Aviation Week & Space Technology

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A McGraw-Hill Publication

August 5, 1963

SPECIAL REPORT:

NASA Research On Aeronautics

Dassault Mystere 20 Transport

AEROSPACE CALENDAR

Aug. 12-14—Guidance and Control Conference, American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 12-16—Conference on Artificial Satellites, Virginia Polytechnic Institute, Blackburg, Va., in cooperation with the National Science Foundation and NASA.

Aug. 14-16—Fifth Biennial Gas Dynamics Symposium, Northwestern University/ American Institute of Aeronautics and Astronautics, Evanston, Ill.

Aug. 18-23—Annual Meeting, Flying Physicians Assn., Aurora (Chicago), Ill.

Aug. 19-21 — Astrodynamics Conference, American Institute of Aeronautics and Astronautics, Yale University, New Haven.

Aug. 19-21—1963 Cryogenic Engineering Conference, Boulder, Colo. Sponsors: University of Colorado; NBS Cryogenic Engineering Laboratory.

Aug. 20-23—1963 Western Electronic Show and Convention (WESCON), Cow Palace, San Francisco, Calif.

Aug. 21-23—National Conference on Shell (Space Structures) Theory and Analysis, Research and Development Div., Lockheed Missiles & Space Co., Palo Alto, Calif. (Attendance by invitation.)

Aug. 26-28—Simulation for Aerospace Flight Conference, American Institute of Aeronautics and Astronautics, Deshler-Hilton Hotel, Columbus, Ohio.

Aug. 26-28—Conference on Physics of Entry

(*Continued on page 7*)

AVIATION WEEK & Space Technology

August 5, 1963

Vol. 79, No. 6

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AEROSPACE CALENDAR

(Continued from page 5)

into Planetary Atmospheres, American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-11—International Symposium on High-Temperature Technology, Asilomar, Calif. Sponsor: Stanford Research Institute.

Sept. 8-11—Annual Meeting, Air Industries Assn. of Canada, Manoir Richelieu, Murray Bay, Quebec.

Sept. 9-11—Seventh National Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington, D. C.

Sept. 9-12—18th Annual Instrument-Automation Conference & Exhibit, Instrument Society of America, McCormick Place, Chicago, Ill.

Sept. 10-12—National Symposium on Space Rendezvous, Rescue and Recovery, Edwards AFB, Calif. Sponsors: American Astronautical Society; Air Force Flight Test Center.

Sept. 10-12—New York University's Third Annual Air Transport Conference, Washington Square Center, New York, N. Y.

Sept. 11-15—17th Annual National Convention & Aerospace Panorama, Air Force Assn., Sheraton-Park and Shoreham Hotels, Washington, D. C.

Sept. 16-18—International Aviation Research and Development Symposium, Atlantic City, N. J. Sponsor: FAA.

Sept. 18-19—1963 Airwork Operations and Maintenance Symposium, Millville, N. J.

Sept. 19-20—Third Annual Conference on Environmental Effects on Aircraft Systems, U. S. Naval Air Turbine Test Station, Trenton, N. J.

Sept. 20-21—11th Annual Conference on Communications (Microelectronics), Institute of Electrical and Electronics Engineers, Hotel Roosevelt, Cedar Rapids, Iowa.

Sept. 20-29—Ninth Annual Houston International Trade & Travel Fair, Sam Houston Coliseum, Houston, Tex.

Sept. 23-25—Symposium on Aeroelastic and Dynamic Modeling Technology, Biltmore-Hilton Hotel, Dayton, Ohio. Sponsors: Air Force Systems Command's Aeronautical Systems Div.; Aerospace Industries Assn.

Sept. 23-27—National Aeronautic and Space Engineering and Manufacturing Meeting and Display, Society of Automotive Engineers, Ambassador Hotel, Los Angeles.

Sept. 23-27 — International Telemetering Conference, Savoy Place, London, England. Sponsors: Institution of Electrical Engineers (London); American Institute of Aeronautics and Astronautics; Institute of Electrical and Electronics Engineers; Instrument Society of America.

Sept. 24-26—16th Annual Convention and Aircraft Show, National Business Aircraft Assn., Shamrock-Hilton Hotel, Houston.

Sept. 25-26—Second Annual Symposium on the Physics of Failure in Electronics, Chicago, Ill. Sponsors: Rome Air Development Center; Armour Research Foundation.

Sept. 26-Oct. 1—14th Congress, International Astronautical Federation, Paris.

(Continued on page 9)

AEROSPACE CALENDAR

(*Continued from page 7*)

Sept. 27-28—Society of Experimental Test Pilots' Seventh Annual Report to the Aerospace Profession and Awards Banquet, Beverly Hilton Hotel, Beverly Hills.

Sept. 30-Oct. 1—Manned Interplanetary Exploration Meeting, American Institute of Aeronautics and Astronautics, Cabana Motor Hotel, Palo Alto, Calif.

Sept. 30-Oct. 2—Canadian Electronics Conference, Institute of Electrical and Electronics Engineers, Exhibition Park, Toronto, Canada.

Oct. 1-3—Eighth National Symposium on Space Electronics, Institute of Electrical and Electronics Engineers, Fontainbleu Hotel, Miami Beach, Fla.

Oct. 1-3—National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M. Co-sponsors: Los Alamos Scientific Laboratory; AEC Albuquerque Operations Office; AF Special Weapons Center; AF Directorate of Nuclear Safety; Sandia Corp.; University of New Mexico.

Oct. 2-4—National Assn. of Air Traffic Specialists, Sheraton-Oklahoma Hotel, Oklahoma City, Okla.

Oct. 7-9—Ninth National Communications Symposium, Institute of Electrical and Electronics Engineers, Hotel Utica, Utica.

Oct. 7-11—International Air Transport Assn. 19th Annual General Meeting, Rome, Italy.

Oct. 8-10—10th Annual Air Force Science and Engineering Symposium, Air Force Academy, Colo. Sponsors: Office of Aerospace Research; AFSC.

Oct. 9-11—21st Annual Aerospace Electrical/Electronics Conference, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 12-21—1963 General Conference, Federation Aeronautique Internationale, Mexico City.

Oct. 13-17—16th Annual Meeting and Conference, Airport Operators Council, Roosevelt Hotel, New Orleans, La.

Oct. 14-16—Eighth Annual Exposition and Symposium, Air Traffic Control Assn., Statler Hilton Hotel, Dallas, Tex.

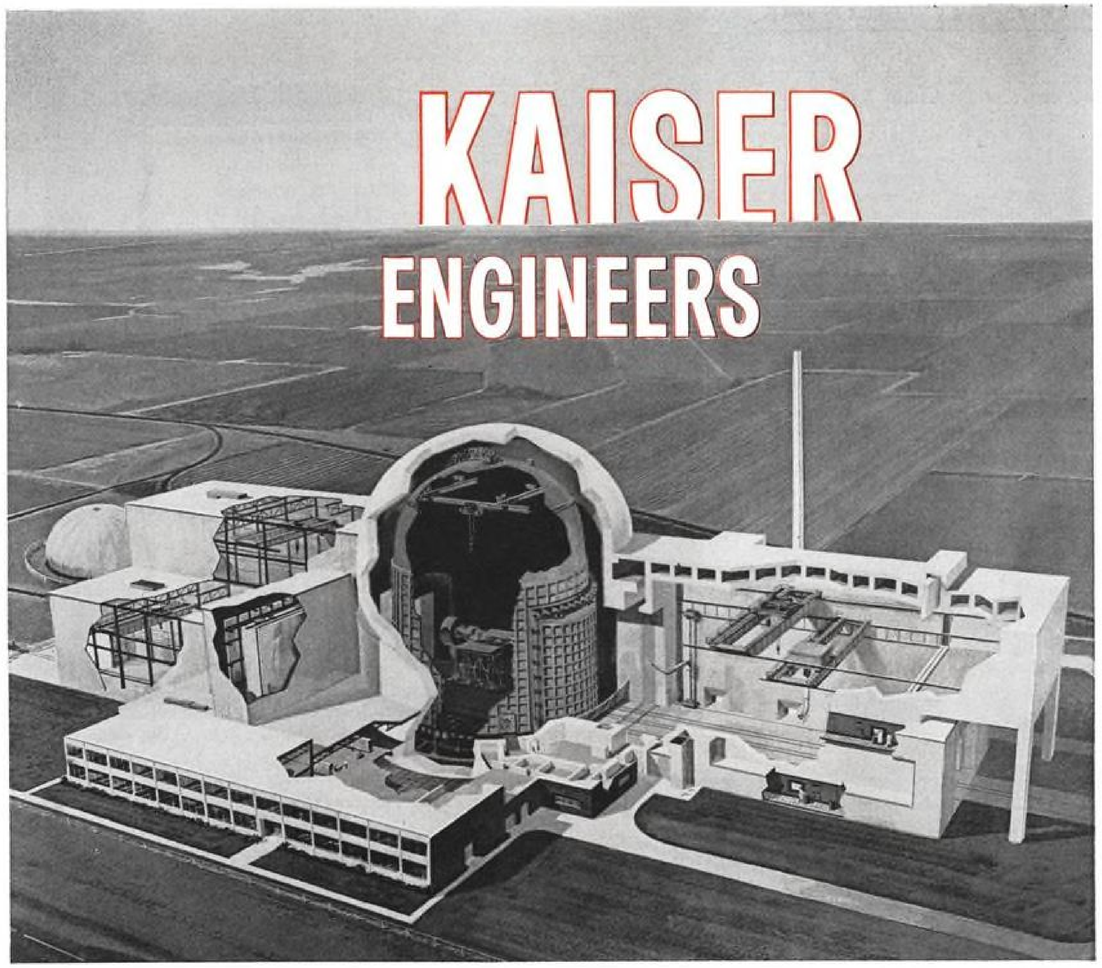
Oct. 15-18—Eighth Symposium on Ballistic Missile and Space Technology, Naval Training Center, San Diego, Calif. Sponsors: AF Space Systems Div.; AF Ballistic Systems Div.; Aerospace Corp.

Oct. 16-18—Tenth National Vacuum Symposium, American Vacuum Society, Statler Hilton Hotel, Boston, Mass.

Oct. 17-18; Oct. 21-22—Ninth Anglo-American Conference, American Institute of Aeronautics and Astronautics-Canadian Aeronautics and Space Institute-Royal Aeronautical Society. Massachusetts Institute of Technology, Cambridge, Mass. (Oct. 17-18). Queen Elizabeth Hotel, Montreal, Canada (Oct. 21-22).

Oct. 21-23—Tenth Annual East Coast Conference on Aerospace and Navigational Electronics, Institute of Electrical and Electronics Engineers, Emerson Hotel, Baltimore, Md.

Oct. 22-24—Conference on Expandable Structures, National Cash Register Co.'s Sugar Camp, Dayton, Ohio. Sponsor: Aeronautical Systems Division's Propulsion and Flight Dynamics Laboratories.



Designs... for NASA

NASA Lewis Research Center's Space Propulsion Facility is designed to simulate outerspace environment, including high vacuum, cryogenic temperatures, and solar radiation. The facility incorporates capability for testing full-scale nuclear and non-nuclear spacecraft, including nuclear power generation and electric propulsion systems. Kaiser Engineers' assignment — feasibility study, design criteria, preliminary nuclear hazards report, detail design, construction specifications, critical path scheduling. Kaiser Engineers is proud to be a member of the NASA team developing this advanced facility. KE also numbers among its clients the AEC, Air Force, Army Corps of Engineers, Navy Bureau of Yards and Docks, and leading aerospace industry firms.

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WHAT MAKES AN INSTRUMENTATION CABLE FAIL?

It can pass inspection perfectly one minute and fail miserably the next. Simply manufacturing it to spec isn't good enough. Insurance against failure must be built into the cable at every step from diagram to installation.

Where can it go wrong? At almost any point not adequately safeguarded. Here are four of the most common trouble spots:

(1) Incompatible Plasticizers
(2) Filler Material
(3) Component lay-factors
(4) Shielding

INCOMPATIBLE PLASTICIZERS A unique form of chemical warfare within cable materials has fouled more than one missile program. Plasticizer materials have to be added to compounds to obtain the required flexibility. These additives are seldom compatible with each other. Incompatible plasticizers used in systems in contact with each other without control may attack each other with disastrous effects. (As a prime example, additives in low temperature neoprene jackets are not always compatible with the insulating materials.)

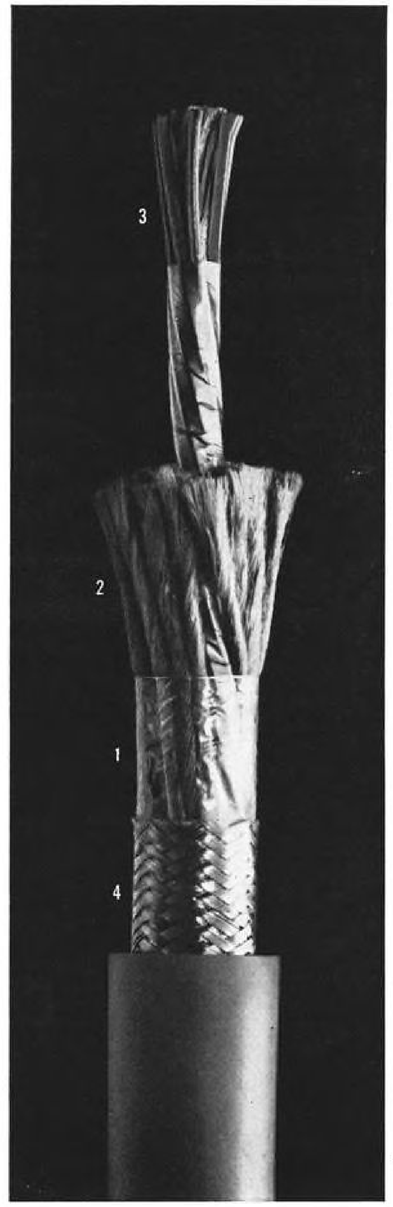
Manufacturers can control plasticizer migration problems by selecting proper materials and by using suitable barriers between components. Many specifications make the use of barrier material optional and a manufacturer whose only concern is price will leave it out.

Rome-Alcoa, as a result of its wide experience with materials, always uses barriers where migration could be a problem.

FILLER MATERIALS When spurious signals arrive at your display, recording or control panel, the fault could be in the improper selection of filler material. Compatibility between insulations and filler materials is of prime importance.

In the case of some plastics or rubbers, the material's "memory" can cause it to shrink disproportionately, creating undue stresses internally in the cable. This can cause kinking of the insulated conductors; electrical failures follow.

Only experience can tell a cable manufacturer how to compensate for "memory" and how to control compatibility in filler materials. Experience in areas such as this has given Rome-Alcoa its remarkable record of instrumentation cable reliability.



COMPONENT LAY-FACTORS Conductor kinking can also be a result of mistakes in the twisting of component conductors. Inconsistent tensions and improper sequence of lay-up can create uneven tensions in the assembled conductors.

In such cases, individual conductors may actually push through their insulations, causing electrical failures.

Obviously, these mistakes should be avoided during cabling. At this stage in cable construction careful, experienced workmanship can provide safeguards against possible trouble later on. Such careful craftsmanship sometimes costs a little more, but it can make the difference between success and failure.

SHIELDING Constructed of many ends of fine strands, shielding braids are prone to having broken and loose ends. These can break through insulations and short out component conductors. Improperly treated, they are the most common cause of shielding failures.

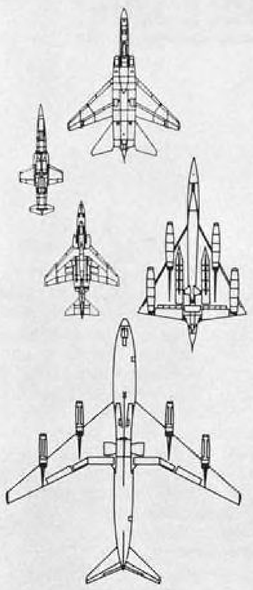
It's cheaper to let such loose ends remain in the braid—but it can also be disastrous. Experience on thousands of such shieldings has taught Rome-Alcoa the exact tensions which must be maintained, as well as methods of protecting and treating loose ends.

HOW TO AVOID FAILURES No manufacturer can promise you 100% reliability at every development stage. But it's only logical that the one way to be sure of maximum reliability is to have your cable planned and manufactured by a company with depth of experience and a record of reliability in the field.

Rome-Alcoa is, frankly, one of the few companies that qualify. We've been designing and constructing these cables since their first conception—long enough to know what can cause a cable failure, and how to avoid it. If you're planning to design or install instrumentation cable soon, call us.

As a starter, send for our 24-page booklet titled "Instrumentation Cables, Cable Assemblies and Hook-up Wires." In it, we describe instrumentation cable constructions, production, military specifications and our qualifications. For your copy, write Rome Cable Division of Alcoa, Dept. 26-83, Rome, N.Y.

ALCOA
ROME CABLE
DIVISION



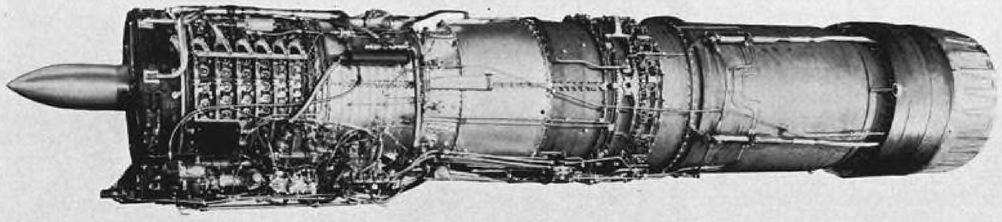
The versatile J79 turbojet—General Electric's Mach 2, 17,000-pound-thrust powerplant—provides a wide variety of aircraft with a remarkable capability for speed, efficiency, and reliability. Developed to meet the Air Force's rigid requirements for a Mach 2 aircraft, the J79 now powers the USAF's General Dynamics B-58 Hustler and Lockheed F-104 Starfighter, the Navy's North American A-5 Vigilante and McDonnell F-4B Phantom II, and the Air Force's new McDonnell F-4C. Civilian derivatives of this high-performance engine are found in both the Convair 880 and 990 commercial jet airliners, as well as in marine and industrial applications.

Military and commercial versions of the J79 have logged more than two million flight hours—in the course of which J79-powered military aircraft established 37 world class records for speed, altitude, and time-to-climb. Already the owner of more than half the Free World's Mach 2 flight time, this General Electric turbojet is daily accumulating supersonic flight hours at an ever-increasing rate.

With continuing advances in reliability and vigorous cost-reduction programs, the J79 is meeting customer demands for maximum performance at reasonable cost—another example of the *Accent on Value* from General Electric's Flight Propulsion Division, Evendale, Ohio.

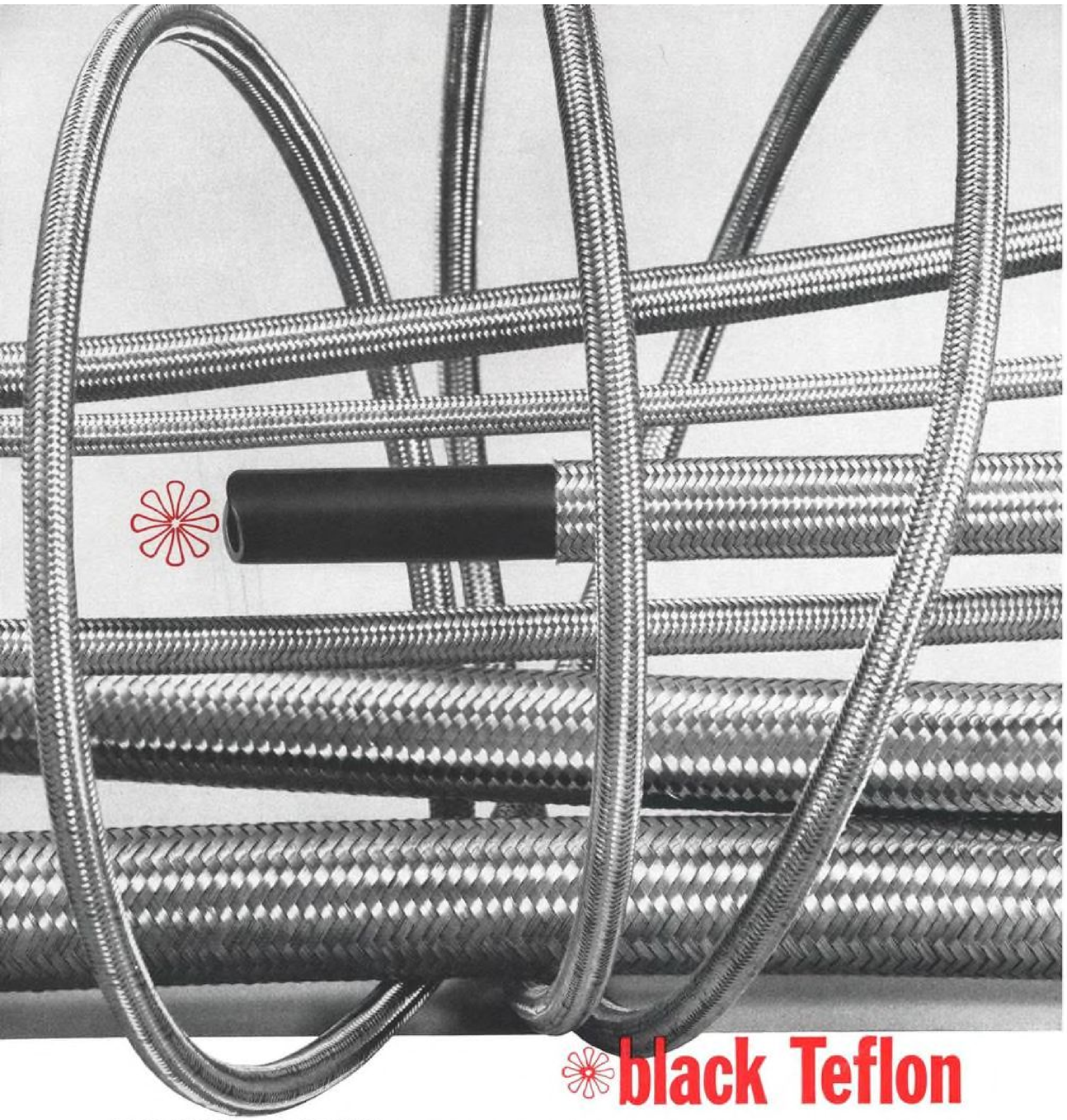
AEROSPACE AND DEFENSE GROUP **GENERAL ELECTRIC**

HIGHEST COMMON DENOMINATOR



As the hand builds, the mind must shape the systems of tomorrow to combat the inevitable encroachment of obsolescence. This is the way of RADCOM-Emertron where the undefined parameters of the electromagnetic spectrum are being researched into useful existence now for next-generation military and commercial applications. It will ensure the extension into tomorrow of RADCOM-Emertron's ability to design, engineer, manufacture, and field-support large-scale communications, ECM, surveillance, and shipboard electronics systems. ☐ To obtain a complete discussion of capabilities, product lines, and facilities, write: 1140 East West Highway, Silver Spring, Maryland ⊞ **RADCOM-Emertron** Division of Litton Industries

radcom-emertron products include radar altimeters & associated ground equipment, and airborne, shipboard & ground-based microwave antennas



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What took on-the-job training away from the job? **AMPEX VR-1500**

The Ampex VR-1500 is a low-cost portable television recorder/reproducer that converts a closed circuit television system into a powerful industrial training tool. With the VR-1500 you put to work the remarkable versatility of magnetic tape. It's the most advanced way yet to implement on-the-job training. You can train new employees and instruct older employees in new skills and methods. It will help you teach safety procedures, demonstrate new equipment, facilitate sales training and management development programs. You can produce your own training material at any desired location. And it can be produced expertly by your own training personnel to meet exact requirements. By using the VR-1500 as a training tool you save time and money. There's no costly developing; you can play back tapes immediately. They're easily stored and can be used time after time. And recorded material can be erased and new material recorded. For more information about the VR-1500 write to Ampex Corporation, Redwood City, California. (Ask for Bulletin 1524.) Term financing and leasing available. Worldwide sales, service.

