and activation of the system from the cockpit rotates each rotor to the proper position. All blades fold back along the centerline, and the varying amount of travel required for each blade is controlled by hinge stops. When the stop is reached, the electric motor stalls out, eliminating need for a shut-down switch.

Dynamics of the folding system have been tested in flight and on a test stand by simulated weights and by using the actual system, but qualification of the folding mechanism itself, requiring 5,000 cycles, is in early stages.

Other changes in the internal and external configuration:

• **Particle separation system** in the engine inlet. This system basically is a series of small traps on an inlet centerbody that Vertol says will effectively bleed off foreign objects, especially sand particles that have proven especially troublesome in the foreign-object category. Requirements of this system and inlet duct heating for all-weather operation have brought minor changes in engine duct configuration. Power loss from the separator is given by Vertol as ½%. Loss from inlet screens, like those used by New York Airways and which the Marine helicopters may be equipped with, is ¾%, Vertol says.

• **Auxiliary powerplant**, a Solar Aircraft P-7 turbine which provides self-starting capability and power for folding and unfolding the rotor blades. Mounting of the auxiliary powerplant in the rear rotor pylon meant some lengthening and alteration of the fairing contour.

• **Integral hydraulic starter** which spins the auxiliary powerplant up to 80% rpm. for start. The auxiliary powerplant, in turn, operates an a.c. generator and a hydraulic pump for restoring hydraulic pressure to an accumulator for the next starting cycle and pressurizes the utility hydraulic system. Utility hydraulic system has 3,000 psi. capability for starting, operation of the rear ramp and door, cargo winch and blade positioning for folding. Two separate 1,500-psi. hydraulic control systems are used, as on the 107.

• **Modified electrical system** which uses two transmission-driven 40-kva. a.c.-d.c. brushless generators developed by Leland Airborne Products, a division of American Machine and Foundry Co. The system is simpler, 50 lb. lighter, more flexible and has greater load capacity than the 107 system.

• **Integrated cargo handling** system permitting loading or unloading by one man of palletized cargo or wheeled vehicles. The cabin floor is stressed for

Chinook Management System Reorganized

Boeing's Vertol Division has reorganized its Army CH-47A (formerly HC-1B) Chinook program management system following a two-week visit by an Air Force Systems Command Program Management Survey team. Air Force manages the program for the Army and sent in the team because of program slippages, which now leave the helicopter about a year behind schedule.

Both Vertol and Air Force feel positive action has resulted from the survey, although full effect cannot be determined yet. Vertol also is making suggested changes in the industrial engineering area, which includes production methods, tooling, value engineering, etc.

Change in the program management stresses strengthening the program manager's office and not personnel changes. The program manager, who formerly had only an assistant, now has a representative from all major functional areas as part of his staff.

The new system is not a full project system that cuts across company functional lines like systems used on some high cost weapon system programs, but rather represents a matrix of the two. Vertol now is in process of adopting the same system for its 107 program management, which includes the Marine CH-46A.

One problem, which has become a common one in the defense industry, is getting an accurate fix on the program's real status. This entails measuring not only money spent and progress made but determining how much progress should have been made for the money spent and time involved. Vertol is seeking improved techniques in this area.

Chinook problems appear to stem partly from the impact of major programs like the Chinook and the Marine CH-46A on Vertol in the last two years after the company had dropped down to an employment of 1,700 persons in 1958-59 following phase-out of the H-21. Employment now tops the 6,000 level.

Chinook program also called for living with a new way of development, in that prototypes were dispensed with to compress lead time. When development problems arose—for example, in qualification of upper control system components or in redesign of the transmission to accommodate the increase in rating of the Lycoming T55 engine powering the helicopter to 2,200 shp.—delays resulted and a substantial fund overrun developed.

A $4-million contract reported last week for Vertol by Sen. Joseph S. Clark (D.-Pa.) reportedly represents final funding of the overrun. Continued funding of the program is expected.

Vertol has completed the 11 test helicopters called for by the original contract and now is ready to roll out first production ships. Helicopters are expected to be delivered to Army operational units next spring following completion of Air Force pilot evaluation, expected this fall, and Army user trials at Ft. Rucker, Ala., that will begin following the Air Force tests. Component 150-hr. qualification has been completed, Vertol said.

Expansion of its facilities also is under way by Vertol—all company-funded. A new engineering building and a blade manufacturing building are occupied or will soon be occupied on a 290-acre site near the Philadelphia International Airport.

Future plans call for moving flight test operations from the airport to the new site and erection of a new manufacturing building. Vertol's present company-owned plant at Morton, Pa., may eventually become wholly a research and development facility.

Problems in the Chinook program figured in the Air Force decision to buy six Sikorsky HSS-2 helicopters as interim SOR-190 aircraft to support Texas Tower operations this winter off New England (AW May 7, p. 68). Air Force now has three aircraft bailed from the Navy for this mission, and these may be purchased as part of the interim buy.

No contract had been signed with Vertol, though it had been named as winner of the SOR-190 competition last summer about a month before the USAF team arrived, and long-range future of the program is still not clear.

Marine CH-46A Helicopter Performance

	NASA Std. Atmosphere
Gross weight—primary assault mission	18,700 lb.
Weight empty	11,701 lb.
Useful load	6,999 lb.
Payload—primary assault missions	4,000 lb.
V_{cruise} at sea level (takeoff gross weight less 20% initial fuel)	130 kt.
Hover ceiling out of ground effect military power (takeoff gross weight less 10% initial fuel)	6,500 ft.
Minimum level flight speed (takeoff gross weight less 40% initial fuel, one engine inoperative, sea level)	45 kt.
Rate of climb	
Forward at normal rated power at sea level	1,540 fpm.
Vertical at military power at sea level	1,290 fpm.

300 lb./sq. ft. and is fitted with rollers for cargo pallets and treads for wheeled vehicles.

Flight demonstration included hover, sideways left and right and backwards flight and vertical climb to 200 ft. at a 1,700 fpm. rate of climb. The aircraft made a single-engine flyby on one engine at 90 kt. IAS and two-engine flyby at 130 kt. IAS. One flyby also was made at 110 kt. with the rear ramp open. Rapidity of the self-contained start system was demonstrated. In connection with starting, the helicopter developed a form of ground resonance, bouncing on the nose wheel during early rotor spin in the 20-rpm. range. The oscillation disappeared quickly as rotor speed increased.

Marine Corps is buying the CH-46A as one of three classes of helicopters to replace its piston-engine helicopter fleet to meet vertical envelopment concept requirements. The light Bell HU-1E, Marine version of the Army HU-1B, expected to go into production next month, will replace Kaman HOK helicopters and Cessna OE (L-19) fixed-wing reconnaissance aircraft now operated together in observation squadrons. The CH-46A will replace the Sikorsky HUS- (S-58), and the new heavy assault helicopter just awarded to Sikorsky will replace Sikorsky HR2S twin-piston-engine helicopters.

Current CH-46A programing calls for delivery of the remaining 11 helicopters of the original batch ordered in the 12-month period through November, 1963. Bench and qualification tests are on schedule and the first 50 hr. of tiedown testing is completed. A 150-hr. tiedown test phase will begin within a week or two, and a final 250-hr. tiedown test is to be completed by April, 1963.

Navy Preliminary Evaluation will begin at the Vertol plant late this year, and Phase Two of this Evaluation is scheduled for February, 1963. Board of Inspection and Survey trials are due in June, and the Fleet Introduction Program (FIP)—with Marine Air Group 26—in the fall. First deliveries to squadrons are planned for early 1964, and the Navy Aviation Supply Office will take over full logistic support responsibility from Vertol in mid-1964.

CH-46A program falls under the over-all 107 program at Vertol. This program also includes:

- **New York Airways** commercial program. Ship No. 5 for New York Airways now is flying at Vertol, but some uncertainty exists over whether NYA will take delivery because of subsidy considerations (AW Sept. 17, p. 41).
- **Japanese license program.** Vertol has delivered three ships to its licensee, Kawasaki Aircraft, and will deliver major components for seven more through the middle of next year.
- **Royal Canadian Air Force** order for six ships. One is flying now at Philadelphia and another is coming off the line with deliveries due next year. These are fitted with oversize sponson fuel tanks providing 900 more gallons (AW July 16, cover) and were expected to be bought by the Air Force for its Specific Operational Requirement 190 helicopter. Canadian army also may order the 107.
- **Swedish order** for nine, to be used as anti-submarine warfare aircraft. Deliveries are scheduled to begin March, 1963. Swedish version will be close to the Marine version, but will not have folding blades.

Armed Helicopter Study

Army is studying requirements for a fighter helicopter with speeds of 160-200 kt. as an escort for the Vertol CH-47A Chinook and for assault missions, and may seek an industry competition soon.

Army interest was strong in Bell Helicopter Corp.'s Warrior or HU-1F proposal, an armed, advanced HU-1 that utilizes a tiltable rotor—about 5 deg. travel—and a stub wing for providing maximum speed in the 160-kt. range. Bell has shown a mockup of the proposal to Army personnel.

Proposals and interest on the part of other helicopter companies since have increased likelihood of a competition.

Defense to Improve Technical Data Flow

Washington—Steps to strengthen the role of the Armed Services Technical Information Agency in acquiring technical information and disseminating it throughout the Defense Dept. were initiated last week.

The action came after Sen. Hubert H. Humphrey (D.-Minn.), chairman of a Senate Government Operations subcommittee, claimed that duplicated research and mishandling of information has cost the nation $1 billion in wasted effort.

Concern for the "generally disorderly state" of Defense Dept. efforts in this field was voiced by Roswell Gilpatric, deputy secretary of defense. He ordered Dr. Harold Brown, director of Defense Research and Engineering (DDRE), to coordinate a study in conjunction with the assistant secretaries for installations and logistics and public affairs and the director of the Defense Intelligence Agency. The study would "develop a comprehensive DOD policy governing functions, organization and operation of an integrated DOD scientific and technical information program."

Key to the solution of the problem lies in rewriting the mission statement of the Armed Services Technical Information Agency. At present, the agency, which is operated by the Air Force for the Defense Dept., cannot require submission of information unless a request is received for it.

As a result, the agency is receiving only an estimated 5% of the reports it should. These reports originate in a variety of activities and laboratories and cover every facet of the physical and electrical sciences. Requiring automatic submission of reports will give the agency a complete library, increasing its effectiveness.

The agency's users are procurement agencies, laboratories and contractors.

Under the rewritten mission statement, which has been approved by the three services and is now awaiting the approval of DDRE, "aggressive dissemination" will be pursued and the agency's organization will be altered to allow it to coordinate more effectively the work of other information gathering and disseminating activities.

An office of Director of Technical Information will be established under Dr. Brown to serve as a focal point in developing and recommending policy and to provide coordination and review of over-all DOD scientific and technical information activities. The services and the Advanced Research Projects Agency will also designate representatives to act as focal points for the effort.

NASA Considers Use of Centaur As Titan 2, Saturn Upper Stage

Washington—Centaur is being considered as an upper stage for Titan 2, Saturn C-1 and Saturn C-1B boosters for advanced payloads as well as for its primary Atlas-booster application in the Surveyor mission. Decision on expanding Centaur to these advanced missions depends on National Aeronautics and Space Administration's success in solving what it considers the six most critical problem areas it has identified in the program.

These are the key points in a NASA report to the House space committee on the agency's re-evaluation of Centaur, which also lists the agency's reasons for accelerating the Centaur program and shifting its management to Lewis Research Center from Marshall Space Flight Center (AW Oct. 8, p. 40).

The report is signed by Dr. Hugh L. Dryden, deputy NASA administrator, and it confirms that continuation of the Centaur program will require total funding of $100 million in Fiscal 1963.

Vincent L. Johnson, Centaur program manager, said previously that NASA would increase the Centaur budget over the $67 million in the authorization request.

These are the reasons given by NASA for continuing the Centaur program:

- **Use of Centaur on a Titan** and Saturn upper stage would cut in half the cost of a heavy payload launch vehicle made up of all-Saturn stages. NASA is studying the application of Titan-Centaur and Saturn-Centaur for heavy orbiting observatories and synchronously-orbiting communications and weather satellites.
- **Atlas-Centaur** would be a standard vehicle for a large number of Surveyor payload launches to obtain scientific and engineering data for the Apollo manned lunar landing mission. The unmanned Surveyor (AW Oct. 8, p. 77) will be launched "no later than early 1965," according to the report.
- **Centaur development** would advance the technology of liquid hydrogen propulsion systems.

The report says the program management was transferred to Lewis because of its background in liquid hydrogen work dating to 1950 and a management capability at Lewis that has not been fully exploited. Without responsibility for Centaur, the report says, Marshall can put its full efforts on the Saturn vehicle family.

Although it is not mentioned in the report, Marshall was a reluctant manager of the Centaur program and had recommended scrapping the Centaur vehicle.

The six critical problems faced by the program are:

- **Guidance system** requires additional development effort to achieve the required accuracy with good reliability.
- **Tank fabrication** will require better welding techniques, somewhat heavier metal in weld areas, and investigation of better steels for use at liquid hydrogen temperatures.
- **Separation of Centaur** from Atlas in flight requires further analysis and possibly some changes in order to achieve a sufficiently high probability of clean separation.
- **Redesigns of the nose cone** and insulation panels must be fully reviewed and tested to prove their capability to withstand the aerodynamic loads encountered. The redesigns were made after the first Centaur flight May 8 which ended 54 sec. after liftoff when the Centaur stage failed and the entire vehicle was destroyed.
- **Capability of Atlas Centaur** to carry heavy payloads under severe wind conditions must be analyzed in greater detail to assure adequate margins of safety.
- **Fabrication quality** on Centaur requires additional improvement to reach the level of quality control desired.

Apollo Spacesuit Contract Issued

New York—Contract authorizing the team of United Aircraft Corp.'s Hamilton Standard Division and International Latex Corp. to begin work on the spacesuit for Apollo crewmen has been let by National Aeronautics and Space Administration.

Delivery time for the first suit is 10 months from the contract date, which is Oct. 5. Contract totals $1.55 million.

As prime contractor, Hamilton Standard is charged with management responsibility of the over-all program and with development of the back-pack—life-support system which crewmen will wear during lunar explorations. Latex will fabricate the suit with Republic Aviation Corp. furnishing human factors information and environmental testing of the suit on a subcontract basis. Republic also has the capability for testing the back-pack system.

NASA selected the team from a field of about 15 bidders this summer (AW July 30, p. 13), but final award of the contract was delayed because the companies had bid as members of separate teams. Hamilton Standard bid with David Clark Co. as its subcontractor and Latex, also bidding as prime contractor, had Republic and Westinghouse Electric Corp. as its subcontractors.

NASA split the teams and awarded the prime and subcontracts on an individual basis.

Hamilton Standard and Latex then had to establish their working relationship before the contract could be finalized. Latex was allowed to keep Republic as a subcontractor.

Other companies submitting bids included North American Aviation, Ling-Temco-Vought, Northrop Corp.'s Space Laboratory, Bendix Corp.'s Eclipse-Pioneer Division, Litton Systems, General Electric in association with B. F. Goodrich, and Garrett Corp.'s AiResearch Division in association with Grumman Aircraft Corp.

The life-support system in Hamilton Standard's back-pack will include a heat exchanger and an oxygen supply. There also will be a two-way radio, for communications with the command module. The contract does not provide for a propulsion system in the pack, but a company spokesman said one could be included.

Apollo crewmen will strap the contoured pack to their backs prior to exiting from the lunar excursion module. The life-support systems will plug into outlets in each crewman's suit.

The suit, a combination support and restraint design, will be made of a rubberized fabric and will be engineered to protect the crewman from the moon's harsh environment. The final design is expected to closely resemble a suit shown by Latex early last year (AW Apr. 24, 1961, p. 33).

Unlike previous spacesuits, it will allow the lunar explorer greater mobility under full pressure, enabling him to walk with ease, climb ladders and even touch his toes.

Consideration also is being given to a self-contained radiation shield, probably to fit around the trunk of the spaceman's body. Water or saturated hydrocarbons probably will be pumped through a liner on the outside of the suit to provide protection during solar flares or during passage through the Van Allen radiation belts.

The suit previously shown by Latex could be donned by a spaceman unassisted in 4-6 min. It was tested through re-entry temperature profiles reaching 260F loads for 35 min. Cooling was provided by oxygen pressurization and a circulation system which removed carbon dioxide and provided moisture control. The suit had a pressure of 5 psi.

Research Groups in West Germany Advocate Increased Space Effort

By Cecil Brownlow

Geneva—Two West German industry-research organizations are advocating a two-pronged, four-year program designed to place West Germany among the European leaders in the space sciences. Plan, which could begin next year and would include man-in-space studies, is now under review by the Ministry for Atomic Energy.

While advocating a full range of research projects, the program would restrict immediate hardware to a limited number of projects within the present West German capability. One future facet would be the training during the four-year period of "no less than 3,700 scientists and technical men" in the various areas of space technology.

Drafted and submitted to the government as a joint proposal by the German Assn. of Air and Spacecraft Industries and the German Society for Aeronautics, the program plans a total outlay of approximately $233 million during the four years of its existence.

Primary purpose of the project, according to the two associations, "is to make it possible for the German Federal Republic to participate actively in the international work on space research and space travel developments."

Industry, under the plan, would have three specific objectives—"recover the technical lead achieved by other countries," implement a systematic working program "embracing the entire field of space travel as a basis for European and/or Atlantic cooperation" and provide new solutions to problems with a view of cutting costs.

To implement this, the sponsors of the program say that the West German industry during the four-year period should:

- **Expand upon proposals** already initiated, including assigned development of a third-stage booster for the planned launcher system under development as a multi-nation European program. In connection with this, the proposal urges further development work on chemical propulsion techniques based upon hydrogen peroxide or hydrogen fluoride since their efficiency "can still be substantially improved." Development of recoverable high-altitude research rockets also would be accelerated under this phase of the program.
- **Initiate a long-range** "pioneering" research and development program, including such long-range projects as controllable and recoverable spacecraft and space stations.
- **Construct development** and test facilities, including space simulators, that would be available for use by the industry as a whole.

Research projects would include:

- **Kinetics,** including high-altitude studies, boundary layer and cooling.
- **Flight mechanics and control,** particularly trajectory calculation, inertial navigation and high-reliability components.
- **Propulsion,** with research geared toward increasing the efficiency of liquid, semi-liquid and solid fuel combinations. Utilization of atomic energy for propulsion also would be considered.
- **Structural design,** strength and materials.
- **Communications equipment.**
- **Bioastronautics,** including simulated environmental tests of man in space.
- **Meteorology.**
- **Applied mathematics** in the fields of statistics, theory of probability, operational research, differential calculus, the LaPlace cosmological system and group theory.
- **Physics and chemistry,** including cryogenic temperature effects on materials and problems of weightlessness.

Program also urges a central data collection and information center for use by all interested industry and research facilities. This could be achieved, it says, by expansion of the present Central Aviation Documentation and Information Office to include space activities.

Sponsors of the project emphasize that outlays for the first year of the plan would be only $31.5 million, or approximately 0.04% of West Germany's gross national product as compared with the 0.06% to 0.08% France, England and Italy will channel into space activities next year under current plans. West German program, however, would gradually build to a total of $84.3 million for the fourth year.

In urging adoption of the plan, the sponsors of the program emphasize that "German participation in these projects is not a matter of national prestige or eagerness for scientific adventure . . . it has actually become a question of national existence since space technology exercises a powerful impact on all other technical sections and has a decisive bearing on the development of the entire German industry and of the over-all national economy."

Republic F-105F Order

Air Force has ordered approximately 140 two-seat F-105F fighter-trainer aircraft from Republic Aircraft Corp., Farmingdale, N. Y. in place of a number of single-seat F-105D versions of the Mach 2 jet fighter-bombers.

Republic said the aircraft has the same mission capability as the former single-seat version and at the same time will double as a trainer for the Air Force.

F-105Fs will be assigned to all units which now have earlier models of the aircraft. First production units are due next July. The F-105F is 31 in. longer than the D model and has a slightly higher vertical fin.

Aerojet IAM Contract Vote Expected Shortly

International Assn. of Machinists' members at Aerojet-General Corp. will vote Oct. 28 on whether to accept a new labor contract negotiated by company and union leaders in Washington (AW Oct. 15, p. 37). Eugene F. Marotta, business representative of Azusa IAM Lodge 1893, District 80, said the union negotiating committee is recommending "100%" acceptance of the contract.

Marotta termed the proposed contract the "best in the entire industry" and said outlook for acceptance is "very good." IAM members on Sept. 30 voted to reject an earlier company offer on recommendation of union locals.

Union shop was not an issue in Aerojet-General/IAM negotiations since the company already has a union shop. In addition to pay raises, the new contract reportedly offers an improved medical and dental program plus new provisions on seniority, promotions, vacations and jury duty allowances.

In another aerospace-labor situation, National Labor Relations Board is expected to complete tabulation late this week of votes in an election Oct. 19 on acceptance or rejection of a union shop for North American Aviation employes in United Auto Workers bargaining units in California, Columbus, Ohio, and Neosho, Mo.

Election is scheduled at General Dynamics' West Coast facilities Oct. 23 on whether employes in IAM bargaining units want a union shop.

Boeing-IAM negotiators continued discussion of issues other than those before a presidential fact-finding board in Seattle with federal mediators last week. Rohr-IAM negotiations continued at Riverside, Calif., and Lockheed-IAM negotiations in Los Angeles—both presided over by federal mediators. The union shop is an issue in all three of these disagreements.

At Douglas Aircraft Co., a contract offering a 5% pay raise and fringe benefits for 4,600 professional people belonging to the Southern California Professional Engineering Assn. was approved by association membership last week. Pay hike is retroactive to Oct. 1.

FAA Crop-Dusting Crash Study May Result in Safer Pesticide

Washington — Federal Aviation Agency's search for a cheap and far less toxic pesticide has produced several discoveries in the field of bio-chemistry that may lead to a major breakthrough.

For more than a year, a team of scientists working under Dr. Stanley R. Mohler, director of FAA's Civil Aeromedical Research Institute (CARI), has been studying why aircraft flown by skilled crop-dusting pilots crash so frequently.

Underlying this team's work has been the premise that poisons commonly used to spray or dust crops can and do accumulate within a pilot's body. This accumulation takes place at the lowest possible level, inside individual cells, where it is difficult to detect.

In seeking to learn more about this potentially deadly process, FAA researchers have pinned down what they feel are two fundamentally important bio-chemical facts:

- **Causal connection** exists between the buildup of certain toxic substances at the cellular level and the onslaught of sugar diabetes.
- **Buildup of poisons** within the cell interferes with the so-called phosphate bond reaction, which controls how fast the human body produces energy.

A family of chemical substances known as chlorinated hydrocarbons form the base of many modern pesticides. Although the molecule of a typical hydrocarbon pesticide is a complex chain of atoms, an infinitesimal portion of it gives the chemical its toxic quality.

To learn how this portion can be reshaped so as to render the chemical harmless to humans is a goal of FAA.

Chlorinated hydrocarbons kill insects by producing convulsion and they affect man the same way. In addition, they can penetrate the skin without benefit of cut or bruise. Often, they are toxic weeks after aerial application. Because of such dangerous qualities, U.S. agricultural authorities have sharply curbed the use of chlorinated hydrocarbons. As a result, many operators have switched to another group of chemical pesticides known as the high energy phosphates.

The phosphates lose their potency soon after application. Thus the public is protected from their harmful side effects, but crop-dusting pilots are not. According to Dr. Paul Smith of the Civil Aeromedical Research Institute, the phosphate pesticides have an effect similar to that of nerve gas, producing visual disturbance and then paralysis. As such, they are particularly hazardous to pilots.

To illustrate the problem's magnitude, in 1959—the last year covered by statistics—there were 5,000 aircraft and 4,000 pilots engaged in the U.S. crop-dusting industry. Together, they logged 900,000 flight hours and treated 51 million acres. During the same year, the 313 crop-dusting accidents reported to CAB claimed a total of 57 lives.

In 1960, there were 279 crop-dusting accidents and 39 lives were lost. Last year, 39 pilots died in 281 accidents.

Poison is the probable cause in at least 20% of all crop-dusting crashes, according to CARI, and probably is a contributing factor in at least one third.

New Rangers

Cape Canaveral—Five new spacecraft were added to the Ranger series last week by the National Aeronautics and Space Administration to provide support for the manned lunar landing program, as predicted by Aviation Week (Sept. 3, p. 17).

The added Rangers are intended to pick up slack in the unmanned lunar exploration program caused by delays in the Centaur upper-stage project. Centaur has been scheduled to carry the heavier Surveyor spacecraft to the moon.

The new Rangers, numbered 10 through 14, will be launched by Atlas-Agena D vehicles. Exact nature of the payloads has not been determined, but it is possible that Rangers 10-14 may carry either a photographic or a surface-measuring capsule (see p. 23).

Ranger 5 Launch

Cape Canaveral—Ranger 5 rough lunar landing spacecraft was successfully launched here Oct. 18 as the payload of an Atlas Agena B vehicle and was injected into an escape trajectory 32 min. after launch when over the east coast of South Africa.

Launch was at 12:59 p.m. EDT and impact was expected about 70 hr. later, or during mid-morning Sunday, Oct. 20. Jet Propulsion Laboratory, which is managing the project, was not able to confirm trajectory elements until about 6 p.m. Oct. 18, when both Johannesburg, South Africa, and Woomera, Australia tracking stations had Ranger 5 in sight and were to establish rates and attitude angles.

JPL confirmed the excellent performance of both Atlas and Agena B vehicles, operation of the two-way lock Doppler system and deployment of the solar paddles on the basis of data received by Johannesburg. Lockheed Agena stage burned 150 sec. after its first ignition, coasted 25 min., and then burned 90 sec.

Critical flight events which determined if the 755-lb. spacecraft met its objectives of obtaining television photographs and seismometer data from the lunar surface were acquisition of the sun and the earth; midcourse correction maneuver about 12 hr. after launch and then reacquisition of the sun and earth; a terminal maneuver to permit operation of the television system, and ejection of the seismometer capsule.

Midcourse correction is designed to place the spacecraft on a collision course with the moon, and is the same fundamental maneuver first used successfully in the Mariner 2 spacecraft, which is on a trans-Venus trajectory (AW Oct. 15, p. 30).

News Digest

USAF-Boeing Minuteman ICBM was destroyed by the range safety officer 8 sec. after launch from the Atlantic Missile Range Oct. 17 when it began to veer toward Cocoa Beach. A photographer was injured scrambling for cover, and flaming debris started a small fire in the nearby Jupiter launch area, damaging the missile and some ground equipment. On Oct. 12, a USAF-Martin Titan 2 ICBM flew 5,000 mi. down range in the fourth completely successful flight in six tests.

Exchange of 46,400 shares of each other's stock has been made by Pan American World Airways and National Airlines on a share for share basis. The exchange represents a 10% divestiture of the carriers' interest in one another by Oct. 28, as ordered by the Civil Aeronautics Board. The CAB has said all the carriers' holdings in each other must be divested by July 31, 1964. Pan Am and National exchanged 400,000 shares in 1958 when National was leasing Pan Am jets.

West German government is buying Beech 1001 piston-powered targets, with deliveries to begin early next year. U.S. Army Materiel Command will handle procurement. Model 1001 is in operation with U.S. Army as 1025 Cardinal and with U.S. Navy as KDB-1.

Aerojet 100-in.-dia. solid propellant motor, fired recently at Sacramento under Air Force's large rocket motor program, tested new methods of thrust vector control and ignition. Also evaluated was a new nozzle throat which, at the end of the run, experienced a burn-through at the point where the nozzle exit cone attaches to the throat. Peak thrust of about 300,000 lb. was attained during 90-sec. duration.

IATA Traffic Conference Near Stalemate

Airlines agree on fare increase need, but split on conditions and restrictions may force meeting to close.

By L. L. Doty

Widespread differences over details of proposed changes in international rates and fares again threatened to bog down the International Air Transport Assn. traffic conferences at Chandler, Ariz.

Although it is generally agreed that net returns to the airlines can be increased by boosting both passenger and cargo rates, representatives of IATA's international carrier members have been unable to settle on the conditions and restrictions which should apply to a fare increase. Lack of accord on these issues has forced previous traffic conferences into recess (AW Jan. 1, p. 28).

Chances are strong that the conference on cargo rates will end in recess and there is now some likelihood that the North Atlantic passenger fare conference will end without a decision. Here are key issues that blocked a settlement as of late last week:

• **Pan American World Airways** and Scandinavian Airlines System (SAS) asked that IATA carriers be authorized to reduce propeller passenger fares to the level now being charged passengers by Loftleider, Icelandic Airlines. This carrier is not an IATA member and has attained notable success in maintaining high load factors on its North Atlantic route with fares substantially less than those charged by IATA airlines. Pan Am and SAS also asked for authority to reduce fares even further should Loftleider drop its rates in order to keep its competitive advantage. Virtually all carriers are opposing this proposal.

• **The "malpractice" resolution,** designed to curtail tariff violations (AW Sept. 17, p. 38), has run into stiff opposition and is seriously retarding progress toward unanimous agreement on the general fare level. Under this resolution, three carriers which suspect a fourth carrier of committing a breach of tariff regulations could advise the offender that unless the violations were stopped, an open-rate situation could be declared in 15 days.

The drive for lower fares by Lufthansa German Airlines (AW Sept. 24, p. 38) failed because of lack of support from other airlines.

It is now apparent that virtually all international airlines came to the traffic conferences determined to raise rates, even though the general atmosphere of the IATA Annual General Meeting in Dublin (AW Sept. 10, p. 36) indicated a trend toward lower fares.

As of late last week, the traffic conferences on cargo rates were practically at a standstill. There is considerable disillusionment over the higher weight break points adopted last year but there is sharp disagreement over how the break points should be adjusted—or to what degree and in what freight categories they should be dropped.

About five days were spent in arguments over specific commodity rates resulting in only a few very tentative settlements. With these two basic issues still in a state of suspension, it is very unlikely that a tariff structure satisfactory to all carriers can be established. As of late last week, a composite cargo rate-policy meeting was called in hopes of developing some platform on which a tariff could be built, but feeling among delegates was that the move would prove fruitless.

Tendency in the cargo field is for higher rates. Proposed increases have ranged from 30% to as high as 50% over current levels.

In the passenger fare category, only KLM Royal Dutch Airlines showed signs of supporting the Lufthansa call for a fare reduction. A number of carriers wanted to hold the fare line, but when proposals for an increase of rates were placed on the floor, tentative agreement was reached unanimously and quickly.

As of late last week, the following increases had been tentatively agreed upon and probably will be the basis of rates passengers will pay in international travel beginning Apr. 30 when the present fares expire:

• **Group fares** will be increased by a token $10. However, privileges permitting "spontaneous" groups to take advantage of the group fare will be eliminated. Spontaneous groups are defined as 25 or more persons who have organized for a joint trip overseas without solicitation from travel agents or airline sales personnel. Groups which can prove they have been members of an established organization such as a club, union or association for six months or more still may qualify for the group plan.

• **Regular economy and first-class** fares will not be raised directly but revenues will be increased by reducing the round-trip discount of 10%, now available on all tickets, to 5%. Thus, the one-way fare will remain the same but the round-trip fare will be increased by 5%.

• **Full agreement on the 17-day** excursion fare had not been reached as of late last week, but it now appears that this promotional fare will be extended somewhat to meet public demands for rate reductions. The excursion fare is now effective between October and March, and it may be extended into April. Consideration has been given to revising the 17-day time limit to 14 days minimum and 21 days maximum. Another proposal calls for making the rate effective throughout the year with a 17-day limitation during on-season periods and a 23-day restriction during off-season periods.

ICAO Proposes Criminal Jurisdiction Rules

Washington—International Civil Aviation Organization has drafted new rules which may simplify the process of establishing legal jurisdiction over crimes committed on international flights.

Terms of a new agreement, which are being studied by ICAO members prior to ratification next year, call for all parties to recognize that prosecution of the offender will come under the jurisdiction of the country in which the aircraft is registered.

Wherever extradition treaties exist, they will apply as though the aircraft crime had been committed within the territory of the state of registration, the agreement provides.

New legal protection is also afforded pilots who presently have no international rules recognizing their right to restrain or arrest any person interfering with the safety of the flight. The current risk of a pilot being sued or prosecuted for such action will be removed by the agreement.

Lockheed, FAA Gather Runway Data

Washington—Production of the Lockheed C-141, a heavy jet freighter that can take off in relatively short distances, is forcing its manufacturer and Federal Aviation Agency to re-appraise the strength of runways at hundreds of smaller U. S. airports.

FAA now is updating its stress and strength data on the so-called dominant runway at about 75 large and medium hub airports, in response to a Lockheed request. A report containing these revised statistics is due next month. Meanwhile, Lockheed is beginning the slow process of collecting similar information on many lesser airports not to be covered by the agency survey.

Runway strength data on these airports is either not available or hard to obtain. Yet it must be had if the 315,000-lb. gross weight C-141 is to be operated at anywhere near peak efficiency as a domestic cargo transport.

C-141's main landing gear loading is 35,600 lb. per wheel at maximum takeoff weight, and 30,200 lb. per wheel when fueled to carry its design payload of 70,000 lb. for 2,000 naut. mi. It thus will exert a force on a given runway slightly greater than now exerted by long-range Douglas DC-8 and Boeing 707 transports.

But the C-141, even at maximum weight, can operate from runways of 6,000 ft., while the DC-8 and 707 usually require a longer takeoff run to meet FAA standards.

New Plan Would End FAA Effort To Develop Anti-Collision System

By Philip J. Klass

Washington—Federal Aviation Agency may end its efforts to develop an airborne anti-collision system. No Fiscal 1963 funds would be authorized for new programs, under a master development plan submitted to FAA Administrator N. E. Halaby.

If approved, the action will be a major reversal of agency policy stated by officials at the FAA-sponsored anti-collision system symposium in July (AW July 30, p. 51), and even more recently in the FAA report on its Project Scan survey of near-miss incidents during Fiscal 1962 (AW Oct. 15, p. 42).

In summarizing 549 near collisions in this period, FAA said it has "a determined effort to develop electronic hardware to warn of and help prevent midair collisions."

Through Fiscal 1962, FAA has spent or allocated nearly $1.5 million for research into anti-collision systems. Of the Fiscal 1962 allotment of some $450,000, research on contracts totaling about $362,000 is currently being performed. The future of these contracts is uncertain.

The recommendation that FAA not fund any new anti-collision system developments this year is based on the conclusion that none of the techniques thus far investigated by FAA or proposed by industry shows sufficient promise to warrant continuing effort, according to Robert Shank, deputy director for development.

There also is the view within FAA that the basic solution to the collision problem is an improved air traffic control system and that all available funds should go into this area. This difference of opinion has always existed within the agency, but the proponents of improved traffic control appear to have gained the upper hand over advocates of anti-collision system development.

The proposed action comes as a surprise in view of progress reported during the recent FAA-sponsored anti-collision system symposium, particularly in the field of infrared proximity warning systems capable of alerting the pilot to a nearby intruder and indicating his approximate bearing.

Extensive simulator tests conducted at the National Aviation Facilities Experimental Center (NAFEC) in Atlantic City have demonstrated that the distance at which a pilot can spot another aircraft is increased by a factor of 10:1 or more when he is automatically alerted to the presence of another aircraft and its approximate bearing.

During the symposium, a report on carefully instrumented tests conducted by the Naval Ordnance Test Station indicated that an infrared proximity warning indicator can detect other aircraft at ranges of up to 6 mi. in daytime and 9 mi. at night using the infrared energy emitted by existing rotating anti-collision beacons. If such beacons were outfitted with a more powerful source of infrared energy, even greater detection ranges would be possible, a Navy representative said.

Shank told AVIATION WEEK that because FAA funding authorized by Congress was less than requested, the agency has been forced to trim its programs. A study of the various cooperative type of anti-collision systems, which can assess the degree of the collision hazard and alert the pilot only to true threats, indicates that they fall short of feasibility for reasons of cost, complexity and/or performance, Shank said.

The less complex proximity warning indicator type system that operates at radio frequencies would give false alarms, while an infrared system is usable only in fair weather, Shank says.

Analysis of the 549 near-miss incidents reported to FAA under Project Scan shows that 78% of them occurred in clear weather where visibility at flight altitude was greater than 5 mi.

The airlines have been critical of FAA's modest funding of anti-collision system developments. At the July symposium, FAA spokesmen indicated that they hoped to double in Fiscal 1963 the total of about $450,000 budgeted for this purpose in Fiscal 1962.

During the conference, Air Transport Assn.'s Frank White criticized the agency for lack of funding in development of proximity warning indicators and for its "series approach" to the problem. At the same meeting, American Airlines Vice President William Littlewood said that progress had been "disappointingly slow," and he also criticized the FAA for devoting too little effort to an airborne proximity warning indicator.

Littlewood told AVIATION WEEK that it would be a "great disappointment" if Halaby approved the plan to drop further efforts in this field.

Another airline industry spokesman questioned whether FAA was applying its own budgetary cut wisely, pointing out that the agency recently awarded contracts for $282,000 to Litton Industries and Pan American Airways to evaluate an inertial navigation system for civil operations (AW Oct. 8, p. 51).

"Since Doppler radar navigators currently are doing a sufficiently good job to justify eliminating the human navigator, it is hard to understand why the FAA should spend this kind of money to evaluate a competing system when it can not find money to support development of an airborne proximity warning indicator for which the need is so pressing," this spokesman said. He added that at least one company has proposed to develop a cooperative infrared proximity warning indicator for about half of what the agency is spending to evaluate inertial navigation techniques, but was told that there were no funds for such a program.

Shank told AVIATION WEEK that the FAA would be able to find funds to support any really promising new anti-collision technique, even if no money was specifically earmarked for such projects in the current year's development program. Acknowledging that the proposal not to fund any new developments or investigations in this field may evoke strong criticism, Shank said the plan is "technically sound if not politically expedient."

CAB Abandons Plan to Formulate Merger Guidelines for Carriers

Washington—Civil Aeronautics Board has abandoned plans to devise a blueprint for airline mergers after concluding that no single formula can be devised to satisfy the needs of all carriers.

CAB Chairman Alan S. Boyd told an Aviation/Space Writers Assn. meeting last week that the Board decided to drop the project after it became apparent that the complexity of the problem would make it difficult to arrive at a practical solution. Several of his points were supported by Federal Aviation Agency Administrator N. E. Halaby.

Discussing the problems of competition, Boyd predicted that ultimately the airline industry will have only one class of service. The only exception would be if a supersonic transport became operational, in which case there might be two classes—supersonic and subsonic.

Halaby said he anticipates an announcement from the British and French governments soon on a plan for joint development of a Mach 2-plus supersonic transport (AW Sept. 17, p. 34). No decision has been reached on the degree of financial support the government will provide for U.S. supersonic transport development, he said, but it will probably be limited to one prototype.

Reviewing FAA's role in the pilot vs. flight engineer cockpit dispute, Halaby said that Eastern Air Lines has apparently broken a strike of the Flight Engineers International Assn. by "brute force." The agency approved a new flight engineer training program for Eastern, but has no plans to require pilot training for flight engineers. The recommendations of the Feinsinger Commission, calling for a three-man turbojet crew, will lead to this anyway, Halaby said.

Under present FAA regulations, either a commercial pilot or licensed mechanic is eligible to take the written examination given by the agency to flight engineer applicants. Halaby told the meeting that when this test was given to interested pilots on one airline, 86% passed it. He said only 66% of the mechanic-trained applicants from the same airline passed the test.

FEIA later challenged this statement as evidence of Halaby's "partisan feelings toward his brother pilots." Reason for the high percentage of pilots passing the flight engineer exam, according to FEIA President Ron Brown, is that the Air Line Pilots Assn. supplied its members with "crib sheets" complete with answers. Under such conditions it was "incredible" that 100% of the Eastern Air Lines pilot group did not pass the agency's examination, Brown said.

ALPA President Charles H. Ruby later denied the cribbing, and labeled it "irresponsible." He said most pilots passed the test with ease because they already must know most of the answers in order to hold their pilots' licenses.

In an earlier speech in Miami, Halaby said FAA plans to increase inflight inspections as a result of publicity given a series of photos alleging pilot laxity in the cockpit (AW Oct. 15, p. 43). He said that any pilots found guilty of such inattention will face suspension or revocation of their licenses, or a civil penalty. He noted that in 1959, an airline pilot found guilty of sleeping in the cockpit was grounded for 60 days.

FEIA chapter officials at American Airlines repudiated the use of such tactics as the photos "as a weapon of last resort in an industrial relations dispute."

Aeroflot Official Is Dubious About Il-62

Moscow—Aeroflot's middle-echelon management appears less than enchanted with last month's unveiling of yet another huge, long-range prestige transport—the 182-passenger Ilyushin Il-62 (AW Oct. 15, p. 47)—at a time when the state-owned Russian carrier has far more pressing needs. These include excess domestic seat and cargo capacity on many main routes and unsuitable equipment for secondary links, especially in Siberia.

M. Korolev, deputy chief of Aeroflot's Far Eastern Territorial Administration based at Khabarovsk, said shortly after the Il-62 roll-out that what this area needs most is a turbine-powered aircraft in the 15-25 metric ton (33,000-55,000 lb.) gross weight category, which has substantial freight-carrying capacity and can operate from short, unpaved runways. The Il-62 is believed to have a gross weight well over 300,000 lb.

Russia's twin-turbofan Tupolev Tu-124 and twin-turboprop An-24 come closest to meeting Korolev's specifications. However, Aeroflot has experienced serious delays in putting these two aircraft into regular service, although they were first exhibited publicly in the spring of 1960.

Aeroflot's present methods of air cargo planning are often "hit-or-miss," according to Korolev. The USSR's State Planning Committee presents an over-all annual cargo goal to Aeroflot's Moscow headquarters, but directives on how to meet the plan are not sent to the airline's regional administrations.

"As a result, aircraft are frequently idle because they lack loads. This naturally increases transportation costs."

"In the spring and early summer, westward-bound planes on the Siberian run carry full loads of vacationing passengers," he said. "But the aircraft are empty or only half full on return flights. The picture is reversed in late summer and early fall.

"The State Planning Committee should take this into consideration and see to it that regional economic councils and departments provide Aeroflot with more air cargo."

Korolev said that something should also be done to stimulate the use of airmail. "At present, the Ministry of Communications' rate policy is deterrent to airmail development," he said.

Aeroflot's seasonal tariff reductions have been a good thing for both passengers and the carrier, Korolev said, but "Aeroflot's Main Administration is extremely timid about making the fullest use of promotional fares."

Korolev said that cargo aircraft are especially necessary in the Soviet Far East to carry tractors, bulldozers and other equipment to remote areas. "Our lack of proper planes for this purpose often means that vital equipment lies around in warehouses for months until it can be shipped by river transport."

He noted that Eastern Siberia needs more large helicopters and called for development of a special, high-efficiency airplane for agricultural work.

Studebaker Moves To Acquire Supplemental

New York—Studebaker Corp. has asked Civil Aeronautics Board to disclaim jurisdiction or approve certain interlocking relationships resulting from its recent acquisition of Trans International Airlines, a jet-equipped U.S. supplemental carrier.

Studebaker acquired the airline for the equivalent of $1 million in stock as part of a diversification program begun in 1959. Buyers Burlingame, Studebaker vice president of finance, cited Trans International's good management and said he expected the airline to be "quite profitable" in future Military Air Transport Service operations. This year, MATS charters accounted for about 90% of Trans International's business.

The airline, which will be operated as a wholly owned subsidiary, had a pretax income of about $1 million for the first six months of 1962 and expects between $1.5-$2 million total pretax earnings for the year. Trans International has one turbofan DC-8, three 1049H Constellations, one 1049G Constellation and one DC-8F freighter on order.



TURBOFAN-POWERED DOUGLAS DC-8s fly Delta Air Lines' southern transcontinental routes between Atlanta and California. Three of Delta's nine DC-8s now have Pratt & Whitney JT3D-1 turbofans, but entire fleet will be converted to fan power next year. Tenth DC-8 with fan engines will be delivered in December. DC-8s are also receiving white paint job over all of exterior like Delta's 16 Convair 880s.

Early Profits Indicate Further Delta Gain

By James R. Ashlock

Atlanta—Delta Air Lines is continuing its philosophy that bigness isn't synonymous with success, and has launched current fiscal year operations toward profits even greater than the $6,985,000 it netted in 1961-62.

With only 25 jets, a small fleet compared with those of Delta's prime competitors, the carrier in July and August made $4,452,000 after taxes, an impressive 3,150% more than during the same period a year ago (AW Oct. 16, 1961, p. 36).

Delta officials admit that the Eastern Air Lines strike brought sizable windfall benefits, although Delta hasn't determined exactly how much. But Delta's requirement to fly several hundred extra sections during the strike, with its personnel working 12-16 hr. a day, is evidence of the strike's impact.

Even without the Eastern strike Delta would have begun the fiscal year with a profit, officials said. The airline has reached a point where its fleet size is fairly stable for six to seven years, and the airline is unencumbered by debt burdens as large as those other carriers incurred in buying huge fleets.

Credit Sources

Delta has $10 million available in revolving bank credit, plus $5 million from insurance companies. The $5 million will be drawn down this year in buying another fan-powered Douglas DC-8 to be delivered in December. Four-year repayment of the $5 million will begin in 1969. In addition, Delta will begin six-year repayment in 1968 on $25 million of credit arranged in 1958. Twenty-seven banks back Delta's credit.

Rather than expand its fleet in order to achieve saturation of competitive markets, Delta believes in concentrating its relatively few airplanes on routes that are less competitive and more productive.

"In this respect, at least, we've followed a pattern opposite from that of other airlines," said C. H. Dolson, executive vice president-operations.

Jet utilization is now 7 hr. 15 min. daily on Delta's 16 Convair 880s, compared with 6 hr. 8 min. a year ago. On the nine DC-8s it is 8 hr. and 16 min., compared with 8 hr. this time last year. Increasing use of the jets is reflected in utilization of the DC-7s being reduced to 5 hr. 36 min., against 7 hr. 15 min. in July-August, 1961.

Although DC-7s, DC-6s and twin-engine Convairs comprise the majority of Delta's 76-plane fleet, the 25 jets carry 62% of the traffic, and will carry 67% when the tenth DC-8 arrives.

Jet Costs

Cost of operating the DC-8 is $2.12 per aircraft mile, including overhead and depreciation. On the Convair 880, it is $1.69 a mile. DC-8 load factors in July-August were 71%, compared with 64% a year ago, while the 880 carried 69% against 53% in the same months of 1961.

Delta's success hinges largely on effective cost control plus the ability to obtain maximum benefits from its jets through productive scheduling. Because of its comparatively small jet fleet, maintenance requirements have been tightened to assure maximum equipment reliability.

"We've been fortunate in being able to run the 880s on shorter segments," Dolson said. "We have no hesitation in using them to link less dense markets with major connection points like Atlanta."

The 880, for example, flies from Newark to Philadelphia, a 15-min. segment, before proceeding to Atlanta. It has effectively replaced many DC-7 routes so that the longest piston schedule Delta now flies is Washington-Atlanta. However, versatile use of the 880 by Delta is indicated by its being flown on Caribbean routes from New Orleans to San Juan, Montego Bay and Caracas.

DC-8 Schedules

Widespread use of the 880 has freed most of Delta's DC-8s for long-haul service, particularly on the year-old routes to the West Coast. Delta now has seven daily flights to California compared with three in 1961, and is serving San Francisco in addition to Los Angeles. It was the first carrier to establish all-jet service into Los Angeles.

In spite of Delta's expansion into the profitable southern transcontinental market, it is entertaining no ideas of pulling out of smaller cities.

"We haven't followed the policy of trying to rid ourselves of service to small cities," Todd G. Cole, executive vice president of administration, said. "We feel a balanced schedule pattern is the most productive."

Route pattern now includes 14,088 mi., with service to 62 cities in 22 states, plus Washington, D. C. Of Delta's 8,900 employes, 4,400 are based in Atlanta.

Atlanta's growing importance as an

air hub has been a boon to Delta. In 1950, 395,876 passengers boarded airlines operating at Atlanta. In 1961, the total was 1,292,627. Delta currently operates 146 daily arrivals and departures at Atlanta.

Delta has woven a strong connection pattern between principal southern cities and Atlanta. Cole says the old traveling salesman's remark that "I don't know whether I'll go to heaven or hell, but I know I'll have to change at Atlanta" is as true today as during the railroads' peak passenger era.

What disturbs Delta officials is the continued granting of routes into Atlanta to local service airlines. Cole says Delta worked a long time building up its schedule pattern in the south and feels it is serving the market adequately without infringement by smaller airlines.

Delta's concern over crowding in its areas of operation is understandable, for it is still trying to develop new markets which are not yet self-supporting.

The Caribbean schedules, for example, produce a deficit, although the return is growing.

Delta has been more fortunate than most carriers, in that it has never been shut down by a work stoppage. Also, its jets have always been flown by three-man crews.

Nor does Delta believe in too-rapid adoption of new equipment that is expensive but not absolutely necessary. It has not, for example, equipped its jets with engine vibration monitors, preferring instead to seek better engine reliability through precise maintenance and inspection.

Although Delta was the first carrier to begin domestic operation with the DC-8, only three of its nine jets have fan engines. However, it will spend $10 million next year to convert all its DC-8s to turbofan power.

Cole said that Delta will probably need more jets as its markets grow, and that it will order DC-8s if the need arises.

The carrier feels the DC-8 and Convair 880 provide the most effective fleet combination for its purposes.

Delta exerts special effort in monitoring the performance of its jets through an efficient system developed by Arthur C. Ford, director of engineering. Charts in Ford's office give a clear, up-to-date picture of both DC-8 and 880 performance, with all problems listed according to frequency of occurrence and prescribed remedies.

Ford's records show that since Delta began operating the DC-8, 135,000 man hours have been devoted to improving it, 60,000 by Delta personnel and the rest by Douglas. On the 880, Delta has provided 85,000 improvement man hours and Convair 50,000.

This has resulted in the DC-8's being improved to the point that it is the object of only 4.2 delays in each 100 flights, compared with 18 per 100 flights in 1960. The 880 today is charged with 4.5 delays each 100 flights, whereas it caused 27 in each 100 in 1960. Ford considers a delay as being one minute or more over scheduled departure time.

On both the DC-8 and 880, landing gear, hydraulics and electrical problems are listed as the most frequent delay causes, with the exception of powerplants. Passenger doors also caused problems on both aircraft, although modifications have corrected most of the faults in the doors' complex locking and sealing mechanisms, Ford said.

Although the hydraulic and electrical systems receive much attention, Ford says, they are not abnormal for aircraft as instrumented and new as the jets.

"All in all, we've been very satisfied with both the DC-8 and 880," Ford said. "Their reliability has been exceptional."

Ford said the 880s have been subjected to especially heavy demands. Because of the way Delta uses them, the 880s make an unusually large number of takeoffs and landings, and there is usually an average of only 20 min. for line maintenance at many stops.

Topping Ford's problem list are false fire warnings on both the General Electric CJ805-3 engines of the 880 and the Pratt & Whitney JT3C-6 powerplants of the DC-8. Ford said this can be corrected by reducing the size and relocating the fire sensor ring on the engine. A competing carrier holds the patent on this modification and Ford is discussing rights to apply it to Delta's jets.

In the last three months, Delta encountered 15 shutdowns on the CJ805-3 during 45,560 hr. of operation. On the JT3C-6, three shutdowns were made in 17,393 operating hours. Several of these were due to false fire warnings.

C. Boyce Wilder, assistant vice president-operations and technical services, said Delta has not been bothered with the engine mount difficulties reported by other 880 users.

"We believe we've had better success with the CJ805 than some other carriers because we're devoting more time to proper balancing during overhaul," said G. J. Dye, director of maintenance and overhaul.

Dye said Delta is convinced that proper balancing, even to the extent of lowering prescribed balance tolerances, is the key to longer engine bearing life and less vibration. One problem beyond Delta's control is the oil used in its jet engines. "Our suppliers are going to have to give us a better oil," Dye said. "We've had a high frequency of oil coking and feeder line clogging."

Time between overhauls (TBO) on the CJ805 is now 2,200 hr., with 2,300 TBO on the JT3C-6. The JT3D-1 turbofan, which Delta began operating in April, has a 1,200 TBO.

Delta's main concern is the proposed merger of Eastern and American Airlines. Delta officials maintain they will continue to oppose the move, their main objection being that a combined American and Eastern airline would get too great a percentage of available traffic.

Delta is one of the carriers advocating coach fares which are 85% of first-class fares. It disapproves of the current experiment providing first-class, business and economy coach configurations.

"Should this approach prove unsuccessful, hopefully the Civil Aeronautics Board will once again consider revisions to the fare structure which will reduce the percentage differential between first-class and coach," Cole said.

BOAC Deficit to Spark Parliamentary Debate

London—Opposition Labor Party members of Parliament probably will use the introduction of a new bill to determine borrowing powers of nationalized corporations as a peg to start a full-scale debate on British Overseas Airways Corp. deficit early in November.

Number of Labor members and union leaders are currently preparing a case for reorganization of BOAC which includes study of eventual merger of BOAC and British European Airways. Latter move is bitterly opposed by top echelons of the two state-owned airlines.

Little known fact behind BOAC's massive writedown of its Bristol Britannia and de Havilland Comet fleet (AW Oct. 15, p. 38) is that considerable Ministry of Aviation pressure was brought to bear toward this end.

Reasoning centers on last year's White Paper on nationalized industries, which calls for a five-year profitability plan to be set forward by BEA and BOAC. Ministry thinking was that this could not be done unless BOAC assets were valued realistically.

Parliament is scheduled to reconvene at the end of October and Minister of Aviation Julian Amery undoubtedly will be questioned on the BOAC losses. Union position, as stated by BOAC shop stewards' committee, is that the government has "sabotaged" the nationalized airlines by allowing independent airlines to operate competitively with BOAC and BEA.

Court May Accelerate TWA-Hughes Suit

By Ward Wright

New York—Pace of the $481-million Trans World Airlines-Hughes Tool Co. antitrust suit—now nearly 17 months old—may be accelerated if the U. S. District Court here rules that a pre-trial conference be held to limit the issues.

Specifically, TWA has a $115-million claim against Hughes Tool for charges including: alleged boycott of other aircraft suppliers, restraint of trade, delay of TWA's jet equipment programs and attempt to monopolize a "substantial segment" of interstate and foreign commerce. TWA's complaint would also require Howard Hughes to divest himself of his 78% interest in TWA, now in the hands of a three-man voting trust. Hughes Tool's $366-million counter-claim centers around charges that various lending institutions involved in TWA jet equipment programs, some of their officers, and a party in the three-man voting trust have conspired to gain illegal control of the airline.

At present, the case is far from trial. Hughes Tool Co. last week was scheduled to complete the deposition of the second of three TWA witnesses to appear since last February. Chester C. Davis, Hughes Tool's attorney here still has about 20 more TWA witnesses on his list for deposition.

After Hughes Tool, then TWA, Metropolitan and Equitable life insurance companies, and other parties will have the right to depose Hughes Tool witnesses. However, the extent of their depositions probably will be determined by Howard Hughes' testimony. He is scheduled to appear for deposition before the Los Angeles U. S. District Court Oct. 29 (AW Oct. 1, p. 42).

Possibility of some procedure to shorten the case was brought up last month by J. Lee Rankin, court appointed Special Master to supervise the deposition taking. Rankin, expressing concern over length of TWA President C. C. Tillinghast, Jr.'s testimony—nearly 7,000 pages taken between February and July—indicated that he still didn't understand what TWA's "ultimate facts" were.

Rankin said he would allow parties to move for a pre-trial conference to weed out extraneous charges and issues and to determine the facts in the case. Depositions would be suspended during the conference and when resumed, questioning would have to stay within guidelines set by the conference or risk being cut off by the Special Master.

Late last month, Davis, who appears confident that testimony from three TWA witnesses heard so far will not support antitrust charges, moved for a pre-trial conference against opposition from TWA and other parties who contend that such a conference would be premature.

The issue is now before Judge Charles M. Metzner for ruling.

Latest TWA witness to testify is Robert W. Rummel, vice president of planning and research, and the man closest to the engineering aspects of TWA's equipment programs for nearly 20 years. Rummel, who began testifying Sept. 11 after former TWA Senior Vice President of Finance and Treasurer A. V. Leslie's deposition was temporarily suspended, has worked closely with Hughes on equipment matters since World War 2. Rummel also received as much as one-third of his total income between 1956 and 1960 as a special equipment representative for Hughes Tool.

Recounting TWA's equipment programs over the years in answer to Davis' questioning, Rummel testified that Hughes, at certain periods, told him not to deal with these manufacturers, primarily to prevent TWA from suggesting improvements to aircraft going to a competitor:

- **Douglas.** Hughes asked Rummel and his engineering staff "not to do much" with Douglas during the DC-8 development period.
- **Lockheed.** Rummel said Hughes asked him not to talk or deal with Lockheed during the 1955 Electra development period.
- **Boeing.** During the 707 development period of 1953-54 Hughes asked Rum-

Tillinghast Outlines TWA Merger Efforts

New York—Trans World Airlines President Charles C. Tillinghast, Jr., in his nearly 7,000 pages of testimony in the TWA-Hughes Tool antitrust case, outlined an airline-by-airline account of how he tried to merge TWA with the following airlines:

- **Eastern—Tillinghast said he had engaged in merger talks with Eastern President Malcolm A. MacIntyre from the fall of 1961 into January, 1962, which were ended by the American-Eastern merger agreement. MacIntyre said he wasn't concerned over the "Hughes problem" because of the existing voting trust, but he expected resistance from Eastern's board of directors over Hughes and a desire not to get involved in international business. Later at a meeting at the Ritz Tower in New York between Tillinghast, MacIntyre, Ernest R. Breech and Eddie Rickenbacker the "Hughes problem" was presented as a serious obstacle to a TWA-Eastern merger.**
- **Northwest—Tillinghast said he talked to Northwest President Donald W. Nyrop about a merger that would close the Pacific gap in their route systems and leave the merged carrier as one of a two-carrier "chosen instrument." Nyrop said he wasn't interested in becoming involved in the "Hughes situation" which he characterized as ". . . a problem peculiar to TWA, which other people are fortunate not to have."**
- **Continental—Tillinghast said he talked with Robert Six of Continental Air Lines from January to June, 1962, about various merger proposals, including a Northwest-Continental-TWA merger which was seen as the core of a larger merger that might include Braniff Airways and possibly National Airlines. Six said Hughes was one of his close friends, but he wouldn't work for him. Six told Tillinghast that the TWA-Hughes Tool lawsuit was not helping anybody and that it would be wise to end it. Six said that for Hughes to give up control of a merged TWA-Continental forever would be ". . . a good thing for him and a good thing for Continental."**
- **Pan American—Tillinghast said merger talks have been going on since last January and are still serious.**
- **National—Tillinghast said National President G. T. Baker told him that Hughes was "a good friend" but he didn't want any business dealings with him. Baker said he wasn't interested in any TWA merger unless it was a nucleus of a four or five airline merger.**
- **Delta—Tillinghast said he telephoned C. E. Woolman, Delta's president, who indicated he would talk mergers but no discussions followed.**
- **Braniff—E. O. Cocke, TWA senior vice president and system general manager, approached Braniff's President Charles E. Beard in April about a TWA merger. Beard said he was generally interested but would have to be assured something would be done about the "Hughes problem." If TWA wants to get specific, he would talk merger, Beard said.**
- **Western—Tillinghast said he talked with Western Air Lines President T. C. Drinkwater about a TWA merger in the spring. Drinkwater, said he "felt he was doing fine" and didn't want to talk merger to any one.**

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CSA African Bid

Prague—CSA Czechoslovak Airlines is making a strong bid to establish its growing nonscheduled air taxi operations in Africa within the near future. Alternatively, it plans to offer technical and operational know-how to prospective African charter companies in much the same way as a number of scheduled carriers on the African continent are depending on Russian or Czech equipment and aid (AW Sept. 10, p. 71).

CSA also hopes soon to gain approval to operate air taxi flights from Prague to several West European points, particularly initially to Austria, West Germany and Switzerland. Its efforts during the past year to extend its charter operations beyond its national borders for the first time (AW Nov. 13, 1961, p. 48), and obtain the necessary landing rights in these areas, still under negotiation, have not been successful thus far, according to a spokesman for the Czech carrier.

mel not to get involved, because he felt it might be a "premature effort."

• **Convair.** Rummel said Hughes repeatedly asked him in 1959-60 not to become involved with the Convair 990 program even though he was committed to buy the 880.

Describing the origin of the long-standing Hughes-TWA-Lockheed Constellation relationship, Rummel testified that it was a combination of price, availability and performance that made TWA select the Constellation in the equipment scramble after World War 2.

During the years immediately following the war, Rummel testified, he and Hughes looked into almost every conceivable equipment possibility for TWA. At one point, in the late 1940s, Rummel credited TWA (with Hughes' participation), in getting the Glenn L. Martin Co. back into commercial transport production.

TWA had ordered Martin 303 aircraft for DC-3 replacements. Later, the TWA order, along with those of other carriers, was allowed to lapse and Martin stopped work on the 303 and withdrew the 202.

TWA, with Hughes' approval, then began negotiating with Convair for an advanced version of the 240. Negotiations were well along, when Martin indicated it would like to re-enter the picture with an advanced version of the 202 to be called the 202A, using some 303 components. Hughes and TWA urged Martin to produce a larger, pressurized version of the 202 to be called the 404. TWA eventually bought 60 404s, leased 12 202As and dropped its negotiations with Convair.

About 1949, Rummel said, TWA was wavering between buying the improved Lockheed 749A series Constellation or the Douglas DC-6B—on which Rummel and his staff had done a great deal of development work.

Both he and Hughes favored the DC-6B at the time, Rummel said, although "it wasn't always easy to know what Mr. Hughes favored and didn't favor." Other top TWA management wanted the 749, Rummel said.

TWA studies showed the DC-6B to have a lower seat mile cost than the 749A, but the 749A appeared to offer a long-term saving through interchangability of parts and ground equipment used in connection with TWA's existing Constellation fleet.

Hughes finally agreed to TWA's buying 749As. After that, Douglas offered the DC-6B to other airlines and it went on to become a highly successful aircraft. "Hughes always used this as an example of why TWA should not work to improve a design until they were sure they were going to buy," Rummel said. Rummel said he was sure Donald Douglas, Jr., would admit, "the only reason on the earth the DC-6B exists, which we did not buy, was TWA's negotiations with Douglas."

When Lockheed proposed the longer fuselage 1049 Constellation, Hughes, with the consent of TWA management, asked Rummel to negotiate with the company. Rummel negotiated for months, when Hughes called him back saying Lockheed was being unreasonable about price.

Later, after Eastern Air Lines had ordered a quantity of 1049s at a better price than that quoted Rummel, Hughes became interested again and resumed negotiations with Lockheed personally.

Hughes finally ordered 1049s for TWA but was unable to get all the modifications TWA wanted incorporated into them.

The next large equipment acquisition was the 1049G series Constellation which was in competition with the DC-7. Rummel said he, and an influential segment of TWA's top management, favored the DC-7 but he got the impression that Hughes liked the 1049G.

TWA had a chance to get good DC-7 delivery positions if they ordered, Rummel said, but by the time Hughes was ready to make the decision, the positions were gone and the aircraft sold.

TWA still needed aircraft and Lockheed could deliver, so TWA management agreed to buy the 1049Gs, Rummel said. The 1049Gs could not match the DC-7's speed and Hughes experimented with mounting wing-tip turbojets on the 1049G to close the speed gap. The idea didn't work because the increase in speed sharply decreased the aircraft's range.

Hughes' next large aircraft order was in 1954 when he ordered 25 Lockheed 1449A turboprop Constellations at a time when most TWA management, including Rummel, wanted DC-7s, then in competition for the long-range aircraft market.

Rummel said the 1449A was uneconomical, but Hughes was determined to buy the aircraft. Rummel said at one point he risked Hughes' anger by asking him whether he wanted to buy aircraft that could make money for TWA. Hughes said he realized he and TWA differed on the 1449A and he did want an aircraft that would make money, but he thought Lockheed "could do a better job than the papers indicated" and if not "they would lose a long-standing customer."

Rummel said Hughes again considered the wing-tip jet idea for the 1449A, but studies indicated the aircraft "wouldn't go halfway across the continent" due to increased fuel consumption. Finally, Lockheed withdrew the 1449A engine after Pratt & Whitney indicated the engine would need further experimentation to meet earlier fuel consumption guarantees. Lockheed was then forced to redesign around a smaller Allison turboprop engine.

This design, called the 1549A, proved somewhat underpowered, Rummel said, and Hughes pursued the wing-tip jet idea further. In the end, this design also proved uneconomical for a long-range aircraft and Lockheed eventually powered the aircraft with Wright turbo-compound piston engines and redesignated it the 1649A.

In April, 1955, Lockheed apparently had some second thoughts about the 1649A market and asked Hughes to let them withdraw the aircraft entirely, Rummel said. Hughes refused and Lockheed had to build the aircraft.

It became apparent that the 1649A had a number of design and perform-

Air Union Treaty

Final details of the Air Union treaty can now be worked out as a result of President de Gaulle's personal decision in favor of the scheme.

French president's ruling was handed down despite the recent fall of the French cabinet. It was assumed that the cabinet downfall plus upcoming French parliamentary elections would kill off any chance of French agreement this year. The three other West European governments—Belgium, Italy and West Germany—already had given their approval.

Now that de Gaulle has given French agreement "in principle" Air Union officials estimate final treaty details may be worked out by year-end. This means the treaty could be ratified by the parliaments of the four countries by mid-1963.

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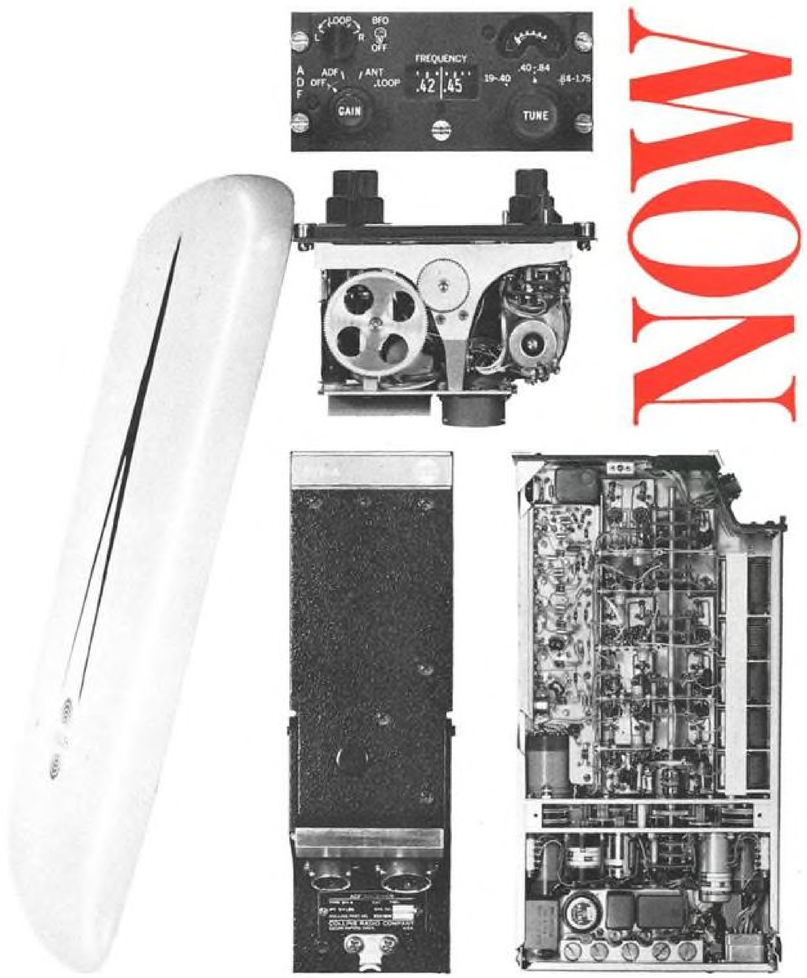


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ance deficiencies, both in the aircraft and some of its components, Rummel said, and Hughes and TWA's management ordered an account kept of their economic impact. TWA wanted to use these figures as a possible lever to get improvements from Lockheed or to safeguard its rights if it decided to cancel.

Hughes wanted the account kept for possible use in a lawsuit against Lockheed and the engine and propeller manufacturers in case deficiencies were not corrected.

In the end there was no suit. TWA's claims against Lockheed, and Lockheed's claims against TWA were largely written off against each other, Rummel said.

1049H Requirement

Need for the 1049H Constellation arose out of an International Air Transport Assn. economy fare plan requiring high-density seating, Rummel said. Initially, there was strong support for the aircraft in some quarters of TWA management, and Hughes agreed to order the aircraft—after some question as to whether TWA really needed them. "I don't recall anyone willing to stand up and be counted with Hughes once the 1049H program had been undertaken," Rummel said. The 1049, at economy fare configuration, only succeeded in diverting TWA's regular coach traffic, Rummel said.

During the Lockheed Electra development period, Rummel said, Hughes flew the Electra several times and had indicated that it was "a sweet flying airplane." However, by this time, he and Hughes were less prone to want turboprop aircraft than jets because of what they regarded as unsolved problems with propellers connected to turbines. TWA management never had a strong desire for the Electra as far as he knew, Rummel said.

Rummel said the Hughes Tool-Convair jet relationship began with a series of highly secret meetings between Hughes, Convair and himself in 1953 and 1954. At that time there was serious doubt about whether an economical jet transport could be built. Rummel said Hughes ordered secrecy to keep plans for TWA equipment from leaking to competitors.

Hughes-Rummel-Convair team first looked at turboprop aircraft designs, then at a combination aircraft using turboprop engines in an international version and turbojet engines in a domestic version.

This latter scheme proved feasible on paper, Rummel said.

This design gave way to the Convair Model 18, a large turbojet aircraft similar to the Boeing and Douglas products, but tailored to the needs of TWA. The Model 18 led to the six-engine Model 19, which was later supplanted by a large four-engine double-deck transport designated the Model 20.

Hughes was particularly interested in this design, Rummel said, but the General Dynamics board of directors killed it as being too ambitious to begin in light of Boeing and Douglas' lead in taking jet orders.

After the Model 20 was dropped, Rummel said he tried to convince Hughes that he would have to consider Boeing or Douglas aircraft if TWA were to have jet equipment simultaneously with the rest of the industry.

Hughes agreed to buy enough Boeings to keep TWA competitive until aircraft more suitable to TWA became available. Rummel said he began to work in earnest with Boeing on configuration and delivery problems when Hughes called to tell him to look at the Convair Model 22—the 880 design.

Rummel said he looked at the 880 and found TWA's management still preferred the larger Boeing aircraft. Hughes then asked him to work with Convair on the project, and Rummel had to work in stages between Boeing and Convair.

'Project Greenland'

During the 880 development period in 1956, Hughes began "Project Greenland"—the code name given to a Hughes plan to build jet aircraft superior to those being offered. Hughes filed an application with CAB to go into the aircraft business.

The Board, in turn, wanted more specific data and "Project Greenland" died out.

At the time, Rummel said, Boeing was "incredulous" and was not pleased with the thought of another competitor in the jet aircraft market. Convair, which was about to sign a preliminary agreement with Hughes Tool about the 880, was "quite shaken," Rummel said, and wanted to know what Hughes' plans were.

Hughes finally ordered eight Boeing 707-120s and 18 707-320s early in 1956, and later committed Hughes Tool for 30 880s in September.

Regarding these aircraft, Hughes told Rummel that he didn't want records, letters, or files kept that might indicate the aircraft were destined for TWA. Rummel said Hughes' idea was to approach Civil Aeronautics Board for approval of Hughes Tool's jet equipment plans for TWA at one time rather than piecemeal.

It became apparent that the 880s were going to be late in delivery, and the Boeing order was altered to 15 707-120s and 12 707-320s. In the meantime, TWA management was reluctant to commit any large sums for 880s until it knew how many it was getting, Rummel said.

TWA's purchasing department began to chafe at their inability to provision the aircraft until they knew how many 880s they were getting, Rummel said. Provisioning for the 707s involved Hughes Tool and TWA lawyers drafting spare parts orders with copies to Hughes and Boeing. When the parts arrived, they were checked in by TWA, and the order forwarded to Hughes Tool for payment to Boeing.

TWA was faced with an imminent price increase on 880 provisions, Rummel said, but he was unable to reach Hughes for authority to order. He had to negotiate for spares on a nothing down, no-cost-for-cancellation basis. Sometimes, Rummel said, he had to put up money and negotiate on a money-refund-for-cancellation basis. When one cancellation date approached he would negotiate an extension, until TWA's purchasing department had "stacks" of orders for 880 provisions waiting for Hughes authority, Rummel said.

Finally, Hughes gave the word and ordered $1.8 million in provisions for the 880s.

Rummel said that the same inability to reach Hughes for decisions made TWA late in ordering terminal and hangar space at O'Hare and Idlewild airports.

Another time, TWA wanted some leading edge devices installed on the 880s at a cost of $30,000 per aircraft. Rummel said he couldn't reach Hughes for clearance and when he got it, it was too late to install the devices.

By late 1960, the 880 production line was "chaotic" because no one knew which 880s TWA would get, Rummel said.

In May, 1960, CAB had approved certain 880s for TWA by serial number, but later, Hughes had reportedly changed his mind, which added to the confusion. This issue wasn't settled until 1961, Rummel said. TWA eventually took delivery on 20 880s beginning early in 1961, except for one 880 delivered for training in May, 1960.

Keen Interest

Rummel testified that TWA did considerably more aircraft development work than other airlines due to Hughes' keen interest in equipment and safety. Manufacturers frequently approached TWA with new equipment ideas because of a belief that Hughes could do anything he wanted regarding equipment, Rummel added.

Some other manufacturers and aircraft receiving attention from Hughes were:

• **Bristol.** Rummel said Hughes gave the Bristol Britannia "very active consideration" during the aircraft's early development stage in 1952.

Delivery delays and the prospect of competitive U. S. turboprop and jet air-

craft designs reduced the Britannia's value to TWA and the idea was dropped.

• **Avro of Canada.** Hughes and Rummel gave some consideration to the Avro C-102 jet transport in 1950. In 1954, they worked secretly with Avro on development of a six-engine supersonic transport (900-1,200 mph.).

• **Canadair.** Canadair tried to interest Hughes and TWA in a redevelopment of the Britannia as a complement to any regular Britannias they might buy. This design, of which CL-44 is an outgrowth, aroused only mild TWA interest.

• **De Havilland.** Rummel said he went to England to look at the Comet 1 and conferred with Hughes by phone. Rummel said he opposed the Comet 1 for a number of technical reasons and Hughes seemed to agree.

After the Comet 1 crashes, Rummel said Hughes told him in 1954 or 1955 to get in touch with Frank Lloyd of de Havilland secretly to see what he could "really do" about early deliveries and prices of the redeveloped Comet series. Rummel said he could not promise deliveries in time for a seasonal need and Hughes dropped the idea.

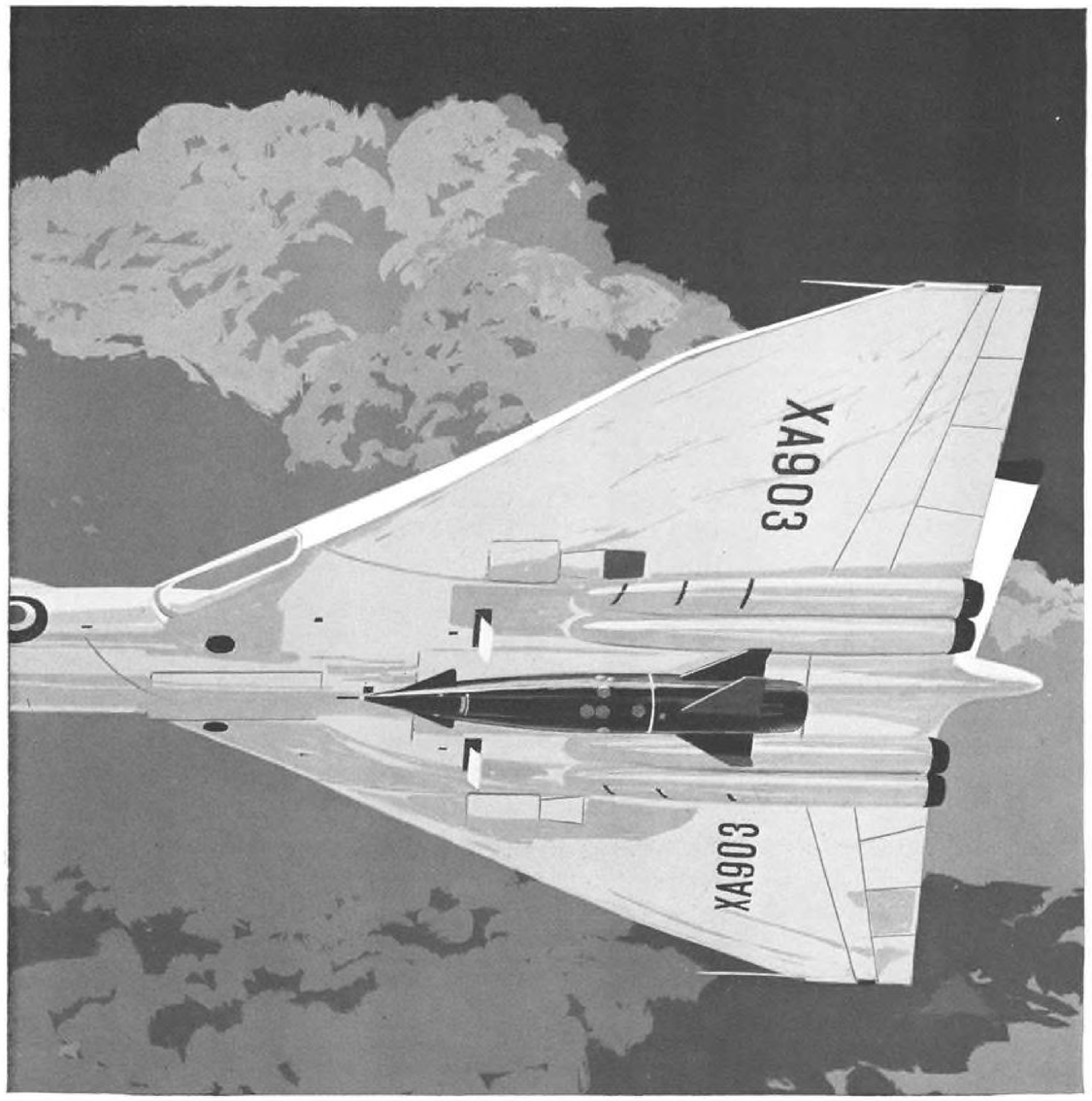
• **Vickers.** Rummel said he was "frankly skeptical" from the beginning about the Viscount's economy and he recommended that Hughes not buy it for TWA. Hughes however, had a great technical interest in the aircraft. When Vickers offered TWA 15 Viscounts canceled by Capital Airlines, Hughes sent a team to Trans-Canada and Capital for operating statistics.

Hughes, satisfied, made an agreement with Vickers for the 15 aircraft while Rummel tried to get Vickers to incorporate certain modifications. Meanwhile, TWA management was having second thoughts about the Viscount's financing, payload and range.

Vickers thought they had a price agreement and they didn't, Rummel said. TWA decided not to buy the aircraft and Hughes was left with a personal commitment with Sir George Edwards of Vickers for the 15 Viscounts.

Hughes wanted to go through with the Viscount deal, saying it was worth more to his reputation in Europe to stick with it than to back out. A year later, Rummel said, Sir George assured Hughes that he understood the situation and that he was satisfied that Hughes had done all he could. Vickers, Rummel said, had never really known whether it was dealing with TWA, Hughes Tool or Howard Hughes.

• **Sud Aviation.** Rummel said he and Hughes had followed Caravelle since development in the early 1950s. Hughes gave the aircraft serious consideration through 1957 and even considered having Hughes Tool manufacture the aircraft under license in the U. S.



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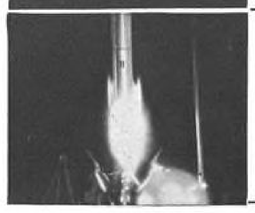
The Bristol Siddeley Stentor, using HTP and kerosine as propellants, is the most advanced rocket engine yet designed in the UK. Unlike other pump-fed rocket engines, Stentor is capable of being stored, or remaining on periodic stand by fully charged with propellants, for up to two years without any detrimental effects.

A feature of the Stentor is that its components can be regrouped to create a wide range of new power units. An example of this is the Bristol Siddeley Gamma 301, a new rocket engine for the Black Knight space research vehicle. At comparatively small expense and with a minimum of additional development, Black Knight is being provided with a more powerful engine which incorporates all the background development of the successful Stentor.

By using combinations of proven components from Stentor and other engines, Bristol Siddeley can produce, at an economical cost, a range of rocket engines from 50—100,000-lb thrust.



The Bristol Siddeley PR 37 rocket engine was specially designed as a boost unit for the Jindivik target drone



Black Knight is powered by the Bristol Siddeley Gamma rocket engine

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AIRLINE OBSERVER

► Look for a major reorganization of KLM Royal Dutch Airlines' management structure—a move designed to reverse the carrier's declining economic fortunes. A firm of management experts recently completed a study of KLM's management and operational makeup and is now making its recommendations for reorganization.

► **Domestic trunkline traffic showed a 6.5% increase in September over the same month last year, but an 8.7% increase in available seat miles dropped the load factor for the month to 53.8%, compared with 55% in September, 1961, and 61.66% in the same month of 1960. September was the 29th consecutive month in which load factors have failed to increase.**

► Japan Air Lines has approached major Pacific carriers, including British Overseas Airways Corp., Pan American World Airways, Northwest Airlines and Qantas Empire Airways, suggesting that capacity on Pacific routes be voluntarily limited before over-capacity becomes a problem similar to that on the North Atlantic.

► **Electronic countermeasures devices employed by Strategic Air Command and North American Air Defense Command aircraft are causing concern among U. S. air traffic controllers. Jamming techniques used by the two commands sometimes destroy the picture on civil controllers' radar scopes. Although such damage usually is brief, controllers are alarmed when it occurs during an unannounced USAF training mission.**

► FAA is attempting to persuade federal and state road building authorities to construct small, general aviation airstrips alongside turnpikes and other major thoroughfares. Four such airstrips were recently developed by the Oklahoma Turnpike Authority parallel to state highways. FAA also is working with the Federal Bureau of Public Roads to help ensure that new roads do not isolate general aviation airports, thus forcing construction of expensive access ways.

► **United Air Lines will adopt electrical discharge machining and electrolytic grinding—the reverse of plating procedures—for refinishing turbine engine components. These processes, now being used on turbine blades, will be expanded to include engine cases and air seals.**

► FAA Administrator N. E. Halaby continues to show reluctance to use the name Dulles when referring to Washington's new international airport, slated to be opened next month. At a recent press conference, Halaby mentioned the airport twice as "Chantilly" and once as the "international" airport.

► **State Department has simplified visa procedures for non-immigrant visitors as a means of promoting foreign travel to the U. S. Under the new plan, visa applicants will no longer be required to appear personally before a consular officer but may submit applications by mail. Last year, the widely-criticized long-form visa application was replaced with a simplified short-form.**

► Civil Aeronautics Board report on air cargo costs, prepared under contract by the Systems Analysis and Research Corp., has been completed. Developed to provide the Board with a working formula for costing air cargo, the report consists of 29 straight-line equations. Included in the extremely complex report are statistical estimates of reliability of the equations, application of the formula to annual expenses reported by carriers for the 1958-60 period and a detailed discussion of the entire air cargo problem.

► **British Ministry of Aviation is studying plan to use London (Heathrow) Airport's two parallel runways for simultaneous takeoffs to reduce traffic congestion. Possibility of dual landings also is under study.**

► Coach service accounted for 67.9% of total revenue passenger miles generated in September by the domestic trunklines, compared with 61.5% in the same month last year. For the first nine months of the year, coach accounted for 64.8% of the total, compared with 57% for the same 1961 period.

SHORTLINES

► **Alaska Airlines** has filed a tariff with the Civil Aeronautics Board calling for group fares between Seattle and Fairbanks and Seattle and Anchorage. Regular fares would be cut 25% for persons traveling in groups of 10 or more.

► **Allegheny Airlines** will experiment with a new travel service it calls conventionaire service. Special flights, operating on a fixed time schedule, will be conducted between Philadelphia and Atlantic City to accommodate persons attending two conventions being held in the New Jersey city next month.