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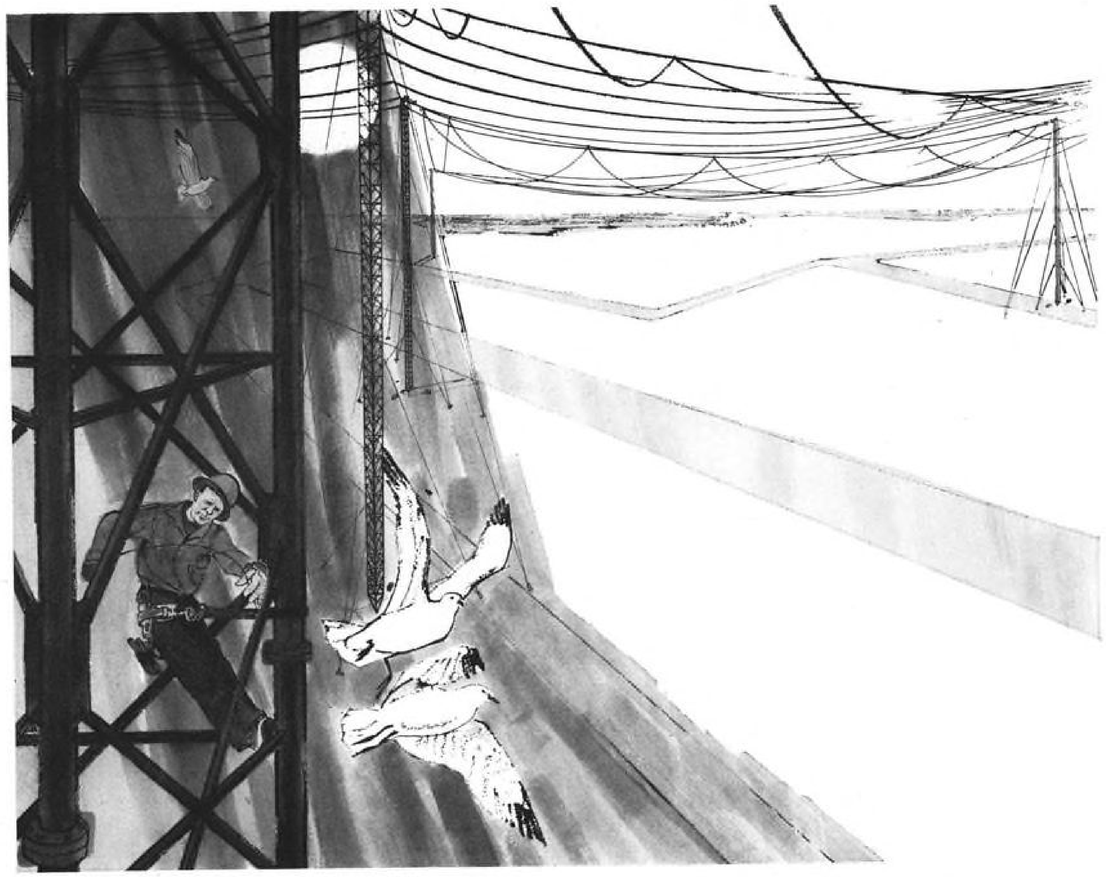

Anthorn—
NATO voice of command...

During World War II, the air over Anthorn, England, crackled with control-tower chatter typical of B-17 bases everywhere. Soon, that air will be charged again — this time with the big voice of NATO's new Very-Low-Frequency radio transmitter. With a power of 550-kw, it will feed a six-point-star antenna array stretching 4300 ft. over the old runways.

Like the U. S. Navy's staggering 2-megawatt VLF facility at Cutler, Maine, and VLF Pacific in Australia, the transmitting equipment for this new NATO command communication system is being designed and produced by LTV's Continental Electronics. VLF operation in the 16 - 20-kc range was selected for its immunity to ionospheric disturbances and because VLF propagation follows the curvature of the earth, thus giving added range to the station. Continental is associated with Redifon, Ltd. of London on the Anthorn project.

Long recognized as the producer of the world's most powerful transmitters, Continental produced the megawatt Voice of America transmitters, the BMEWS multimegawatt radar transmitters, and Nike-Zeus acquisition radar. Combined with Continental's activity in the fields of standard broadcast AM, HF, UHF, Single Sideband and microwave transmitters, these projects reflect another facet of LTV versatility. Continental Electronics Manufacturing Company, 4212 South Buckner Blvd., Dallas 27, Texas, a subsidiary of Ling-Temco-Vought, Inc.

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For more efficient use of equipment and better utilization of the communication spectrum, you may need multiplexing techniques. □ Electronic Communications, Inc., builds the only multiplexing designed from conception for the exacting demands of airborne operation. It was specifically developed for major military command and control systems. Designed to Air Force and Navy specifications, ECI's new solid state multiplexer is better qualified for any application—airborne, fixed, or mobile. □ This compact, light weight, mil spec multiplexer is only one example of ECI's broad capability. For a demonstration of how this capability can help solve your communication problem . . . . **ask**

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CONTENTS

COVER: Dassault Mystere 20, multi-purpose twin-jet executive transport (AW June 10, p. 90) is shown in its demonstration flight at the Paris Air Show. Prototype is powered by Pratt & Whitney JT12A-8 turbojets of 3,300 lb. thrust each. Dassault will adopt turbofans in future versions (see p. 40). For additional in-flight photos, see pp. 56-57

PICTURE CREDITS

Cover—Ron Appelbe; 30, 31, 32, 33—Aviation Week; 47—Miami Metro News Bureau; 49—Atlanta Municipal Airport; 56, 57—Ron Appelbe; 58, 59, 60—NASA; 66, 67, 70—Turbomeca; 71—Boeing Vertol; 72, 73—Curtiss-Wright; 75—Raytheon; 77—Lockheed; 79 (top)—U. S. Navy; 79 (bot.)—Lockheed; 82—NASA; 104—P. J. Klass; 109, 110—A. M. Adams; 95, 100—Ron Appelbe; 114, 115—U. S. Navy; 116—Lockheed.

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Industry Sales Problems

Last week, European Editor Cecil Brownlow presented readers of this magazine with a perceptive analysis of the new type of sales problems facing U. S. firms in the international aerospace market (AW July 29, p. 64). The week before, C. R. Smith, president of American Airlines, presented this same industry with a good example of its sales problems in the domestic market when he bought 15 British Aircraft Corp. BAC 111 short-range jet transports with an option on 15 more (AW July 22, p. 325).

The lesson of both these events is that competition is getting stiffer and only more alert managements and faster-galloping technology are going to prevail against the rising tide of international competition.

After nearly two postwar decades of dominating the commercial aircraft market, U. S. manufacturers are beginning to feel an increasingly sharp bite from foreign competition. It has always amazed us to watch U. S. transport manufacturers ignore the short- and medium-range jet markets while they over-competed among themselves in the large jet market. The French Caravelle has already penetrated this market in Europe, Asia and both Americas, and the BAC 111 is proving attractive to airlines in many lands as they move into the second round of this type buying. The Caravelle has proved its abilities in airline service and the first BAC 111 is ready to fly, but as yet only brochures have appeared in this competition from U. S. manufacturers.

Twin-Jet Challenge

Stepping down a notch in the jet scale we find both British and French twin-jet executive models challenging those of U. S. manufacture for the international market, including domestic sales. Dassault's impending deal with Pan American World Airways for the Mystere 20 will provide an excellent wedge into the U. S. market. And then there is the Swiss Pilatus Porter, in both its piston- and turbine-powered versions, quietly selling all over the world and winning acclaim from those hardened judges of aircraft efficiency, the Alaskan bush pilots.

Is there anything in the U. S. design sheds that will offer the equivalent of the French Breguet 941 series for either military tactical transport requirements or a bush freighter for underdeveloped areas?

Several major U. S. airlines have approached American manufacturers with their need for a VTOL-type, short-haul transport to serve the densely populated megalopolis that is already developing. So far, their efforts have been unsuccessful. Meanwhile, the resurgent German aircraft industry is working busily on a wide variety of VTOL short-haul transport designs aimed at both military and civil requirements. Will this segment of the U. S. transport market go to the Germans by default?

The Anglo-French handwriting is already on the supersonic transport wall. The major U. S. carriers have only a few more months of grace in which to make decisions either to retain the places cleverly blocked out for them on the Concorde production lines or to suffer a stiff competitive blow while waiting to see when and if the U. S. supersonic transport program develops into commercial hardware.

Military Competition Stiffens

In the military field the competition is getting even tougher. Politics, which fortunately play only an insignificant role in transport sales, loom much larger in the military sales problem. European aeronautical technology is passing out of its dependence on U. S. research, while that industry is working on its own generation of supersonic aircraft and the U. S. research effort in aeronautics has dwindled.

It is perfectly true that the U. S. aerospace industry has been concentrating its major effort on space technology and missile development, to the neglect of matters aeronautic. However, we know of no major manufacturer in the aerospace business which has more business than it wants. We know of only one that has publicly declared itself out of the aircraft market, though there is some question as to how voluntary this policy may have been.

There is still an enormous amount of business in the military and commercial aircraft market around the world. If the U. S. industry doesn't shed some of its technical and management complacency soon and compete with harder drive and sharper technology, it may find itself grasping a dwindling share of the international market that provided so much of the sinew of its supremacy.

—Robert Hotz

WHO'S WHERE

In the Front Office

E. Finley Carter, a director, Eitel-McCullough, Inc., San Carlos, Calif. Mr. Carter was the first president of Stanford Research Institute.

Charles B. Smith, associate of Laurance S. Rockefeller, elected a director of MHD Research, Inc., Newport Beach, Calif.

Charles M. Mooney, division vice president, Federal Government Systems Support, Radio Corp of America, Washington, D. C.

Dr. Finn J. Larsen, vice president-research and development, Honeywell's Military Products Group, Minneapolis, Minn. Until his resignation July 25, Dr. Larsen was Assistant Secretary of the Army for Research and Development.

Carson E. Boone, executive vice president, H. I. Thompson Fiber Glass Co., Gardena, Calif.

Edwin D. Campbell, executive vice president, Itek Corp., Lexington, Mass.

Carl Richardson, vice president-Analytical and Electronic Instruments, Baird-Atomic, Inc., Cambridge, Mass.

Paul B. Hendel, Jr., vice president-foreign operations, The Polymer Corp., Reading, Pa.

L. J. Kevitt, vice president, The Aircraft Fitting Co., Dania, Fla.

Jack I. Hamilton, vice president and executive assistant to Gerald J. Lynch, president and board chairman of Menasco Manufacturing Co., Burbank, Calif.

Dr. George Gerard, vice president-research and engineering, Concord Laboratories of Allied Research Associates, Inc., Concord, Mass.

Blair Bolles, vice president-government relations, Fairbanks, Morse & Co., with headquarters in Washington, D. C.

Donald H. Blouch, a vice president and general manager of the new Tape Service Div of General Kinetics, Inc., Arlington, Va. **Also: Thomas L. Herb, Jr.,** treasurer of GKI, succeeding **Alfred E. Roberts,** who continues as secretary and a vice president.

William J. Drummy, vice president-engineering and sales, Adel Div., General Metals Corp., Burbank, Calif., and **B. R. Teree,** vice president-engineering.

Theodore G. Haertel, director, Industry Planning Service of the Aerospace Industries Assn., Washington, D. C.

Honors and Elections

James S. McDonnell, Jr., founder and chairman of McDonnell Aircraft Corp., has been named recipient of the 1963 Daniel Guggenheim Medal for notable achievement in the advancement of aeronautics and space flight.

Dr. Donald A. Dooley, vice president and general manager of Aerospace Corp.'s Engineering Div. (San Bernardino Operations), has been temporarily assigned to the Air Forces's Project Forecast to head the Project Forecast Space Panel.

John D. Campbell, manager of the Environmental Test Dept., Philco's WDL Div., has been elected president of the Institute of Environmental Sciences for 1963-64.

(*Continued on page 119*)

INDUSTRY OBSERVER

► Defense Dept. is expected to continue with Phase 2 development on only two elements of the mobile medium-range ballistic missile (MMRBM) program as a result of a $100-million slash in the $143.1 million requested for Fiscal 1964 (AW July 29, p. 21). These are the stellar-inertial guidance system at Kearfott Div. of General Precision and the command and control system effort at Martin Co. These two elements are considered the most critical in determining over-all technical feasibility of the MMRBM.

► **A recent Soviet article suggests the Russians may be considering use of an Apollo-type Lunar Excursion Module (LEM) released from a spacecraft in lunar orbit. The article, appearing in the newspaper Yerevan Kommunist, was written by Nikolay Varvarov and says "It would be most feasible to effect a lunar landing" by departing from a space station in near-earth orbit with a spacecraft becoming an artificial satellite of the moon. "A small ship would be detached from the mother ship to make the actual landing," later returning to the lunar orbiting spacecraft for the flight back to the near-earth station. A ferry vehicle would be used to return the astronauts to earth.**

► Computer program representing a comprehensive planetary transportation system model for the 1975-1995 period will be developed independently by General Dynamics/Astronautics under a $72,987 contract and by Martin-Denver under a $74,841 contract, both from NASA's Marshall Space Flight Center. The study program ultimately will consider payloads in relation to missions involving earth, moon and planetary space stations and lunar, Mars, Venus, Jupiter and solar space exploration.

► **Attitude control system using forces generated by solar pressure has been proposed to NASA by Jet Propulsion Laboratory. In the system, a reflective vane-like appendage mounted on the side of the spacecraft away from the sun would generate a restoring force to counteract the destabilizing action of solar pressure. Solar pressure torques accounted for about half of the total control system fuel in the Mariner 2 spacecraft.**

► First flight of the General Electric/Ryan XV-5A lift-fan research aircraft originally planned for early this month (AW Jan. 21, p. 65) has now been postponed until at least December. Attempt to cut development time by six months, made at Army's insistence, apparently is the cause for the delay.

► **Development of a gyro-stabilized optical gunsight for use by helicopters against ground targets is being handled by Army's Frankford Arsenal, Philadelphia. Arsenal will issue request for proposals to industry Aug. 6 with proposals due Sept. 16.**

► Technical proposals for investigation of advanced aerospace vehicle crew station criteria were due from industry bidders today in a competition sponsored by USAF's Aeronautical Systems Div. Cost proposals will be submitted Aug. 15. Vehicles involved in the study will be capable of both low and high earth orbits for missions of 3 to 10 days duration respectively.

► **Jet Propulsion Laboratories is evaluating industry proposals for heat flux study in relation to planetary orbiter radiator surfaces. The six-month study anticipated in the competition will consider orbital altitudes of 100 km. minimum and 30,000 km. maximum for both Venus and Mars.**

► New Zealand Ministry of Defense is shopping for light and medium helicopters for air force use, with at least one version needed for search and rescue operations and another for training purposes. Funds are available, but the size of the order and the types have not been determined.

► **North American Aviation's Space and Information Systems Div.'s initial briefing for NASA under the company's contractual study for a modified Apollo logistics vehicle is scheduled for Sept. 3 and the final report is due Dec. 31. Companies interested in non-funded participation in the guidance and navigation portion of the study will submit data to S&ID by Aug. 15.**

Washington Roundup

Red Chinese Rumblings

U. S. is keeping a close watch on increased Red Chinese military activity on the Indian border, in Korea and Vietnam. State Dept. thinks new Chinese outbursts may be an effort to increase tension in Asia, thus damaging the hopeful climate created by the U. S.-U. K.-Soviet Union nuclear test ban treaty (see p. 26).

U-2 reconnaissance flights over the Himalayas produced little evidence of a Red Chinese buildup on the Indian border, but ground sources report definite troop movements. After last fall's fighting, 200,000 Chinese troops pulled back only 12 mi. into Tibet. The end of the rainy season is approaching and these troops could be back for another invasion of the Indian border in September or October.

Red China's truculence and threatening gesture toward India, which has announced it will sign the test ban treaty, have brought Moscow and New Delhi closer together. Soviet Union has offered India quick delivery of radar-controlled mortars, ground-to-air missiles, transport aircraft, helicopters and mountain artillery.

U. S. support to India may be increased, too. Indian military officials are now in the U. S. taking a close look at our military training programs, and India, the U. S. and Britain will hold combined air exercises in the Delhi-Calcutta area this fall to acquaint the Indian Air Force with the latest in supersonic aircraft operations.

Karachi-Tokyo Route

International cross-currents created by Soviet-Red China rift threaten to swamp Pakistan Airlines' effort to establish a Karachi-Tokyo route which would serve Canton or Shanghai. The airline selected the Red Chinese cities as intermediate stops after Great Britain denied it entry into Hong Kong. Soviet Union is irritated at the Chinese effort to ingratiate itself with Pakistan, and is understood to have threatened to curtail Aeroflot service to China. On top of this, Japan, which would like to start air service and limited trade with Red China, rebuffed the Pakistan bid rather than risk offending the U. S.

U. S. military airlift capability will be four times greater in 1967 than it was in 1960, Defense Secretary Robert S. McNamara said last week. He told a special House Armed Services Airlift Subcommittee that substantial military supplies have been pre-positioned in Europe and the Far East, lending credence to reports that the Defense Dept. is planning massive exercises late this year involving movements of entire divisions in both areas. Nineteen such strategic mobility maneuvers are planned in Fiscal 1964. Buildup of military airlift capability will include introduction of the C-141 into Air Force inventory in 1965. The C-141 is scheduled for rollout Aug. 22 at the Lockheed-Georgia plant.

TFX: Conflict on Conflict

Bitterest dispute yet over the TFX (see p. 38) broke out on the House floor Aug. 1 when Rep. H. R. Gross (R.-Iowa) called on President Kennedy to fire Navy Secretary Fred Korth for conflict of interest. Rep. James C. Wright (D.-Tex.) charged that Gross' remarks were "intemperate" and made an emotional defense of Korth.

Earlier, Sen. Milward L. Simpson (R.-Wyo.) said in a Senate speech that he was "shocked to see spelled out publicly the obvious business and political cross-currents which figured in Secretary Korth's judgment on the aircraft contract." Rep. Wright also replied to Sen. Simpson's speech, charging that it was an attempt to make Korth a scapegoat in the TFX controversy. The clashes resulted from Korth's testimony that he was president of the Continental National Bank of Ft. Worth, which had loaned General Dynamics money shortly before he became Navy Secretary (AW July 29, p. 18).

NASA Large Solids

U. S. space agency may get back the solid-rocket development program it relinquished to the Air Force. Rep. George Miller (D.-Calif.), chairman of the House space committee, told the House when the NASA budget was being debated Aug. 1 (see p. 37) that if the Air Force cut back its solid-rocket program (AW July 8, p. 18), his committee would consider funding a NASA solid-rocket development.

The fine hand of the Kennedy clan is credited with resurrecting the Boston Electronics Research Center after it was buried by the Senate space committee July 25. On Aug. 1—only six days after eliminating the entire $5 million requested by NASA to start work on the center—the Senate committee voted in closed session to restore all of the funds. Previously, the House space committee cut $1.1 million from the request and ordered NASA to prepare a new and more thorough justification for the center.

Thread by which controversial Lt. Col. John A. (Shorty) Powers had clung to his job as "voice of Project Mercury" was finally severed last week. In recognition of his devotion to the program—even his critics admit he was a tireless worker—he was moved into an administrative job. He was replaced at the Manned Spacecraft Center by Paul Haney, Washington manager of the manned flight information program and a quiet spoken ex-newsman with no known addiction for the spotlight.

—Washington Staff

Space Blast Detection System Considered

U. S. faces decision on billion-dollar program; agreement on nuclear test ban treaty might spur action.

By Katherine Johnsen

Washington—Nuclear test ban treaty will confront the U. S. with the question of whether to move forward with what could be a billion-dollar effort to establish an operational land-based and satellite system to detect possible clandestine explosions in space.

Although the U. S. can detect nuclear tests in the atmosphere and underwater, it has a very limited capability for detection in space. The fact that this lack worries some members of the Senate, which must approve the test ban treaty, may spur action toward establishing such a system.

The treaty prohibiting testing in the atmosphere, underwater, and in space is scheduled for signing Aug. 5 in Moscow by Secretary of State Dean Rusk and the foreign ministers of the United Kingdom and the USSR. Final approval by the U. K. and USSR will be automatic. By custom the British government will go through the formality of submitting the treaty to Parliament. The minority opposition to the ruling Conservative government has already given its endorsement.