► **Convair 990A** turbofan transport was awarded an FAA type certificate last week. The 990A is a modified version of the 990 that incorporates re-faired engine pods, a wing with slightly less camber, full-span leading edge Krueger flaps and a new fillet at its wing roots. General Dynamics reports a test version of the 990A has attained 625 mph.

► **Local service airlines** showed a 21% increase in revenue passenger miles flown in September, compared with the same month last year. Load factor for the period was 43.5%, contrasted to 41.6% reached in September, 1961. For the first nine months of the year, a 20% traffic gain was registered.

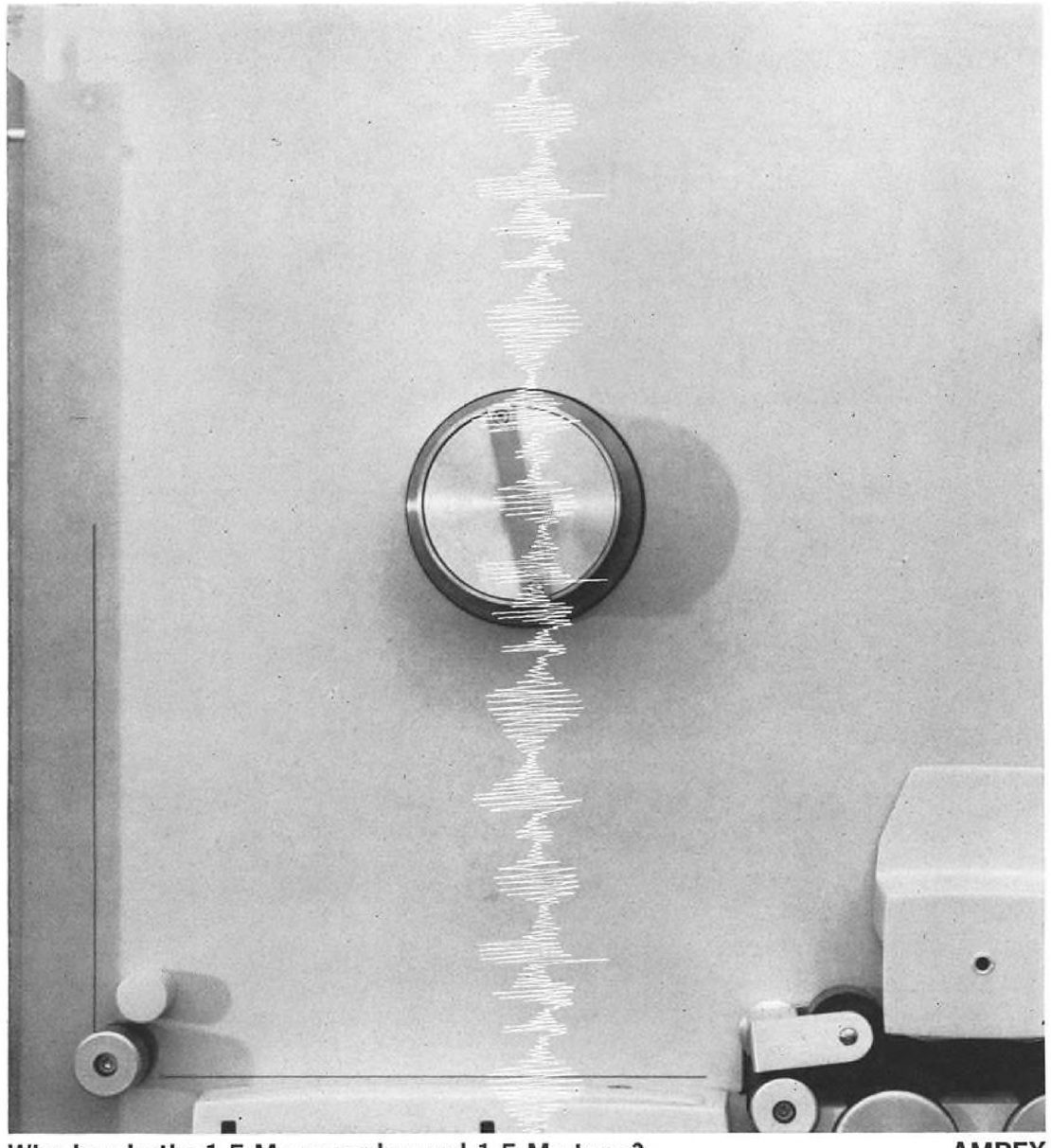
► **Northwest Airlines** will begin jet service at Dulles International Airport Nov. 19 with an initial schedule of four jet flights daily between Washington and the northwest coast.

► **Piedmont Airlines** is expanding its research in planning, marketing and scheduling and has created a new post of director of research, to be headed by Robert W. Kadlec.

► **Seaboard World Airlines** and Lufthansa German Airlines have extended until June 30, 1963, their agreement calling for the mutual use of cargo space between New York and Frankfurt on Seaboard's CL-44 turboprop all-cargo aircraft.

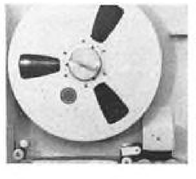
► **Scandinavian** countries have signed a bilateral agreement with Yugoslavia to operate direct air services between Stockholm and Belgrade.

► **United Air Lines** will inaugurate its service at Dulles International Airport on Jan. 13 with one daily jet nonstop flight to San Francisco and one daily jet nonstop to Los Angeles. One propeller flight will be operated daily to Norfolk.



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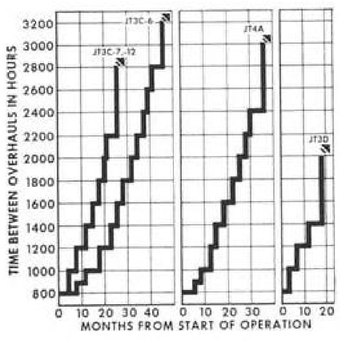


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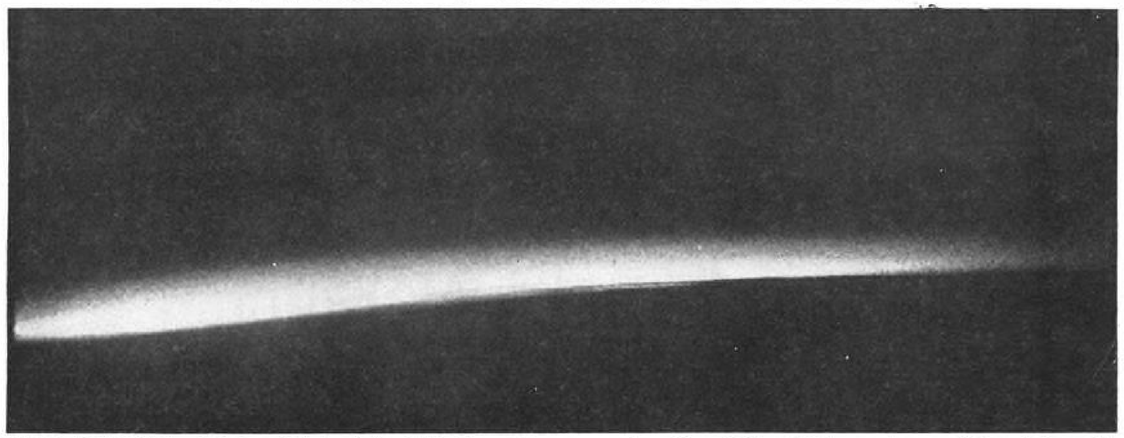
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NIGHT AIRGLOW, located at an altitude of about 55 mi., restricts exposure times for earth-bound telescopes because it fogs photographic plates. Phenomenon was photographed by Lt. Cdr. Scott Carpenter from Mercury Atlas-7 flight in May.

Space Sciences Expansion—Part 3:

View of Stars Clarified by Space Vehicles

By Edward H. Kolcum

Washington—Adaptation of space vehicles for astronomical research is considered as great an advance in this science as the invention of the telescope, because satellites make available a vast amount of information on the nature of the universe that never penetrates the atmospheric cloud of gas surrounding the earth.

The ability to launch instruments above this atmospheric mantle gives astronomers a means of measuring undistorted optical and electromagnetic radiations that will tell them how fast stars are evolving, the makeup of interstellar gas, and whether stellar atmospheres exist.

Long-range U. S. rocket-satellite astronomy plan encompasses a three-part program which will help to unravel the mysteries of the stars, and help man determine his relationship to the universe around him.

Dr. James E. Kupperian of National Aeronautics and Space Administration's Goddard Space Flight Center, looks on astronomy as a pure science, without significant commercial value. Rather, the only value it returns is the knowledge it supplies about the world around us. As in other space sciences programs (AW Oct. 8, p. 55; Oct. 15, p. 58), satellite astronomy will have a fallout in the development of instruments, methods and techniques, but Dr. Kupperian believes the fallout should be natural rather than forced.

NASA's space astronomy program, which it calls astrophysics, is made up of a long-range plan based upon these operational techniques:

• **Scanning rockets:** taking optical measurements by spatially scanning the sky along the path made by a rocket which has been spun to maintain flight stability.

• **Inertial pointing rockets:** pre-selecting stars and pointing the rocket payload at them to obtain spectral measurements.

• **Orbiting astronomical** observatories: employment of a pointing, orbiting platform as a base for telescopes and spectrometers for long-duration observations of selected stars, nebulosities and galaxies.

Although astronomy is the oldest of sciences, its evolution into the science of astrophysics using space vehicles has the potential of providing more information in just a few years than has been gathered by ground-based optical and spectral observations through past centuries.

U.S. is still in the first, rocket-scanning phase of its program, but already has made significant advances in astronomical knowledge as the result of three key rocket flights.

The net result of data from these flights, Dr. Kupperian said, is the conclusion that "hot" stars do not behave as ground observations indicated they would. This conclusion stems from the unexpectedly small amount of ultraviolet radiation which hot stars emit. It means, fundamentally, that hot stars are not burning up as fast as astronomers had theorized, and a new theory must be developed concerning the evolution of stars.

Hot stars are those with energy emissions in the ultraviolet range, with spectral temperatures higher than about 10,000F.

Scientists consider stars young if they were formed, became luminescent and began emitting energy between 10,000 and 1 million years ago.

The three rocket flights of greatest astronomical interest were:

• **Aerobee 25,** flown the night of Nov. 17, 1955, by the Naval Research Laboratory from White Sands, N. M. Payload of this rocket detected the first celestial signals in the ultraviolet range from bodies other than the sun.

• **Aerobee 31,** launched Mar. 28, 1957, by NRL from White Sands. This payload discovered thick clouds of gas called nebulosities, provided the first indication that hot stars emit less ultraviolet radiation than had been predicted, and saw far fewer stars in the ultraviolet spectrum than astronomers thought could be seen. Failure to see predicted stars has been traced to ultraviolet deficiencies in their emissions.

• **Aerobee 4:11,** launched by Goddard Nov. 22, 1961, from Wallops Island, Va. This payload provided the first ultraviolet spectra of 15 stars and defined the amount of ultraviolet deficiency in them.

Other astronomical rockets launched between the Aerobee flights served to confirm the fundamental findings and helped develop instrumentation and techniques both for pointing rocket experiments and for satellite astronomical observations.

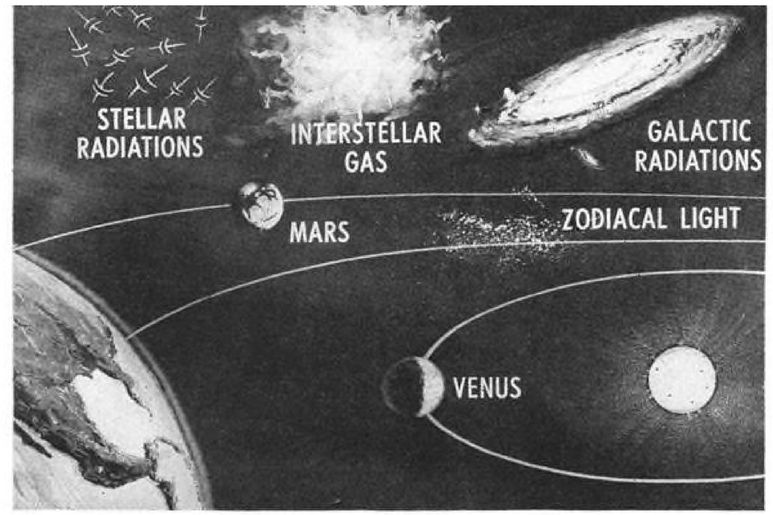
Interpretation of the data returned by the Explorer 11 gamma ray telescope satellite, launched Apr. 27, 1961, has not been completed, because reduction of data from its six months of operation has just been finished. Similar gamma ray experiment will be carried on a satellite to be launched next year, probably the S-57.

Gamma rays represent the highest range of electromagnetic radiation, and Explorer 11 was the first satellite to measure these rays, which arise from the collision of cosmic rays and gas in the galaxy.

Although gamma rays tell something of what occurs in the galaxy, the instrumentation developed for the science of astrophysics is designed basically to measure and analyze light, the main source of communications between the earth and the stars. Earth-bound telescopes and spectroscopes are severely hampered in their measurements because of airglow in the night sky, the "twinkle" of stars, and the absorption characteristics of the earth's atmosphere.

Airglow restricts the amount of exposure time of telescopes, because it fogs plates during long exposure. Airglow is emitted from photochemical reactions in the earth's atmosphere at an altitude of about 55 mi. It was observed and reported by all three U. S. orbital pilots—Marine Lt. Col. John H. Glenn, Jr., Lt. Cdr. Scott Carpenter and Cdr. Walter M. Schirra, Jr.

The problem of "seeing," caused by the motion of the atmosphere which makes stars appear to twinkle, results in blurred images on exposed photographic plates. For this reason, large earth-bound telescopes produce no sharper images than a good 6-in. telescope, Dr. Kupperian said.



THIS NATIONAL AERONAUTICS and Space Administration drawing illustrates the areas of astrophysical interest in the space program. Most advanced instruments in the long-range plan will be contained in Orbiting Astronomical Observatory payloads.

Large telescopes carried aloft by balloons can reduce the twinkling problem, but balloons cannot ascend above the atmospheric mantle and the telescopes they carry are hampered by airglow and absorption.

Absorption is the most serious problem, Kupperian said. Because of its ozone and molecular oxygen, the atmosphere is completely opaque to optical radiations with wavelengths shorter than 3,000 angstroms. It is necessary to observe from above 120 mi. altitude to be free from the absorption of ozone and molecular oxygen. It is here that the fundamental problem exists: most stellar radiation from hot stars, and many of the atomic lines are in the shorter ultraviolet and X-ray wavelengths, and it is these spectral measurements which are of prime astronomical interest.

X-ray radiation ranges from 0.01 to 50 angstroms, and ultraviolet from 50 to 3,900 angstroms.

Early Aerobee flights, carrying 0.25-in. telescopes, looked at a spectral band centered on 1,300 angstroms. It had been theorized that this band would be plainly visible—but it was not. The 1961 Aerobee flight observed from 1.6 to 3,000 angstroms, and data indicate that theory breaks down in observations between 2 and 2,500 angstroms.

From a space flight standpoint, the science of astrophysics will be given its greatest advance with the launch of the OAO spacecraft series (AW Feb. 13, 1961). Current plan calls for the astronomical observatory program to start in about two years, with one satellite to be launched annually and each payload somewhat more sophisticated than its predecessor. Basic missions which have already been established for the spacecraft include:

• **OAO 1.** Obtain ultraviolet sky map, nebulae photometry, calibrate instruments and qualify the on-board television system. Nebulae photometry involves measuring cosmic ray emissions from nebulosities.

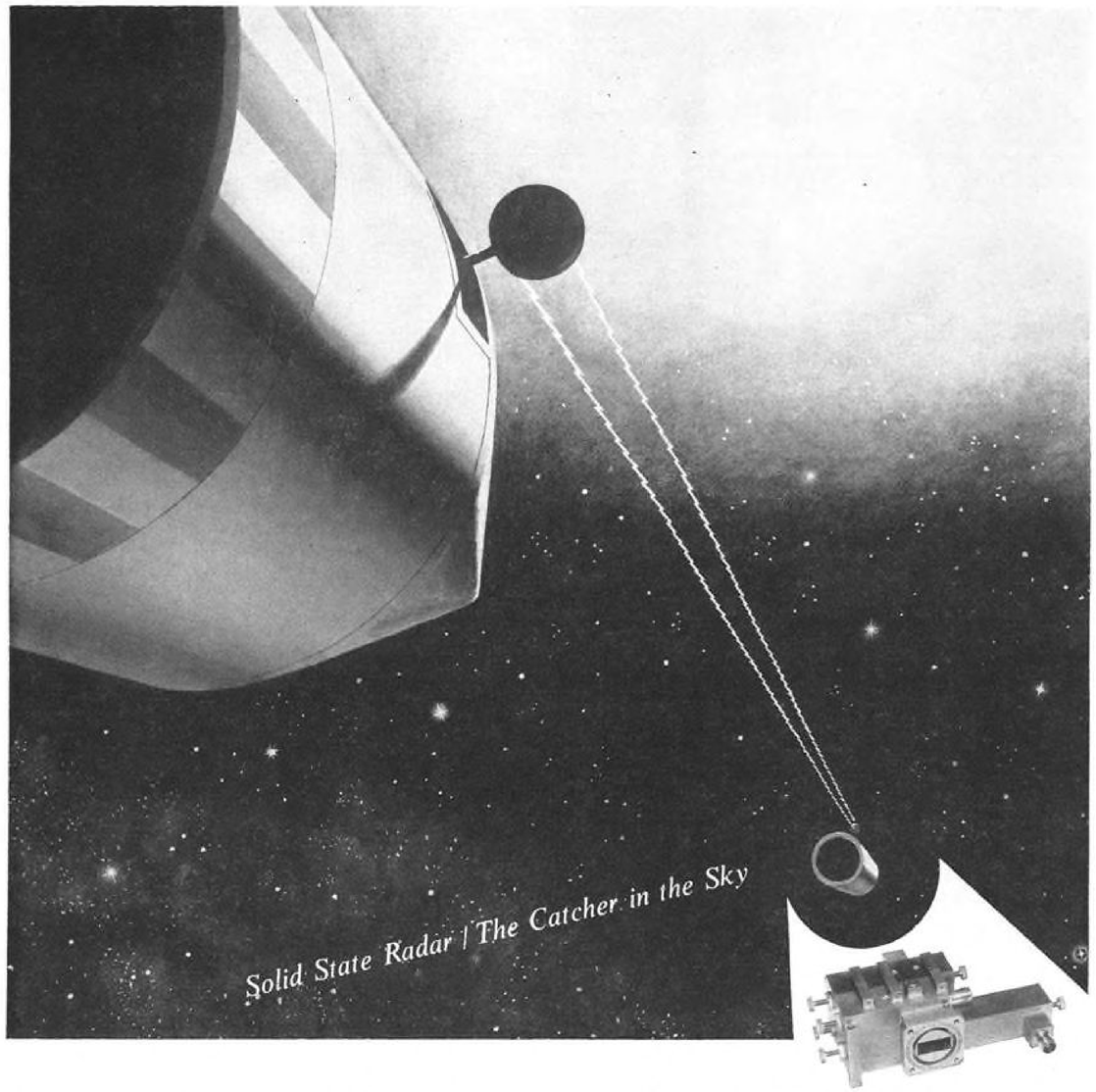
• **OAO 2.** Obtain energy spectra and distributions of approximately 20,000 stars, observing about 10,000 in detail. This satellite will contain a 36-in. telescope.

• **OAO 3.** Measure and survey the interstellar media and absorption spectra; study in detail the atomic and molecular hydrogen lines in stars, and attempt to determine the role of molecular hydrogen in the galaxy.

Dr. Kupperian feels the work already done in astrophysics has fairly well established the sequence of investigation in the immediate future. Goals will be first to determine how fast stars are evolving, thereby determining their ages. Then, through spectral analyses,

Major Space Science Experiments

Payload	Launch	Significance
1. ASTRONOMY		
Aerobee 25	Nov. 17, 1955	Detected ultraviolet signals from star other than the sun.
Aerobee 31	Mar. 28, 1957	Discovered nebulosities; measured deficiency in stellar ultraviolet emissions.
Aerobee 4:11	Nov. 22, 1961	Provided ultraviolet spectra of 15 pre-selected stars.
Explorer 11	Apr. 27, 1961	Made first gamma ray spectral measurements.
2. COSMIC DUST		
Explorers 1, 3, 8, 13 Vanguard 3 Midas 2 Samos 2 Pioneer 1 Rocket payloads Lunik 1, 2 Sputnik 8		Counted micrometeoroid impacts and measured velocities at impact.



A new solid state radar system built by STL engineers and scientists can send out and receive signals at X-band frequencies to help man rendezvous and dock vehicles in space. STELATRAC is its name. It is the first solid state system of its kind. The X-band transmitter is shown above. It has successfully passed temperature and vibration tests. STELATRAC can also be used as a command link between vehicles in flight. By altering its module design, the flexible radar system operates as an altimeter and doppler velocity sensor to guide spacecraft safely to the surface of the moon and planets. Today STL is busy on many such projects as STELATRAC. STL is also prime contractor for NASA's OGO and a new series of classified spacecraft for Air Force-ARPA. And STL continues Systems Management for the Air Force's Atlas, Titan and Minuteman programs. These activities create immediate openings in Theoretical Physics • Systems Engineering • Radar Systems • Experimental Physics • Applied Mathematics • Space Communications • Antennas and Microwaves • Inertial Guidance • Analog Computers • Solid State Physics • Computer Design • Telecommunications • Space Physics • Digital Computers • Guidance & Navigation • Electromechanical Devices • Engineering Mechanics • Aerodynamics • Propulsion Systems. For Southern California or Cape Canaveral positions, write Dr. R. C. Potter, Department A23, One Space Park, Redondo Beach, California, or Box 4277, Patrick AFB, Florida. Your inquiry will receive a prompt reply. STL is an equal opportunity employer.

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astronomers hope to determine the compositions of stellar structures.

Although the most pressing interest in micrometeorites centers around the effect of these particles on manned and unmanned spacecraft, there is a deep astronomical interest in the subject because micrometeorites apparently are produced by comets.

Data from Explorer 1 and 8, Pioneer 1, Vanguard 3, rockets and Soviet experiments indicate that hazards from these particles has been overestimated; statistically, Dr. Kupperian believes chances for collision with a large particle are insignificant, and the mass of small particles is such that they could not penetrate a space vehicle. Dr. Kupperian said there is no firm evidence that any U. S. satellite has had its instrumentation affected by cosmic dust.

Maurice Dubin of NASA Headquarters also feels the extent of the cosmic dust hazard appears to be considerably less than earlier estimates, and he bases his conclusion on penetration and fracture experiments carried on Explorers 1, 3, and 13; Vanguard 3; Midas 2 and Samos 2.

Meteorite Composition

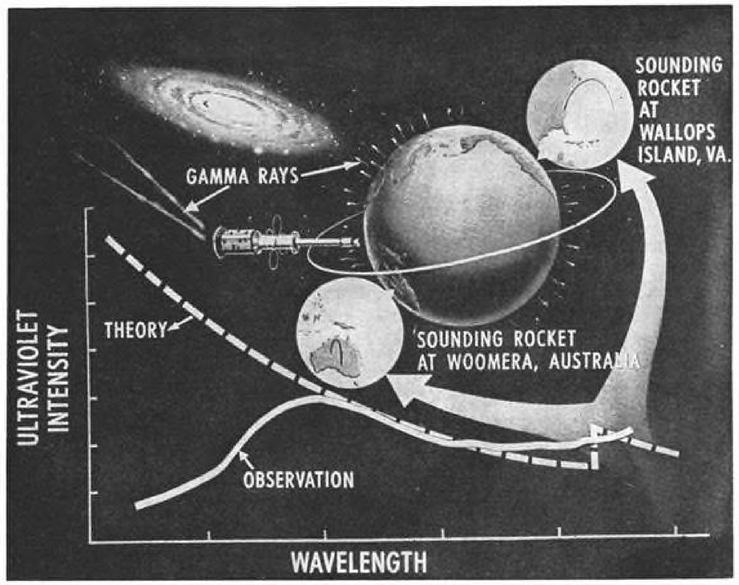
Dubin said the majority of meteorites are stones, and only 10% have properties indicating the heavier densities of iron or iron nickel. Most meteors observed visually or by radio and optical means appear to have fluffy structures, indicating again that they are made of dust and ice and stem from comets.

From a scientific viewpoint, micrometeorites become an exciting topic because of the fundamental questions they have raised. For example, if they do come from comet tails, how did they get there? What is the role they play? What is the role of the comet . . . is it a planet of recent origin? Where do comets originate? Are they formed continuously? Are they true members of the solar system?

Current theory is that comets are made of dust and ice; they are very light and are more affected by cosmic rays than by gravity. But it is questions like these which man has pondered through the ages that might be answered in this century because of man's newly attained ability to put his instruments and laboratory in space.

Space Science Reprint

Reprints of Aviation Week and Space Technology's three-part series on U. S. accomplishments in the space sciences and future goals of the U. S. program will be available after Nov. 5 at 50 cents per copy. Write to Space Technology Editor, 330 W. 42nd St., New York 36, N. Y.



TWO FACETS OF ASTROPHYSICS are illustrated in this drawing. Graph shows that from rockets launched so far, theory on ultraviolet emission has been upset. Gamma ray telescope, carried on the Explorer 11 satellite, was the first satellite which measured these rays, which result from a collision of cosmic rays with interstellar gas.

NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.:

Minneapolis-Honeywell Regulator Co., Pottstown, Pa.—$51,000 for low temperature resistance thermometer calibration system for Saturn.

Cadillac Gage Co., Warren, Mich.—$129,000 for hydraulic package assemblies for Saturn.

Republic Aviation Corp., Farmingdale, N. Y.—$58,000 for theoretical and experimental evaluation of high energy forming of hemispherical shapes in metals.

Cadillac Gage Co., Warren, Mich.—$107,000 for hydraulic package assemblies for Saturn.

University of California, Berkeley, Calif.—$90,000 for study of detonations of mixtures of gaseous hydrogen and oxygen.

Space Technology Laboratories, Inc., Los Angeles, Calif.—$99,000 for rendezvous and docking requirements for Saturn-based systems.

Frebank Co., Glendale, Calif.—$79,000 for design, development and updating of pressure switches for Saturn.

Aerojet-General Corp., Sacramento, Calif.—$195,000 for feasibility demonstration of staged combustion using O_2/H_2 propellants.

Ling-Temco-Vought, Inc., Dallas, Tex.—$124,000 for engineering services for reliability tests on space vehicle hardware, Saturn Project.

Republic Aviation Corp., Farmingdale, N. Y.—$50,000 for study of natural vibration modes and frequencies of space vehicles.

Republic Aviation Corp., Farmingdale, N. Y.—$59,000 to design and furnish models of Saturn vehicle and booster fins, and conduct reliability tests and analytical studies of system stability throughout booster trajectory.

Republic Aviation Corp., Farmingdale, N. Y.—$167,000 for fabrication of integrally stiffened test cylinders and spares for Saturn.

United Nuclear Corp., White Plains, N. Y.—$67,000 for synthesis of minimum weight shields for protection against proton radiation.

Data Corp., Dayton, Ohio—$90,000 for optical guidance feasibility study.

Adcom Inc., Cambridge, Mass.—$83,000 for study of improved secure command communications techniques for Saturn vehicle.

Adcom Inc., Cambridge, Mass.—$84,000 for study of processing of predetection recorded telemetry signals.

Parker Hannifin Corp., Los Angeles, Calif.—$64,000 for precision fittings.

Robins Engineering, Inc., Birmingham, Ala.—$217,000 for construction of central communication facility building.

Vector Corp., New Orleans, La.—$325,000 for design of Michoud Operations facilities.

Western Electric Co., New York, N. Y.—$65,000 for communication facilities.

Aluminum Co. of America, Washington, D.C.—$59,000 for aluminum alloy plate and sheet.

North American Aviation, Inc., Canoga Park, Calif.—$291,000 for high pressure pumping technology.

North American Aviation, Inc., Canoga Park, Calif.—$151,000 for investigation of cooling problems at high chamber pressures.

Texas Instruments, Inc., Dallas, Tex.—$356,000 for d.c. amplifiers for Saturn.

Minneapolis-Honeywell Regulator Co., Boston, Mass.—$90,000 for rate gyros for Saturn.

Ampex Corp. Atlanta, Ga.—$65,000 for reproducer and recorder for Saturn.

Clevite Corp., Cleveland, Ohio—$59,000 for recording systems for Saturn.

Sperry Rand Corp., Bristol, Tenn.—$52,000 for program devices for Saturn.

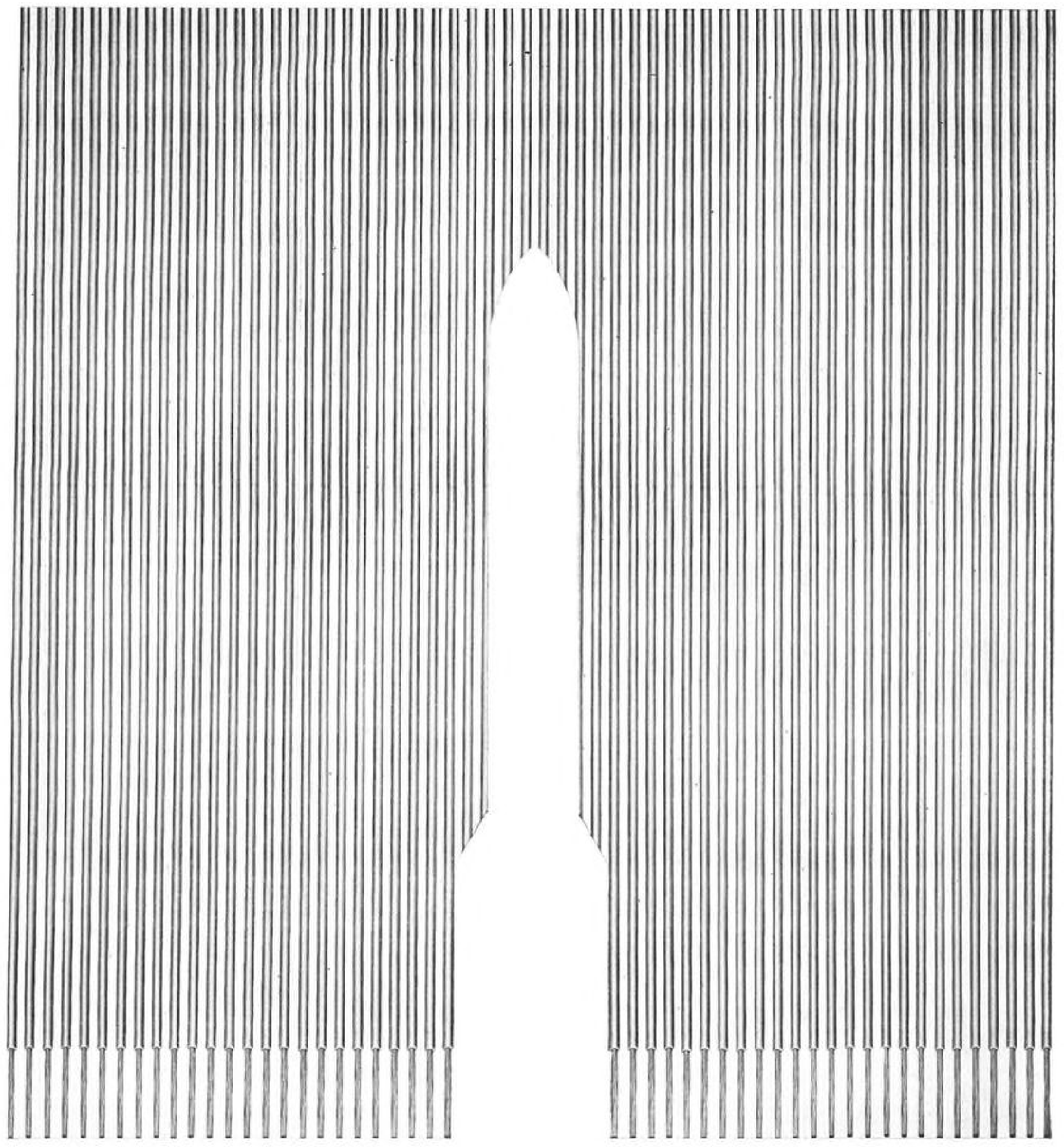
General Electric Co., Birmingham, Ala.—$84,000 for unimite relays for Saturn.

Vector Manufacturing Co., Inc., Southampton, Pa.—$81,000 for subcarrier oscillator for Saturn.

Air Force Systems Command, Washington, D.C.—$2,000,000 for contract with Lockheed Missiles & Space Co. for research and development effort; Agena-B vehicles, launch services and associated equipment and services required to support Project Gemini.

Air Force Systems Command, Arnold AFB, Tenn.—$50,000 for investigation to obtain valid stability and drag data in hypersonic Mach number regime (Mach 5.0-10.0) by artificially simulating full-scale flow conditions in wind tunnel with small scale vehicle models utilizing boundary layer trips.

Army Engineers, Mobile, Ala.—$1,500,000



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Skybolt Mated Prior to Test Launch Over AMR

First close-up photo of live test round of USAF-Douglas Skybolt air-launched ballistic missile (ALBM) shown being mated to B-52G at Eglin AFB, Fla., prior to recent test firing over the Atlantic Missile Range. Note sharply tapered re-entry body (AW June 5, 1961, p. 38), fixed and movable control surface configuration. Stage separation probably occurs near black painted area in midsection.

for design, engineering and management services for construction phase of F-1 engine test stand.

LAUNCH OPERATIONS CENTER, COCOA BEACH, FLA.:

General Dynamics/Astronautics, San Diego, Calif.—$1,000,000 for activation of Launch Complex 36B for Centaur.

Beech Aircraft Corp., Boulder, Colo.—$80,000 for engineering services, studies of cryogenic systems and criteria development.

Astro-Space Laboratories, Inc., Huntsville, Ala.—$60,000 for propellant monitor and calibration system for Saturn.

Air Force Systems Command, Patrick AFB, Fla.—$50,000 for services and materials for AMR range support.

WESTERN OPERATIONS OFFICE, SANTA MONICA, CALIF.:

Douglas Aircraft Co., Santa Monica, Calif.—$1,000,000 for studies and preliminary design for Saturn S-4B vehicle.

North American Aviation, Inc., Canoga Park, Calif.—$98,000 for study of suitable propulsion systems for most effective soft-landing systems.

Aerojet-General Corp., Azusa, Calif.—$131,000 for study, design, prototype fabrication, and testing of large-scale controllable thrust injector system for cryogenic propellants.

Atlantic Research Corp., Alexandria, Va.—$75,000 to study feasibility of sealing solid propellant rocket motors to achieve protection from environment conditions of space.

Aerojet-General Corp., Sacramento, Calif.—$146,000 to study high effective area ratio nozzles for spacecraft engines.

Space-General Corp., Glendale, Calif.—$146,000 to study feasibility of employing portion of spacecraft structure as an expansion surface in place of conventional nozzle.

Navy, Bureau of Yards & Docks, Port Hueneme, Calif.—$50,000 for helium for Centaur Project.

Air Force Logistics Command, Olmstead AFB, Pa.—$2,369,000 for liquid oxygen and nitrogen and RP-1 for use under contract NASW-16, Saturn Project.

Air Force Logistics Command, Olmstead AFB, Pa.—$229,000 for liquid oxygen and nitrogen for use under contract NAS8-19, Saturn Project.

Motion Simulator

Washington—M. B. Electronics Division of Textron Electronics, Inc., has been awarded a $537,000 contract to design and build a six-degree-of-motion simulator for astronaut training at Wright-Patterson AFB. Project will be jointly funded by Air Force Systems Command and National Aeronautics and Space Administration.

Simulator will provide vibration forces in pitch, yaw, roll, horizontal, vertical and transverse motions. Vibrations up to 30 cps. can be induced.

Device is to be completed within a year and will be qualified by monkeys and anthropomorphic dummies before it is used for astronaut training. Initial load capacity will be 2,000 lb., which will accommodate a pilot and his life support couch. Program will be regulated by magnetic tapes of vehicle loads during launches.

AFSC Demonstrates Free Flight in Tunnel

Actual flight of controllable aerospace vehicle models in wind tunnels by means of a new technique was successfully demonstrated in a recent three-week test series sponsored by the Air Force Systems Command at the University of Michigan.

The concept, under development by Giannini Controls Corp.'s Aeromechanics Research Division, is known as Model Fly. It is expected to result in a substitution of wind-tunnel models for full-scale prototypes in many of the maneuvers required in control and loads flight testing of aerospace vehicles.

During the wind tunnel testing, a model on a trapeze-like mount flew freely—insofar as its aerodynamic, structural and inertial reactions were concerned—and a servo system on the mount demonstrated the ability to cancel out the mount's inertial forces and moments, thus permitting flight.

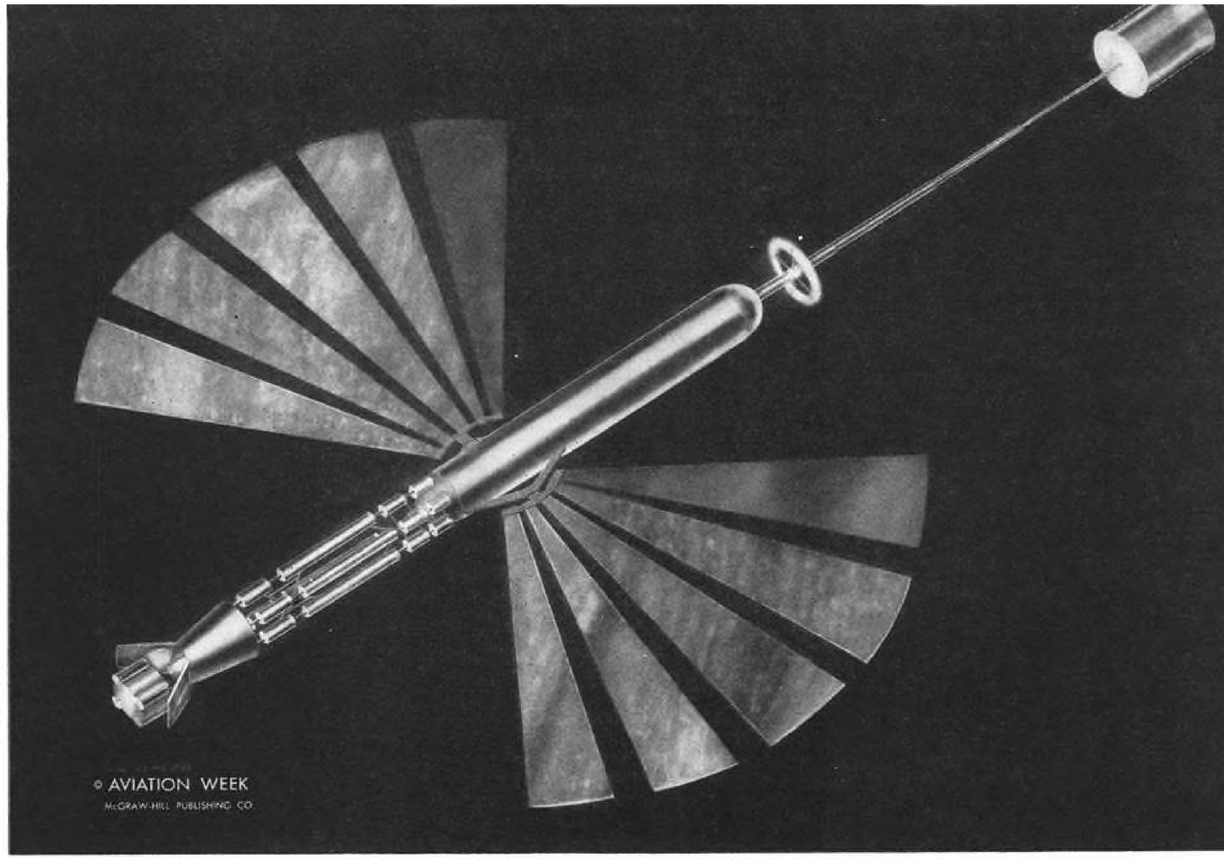
Initial test series was conducted at subsonic speeds, but further development is planned to allow transonic and supersonic operation.



PERT TEST PILOT is the role of the operator who can review and revise networks, and see the effect of proposed revisions inserted by the cursor control when he has a COED MK II display. By providing alpha-numeric, special symbol, and both straight and curved line graphical display capability, the Mark II can be used for simulation, command and control, situation display, and other man-machine systems.

COED MK II is our second generation Computer Operated Electronic Display, for large-scale computer systems. The Mark II provides the needed "match" for full utilization of high-speed digital computers (such as our Bendix® G-20) in systems design, program management, and implementation of real-time data processing systems. It gives a quick-look review of problem solutions or processed data, as well as on-line display and control for repeated solutions and optimization. Engineers interested in using such advanced design tools, or interested in applications of advanced display techniques, are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—An Equal Opportunity Employer.

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GENERAL ELECTRIC Missile and Space Division design for a one-megawatt space power system is based on a nuclear turbogenerator cycle with conventional use of rotating machinery. The nuclear reactor (at left, in artist's conception shown above) furnishes heat to pressurized lithium loop which transfers heat through heat-exchanger boiler to a power loop operating on liquid potassium. Lithium tank is the conical unit that is located to right of the reactor; the radiators fan out for heat rejection.

GE Studies Large Space Power Systems

By David A. Anderton

Cincinnati—General Electric Co. Missile and Space Division is conducting an extensive program here aimed at the development and production of large space power systems within this decade.

Program has two general goals:

- **Advances in technologies** of seals, bearings, metal joining and materials.
- **Component development** of hardware for turbines, boilers and pumps.

Experimental work on the program so far has extended the use of columbium alloys into containment and turbine-wheel materials; has emphasized the corrosion resistance of those alloys to alkali metals; has advanced the technique of making tube-to-tube joints of refractory alloys and stainless steel or superalloys.

Three forced-convection loop experiments have produced test data on the limits of nucleate boiling phenomena. Dynamic seals have been tested in the laboratory using water; liquid-metal runs are scheduled to start early next year.