The only possibility for an upset is the U. S. Senate, which must recommend ratification by a two-thirds vote to enable President Kennedy to take final action on the part of the U. S.

U. S.'s ability to detect possible clandestine violations in the atmosphere or underwater is generally unchallenged. The President expressed it this way in his address to the nation on the test ban treaty:

"This nation now possesses a variety of techniques to detect the nuclear tests of other nations which are conducted in the air or under water. For such tests produce unmistakable signs which our modern instruments can pick up."

Underground testing, omitted from the ban treaty, presumably will be continued by the U. S. and the U. K., working cooperatively, and by the USSR. To date, the U. S. has announced only one Soviet underground test, later confirmed by the USSR. This was on Feb. 2, 1962.

It is possible that the U. S. will expand its detection system for underground events, simply to follow developments of other nations.

Sen. John Pastore (D.-R. I.), chairman of the Joint Congressional Committee on Atomic Energy, told AVIATION WEEK & SPACE TECHNOLOGY that "once the treaty becomes a reality, it will be incumbent on our committee to make a thorough study of all our detection technology." Past hearings on detection, Sen. Pastore noted, have occurred when a treaty was only "an academic discussion."

"Once the treaty comes here, there is a responsibility and a reason for exhaustive and penetrating interrogation," he said. Sen. Pastore has indicated he favors the treaty.

The Administration has indicated no urgency so far in establishing a comprehensive space detection system. Some capability does exist, in the form of instrumentation carried piggy-back on other types of satellites.

The cost of a system of space detection varies widely, depending on how comprehensive and refined a system is desired and on such variables as the life span of spacecraft and the reliability of launch vehicles.

Cost estimates of a satellite system have dropped sharply and are expected to continue to do so as space technology advances. Late in 1959, Space Technology Laboratories priced the satellite system theoretically developed by an international working group at Geneva at $1.2 billion to establish and $200 to $300 million a year to maintain. By 1961, Defense Dept.'s Advanced Research Projects Agency, because of improvements in space technology, refined this cost estimate to over $200 million to establish and $100 million a year to operate. ARPA now estimates that the operational cost eventually could be reduced to around $30 million a year with improvements in launch reliability and spacecraft lifetime.

One of the major objectives of a detection system would be to make space testing so costly and so difficult it would not even be given serious consideration by a would-be violator.

At the present state of the art, even without the problem of evading detection, space testing of nuclear devices would be difficult and costly. It would require launch coordination between nuclear devices and diagnostic devices. A detection system could add to this a requirement for heavy shielding to preclude detection.

This, in turn, would further complicate the would-be violator's diagnostic problem.

Experts appear agreed that a desirable space detection system would be a combination of satellites and land-based instrumentation—at least at present. Satellites have advantages in coverage, while land-based instruments can be checked more easily and malfunctions verified.

In such a system, land-based detection would extend in space to roughly earth-moon distances—or out to about 240,000 mi. About six satellites would cover primarily deep space. The satellite aspect would cost several hundred million dollars to establish and, at present, about $100 million a year to operate. Cost of the land-based aspect would be dependent on the surface of the earth covered.

The land-based system, developed under ARPA's Vela-Sierra research and development program, could be rapidly implemented, since most of the basic instrument development has been completed. Even if restricted to locations outside the Communist bloc countries it would have the capability to detect a 10-kiloton unshielded test roughly out to earth-moon distances.

Flight testing on a satellite system, also developed by ARPA under a program formerly designated Vela-Hotel, is scheduled to start this fall (AW Mar. 18, p. 36). A series of five launches of two satellites each, in tandem, is planned. The shots will be timed to allow incorporation of improvements indicated by the previous launch.

The satellite research program's mission is to develop detection in space from 15 to 18 mi. out to an eventual maximum of 200 million mi. The mission of the land-based Vela-Sierra program covers space from 15 to 18 mi. out to about a million miles.

U. S. tested nuclear explosions up to 400 mi. in space during the Dominic series in the Pacific last year. Substantial information from these tests is being applied to the Vela-Sierra and land-based detection research programs.

ARPA has allocated $31.2 million for the two research and development programs for Fiscal 1964: $27.5 million for the satellite program and $3.7 million for Vela-Sierra. Through Fiscal 1963, a total of $62 million was obligated: $50 million for the satellite program and $12.3 million for the land-based one.

A decision to establish an operational system for detection of nuclear explosions in space would pose the question of the operating agency. The possibilities appear to be Air Force or ARPA, which is currently limited to research and development activities.

President Kennedy explained:

"There is at present a possibility that deep in outer space, that hundreds and thousands and millions of miles away from the earth, illegal tests might go undetected.

"But we already have the capability to construct a system of observation that would make such tests almost impossible to conceal and we can decide at any time whether such a system is needed in the light of the limited risk to us and the limited reward to others of violations attempted at that range. For any tests which might be conducted so far out in space which cannot be conducted more easily and efficiently and legally underground would necessarily be of such magnitude that they would be extremely difficult to conceal."

The Administration has had under consideration for several months a modest program for detection of underground tests that is considered adequate. It would involve about 15 seismic stations ringing the USSR. Each would cost about $1 million and the annual operating cost of the system would be about $10 million (AW Mar. 25, p. 103). Sen. Pastore said last week that an adequate system for underground detection is "positively required."

ARPA's detection programs include:

• **Satellite.** A major objective of this year's research flights is to obtain data on outer space natural phenomena which can give a "false alarm" of a nuclear detonation. Each spacecraft, costing about $350,000, will contain three types of detectors: ten X-ray detectors, six gamma-ray detectors, and a two-element neutron detector.

• **Vela-Sierra.** Since the primary radiations from a nuclear explosion—X-rays, gamma-rays, and neutrons—do not reach the earth's surface, land-based detection relies mainly on secondary effects. The three main effects are: ionization produced in the upper atmosphere by X-rays or trapped electrons; the electromagnetic pulse produced by the interaction of the prompt gamma-rays; and the fluctuations of the earth's magnetic field which are probably caused by interactions in the ionosphere.

• **Shielding.** Although it has been verified that nuclear explosions can be shielded to frustrate detection, it has also been determined that it would be possible for satellites to detect shielded tests with different sensors than those used for unshielded tests.

Primary emphasis in theoretical work has been on shielding against the X-rays because these have the greatest detection ranges and are also more easily shielded than gamma-rays or neutrons.

Elaborate nuclear tests in space—which would be banned by the treaty—are required at this time to determine shielding effectiveness experimentally.

The basic engineering problems for shielding a nuclear explosion—design and fabrication, boost into space and deployment in the proper geometry at test time—are similar to the problems in space exploration, according to ARPA. In testimony last March to the Joint Atomic Committee, ARPA said:

"The degree of sophistication and reliability that will be required for the successful completion of the manned lunar mission is judged to be more than adequate to conduct a test with rather elaborate shielding.

"Already the Mariner 2 Venus mission has demonstrated many of the techniques needed for a successful completion of a shielded test. It is therefore clear that we have to develop the technology for detecting shielded tests."

Tata Rejection

New Delhi—Indian cabinet has rejected recommendations by a committee headed by J. R. D. Tata that present plans to build the Avro 748 twin-turboprop and the Soviet-designed MiG-21 fighter be scrapped.

Cabinet gave as its reason the heavy commitments already made in the Avro project.

Tata committee had recommended instead that India build the de Havilland Caribou (AW July 15, p. 23).

Indian air force maintenance command meanwhile announced that production of the Avro 748s would be increased.

Avro 748 production facilities will be expanded, the air force said.

Lunar Horizon Study

Los Angeles—Northrop's Nortronics Div. is studying methods of accurately detecting the lunar horizon, under a 10-month contract from National Aeronautics and Space Administration's Marshall Space Flight Center.

The investigation, targeted for ultimate application to orbiting vehicles, such as a lunar logistics system, considers the difficulties likely to be encountered in differentiating between the true horizon gradient and numerous other existing gradients.

The technique to determine the lunar local vertical will aim for an accuracy of ±0.1 deg.

Program will outline several approaches to the problem, followed by fabrication of a laboratory model to demonstrate the capability of acquiring the lunar horizon, either illuminated or non-illuminated, and discriminating against false or misleading gradients, such as crater shadows.

Test Ban Reinforces French Aim

Paris—French military and political proponents of an independent nuclear force for France regard the recently negotiated limited nuclear test ban treaty between the U. S., the United Kingdom and the Soviet Union as concrete and dramatic confirmation of their views.

The ban also places an additional strain upon the already shaky military-political structure of the North Atlantic Treaty Organization and, in France's view, on NATO's future in its present form after the expiration of the current treaty agreements among the member nations in 1969.

President Charles de Gaulle has consistently rejected U. S. suggestions that he accept a multilateral nuclear force for NATO. At the same time the U. S. would have France abandon that country's efforts to develop an independent deterrent of its own through procurement of an intermediate-range ballistic missile and atom stores for its planned force of Dassault Mirage 4 supersonic strategic bombers.

Last week, at a press conference President de Gaulle said:

"The fact that the Russians also now possess enough to destroy the universe, and notably, the new [North American] continent, make it natural that America sees her own survival as the principal objective of an eventual conflict and envisages the moment and the degree and the methods of her nuclear interventions for the defense of other regions only as a function of that natural and over-riding necessity.

"This is one of the reasons why France has provided herself with her own atomic weapon. The result is that for the French government, important changes must be made in the conditions of its means of participating in the alliance, for this organization was built on the basis of integration which no longer is of any value for us."

As an alternative, de Gaulle suggested that France would "wholeheartedly abstain" from procuring nuclear weapons should the U. S. and Russia decide to disarm, "that is to say if they finally decide to destroy and to ban nuclear means . . . but it does not seem that we are yet near that point. And the sad Geneva [disarmament] conference will have sat, as could have been foreseen, for nothing."

President de Gaulle added that he plans to call a disarmament conference of his own before the end of the year, inviting "the interested states" to study this "essential problem." He indicated that probable topics of discussion would include "space, air and sea launching vehicles for nuclear missiles."

NASA Technology Utilization Scrutiny Due

By Alfred P. Alibrando

Washington—U.S. space agency's much-criticized technology utilization program—accepted "on faith" by congressional space committees this year—will be examined closely in next year's hearings to determine whether it is producing tangible benefits.

National Aeronautics and Space Administration started the program on an experimental basis in May, 1962. The agency since has created an Office of Technology Utilization under Dr. George L. Simpson, Jr., and asked for $3.5 million in its Fiscal 1964 budget to continue the program.

Purpose of the program, according to NASA, is to "locate, research, analyze and disseminate to business and industry the useful results of NASA research and development so that this knowledge may be applied for commercial use."

The technology utilization program was studied carefully this year by House space committee members. Rep. Ken Hechler (D.-W. Va.), chairman of the subcommittee which considered that portion of the NASA authorization bill, said it was difficult to determine the value of the program because it was relatively new.

"We had to accept much of the program on faith," he said. "The concept is a good one but there was no way for us to determine whether the program is doing what it is supposed to do."

Rep. Hechler and Rep. J. Edward Roush (D.-Ind.), subcommittee member, who directed the examination of the technology utilization program, conceded that there are many on the Senate and House space committees who are skeptical of the program.

"We're fully aware of this," said Rep. Hechler, "but we believe the program has great potential. If the NASA program contained no provision for technology utilization, we would have difficulty supporting it."

Rep. Hechler said the committee next year would examine parts of the program "in depth," calling in private industry representatives and officials of the research organizations which are participating in the program under contract to NASA.

"We hope to make an independent determination, to find out whether the program is useful or just another boondoggle," Rep. Hechler said.

During the Hechler subcommittee's hearings, some members suggested that the technology utilization program, which includes grants to research organizations and universities, was too much in the nature of a public works program and too far afield from the space and aeronautical research and flight activities NASA was organized to perform.

The subcommittee voted to recommend an authorization of $2.5 million for the program, cutting $1 million from the amount requested by NASA. However, when the full House space committee considered the technology utilization item, it voted to restore the $1 million.

"It was not planned," Rep. Hechler said, "and while I was happy to support the restoration, I was surprised."

As to the question of whether NASA is going beyond its congressional charter in the technology utilization and university grant programs, Simpson maintains that not only is this activity within the sphere of the agency's responsibility but that the space act requires such programs. He cited these portions of the act that require:

- "**The establishment** of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes.
- "**The most effective** utilization of the scientific and engineering resources of the United States. . . ."

In establishing the technology utilization program, a system was set up whereby NASA field centers and industrial contractors report to NASA headquarters technological advances that might be of interest and use in other space and non-space industries.

NASA headquarters evaluates these advances, weeds some out and sends those that survive to seven research institutes for further evaluation. Information on discoveries, innovations and advances deemed worthy of broad dissemination is then prepared for distribution to those who request it. That is, a firm or company seeking an improved method for helium purification could obtain on request information on a recently developed method in which the gas is liquefied and passed through finely divided iron oxide.

James Dennison, who is directly in charge of NASA's technology utilization machinery, estimates that the system has turned up about 800 innovations or advances. The most recent summary, dated July 26, contained 50 items, which included:

Frictionless electromagnetic brake; ceramic vacuum ultraviolet ion chamber; sense amplifier for computer memories; double-throw microwave switch; transient pressure measurement system for blast effect research; process for coating metals; low-cost cryogenic insulation system that eliminates the need for a vacuum; bearing lubricants for use in vacuum conditions; biomedical amplifier and an ultrasonic electroforming process.

Dennison said that reports by Midwest Research Institute of Kansas City, which prepares and disseminates information to industry in a six-state midwestern area, indicate that the program already is a success. MRI has received hundreds of requests for information, a high percentage of them for information on processing and materials. These are some specific subjects and numbers of requests:

Cold galvanizing, 64; magnetic forming, 33; welding back-up tape, 27; welding techniques, 25; explosive forming, 23; silicone coating, 21; and temperature-indicating paint, 19.

A series of meetings in the Midwest at which industry representatives were exposed to about 60 different technical concepts, processes, materials or methods produced 811 responses, according to MRI, with much more interest in new processes and materials than in specific new product ideas.

MRI also reports 16 specific cases where application of techniques or materials were of major benefit to the new user. In one case, a manufacturer who had been experiencing about 25% breakage of miniature, precision wirewound resistors, practically eliminated the breakage by using a ceramic material developed at the NASA Lewis Research Center.

Most of the recent criticism of NASA has been over the expenditure of large sums of money by the agency for "socio-economic" studies and "public affairs" programs.

A contract with Columbia University for support of scientific writers' training and a study of NASA's public affairs activities, which would have amounted to nearly $400,000, was canceled after a storm of adverse publicity.

These are some typical socio-economic study contracts awarded by NASA:

- **University of Colorado,** $117,000 for a two-year study of the social and economic impact of the growth of space-related science and technology on Boulder, Colo. Purpose of the study is to determine how such growth affects population, school requirements, salaries and the general economy of a community. The information is to be developed for application or evaluation use in other communities throughout the nation.
- **Mississippi State University,** $92,615 to study the problems of states with agrarian economies in contributing to space age scientific needs.
- **Oklahoma State University,** $10,800 to study the effects of NASA programs on the regional economy.
- **American Academy** of Arts & Sciences, $181,000 to study the long-range problems related to the development of NASA programs.
- **Midwest Research Institute,** $105,480 for a study on the short and long-term effects of increased participation in space technology on the economy of six midwestern states and an analysis of the technical capabilities of these states in determining the optimum direction of future economic efforts.
- **University of Chicago,** $100,000 to support work on the problems of the administration of research, including factors affecting the introduction and development of technological change in industrial organizations and the effect of technology on public affairs.

"The socio-economic label put on these studies may be unfortunate," said Simpson, "and the emphasis on studying the impact of the NASA program on social and economic conditions may have been harmful.

"Actually, these studies for the most part are related to finding out how to measure the effectiveness of our technology utilization program and providing the means for the local community or region to take advantage of the technology that is available from the space program."

NASA Administrator James E. Webb feels very strongly about the technology utilization and university programs, which provide funds both for research and facilities.

"For the first time the U. S. has an open, unclassified program of great scope which makes possible the fullest use of widespread university resources," he said. "If we develop . . . the resources for research on the campus . . . the campus then can become the transmission medium for research and technology . . . between the government agency and the community."

Some members of Congress feel the university program has not been justified and that it is a substitute for more aid to higher education. However, NASA memoranda of understanding with the universities covering facilities grants place a definite responsibility on the schools to engage in a broad range of space activities and relates the university activities to development of area space research capability.

Webb also cited the need for quickening the pace of introducing new technology.

"The space program is completely different from defense programs in this respect," Webb said. "In those programs, the research and development is followed by production. In the space program there is no production and therefore we must have a continuous technological advancement. We need every mind, every research resource."

Webb and Simpson said they interpreted the Space Act to mean that the agency has a responsibility to help the local community or region understand both the opportunities available for exploiting the technology developed in the space program and the community's responsibility to participate in the program.

During the Hechler subcommittee hearings, Simpson was asked if the NASA program sought to influence the geographical location of the buildup in research and development capability.

". . . We do not go out and beat up trade in the regions that are 'have not' . . . but we encourage people from the 'have not' areas—technologically and scientifically."

Another misunderstanding explored during the hearings was NASA's interest in such urban problems as air pollution and waste disposal. Some members of the subcommittee suggested that even the most liberal interpretation of the Space Act would not justify the agency's participation in solving such problems.

The misunderstanding was clarified in an exchange between Simpson and Rep. Roush, which developed the point that NASA does not attempt to find solutions but will make available information which may help a community solve problems involving air pollution and waste disposal.

Cited as an example was the application of methods and technology developed for disposal of human waste in a spacecraft to the problem of improving community waste disposal systems.

Jet Commander Size Increased

Gross weight of the Aero Commander Model 1121 Jet Commander will be increased 2,000 lb. to a total of 16,000 lb. and the fuselage will be lengthened 30 in. to a total of 50 ft. 11 in.

Changes will allow the useful load of the Jet Commander to be increased to 8,760 lb., baggage and electronics areas to be moved inside the pressure vessel of the cabin and the fuselage fuel tanks to be relocated.

Rate of climb may be reduced somewhat by the changes, but Commander says that it still will be able to meet or exceed all performance guarantees written into contracts for the 62 aircraft now on order.

Changes will not slow certification work, since considerable flight testing on the current prototype has been done at gross weights of between 16,000 lb. and 16,400 lb. First prototype, which now has 56 hr. of flight time, will remain in the test flying program at Bethany until Sept. 1 when it will be modified to the new length and gross weight.

Second flying prototype will be flying about Dec. 1 with the changes incorporated into it.

Additional fuselage section will be located immediately aft of the pilot compartment and in front of the cabin entrance door. Baggage and electronics areas will be in the left side of the aircraft, facing the lavatory which will be moved forward 30 in.

This will allow the two areas to be pressurized to 8 psi., the cabin pressure, rather than to a lesser pressure as previously planned (AW Mar. 4, p. 82).

Fuselage bladder tank, originally located above the wing center section, will be moved below it to allow gravity fuel feed from the wing tanks to the bladder tank, which would act as a sump tank.

Gross weight increase from 14,000 lb. to 16,000 lb. will raise the useful load from 7,200 lb. to 8,760 lb. This will enable the aircraft to carry 600 lb. of radio and electronics gear, 6,633 lb. of fuel (990 gal.) and have 1,500 lb. remaining for crew, passengers and baggage.

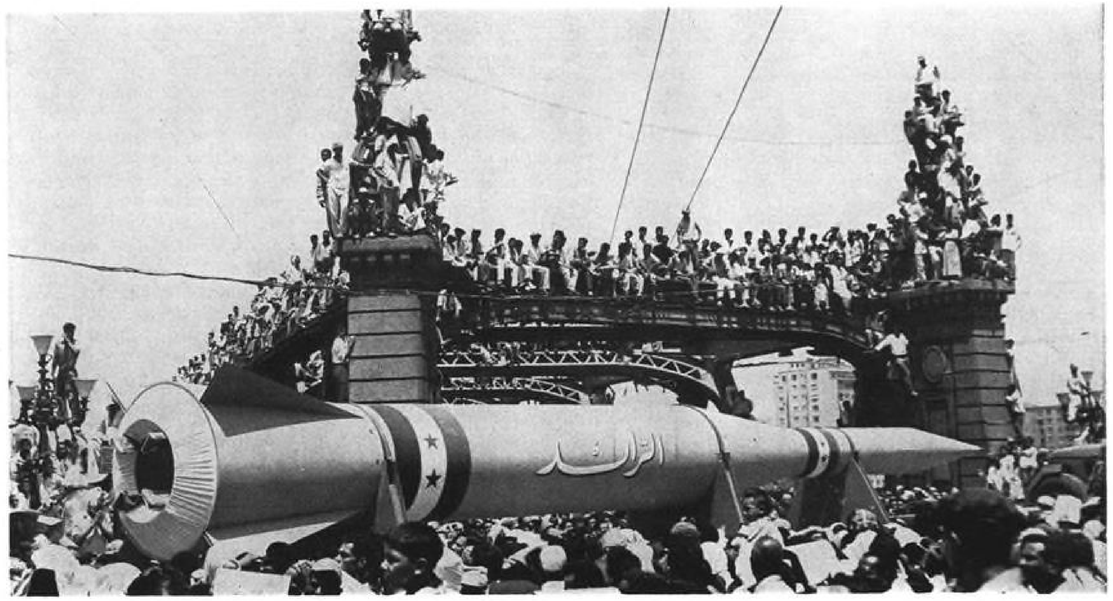
This figures to a crew of one and six passengers or a crew of two and five passengers plus 35 lb. of baggage for each person.

Aero Commander still is expecting certification under CAR Part 4b in March, 1964, and to begin deliveries of the Jet Commander that same month.

All production tooling now is in place at Commander's Bethany, Okla., production facility and work on sub-assemblies, including wing panels, is under way. About 47,000 sq. ft. of manufacturing floor space is being used for the Jet Commander production line. Production rate is scheduled to be two aircraft a month initially and four a month later.

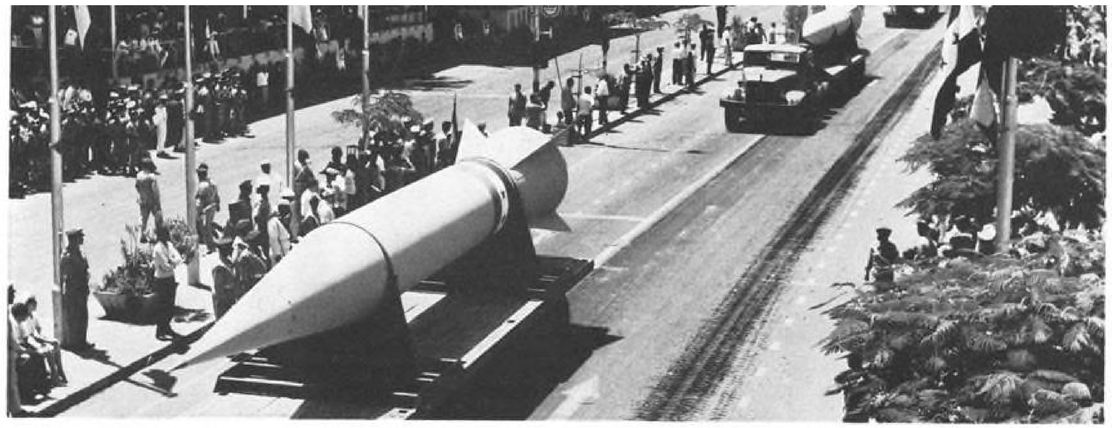
Plans for an increase in factory size have been made.

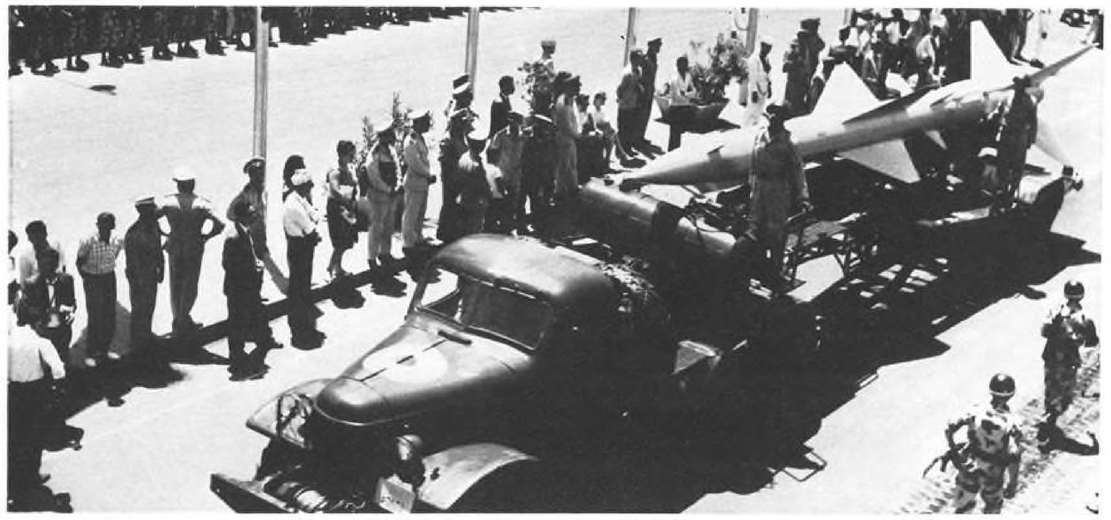
Recent test flights with the first prototype have been aimed at qualifying the Jet Commander's new wing-mounted speed brakes, which were added after the main landing gear was found to be inadequate in slowing the aircraft down.

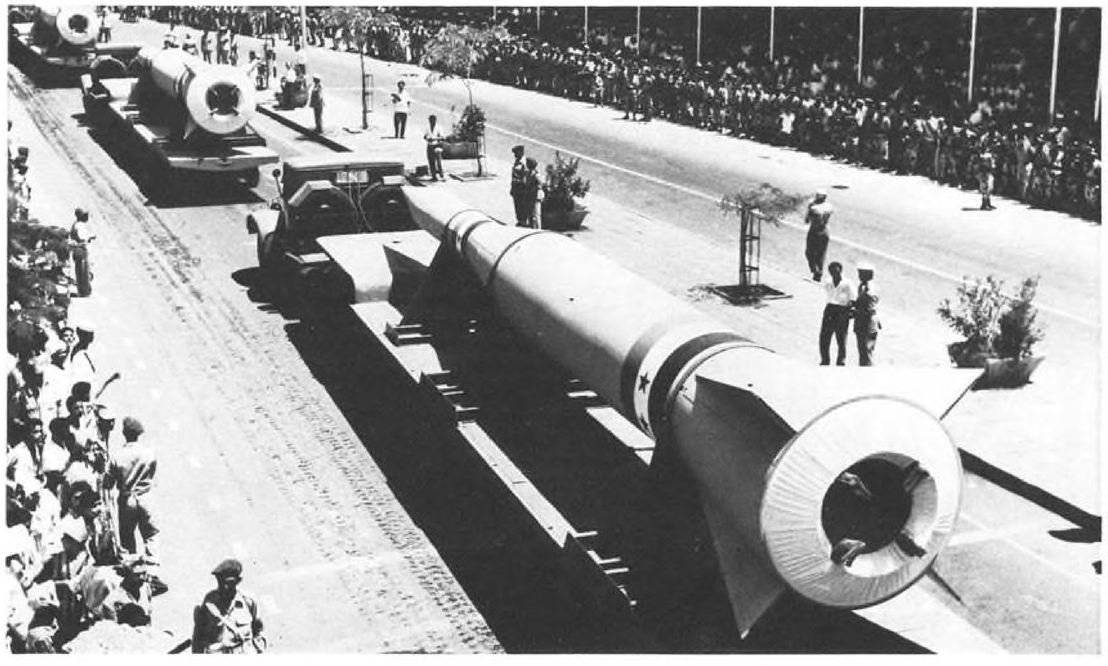


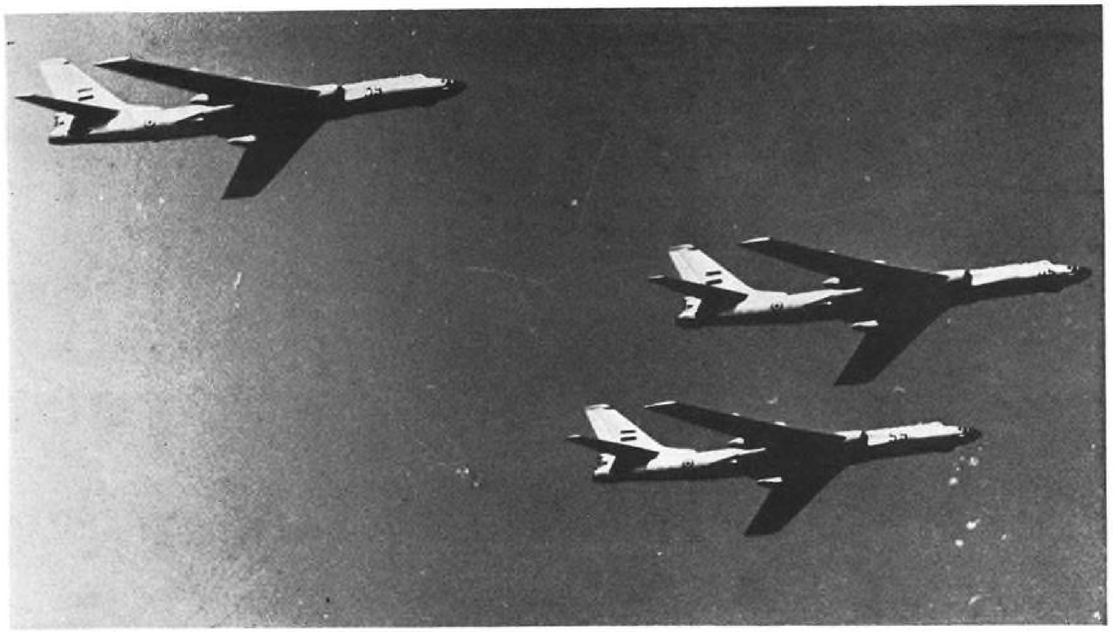
Egypt Shows SA-2, Other Missiles in Parade

Greater variety of missiles, including some not publicly shown before, were put on view by the Egyptian government in the Cairo parade celebrating the 11th anniversary of the Nasser revolution. One new rocket is the two-stage Al Ared surface-to-surface missile (above, this page, and bottom, opposite). Range has been reported variously as over 360 mi. and 620 mi. (AW July 29, p. 26). Al Ared has reportedly been tested successfully several times over the past two months. Note protective covering around nozzle of first stage, which appears to be similar to single-stage missile (top, opposite page), probably one of the 360-mi. range missiles first shown in the parade a year ago and test-fired at about the same time (AW July 30, 1962, p. 20). Design bears some resemblance to World War 2 German V-2, with later modifications. Zafir missile on mobile launcher (left, this page) was seen this year for the first time. Note flame bucket at rear of launching vehicle below erector. Zafir is an Egyptian-made missile, but mobile launcher is Russian design. Russia's SA-2 Guideline two-stage anti-aircraft missile (center, opposite page) is a radar-guided surface-to-air design with a maximum operation altitude of about 80,000 ft. (AW May 6, p. 36). Parade marked first showing of the SA-2 by Egyptians. This missile is similar to the type installed at about 24 sites in Cuba during the crisis in the fall of 1962. One of them brought down a USAF U-2 (AW May 13, p. 30). Note troops in desert combat uniform next to Guideline carrier vehicle. For photos of aircraft displayed during the Cairo parade, see pp. 32-33.



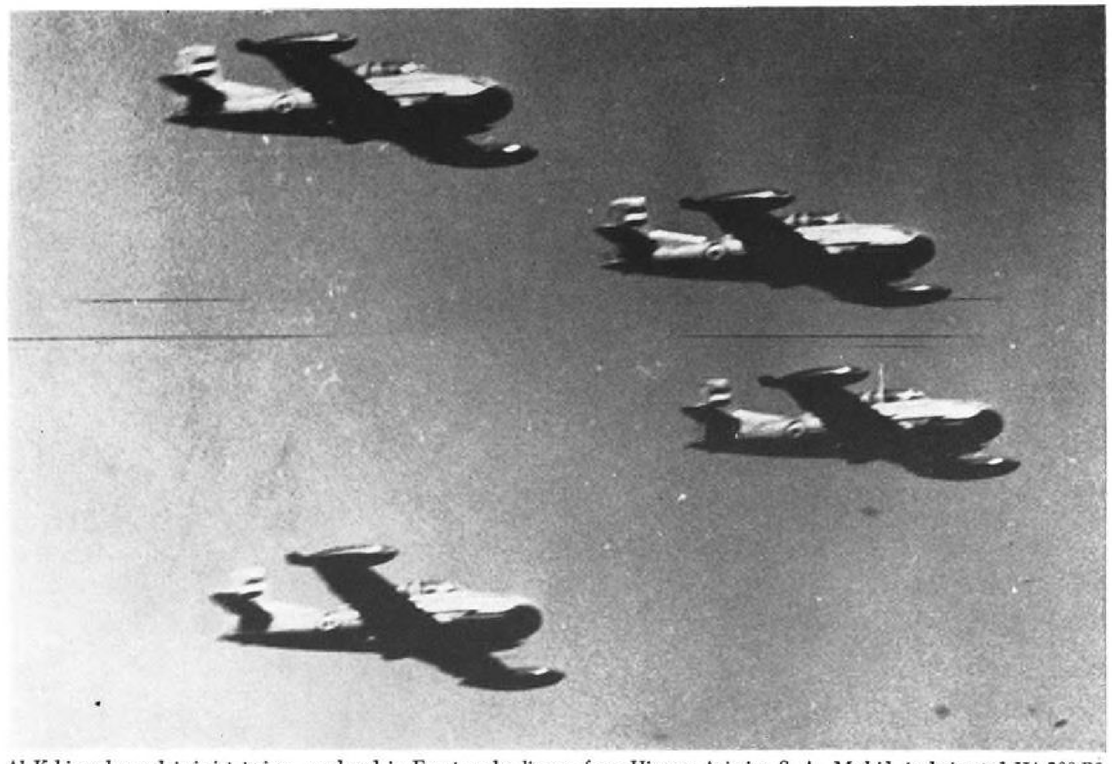




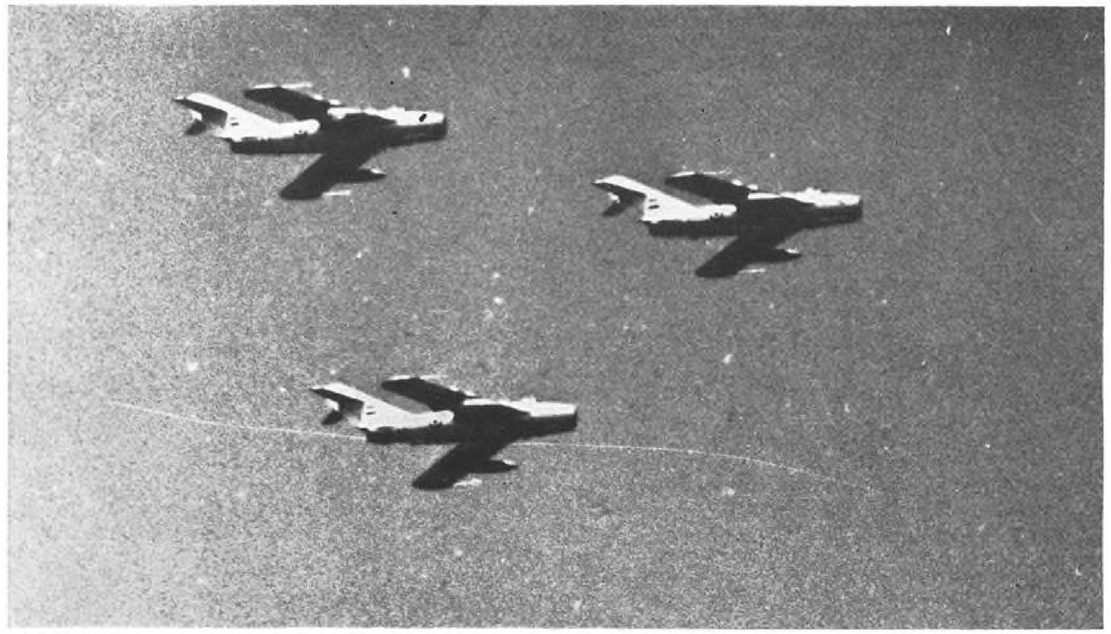


Russian Tu-16 Badger twin-jet medium bombers in Egyptian markings are shown in fly-by during parade marking 11th anniversary of Nasser revolution. Egypt has several squadrons of Tu-16s in service.

Soviet, Messerschmitt Designs Seen in Cairo

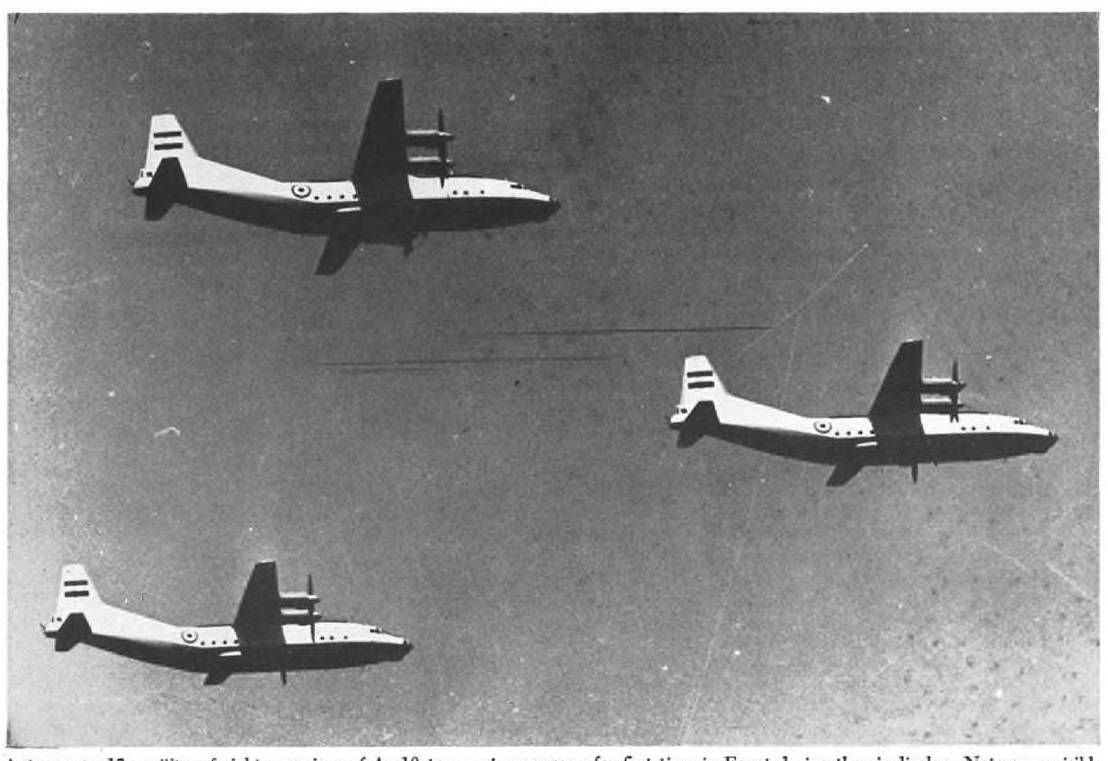


Al Kahira advanced twin-jet trainer, produced in Egypt under license from Hispano Aviacion S. A., Madrid, is designated HA-200-R1 in Spain. Airplane is result of collaboration of Willi Messerschmitt with German, Swiss, Austrian and Spanish engineers.



MiG-17s fly by in Egyptian air display. Aircraft are probably C models with afterburning VK-1A turbojet of 7,590 lb. static thrust and underwing fuel tanks, giving extended range of about 1,160 mi. Each wing tank adds about 105 gal. to normal 445-gal. load.

Egypt Displays An-12 Freighters First Time



Antonov An-12s, military freighter versions of An-10 transport, were seen for first time in Egypt during the air display. Note guns visible in tail turrets. Entirely redesigned rear fuselage and tail distinguish military version from An-10.

Walleye Weapon Plans

Initial feasibility rounds of Navy's television-guided Walleye aerial weapon will be produced by the Naval Ordnance Plant in Louisville, Ky., with subsequent product design to be conducted by BuWeps' Naval Avionics Facility at Indianapolis (NAFI).

A production contract for the free-fall glide weapon (AW July 1, p. 85 and Apr. 9, 1962, p. 31) will be placed with industry later by either NAFI or BuWeps.

Walleye is expected to be used as a close support and interdiction air-to-ground weapon carried by high-performance naval aircraft. It may be effective against hard point targets from altitudes above 70,000 ft. Circular error probability may be as small as six or seven yards.

Now in feasibility stage of development, the approximately 1,000-lb. glide bomb will have four triangular, canard fins and four long, triangular fins extending almost to the end of the weapon from just aft of the canard surfaces.

Walleye will be guided by a simple gyro-stabilized television camera which will supply necessary signals for the weapon's automatic tracking system. The pilot will release the weapon and follow it onto a target by observing images supplied by the camera and displayed in his cockpit while he is escaping from the target area. He can make course and stability corrections which will automatically feed signals to Walleye's guidance system which will command control surface movements.

Because changes in the weapon's trajectory made by the pilot after launch may induce variations in g-loading on the weapon, arming of the high-explosive warhead cannot depend on accelcration changes. Consequently, Navy is anticipating a device for safe arming which is not dependent on acceleration.

Blue Scout Jr. Payload to Gather Frequency Data Above Ionosphere

Cape Canaveral—First USAF Blue Scout Jr. launch from here in 15 months lofted a 50-lb. payload last week to an altitude of about 8,000 mi. in a ballistic flight more than 9,000 mi. down the Atlantic Missile Range.

The payload, provided by Cambridge Research Laboratories of USAF's Office of Aerospace Research, was designed to gather data on certain natural radio frequencies above the ionosphere and to measure the impedance of the ionosphere. The probe carried four tuned radio frequency (TRF) receivers, all solid-state devices, covering 2.2 mc., 4 mc., 1 mc. and 3 mc.

The antenna, a 60-ft. dipole in two 30-ft. segments 180 deg. apart on the rim of the pie tin-shaped probe, was stowed aboard the structure rolled up like a ribbon. Pre-curled longitudinally, each antenna segment snapped out to its full 30-ft. length after jettison of the protective payload fairings and then curled into a tubular shape.

Radio noise detected by the receivers at these frequencies was amplified, encoded and transmitted to AMR ground stations over a 200-mc. frequency-modulated (FM-FM) telemetry link. No attempt was made to differentiate between radio noise reflected off the top of the ionosphere and noise received directly from galactic space. Cambridge is interested in total radio energy input into the ionosphere.

Impedance of the ionosphere was to be indicated by variations in a standing wave generated on one of the antenna segments by a small oscillator. Variations would be a function of the electron density and energy levels surrounding the antenna. Extent of the variations also would provide clues to the characteristics of the electrons.

The probe relayed data back for about 3½ hr. as it climbed to the apex of its trajectory and then descended. It disintegrated during re-entry, so distance flown downrange was extrapolated. There was no attempt at recovery.

USAF presently plans to launch another seven of the 40-ft.-long, four-stage, solid-propellant unguided Blue Scout Jr. vehicles from here. Next launch, which may occur by December or January, may carry as its payload a rubidium-vapor magnetometer to an altitude of 22,000 mi. The other payload possibility is a cosmic radiation detector, which would be flown to an altitude of 8,000-10,000 mi. All Blue Scout Jr. flights from here will be ballistic probes.

More payload possibilities are being studied by the Office of Aerospace Research and are being coordinated with National Aeronautics and Space Administration and other government agencies to avoid duplication or to cover areas of special scientific interest. Payloads will not always be new hardware designs, Air Force program officials stressed after last week's successful flight. Over-all purpose of the series will be to place instruments with an economical launch vehicle in selected areas of space surrounding the earth.

Lt. Col. John Adams, SLV-1B (USAF designation for Blue Scout Jr.) test controller here at the Air Force Missile Test Center, said that the 15-month absence of Blue Scout from the range was attributable to the lack of flyable experiments and not to the launch vehicle.