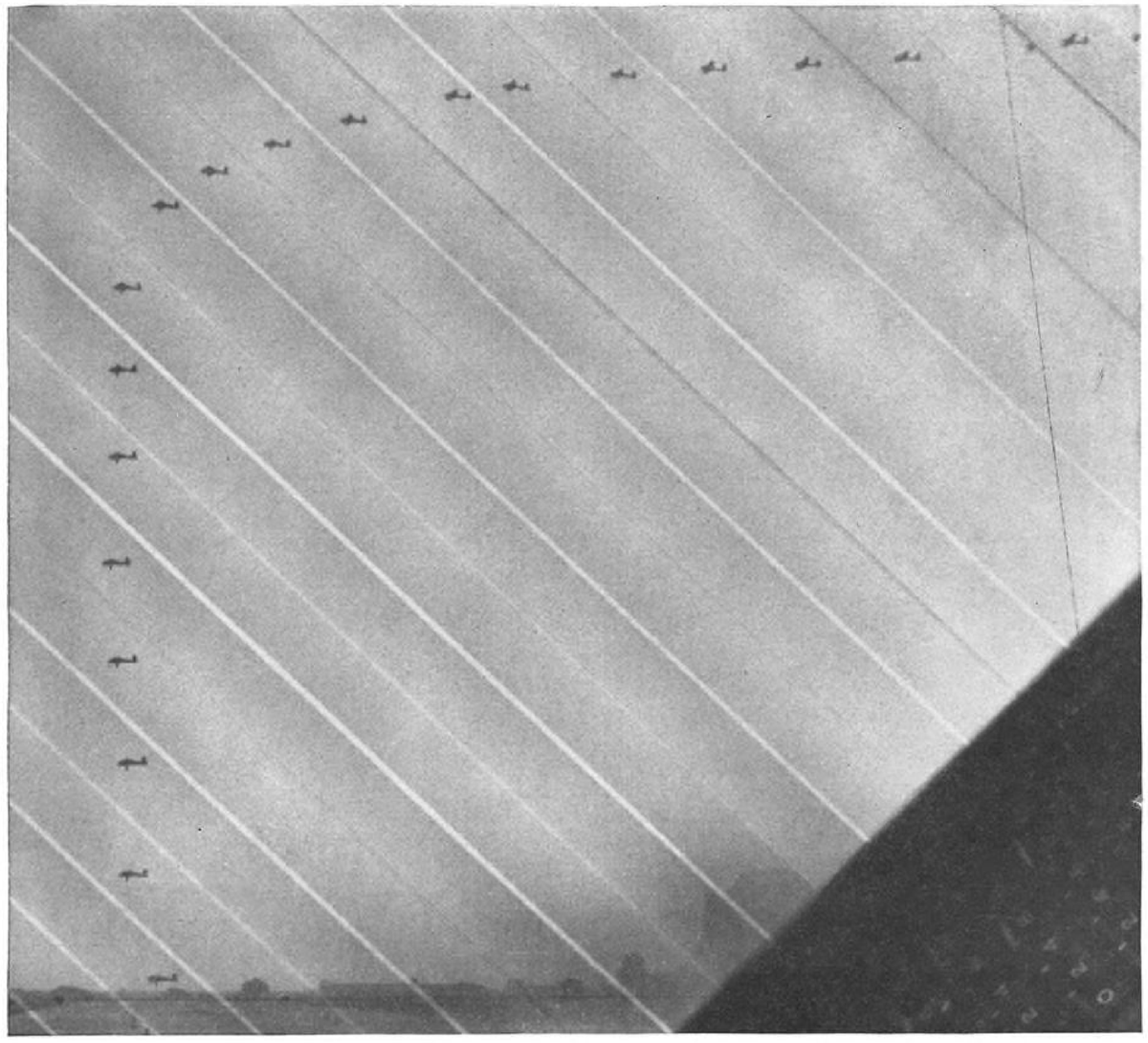
Two stages of a five-stage turbine are operating in a closed-loop liquid-potassium test apparatus; a prototype vortex boiler, using water as a working fluid, has been developed; a liquid-metal pump is in advanced development and, complete with its associated bearings and seals, should be ready to run on liquid metals during the last half of next year.

This work typifies the high degree of activity at GE in the development of large space power systems, says M. A. Zipkin, who is managing the program within the company. But at the same time it underscores the lack of actual performance data, and the inadequate development of such crucial items as the radiator.

In spite of the wide gap between today's experimental beginnings and future operational powerplants, it is possible to bridge the gap—if not in detail, certainly in outline. One conceptual design for a one-megawatt space power system, based on much that is known today, is shown above.

Zipkin says it is more definitive that a preliminary design, and far beyond the conventional artist's conception. "The cycle is firm, the working fluid choices are narrowed to only a few alkali metals, the construction materials are in sight, the temperature is attainable, and the configuration workable. The dimensions and weight are practical, and the predicted performance can be achieved . . . I am firmly convinced that such systems can become a reality within this decade, if we will it so."

GE's program is funded in part by the company and in part by contracts from National Aeronautics and Space Administration's Nuclear Systems and Space Electric Power Offices and the Flight Vehicle Power Branch, Air Force Systems Command's Aeronautical Systems Division. It is based on a nuclear turbogenerator system, using rotating machinery in a conventional manner,



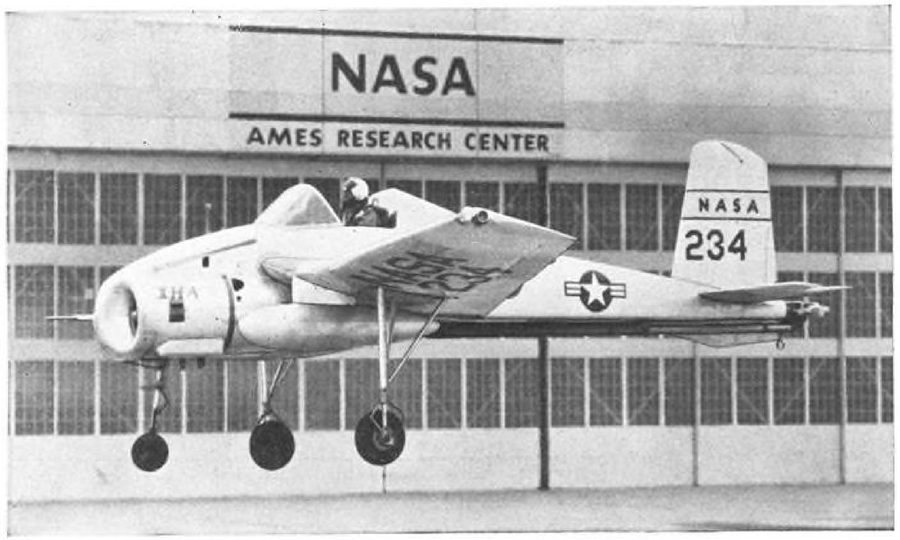
V/STOL U.S.A.

This is a flight analyzer record made at NASA's Ames Research Center in August 1962 showing a transition from conventional flight at an 800 foot altitude through a vertical descent to landing.

The plane is a Bell X-14A VTOL. It is a modified version of the historic X-14, the first jet-powered horizontal attitude VTOL craft to take off vertically, transition to normal horizontal flight, and then hover and land vertically.

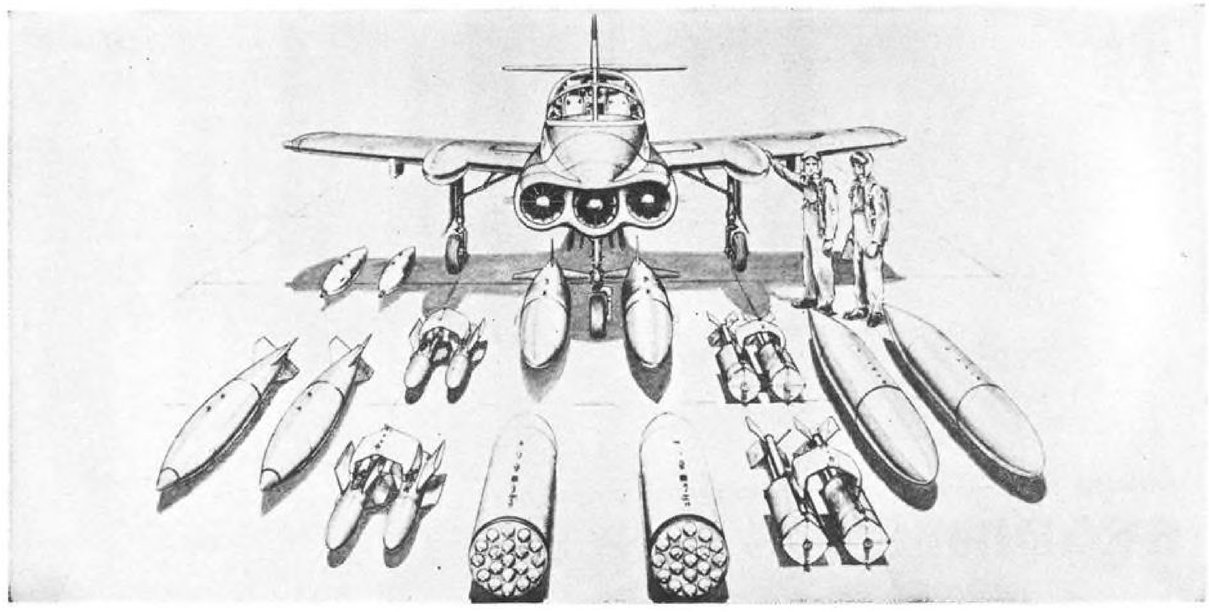
Bell built and flew the original X-14 research airplane for the U.S. Air Force. It made its first hovering flight in 1957, its first complete transition in May 1958. In 1959 it was transferred to NASA's Ames Research Center where it has been in active flight test service in NASA's VTOL evaluation and research program.

Fortunate, indeed, that Bell pioneered this highly practical and successful VTOL airplane. For now we have a proven trainer for the pilots who must be trained to fly the VTOL aircraft which are now under consideration for military service.



A VTOL TRAINER READY...NOW

The Bell X-14A is the only *two-place* jet VTOL presently being flown anywhere in the world. This aircraft has been in active flight testing for over five years . . . is still in operation at NASA's Ames Research Center. Versions of this plane are ready for use as VTOL pilot trainers or as limited warfare close support aircraft.

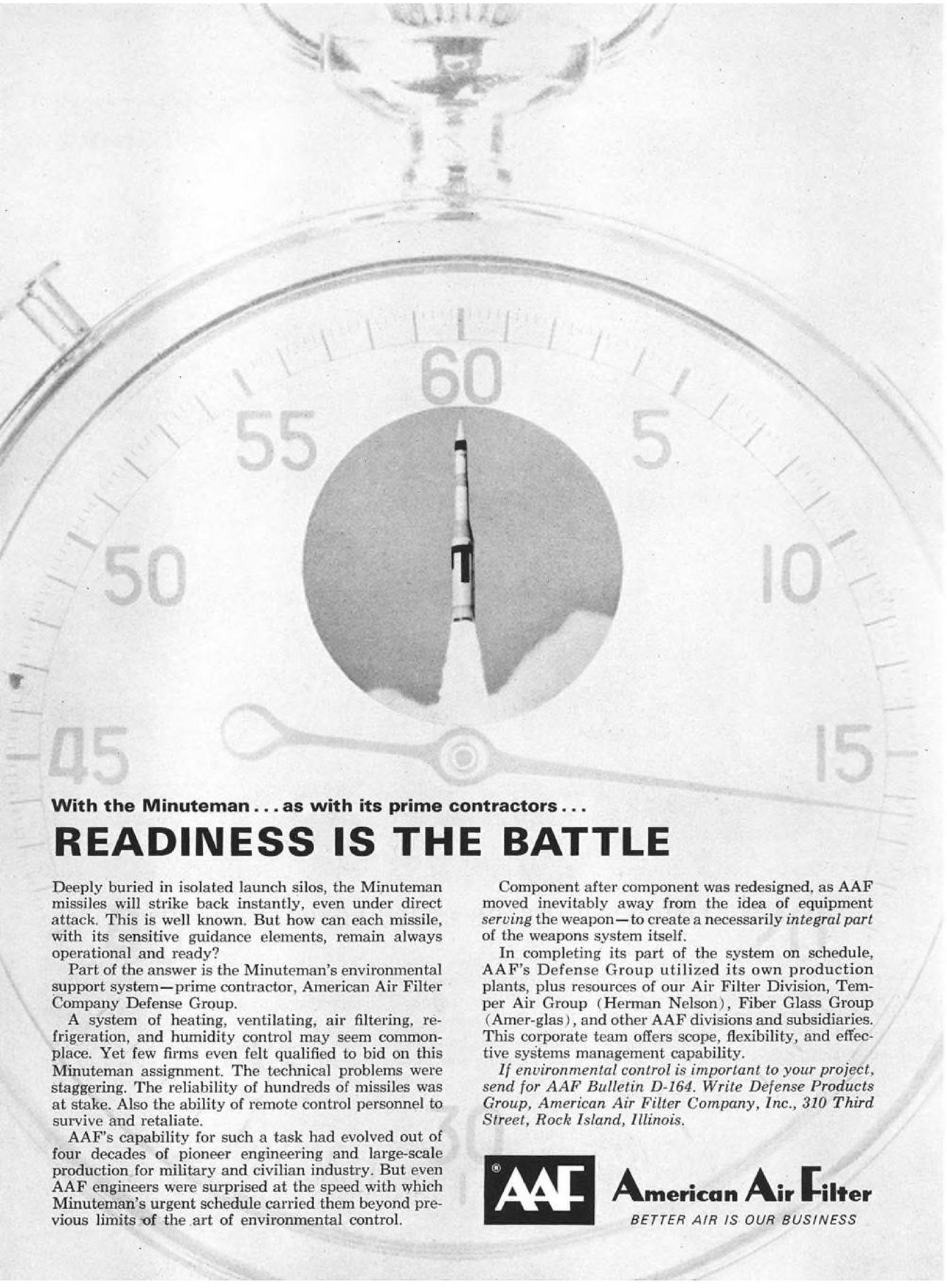


THE X-14C LIMITED WARFARE CLOSE SUPPORT AIRCRAFT

This aircraft is based on the original X-14 machine and uses three engines with thrust diverters. The increased thrust available from this lightweight propulsion system is used with the same proven X-14 control system to produce a rugged aircraft designed to combat aircraft load factors. The high thrust to weight ratio of these small off-the-shelf power plants combined with Bell's thrust diverters provides the most efficient propulsion package of any jet V/STOL concept. This affords the design of small two-place combat aircraft with considerable armament capability and radii. Provisions are available for machine gun pods, air to surface missiles, unguided rockets and a variety of other disposable externally mounted stores.

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READINESS IS THE BATTLE

Deeply buried in isolated launch silos, the Minuteman missiles will strike back instantly, even under direct attack. This is well known. But how can each missile, with its sensitive guidance elements, remain always operational and ready?

Part of the answer is the Minuteman's environmental support system—prime contractor, American Air Filter Company Defense Group.

A system of heating, ventilating, air filtering, refrigeration, and humidity control may seem commonplace. Yet few firms even felt qualified to bid on this Minuteman assignment. The technical problems were staggering. The reliability of hundreds of missiles was at stake. Also the ability of remote control personnel to survive and retaliate.

AAF's capability for such a task had evolved out of four decades of pioneer engineering and large-scale production for military and civilian industry. But even AAF engineers were surprised at the speed with which Minuteman's urgent schedule carried them beyond previous limits of the art of environmental control.

Component after component was redesigned, as AAF moved inevitably away from the idea of equipment *serving* the weapon—to create a necessarily *integral part* of the weapons system itself.

In completing its part of the system on schedule, AAF's Defense Group utilized its own production plants, plus resources of our Air Filter Division, Temper Air Group (Herman Nelson), Fiber Glass Group (Amer-glas), and other AAF divisions and subsidiaries. This corporate team offers scope, flexibility, and effective systems management capability.

If environmental control is important to your project, send for AAF Bulletin D-164. Write Defense Products Group, American Air Filter Company, Inc., 310 Third Street, Rock Island, Illinois.

AAF American Air Filter

BETTER AIR IS OUR BUSINESS

with alkali metals as the working fluids to transfer heat from the reactor to the heat exchanger, and from the heat exchanger through the system.

Output of the system shown here would be used to power an ion rocket engine for space propulsion.

Estimated weight of the system is 8,900 lb., which provides a specific weight of 8.9 lb./kw., well under the currently quoted "desirable" goal of 10 lb. per kilowatt. Over-all length of the system from reactor to the ion engine frame is estimated at 30 ft.

Thermodynamic Cycle

Rankine thermodynamic cycle was chosen for the thermal-mechanical system to get the maximum thermal cycle efficiency and the minimum waste-heat radiator size. There are four loops in the system:

• **Primary loop,** which joins the nuclear reactor to the heat-exchanger boiler. Working fluid here is lithium, circulated at 76 lb./sec., and leaving the reactor at 1,965F. This temperature was chosen to be the maximum consistent with required reactor life of 10,000 to 25,000 hr.

• **Power and heat-rejection loop,** which transfers heat from the boiler through the turbine, condenser, radiator and condensate pump. Potassium is the working fluid, entering the turbine at 1,840F and leaving at 1,240F. Radiator surface area is 1,685 sq. ft.; the fluid enters the radiator at a temperature of 1,190F and leaves at 1,090F.

• **Primary cooling loop,** which transfers heat from the bearings and seals of the primary loop pump, operates with lithium lubricant.

• **Secondary cooling loop,** which is associated with the power and heat-rejection loop. Heat is removed from the liquid potassium which is used to lubricate the rotating machinery and to fill the bearing seals.

Over-all thermal efficiency for the system, based on the electrical output of the generator, is calculated to approximately 16%.

Packaged for launching, the radiators close like the leaves of a fan, and swing to a position enclosing the reactor and the primary loop. The boom holding the payload is telescoped to reduce the over-all length of the package. Fitted with external fairings and shields, the total unit including its payload would form a cylindrical body perhaps 40 ft. long by 4 ft. in diameter.

In space, the radiators unfold and spread to the position shown in the artist's conception; all segments lie in the same plane to minimize radiation scattering from the radiator to the payload.

Reactor is at the opposite end from the payload and is shielded by the lithium tank, which acts as a conical shadow shield. Side scatter shields of boron carbide give partial shielding of the radiators.

Four 250-kw. power conversion units are hung on the open framework forward of the lithium tank. Each unit consists of the rotating machinery necessary to convert the heat energy output from the reactor to the electrical energy output of the generator. Each includes a motor-driven primary loop pump, a heat-exchanger boiler, a turbopump low-frequency alternator, a 250-kw. turbogenerator, and a jet condenser-radiator loop turbopump unit.

The central cylindrical tank contains propellant for the ion engine and provides the major shielding of the payload. It also puts a maximum separation between the reactor and the ion engines; this minimizes the shield cone angle needed to protect the ion engines and at the same time allow them to be far enough out from the radiators to avoid beam interference.

Zipkin's group is converting a building, left over from the Aircraft Gas Turbine Division's high-energy fuel program, into a test facility for work covering the range from advances in technology to component qualification. Three forced-convection loops are currently working, with a heat transfer capability from 50 to 300 kw. There is now under construction a closed-loop turbine test facility using an alkali-metal boiler of 3,000-kw. heat input capacity. An alkali-metal pump test rig is now being designed and constructed. Designers are working on a 36,000-rpm. liquid-metal test apparatus for seals.

A bearing test facility also has been constructed.

Problem Areas

Development of these test facilities was planned to give Zipkin's group a capability to investigate the critical problem areas that must be defined and resolved before large space power systems become reality. Most critical of these is to find a material that can contain the liquid metals at high temperatures while operating in a space environment. Almost of equal importance, according to Zipkin, are the two-phase phenomena of alkali metals, particularly in boiling and condensing heat transfer and the conditions for stable flow.

Columbium-base alloys have been the classical choice for components of advanced powerplants, with the Cb-1Zr alloy used for containment and F-48 used for turbine rotating parts.

But two new alloys threaten the leadership of those two. A new containment material, AS-55, is easily fabricated, it is very ductile and it offers an increase in rupture strength compared with Cb-1Zr.

A new turbine alloy, designated AS-30, is similar to F-48 in its ease of fabrication, but shows increased rupture strength.

AS-55 also shows corrosion resistance equal to the Cb-1Zr alloys, under conditions of exposure to potassium for times up to 1,000 hr. at temperatures up to 2,200F in an ultra-high vacuum chamber.

Much work has been done both analytically and experimentally on the boiling and condensing of potassium and sodium.

Major reason is to determine the regimes of nucleate boiling and the associated heat transfer coefficients. The experimental work here is being done in the 300-kw. test facility.

Bearing configurations have been developed in the group and are under study and test. Water is used as the lubricant to make room-temperature testing feasible. But further, it is possible to make more accurate measurements in water than in liquid metals, and the significant characteristics of the liquid-metal bearings can be closely simulated in water.

Dynamic Sealing

Seals are in the same kind of study phase, with practical demonstrations also made in water.

So far, the group has been tested up to 20,000 rpm. and up to a sealing pressure of 100 psig.

Turbine development has centered on a detailed investigation of the third and fourth stages of a five-stage potassium turbine. These two stages were chosen as being representative of the rear stages, where moisture and blade velocities are greatest and therefore the danger of erosion is greatest. Here also, fluid temperatures have dropped so that nickel superalloys can be used instead of the refractory metals required for the first stages.

The test program for the turbine rig is divided into the following three phases:

• **Aero-thermodynamic** characteristics. Performance mapping will be done with variations in turbine inlet temperature, vapor quality and rotational speed. Temperatures will vary from 1,400F to 1,600F; rpm. from 15,000 to 20,000; and vapor qualities from 85% to 50F superheat.

• **Design-point** endurance run. This test is planned to show the turbine can run for 1,000 hr. without significant erosion of buckets and performance loss. Inlet temperature and vapor quality will be set at 1,550F and 90%, and speed will be held at the design value of 19,200.

• **Endurance test.** This second endurance run is intended to determine the accuracy of predictions of the onset of blade erosion. The run is also scheduled for 1,000 hr.

Prototype recirculating vortex boiler, using water as a working fluid, has been

RAYTHEON at work

Electronic brains avoid nervous breakdowns with new Sorensen QB power supply unit

A new, low-cost non-fluctuating power supply, especially useful for keeping computers accurate and "on the beam" has been perfected by Raytheon's Sorensen unit, South Norwalk, Conn.

Most computers are fed their diet of information as electronic signals measured in minute fractions of a volt. Even minor variations in strength of the signal — caused by power surges or drops — can go through the computer, be misread as information and entirely unhinge the computer's understanding of the problem being presented.

To avoid any such "nervous breakdown" in the electronic brain, a non-varying DC power source is vital. Low priced Sorensen Q B Series power supply units provide the computer with this steady, even current flow.

Sorensen has a long history of supplying reliable power supplies for such intricate systems as Polaris and Titan. This development is another example of Raytheon electronic skills at work — on behalf of business, industry, science and defense.

Raytheon Company, Lexington, Mass.

RAYTHEON



designed and built and is now being tested.

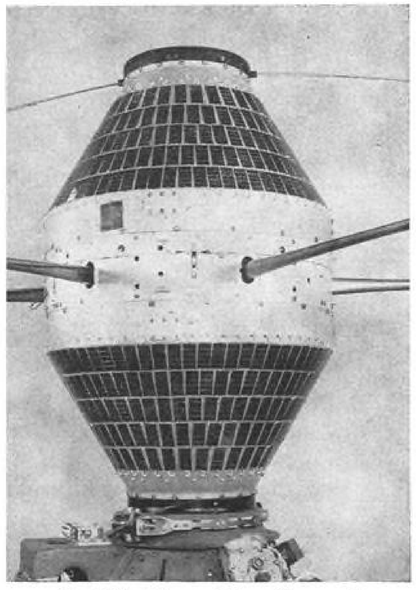
Three-times-size model of a condensate pump is being built for water tests that are planned to define its hydraulic performance and cavitation characteristics.

The multiple-sized geometry was chosen so that significant measurements could be taken.

Objective of pump design in the present development program is to get cavitation-free operation at a suction specific speed (SSS) exceeding the maximum recommended for commercial applications.

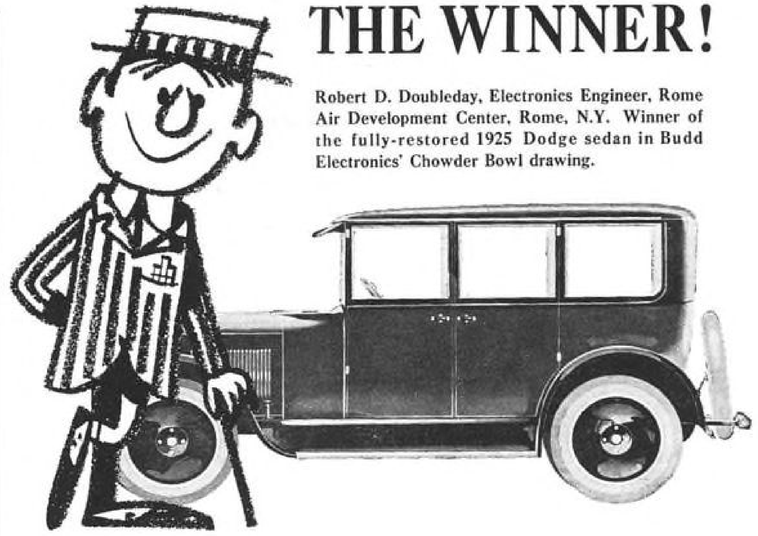
Suction specific speed is a pump parameter which indicates the tendency of a pump to cavitate. The higher the SSS, the closer the operation is to the cavitation regime.

Model pump is expected to start its test program in water during the last quarter of 1962. It will be used as the tooling master for making the full-size liquid-metal pump impeller. That pump is scheduled for water testing during the first half of 1963, and for liquid metal tests during the last half of next year.



S-48 Topside Sounder

Topside sounder, S-48, which is intended to make measurements of the upper atmosphere in an effort to obtain an electron density profile (AW Oct. 1, p. 26), will be launched into a near polar orbit sometime next year. Sounder will be launched by a Scout booster from Pt. Arguello, Calif. The National Aeronautics and Space Administration satellite, and its sounding experiment, were jointly designed and developed by Central Radio Propagation Laboratory of National Bureau of Standards and Airborne Instruments Laboratory of Deer Park, L. I.



THE WINNER!

Robert D. Doubleday, Electronics Engineer, Rome Air Development Center, Rome, N.Y. Winner of the fully-restored 1925 Dodge sedan in Budd Electronics' Chowder Bowl drawing.

(Plus: An entertaining tale of transfluent tradition)

Hail to the winner, and we hope a good time was had by all!

For our part, we enjoyed the excitement generated by the drawing, and the opportunity to meet and hear from so many of you. Your curiosity about our relation to the 1925 car was appreciated too. (The tie-in does appear somewhat baffling on the surface.)

To clarify things a bit, we herewith depart from our usual hard-sell advertising approach (?) to relate this tale:

Once upon a time—to be precise, half a century ago—a company was formed that dealt by design with new ideas. The automotive industry was the first to profit.

Example: Budd had an idea that auto bodies of steel were safer, more practical, and ultimately cheaper than those of wood. The company researched, engineered and sold the idea—*to an industry that had inherited its traditions from the carriage trade.*

Result: By 1922, 1 out of 12 cars produced in the U.S. had the all-steel body . . . by 1923, better than 1 out of 4. You take it from there.

And talk about reliability engineering (one of our many favorite topics)—in those prehistoric days Budd engineers sent steel-bodied autos hurtling over cliffs, stood full-grown elephants on top of them . . . unheard-of feats no maker of wooden bodies would dare to match.

Among many other cases in point: the first stainless steel aircraft in 1931 (you can see it at the Franklin Institute in Philadelphia) . . . America's first stainless steel railway car in 1932 . . . and coming to today, the first stainless steel satellite, the S-6. The whole adventurous story of men, materials and ideas could verily grip your attention for hours on end.*

The point we hope you're getting already, though, is that this tradition of research, decision and action . . . basic at Budd through the years . . . is just as strong today at Budd Electronics. We don't believe in forgetting the past. Its accomplishments have set high standards. The 1925 sedan is one reminder of those standards. But we don't rely on past achievements, and we can show you some unusual capabilities to prove it.

We'll gladly amplify on areas of interest to you. And if, by chance, you're not yet enjoying the camaraderie of the Budd Electronics Chowder and Marching Society, drop us a note for membership details.

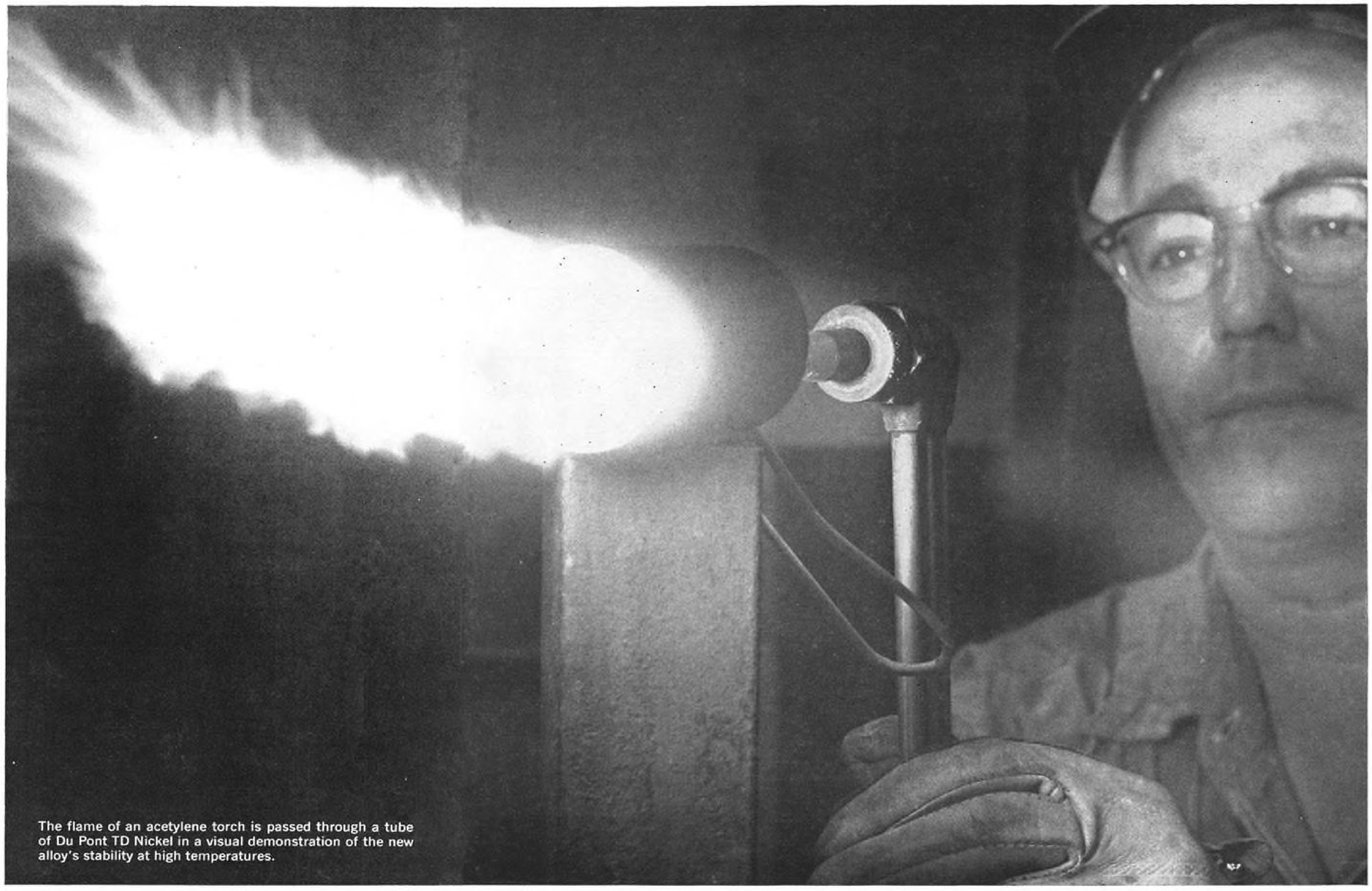
*Not to mention our photo album, replete with savory oddments ranging from the Grant Six, the Wills St. Claire and the Vim express truck to the shop worker nattily attired in a bowler hat, a custom we really think should be revived.

Budd ELECTRONICS
A DIVISION OF THE BUDD COMPANY, INC.

Data Processing & Display Systems
RF Systems • Earth Sciences
Environmental Control Systems
Dynamic Omniforce Facilities Eng.
Reliability Eng. • Field Eng.

What can this new metal help you do?

Du Pont TD Nickel permits continuous operation of equipment and components up to 2400°F—offers new design and performance opportunities in uses where the physical properties of present alloys present limitations.



The flame of an acetylene torch is passed through a tube of Du Pont TD Nickel in a visual demonstration of the new alloy's stability at high temperatures.

Du Pont TD Nickel is a new alloy composed of 98% nickel and 2% (by volume) thoria. This unique dispersion imparts useful—and stable—mechanical properties to nickel at temperatures up to 2400°F.

For example, TD Nickel has an ultimate tensile strength of 10,000 psi at 2400°F—approximately 90% of the melting point of nickel. Relative to many nickel or cobalt base superalloys, TD Nickel has *superior mechanical properties* in the 1900°-2300°F range. TD Nickel also retains the *desirable physical properties* of pure nickel.

Yet, TD Nickel *is workable* in normal atmospheres . . . can be cold-drawn, rolled, forged, machined, sheared . . . *using standard metalworking techniques.*

Your present—and future—equipment and/or components may well benefit from the unique combination of properties available only in Du Pont TD Nickel.

Commercial Quantities Available—Commercial quantities of ½", ¾" and 1" diameter bar stock TD Nickel are available. Strip, sheet forms and tube hollows will be in production in the near future.

For complete descriptive data on Du Pont TD Nickel and its properties, use the coupon or write on your company letterhead. Please list the particular interest you have.

DU PONT METALS CENTER

E. I. du Pont de Nemours & Co. (Inc.)
Pigments Department—Metal Products
Room TD-4 Nemours Building
Wilmington 98, Delaware

Please forward technical data on Du Pont TD Nickel. I am interested in evaluating TD Nickel for:

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Name_____ Title_____

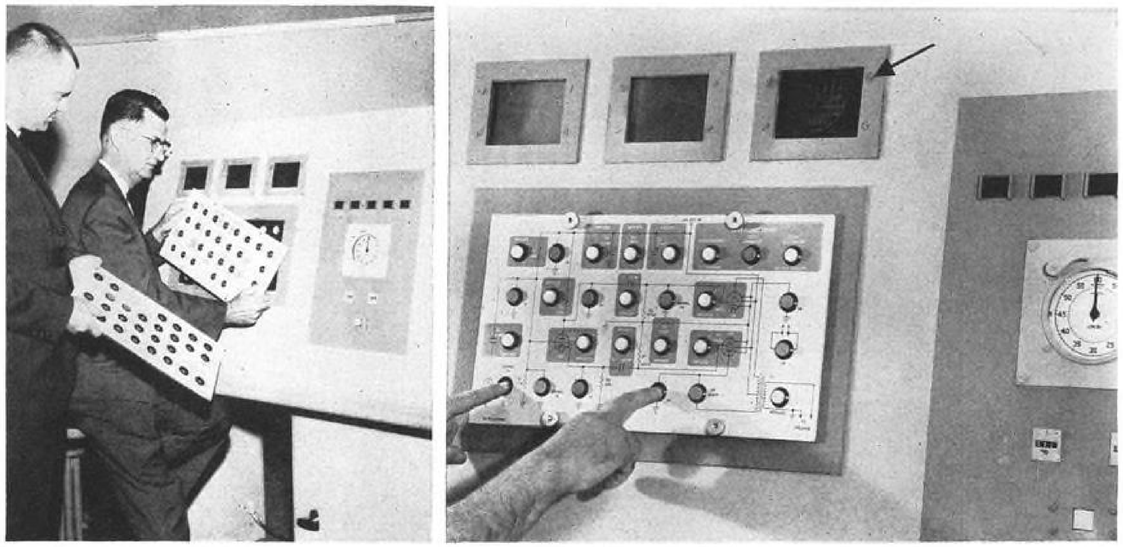
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Better Things for Better Living
. . . through Chemistry

DU PONT



VERSATILE TRAINING DEVICE for maintenance personnel can be used for variety of different systems merely by changing student panel containing system functional block diagram and plug-boards at end of console. Trainer allows student to make variety of measurements at critical points in the system, displaying result of measurement as he would see it if using actual instrument. Scope waveform is shown in top right display. New trainer was developed by North American Electronic Systems, Inc.

Flexible Maintenance Trainer Developed

By Philip J. Klass

Washington—Versatile training device to develop and evaluate trouble-shooting competency of maintenance personnel, which can be quickly converted to simulate a variety of different systems, has been developed by North American Electronic Systems, Inc., Norristown, Pa.

New device is called System Malfunction Analysis Reinforcement Trainer, or by the acronym of "Smart."

Trainer can be converted from a radar system simulator to a rocket launch system simulator merely by changing the student's panel, containing a functional block diagram of the specific system, substituting two different interconnection plug-boards, and changing a few 35 mm. slides.

Single Trainer

By similar means, a single trainer can be used both for trouble-shooting training on a large system and for detailed malfunction analysis of each of its subsystems.

Removable student's panel contains a functional block diagram of the particular system to be simulated. At critical points in the system there are push buttons which enable the student to make a simulated measurement of voltage, current, pressure and/or waveform as it would appear on an oscilloscope.

Instructor's panel, which can be located at one end of the trainer or on a separate console, enables the instructor to set in any of several preselected malfunctions. An electric timer and a digital counter are used to score the student by indicating the time and the number of steps which the student takes before he isolates the trouble.

After the fault is inserted, the student's panel gives him a gross indication of the symptom and then it is up to him to isolate the trouble by judicious choice of procedure. The student can select the part of the system where measurements are to be made and the type of instrument he will use, i.e. voltmeter, ammeter or oscilloscope.

An interesting feature of Smart is that the measurements which the student selects are displayed as he would see them if he were using the actual instruments—on ground-glass screens just above the student's panel. For example, if the student decides to measure a voltage at some point in the circuit, when he selects the point and the voltmeter by pushing appropriate buttons, the scale of a voltmeter will appear with the needle indicating the voltage he would find under the particular fault conditions which the instructor has selected.

Where conventional trouble-shooting trainers usually give the student only an indication that the voltage or other measurement is satisfactory or unsatisfactory, the Smart trainer more fully simulates reality.

If the student selects a cathode ray oscilloscope for measurement, another ground-glass screen will display the waveform which he would see under the particular system fault conditions, at the point in the circuit he has selected.

In addition to these measuring instruments, the student also has at his disposal a simulated signal generator which can be used to introduce signals into the system to aid in isolating the fault.

Malfunction Detection

Some of the buttons on the student panel, each associated with a major component or subsystem, are marked "Replace." When the student believes he has isolated the trouble to a specific component or subsystem, he pushes the corresponding "Replace" button. If he is correct, the fault automatically clears. If the student is wrong, the symptoms remain.

When the student finally locates the fault, the instructor can observe and/or record the time and number of steps required to isolate the trouble. The instructor can then insert another type of malfunction and the process is repeated. If desired, peripheral equipment can be provided to record student scores automatically.

Display windows which show instrument readings also can be used to give a helpful hint to a student who exhibits very bad judgment in his trouble-shooting procedure. For example, in a radar system problem where the malfunction is a failure of the power supply and the student persists in making measurements in the indicator circuit, the display panel will automatically display: "Are the tube filaments lit?"

Visual display of instrument measurements and such helpful hints is accomplished with small projectors, one for each screen. Each projector contains 12 slides, any of which can be selected for instantaneous display. An improved model projector is expected to handle 36 slides.

Company History

Smart trainer is the brainchild of several former Burroughs engineers who left the company about a year ago to strike out on their own. North American Electronic Systems, Inc., not affiliated with North American Aviation, is headed by Stanley Baron, also president of Steelcraft Homes, who provided the financial backing needed for the new enterprise.

As digital computer engineers, the group believed it should be possible to design a universal trainer which could be easily tailored to a specific system merely by changing the student's panel and plug-board programing.

Company first built a small suitcase model of Smart for demonstration purposes.

The suitcase model containing 32 push buttons for making measurements or replacements at 32 points in a system, was demonstrated to the military services, according to Robert Eaves, vice president.

Recently, the company has completed a more elaborate model which provides up to 288 push buttons, permitting this number of measurements and replacements.

This model, which can simulate reasonably complex systems, is expected to sell for about $80,000. A smaller model, with 100 test/replacement points, is expected to sell for around $25,000, Eaves says.

Malfunction Indicator

Recognizing the possibility that Smart itself might suffer a malfunction, the company has designed special test plug-boards which can be inserted before a training exercise to check out the trainer.

If the trainer is functioning properly, lights behind all of the push buttons should be illuminated, according to George Young, company vice president.

Young reports that at least three major aerospace companies have expressed serious interest in buying a Smart trainer for their upcoming aircraft and space projects.

But to date the company is still looking for its first firm order.

FILTER CENTER

► **Sun-Pumped Laser Developed**—First direct conversion of sunlight into coherent infrared radiation is claimed by RCA Laboratories, using a calcium-fluoride crystal and a 12-in.-dia. hemispherical mirror. With crystal cooled to liquid neon temperature and exposed to about 50 w. of solar energy, it emitted energy at 2.36 microns, company reports. The project is part of research effort sponsored by USAF's Aeronautical Systems Division, Electronic Technology Laboratory.

► **Optical Computers Stir Interest**—Possibility of achieving extremely high-speed, high-capacity, computers of unusually small size suitable for use by the military and as small commercial desk computers is attracting varying degrees of attention at companies like Radio Corp. of America, American Optical, International Business Machines, Thompson Ramo Wooldridge, Librascope and Bolt, Beranek and Newman. Among many ideas under study is the use of quantum energy levels of an atomic structure to store information, an approach which might make possible a one bit per 100 trillionths of a cubic centimeter storage density. Reports of activities in this area by engineers at American Optical, Bolt, Beranek and Newman and RCA will be presented this week in Washington at a symposium on optical processing, jointly sponsored by Office of Naval Research and American Optical. RCA's work on neuristor type logic using optical masers, supported by RADC (AW July 9, p. 42), is scheduled for presentation.

► **Transitron Report Reflects Price War Damage**—Recently issued annual report of Transitron Electronic Corp., once second largest semiconductor company in the country, reflects damage wrought by the price war in the semiconductor industry (AW June 12, 1961, p. 73). For the period ending June 30, Transitron's net sales were $28.8 million, compared with $37 million the previous year and $47.7 million in 1960. Net loss after taxes and a special $250,000 renegotiation refund was $498,000, compared with a loss of $1.45 million last year and an $8.1 million profit in 1960. During Calendar 1961, the semiconductor unit sales for the industry soared (AW Mar. 19, p. 57), while over-all dollar volume just about equalled 1960, indicating sharp price declines. In the first seven months of this year, unit sales of transistors rose about 40% while dollar volume fell slightly, indicating continuing rough marketing environment.

SYSTEMS PROGRESS



PRECISION OPTICAL SYSTEMS FOR AIRBORNE-RADAR SIMULATION

The Electro-Optical Department of Consolidated Systems Corporation is now producing the optical system for a complex simulator that displays airborne radar returns from a moving photographic film.

Design of the system required maximum ultraviolet transmission, resulting in the development by CSC of special reflectors with multilayer coatings in the wavelength region of 3800 A. To withstand temperature changes, bonded quartz optical elements are used.

In addition to optical systems, CSC's Electro-Optical Department produces military and industrial cameras, optical instrumentation for satellites and spacecraft, precision optics from conventional and exotic materials. Other CSC divisions are developing systems in space sciences, industrial control, missile and spacecraft instrumentation, support and checkout, data acquisition and reduction.

For systems experience proved in hundreds of successful installations, now available for application to your military or industrial problems, call the nearest CSC regional office or write:

CONSOLIDATED SYSTEMS CORPORATION

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Project Gemini Rendezvous Radar To Use Interferometer Techniques

Use of interferometer techniques in the Gemini rendezvous radar and a cooperative transponder in the target vehicle should enable the target to be detected at ranges out to 250 mi. and to be tracked precisely as close in as 20 ft., M. S. Wheeler of Westinghouse Air Arm Division reported at the recent National Symposium on Space Electronics and Telemetry in Miami Beach. The report was co-authored by P. S. Hacker, also of Air Arm.

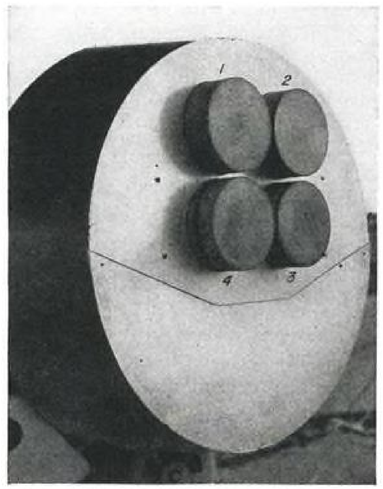
Westinghouse plans to use an array of four small Archimedean spiral antennas for the Gemini radar. The antenna design was selected to give good angular tracking accuracy with minimum equipment size, power consumption and inertia of rotating elements.

Four-spiral array is expected to permit detection of the target when it is as much as 25 deg. off the Gemini capsule's fore-aft axis and to determine its angular position to within about one milliradian, Wheeler reported. This corresponds to about 1,300 ft. at a range of 250 mi.

One of the four spiral antenna elements serves as the transmitter, while the other three are used for receiving. One of the three receiving antennas is shared, being paired first with the antenna above it for measuring target position in the vertical plane. Then it is paired with the antenna to its left for angular determination in the horizontal plane (see photo). The antenna elements are separated by one wavelength, or roughly 8 in. at the 1,500-mc. operating frequency. Each is elevated one-quarter wavelength above a metal ground plane.

For the Gemini application, Westinghouse has adopted a modification of the usual interferometer technique. Normally, a phase shifter in one of the two antenna elements is varied until the difference arm output of a hybrid is nulled. But this requires two channels of amplification to provide automatic tracking, Wheeler pointed out. Additionally, this conventional approach requires a high degree of linearity in the phase shifter.

Because the target vehicle carries a transponder that replies to Gemini transmissions on a slightly different frequency, and the target antenna can be designed to radiate circularly polarized energy, a less complex technique can be used to introduce phase shift in the Gemini interferometer array. This requires that the Gemini spiral antennas be circularly polarized with the same rotational sense as the target antenna.



FOUR ARCHIMEDEAN SPIRAL antennas will be used in Gemini radar. Antenna (1) is transmitter, while (2) and (3) are used as pair in vertical plane and (3) and (4) are used as pair in horizontal plane. Elements (2) and (4) are rotatable to obtain phase shift; others are fixed.

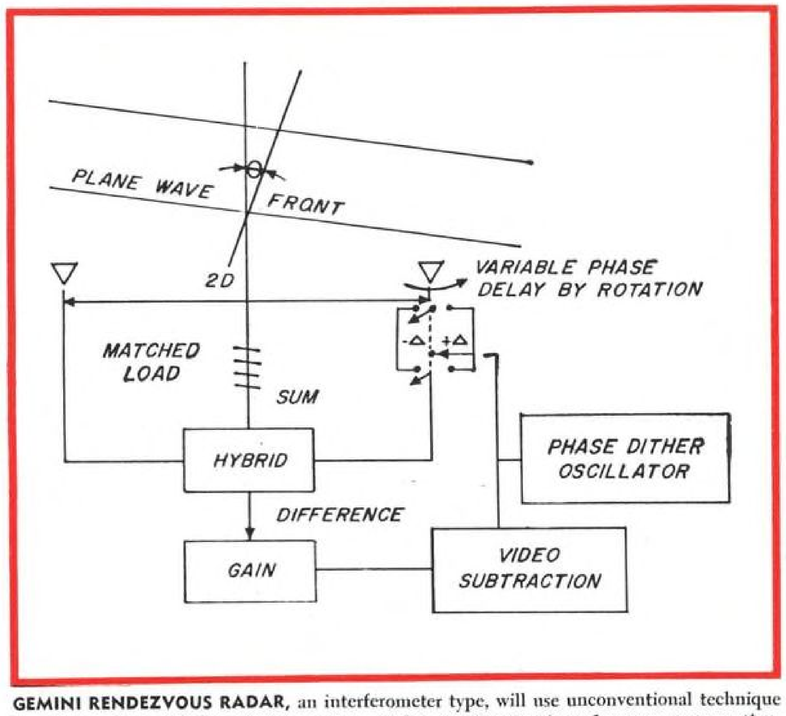
Under these conditions it is only necessary to rotate one of the spiral antennas of each pair to achieve phase shift. The magnitude of the resulting phase shift is proportional to the rotation angle, Wheeler said.

Gemini system will operate with a single-channel receiver in which the phase delay in one arm of the interferometer is modulated ("dithered") in synchronism with the pulse repetition rate of the transmitter. On alternate receptions the phase is changed by a small increment, and the video difference between adjacent pulse returns then provides an error signal which can be used to track the target.

Technique provides the same type of error sensing as the sequential lobing technique sometimes used in single-channel tracking radar, Wheeler said.

If the rotatable spiral antenna in each of the two coordinates is oriented to give zero differential phase delay, exclusive of the dither phase, a null will be detected at the output of the video subtraction circuit when the target is dead ahead. If the target is at some other location, an error signal will be developed which can be used to rotate the two spiral antennas automatically to track the target vehicle.

Target's angular position with respect to the Gemini in a vertical and horizontal plane can then be read off directly

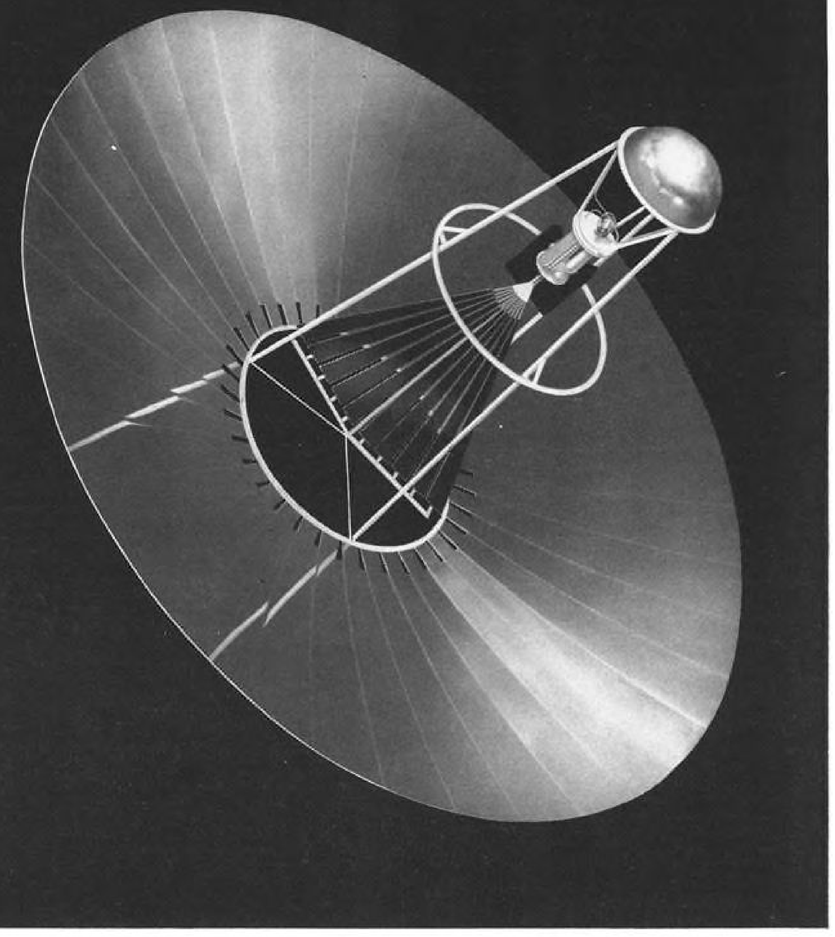


GEMINI RENDEZVOUS RADAR, an interferometer type, will use unconventional technique to achieve phase shift to minimize radar weight, rotating inertia and power consumption. Target vehicle antenna will radiate circularly polarized energy and Gemini capsule will use circularly polarized spiral antennas. One in each pair will be rotated to provide phase shift. Phase dither will provide error sensing for automatic target acquisition and tracking.

TAPCO POWER-SYSTEM EXPERIENCE

ENERGY SOURCES
Solar
Chemical
Nuclear
Mechanical
Electromagnetic
Stored Thermal

CONVERSION METHODS
Turboelectric
Turbohydraulic
Piston Engine
Fuel Cell
MHD
Thermionic

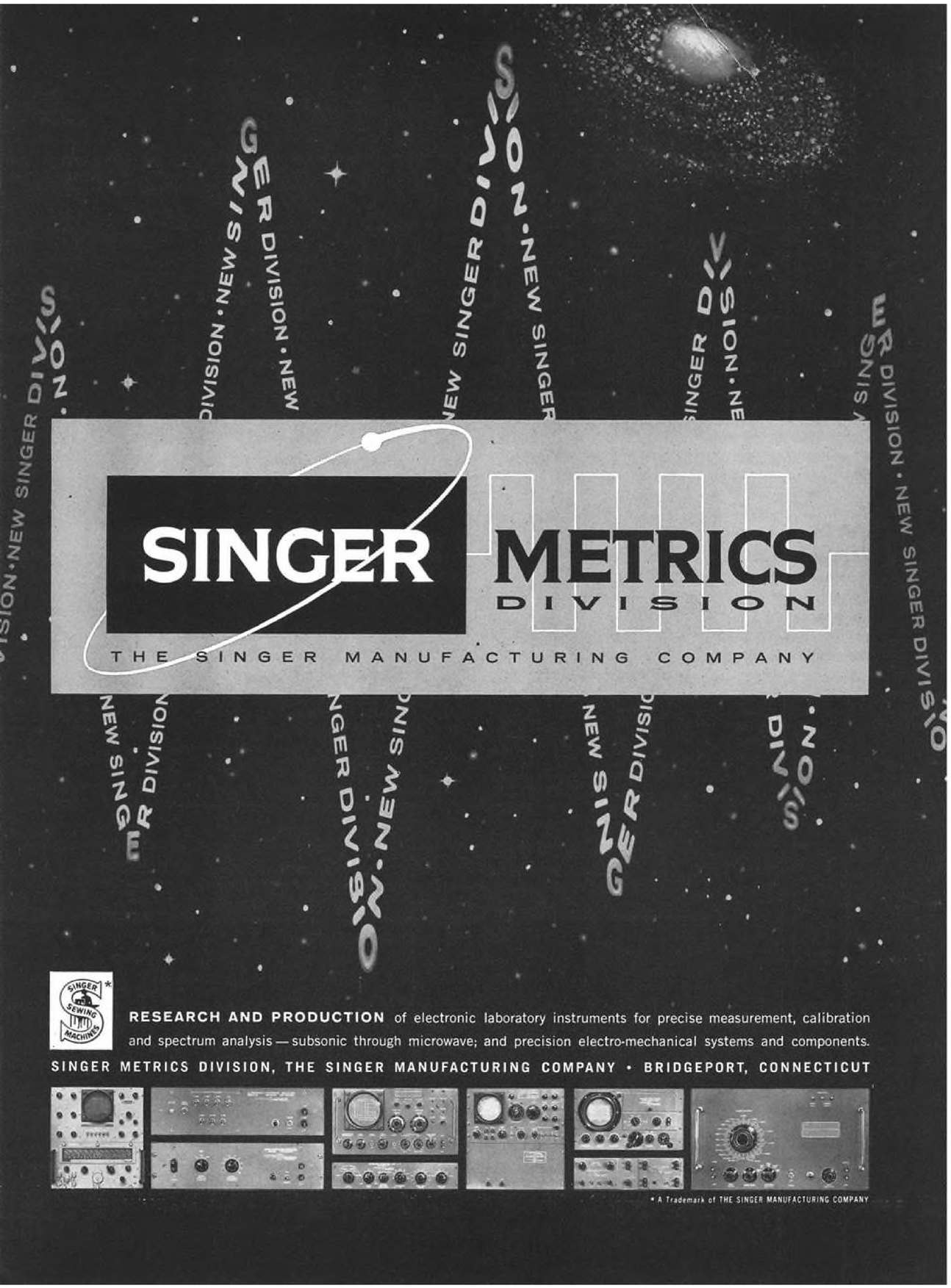


ITEM: The turboalternator unit (CRU) has successfully completed a continuous endurance run of **2,350** hours. Upon disassembly and inspection, no bearing wear was evident. Sunflower is under contract with NASA Lewis Research Center.

Sunflower Space-Power System: A mercury closed Rankine cycle configuration adaptable to wide range of Earth, Moon, Mars and Venus missions. Solar radiation and LiH heat-of-fusion are energy sources, the latter acting during dark periods of orbit. Mercury-vapor-driven turboalternator converts energy to electric power. Space radiator rejects waste heat. Packaging and deployment of solar collector are effected by employing radial petals hinged at I.D. Independent orientation of vehicle and collector is possible. System shown is for Earth orbits ranging from 300 to 20,000 nautical miles altitude. System provides 3-kw, a-c power continuously for at least one year. Tapco, a division of Thompson Ramo Wooldridge Inc., 23555 Euclid Avenue, Cleveland 17, Ohio.

TRW **TAPCO**
Thompson Ramo Wooldridge Inc.

DESIGNERS / MANUFACTURERS FOR SPACE, MISSILE, AIRCRAFT, ORDNANCE, ELECTRONIC, NUCLEAR INDUSTRIES



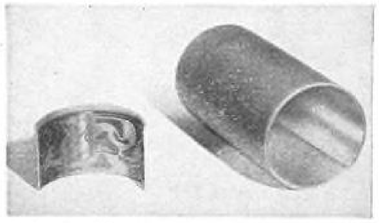
from synchros driven directly by the servo motors operating the rotatable elements.

Characteristic of an interferometer radar is that the greater the spacing between antenna elements the better the accuracy, but this results in ambiguities—two or more different target positions which appear as one to the radar. This can be overcome by using additional pairs of antenna elements with different spacings, but this increases system weight and complexity.

Westinghouse has settled for the one-wavelength spacing between elements, which avoids any ambiguity within ±30 deg. of the capsule forward axis but provides adequate tracking accuracy. The Archimedean spiral antennas selected can be built to have matched gain within 1 db. in the angular area of use, Wheeler said.

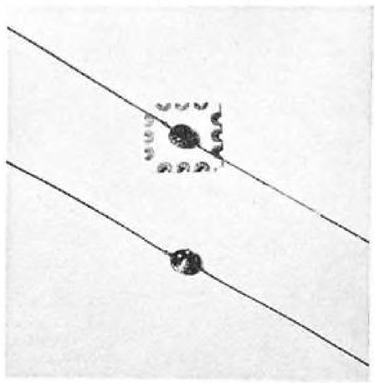
NEW AVIONIC PRODUCTS

• **Semi-tubular printed circuit board,** made of glass epoxy rolled tube with two-ounce copper cladding laminated



on inner diameter. Purchaser can etch any desired circuit configuration. Manufacturer: The Richardson Co., Melrose Park, Ill.

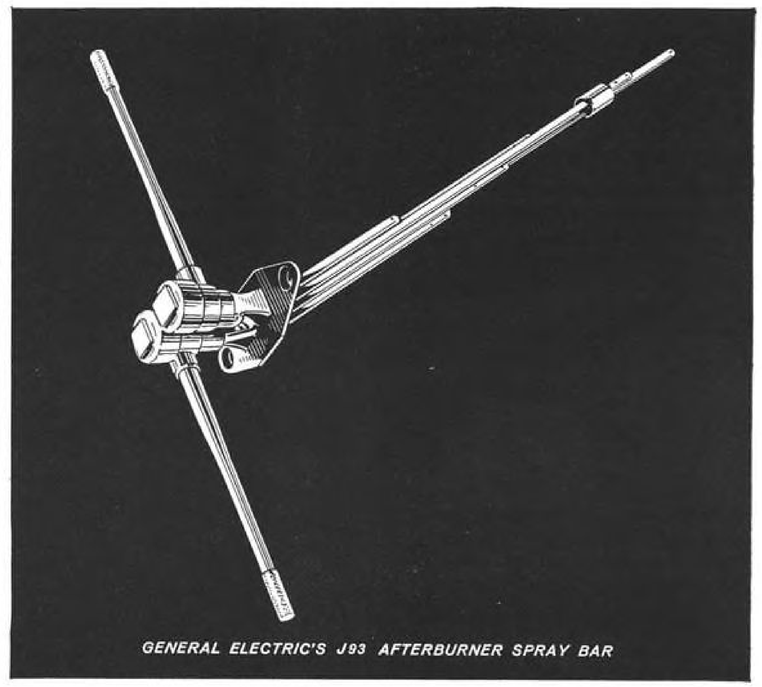
• **Disk-shaped tantalum capacitor,** with extremely high volumetric efficiency, reportedly undergoes only 1% change



in capacitance when tested to method 106 of MIL-STD-202A. New capacitors are available in voltage ranges of 3 to 35 v., in capacitances of 0.12 to 160 microfarads, with standard tolerance of 20%. The new disk-type capacitors are polarized. Manufacturer: Transitor Electronics Inc., West Road, Bennington, Vt.

• **Precision time code generator,** Model HI-138, generates all standard IRIG telemetry formats in serial modulated and unmodulated forms and also provides parallel time-of-day output. Semi-automatic synchronization by means of Station WWV signals is included. Technical Bulletin 538 gives added details. Manufacturer: Hyperion Industries, Inc., 127 Coolidge Hill Road, Watertown, Mass.

• **Optical tracking sensor,** Model 551A, designed to distinguish satellites and missiles against a stellar background by computing the difference in their angular rates. Device can detect a 12th magnitude star at night and a fifth magnitude star in daytime. Automatic gain control maintains linear tracking signals regardless of illumination level. Tracker is available with interchangeable telescopes which operate with standard 40 in. focal length reflector, f/6.3, 8 in. in diameter. Angular field of view is adjustable from one minute of arc to two degrees. Manufacturer: OPTOmechanisms, Inc., Plainview, N. Y.



GENERAL ELECTRIC'S J93 AFTERBURNER SPRAY BAR

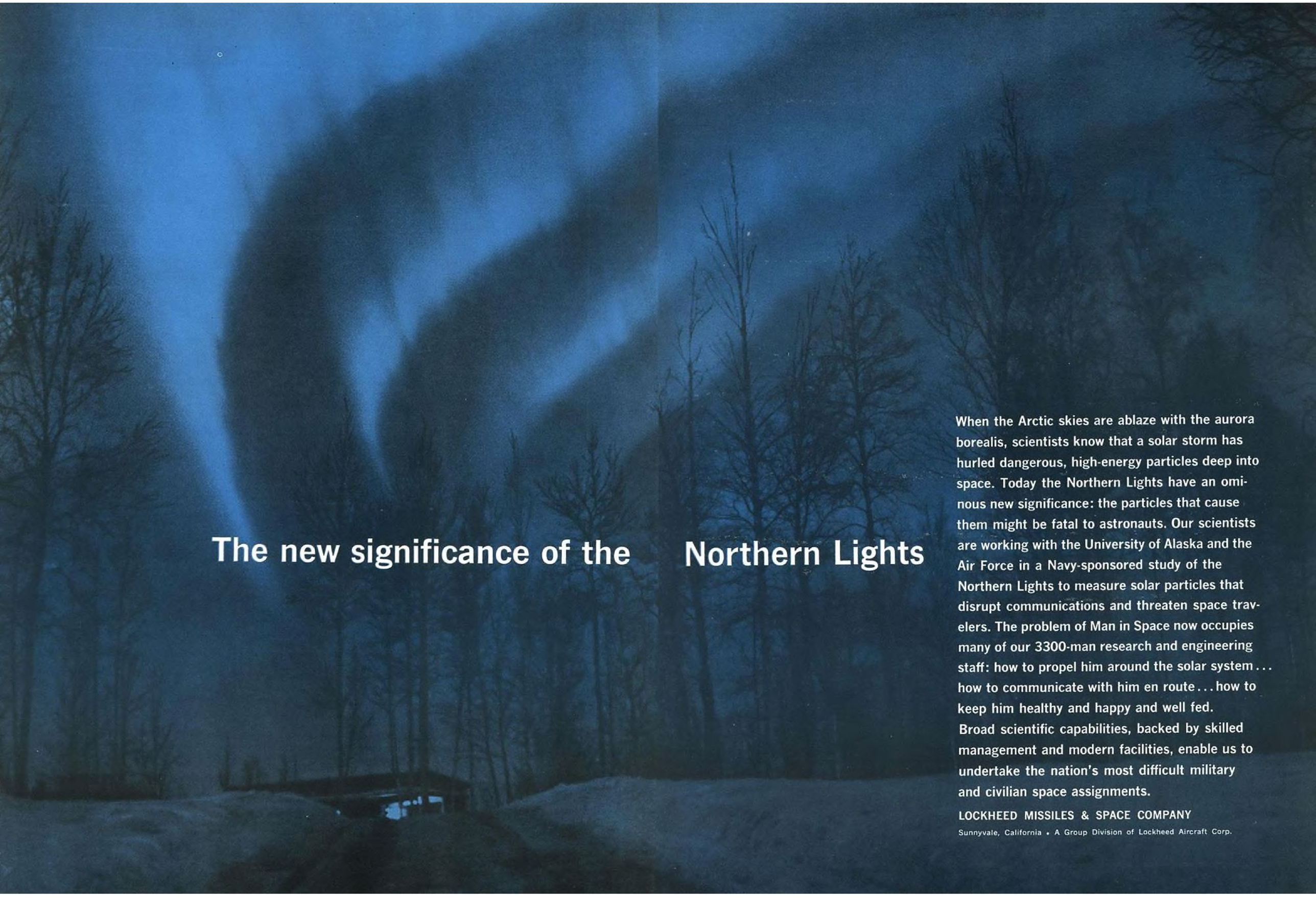
A PRODUCT OF DELAVAN EXPERIENCE

General Electric's J93 turbojet engine is designed to fly about 2000 miles an hour at altitudes between 60,000 and 70,000 feet. This is the Afterburner Spray Bar manufactured by Delavan for use on the J93.

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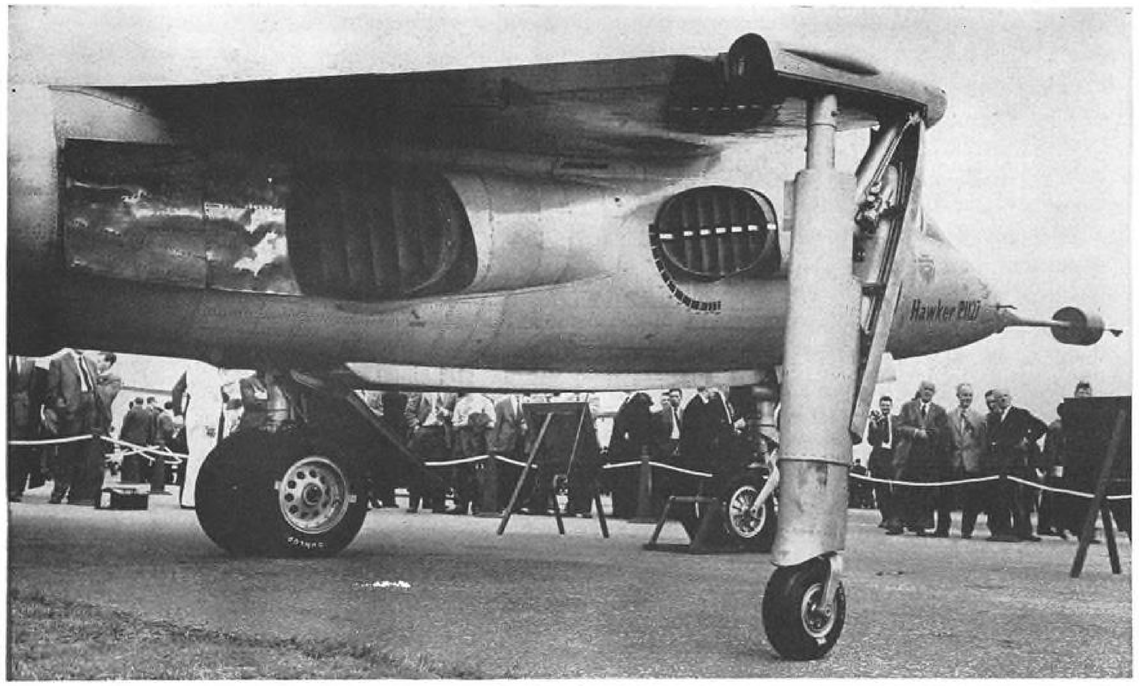
The new significance of the Northern Lights

When the Arctic skies are ablaze with the aurora borealis, scientists know that a solar storm has hurled dangerous, high-energy particles deep into space. Today the Northern Lights have an ominous new significance: the particles that cause them might be fatal to astronauts. Our scientists are working with the University of Alaska and the Air Force in a Navy-sponsored study of the Northern Lights to measure solar particles that disrupt communications and threaten space travelers. The problem of Man in Space now occupies many of our 3300-man research and engineering staff: how to propel him around the solar system . . . how to communicate with him en route . . . how to keep him healthy and happy and well fed.

Broad scientific capabilities, backed by skilled management and modern facilities, enable us to undertake the nation's most difficult military and civilian space assignments.

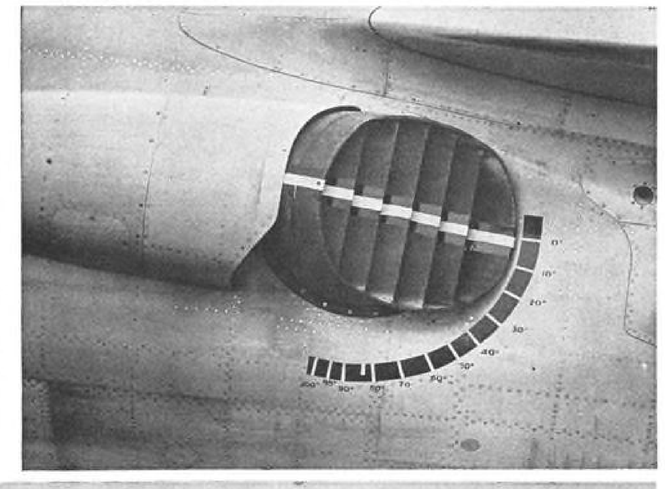
LOCKHEED MISSILES & SPACE COMPANY

Sunnyvale, California • A Group Division of Lockheed Aircraft Corp.

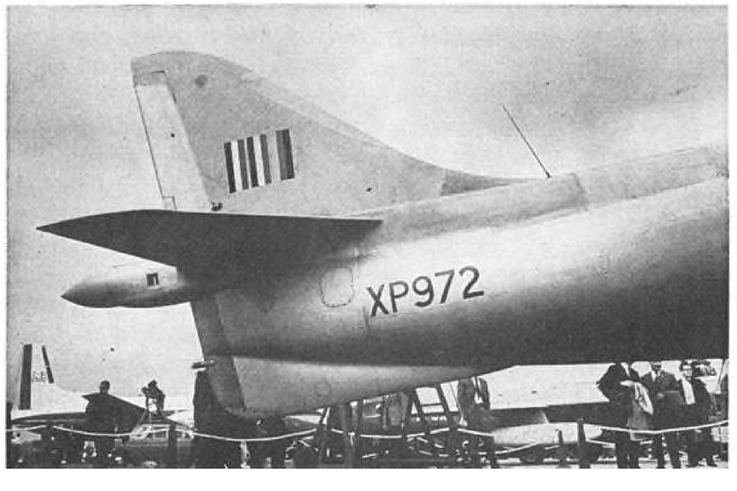


Hawker P.1127 VTOL Details Are Shown

Hawker P.1127 VTOL strike fighter on static display, above, shows unusual wing-tip outrigger gear and starboard exhaust nozzles of the Bristol Siddeley BS.53 vectorable thrust powerplant. Note exhaust shield on fuselage behind aft nozzle. Outrigger gear retracts rearward into semi-cylindrical wells (AW Sept. 17, p. 54). Photo at right shows forward exhaust port and aerodynamic fairing. Angular calibration on fuselage and stripe on vanes indicate deflection of nozzle. Note that nozzle may be swiveled approximately 10 deg. past vertical, enabling aircraft to move rearward in hovering flight. Orifices for bleed-air attitude control jets may be seen below in wing tip, left, and in faired afterbody at right. Aircraft shown is third prototype in series.







PRODUCTION BRIEFING

United Technology Corp. has been awarded an interim contract by Air Force's Space Systems Division for preparation of development plans for the 120-in.-dia. segmented solid propellant rocket motor which is to be used in the booster stage of the Titan 3 launch vehicle. Plans will cover preparation of model specifications and the design, fabrication and testing of the rocket motor.

Astropower, Inc., Costa Mesa, Calif., is studying compatibility of various metals and alloys with high energy rocket propellants under a $170,933 contract to provide Air Force Systems Command's Aeronautical Systems Division with information on suitability of materials for fuel tanks in which oxygen-fluorine liquid propellants would be stored during space missions. Materials tested also will have applications in propulsion system pipes and valves.

Avco Corp. will build a large-scale superconducting magnet for use in nuclear physics experiments at the Argonne National Laboratories. The magnet, which will have an inside diameter of 10 in., will produce a field strength of 50,000 gauss. Development is financed by a $147,775 contract from the Argonne Laboratory.

North American Aviation, Inc., has received a $9-million letter contract to begin production of 36 additional T3J-1s, Navy's version of the Air Force T-39. NAA is currently building 10 T3J-1s under a previous contract. New contract calls for delivery of three aircraft a month beginning in June, 1963.

Fairchild Stratos Corp.'s Aircraft-Missiles Division has been selected to build the heat shield for the mobile medium-range ballistic missile (MMRBM) re-entry vehicle which will be developed by Ford Motor Co.'s Aeronutronic Division (AW Oct. 8, p. 30). Contract covering a four to six month definition phase, was awarded by AFSC's Ballistic Systems Division.

Vitro Corp. of America has been awarded a $10,840,816 Navy contract continuing its system coordination engineering work on the Polaris Fleet Ballistic Missile weapon system and expanding its activities in testing and support for the Polaris submarine fleet.

Bendix Corp.'s Eclipse-Pioneer Division will continue to perform engineering services for the Pershing missile system and produce components for its guidance system under new Army contracts totaling $24,780,387.

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EE 2-54


Water Alcohol Check Valve


Direct Acting Solenoid

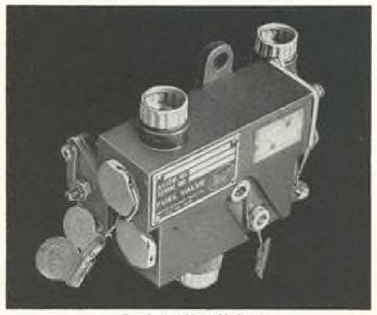

Thermostatic Air Bleed Valve

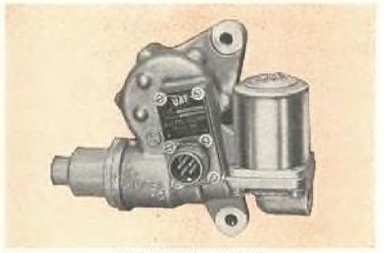

Oil Dilution Solenoid

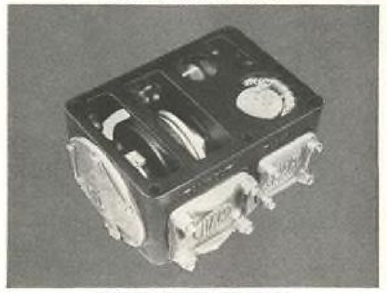

Brazed Fuel By-Pass Valve


Pressure Regulator


Thermal By-Pass Valve

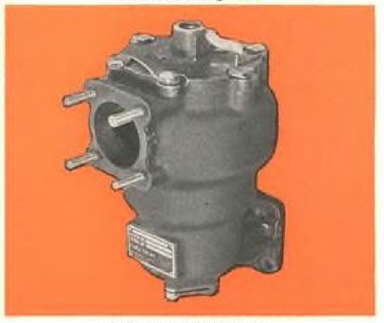

Fuel Igniter Valve


Hot Streak Igniter


Diverter Segregator Valve



Aerofuse

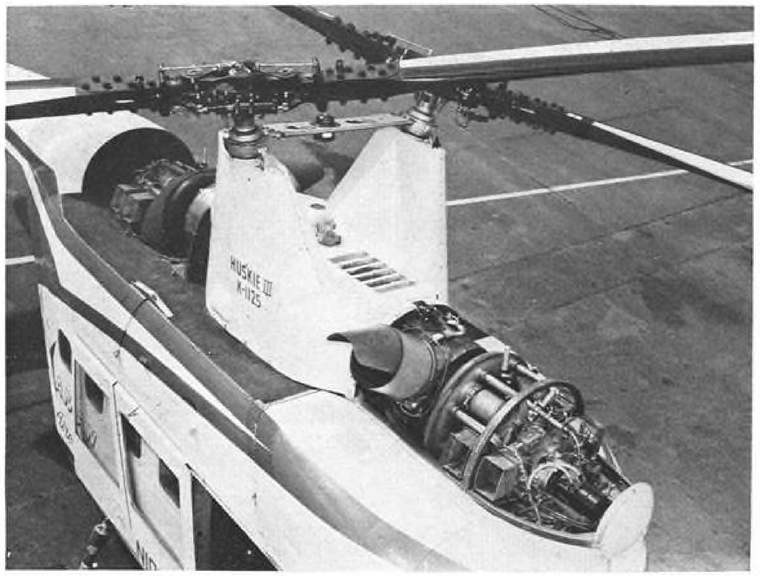

Fuel Throttling Valve

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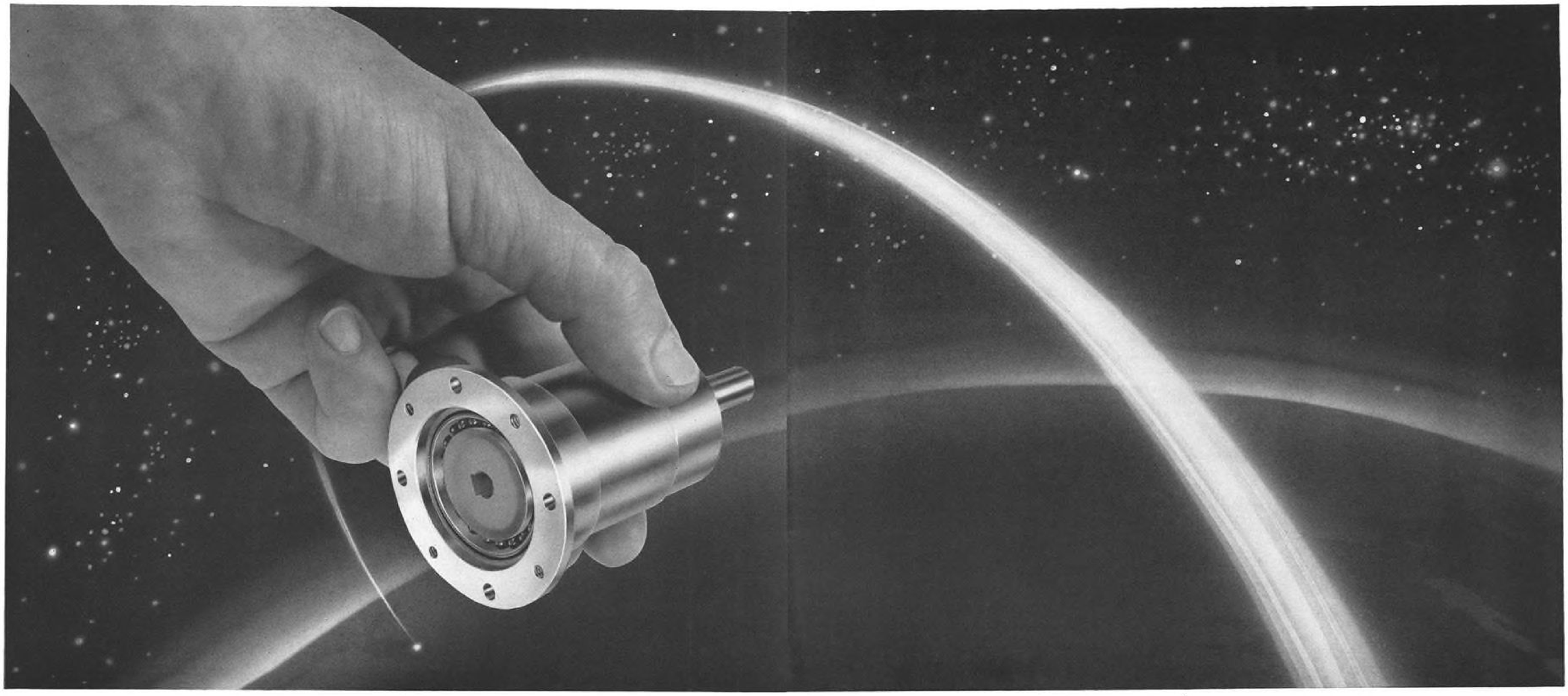
Kaman K-1125 helicopter has twin Boeing YT-60 engines arranged fore and aft of rotor towers. Engine intakes are small oblong shapes on side (above left) which deliver air directly to single-piece, back-to-back centrifugal compressor. Helicopter has been flown with small, forward-facing airscoops for noise preventive purposes. Right, tail surface arrangement is shown.

Kaman K-1125 Engine Placement, Details Shown





New cockpit and frontal area design is shown. Air intakes above windshield, left, are for oil cooling system. Note single piece, movable elevator on tail boom in photo at right. Boom's humpbacked appearance is caused by vibration fix (AW Oct. 8, p. 102).



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Funds, Manpower Shift West, Northeast

By Larry Booda

Washington—Shift in federal spending for defense and non-military space activities among geographical areas and changes in the types of goods and services purchased has spotlighted the concentration of technical manpower on the West Coast and northeastern U.S.

Two recent surveys, one by the Defense Dept. and the other by the Commerce Dept., show that the changing nature of procurement from high volume hardware production to increased emphasis on research and development and low-volume custom production has caused a shift in contract awards and the use of scientists and engineers.

According to the Commerce Dept. survey, 60% of the research and development performed in industry in 1953 was financed by industry itself for commercial purposes. The other 40% was financed by the government for defense, space and other purposes.

In 1961, that proportion was exactly reversed, with 60% of industry-performed research and development being paid for by the government. In 1953, 1.7% of the research and development money went into space activities. By 1961, this had risen to 10%. It is higher now, but specific figures are not yet available.

In 1961, 69.1% of all prime military contracts for research and development were placed in five states. California led with 41.3%, with New York following with 12.2%, Massachusetts 5.8%, Washington 4.9%, and Colorado 4.9%. New Jersey had 3.8%, Pennsylvania 3.7%, Maryland 3.4%, Utah 3.0%, Florida 2.5%, Ohio 2.3% and Connecticut 2.0%.

The remaining 10.3% was spread among the remaining 38 states. California, Washington and the northeastern states accounted for 77% of these contracts in 1961.

Over-all Defense Dept. prime contracts for supplies, research, development, services, construction and facilities are expected to rise to $27 billion in Fiscal 1963, up $2 billion from Fiscal 1962. Of this total $20 billion will be for hardware, compared with $18 billion in Fiscal 1962. The total dollar amounts for previous years included in the Defense Dept. study were $20.4 billion in Fiscal 1960 and $22.1 billion in Fiscal 1961.

About 80% of the major Defense Dept. procurements now are for hardware. The proportion devoted to missiles has leveled off at about one third after rising steadily since the mid-1950s. Spending for aircraft has also reached a plateau of 28%, representing a decline since a peak reached during the Korean war.

Army ordnance purchases had gone down to 12.5% last June, but are now on the rise. Ship construction and modernization has been holding steady at 8%, down from a peak of 26% during World War 2.

The biggest rise in hardware procurement for Fiscal 1963 will be in Army weapons and electronics other than those associated with major weapon systems.

It was noted by Deputy Secretary of Defense Roswell Gilpatric that mass production industries have tended to shy away from development and production of sophisticated systems. These systems require more emphasis on development and then custom—rather than mass—production, he said.

He also noted the concentration of research talent in California and Washington, but added that in Fiscal 1962, the central states started making a comeback in this field.

J. Herbert Hollomon, assistant Secretary of Commerce for science and technology, stated recently that technically educated people are the most necessary ingredient in the conversion of raw material to finished product. "They are also the chief limiting factor to our technical progress. You can't increase the supply of brains on an assembly line," he said.

"They are an irreplaceable resource in need of conservation—the one we can least afford to waste. Witness the scramble after World War 2 by the occupying powers to persuade or to kidnap key technical personnel," he said.