He said that Blue Scout had development problems, but said they had been resolved before the last previous flight from here in April, 1962.

AF Capsule Recovery

Washington—Air Force last week reported that its rate of recovering capsules ejected from space during 1962 was 75%, but a Defense Dept. ruling prevented the service from disclosing how many capsules were involved, or how many were snatched in the air as they parachuted to earth.

National Aeronautics and Space Administration's Satellite Situation Report and the United Nations registry of space objects indicates that in 1962, there were 17 payloads for which recovery probably was attempted — that is, they were launched by Atlas Agena or Thor Agena, and decayed a few days after launch. Through July 15 of this year, there have been five payloads in this category.

The 6593rd Special Test Squadron of Hickam AFB last week received the USAF Outstanding Unit Award for developing and applying recovery techniques. This unit uses both air snatch with Lockheed JC-130B aircraft to recover 300-lb. Discoverer-type capsules and water pickup to recover Samos-type capsules, weighing more than 1,000 lb.

NASA Requests Fuel Facility, Supply Bids

Washington—Bid requests were sent last week to 45 chemical and petroleum companies for construction of a liquid hydrogen manufacturing plant and storage facility and supply of 78 million lb. of the propellant to National Aeronautics and Space Administration during the 5½-year period beginning in April, 1965.

NASA is specifying that the storage plant be within 50 navigable miles of the Mississippi Test Facility. The manufacturing plant can be situated at the contractor's discretion.

No cost estimate has been made for manufacturing and storage facilities, but NASA estimated the hydrogen will cost about $37 million. It will be used for hydrogen-fueled engine tests both at Mississippi and at Marshall Space Flight Center.

House Considers $5.2 Billion for NASA

By Edward H. Kolcum

Washington—Legislation authorizing $5.2 billion for the U.S. space agency in Fiscal 1964 was scheduled for House debate and vote late last week after a rocky 90-min. session before the House Rules Committee on July 31. The bill up for full House approval represents a $474-million cut from the Administration's request.

Although House space committee Chairman George P. Miller (D.-Calif.) characterized the request as the "rock bottom" amount needed to keep the U.S. space effort moving, he had a difficult time convincing several members of the Rules Committee, including Chairman Howard K. Smith (D.-Va.), of the need for large space expenditures.

Rep. Smith criticized Rep. Miller for the brevity of his opening statement in which he explained the bill, saying that "this is a short statement for $5 billion." Rep. Smith said later, "I don't understand this scientific stuff at all."

The bill authorizes National Aeronautics and Space Administration to spend $4 billion for research and development, $692 million for facilities construction and $508 million for administrative operations. The cuts (AW July 22, p. 322) actually totaled $489 million, but $15 million was added to the original request in the category of facility planning and design, for a net reduction of $474 million.

Several members of the House space committee, despite the unfavorable reception the bill received in the House Rules Committee, forecast favorable House action. The Rules Committee agreed to allot five hours for debate.

Rep. Smith's reaction to the bill set the stage for what was generally an unfavorable reception. The chairman said at one point that "I can't see any use of going to the moon," and when Rep. Miller tried to compare the lunar trip with the early efforts of the Wright brothers, Rep. Smith commented that when the Wright brothers were preparing for a test flight here, "Everybody in Alexandria [Va.] regarded them [as] a pair of nuts."

In response to questions from Rules Committee members, Rep. Miller attempted to make these points:

- **Assurance that man** will be able to land on the moon is not yet in hand, but "I have sufficient confidence in American scientists and technologists that they will develop devices that will assure" a successful manned lunar landing mission.
- **Total cost of Apollo** will be $20 billion, and the lunar landing will be made before the end of this decade.
- **Cooperation with Soviet Russia** in the lunar program is possible and desirable (see p. 34). There are indications that USSR will not attempt the lunar landing, but even if U. S. were not in a space race with Russia, "it would not change my mind [about the U. S. space program] or the majority of the space committee members."
- **Cooperation and liaison** between NASA and the military is impressive. NASA provides Defense Dept. with the information it needs for its space program. There currently are 300 military officers working in NASA, and the space committee has found no duplication of research and development in NASA and the military.

Rep. Clarence J. Brown (R.-Ohio), ranking minority member of the Rules Committee, criticized government agencies for what he characterized as a "heyday" for scientists, during which members of the scientific community "are playing with government money" under no controls and no top-level supervision.

Rep. H. Allen Smith (R.-Calif.) said he has been having increasing difficulty in explaining the space program to its critics among his constituents, and Rep. Miller agreed to prepare a justification for the program.

The bill contains a full section of amendments to the 1958 Space Act designed to make it harder for NASA to reprogram and transfer funds from projects for which it was appropriated (AW July 15, p. 28). Basically, the agency must now give 30 days notice to the House space committee before it can transfer amounts exceeding $250,000 from one program to another, and no more than $20 million can be reprogramed during the entire fiscal year.

Presently, all the agency must do is notify the committee that it has transferred funds. More than $200 million was transferred between projects in Fiscal 1963 money.

In summary, NASA's Fiscal 1964 authorization bill contains these amounts:

- **Manned space flight**—$3.2 billion approved by the space committee, a cut of $259 million from the request.
- **Space sciences**—$666 million approved, a cut of $97 million.
- **Administrative operations**—$508 million approved, which includes salaries, a cut of $52 million from the request.
- **Advanced research**—$372 million approved, a cut of $37 million.
- **Tracking and data acquisition**—$316 million approved, a cut of $33 million.
- **Facilities construction**—$692 million approved, a cut of $108 million.
- **Applications**—$113 million approved, a cut of $10 million.
- **Advanced design**—$25 million approved, an increase of $15 million.

The net reduction is 8.3%. Rep. Miller said that despite comments by NASA officials to the contrary, these cuts will not cripple the over-all space program, but he added that "it would be unwise to cut further."

In separate opinions of House space committee members attached to the formal report accompanying the authorization bill, Rep. William F. Ryan (D.-N. Y.) expressed dissatisfaction with the activities of the Communications Satellite Corp., and said the corporation should reimburse the government for R&D work and for satellites.

Rep. James G. Fulton (R.-Pa.) said he will introduce a bill to establish an inspector general who will oversee and evaluate NASA's operations.

A group of six Republican space committee members, while not disagreeing with the report, feel that the military space program is not receiving its proper share of the space dollar. Subscribing to this view were Rep. Richard L. Roudebush (Ind.), Thomas H. Pelly (Wash.), Donald Rumsfeld (Ill.), James D. Weaver (Pa.), Edward L. Gurney (Fla.), and John W. Wydler (N. Y.).

In addition, Rep. Pelly submitted a minority view protesting both the cost and urgency of the Apollo program, and said he favors a program stretchout.

Space Agreement

Washington—Soviet Russia is expected momentarily to sign an agreement clearing the way for a cooperative space program with the U. S., beginning with joint communications experiments early next year using the Echo 2 satellite as a passive reflector. U. S. already has signed the agreement.

U. S. and Russia had agreed more than a year ago to conduct a three-part cooperative space program and the terms of implementation were signed by scientists last May. U. S. made formal the agreement shortly thereafter.

As soon as Russia signs the agreement, planning will begin for the most important part of the cooperative program—co-ordinated weather satellite launches that will result in cloud cover photographs of every spot in the world every six hours (AW Mar. 15, p. 21). Third part of the pact calls for co-ordinated mapping of the geomagnetic field.

TFX Chief Would Drop Thrust Reversers

By Donald E. Fink

Washington—F-111 (TFX) program director has recommended against including thrust reversers in the tactical fighter's design because of technical problems, schedule delays and cost increases it might create.

The recommendation came to light last week during the continuing Senate probe of the F-111 contract award to General Dynamics-Grumman. Air Force had studied the feasibility of adding the type of thrust reversers proposed by Boeing to the General Dynamics design (AW Apr. 8, p. 26), which calls for conventional air brakes and spoilers.

Testifying before the Senate Permanent Investigations Subcommittee, Col. Charles A. Gayle, F-111 program director, said, "the contractor [General Dynamics], among other means of deceleration, has looked into the thrust reverser and has given us his analysis, cost effects and other features, and schedule effects.

"They have been reviewed by the configuration control board, and . . . my position . . . considering all aspects of the installation of thrust reversers . . . is they should not be installed."

He added that this was his final decision, "which has been forwarded to higher headquarters."

Pratt & Whitney, whose JTF10A-20 engine was specified for both the Boeing and General Dynamics designs, was not the only company considered for the thrust reverser, Gayle said. Rohr Aircraft Corp. also had a design that was considered.

The Rohr design was cheaper and lighter, he said, but technical and design problems, which probably would have involved moving the wings to balance the airframe, were basic factors in the determination not to include thrust reversers.

Cost Comparisons

Earlier in the week, the subcommittee challenged members of the military evaluation teams for failing to compare directly the Boeing and General Dynamics proposals, especially in the realm of cost differentials and past performance records. The main witness during this portion of the hearing was Warner R. Wilson, contractual specialist and head of the F-111 cost team at Wright-Patterson AFB, Ohio. Gayle and members of the F-111 technical and operational evaluation teams also appeared.

Air Force Secretary Eugene M. Zuckert, who had been presenting a lengthy statement to the subcommittee (AW July 29, p. 19), interrupted it so the other witnesses could give the subcommittee the same briefing that led to the contract award.

At issue during the questioning of the cost experts was whether Boeing's cost estimates—approximately $130 million less than General Dynamics for the research and development phase of the contract and approximately $400 million less for the production portion—represented significant savings or whether they represented over-optimistic cost estimates as contended by the defenders of the General Dynamics award.

Wilson said his team established $100 million as the difference between the two proposals—the figure ultimately was adjusted by Air Force to $130 million—but made no detailed analysis of it, because "there is no direct relationship established, so there is no need to."

Wilson was then asked if past performance of the two companies was considered in making cost evaluations of their proposals. A chart prepared by the subcommittee was introduced, which purported to show that Boeing had a past record of underruns averaging 2.6% on $9 billion worth of airframe contracts. General Dynamics, according to the subcommittee figures, had 4.3% overruns on about $2 billion worth of business.

Wilson contended that the chart was not valid for the F-111 proposal because it covered aircraft in a different category which did not require the technological advances required in the F-111 program.

Sen. McClellan asked Wilson if his team took past performance into consideration in weighing the two proposals. Wilson replied that they considered it very seriously, but that they did not "have charts drawn up of the data that you have in detail here now . . . because of the lack of it being real comparable data for the purpose of the evaluation."

The subcommittee pressed Wilson for a clearer definition of what he termed comparable data, resulting in this exchange:

Sen. McClellan. You are not going to find exact comparability anywhere, are you, because this is a venture beyond the state of the art at the present?

Wilson. That is right, and that is why I say that . . .

Sen. McClellan. Then you can go nowhere to find figures that substantiate any judgment that you claim you exercised, is that right?

Wilson. No, sir, we must find comparability, and we must dig out the best data that we have available, and we must make allowances and adjustments to make it comparable.

Sen. McClellan. Did you dig this out of the past records of the two bidders? Did you dig it out and take it into consideration?

Wilson. All of this particular data, no, sir.

Sen. McClellan. What did you dig out on them and take into consideration, of their past performance? Do you have any record of it, and can you submit to us now any document or any figures that you used based on their past performance in evaluating and in coming to your judgment? Can you lay anything before us now that you used, that you did dig out, that you considered at the time that you evaluated and came to your judgment?

Wilson. No, sir, not in the sense of laying it out before you, because there is so much of this that is done that we just don't make a record of it.

Sen. McClellan. I am trying to find out actually how you operate, and how this thing works. I am beginning to come to some suspicion that there is a great deficiency in the way this thing operates. I want to know how you weighed that record and how you evaluated it and applied it in this instance before you came to your decision. . . . If you have anything you can lay before us that reflects that, I would like to see it.

Wilson. I don't have anything that I can lay before you, sir.

Lower Bid

The subcommittee then produced data which it said pinpointed the reason for Boeing's lower bid. The subcommittee figures showed Boeing saved $261,922,000 on lower labor costs and $351,499,000 on lower overhead costs. The subcommittee subtracted $274 million, which it said represented Boeing's higher materials cost, and then added $76.6 million, which it said represented Boeing's lower support equipment costs and lower profit percentage figured on the lower production costs.

The final figure arrived at by the subcommittee was $415,421,000 in Boeing's favor. Figures submitted by General Dynamics and Boeing in their proposals were $5,803,544,000 and $5,387,439,000, respectively—a difference of $416,105,000 over the total program.

When asked if a large part of Boeing's lower bid was attributable to the difference in the labor and overhead rates and costs, Wilson said, "in real broad terms, yes, sir."

U.K. Will Build Aircraft Carrier For P.1154 Fighter Operations

London—Great Britain will spend $180 million on construction of a conventionally powered aircraft carrier specially designed to operate the Hawker P.1154 supersonic VTOL strike fighter built under a joint development program with the Royal Air Force.

Minister of Defense Peter Thorneycroft said the decision to build the new carrier, as yet unnamed, extends the useful life of the Royal Navy's Fleet Air Arm to 1980.

The carrier will replace HMS Ark Royal and HMS Victorious, but two other carriers—Eagle and Hermes—can continue operations until 1980 by a series of modifications and refits.

Thorneycroft said the Royal Navy and the Royal Air Force recently agreed on characteristics of a common P.1154 version and design studies are now well advanced. The Navy has always preferred a two-seat version and it is known that Hawker Aircraft has submitted a potential design to both services, one for training and the other for operational sorties. Basic airplane, however, will be a single-seater and the order probably will be in the neighborhood of 200 units.

The P.1154 will replace the Hawker Hunter and the de Havilland Sea Vixen. However, interim airplanes will be the Blackburn Buccaneer strike fighter, and the Royal Navy has shown interest in the Chance Vought Crusader, powered by Rolls-Royce Spey engines, the same powerplant used by the Buccaneer.

Talks currently are under way between Short Brothers and Harland, of Belfast, and Chance Vought, on possibility of building the Crusader at Belfast under license, if the Royal Navy decides to order the airplane in quantity.

The new carrier will incorporate a refinement of the angled-deck principle, pioneered by the British, called a parallel deck in which two lanes can be used for landings and takeoffs. Despite the use of VTOL fighters, catapults will be fitted to allow a mixed fleet of other types. Carrier will be in the 50,000-ton class.

In reply to criticism of the vulnerability of carriers in the age of nuclear weapons, Thorneycroft contended that the carrier still remains probably the most flexible instrument of conventional war and this factor has governed the decision to go ahead with the project.

Lord Carrington, First Lord of the Admiralty, said the ship will be completed about 1971. The Sea Vixen, he said, will have to be replaced in the early 1970s and the RAF's Hunter somewhat earlier than that. The decision also means, he continued, that the British government will be able to deploy two carriers east of Suez most of the time.

RL10-A3 Order

Washington—Pratt & Whitney will receive $14.9 million to deliver 49 RL10-A3 hydrogen-fueled engines to stage manufacturers during 1964, under a National Aeronautics and Space Administration order. Six RL10-A3s power the Douglas S-4 stage, which is the second stage of the Saturn 1, and two are used to power the General Dynamics/Astronautics Centaur stage.

News Digest

Procurement of a passive space surveillance system, capable of distinguishing between celestial background and spacecraft in earth orbit or a high trajectory based on solar energy reflected from the spacecraft, is planned by Rome Air Development Center. RADC is soliciting companies for upcoming competition.

Mariner 2 Venus probe completed its first orbit of the sun on Aug. 1, having traveled an estimated 540 million mi. in space since its Aug. 27, 1962, launch. The now-silent probe flew past Venus last Dec. 27 and is in an orbit with a period of 346 days, aphelion of 113.6 million mi., and perihelion of 62.5 million mi.

Dr. Lawrence Kavanau has been named executive vice president of North American Aviation's Space and Information Systems Div. Dr. Kavanau recently resigned as special assistant for space to director, Dept. of Defense Research and Engineering (AW July 15, p. 31).

Northrop F5 fighter-bomber was flown for the first time last week from Edwards AFB, Calif., with the company's test pilot, Henry E. Choteau, at the controls. Flight duration was 90 min. A second F5 will be completed this month and flown in early September, and a third plane will be test-flown in October.

Air Proving Ground Center at Eglin AFB, Fla., last week put into operation a 16-ft.-dia. centrifuge capable of testing 500-lb. payloads at forces up to 100g. The facility was built at a cost of $52,000.

Relay 1 satellite completed 203 days of successful operation July 29. Satellite was designed by Radio Corp. of America to operate for at least a year. Previous record for a communications satellite was 185 days.

Mark W. Cresap, Jr., 53, recently retired president of the Westinghouse Electric Corp., died July 28, a short time after ill health forced him to leave the firm (AW July 22, p. 335). Cresap joined Westinghouse in 1951 and became president of the firm in January, 1958.

Dr. Robert M. White, 40, president of Travelers Research Center, Inc., Hartford, has been appointed chief of the U.S. Weather Bureau, succeeding Dr. Francis W. Reichelderfer, who is retiring after heading the Weather Bureau for 26 years.

Henri G. Marescot has been named general manager of Air France's North, Central American and Caribbean Div. He succeeds Henri J. Lesieur, who becomes executive consultant to the Air France management in Paris. Marescot was formerly manager of the airline's Japan and East Asia Div.

S-66 polar ionosphere beacon satellite (see p. 82) has slipped about six weeks until late September because of Scout launch vehicle problems.

Syncom 2 Drift Rate

Cape Canaveral—Drift rate of the Syncom 2 communication satellite was being observed closely last week by the National Aeronautics and Space Administration and the scientific community as an indication of the presence or absence of gravity gradient variations at certain points over the earth.

Theory holds that the earth's oblateness produces two neutral gravity gradient points, one over the Indian Ocean and the other over the Pacific Ocean, where a synchronously-orbiting satellite would require no station-keeping control system, and two negative points, one over the Atlantic and the other north of Australia, where a synchronous orbit could not be sustained short of the continuous operation of a satellite's control system.

Syncom 2 (see p. 75) was expected to drift westward through the negative gradient point over the Atlantic sometime last week. If the theory is valid, the point should change the satellite's drift rate.

New Soviet N.Y.-Moscow Route Bid Seen

By L. L. Doty

Washington—Possibility that the Soviet Union may make another bid for a New York-Moscow air route is growing as a result of the new atmosphere generated by the nuclear test ban treaty recently initialed by the U.S., Great Britain and the Soviet Union.

Meanwhile, the U.S. is showing increasing concern over the expansion of communist airline operations in the Western Hemisphere and throughout Africa (AW Sept. 10, p. 71). Recent success of the Russian carrier, Aeroflot, in winning rights from Guinea to operate beyond Conakry to Cuba on the Moscow-Havana run (AW July 1, p. 25) is viewed as a major step in the carrier's expansion program.

The Russians are known to be eager to enter the New York market and U.S.-Soviet negotiations two years ago on a bilateral air transport agreement were carried on in a harmonious atmosphere (AW Aug. 14, 1961, p. 25). The final agreement was initialed by both sides, but was then refuted by the U.S. because of a split in relations between the two countries over the Berlin wall (AW Aug. 28, 1961, p. 39).

Although no formal move has been made, U.S. observers believe that the Russians may feel the agreement on the nuclear test ban paves the way for reopening talks on commercial air services. How the U.S. will respond to such a bid is not yet known.

The new policy on international air transportation (AW Apr. 29, p. 34) omits any reference to relations between the U.S. and Russia. This subject is being treated separately in another study being conducted for the White House.

The Russians are now emphasizing expansion of their air routes in Africa, South America and the U.S., in that order. Focal point of the over-all expansion plan is Cuba.

Currently, however, the chief concern of the U.S. is Russia's recent success in strengthening its foothold in Africa. Last year, the Russian drive for air routes in Africa appeared to have slowed down considerably (AW Sept. 10, p. 71), but indications are now strong that the expansion program has gained renewed strength.

At present, the Russians are building a new jet airport in Yemen for the new republican government of that country. The U.S. is viewing that project as a key point in the pattern of Russian air routes, since the new airport could serve as a jumping-off point for India and East Africa, and as a link in a route across Central Africa to Conakry and beyond to Latin America.

Africa currently provides Russia's only access to the Western Hemisphere, since those Western European countries that Aeroflot serves refuse to grant beyond rights to the Russian carrier. In addition, the Scandinavian countries will not give the Soviet Union transit rights, which leaves Aeroflot with only one northern route—the devious line from Murmansk, across the Bering Sea, north of Norway and Sweden.

These are other steps Russia is currently taking in hopes of reinforcing its African civil air services:

- **Attempts to win** beyond rights from Morocco and Algeria, similar to those granted by Guinea, are now being made.
- **Effort to get landing rights** in Ethiopia and Somalia is being made, in order to give Aeroflot a route along the east coast of Africa. Aeroflot now serves Khartoum, but Sudan permits only a westward operation and has rejected an Aeroflot bid for north-south operations.

Meanwhile, Cuba appears to have launched an expansion program for its air services. At present, Cuba is linked with Madrid by service operated by Iberia. U.S. has protested to the Spanish government over this service, but there are no signs that Spain is ready to withdraw the operation.

The only direct air link between Cuba and South America is through Mexico, but last week the Havana radio announced that British Guiana had granted reciprocal landing rights to the Cubans. The British colony, which is under the government of Premier Cheddi B. Jagan, a Marxist, said the plan embraced the organization of a Guianese airline and was designed to "facilitate international travel."

Reportedly, the Jagan regime has offered similar rights to Venezuela, Surinam, Trinidad, Jamaica and the Dutch West Indies. Because the Jagan government is sympathetic to Castro, the air route could serve as easy access for Cuban agents to Latin America.

Last week, the State Dept. said the U.S. was in close consultation with the British government over the relationship between Cuba and British Guiana.

Pan American Mystere 20 Order Near

New York—Negotiations between Pan American World Airways and Generale Aeronautique Marcel Dassault have progressed to the stage where a firm order from Pan American for 40 Mystere 20 executive jet aircraft probably will be announced this month.

Pan American will also option three lots of 40 aircraft each, bringing the total possible order to 160 of the French-designed and built jets.