In 1963, the Commerce Dept. survey stated, the supply of scientists and engineers for research and development is expected to increase by 27,000. But the increase in the space research and development effort alone will require 25,000 additional scientists and engineers. This is almost the entire new supply and is equivalent to about 20% of the total now in commercial-industrial research and development.

Hollomon said this was the distribution of the number of scientists and engineers per million population in 1961:

Midwest	7.5
West	12.4
Middle Atlantic	10.4
New England	10.3
South	8.1



S-61 Delivered to Japanese Carrier

Sikorsky S-61 helicopter arrives at Brooklyn, N. Y., to be shipped to Japan's Nitto Airlines for use in and around Osaka. The helicopter was carried to Japan aboard the Hudson Maru, Japanese vessel. The twin-turbine helicopter was the first of its kind scheduled for Japanese use. Order was handled by Mitsubishi Heavy Industries, Ltd., a Sikorsky licensee.

In the same year the dollar value per million population of all military contracts was as follows:

Midwest	$70,000
West	260,000
Middle Atlantic	130,000
New England	230,000
South	70,000

Dollar value of military research and development contracts in Fiscal 1961 was:

Midwest	$9,000
West	128,000
Middle Atlantic	35,000
New England	47,000
South	10,000

Scientist, Engineer Breakdown

The total supply of scientists and engineers in 1961 was 1,400,000—400,000 of whom were doing research and development work. Of that number, 250,000 were working on research and development for defense and space and 120,000 for private commercial and industrial purposes. Of the 120,000, 100,000 worked for 300 companies that did 80% of the research and development performed and financed by industry. This left 20,000 for all the other commercial and industrial enterprises in the U. S.

"This increasing concentration or bias of our scientific and technological capability as to purpose, geography, companies and use of manpower is aggravated by the fact that our technically qualified manpower is now a critically scarce resource . . .," Holloman said. "Some of the goals are going to be achieved at the expense of other equally vital ones. . . . We must face up to the urgent necessity to do something now that will enable us to meet all our national commitments."

Hollomon stated that there must be a more effective diffusion of technology from the space and defense effort to other parts of the government and in civilian industry. This, he asserted, can be done by streamlining the methods of disseminating information. One way would be to use automatic information handling systems and other new devices, he said.

He also said that there must be industry-government cooperation so that the risks of large projects can be shared and the technological gap between leading and lagging firms narrowed.

Hollomon included a plea for support of education in the physical sciences, pointing out that Russia graduates 120,000 engineers per year compared with 35,000 for the U. S.

"If we continue the biased concentration of our resources in a few geographical areas, in a few industries and companies and in a few narrow fields of highly specialized science not necessarily supporting growth or serving society's basic needs, we will in fact have created in the process an environment in which science itself cannot

Total Military Prime Contract Awards

BY STATE AND REGION

(Includes supply; research, development, test and evaluation; construction; and facility contracts of $10,000 or more, within the United States)

	FY 1960		FY 1961		FY 1962	
	Millions of dollars	Percentage of total	Millions of dollars	Percentage of total	Millions of dollars	Percentage of total
NEW ENGLAND						
Maine	32	0.2	97	0.4	80	0.3
New Hampshire	72	0.4	105	0.5	59	0.2
Vermont	19	0.1	16	0.1	16	0.1
Massachusetts	1,070	5.2	1,072	4.8	1,310	5.2
Rhode Island	26	0.1	25	0.1	58	0.2
Connecticut	839	4.1	1,019	4.6	1,213	4.8
Total	2,058	10.1	2,334	10.5	2,736	10.8
MIDDLE ATLANTIC						
New York	2,378	11.7	2,643	12.0	2,669	10.7
New Jersey	1,275	6.2	950	4.3	1,063	4.3
Pennsylvania	671	3.3	804	3.6	952	3.8
Total	4,324	21.2	4,397	19.9	4,684	18.8
EAST NORTH CENTRAL						
Ohio	907	4.4	1,004	4.5	1,063	4.3
Indiana	311	1.5	353	1.6	637	2.5
Illinois	385	1.9	437	2.0	531	2.1
Michigan	601	2.9	590	2.7	678	2.7
Wisconsin	167	0.8	222	1.0	259	1.0
Total	2,371	11.5	2,606	11.8	3,168	12.6
WEST NORTH CENTRAL						
Minnesota	193	0.9	189	0.9	297	1.2
Iowa	147	0.7	127	0.6	179	0.7
Missouri	337	1.7	338	1.5	546	2.2
North Dakota	9	.....	13	0.1	100	0.4
South Dakota	44	0.2	28	0.1	113	0.5
Nebraska	71	0.4	51	0.2	53	0.2
Kansas	574	2.8	539	2.4	394	1.6
Total	1,375	6.7	1,285	5.8	1,682	6.8
SOUTH ATLANTIC						
Delaware	53	0.3	28	0.1	47	0.2
Maryland	516	2.5	528	2.4	569	1.9
District of Columbia	95	0.5	150	0.7	182	0.7
Virginia	422	2.1	505	2.3	446	1.8
West Virginia	36	0.2	62	0.3	134	0.5
North Carolina	173	0.9	237	1.1	269	1.1
South Carolina	31	0.2	41	0.2	65	0.3
Georgia	178	0.9	301	1.4	337	1.4
Florida	490	2.4	493	2.2	645	2.6
Total	1,994	10.0	2,345	10.7	2,594	10.5
SOUTH CENTRAL						
Kentucky	33	0.2	46	0.2	44	0.2
Tennessee	109	0.5	144	0.7	184	0.7
Alabama	103	0.5	106	0.5	154	0.6
Mississippi	47	0.2	69	0.3	100	0.4
Arkansas	11	0.1	47	0.2	85	0.3
Louisiana	197	1.0	139	0.6	244	1.0
Oklahoma	147	0.7	123	0.6	136	0.5
Texas	1,138	5.6	1,138	5.1	1,006	4.0
Total	1,785	8.8	1,812	8.2	1,953	7.7
MOUNTAIN						
Montana	27	0.1	95	0.4	31	0.1
Idaho	47	0.2	14	0.1	26	0.1
Wyoming	42	0.2	24	0.1	23	0.1
Colorado	247	1.2	466	2.1	565	2.3
New Mexico	78	0.4	64	0.3	61	0.2
Arizona	169	0.8	245	1.1	153	0.6
Utah	176	0.9	350	1.6	299	1.2
Nevada	9	.....	9	.....	8	.....
Total	795	3.8	1,267	5.7	1,166	4.6
PACIFIC						
Washington	715	3.5	646	2.9	921	3.7
Oregon	24	0.1	28	0.1	46	0.2
California	4,839	23.7	5,277	23.9	5,993	23.9
Total	5,578	27.3	5,951	26.9	6,960	27.8
ALASKA AND HAWAII						
Alaska	79	0.4	92	0.4	63	0.3
Hawaii	49	0.2	27	0.1	32	0.1
Total	128	0.6	119	0.5	95	0.4
Grand Total	$20,407	100.0%	$22,112	100.0%	$25,039	100.0%

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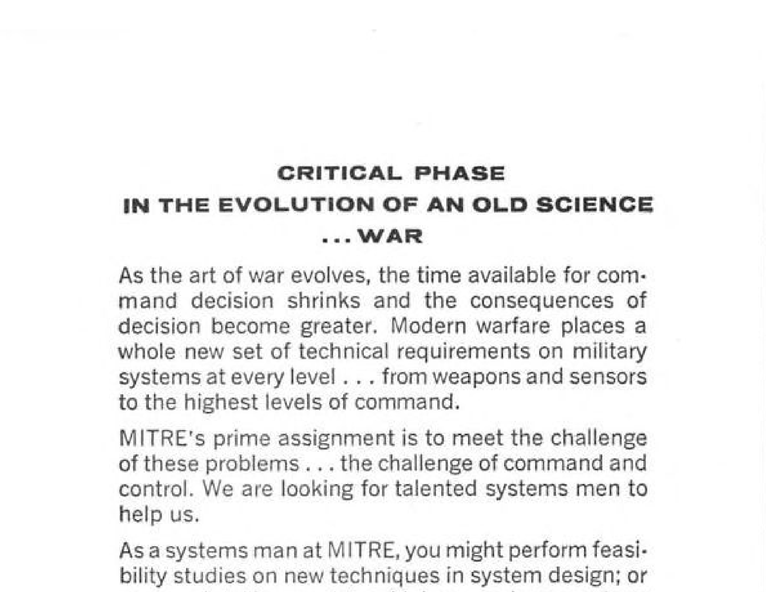
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flourish and the society cannot afford," he said.

The Defense Dept. survey pinpointed shifts in the department's spending for prime contracts in Fiscal 1960 for every region of the continental U. S.

In terms of dollars spent, every region gained. This reflected the increased Defense Dept. spending during this three-year period. In terms of percentages, however, the Middle Atlantic and South Central states decreased.

Contract awards to 34 states increased during this period and 16 decreased. Those in the Rocky Mountain region received the greatest dollar value percentage increase with 47%. This largely reflected the start of operations of the Martin Marietta plant in Denver.

Two states suffered severe losses, Texas and Kansas. In the case of Texas, the phaseout of B-58 bomber production at the General Dynamics Fort Worth plant accounted for the drop from $1.13 billion to $1 billion in value and a national percentage drop from 5.6% to 4.0%. The narrow scope of the survey was evident in this instance, however, for Texas gained from another government agency with the establishment of the National Aeronautics and Space Administration's Manned Spaceflight Center at Houston.

The Kansas drop from $574 million to $394 million and from 2.8% to 1.6% is the result of phaseout of B-52 production at the Boeing Co.'s Wichita plant.

California leads in dollar volume of contracts at $5.99 billion, outstripping every other state and every region. This represents an increase of $1.38 billion over Fiscal 1960. Percentage increased from 23.7 to 23.9. Second largest dollar volume went to New York, but the percentage of that state dropped from 11.7 to 10.7.

The other large volume states were Massachusetts, which rose from $1.07 billion to $1.3 billion with the percentage remaining the same at 5.2; New Jersey, which dropped from $1.27 billion to $1 billion and a percentage drop from 6.2 to 4.3; Pennsylvania, which rose from $671 million to $952 million and gained from 3.3% to 3.8%; and Washington, which rose from $715 million to $921 million and gained from 3.5% to 3.7%.

Beech Fiscal 1962 Sales Show Decline

Fiscal 1962 sales of $67 million were announced last week by Beech Aircraft Corp., the second consecutive decline for the Wichita, Kan., aircraft and missile manufacturer.

Sales for Fiscal 1961 were $70 million and sales for Fiscal 1960 were $98.7 million (AW Oct. 23, p. 105).

Federal Aid Sought To Update Training

New York—Cost of programs to keep engineers and scientists current with new technology remains a prime stumbling block to the U. S.'s realization of the full potential of its technical manpower. And this obstacle is likely to remain until the government furnishes some kind of financial support to retraining and utilization programs, according to opinions expressed publicly and privately at the Manpower Utilization Conference, here recently.

However, it appears that for the present, any comprehensive programs in the aerospace industry to re-train and better utilize the existing engineering and scientific force will remain voluntary and at the company's own expense.

Before the conference, which was sponsored by the Institute of the Aerospace Sciences at the request of the President's Office of Emergency Planning, there had been some speculation that the government might take a more active role in aiding industry to implement programs to re-train and keep scientists current with new technology. This view stems mainly from increasing talk by defense officials about closer control of engineers and scientists.

At the conference, over 100 delegates from aerospace companies throughout the U. S. were organized into workshops to seek remedies for the problem of "technical obsolescence" among scientists and engineers—a condition where the advance of technology decreases the usefulness of scientists and engineers who have not been kept abreast of developments.

The conference also considered the problem of whether any shortage of engineers now exists and how technical obsolescence, which tends to deprive the industry of the full potential of its engineering force, affects this aspect.

At the close of the conference, workshop chairmen reported a wide difference of opinion within their groups as to whether there is any actual shortage of engineers now. Consensus was that if the present declining trend in college engineering enrollments continues, there certainly will be by 1970. With this in mind, it appears imperative that industry get the full value out of the available engineering force.

Reports from the workshop chairmen made it clear that the aerospace industry knows what to do about the problem of keeping its scientific and engineering talent current with new developments. Privately, the delegates mainly questioned who puts these programs into effect and who pays for them.

Major aerospace firms and the Na-



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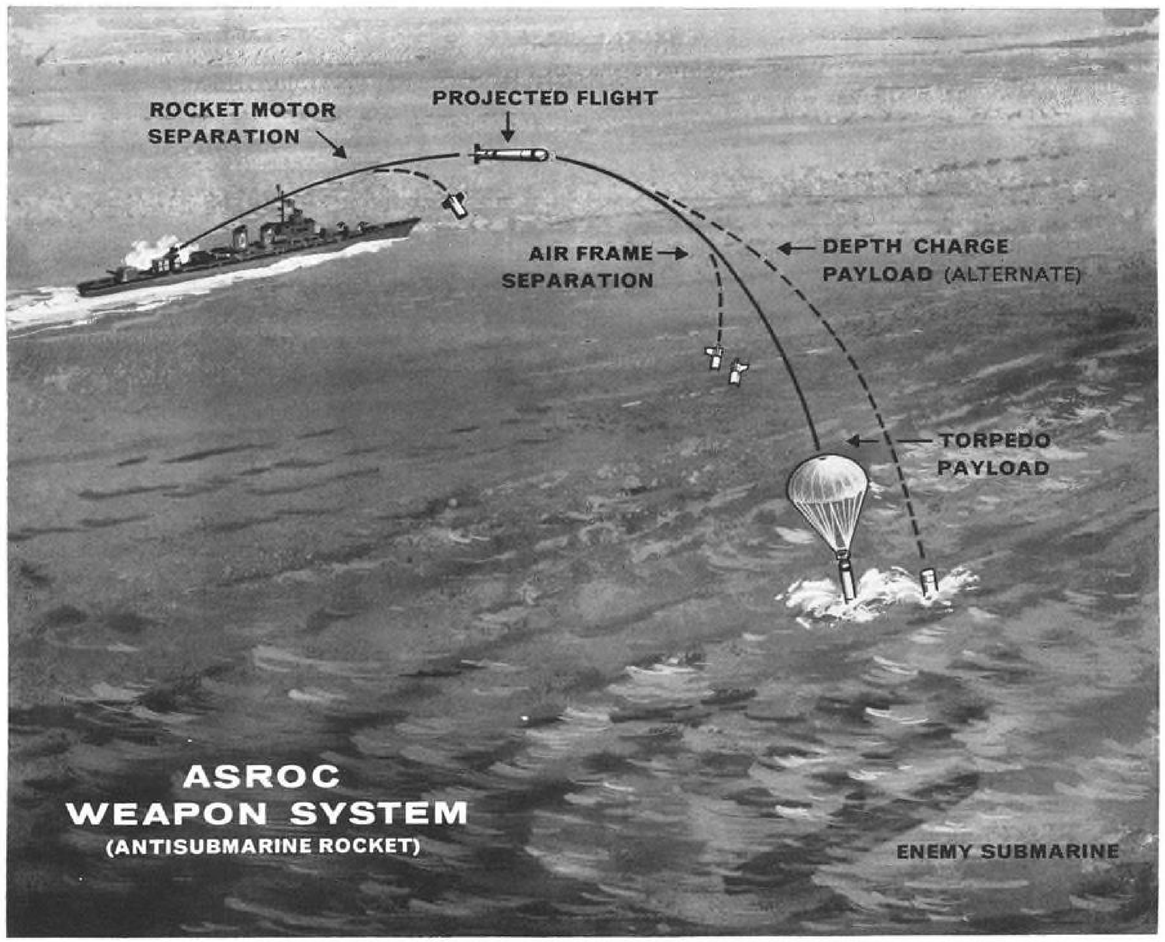
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New metal forming skills speed defense output

Honeywell offers facilities for all three of the most advanced methods of skin fabrication: hydraulic bulging, flow turning and explosive forming. Added to Honeywell's complete facilities for more conventional metal working, these newer techniques simplify many complex jobs.

A typical example is this weapon system externally stored on high-performance aircraft. The main body is rolled and welded in the conventional manner using standard equipment; the more difficult nose cone is flow-turned, the tail cone section is explosive formed.

Honeywell is conducting advanced research involving new methods and new metals (stainless steel, both low- and high-strength alloys; titanium; magnesium; nickel alloys; explosive hardening of beryllium; explosive compacting of copper) in the field of skin fabrication. Besides doing jobs that can't be handled by conventional processes, new refinements in technique are producing finer tolerances, greater flexibility, lower scrap rate.



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Honeywell-developed weapon gives craft long range anti-sub capability

As part of the Navy's modernization program, a formidable number of fleet vessels have been equipped with ASROC (antisubmarine rocket). Capable of blasting a sub with homing torpedoes or depth charges at a greatly extended range, ASROC was developed by the U.S. Naval Ordnance Test Station (NOTS), for the Bureau of Naval Weapons. As prime contractor, Honeywell is responsible for the entire ASROC weapon system, including computer, launcher, missiles and all aspects of control.

ASROC makes it possible for surface vessels to attack enemy submarines in a matter of seconds after detection. A combination of rocket, torpedo or depth charge, integrated with sonar and computer, ASROC detects and tracks submarines by bouncing short bursts of sound off the target. Returning echoes are magnified aboard ship to provide the course and speed of the target.

After the contact is identified and tracked, the ASROC payload (torpedo or depth charge) is aimed and launched with deadly accuracy by the shipboard digital fire-control system. During the entire search, detection, track and launch operation there is no need for the attacking vessel to maneuver or leave a convoy; ASROC can launch its weapons as the sonar identifies targets.

Sergeant missile battalions being activated

The Army's highly mobile Sergeant surface-to-surface missile will be the major striking force of battalions of nuclear artillery now being activated.

With a range of 75 miles, the 34½-foot, 10,000-pound Sergeant carries a Honeywell-developed warhead. Altogether, Honeywell has participated in more than two dozen missile programs in capacities ranging from prime contractor to supplier of precision inertial components.

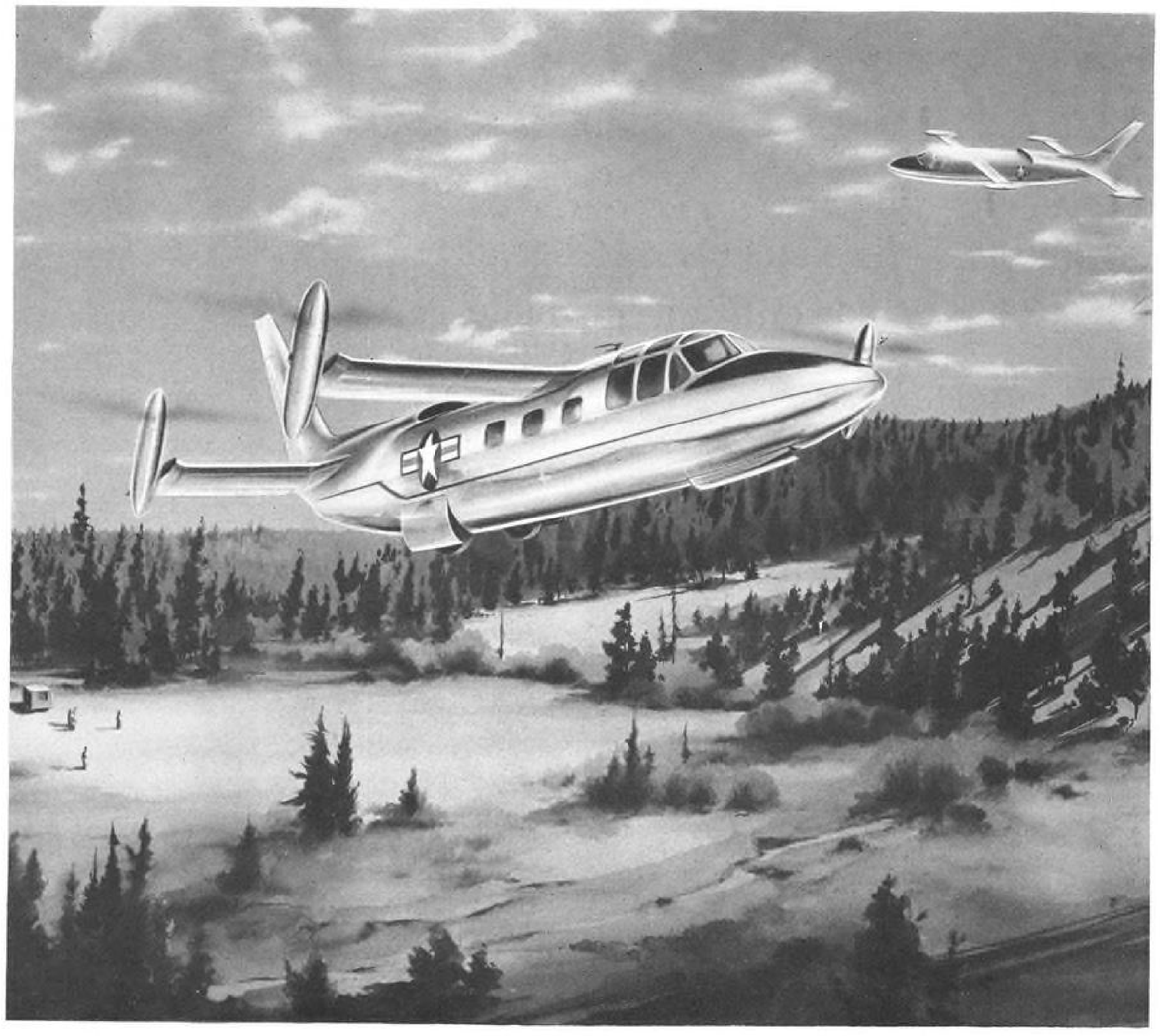


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The Curtiss-Wright X-19 . . . a new Flight System Concept

The twin-engine, four-propeller VTOL aircraft, pictured above, is being built today, under contract from the US Air Force, by Curtiss-Wright for operational evaluation and environmental testing by the Tri-Services: US Air Force, US Army, US Navy.

As conceived and developed by the Curtiss Division, the X-19 is designed to answer a military and commercial need for practical, efficient, high-speed VTOL aircraft. Combining vertical take-off and landing ability with one-engine-out safety, the tri-service X-19 utilizes tilt-propeller radial force to supplement thrust and wing lift for smooth stall-free transition.

Other design advantages include: flight speeds from hover to near-jet, long engine life, low outflow velocity at hover, extremely-low noise level, simple, stable operation in hover, transition, and cruise using conventional fixed-wing aircraft controls.

These attributes make the X-19 highly adaptable for a wide variety of all-weather operations. It is a new flight system concept by Curtiss-Wright.

Curtiss Division
Curtiss-Wright Corporation
Caldwell New Jersey

tional Aeronautics and Space Administration already spend large sums on engineer re-training programs and personnel to manage them, while many smaller firms are completely without such programs. Opinions of delegates indicated that the aerospace industry could do more to get full value out of its technical personnel if the government is willing to pay for it.

Two ideas of how the government might support these programs were suggested: One plan would give companies having technical manpower utilization programs a tax break to help offset the costs; another idea called for a change in government contract accounting procedures to cover re-training and administrative costs of such programs.

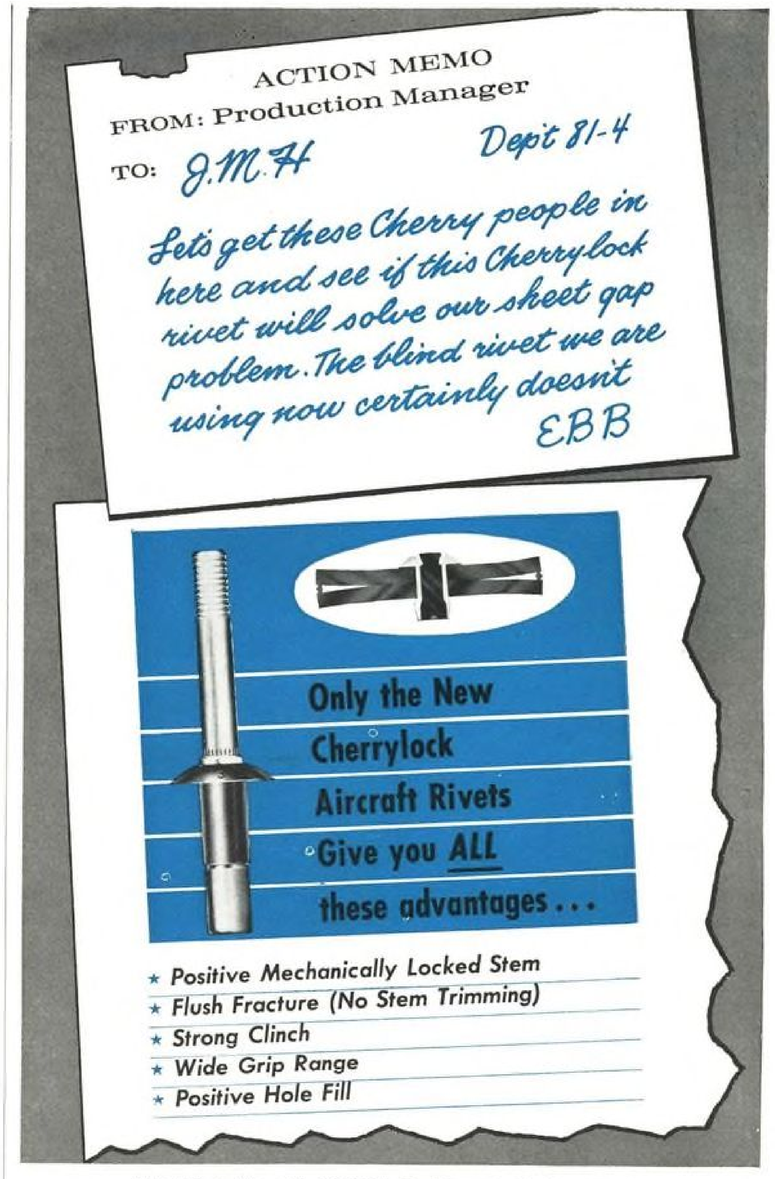
In summing up the results of the conference, William G. Torpey, consultant for the Executive Office of the President, said that over 70 ideas on better technical manpower utilization were brought up. Of these, he called the conferees' attention to 20 "take-home ideas" which companies could use on a voluntary basis.

Assistance Pledged

Torpey said that the solution to the problem of acquiring more effectiveness out of existing engineering and scientific talent was too broad to permit any rigid guidelines to be laid down. Torpey also pledged the assistance of his office to any firm wanting to work out a technical manpower utilization program.

Some ideas produced at workshops:

- **Graduate and short courses.** Industry should explore such things as additional time off and pay increases to stimulate interest in outside study.
- **Proper job assignment.** Don't use engineers and scientists in jobs that could be handled by technicians. Creative engineers should be recognized and allowed to advance at their own pace. Non-creative engineers should be assigned to non-creative tasks.
- **Status and incentives.** Achievement should be accompanied by advances in status such as new job titles and publication of deserving papers. Good work should be rewarded monetarily or by awards or both.
- **Some alternative** to proposal writing requirements. Most conferees agreed that proposal writing often keeps their best talent occupied when they could be working on development programs. Few had any concrete remedies, short of the government's designating a firm to undertake a given project—a solution most felt was unacceptable.
- **Better communication** between the engineer and management. Some felt communications were breaking down at the first line supervision level where new supervisor-engineers have not yet begun to think like management.



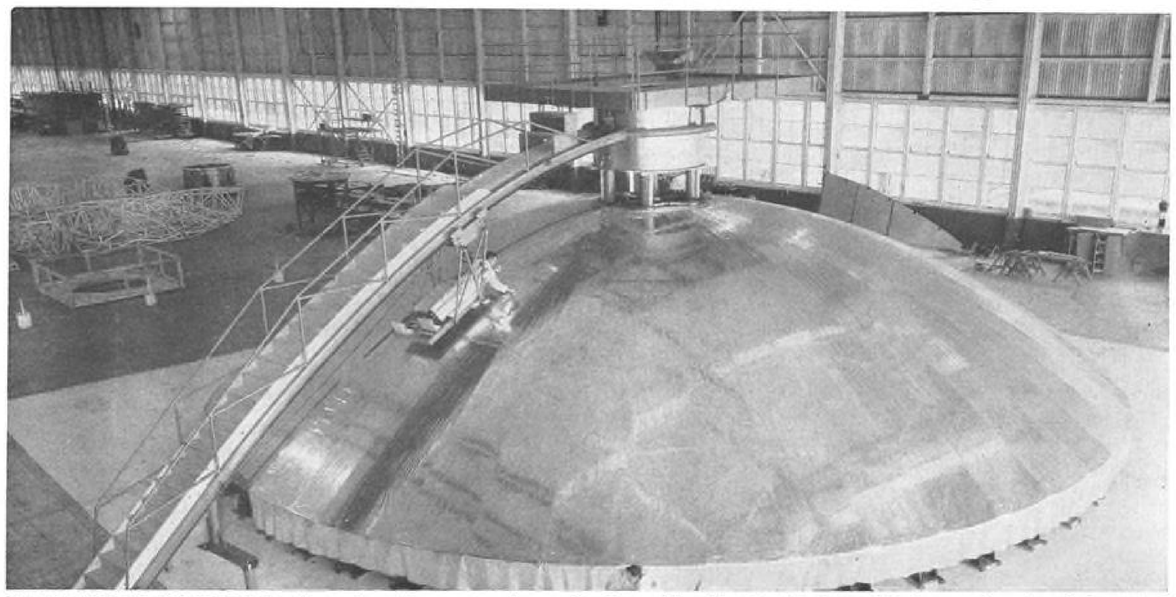
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SOLAR ENERGY COLLECTION reflector is under construction at Goodyear Aircraft's Ariz. Division. Workers apply strips of aluminized film to the form on which the 45-ft. inflatable foam rigidized collector is being built. Ground tests are set for early next year.

Goodyear Pushing MMRBM Transporter

By Arnold Sherman

Akron, Ohio—Phase One program definition of the transporter-launcher for the mobile medium-range ballistic missile (MMRBM) system is getting top priority at Goodyear Aircraft Corp. here.

This is happening despite the reluctance of North Atlantic Treaty Organization nations, over whose roads the transporter eventually will roll (AW Oct. 8, p. 30), to base the system within their borders and finance its production. Another obstacle is uncertainty as to just how far Defense Dept. will back the complete program.

External configuration of the transporter, which will have the capability of launching a two-stage, solid-propellant missile from 200 to 2,000 naut. mi., is expected to resemble either a furniture van or a tank truck. The top of the vehicle will slide open, the missile will automatically be erected and the firing will take place from a platform on the tail of the truck. (See artist's rendering that appeared in May 7 issue of AVIATION WEEK.)

Maximum width of the transporter will be eight feet. The vehicle will have to be capable of a 50-mph. speed on paved thoroughfares. It will be required to negotiate grades up to 30% and right-angle intersections not more than 23-ft. wide. The system will have to be operational after withstanding peak incident overpressure of 10 psi. min.

Although efforts probably will be made to make the vehicle as unobtrusive as possible, its identity will be unmistakable. Constant mobility, rather than disguise, will be its major asset. The device will be air-transportable by a C-130 workhorse.

Prior to launch, the vehicle will be driven off the highway and onto grass or gravel. Struts, located behind the front wheels, will sink into the ground, anchoring the truck during firing to ensure stability. Firing damage to the truck will be minimal, probably consisting of scorched areas around the tail platform.

Phase One costs are still being negotiated but AVIATION WEEK has learned that the dollar figure will approximate $500,000. Sen. Carl Hayden (D.-Ariz.), in announcing the contract, estimated that Goodyear's Litchfield Park, Ariz., facility would receive as much as $100 million in contracts if the system develops through Phase Three, production. The MMRBM task force is being mustered at Litchfield.

Robert W. Richardson, Goodyear Aircraft vice-president-sales, said the Navy has assigned three liaison officers to the Ballistic Systems Division as part of the program. One of the requirements for the launcher is a capability to be fired from ships as well as vehicles. "The system must be capable of hot launches [ignition on the launch platform of the truck] and cold launches [ignition of the missile in the air] from sea," Richardson said.

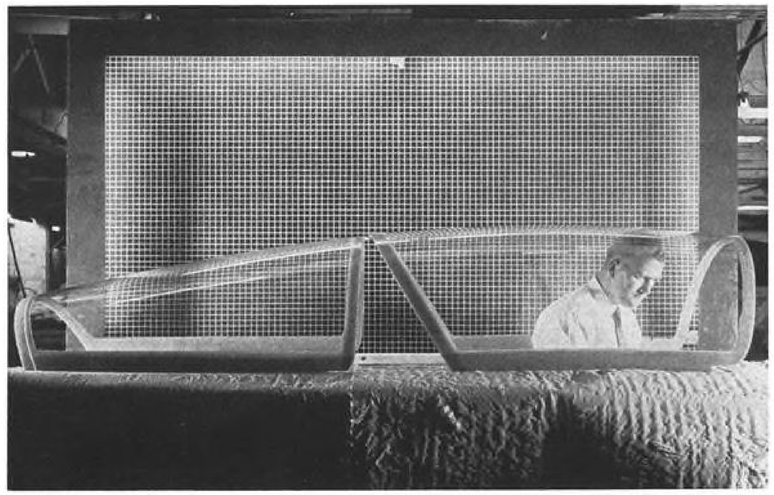
Final Defense Dept. decision to proceed with production of the vehicles is not expected before mid-1963. In the interim, after Phase One studies are completed, the next stage, Phase Two, will include construction and testing of a prototype vehicle.

T. A. Knowles, president of Goodyear Aircraft, told AVIATION WEEK that his design team had worked on the MMRBM proposal for two years.

DOD had narrowed the launcher-transporter competition to two companies. American Machine and Foundry was the runner-up. However, many of the large auto manufacturers also had bid on the competition, and Goodyear Aircraft, a wholly-owned subsidiary of Goodyear Tire and Rubber Co., finds itself in the position of having beaten some of the parent company's most important tire customers for the award.

In the over-all MMRBM program, Goodyear Aircraft figures as an associate prime contractor. Thiokol won the propulsion award; Ford Aeronutronic is responsible for the re-entry vehicle phase. Naming of an integration contractor is expected shortly.

Without minimizing the potential importance to Goodyear of MMRBM, the largest Goodyear contract extant is



GOODYEAR AIRCRAFT engineer gives forward and aft canopies for the Phantom 2 final inspection. Canopies are as transparent as plate glass and are inspected against a grid background. Canopies for the F4H and F-100 are produced at the company's Litchfield Park, Ariz. facility under subcontract from McDonnell Aircraft Corp.

Navy's Subroc anti-submarine warfare missile. Richardson said that test firings on land and underwater are going on at the present. He also said that Navy's nuclear attack-class submarines are being built to accommodate the Subroc missile, which is fired underwater like a torpedo, rises into the air where the warhead separates from the booster, and then re-enters the water on a collision course with its target.

"It's a complex bag of tricks," Richardson said. "You have to take into consideration hydrodynamics, aerodynamics, and re-entry." All work on Subroc is done at Goodyear's 3-million-sq.-ft. Akron plant. The 1-million-sq.-ft. Litchfield facility, which completes the GAC complex, was originally purchased for cotton manufacture, according to Richardson.

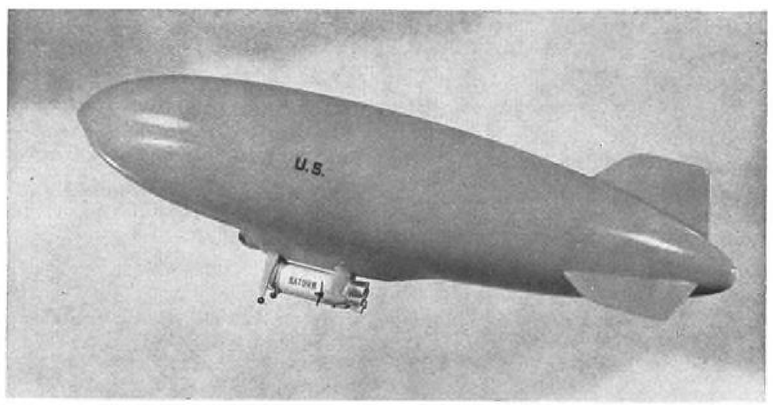
Goodyear Aircraft has been manufacturing blimps since World War 1 and considerable GAC effort is still directed at inflatable structures.

Goodyear recently unveiled a 30-ft. model of an inflatable space station which the company has entirely funded (AW Oct 20, p. 99). "We had hoped that NASA would show a greater interest in the proposal than they have," Richardson said. "Although we thought if we could generate any interest it would be from the Manned Spacecraft Center in Houston," he added, "interest seems to be coming from von Braun in Huntsville."

Company Funds

Asked if Goodyear would continue developing the station with its own funds, Richardson said the company will sink no more funds in the project.

Both Knowles and Richardson said they think the government and NASA are missing a good bet in not using



MODEL of a Goodyear ZPG-3W, modified for carrying Saturn S-4 stage, shows GAC concept for booster transportation by airship. Carriage of bulky radars was also suggested.

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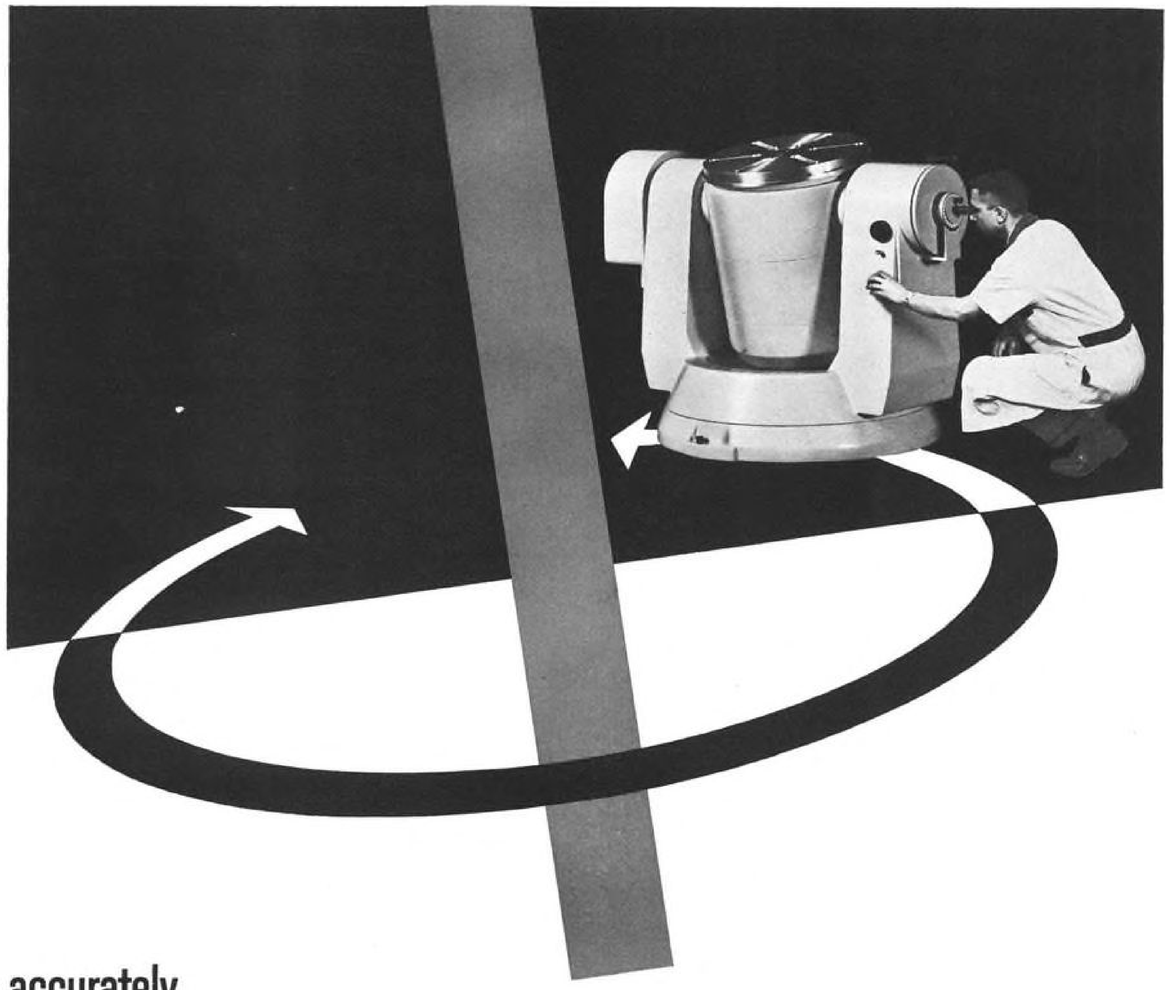
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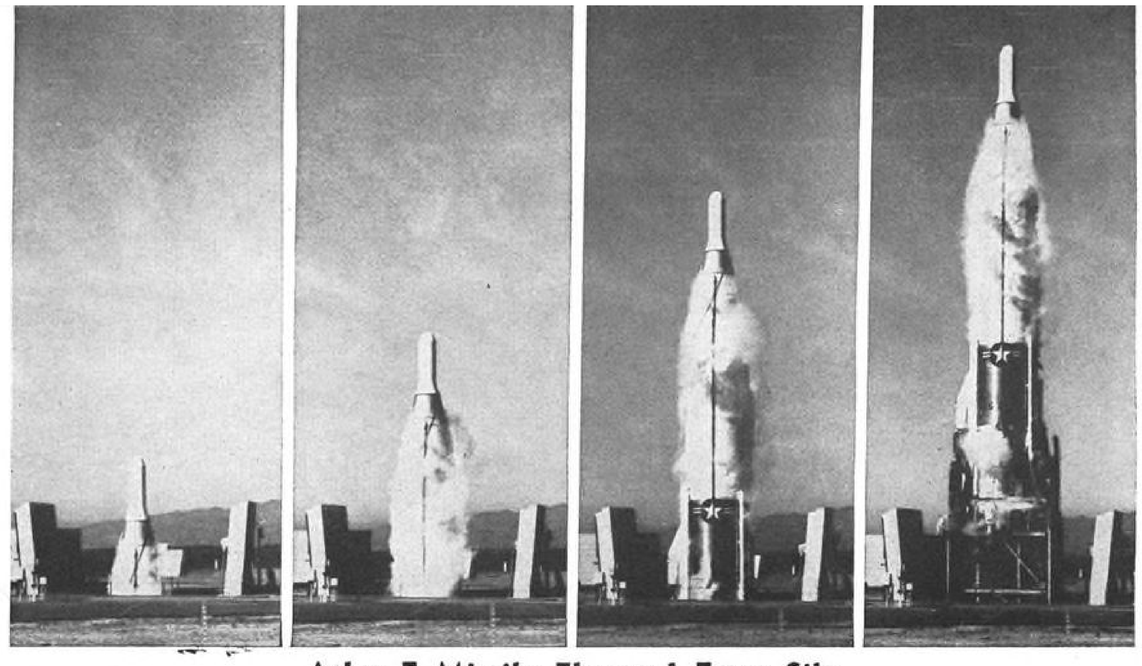
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Atlas F Missile Elevated From Silo

Fully fueled USAF Atlas F is shown in elevation sequence from an underground silo at Vandenberg AFB, Calif. Missile is sealed in its silo by 140-ton steel and concrete doors, which lift open to allow it to be elevated. Vapor is condensation from liquid oxygen.

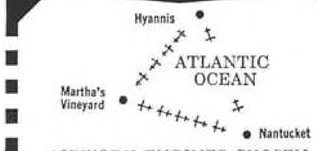
blimps as missile carriers. Knowles said that an airship can be built to haul a 150,000-lb. missile slung underneath it. Knowles pointed out that as effective as barges might be, salt sprays are a potential danger to their cargo.

"We have never recorded more than 1/2g in an airship," he said. "This is an important condition when you correlate it with sensitive missile components."

Richardson added that the blimps could easily carry bulky radar structures as well as the missiles.

A major Goodyear effort has been the building of receiver-transmitters for the Nike Zeus anti-missile system. Richardson said that GAC is the biggest hard-

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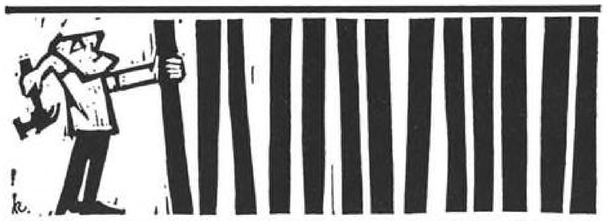
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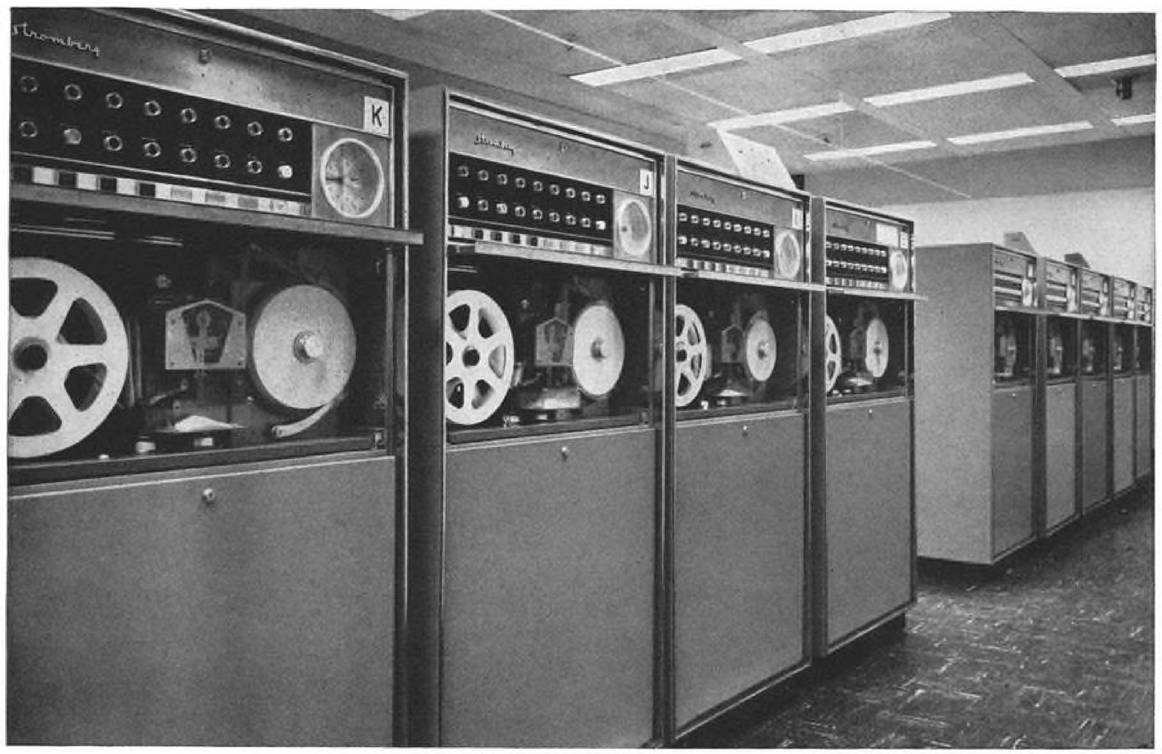


Near the town of Lunch, Nebraska there is a large triangular plot of land bounded by three straight roads which are 855, 870, and 975 yards long respectively. The owner of the land, a friend of mine, told me that he had decided to sell half the plot to a neighbor, but that the buyer had stipulated that the seller of the land should erect the fence which was to be a straight one. The cost of fences being high, my friend naturally wanted the fence to be as short as possible. What is the minimum length the fence can be? *—Contributed*

Our USECO Division's new line of plastic encapsulated cups come in all shapes and sizes to fit almost any electronic module or component. Molded of glass-filled diallyl phthalate, the cups are light, rugged, economical, and non-corrosive. Nice lookers, too! Their measurements are available from U.S. Engineering Co., 13536 Saticoy St., Van Nuys, Calif.

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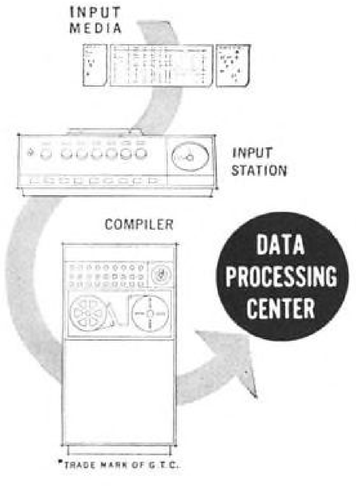


A partial view of the TRANSACTER System Compiler units at Boeing Transport Division.

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Initially installed in June 1960 at Boeing's Transport Division, Renton, Washington—TRANSACTER input stations and Compiler units are efficiently collecting, transmitting and recording vital, accurate production data for instantaneous processing. Thus management reports are continuously available for the never-ending improvement of Boeing customer service.

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ware subcontractor in the project. "If Nike goes, it will have a major impact on Goodyear," he said.

Among other Goodyear projects:

- **Design and erection** of the Ballistic Missile Early Warning System 84-ft. antenna.
- **Submarine antenna masts** for Polaris submarines.
- **Radome construction** for B-52, C-130 and RF-110 aircraft.
- **Canopies** for the F4H and RF-110.
- **Filament winding** of cases for the Polaris A3. (Richardson said Goodyear will attempt to get filament winding subcontracts for the MMRBM as well.
- **Center wing sections** for the B-52.
- **Advanced flight simulators** for the W2F and A2F.
- **Plexiglass windows** for all the Boeing 707s.
- **Side scan radar** for the RF-110 (AW Oct. 15, p. 37).

Goodyear recently completed fabrication of the 30-ft. mobile Syncom satellite tracking antenna under subcontract from Bendix Radio. The parabolic antenna is mounted on a pedestal which is attached to a 32-ft.-long erection trailer. The assembly weighs 34 tons.

Another current Goodyear Aircraft activity is the design of an inflatable fabric radio antenna which can double as a container for a radio transmitter to be used in ocean recovery of nose cones.

When the antenna package strikes the water, it is inflated by a salt water-activated device and the transmitter begins emitting signals to recovery teams in the area. The structure was designed under subcontract to Hughes Aircraft.

One paradox of the over-all Goodyear corporate pattern is that while there is a Goodyear Aircraft Corp., there is also a Goodyear Aviation Products Division, which is a unit of Goodyear Tire and Rubber Co. The products division manufactures aircraft wheels and brakes, tires and tubes, deicers.

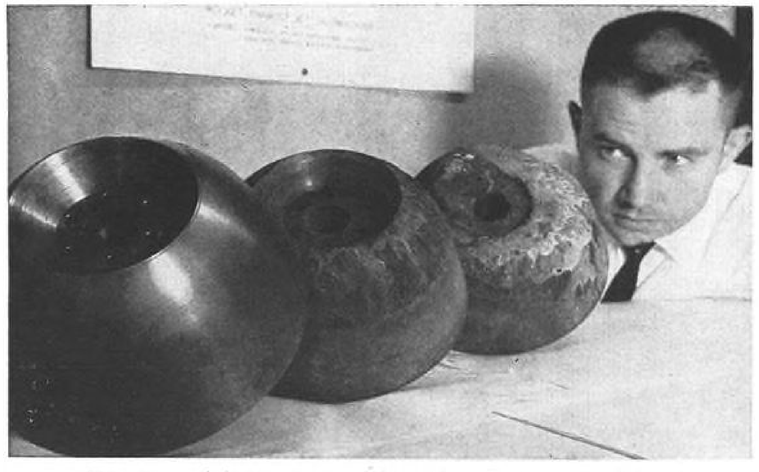
The products division handles rubber-based manufacturing; GAC is responsible for the larger metal-based construction. Asked why Goodyear maintains two separate organizations when it is apparent that one would probably do, Richardson shrugged and said: "The damn thing grew up that way."

Both Richardson and Knowles are part of an executive group which meets bi-weekly with Goodyear Tire officials. Knowles is the chairman of the committee. The purpose of the meetings is to acquaint Goodyear Tire with the progress, requirements and needs of the subsidiary.

As an integral component of the $1.5-billion rubber manufacturer, Goodyear Aircraft, unlike many other defense and aerospace firms, is seeking no diversification into consumer manufacturing. At present, 90% of GAC's work is defense-oriented. "And our objective is not to go into civilian consumer goods," Knowles said. "There is no pressure on us to do so," he added.

Richardson, apparently alluding to pressures being exerted by geographical and political considerations in contract awards, said: "We can't get the towel out and cry—not with Goodyear Tire backing us."

Knowles said that one of GAC's most critical problems is lack of technical personnel. "There is a great shortage of technical people in certain areas," he said. At present there are about 5,000 people employed in Akron—a third of these are engineers.



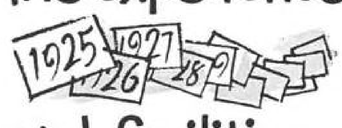
Device Measures Missile Exhaust Heat

Army Missile Command engineers have developed a calirometer, a small copper disk mounted in the tip of the steel holder, to get precise temperature readings of solid-propellant missile exhaust flame. Instrument weighs 50 lb.; resembles scaled-down missile nose cone. Heat is calculated through instrument ablation. Progression of erosion is shown above.

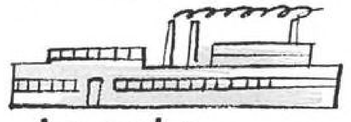
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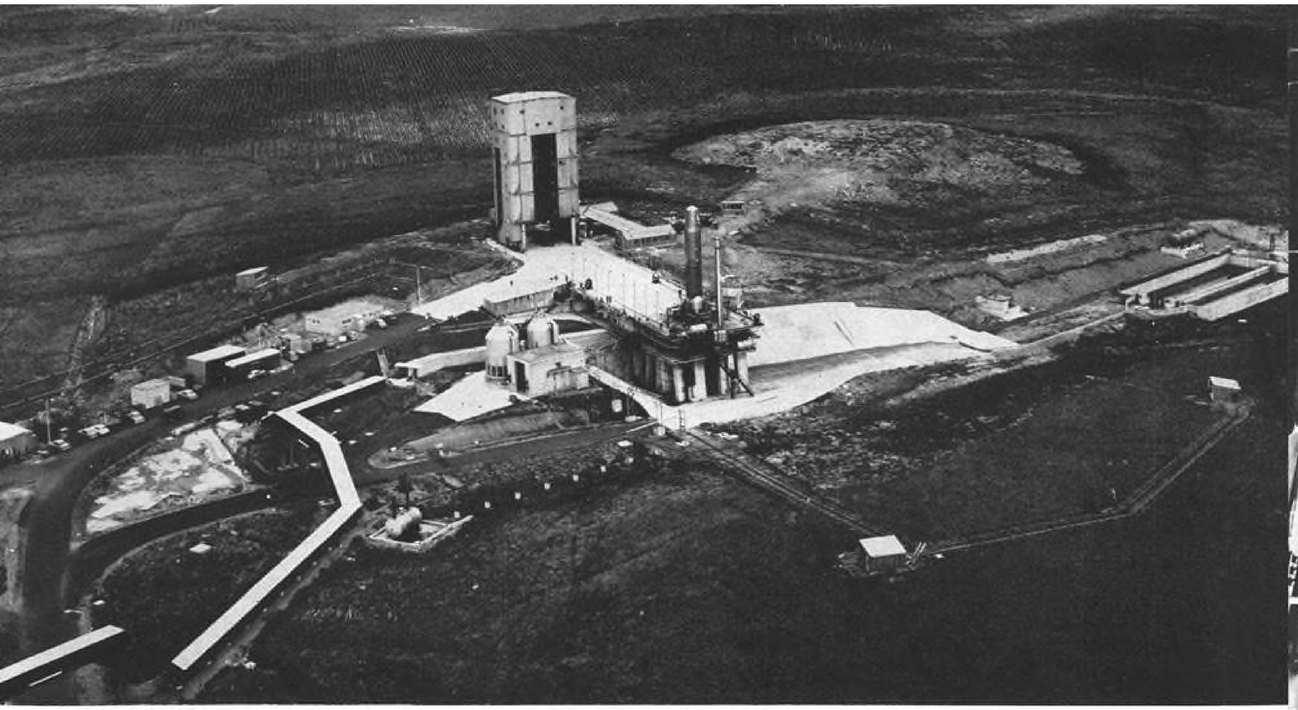
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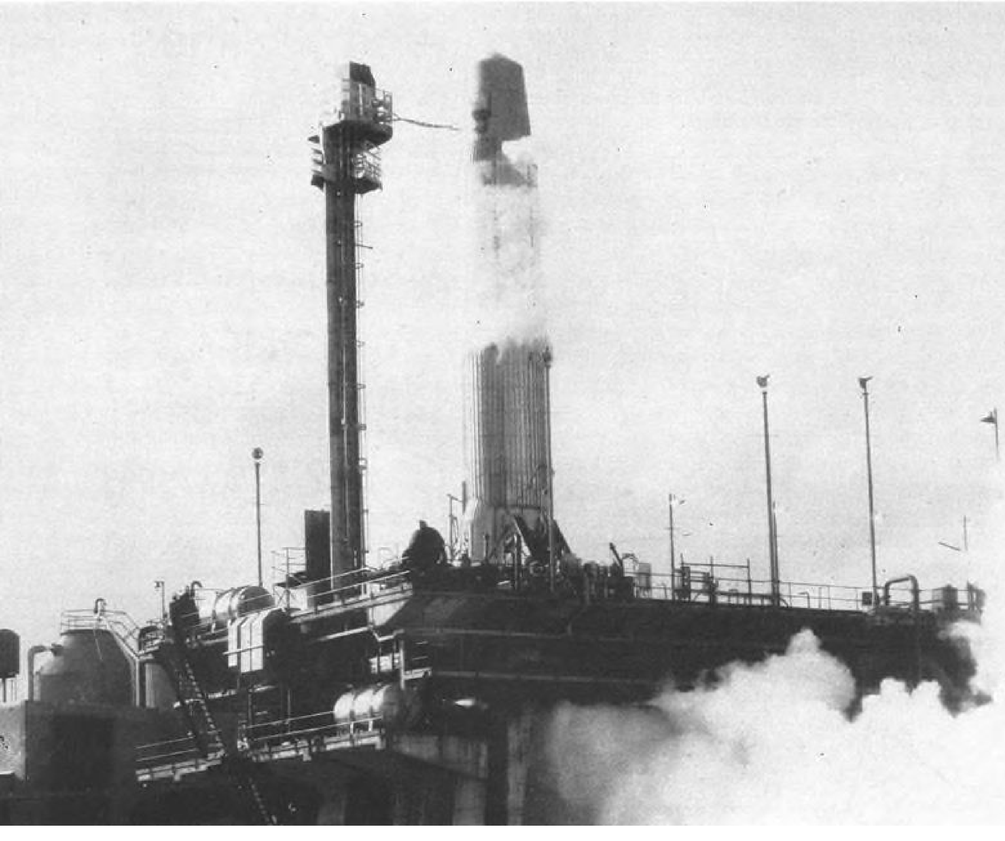
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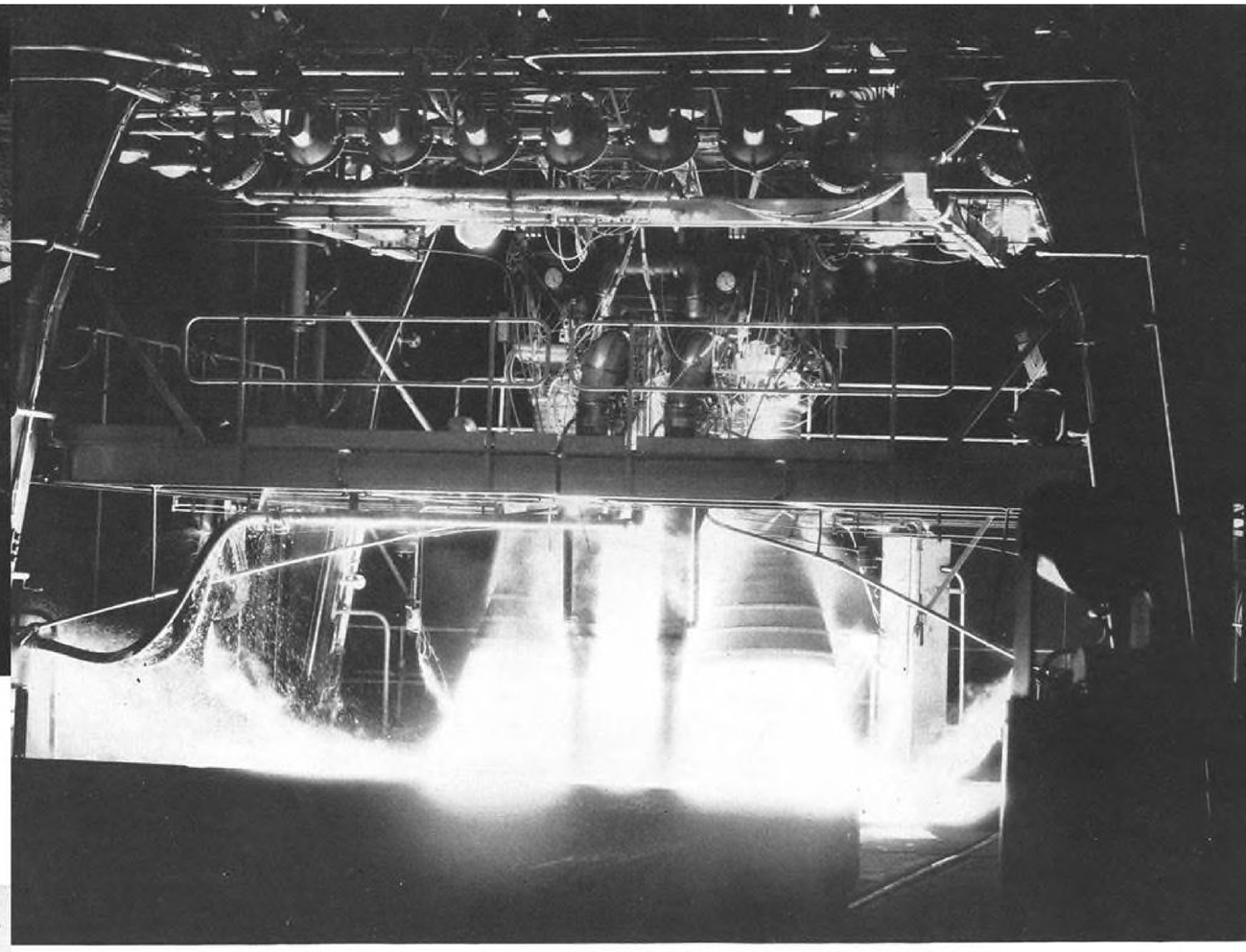


De Havilland Blue Streak, which will serve as first stage launcher on the joint European space vehicle program, is being static-tested at British Ministry of Aviation's Spadeadam Rocket Establishment near Carlisle, England. French-designed second stage is in advanced development phase, and West Germany is developing the third stage (AW June 25, p. 31).

Blue Streak Launcher Static-Tested at Spadeadam

Two Rolls-Royce RZ.2 rocket engines (AW July 17, 1961, p. 57) are fired at a thrust of 150,000 lb. each during a recent test of the Blue Streak at Spadeadam. This was 10% more thrust than needed for the first launch next year at Woomera, Australia, test range.





Closeup (above) shows firing of two RZ.2 engines for Blue Streak. Three test stands at Spadeadam are constructed of concrete and steel. Engines are mounted to deflect thrust vertically into water-cooled unit which then deflects flames horizontally. Concrete blockhouse (below) serves as control point for Blue Streak tests, and is located about 1,000 ft. from test stand. Tests can be observed through periscope, center of photo, and by closed-circuit television. Instrumentation includes recording galvanometers, strip chart recorders and magnetic tapes.





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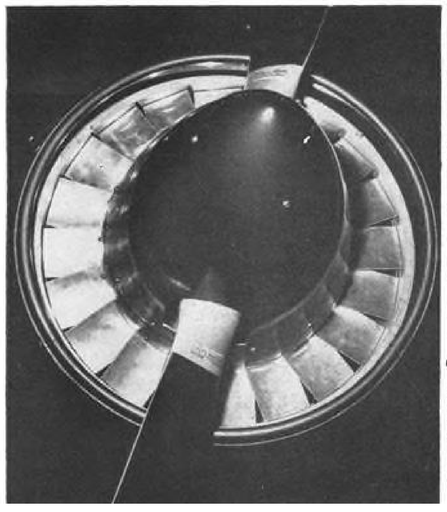
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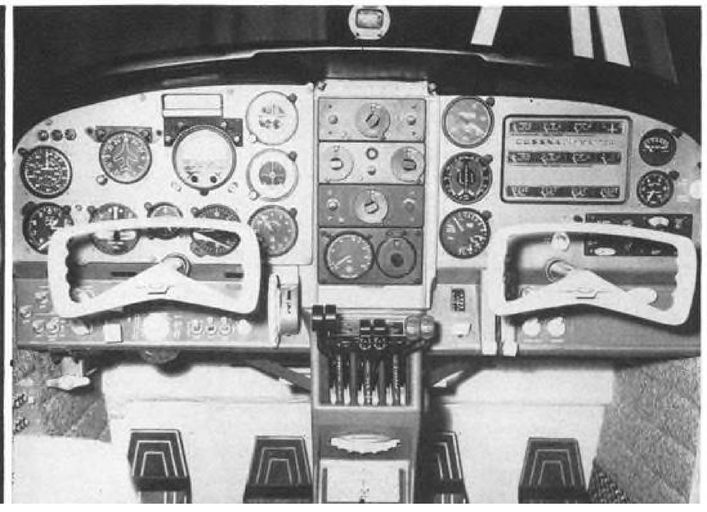


CESSNA SKYMASTER takes off with front engine dead and propeller feathered. Unique pusher-tractor aircraft has new aft fuselage configuration for improved engine cooling. Below is 175-hp. Skyhawk/Powermatic, de luxe version of the 172/Powermatic.



REAR ENGINE FAN of the Skymaster, below left, contains 20 blades and turns with the propeller to provide positive ejection of engine cooling air. Revised panel of the Skymaster now has conventional engine controls mounted on a projecting pedestal, replacing knob-type, push-pull controls originally installed. Red lights are mounted on rpm. controls in center to warn of engine failure.





Cessna Expects Sharp Increase in Sales

By Erwin J. Bulban

Wichita, Kan.—Confidence that Cessna Aircraft Co.'s business aircraft sales will show a substantial improvement in the last four months of 1962 over an already favorable January-August period, resulting in a probable commercial retail dollar volume of $67 million, was expressed here by high-ranking company officials.

Cessna marketing division manager Frank Martin said the company's retail January-August dollar volume already exceeded by $10 million the $35 million which was tallied in business aircraft sales during the same period last year.

Cessna dealer retail sales in the period were 4% higher, and inventories of aircraft were down approximately 2% from those of January-August, 1961.

His position, echoed by other executives, was that, with Cessna's business showing this definite uptrend, everything points toward the company having an even better year in 1963. In fact, next year would be the biggest in Cessna history, both in number of units retailed and dollar volumes, they believe.

Confidence was also expressed that the company's growth in the next five years would be at a minimum rate of 10% per year, compounded each year.

Occasion for optimism was preview of Cessna's 1963 model line for 1,600 distributors, dealers and the press. It consisted of 19 models, including the novel tractor-pusher Skymaster. Two of the new types, the Skyknight twin and Model 205 have already been made public (AW Aug. 6, p. 109; Aug. 27, p. 111) and four others are being kept under wraps until Dec. 10. This is planned to enable the company to fill its distribution pipelines with the new airplanes prior to public unveiling.

With so many models in the line, staggering of production schedules is required to provide adequate supplies of airplanes. Aircraft to be introduced later include the Model 182 and Skylane, the Model 210 and Model 310H.

Following the preview of the new line, distributor-dealer personnel flew away more than 150 new airplanes from the factory, representing an estimated retail volume of more than $2.5 million. Included in the flyaway were Models 150, 172 and Skyhawks. Delivery of new Models 180 and 185 Skywagons begin this month and Models 182, Skylane and 210 will begin to leave the factory in early December.

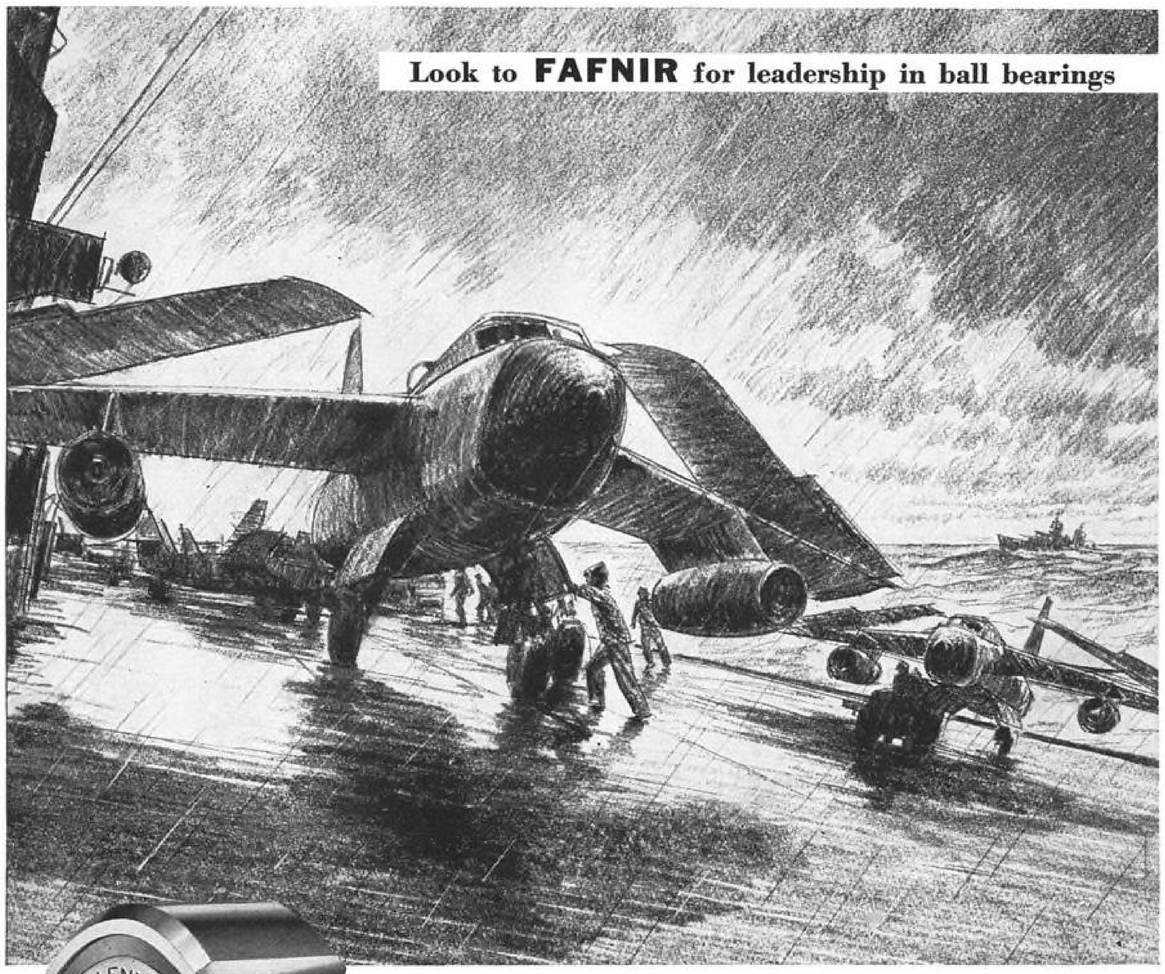
Highlights of the new airplane pre-

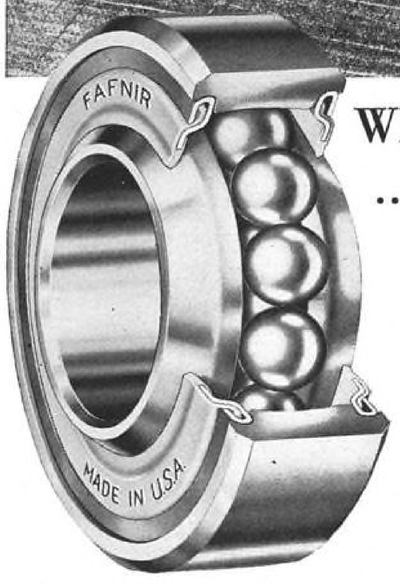


AIR INTAKE for the Skymaster's rear engine has been placed atop the aft fuselage. Variable underwing intakes have been removed. Note 6-seat interior and de-icer boots.



CESSNA CH-1D SKYHOOK helicopter comes in three versions for 1962, including utility version which has newly developed floats and rescue hoist or cargo sling.





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view and discussions with Cessna executives include:

• **Skymaster** four-to-six-placer, powered by two 210-hp. Continental IO-360 engines in tandem, is scheduled for public introduction by distributors and dealers in April, with a price of $39,950 established for the airplane with basic equipment. Cessna expects that initial production will provide approximately 100 Skymasters in the balance of 1963 from time of its introduction.

• **Turboprop-powered airplane** is still in the preliminary study stage and Cessna definitely has no plans to compete with the new Beech Model 120 (AW Oct. 1, p. 18) in the foreseeable future by development of an airplane in that size and weight class, according to Senior Vice President Del Roskam. He also indicated that the company plans no participation in a smaller turbine-powered business plane program, such as that developed by Beech with Sferma in France which is resulting in production quantities of Turbomeca Astazou-powered Beech Barons.

• **Sport plane,** probably single-place and costing approximately half as much as the model 150—which sells in the $8,000-9,000 class—is a very active project at Cessna, although the final design has not been defined. Several configurations have been secretly built and flight tested. A relatively new program, the sport airplane represents a top management feeling that far too much emphasis has been placed on promoting the airplane purely as a business tool and that a breakthrough in airplane marketing requires a return to emphasizing the pure appeal of pleasure, thrills and prestige of flying to bring larger numbers of potential customers under the industry's influence. Once "sold," these new owners will tend to move up gradually to higher-priced, more sophisticated equipment. Cessna apparently intends to start a program soon promoting the pleasure aspects of flying as part of the groundwork leading to the new small low-priced airplane it has in development.

• **Wholesaler-dealer program,** whereby all distributors and dealers will be independent organizations, is expected to be completely implemented in 1963 with signing of new franchise contracts by the factory in January. Plan is to eliminate long-standing complaints from many dealers that some distributors also owned dealerships which gave these dealer outlets an edge in pricing over independent dealers. Cessna has been moving towards having its distributors —the wholesalers—divorce their dealer outlets into completely separate organizations from the parent company. The dealer outlets would have their own management and they would be handled on the same basis as the independent dealers in their respective territory.

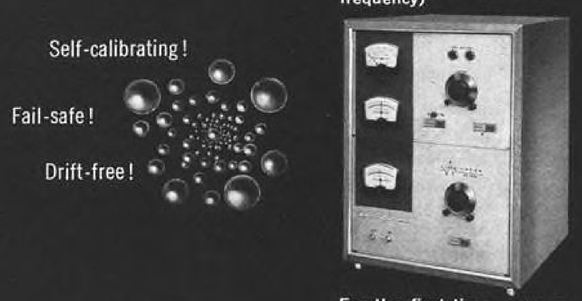
Second prototype Skymaster displayed, considered a production configuration, showed a number of recognizable changes over the earlier version as a result of development since the initial four-place prototype started flight tests last year. Skymaster has received Federal Aviation Agency certification, and company officials say that approval of the final configuration with modifications is a matter of paperwork.

Particularly thorny problem handed to the design staff by management has been an insistence on extremely low cabin noise levels. Some of the changes in the airplane's configuration are basically tied to this ambitious program, though Cessna declines to say at this time just what decibel levels it is seeking.

Most noticeable changes include a major revision and clean-up of the aft engine cowling lines, which was done to ensure minimum airflow separation and accompanying burble with attendant noise and vibration. Variable-inlet airscoops under the wings (AW Nov. 13, p. 117) have been deleted, and a single large dorsal ram-air intake has been placed atop the aft fuselage.

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propeller, has been placed in the rear face of the aft cowling to provide positive exit of engine cooling air. This accelerated airflow also tends to suck with it airflow coming off the rear fuselage.

Aimed at providing a step-up, twin-engine airplane requiring minimum indoctrination for a single-engine pilot, the tandem-engine Skymaster has a gross weight of 3,850 lb. and empty weight of approximately 2,300 lb. Cruise speed is conservatively listed as "over 170 mph." at 75%, power at 7,500 ft. With standard fuel capacity of 92 gal., the Skymaster has an endurance of more than 4 hr. or 730-mi. range; an optional 38-gal. auxiliary fuel supply will extend this to more than 6.8 hr. or 1,030 mi.

Limited preliminary date also credits the airplane with a service ceiling of 18,800 ft. Single-engine service ceiling will be better on the rear engine–9,000 ft.–than on the forward powerplant by 1,500 ft. Flight test program has included takeoffs with both front or rear engines cut.

People who have flown in the airplane say that it shows excellent single-engine performance.

The 76-in.-dia. full-feathering, constant-speed propellers counter-rotate to obviate torque effects.

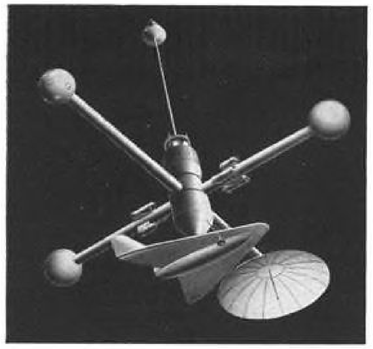
Tandem engine installation has been the subject of an FAA investigation into the possibility of requiring a special pilot rating for the Skymaster configuration. This has been resolved by a requirement for former single-engine pilots to acquire a classification termed "Airplane Multi-Engine Land–Limited to Center Thrust." Current multi-engine pilots will not require this additional rating, according to Cessna.

Basic flight test requirements for the new rating include demonstration by the pilot to a FAA inspector or pilot examiner of ability to maintain proper climb rate with the front propeller windmilling and feathered and also with the rear propeller in the same configurations. Other requirements are single-



Prototype Enstrom F-28 in Flight Test

Flight test is under way on the prototype Enstrom F-28 three-place helicopter and R. J. Enstrom Corp. of Menominee, Mich., is expecting to complete certification in early 1963. Helicopter is powered by a 180 hp. Lycoming O-360 engine driving a three-blade metal rotor. Top speed is approximately 109 mph. and the helicopter cruises at approximately 90 mph. Maximum gross weight is 1,950 lb. Price will be under $30,000, company says.



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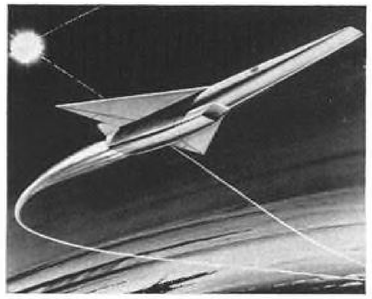
The answer at Lockheed-California Company's Spacecraft Organization is—Yes. Proof: the Spacecraft design pictured here. It reflects the maturity developed in our thinking about manned space systems.

The station—aerospace traffic control center of the 1970's—will be assembled in orbit in a series of pieces brought together by rendezvous techniques. Included: Command center; living quarters; maintenance station; radar and infrared sensing devices; nuclear power supply; communication links with the earth and other space vehicles. As now planned, 12 people will man the vehicle. Their tour of duty will be measured in weeks.

For four years Lockheed-California Spacecraft has concentrated on the needs of man in space. Activities embrace all fields pertaining to development of such complex spacecraft, as well as related supporting technologies: Space physics (radiation hazards); astrodynamics (rendezvous); biophysics (human engineering); metallurgy and manufacturing processes (materials and structures).

Scientists and Engineers of outstanding talent and training are needed to develop the new Spacecraft concepts of Lockheed-California in the following fields: Digital Communications; Antennas and Propagation; Advanced Systems Planning; Bioastronautics and Space Medicine; RF Equipment; Astrophysics; Astrodynamics; Communications Analysis; Aerophysics; Tracing, Telemetry, Command Engineering; Weapons Effects; Operations Research; Theoretical Physics. Write: Mr. E. W. Des Lauriers, Manager, Professional Placement Staff, Dept. 1110, 2406 N. Hollywood Way, Burbank, California. An equal opportunity employer.

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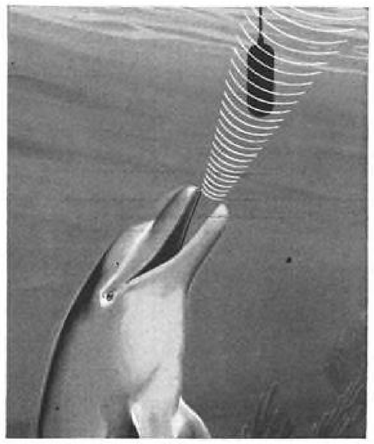
1) The Supersonic Transport design concept, which typifies the Company's creative thinking and planning.
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3) The Hydrofoil—whose stability, control and noise are now under intensive study by the Company.

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This dolphin is talking...and LOCKHEED is listening!

Yes, Lockheed oceanographers and marine scientists listen to "dolphin talk." Studying acoustical characteristics of underwater creatures is part of their daily work. Unraveling the mysteries of the sea is typical of the many research projects in which they are engaged—projects that constantly create new openings, fresh opportunities. Other fields now being probed: Internal waves; low-level marine meteorology; marine geology. Moreover, for its own use, Lockheed has adapted and commissioned the deep-sea research vessel Sea Quest—one of the few such ships owned by industry.

The Sea Quest already has revealed many significant facts about sub-surface sound emission. For instance:

It has been discovered that the "sonar" system of a porpoise can sense underwater obstacles as far as a quarter mile away. Readings so obtained are added to the library of underwater animal sounds. This already includes sea lions, seals, porpoises, shrimp and many varieties of fish.

Other Lockheed scientists and engineers are busy on other projects. For example: One group is absorbed in the improvement of airborne ASW avionics. Geophysicists are concerned with the interaction of ocean, atmosphere and geography.

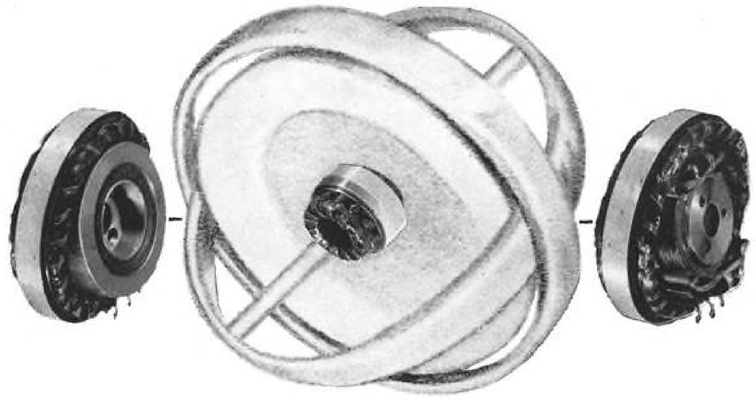
Scientists and Engineers who couple intellectual curiosity with creative ability—who like to brave the unknown and untried—will do well to investigate these opportunities: Hydrodynamics; Aerodynamics for Marine Vehicles. Write today Mr. E. W. Des Lauriers, Manager, Professional Placement Staff, Dept. 1110, 2406 N. Hollywood Way, Burbank, California. An equal opportunity employer.

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engine stall in straight and turning flight under similar propeller conditions, simulation of engine failure at speed approximately 10% above stalling with the airplane in takeoff configuration to show climb-out capabilities and engine procedures, loss of rpm. associated with complete power loss at various speeds from stall to cruise, single-engine landing with inoperative engine idling at zero thrust rpm., and in-flight unfeathering of propeller.

Cessna feels that a pilot versed in the Model 172 should be able to handle the requirements for the new rating in 3 hr. or less.

Basic layout provides a single 3-ft.-wide cabin entrance door on the right side and numerous large cabin windows, affording a total viewing area of 3,709 sq. in. The cabin is 9.5 ft. long and nearly 4 ft. wide, providing considerable leg room in the four-place version.

The optional five-to-six-place interior layout will have individual seats, with an aisle between the center pair. Baggage compartment, capable of holding 160 lb. of luggage, has a door on the right rear side of the cabin.

Cockpit Layout

Cockpit provides communication navigation equipment in the center of the panel, with conventional-type multi-engine controls on a pedestal extending forward below the radios. Pedestal and levers arrangement replaces an earlier design utilizing knob-type push-pull controls based almost flush with the bottom of the panel. Each engine has a thrust indication switch which activates a red light mounted on the appropriate propeller rpm. control lever to assist the pilot in quickly locating loss of thrust.

Front-engine controls are located on the left side of each pair of gated levers; rear-engine controls on the right. Engine instrument presentations and engine controls are paired vertically, with front-engine instruments on top.