Two General Electric CF-700 turbofan engines will be the powerplants on the aircraft, replacing the Pratt & Whitney JT12A-8 turbojets on the prototype (AW June 10, p. 90) which is now flying (see pp. 56-57). General Electric engines will increase the thrust of the aircraft from 6,600 lb. thrust (3,300 lb. for each engine) to 8,400 lb. thrust (4,200 lb. for each engine).

Fuselage length for the Pan American aircraft will be increased 18 in., from the prototype's 51.5 ft.

Use of the General Electric turbofan engines and the increased length will boost the range of the Mystere 20 to approximately 1,600 stat. mi. with reserves and standard air transport holding capability.

Pan American officials said that if the aircraft are purchased, they will be "dry leased" to operators, with the airline providing neither pilots nor maintenance support.

Corporations leasing the Mysteres from Pan American would supply their own pilots and fixed-base operators probably would provide maintenance facilities.

In addition, Pan American foresees using the aircraft for charter flights and for pilot training.

Dassault announced recently that no production plans would be formulated until a production order was in hand. But Pan American is understood to want delivery of 15 aircraft the first year and 25 the second year.

Pan Am Attacks Plan to Divide Transatlantic Routes With TWA

By James R. Ashlock

Washington—Opening of the Civil Aeronautics Board's transatlantic route renewal hearings here last week was marked by a quick attack from Pan American World Airways against any division of existing routes between itself and Trans World Airlines.

Elihu Schott, attorney for Pan American, opposed the so-called "area concept" in a stiff cross examination of John B. Flynn, analyst with the CAB's bureau of economic regulation.

The bureau has proposed the route division as a means of reducing excess capacity and strengthening U.S. flag carrier competition against foreign airlines. Under the plan, Pan American would receive exclusive rights to certain northern European points and any future rights into Iron Curtain countries, and TWA would become the sole U.S. operator serving southern Europe and Africa.

Area concept is favored by TWA, largely because it would provide relief from the dominance Pan American has traditionally enjoyed through being the only U.S. airline into 20 European cities, compared to four where TWA is exclusive.

Both Pan American and TWA would sacrifice some business in 1964 if the area concept were adopted, Flynn said. Neither carrier could be expected to pick up 100% of the other's business on the exchanged routes.

Pan American could expect to carry about 35,000 fewer passengers and TWA 1,600 less than if the existing competitive situation continued through 1964. However, Flynn said that schedules could be reduced with removal of competitive pressures, resulting in cost savings that would more than cover the estimated $15 million revenue loss.

Flynn said that forecasts indicate 2,440,484 persons will fly the North Atlantic in 1964. Under present arrangements, Pan American and TWA can expect to carry 38% of this volume, he said, with Pan American receiving 60% of their combined volume and TWA 40%.

"Thus far in 1963, our carriers are providing 40.7% of the seating capacity and moving 41.7% of the passengers," Flynn said. "In view of the minor schedule changes proposed in 1964, we expect both percentages to decline."

Forecasts indicate, Flynn said, that under the area concept, Pan American would pick up 90% of that business now carried by TWA to London, Frankfurt, Shannon, Bombay, Dhahran and Tel Aviv, while TWA would receive 90% of Pan American's current volume to Paris and Rome.

While TWA agrees generally with these estimates, Pan American thinks it could expect no more than 43% of TWA's current New York-London volume and 46% of its New York-Frankfurt traffic.

Flynn stressed that it is the purpose of foreign airline combines such as Air Union to reduce costs through lesser competition and schedule frequency. Because of this, Pan American and TWA, even after reducing competitive frequencies between themselves, could still have a capacity and service advantage over their foreign competitors, the bureau feels.

"Under the bureau's area concept," Flynn said, "we believe Pan American and TWA would be in a position to concentrate their schedules and promotion more heavily on a fewer number of key European gateways, with better over-all results."

The bureau devised the area concept in early 1962, and Schott's attack on it now is based on the claim that reasons for it then are not valid today.

Schott obtained, in his questioning, acknowledgement from Flynn that both Pan American and TWA had gained substantially in transatlantic passengers and revenue since 1962, and that TWA's financial position has improved. TWA itself, Schott said, was forecasting $154 million in transatlantic revenues for 1964, which was well above the $135 million predicted for the airline by the bureau.

Reductions in pilots, mechanics and other personnel would also result from Pan American's loss of service points, Schott said. There is also a question with Pan American of whether the predicted cost savings under the area concept would cover the passenger losses, he said. Paris and Rome, two points Pan American would lose in the arrangement, account for 25% of Pan American's business to Europe.

The hearings are the first over-all revaluation of the transatlantic route picture in over a decade. Temporary certificates, subject to review each seven years, were awarded TWA and Pan American for operations to Europe. Present hearings are actually four years late, as they were due in 1959 at the end of the last seven-year increment.

The three carriers involved in the hearings—the third carrier being Seaboard World Airlines—have yet to present their cases. Hearings may last more than three weeks.

Pan American, aside from the economic arguments it will make against the area concept, will stress its historical role as the first U. S. international flag airline. The fact that it pioneered many of the routes now in question should preclude any consideration of giving them to TWA, the carrier's officials feel (AW July 29, p. 28).

But E. O. Cocke, senior vice president of industrial affairs for TWA, said in a brief filed with the CAB that TWA is seeking to "redress, in some measure, the traffic imbalance which exists in favor of our principal U. S. flag competitor, Pan American."

Cocke said that TWA and Pan American dissipate much of their energies and strength in competing against one another.

"The area concept would eliminate this unnecessary competition and permit TWA and Pan American to concentrate and marshal their resources against their foreign competitors," Cocke said.

Although TWA favors the area concept in principle, it does not want certain restricting features of the bureau's plan. Cocke said TWA objects to the bureau's proposal that TWA's authority be terminated at Shannon, Tel Aviv and east of Cairo. TWA would also be barred from transatlantic service out of Philadelphia.

"The bureau area concept would eliminate TWA from Asia and all of its vast undeveloped traffic potential and from any opportunity of sharing the round-the-world market," Cocke said. "Pan American's ability to tap the round-the-world market gives it a substantial traffic advantage over TWA."

One point on which TWA and Pan American can be expected to join forces is in opposing Seaboard's request that it be granted passenger rights across the Atlantic.

Seaboard is proposing a no-frill $133 one-way fare on its CL-44 cargo freighters, putting seats in space not taken up by cargo. Pleading its need for the passenger business, Seaboard said that commercial all-cargo business is not yet self-supporting, and additional revenue sources are needed.

Johnson to Delta

Delta Air Lines last week announced the resignation of Todd G. Cole as executive vice president and director. At the same time, Delta reported that Earl D. Johnson, former president and vice chairman of the board of directors of General Dynamics, had been elected to fill the two posts.

Cole, considered an airline financial specialist, has been with Delta since 1940 and was named executive vice president in 1959. Johnson resigned from General Dynamics last June.

Bid to Reverse Northeast Ruling Seen

Washington—Controversy stirred by the Civil Aeronautics Board's decision to remove Northeast Airlines from the New York-Florida market is expected to give unprecedented strength to petitions for reconsideration that will be filed after the CAB issues its formal order in the case.

Denial of the renewal of Northeast's operating certificate for the route has drawn a storm of criticism from the New England area, and has brought about political pressure for a switch in the decision. It is the first time in Board history that a major route has been taken away from a trunkline carrier, and it is the first significant move the CAB has made toward curtailment of competition on major air routes.

Although there are no signs that the CAB will reverse its decision pending issuance of a formal order, petitions for reconsideration will be given close attention and could bring about a new decision if Northeast can prove the service is an economic requirement.

Meanwhile, Northeast will take no action on the press release decision issued by the CAB until the formal order is received. CAB Chairman Alan S. Boyd last week telegraphed Northeast President James W. Austin, asking that the carrier inform the Board of its plans and any steps it "would desire to have the Board take in order to facilitate continuation of New England operation."

The 3-2 decision came as a surprise to the airline's management, which had been highly optimistic that the airline would retain its Florida routes.

Rumors to the contrary were persistent, however, during the 24 hr. before the decision was announced. Prior to the announcement, Eastern's stock rose $1\frac{7}{8}$ points on the New York Stock Exchange, suggesting a reaction to these rumors and recalling the famous "leak" of 1956, when Northeast's stock climbed 3 points before the Board announced its intent to give the airline a five-year temporary certificate between New York and Florida (AW Aug. 20, 1956, p. 38).

Last week, Sen. Edward M. Kennedy (D.-Mass.) and Sen. Leverett Saltonstall (R.-Mass.) sent a joint telegram to Boyd advising the Board that they had asked the Justice Dept. to investigate the Northeast case to see if the economic effect of limiting service on the Florida route would restrict competition and tend to create a monopoly in violation of anti-trust laws. They asked for a postponement of the final order.

In denying the request, Boyd stated that it would be inappropriate to comment on the competition question before the Board's final decision was released. He noted that the extent to which competition is necessary has been thoroughly studied and subjected to "adversary proceedings." He said:

"The Board cannot overlook the fact that, as the agency charged by Congress with the responsibility for determining our air route pattern, the Board is under a mandate to dispose of its route proceedings as promptly as possible. In these circumstances, the Board feels that it is not in a position to postpone further proceedings for the purpose stated in your telegram."

Boyd joined members Whitney Gillilland and Chan Gurney in voting to displace Northeast from the Florida routes. Vice Chairman Robert Murphy and Member G. Joseph Minetti dissented.

The majority found that the record of the proceedings show that the public benefits anticipated when the certificate was granted to Northeast have not materialized and that "the future prospects for operation of Northeast's system on a profitable basis are extremely remote." The majority also ruled that two carriers are capable of meeting all air traffic requirements in the Florida East Coast market.

The tentative decision also calls for a restoration of Northeast's subsidy eligibility and stated that the Board will "exercise its full authority to maintain or provide an adequate level of local service in New England."

The minority agreed that Northeast should be granted a subsidy for the New England services, but added that there is a substantial need for a third carrier in the "flourishing, heavily-traveled" New York-Florida market which, Minetti and Murphy said, is one of the largest in the world.

The dissenters expressed agreement with findings of the CAB examiner who stated that "to set aside a market involving nearly 2 million annual passengers for two carriers could well be considered a protected market for a few."

They termed Northeast's entry into the market a competitive spur and found that Northeast had contributed substantially to stimulating air travel and to improving service on the route. They charged that limitation of the market to National and Eastern was "turning back the clock" and "downgrading the needs and convenience of the traveling public." They added in their dissent:

"Solicitude for the well-being of Eastern undoubtedly influenced the majority decision to eliminate Northeast in the New York-Florida market. However, this decision is an equal boon to National which is enjoying its greatest era of prosperity on a recently enlarged route system extending from Boston Harbor to San Francisco Bay . . . special protection for National is not justified by a scintilla of evidence in the record."

National and Eastern officials were unwilling to comment on the decision pending issuance of a formal order. Eastern President Malcolm MacIntyre did state in Boston last week that his carrier would be in a position to absorb a majority of employes who may be displaced by the Board decision.

Sabena 1962 Losses

Brussels—Sabena Belgian World Airlines has reported 1962 losses of approximately $9.4 million after amortization and depreciation charges compared with the carrier's 1961 deficit of $13.7 million. The loss is being covered by a repayable Belgian government loan.

Receipts during 1962, Sabena's 40th year of operations, totaled $75.3 million, $1.6 million more than the 1961 total of $73.7 million.

Passengers carried increased from 803,854 in 1961 to 926,970 in 1962, 94,700 of them on the airline's transatlantic service.

Total freight transported fell by 11%, however, and was responsible for a decline in the company's over-all load factor to 61.7% from 63.3% in 1961.

Total capacity available was 201,705,900 ton miles, as opposed to 124,501,778 ton miles sold, resulting in increases of 6.2% and 6.6%, respectively, over 1961.

Grand Commander

Several local service carriers have been studying Aero Commander's Grand Commander as an aircraft to enable them to serve smaller towns in their areas.

The move is seen as a means of countering the growth of third-level or intrastate carriers.

Latest airlines to show interest in the Grand Commander are Allegheny and Aloha. Southern Airways also may be interested. Aero Commander does not expect to have certification on an 11-person version of the Grand Commander before 1964, so there is no urgency in the current investigations.

Four Grand Commanders already have been ordered by airlines, two by Bison Airlines of Roswell, N. M., and two by Tradewinds Airlines of Puerto Rico.

USAFE Airlifts Supplies to Quake Site

Wiesbaden, Germany—U. S. Air Force Lockheed C-130 turboprop transports and piston-engine Douglas C-124 cargo aircraft by late last week had ferried to Yugoslavia payloads totaling approximately 655,000 lb., including a full field hospital, to aid survivors of the earthquake-wracked city of Skoplje.

First C-130 of the U. S. Air Forces in Europe's (USAFE) 322nd Air Div. left West Germany's Ramstein Air Base for Belgrade with 20,000 lb. of medical supplies and 5,000 lb. of blankets the day after the earthquake struck the city of 200,000, leaving most of them homeless and taking a toll of more than 1,000 lives.

Skoplje airport was not used during the initial flights, apparently because of damage to the runway.

Another 25 C-130s were dispatched from Ramstein to Belgrade later in the day at the rate of one every 15 min., carrying a complete army field evacuation hospital, including 120 beds, tents, trucks, medical supplies and 250 doctors, technicians and nurses. Total payload was 532,000 lb. The C-130 airlift was completed at midweek by a single flight carrying in 20,000 lb. of additional supplies and medical equipment. The single flight landed at Skoplje.

Later in the week, three C-124s from the rotational Military Air Transport Service squadron attached to USAFE ferried a German technical assistance group with 77,000 lb. of supplies from Germany to Belgrade.

Continental Plans 1970 Service After Order for Three Concordes

Los Angeles—Continental Air Lines has become the first domestic U. S. carrier to order the Anglo-French Mach 2.2 Concorde transport.

Continental President Robert F. Six said that his company had signed an agreement with France's Sud Aviation and England's British Aircraft Corp. for the purchase of three of the 1,450-mph. supersonic airplanes. Continental is tentatively pencilling in a schedule for having the planes in service about 1970.

The three 104-passenger Concordes will cost "in excess of $30,000,000" and will be paid for substantially through internally generated funds, Six stated. "Actually, addition of the supersonic equipment will be far less of a financial burden to Continental than was the initial move from piston aircraft to subsonic jets in 1959," he contended.

The company's equipment currently includes four Boeing 707s and five Boeing 720s. The 707s will be fully written off and the 720s will be within two years of final write-off when the Concordes are expected to be delivered to Continental.

Continental's planes are scheduled to be received after Pan American World Airways gets the six Concordes which the international carrier ordered in June.

Thus, Continental is the second U. S. line to order the Anglo-French aircraft, but should be the first to provide supersonic service within the United States.

In a reference to U. S. attempts to enter the supersonic aircraft field, Six commented that he felt there is room in world markets for both the Concorde and "a bigger, faster U. S. Mach 3 transport." He stated, "the U. S. model, as proposed by the President of the United States, will become the world's basic intercontinental transport while the smaller Concorde will be operated as an intracontinental transport."

Continental said terms of its contract with the manufacturers prevent it from revealing what penalties it would have to pay if it should decide to terminate the contract. Before acceptance by Continental the Concordes must be certificated by the Federal Aviation Agency and meet performance guarantees.

Plans are to introduce the Concordes first on Continental's longest route—Los Angeles to Chicago. Additional plans for Concorde service were not disclosed, although the company's announcement indicated they would be used on the Los Angeles-Honolulu route, if Continental were successful in winning the route in current proceedings before the Civil Aeronautics Board. Flight time from Los Angeles to Chicago on the Concorde would be cut to 1 hr. 48 min., compared with present $3\frac{1}{4}$ hr. schedule with subsonic jets. Other major Continental route segments are Los Angeles-Kansas City and Los Angeles-Houston.

Six said that Concordes are expected to be able to operate at seat mile costs at or below those of our subsonic jets over our present routes, "and will substantially enhance Continental's profit position in the 1970s."

Aeroflot Introducing An-24 on Local Routes

Moscow—For the first time in Aeroflot's 40-year history, Russia's long-neglected local airline passengers this summer are being offered quality service especially suited to their needs.

In the past, Aeroflot's local lines have been served either by hand-me-down transports from trunk routes or by slow, low-capacity lightplanes. Now the twin-turboprop Antonov An-24 (AW June 3, p. 46), designed to operate from unimproved airfields, is beginning to take over short-to-medium-range routes from obsolete and obsolescent Li-2s (Russian version of the DC-3), Il-12s and Il-14s.

Besides providing better passenger service, Aeroflot believes that the An-24s will reduce local airline deficits substantially.

Ton-mile operating costs for the An-24 are expected to be 25-30% below those for the twin-engine, piston-powered Ilyushin Il-14, hitherto Aeroflot's best transport in local service.

One major advantage of the An-24 is its ability, because of improved undercarriage design and lower-pressure tires, to operate from softer unpaved runways than the Il-14. Aeroflot estimates that this characteristic will enable An-24s to "reduce by 10-15%" the periods of time earth runways, still found at most "local" Russian airports, cannot be used because of wet weather, as compared with Il-14 earth runway requirements.

Aeroflot expects to cut costs further by reducing the size of An-24 cockpit crews. As soon as the craft have been "mastered" in scheduled service, they will carry only a pilot and copilot. Flight radio operator and flight mechanic positions will be eliminated by Aeroflot.

Il-12s and Il-14s carry as many as five men in the cockpit—two pilots, navigator, radio operator and mechanic—although Aeroflot is also trying to reduce crews on these planes.

An-24s carry 44 passengers, compared with 36 for the high-density version of the Il-14. Revised takeoff weight for the An-24 is 42,997 lb. against 38,587 lb. for the Il-14.

Block-to-block speed for An-24s, 497-559 mi. flights, according to newly-released data, is 255 mph., compared with 199 mph. for Il-14s. Revised An-24 top speed at maximum altitude is 310 mph. against 256 mph. for the Il-14.

Average An-24 cruising altitude is 19,685 ft. The Il-14 cruises at 8,858-9,843 ft.

Aeroflot claims that An-24s can operate from all airports presently used by Il-14s. Takeoff run for both craft is listed at 1,640 ft.

American President Urges SST Action

New York—American Airlines President C. R. Smith last week urged the U. S. to get moving on development of a Mach 2.4 to 2.5 supersonic transport prototype with a Mach 3 growth capability.

Smith said industry should center its efforts around development of a one-design prototype costing about $300 million. The alternative, Smith said, is a $1-billion development program which undoubtedly would encounter congressional opposition. Smith said the prototype program should answer most of the technical problems involved with a supersonic transport.

Smith's timetable for a Mach 2.4 aircraft with growth potential is: contractor proposals to be submitted by January, 1964; government evaluation to be completed and prototype contract award in March, 1964; first flight by Dec. 31, 1966; preliminary flight evaluation to be completed by April, 1967; final decision on source selection by June, 1967; Federal Aviation Agency certification by December, 1971, including possibly eight deliveries that year, and production and delivery of 12 to 15 aircraft per year beginning in 1972.

Smith said talks with manufacturers have indicated that such a schedule is possible.

Government's role would be to administer the prototype contract, Smith said, with further participation to be held to a minimum. Manufacturers would have the major role in design and selection of components.

In a related development, FAA last week appointed Gordon M. Bain, the FAA assistant administrator for appraisal, to a new post as deputy administrator for supersonic transport development. His job is to coordinate government-industry efforts.

New York Control Center Burden May Curtail Traffic After 1968

By Ward Wright

New York—New York's growing air traffic burden, already saturating the area's Air Route Traffic Control Center for an average of four hours per day, may force the city to turn away traffic after 1968 until a fourth metropolitan airport is built.

This opinion was voiced by Oscar Bakke, assistant administrator, Federal Aviation Agency's eastern region, at a recent presentation of New York's air traffic problem with an emphasis on Idlewild Airport.

FAA Study

Bakke's remarks were backed by the results of an exhaustive FAA study of air traffic in the New York area for one day—Friday, June 7.

Results of the study for that day included these facts:

• **Aircraft handled.** New York Air Route Traffic Control Center handled a total of 3,600 IFR contacts including overflights compared with a normal daily average of 2,800 and a normal peak of about 3,000 contacts.

• **Arrivals and Departures.** Between 5 and 7 p.m. EDT, IFR flights at Idlewild totaled 50 arrivals and 45 departures. VFR flights totaled 12 arrivals and 12 departures in addition to 13 helicopter trips.

During the same period, La Guardia showed a total of 33 IFR arrivals and 34 departures. VFR flights totaled 12 arrivals and 16 departures in addition to six helicopter flights.

Newark had 27 IFR arrivals and 36 departures, 15 VFR arrivals, and 18 departures. There also were 12 helicopter flights.

• **Delays.** Average arrival delay between 5 and 7 p.m. at Idlewild ranged from 0 to 42 min. with an average delay of 23 min. Departure delay ranged from a minimum of 37 min. to a maximum of 1 hr. 57 min. with an average delay of 1 hr. 20 min.

Arrival delays at La Guardia ranged from 7 to 29 min. with an average delay of 15.7 min. Departure delays ranged from 0 to 1 hr. 14 min. with an average delay of 29.9 min.

Newark arrival delays ranged from 0 to 3 min. with an insignificant average, and departure delays ranged from 0 to 1 hr. 7 min. with an average delay of 41.4 min.

• **Traffic load per controller.** From 4 to 6 p.m., traffic in each of the New York metropolitan area's five principal traffic control sectors ranged above the 15 aircraft per hour maximum allowed each controller as a guide in staffing a sector. Each sector is staffed by two controllers.

Traffic per controller, between these hours, ranged from a low of 17 contacts at the Deer Park-Riverhead sector to 27 contacts at Solberg sector.

Average number of contacts from 10 a.m. to midnight ranged from a low of 13 at Colt's Neck and Deer Park-Riverhead to a high of 22 at Poughkeepsie.

Contributing factors to the unusually high June 7 traffic load, Bakke said, were college and weekend vacationers coupled with a marginal VFR condition which was not bad enough to discourage business flying. Nevertheless, FAA officials feel the June 7 peak is indicative of a trend that will eventually limit the influx of aircraft into the New York area.

Current Plans

Present plans for relief of New York's shrinking air space center around construction of a fourth airport well outside the traffic patterns of the present metropolitan terminals.

Port of New York Authority, a bi-state agency operating New York's metropolitan airports, estimates that it would take from six to seven years to complete a new airport if it were begun today. This could mean a period of one or more years of restricted aircraft scheduling beginning about 1968 until the new metropolitan airport reaches its completion.