Normal tankage is outboard of the tail booms; optional tankage would be placed in wing panels between the booms and cabin. The standard tanks feed into a 3-qt. sump in the lower portion of the boom, with fuel going from the sump through an auxiliary pump to the fuel selector valve—left main tank to front engine, right main to the rear engine. Cross-feeding is provided. Also, left auxiliary feeds front engine, right auxiliary feeds the rear engine.

Vapor lines from each engine return to the mains. Thus, normal procedure would be to use the main tanks during the first hour of flight to avoid overfilling the mains with return fuel from the auxiliaries.

Skymaster incorporates dual 28-v. 30-amp. alternators rather than conventional d.c. generators, providing a lighter-weight electrical system and higher-voltage outputs at lower engine rpm., particularly at engine idle speeds.

The majority of the electrical power requirements are provided by the alternators at taxi engine rpm.

Optional equipment under consideration includes lightweight wing and stabilizer de-icing boots and a 48.3-cu. ft.-capacity oxygen system with console in the cabin roof.

Basic Details

Basic details of the other new airplanes in the 1963 line being unveiled to the public included:

• **Model 172** was the center of attraction in the current line, offered in four versions, with two powerplant selections available. Airplanes incorporate the rear-view "Omni-Vision" window treatment which was largely responsible last year for a major spurt in 182/Skylane sales and is expected to provide similar impetus to the 172 series this year. Standard 1963 Model 172, with Continental 145-hp. engine, will sell for $10,245, the 172/Powermatic with Continental 175-hp. geared engine for $13,275, the de luxe Skyhawk configuration with 145-hp. engine at $11,995, and with the 175-hp. engine at $14,650.

The higher-powered versions both have constant-speed propellers. Gross weights and useful load increases are featured in the entire 172 series. The Model 172 gross weight is 2,300 lb., with useful load increased to 1,040 lb. Skyhawk gross weight also is 2,300 lb., with useful loading approximately 970 lb.

The 172/Powermatic gross weight is 2,500 lb., with useful load 1,140 lb. Skyhawk/Powermatic gross weight is 2,500 lb., with useful load totaling 1,075 lb.

Control Forces

New 172 series aircraft have larger elevators and stabilizers by 4 in. length, which assist in reducing control forces and enhancing the aircraft's landing characteristics.

• **Skyhook helicopter** also features some major changes over the previous model, including an improved Continental 270-hp. engine with new crankshaft vibration damper weights, double-breaker magnetos to improve starting and smoother power acceleration, new starter overload clutch to protect the starter drive in the event of an engine backfire, heavier connecting rods and hot-forged bolts with rolled threads and flanged nuts. New supercharger clutch has 50% greater capacity, and re-inforced rocker arm boss has 30% greater strength.

New Skyhook CH-1D will be available in three versions in 1963: a de luxe four-place personal transport priced at $79,960, a utility model minus the plush upholstery and other equipment selling for $78,780, and a "municipal" version for use in connection with Civil Defense and civic duties which will sell for $79,600.

CH-1D gross weight has been increased 100 lb. from the CH-1C for a total of 3,200 lb.

Larger-than-normal cargo door will be available on the utility version. Other CH-1D changes for 1963 include flotation gear to replace the skids, a rotor brake that stops the main rotor in 30 sec. from 200 rpm., litters, a cargo sling that can handle an 800-lb. external load beneath the fuselage, and an optional hoist capable of lifting up to 220 lb.

Cessna expects to deliver approximately 35-40 CH-1Ds in 1963, compared with 25 in 1962.

• **Model 150C,** the two-place trainer, patrol and business plane, and the Models 180F and 182F utility airplanes are changed primarily in details. The 150C is continued in three models—the standard plane at $7,775, the trainer at $8,775, and the plusher Inter-City Commuter at $9,435.

The 180F will sell for $15,950 and the Model 185B Skywagon for $19,495 in 1963.

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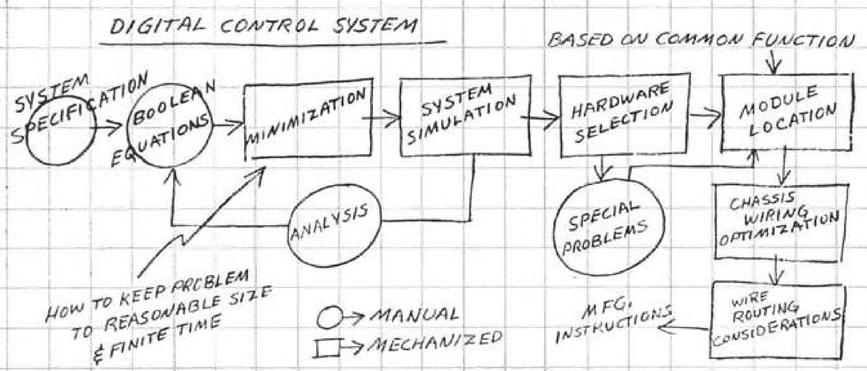
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PIPER APACHE 235 features Aztec tail with one-piece stabilator and is powered by two 235-hp. Lycoming engines.

Piper Aims for 23% Sales Rise in 1963

Retail sales goal of $53 million in 1963 was set before Piper Aircraft Corp. distributors and dealers by general sales manager J. W. Miller at the company's recent annual international sales meeting and new model display at Hollywood, Fla.

The target, a 23% increase over Piper's Fiscal 1962 sales period ending Sept. 30, significantly signaled a sharp departure from company management's pessimistic attitude regarding its own and the business aircraft industry's sales potential in the past two years.

Since some of this previous bearish attitude had been due to concern over the break-in problems being experienced at Piper's new Vero Beach, Fla., light aircraft production facility, indications are that management generally feels that these problems are behind them and that the relatively good showing the industry is making despite some slackening felt by other U.S. industries due to recession presages good times ahead for business aircraft makers and retail outlets in the year ahead.

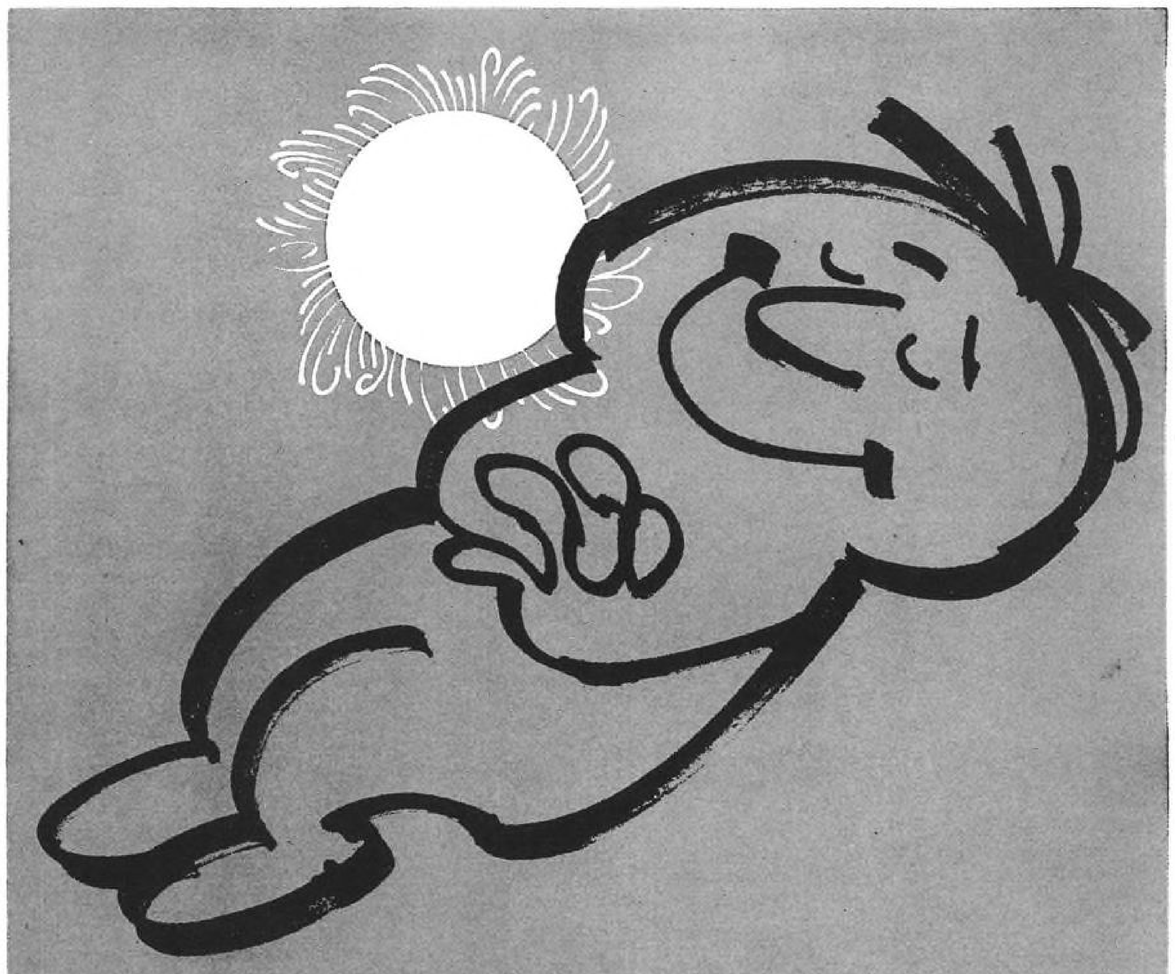
Further confidence in Piper's future is being generated by the company's strong return in the four-place field with its new Cherokee line, a weakness strongly felt at the time it phased out its high-wing Tri-Pacer; and also the good showing made by its six-place Aztec B twin. Since its introduction early in 1962, the Aztec B has accounted for 35% of the entire light twin-engine business aircraft market sales volume during its first seven months of production life, according to the Lock Haven, Pa., producer.

Providing a firm measure of the company's new-felt confidence are its plans to accelerate development of new models to add to its line this year and next. Briefly these include:

- **Comanche 400,** powered by an uprated 380-hp. eight-cylinder Lycoming engine, is expected to be ready to join the 180-hp. Comanche and 250-hp. Comanche on Piper's production lines during the 1963 model year.
- **Twin-engine Comanche** also is nearing the completion of its initial development and also is due to go on the market during the new model year.
- **All-plastic PA-29 Papoose** side-by-side two-seater (AW Nov. 17, p. 104) has been making "satisfactory progress" in flight tests and two additional prototypes are now under construction at Vero Beach to accelerate the new airplane's development program and provide additional service and exposure testing during next summer. The PA-29 now is expected to be added to the Piper model line, with deliveries beginning during the 1964 model year.
- **Cherokee B seaplane** trials are work-

Apache 235 Data

Engines	2 Lycoming O-540-B1A5 235 hp. at 2,575 rpm.
Gross weight	4,800 lb.
Empty weight (standard)	2,735 lb.
Empty weight (Autoflight)	2,850 lb.
Fuel capacity	144 gal.
Wing span	37 ft.
Wing area	207 sq. ft.
Length	27.6 ft.
Height	10.3 ft.
Wing loading	23.2 lb./sq. ft.
Power loading	10.2 lb./hp.
Baggage compartment	25 cu. ft.
Baggage capacity	200 lb.
Cargo space	80 cu. ft.
Top speed	202 mph.
Cruise speed at 7,000 ft. at 75% power	191 mph.
Stall speed, power off, flaps down	62 mph.
Takeoff run, 25-deg. flaps	830 ft.
Takeoff run to clear 50-ft.	1,300 ft.
Landing roll	880 ft.
Best rate of climb	112 mph.
Rate of climb	1,450 fpm.
Best single-engine rate of climb	110 mph.
Single-engine rate of climb	220 fpm.
Cruise range at 75% power at 7,000 ft.	980 mi.
Cruise range at 55% power at 7,000 ft.	1,185 mi.



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U.S. Business & Utility Aircraft Shipments

June 1962

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	3	
560F	3	$928,000
680F	3	
Beech Super 18	1	
33 Debonair	17	
35 Bonanza	16	
50 Twin-Bonanza	2	
55 Baron	18	$3,276,000
65 Queen Air	2	
80 Queen Air	7	
95 Travel Air	3	
Cessna 150	28	
172 Skyhawk	56	
175 Skylark	4	
180	26	
182 Skylane	88	$4,184,000
185 Skywagon	25	
210	19	
310	15	
320 Skyknight	3	
Champion 7EC Traveler	2	
7FC Tri Traveler	1	$57,000
7GCB Challenger	5	
Lake LA-4	1	$21,000
Mooney Mark 20	38	$540,000
Piper PA-18-150 Super Cub	14	
PA-22-108 Colt	19	
PA-22-160 Tri-Pacer	1	
PA-23-250 Aztec	32	$2,701,000
PA-24-180 Comanche	4	
PA-24-250 Comanche	11	
PA-25-150 Pawnee	13	
PA-25-235 Pawnee	30	
PA-28-150 Cherokee	12	
PA-28-160 Cherokee	36	
Totals	556	$11,707,000

Note: Total shipment by industry January-June 1962 numbered 3,526 units having a factory billing value of $72,134,000 compared to shipment of 3,626 units valued at $66,193,000 in the same period last year.

ing out satisfactorily and the company expects to announce receipt of approval on the 160-hp. B model with floats shortly to be followed soon after by the 180-hp. B model in the same configuration.

New products in development by Piper's Electronics Division at Vero Beach include a fuel flow meter for carburetor-equipped airplanes, expected to go on the market soon, plush new radio equipment and a flashing anti-collision beacon.

In light of the company's policy of announcing new models only when significant changes have been incorporated (AW Oct. 1, p. 80) and not programing these on the basis that the company's complete line will simultaneously reflect such improvements, the recent convention starred two airplanes; a considerably revised Apache twin, featuring an Aztec-type tail, and the new, more powerful 180-hp. four-place Cherokee (AW Oct. 1, p. 80).

The new Apache 235 four-to-five-place light twin is powered by two Lycoming O-540-B1A5 engines developing 235 hp. each at 2,575 rpm., a major power increase over the 160-hp. Lycomings in the company's Apache H. The Apache 235 engine is the same as that used in the 250-hp. Comanche, but has been derated slightly to allow use of 80/87 octane as well as 91, 96 and 100 octane fuels.

The new light twin model is priced at $44,990 and thus falls between the Apache H, selling for $37,990 and the more sophisticated 250-hp. six-place Aztec B which retails at $52,990.

To take the increased power and weight, the new Apache 235 uses the Piper Aztec's larger tail, which incorporated a swept vertical assembly and all-moving one-piece stabilator. Application of the new tail configuration permits considerable cost savings in utilizing available Aztec tooling to provide the Apache 235's modified rear. Most important benefits obtained include a gross weight of 4,800 lb., allowing 144 gal. of fuel, five persons including pilot and over 200 lb. for baggage.

Standard instrumentation includes full gyro panel, the Super Custom version including a standard factory-installed instrument flight rules (IFR) radio package consisting of a Motorola T-12B automatic direction finder and a 2½ navigation-communications system comprising a Narco Mk. 10 360-channel transceiver and separate VHF receiver, a Narco Mk. 5 90-channel transmitter and 190-channel receiver and two VOR/ILS indicators. A deluxe package of Collins radio equipment also is available.

WHO'S WHERE

(*Continued from page 23*)

Changes

Welcome W. Bender, director of research, Martin Co., Aerospace Division of Martin Marietta Corp., Baltimore, Md. Mr. Bender continues as director of the Research Institute for Advanced Study (RIAS).

Dr. Karl Undesser, operations manager, Arinc Research Corp., Washington, D. C.

Robert B. Luirette, director of manufacturing, Thompson Ramo Wooldridge's Space Technology Laboratories, Redondo Beach, Calif.

E. C. Whatley, engineering manager, Westinghouse Electronics Div., Baltimore.

Evan Ragland, manager of the newly formed Teledata Laboratory at Motorola's Chicago (Ill.) Military Center.

Thomas H. Herring, senior project engineer, Genistron, Inc., Los Angeles, Calif.

John G. Hazard, general manager of the newly established Cape Canaveral (Fla.) facility of North American Aviation Space and Information Systems Division.

William M. Frash, director-aircraft marketing, Northrop Norair Division of Northrop Corp., Hawthorne, Calif.

George R. Tallent, director-reliability and quality control, Motorola Semiconductor Products, Inc., Phoenix, Ariz.

Robert H. Okada, director of development, Epsco Pacific, Menlo Park, Calif., newly formed affiliate of Epsco, Inc., Cambridge, Mass.

William C. Clauer, director of marketing, C-E-I-R, Inc., Washington, D. C.

Ivan E. Speer, division manager, AiResearch Manufacturing Division, Phoenix, Ariz., succeeding **J. J. O'Brien** (AW Oct. 15, p. 23).

James J. Croke, head of The Mitre Corp.'s Paris (France) office.

Harold A. Page, head, Mechanical Engineering and Design Group, Applied Technology, Inc., Palo Alto, Calif.

Thomas C. Clark, Jr., director of marketing, Space-General Corp., El Monte, Calif.

Dr. Dilip B. Adarkar has joined the staff of Dynamic Science Corp., South Pasadena, Calif.

Stephen P. Dillon, manager-major subcontracts, Douglas Aircraft Co.'s Missile & Space Systems Division, Santa Monica.

C. W. Finnigan, manager of communications, Advanced Technology Staff, The Martin Co.'s Orlando (Fla.) Division, and **W. L. Eddy,** assistant manager of communication, Advanced Programs. Also: Martin's Orlando Division has formed a Special Programs Division and appointed **Albert E. Namey** as director; SPD program managers are **E. C. Laughlin,** Missile Master and Birdie electronic air defense systems, and **N. J. Schmidt,** Lacrosse ground-to-ground missile.

L. E. Kirk, Jr., director of aircraft programs, Aircraft-Missiles Division of Fairchild Stratos, Hagerstown, Md., and **R. A. Henson,** director of commercial aircraft programs. Also: **Dewey Thiessen,** chief engineer of the Aircraft-Missiles Division.

Howard A. Buckner, chief engineer-line engineering activities, Engineering Department, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., and **Stanley G. Best,** chief of research. Engineering aerospace equipment appointments: assistant chief engineers—**Donald Ramaker** for fuel controls, **George P. Townsend** for air inlet and special controls, and **Alphonsus D. Croxall** for propellers; chief project engineers—**Albrecht E. Reinhardt** for space life support systems, and **Roger D. Weatherbee** for environmental conditioning systems and turbomachinery.

Capt. W. J. Martin, air safety officer, Aer Lingus/Irish International Airlines, and **Joseph A. Santos,** technical supervisor at New York International Airport.

Jonmore Dickason, program and planning director, Materials Testing Laboratories Division, Magnaflux Corp., Chicago, Ill.

Charles H. Carter, Jr., general manager, Aerospace Components Division, Atlas Chemical Industries, Inc., Wilmington, Del.

M. E. Harrison, director of engineering, Trimpot Division, Bourns, Inc., Riverside, Calif.

Richard C. King, coordinator-aerospace and defense projects, Kaiser Industries Corp., Washington, D. C.

Jack B. Hippler, manager of aerospace development sales, Lockheed-Georgia Division of Lockheed Aircraft Corp., Marietta, Ga.

C. R. Rockwood, manager-corporate marketing, Texas Instruments, Inc., with offices in Washington, D. C.

Dr. C. H. Sutcliffe, director of engineering, Philco Corp.'s Lansdale (Pa.) Division.

Harold Karp, ordnance production manager, Space Ordnance Systems, Inc., El Segundo, Calif.



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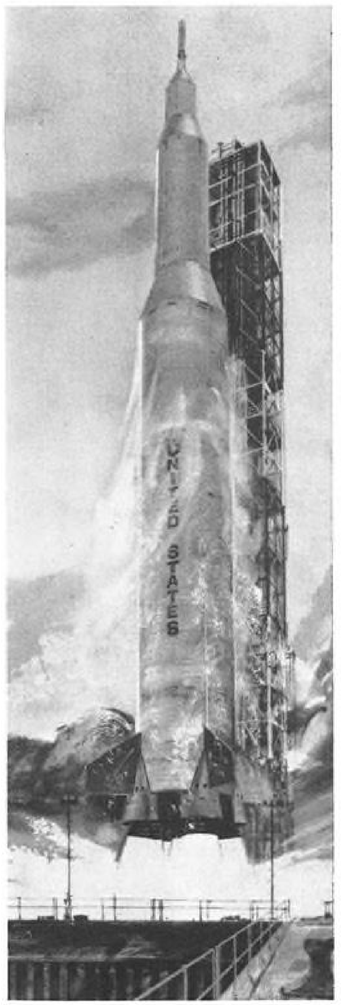
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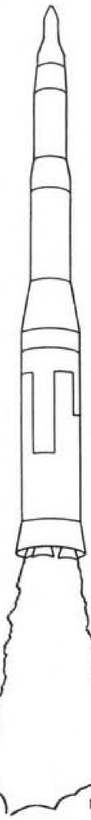
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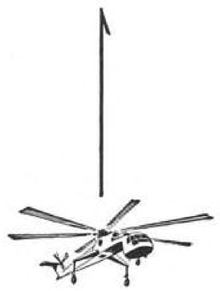
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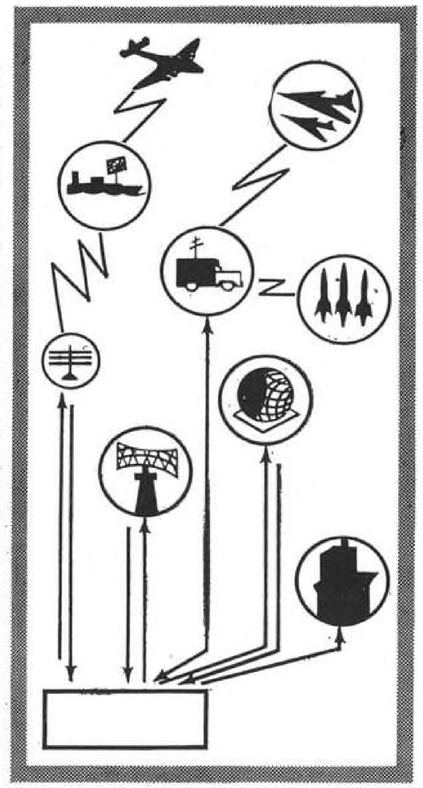
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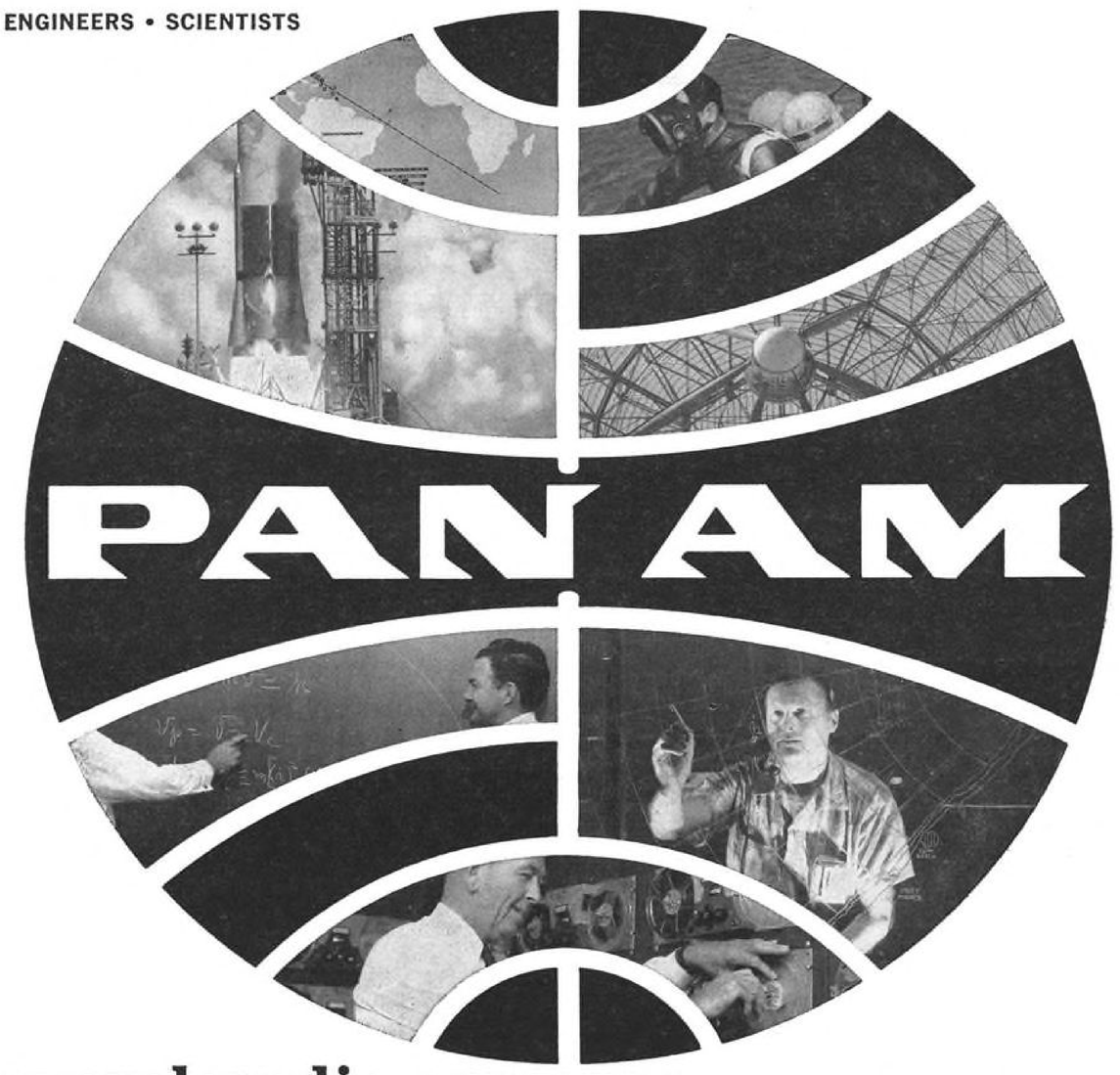
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LETTERS

Transport Study

If your report of the White House study on international air transportation (AW Oct. 1, p. 28) reflects accurately its recommendations and philosophy, the conclusions of the study are indeed surprising.

The burden of the study, as you report it, is that economics should serve as the sole criteria in the operation of international air services by U. S. carriers; that U. S. carriers should concentrate on high-density markets, and that international air transportation should not be considered as a factor in U. S. foreign affairs.

There can be no objection to relieving an industry from what some persons may call "artificial" objectives and controls imposed by government; of allowing it to find its "natural" place in the world of business and commerce; of letting it expand along those avenues where growth is most readily achieved.

But there are some industries which are so closely tied to the higher national interests and which constitute so important a medium for the expression and implementation of national goals, that the significance of their operations to the nation as a whole cannot be ignored. Certainly, international air transportation is the epitome of such an industry.

Today it binds us to other peoples as no other form of transportation can do, and for the foreseeable future its importance in this respect can only increase.

There could be no objection to expanding the potential high-density traffic areas, such as the North Atlantic, by exploiting the undoubtedly unique American capacity for improving mass transportation through fare reductions founded on improved efficiency. But should this be the major objective of U. S. air transport in today's world?

The general goal of enlarging the air transport market by reducing fares in the heavily traveled routes, such as the North Atlantic, where the American genius for mass air transport can be most effectively applied, is surely desirable. But is it desirable at the expense of reducing America's contact with the developing regions of the world?

Whatever actions will bind the peoples of America and Western Europe closer together—and surely improved air transportation can contribute in a major way—is a move in the right direction. But in doing this, we cannot afford to reduce our links to other areas. Are the Communist powers to be given the upper hand in air transportation contacts with the less-developed countries? The latter are the very areas where contact with the Western democracies—and particularly the United States—most need strengthening, for the danger of Communist penetration is far greater in South America, Africa, and the Far East than in Western Europe.

I submit that the paramount goal of the national policy on international air transportation should be shaped foremost toward countering the threat of increased Communist influence in the developing nations, and that the promotion of travel and commerce among the economically advanced regions of the world should be firmly subordinated to this goal.

In summary, economics should not serve as the sole criteria in the operation of international air services by U. S. carriers. Instead, the over-all national objective of countering Communist influence and strengthening the bonds of freedom—worldwide—should be the basis of the national policy in international air transportation.

Is it any wonder that the White House has not released the study, which you state was conducted by private consulting firms?

EDWARD N. STIREWALT
Herndon, Va.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Cost Comparisons

The article in your Sept. 10 issue titled "Gulfstream Viewed as DC-3 Replacement" in which some very questionable direct operating costs are quoted for various transport aircraft, including the DC-3 and the F-27A, compels me to question your source and/or the method used to determine these so-called direct operating costs.

Direct operating costs can be divided into three categories: Flying Operations, Maintenance, and Depreciation. The various items that make up these categories are well defined by the Civil Aeronautics Board, and all airlines report regularly to the CAB (Form 41) their actual operating costs, item by item, individually for each type aircraft operated.

For aircraft in airline service, these data are readily available. For aircraft with little or no airline service, the Air Transport Assn. "Standard Method of Estimating Comparative Direct Operating Costs of Transport Airplanes" is a universally accepted method for deriving these costs and the results obtained by this method correlate with the operating costs as reported to the CAB by the airlines.

The actual direct operating costs experienced by local airline operators of the DC-3 and the F-27A are readily available. Neither the Gulfstream nor the Potez 840 have had any experience in local airline operation and it is highly questionable that any representative operating costs typical of local airline operations can be obtained from the results of a few 100-mi. flights.

Local service F-27 aircraft have flown approximately 17 million miles in the 12 month period ending Mar. 31, 1962, while local service DC-3 aircraft have flown approximately 60 million miles during this same period.

The ratio of DC-3s in operation during this period to F-27s was about 6.5 to 1.

The average mileage per DC-3 for this same period was about 275,000 mi. as compared to over 500,000 mi. for each F-27. To date, the local service airline operators have over 250,000 hr. of flight experience with the F-27; many of the aircraft having accumulated over 10,000 hr. each. Including Alaskan, Canadian, Hawaiian and corporate operators, the F-27 has over 400,000 flight hours to its credit.

Operating costs based on this type of experience are significant, and comparative direct operating costs, in cents per mile, as reported to the CAB by local airline operators of the DC-3 and F-27A for the same 12 month period, are as follows:

	DC-3	F-27A
Flying Operations	41.5	44.0
Maintenance	24.0	32.9
Depreciation	2.6	12.3
Total Direct Operating Costs	68.1	89.2

Note that the cost of flying operations is essentially the same for the F-27A as for the DC-3. The maintenance costs for the F-27A are higher than those of the DC-3 because it is a larger, faster, modern turbine-powered aircraft incorporating many features not found in the DC-3, such as air conditioning, pressurization, etc. The negligible depreciation costs of the DC-3 are the result of the almost completely depreciated status of the aircraft.

I hope that these factual data will help to eliminate some of the confusion that always results when such misleading comparisons are published without standard reference or method of derivation.

JOHN F. EVANS
Hagerstown, Md.

Simulator Projector

In the Aug. 13 issue of AVIATION WEEK AND SPACE TECHNOLOGY, there is an article on the General Precision Link (refueling) simulator appearing on p. 111.

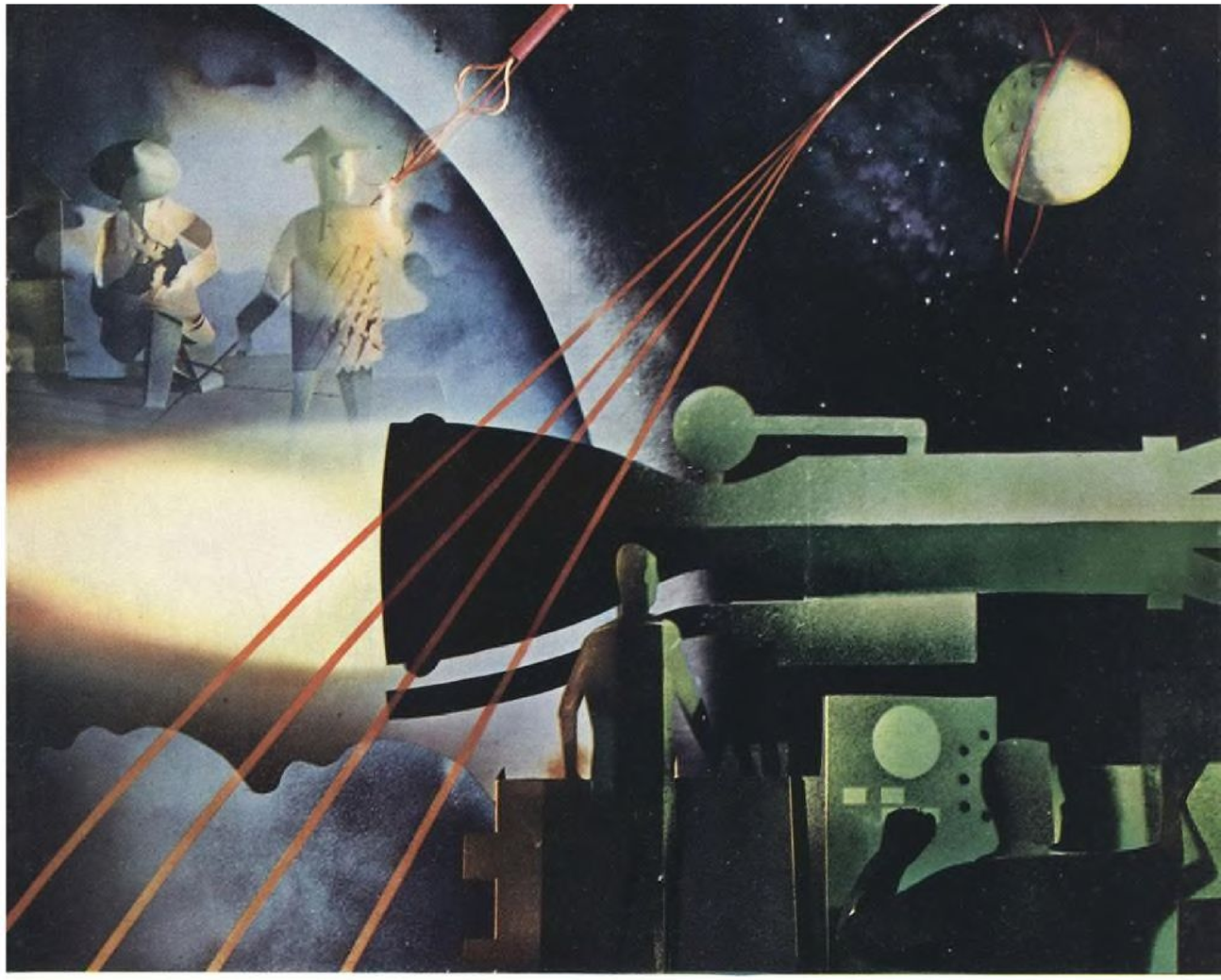
In this article it is stated that "The light-valve projector used in the Link unit. . ."

I would appreciate your correcting this error. The projector being used in the Link unit is the TNT Eidophor. The Eidophor projector is a control layer system of large screen television projection and the most widely used for high-resolution and color quality.

The light valve projector is the name of a competitive product and is also a control layer system type.

NATHAN L. HALPERN
President
Theatre Network Television, Inc.
New York, N. Y.

(Mr. Halpern is correct. The TNT Eidophor projector is used in the Link refueling simulator.—Ed.)



ROCKETRY... FROM KAI-FUNG-FU TO THE MOON

From the first-known use of rockets in the defense of Kai-fung-fu in 13th century China, rocketry has experienced anything but a continuous advance. For many hundreds of years these early fire arrows knew little improvement or new missions. Gradually they were given minor applications as signaling devices, incendiary weapons and lifeline launchers. Suddenly, in the last three decades, rocketry has made its breakthrough as a spectacular source of power.

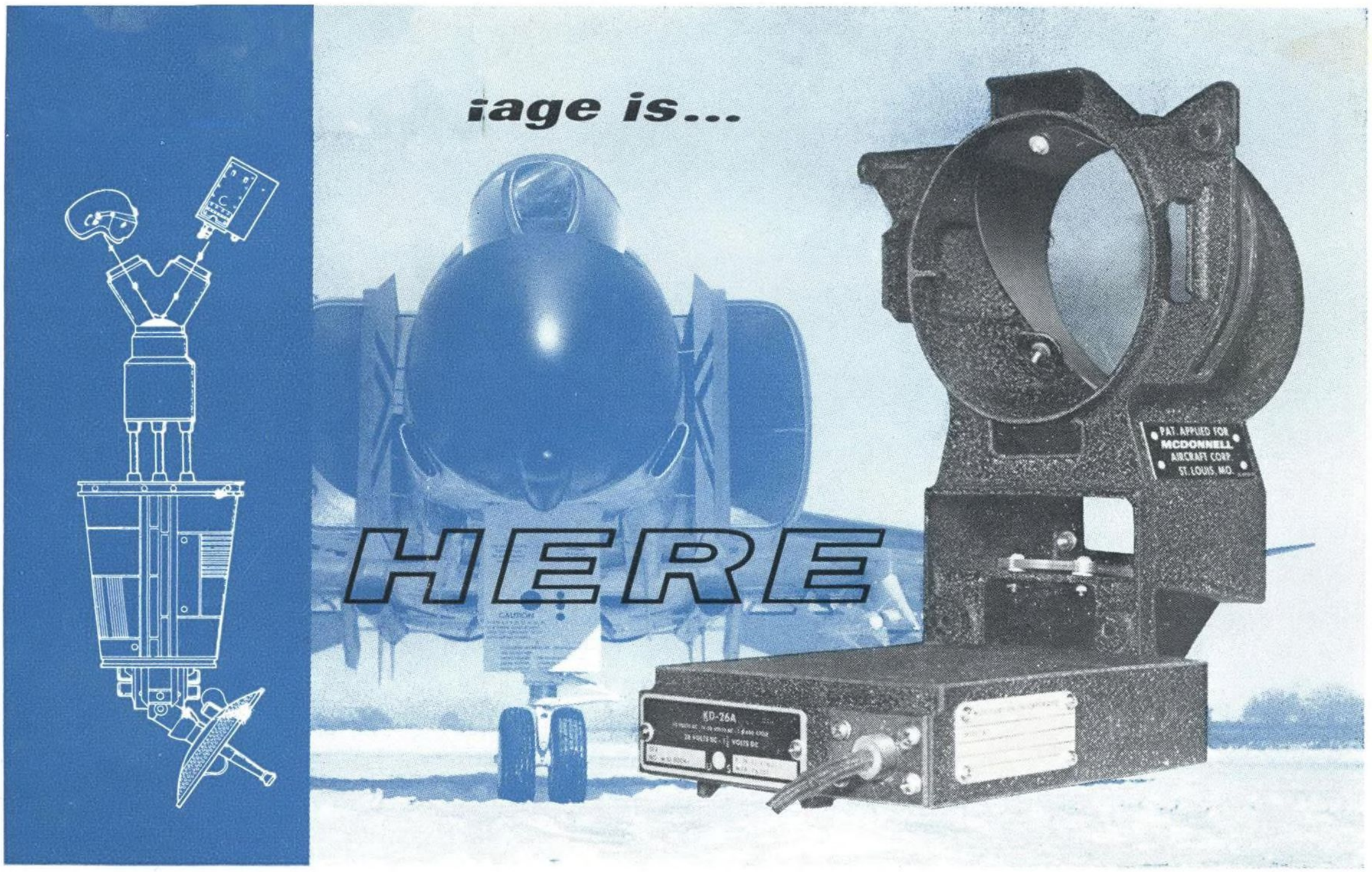
Since World War II, Bell has been in the forefront of rocket engine application and development, beginning with the design of this country's famed X-1 supersonic research airplane, first to penetrate the sound barrier successfully in 1947. It was followed by the Bell X-1A and X-2, which established even higher speed and altitude frontiers. Next came Bell's own liquid-propellant rocket engine for Rascal, the first operational air-to-surface guided missile.

Today Bell is delivering in quantity the highly-reliable Agena 16,000 pound thrust liquid rocket engine which made history February 28, 1959, by propelling this country's first polar satellite into orbit. Since then, the Bell Agena engine has put more useful payload into orbit than any other and now is playing a significant role in Air Force satellite programs and NASA's Ranger moon and Mariner Venus probes. Bell also is providing rocket reaction control systems for the manned Mercury capsule, Centaur, Dyna-Soar and the X-15 research airplane. Bell engineers continue to develop new uses and new engines for even more powerful rocket propellants to help speed this country's conquest of space.

ba BELL AEROSYSTEMS COMPANY • *Buffalo 5, N. Y.*
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A textron COMPANY

OCT. 24 1962



How the Phantom Records What the Radar Sees

Early in the development of the Phantom II, McDonnell designed a Direct Radar Scope Camera (DRSC)* as part of the instrumentation necessary for armament control system evaluation. It was soon apparent that the low cost, low volume, reliability, simplicity, inflight reloading, recording capabilities and projector playback characteristics of this device made it ideal for crew training and evaluation. At the request of the U.S. Navy, McDonnell put the system into production and it is now standard equipment on Phantoms being delivered to the fleet. More recently, the McDonnell Direct Radar Scope Camera was specified for the F8U-2N and the F-110.

The system includes a McDonnell developed KD-26A camera, periscope, and electronic control assembly. Mirrors and prisms are used to shape the periscope to installation requirements. A unique application of an optical principle eliminates glare and double images while allowing the observer to change scope intensity without reducing photographic quality.

The KD-26A is a pulse operated 16 millimeter camera using standard 50 foot film magazine for inflight reloading. During radar search, the shutter is triggered at the end of each azimuth sweep. During tracking, the camera is pulse operated at 2-6 frames per second. Correlator lights are introduced to mark such events as lock-on, firing, snap-up and other incidents where a record is desired. The film can be quickly developed and projected for crew training and evaluation, maintenance trouble shooting or mission documentation.

The McDonnell DRSC is presently being proposed for a number of all weather fighter aircraft in addition to applications such as sonar, air traffic control, weather and navigational radar recording.

**Patent Applied For*

For DRSC brochure, write: McDonnell, Dept. 08, Box 516, St. Louis 66, Missouri



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Engineers and Scientists: Employment opportunities exist at McDonnell, prime contractor on projects in the national interest such as MERCURY, ASSET, GEMINI, and PHANTOM II. An Equal Opportunity Employer. For information, write: Professional Placement, McDonnell, Dept. a w, Box 516, St. Louis 66, Mo.