Decision on a site for a fourth airport, delayed since 1961, is still stalled. Port Authority, whose original proposal calling for a fourth airport near Morristown, N. J., was rejected by that state, has been ordered by the governors of both states to restudy sites at Burlington, N. J., and Pine Island, N. Y. and submit a new report on the sites in 60 to 90 days.

The Burlington site, below Trenton and Bordentown, N. J., is over 65 air mi. from Manhattan and the Pine Island site is over 40 mi. At present, no one has any clear idea of how to bring passengers from either site quickly and cheaply. On receipt of the new Port Authority report, the governors can choose one site or the other or tell the authority to come up with another proposal.

Other Proposal

One other proposal, Raritan Bay below Staten Island—about 25 mi. from city center appears to have been effectively killed. Austin J. Tobin, executive director of the Port Authority, told the meeting that air traffic patterns from existing airports "make this site completely unfeasible from the standpoint of existing air space."

Raritan Bay would have required the use of filled land, which was not considered a major engineering stumbling block in the project.

If either the Pine Island or the Burlington sites were chosen, a revision in the bi-state compact would be necessary to give Port Authority jurisdiction over the airport—a step that would require state legislation.

MIAMI INTERNATIONAL'S double-deck parking system is visible in aerial photograph. Center portion of terminal building is seven stories high, contains hotel and airport offices. T-shaped international finger is near center of terminal. Location of new Eastern Air Lines and Pan American World Airways overhaul centers is to right of Runway 27R-9L at top of picture.

Major U. S. Airports—Part 7:

Atlanta, Miami Share Concepts, Problems

By Robert H. Cook

Atlanta—Atlanta Municipal and Miami International airports share common beliefs and problems in their role as the two largest air traffic hubs in the U. S. Southeast.

Both are staunch advocates of the finger design terminal and each handles an almost equal number of airline passengers. Last year, the Atlanta facility handled 4.1 million passengers and Miami handled 4.2 million.

Their answer to complaints of long walking distances for passengers echoes that of every airport with a similar centralized design—there is no more practical method to handle high volumes of airline traffic (AW June 17, p. 45).

Walking Distance

Walking distance from ticket counters to loading gates can be as much as 1,500-2,000 ft. in Atlanta's angular arrangement of six fingers, and nearly that distance at Miami's six fingers, which radiate outward from the 2,300-ft. long terminal building. A weary trudge of nearly one full mile is possible for the connecting interline passenger at each terminal, and here again the airports both contend that the small percentage of such passengers does not justify concern.

However, a surprising amount of ramp traffic at both airports consists of airline VIP carts, whisking the wiser or better-known passengers to connecting flights. Officials of both airports wistfully hint that it might lighten their complaint files if the airlines would reveal the availability of this service to a larger segment of the public.

The city of Atlanta foresaw these problems nearly eight years ago when it considered building a mobile lounge facility. As in the case of Chicago's O'Hare International Airport (AW July 15, p. 45), the idea was rejected by the airlines, which objected that the design would not permit enough area for operations offices and equipment storage. A circular design terminal with fingers was also considered but rejected in favor of the present design, which requires a built-in transfer time of 20 min. between flight schedules.

With 52 gate positions, the cost of a moving sidewalk through the fingers would be prohibitive, and the airport has also abandoned the idea of electric cart transport in the fingers after a brief experiment two years ago. Carts were used in the fingers over a five-month period, with a 25-cent round trip fare. The idea was dropped because of lack of patronage, Atlanta airport officials say.

One probable reason for passenger complaints about Atlanta Municipal is that ever-increasing numbers of them have arrived late because of air traffic congestion in the area. The airport now handles about 380,000 passengers a month and has experienced landing delays of up to 32 min., and on one occasion a total of 22 flights were scheduled to land at the same time. For several months the Federal Aviation Agency has been placing all scheduled aircraft within a 50-mi. radius of the airport under constant radar surveillance.

Parallel Runway

The only way to solve this problem, Atlanta feels, is to acquire a parallel runway which would permit simultaneous landings and takeoffs, stepping up the airport's present acceptance rate an estimated 50%. The runway would parallel the airport's fully instrumented Runway 9-27.

However, there are problems with both the FAA and the residents of Clayton County, in which half of the airport property is located. Atlanta's city charter forbids the purchase of such land unless it is for "immediate government use." Clayton County residents, many of whom are among the 61 persons who have filed noise law suits totaling $3 million against the airport,

LONG-RANGE VIEW of Atlanta Municipal Airport shows layout of finger design and proximity to the runway system. Area at upper left is portion of old terminal center, now used to accommodate cargo and general aviation operations.

have been opposing the new runway proposal. About 155 acres of land and 500 homes would be involved in the purchase.

As it is now planned, there would be a maximum separation between the runways of only 4,400 ft., as opposed to FAA's own standards requiring a minimum of 5,000 ft.

Atlanta Alternative

If FAA rejects this measurement, Atlanta will have to push further into Clayton County, facing the problem of even greater resistance from the residents and higher purchase costs. But first it needs FAA approval to implement the city charter's "immediate use" clause.

Meanwhile, the airport is changing the grade on Runway 3-21 and plans a 1,500-ft. extension to give it a total length of 7,000 ft.

Last year, the airport earned a net operating profit of $1.9 million, and after principal and interest payments on bond issues, recorded a surplus of $542,000.

With an expansion program in mind, Atlanta has notified the airlines that it intends to negotiate for higher landing fees.

The present landing fee formula has been in effect for 32 years and still has 37 years to run.

Miami International has at least two distinct advantages over Atlanta in the area of passenger convenience. Separate restaurant and lounge facilities are located at the beginning of each finger, and most shopping facilities are duplicated at measured intervals throughout the vast terminal building. In addition, a 270-room hotel has been designed as a part of the terminal building at the airport.

One of the most prevalent public complaints in the past was that the airport's two-story fingers were not air-conditioned. Three have now been refurbished to include air conditioning, and the balance will be finished by the end of this year. The finger used by Eastern Air Lines is being redesigned and modified to use jetway loading bridges and a $2-million project is under way to improve the international finger. The airport has a total of 74 gate positions. International passengers accounted for nearly 25% of Miami International's total passenger volume last year.

With a high percentage of vacationers, the airport is also benefiting from its Airport Expressway, which has cut ground travel time to Miami Beach hotels to about 16 min.

Four Runways

Miami International has four well-equipped runways, including two parallel runways, which it feels will be adequate to handle future traffic growth. About 85% of the total traffic is handled by the 10,500-ft. Runway 27R-9L and its 9,350-ft. parallel 9R-27L, both of which are east-west runways. The other two runways, oriented in a general north-south and northeast-southwest direction are the 8,400-ft. Runway 30-12 and Runway 35-17, which is 6,200 ft. long.

Eastern has completed a new $16 million jet maintenance base on the airport and Pan American World Airways will complete a similar $5-million project including an office building before the end of this year. Site of the new projects is on the north side of the airport property formerly occupied by the old 36th St. Terminal. Construction of the Eastern project was financed through a Dade County Port Authority bond issue, secured by Eastern's signing of a 30-year lease on the property.

It has been estimated that these two airlines, along with Delta and National, have a total investment of more than $150 million in the airport. Present landing fee charges are not levied against these carriers, and the airport has been attempting to negotiate a new fee schedule. The present schedule is effective through 1966.

Preferential Takeoffs

As with most large air terminals, Miami has instituted a system of preferential runway takeoffs to avert noise complaints. It has also reduced all training flights and halted engine run-ups in the very late and early hours. General procedure is to direct departing flights to reach an altitude of 2,000 ft. and distance of 5 mi. over the ocean before turning to cross the city proper at reduced power settings.

The airport reports that it has received good cooperation on the noise problem from surrounding communities. The city of Miami has cooperated in zoning land in the airport area, and complaints from the Miami Beach area dropped after an intensive publicity program conducted by the Port Authority. Main thrust of the campaign, picked up and supported by both newspaper and television media, emphasized the dollar value of air transportation to the Miami area and the need to provide a maximum of safety for the airline passengers.

(The eighth and final article in this series will be a report on Dulles International Airport. It will appear in a subsequent issue of Aviation Week & Space Technology.)

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AIRLINE OBSERVER

► Chances are strong that the next order for the BAC 111 twin-jet transport will be placed by Western Air Lines, which may buy up to 20 aircraft powered by the Rolls-Royce Spey bypass engine.

► **Watch for American Airlines to move into the Washington-New York-Boston commuter shuttle market against Eastern. During American-Eastern merger hearings, American held that there was room for only one shuttle operator in this market, and indicated that if the merger came about, the consolidated carrier would place Lockheed Electra turboprop transports in the operation. American's expected move is now designed to determine which carrier—American or Eastern—will be the only shuttle operator.**

► Trend toward use of U. S. carriers by American tourists is continuing on North Atlantic routes (AW June 3, p. 36). Both TWA and Pan American have become established as top-ranking carriers in the market.

► **Bonanza Airlines' decision to order three Douglas DC-9 short-range turbofan transports, following Civil Aeronautics Board's rejection of the carrier's order for three BAC 111 jet transports, is forcing CAB to make a policy decision. Disapproval of the DC-9 purchase would mean the Board is opposed to the operation of jet transports by a subsidized local service carrier. However, the Board's jurisdiction covers only those carriers that need a government-guaranteed loan to purchase the planes. Thus any policy, implied or explicit, against the use of jets in local service operations will not be all-embracing and could create a competitive imbalance in some areas.**

► International Air Transport Assn. traffic conference, scheduled for Sept. 7 in Salzburg, Austria (AW July 29, p. 28), is now expected to be a composite meeting, embracing all regions. Special meeting was originally called to compromise differences over fare structure established for the North Atlantic at last year's composite conference in Chandler, Ariz. (AW Nov. 5, p. 34).

► **United Air Lines will apply the TARAN—test and replace as necessary—principle to the maintenance of aircraft hydraulic systems components. Under the system, hydraulic components will be tested during overhaul periods and removed when they fail to meet test specifications. Current practice calls for the assignment of each part to a specific TBO—time between overhaul.**

► Domestic trunk carriers and U. S. all-cargo scheduled airlines flew 401 million ton miles of air cargo during the first six months of 1963, an 8.1% increase over the same period last year, according to the Air Transport Assn. Air freight increased 9.5%, air express 2.2% and air mail rose 6.7%.

► **Russia's Aeroflot carried 19% more passengers and 8% more cargo during the first half of 1963 than in the same 1962 period. But the Soviet airline is still falling short of its traffic goals. A 19% passenger gain, if maintained during all of 1963, would bring Aeroflot's total for the year to about 32 million, compared with 27 million in 1962. However, Aeroflot's goal for 1963 is 35 million passengers. During the first half of 1962, Aeroflot had a 29% gain in passengers and a 9% increase in cargo over the same 1961 period.**

► Trans World Airlines pilots will seek a reduction in monthly flight time requirements when negotiations open soon on a new contract. Current contract expires in November. However, TWA's pilots are not expected to offer abandonment of the commercial and instrument rating for flight engineers in exchange for the lower flight time, as was done by American Airlines pilots. TWA is still giving pilot training to engineers as required by the existing contract, with 120 already holding pilot rating and 175 expected to receive it by year's end. Some among TWA's 1,408 pilots had favored the American pilots' formula, in which flight time was reduced from 85 to 75 hr. monthly. But an Airline Pilots Assn. poll of TWA revealed that of 950 votes cast, 731 favored retaining the current crew complement conditions and keeping them separate from any move to gain lower flight time.

SHORTLINES

► **Allegheny Airlines** has reported a 14% increase in the number of passengers carried and an 11% rise in revenue passenger miles for the first six months of 1963, compared with the first half of 1962. The cargo handled increased 14%.

► **American Society of Travel Agents'** 33rd World Travel Congress in October at Mexico City will be attended by Georgi Zoubkov and Vladimir I. Babkin of Russia's Intourist. Civil Aeronautics Board Chairman Alan S. Boyd will be the keynote speaker.

► **Braniff Airways** will expand its electronic reservations system in January when 92 new electronic agent keysets in eight cities will be tied by direct lines to the central data processor in Dallas. Contract for the installation was awarded to Teleregister Corp.

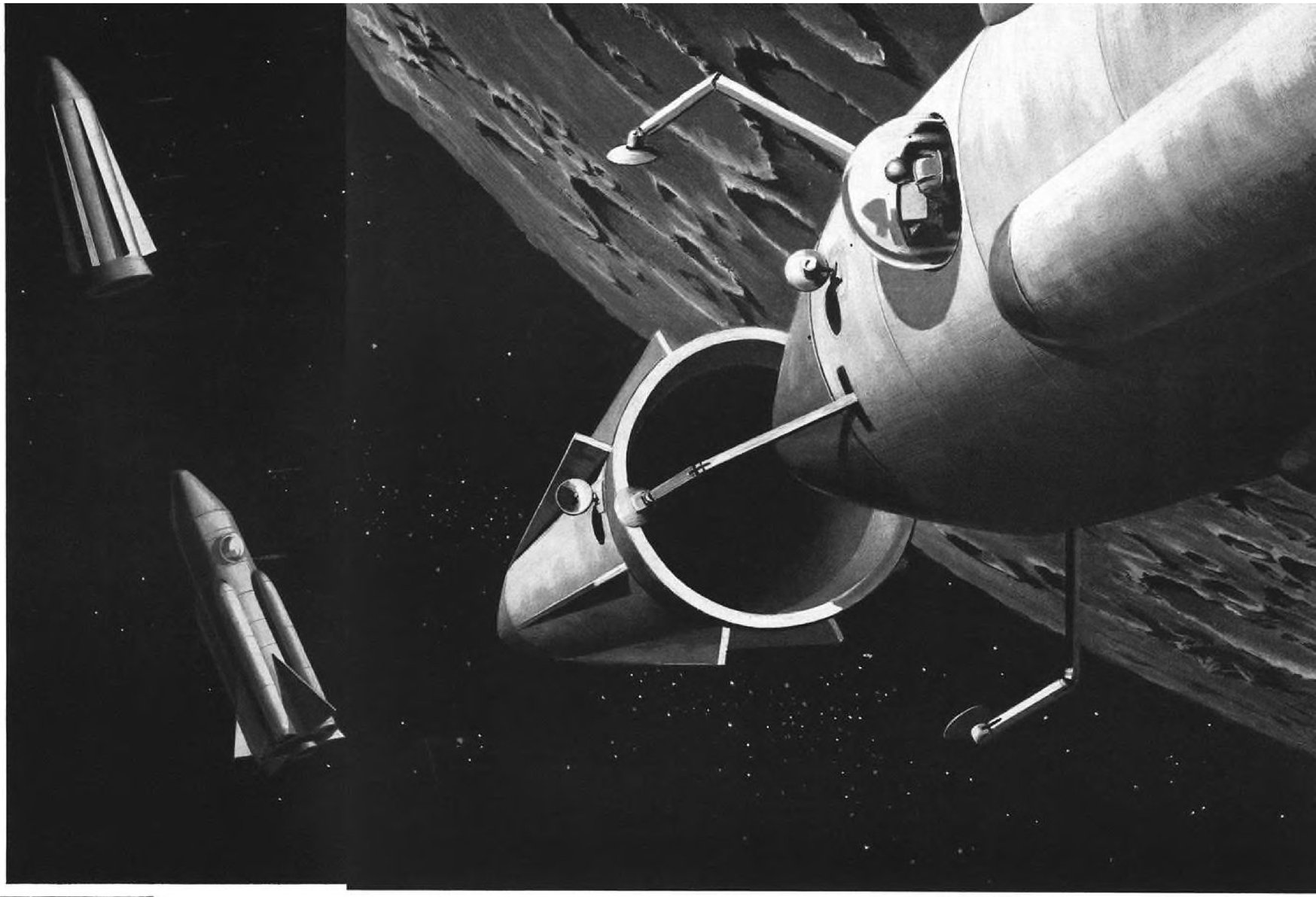
► **Capitol Airways** will take delivery of its Douglas DC-8F convertible passenger-cargo jet transport in August and will place it in service in September.

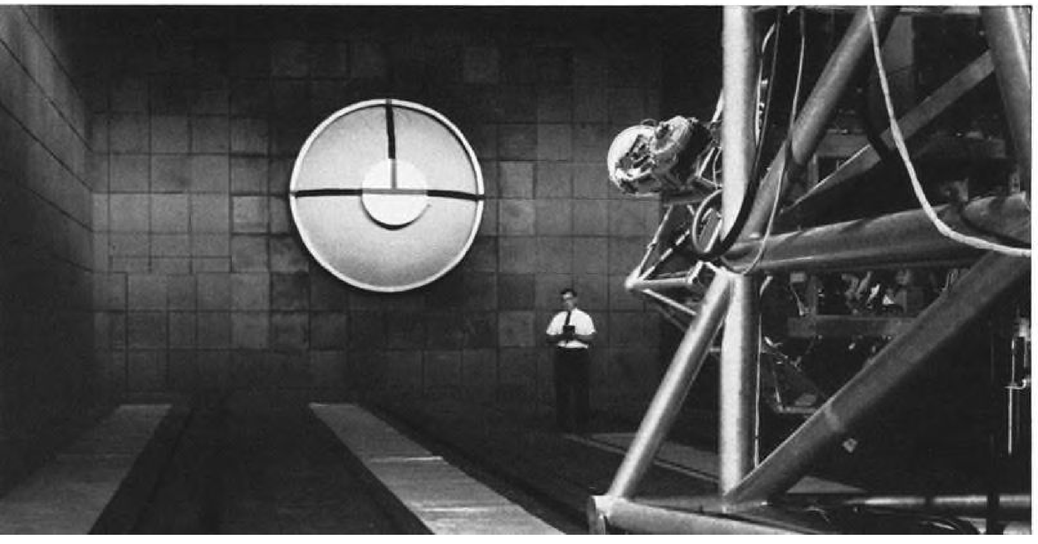
► **Cathay Pacific Airways** has started direct air service between Hong Kong and Jesselton, North Borneo. An additional weekly schedule to North Borneo from Hong Kong has been operated by the airline through Manila.

► **Eastern Air Lines** will convert its 39 Lockheed Electra turboprop transports from all first-class to a dual-configuration coach and first-class seating in September. Forward section will hold 15 coach seats and 54 seats will be installed aft in the first-class compartment.

► **Federal Aviation Agency** last week awarded a $1.8-million contract to Burroughs Corp. for the development of a radar video data processor system (RVDP) for installation at long- and short-range radar locations. RVDP is expected to eliminate need for microwave radio transmitter and repeater facilities now used to transmit data from radar sites to control centers.

► **Slick Corp.** has reported a net loss of $216,256 for the first six months of 1963 compared with a net income of $750,714 in the same period last year. Revenue rose sharply in the second quarter, when a profit was shown, due to increased business of the Slick Airways Div., which, according to the company, was adversely affected in the early months of 1963 by a drop in military contract business.





Top illustrations (left to right): Landing, Rendezvous, Docking.

Left: Raytheon's Prototype Rendezvous Radar installed in the Martin Marietta Company's Closure Test and Training Facility.

RAYTHEON . . . a leader in radar for space vehicles

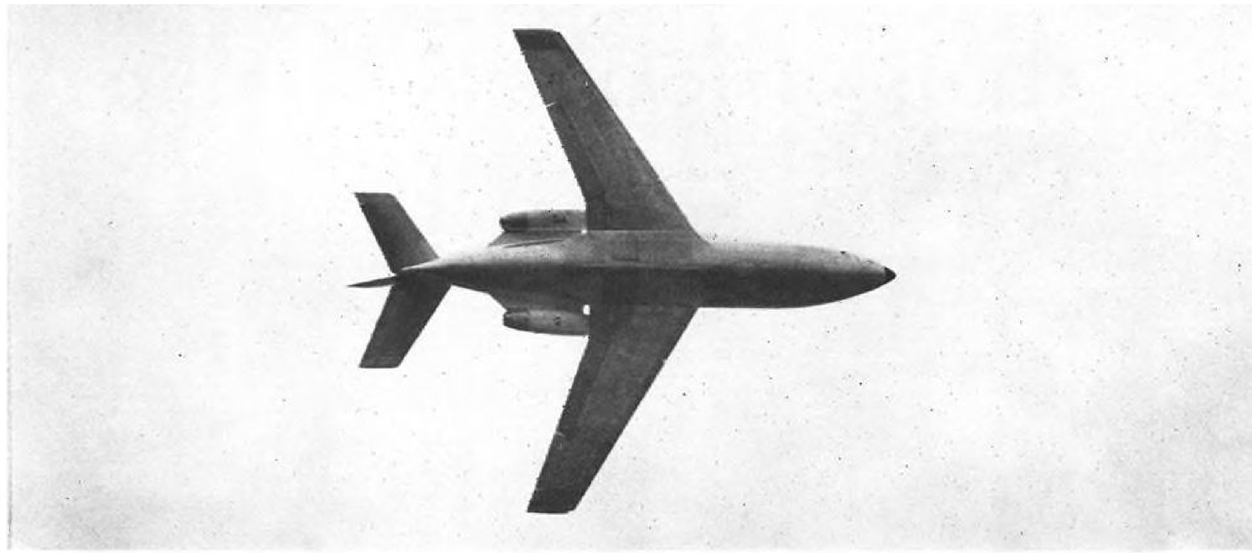
Raytheon — leading designer and manufacturer for ground-based, aircraft, and missile systems — has developed and is testing prototype space radars for RENDEZVOUS . . . DOCKING . . . LANDING.

Currently being explored under Raytheon's in-house space radar program are several interesting configurations. One of these, the Raytheon Rendezvous Radar, has been installed in the Martin Marietta Company's Closure Test and Training Facility at Denver, Colorado. It is applicable to such systems as Apollo, Lunar Logistics System, Mars Excursion or Command Module, Satellite Inspectors, and Manned Space Stations. Variations of the system are now being tested for particular missions.

For additional information — or a discussion of how the same Raytheon integrated system capability can be applied to your requirements — contact Neil A. Montone, Director, Marketing, *Space and Information Systems Division, Raytheon Company, Bedford, Massachusetts.*

RAYTHEON

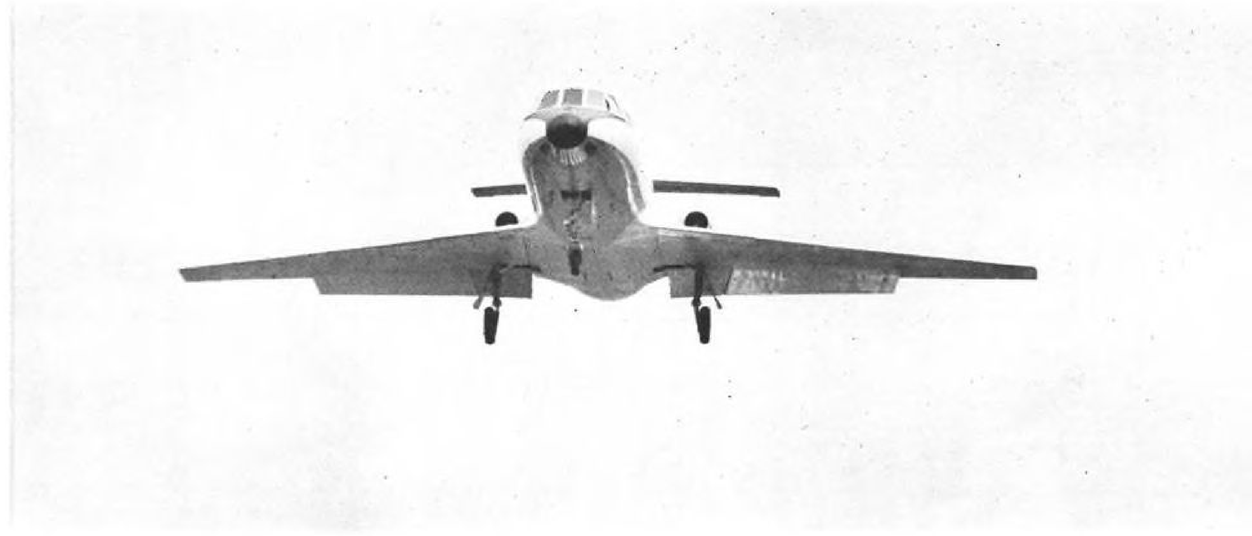
Dassault Mystere 20, powered by Pratt & Whitney JT12A-8s in eight-passenger configuration, has maximum takeoff weight of 19,290 lb.



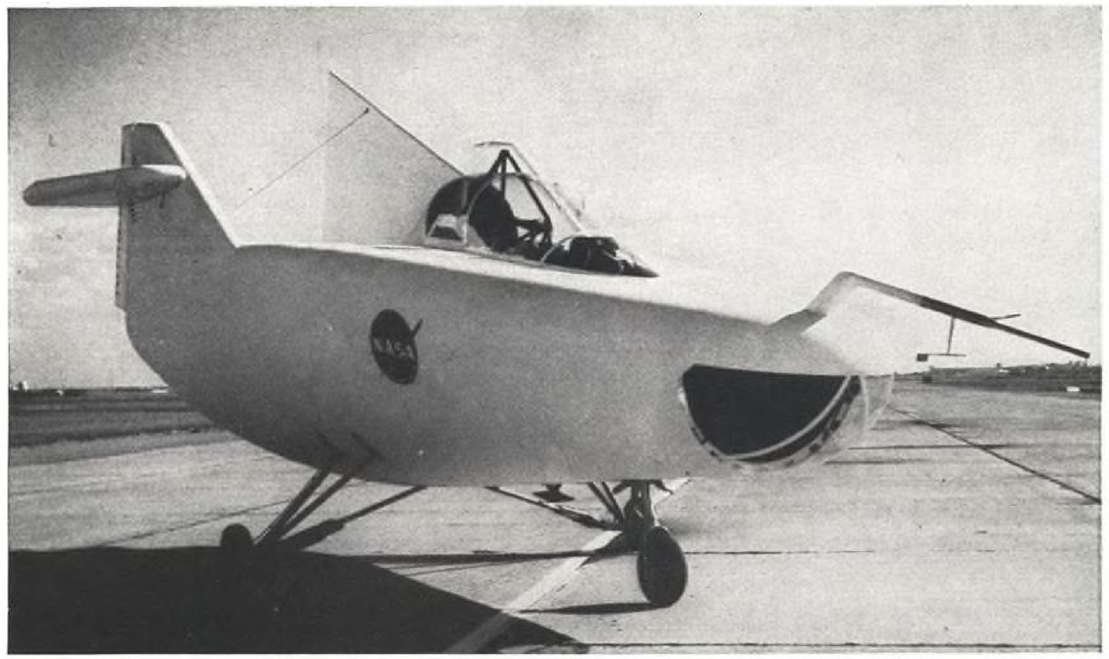
Normal replacement items on Dassault-Sud Mystere 20 aircraft sold in the U. S. will be almost wholly American made, Dassault says.

Mystere 20 Performance Demonstrated

Dassault Mystere 20 executive jet, which made its first public appearance at the recent Paris Air Show, is aimed at a wide international market. U. S. version will offer engine and accessory options to be produced in this country. The prototype, shown here in demonstration flight at Paris Air Show, is powered by Pratt & Whitney JT12A-8 turbojets of 3,300 lb. thrust each. Version for British customers will offer option of Bristol Siddeley Viper 20 engines. Future performance and range may be boosted by adoption of turbofans, possibly the General Electric CF700 aft fan. Maximum cruise with JT12A-8s is quoted as 522 mph. at 30,000 ft.



Landing distance for the Mystere 20 is given as 2,624 ft. for either the Pratt & Whitney- or Bristol Siddeley-powered version. Approach speed for both is 110 kt. Maximum range with IFR reserves for either aircraft is quoted at 1,366 mi.



CONICAL LIFTING BODY model developed by Flight Research Center is a 900-lb. glider model of the M-2 lifting body under study.

NASA Focuses on Three Aircraft Areas

By Edward H. Kolcum

Washington—Character of the U.S. aeronautical research program is changing to reflect the dwindling number of aircraft under development, but the National Aeronautics and Space Administration feels it is keying its full research resources to the aircraft requirements that have been defined as well as those of the future.

NASA's annual aeronautical research funding has dropped from $50 million five years ago to $16.2 million for Fiscal 1964, a factor which has brought increasing criticism that the agency is devoting too little to aircraft research because of its preoccupation with space programs.

The problem, according to Dr. Hugh L. Dryden, deputy NASA administrator, is that "not many new aircraft are being developed. Some feel that NASA can produce a large class of new aircraft and get the [aircraft] industry on the rise. But research will not be on a rising curve as long as so few aircraft are being built."

To counter this criticism, NASA held a research seminar recently to explain that it is focusing research largely on three programs—the supersonic transport, hypersonic research aircraft and vertical/short takeoff and landing aircraft—as well as feeding fundamental data to the basic information storehouse for aircraft programs that may evolve in the future.

Highlight of the seminar was the agency's review of its supersonic transport research. The conclusion that can be drawn from the review is that the agency feels it is able to take a much larger role in the supersonic transport development program—probably to the same degree as in the X-15 program, where NASA is technical manager.

Federal Aviation Agency is over-all manager of the supersonic transport program, with NASA the technical consultant. Dr. Raymond L. Bisplinghoff, director of NASA's advanced research and technology, said the agency is prepared to spend more on this effort if Congress approves the President's request for $60 million in supplemental funds to start the program moving (AW July 1, p. 39). A total of $3.8 million has been allocated for supersonic transport research in NASA's Fiscal 1964 request, but the agency feels it has now isolated the critical problems associated with the aircraft and is ready to commit more money to the work of solving them. These problems are in the areas of the engine, structures, materials and aerodynamics.

Charles H. Zimmerman, director of aeronautical research, said NASA would like to have two competing supersonic transport types under development through prototype construction. James E. Webb, NASA administrator, said NASA is on the record favoring a steel aircraft capable of Mach 3 speeds. Langley Research Center will be host to an industry conference on the supersonic transport Sept. 17 and 18 (AW July 29, p. 27), when NASA will release the results of configuration studies being made by Boeing and Lockheed (AW Apr. 1, p. 58) as well as the in-house research under way.

Fiscal 1964 NASA Aeronautical Research

Program	Effort in Manpower (% of total)	Funding (in millions)
Supersonic transport	22	$ 3.8
V/STOL	15	1.6
X-15	14	0.9
Loads, structures	13	2.5
Aerodynamics	13	1.9
Operating problems	13	2.4
Propulsion	10	3.1
Total	100	$16.2

Other seminar highlights were:

• **Hypersonic aircraft** have a wide variety of potential missions, according to Laurence K. Loftin, Jr., assistant director at Langley, with the greatest potential in an orbital supply system and in very high speed transportation between points on the earth.

He identified as key hypersonic aircraft research problem areas: high performance ramjets able to operate over the entire speed range, efficient variable geometry hypersonic inlets and exits, advancements in structures and materials, and the standard aerodynamic problem of low drag with high lift-to-drag ratio configurations.

Dr. De E. Beeler, associate director of Flight Research Center, briefly described a hypersonic research aircraft (HRA) capable of flying in the Mach 8 to 10 range that could be the next generation of experimental aircraft.

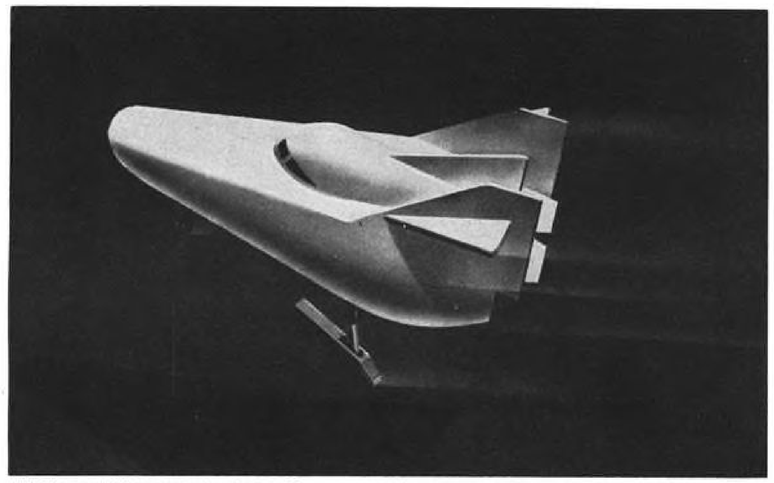
• **X-15** initial exploratory program essentially has been completed, but the aircraft can be modified for use as a hypersonic cruise vehicle testing platform, Dr. Beeler said. Various materials can be placed on the X-15 structure, and the aircraft can carry hydrogen-fuel engines aloft for testing.

• **Vertical and short** takeoff and landing (V/STOL) aircraft research covers a broad area in NASA, but considerable research remains to be done—particularly in the area of operating problems—to bring this aircraft type into an operational status, according to John P. Reeder of Langley.

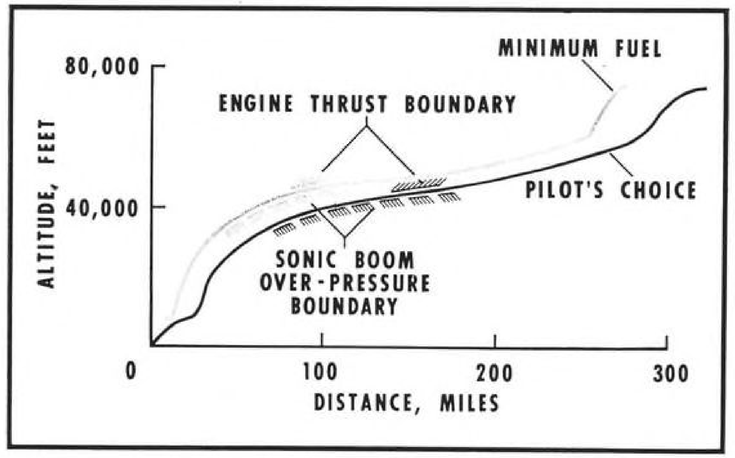
Reeder said helicopters were the first and still are the only true V/STOL aircraft. A promising avenue to improving the helicopter, he said, lies in the use of the hingeless rotor, which will provide much better stability and control, reduce drag on the rotor hub and produce sufficient moment in the rotor mast to handle large center-of-gravity shifts for operating on a sloping terrain.

In order to improve the inherent speed and range limitations of the helicopter and yet retain its qualities, NASA is studying a wide range of propeller-driven V/STOL types, Reeder said, but he pointed out that "the testbed aircraft available thus far have not been adequate for a realistic study of VTOL operating problems," NASA has used the Bell XV-3, Vertol VZ-2, Ryan VZ-3, Doak VZ-4, Bell X-14 and Curtiss-Wright X-100 for extensive flight testing of VTOL concepts.

In addition, the agency participated in the engineering evaluation of the British Hawker P.1127 and trained Hawker pilots with the X-14. NASA is now conducting wind tunnel and free flight studies of models of the Ryan fan-in-wing X-5A and the Bell X-22, with flight research planned for both vehicles, Reeder said.



MANNED WINGLESS VEHICLE is shown in artist's concept touching down on landing skid.



OPTIMUM AND PILOT CHOICE flight paths for SST climb schedule are shown in graph. Pilot choice line, developed through simulator runs, results in excessive fuel consumption. Takeoff, climb and acceleration phase uses about one-third of the fuel load.

Mark R. Nichols of Langley reviewed the NASA supersonic transport technical effort, and he pointed out that flight efficiency at higher Mach numbers is limited basically by the increase in surface temperature.

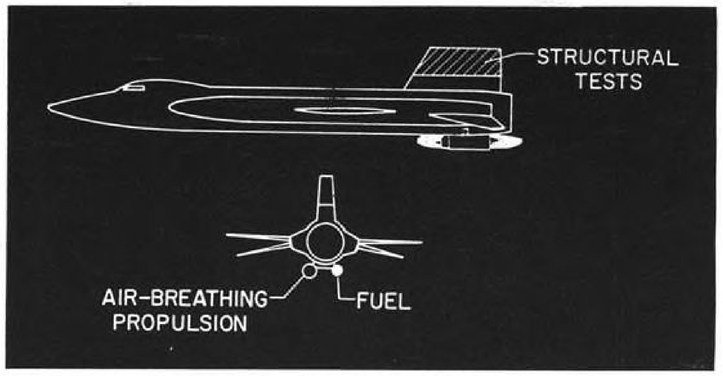
Materials property studies have shown that the tensile strength/density ratio for aluminum alloys drops rapidly at velocities above Mach 2, and these alloys tend to anneal when exposed to high speeds for long times. Temperature at Mach 3 is about 500F.

Sonic boom overpressure is the only critical operating problem introduced by the supersonic transport which other commercial transports do not have to face, Nichols said. However, this makes even more critical the precise climbing, cruising and letdown flight paths the aircraft must fly to avoid the other problems: exceeding maximum lift and altitude, avoiding flutter, gust and buffet regions, and flying within temperature and strength design limits.

Nichols said the transport should be designed to stay under 2 lb./ft.^{2} for sonic boom overpressure, and Harvey H. Hubbard, also of Langley, discussed the research under way to better understand the sonic boom phenomena.

Flight tests, wind tunnel configuration studies and analytical studies of atmospheric propagation are under way, Hubbard said, to obtain an understanding of the way in which booms can be generated, propagated and predicted. These studies are aimed at determining the effects of boom overpressure on light aircraft, building structures, ground motions and communities.

In his review of hypersonic aircraft



ADVANCED RESEARCH USES for X-15 would be applicable to hypersonic cruise vehicles. Tail surface could be testbed for a variety of structures, with air-breathing propulsion systems carried under the airframe, as indicated in the drawing.

research, Loftin pointed out that such a vehicle would give a wide choice of rendezvous launch window and of landing and takeoff locations for an orbital supply system. In addition, it would be both recoverable and reusable.

Loftin concluded that a hypersonic cruise vehicle is possible, but that multistage systems—either all-rocket or a combination of rocket and air-breathing stages—are more attractive than a single stage. He also cautioned that both weights and costs will be high in such a system.

A plan is being developed now to test a hypersonic ramjet up to velocities of 18,000 mph. by launching it as the payload of a three-stage Scout. The Scout launch is not yet an approved project, but an approved plan is to test ramjet systems in four tunnels for speeds, up to Mach 11, scale effects, cold operation and hot operation.

One of the basic problems of a hypersonic aircraft is the environment in which it will operate, Loftin said. This environment will result in a 4,000F heat load on the nose, 3,000F on the leading edges, 2,500F on the lower surface and 1,500F on the upper surface. Complicating these heat loads, which will cause the nose to deflect as much as 25 ft., is the hydrogen fuel, which must be stored at −420F.

Aerodynamic Problems

Problems in aerodynamics stem from the configuration characteristics inherent in the vehicle. Fuselage will have a large volume, and the leading edges must be blunt to survive the heat loads. Stability and control must be maintained at angles of attack from 0-25 deg. In addition, the airframe must be able to survive turbulent heating rates and surface roughness effects.

Plans have been made for flight research in both supersonic transport and hypersonic aircraft research at Flight Research Center, Beeler said. The research program includes:

• **Supersonic transport**—Northrop F-5D will investigate operating problems; North American A-5A flying qualities; North American RS-70 both aerodynamic heating and stabilization systems; a prototype transport, when built, will test structural loads, and the General Dynamics-Grumman F-111 (TFX) will determine lift-drag ratio.

NASA is preparing an agreement by which the RS-70 can be used for this research, either with NASA or USAF crews, as well as for studies of the sonic boom overpressure (AW July 29, p. 27).

The RS-70 and Lockheed JetStar will be used to determine handling qualities, and JetStar for configuration evaluation and design requirements.

In certification of the supersonic transport, the F-5D will be used at minimum flying speeds, and the JetStar for demonstration techniques. The A-5A and RS-70 will be used to determine air traffic control compatibility and for systems evaluation.

• **Hypersonic aircraft.** The X-15 and, if built, the hypersonic research aircraft will conduct research in the disciplines of lightweight structures, air-breathing propulsion, flight control and aerodynamics.

Beeler also pointed out that Flight Research Center is continuing its research for improved light and executive aircraft, for which it uses the JetStar, an Aero Commander and a variety of smaller aircraft. Objectives of this program are to improve stability and control, pilot display, handling qualities and to conduct operations research.

Conical Body

Flight Research Center also has begun preliminary work on a conical lifting body, actually a glider model of the M-2 lifting body. The 900-lb. model has been towed both by automobile and light aircraft. It was built in a few weeks at a cost of $30,000.

Charles W. Harper of Ames Research Center explained the growing use in aeronautical research of simulators that ultimately will be able to fit flight control tasks into early aircraft design. NASA currently uses three methods to assess handling qualities: analytical, in which both pilot and aircraft design are represented by mathematical models, variable stability aircraft and ground-based simulators.

NASA Research Survey

Washington—Survey of the aircraft industry by Dr. Arthur Raymond indicates the National Aeronautics and Space Administration is deficient in only two areas of aeronautical research in terms of what the industry wants, according to James E. Webb, NASA administrator.

Although the areas were not identified by Webb, the main deficiency is known to be in air-breathing propulsion research, which is virtually non-existent in NASA. The second area is believed to be in electronics.

Dr. Raymond, retired vice president for engineering at Douglas Aircraft Co. and now a NASA consultant, surveyed the entire aircraft industry as a result of criticism that the agency is not conducting enough aeronautical research. Dr. Hugh L. Dryden, deputy NASA administrator, commented that the critics suffer from the fact "that they don't know what's going on" in aeronautical research.

NASA's Lewis Research Center formerly was a leader in air-breathing propulsion research, but in the past few years has been devoting most of its effort to space propulsion projects.

PRODUCTION BRIEFING

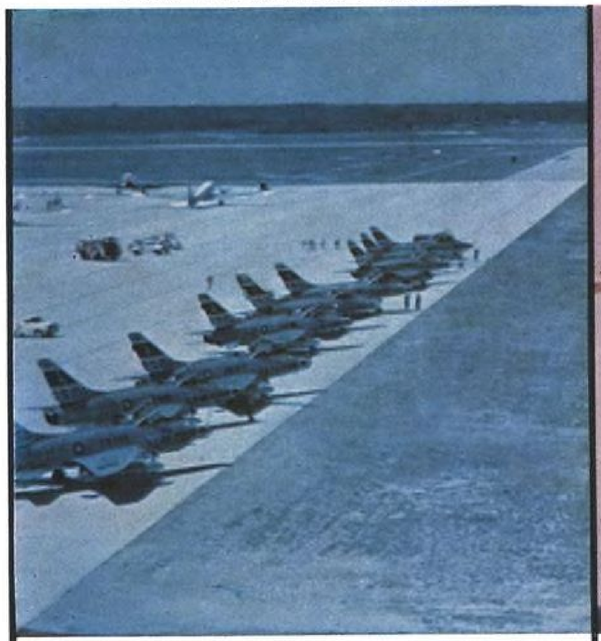
Garrett Corp.'s AiResearch Aviation Service Div., Los Angeles International Airport, has a $2.4-million follow-on contract for the conversion of 120 Air Force KC-97G aerial tankers to C-97G transports. Fifteen aircraft have been converted and kits are being built for the 120. Converted aircraft will carry troops, stretchers, cargo or any combination of these. Value of the entire program is $5 million.

Air Force will sell as scrap nearly 1,000 reclaimed aircraft hulks within the next 90 days. All four sales will be held at Defense Surplus Sales Office, Davis-Monthan AFB, Tucson, Ariz. First sale will be for 254 aircraft including T-33s, B-47s, B-50s, F-80s, F-89s and KC-97s. Second sale, also Aug. 6, is for 40 B-29 carcasses located at Aberdeen Proving Ground, Md. Third sale, tentatively scheduled for Sept. 5, is for 290 miscellaneous fighter carcasses. Fourth sale, to take place about Nov. 5, is for miscellaneous aircraft.

(*Continued on p. 65*)

How Goodyear "Engineered Value" solved 4 more flight problems

FOR THE ARMED FORCES



PROBLEM: Portable refueling base
SOLUTION: PILLOW Tanks

ADVANTAGES: Lightweight. Collapsible. Store fuel (or any other bulk liquid) temporarily or permanently. Can also be used for emergency bulk liquid transportation. Minimum vapor loss. Move easily.

FOR LIGHT PLANES

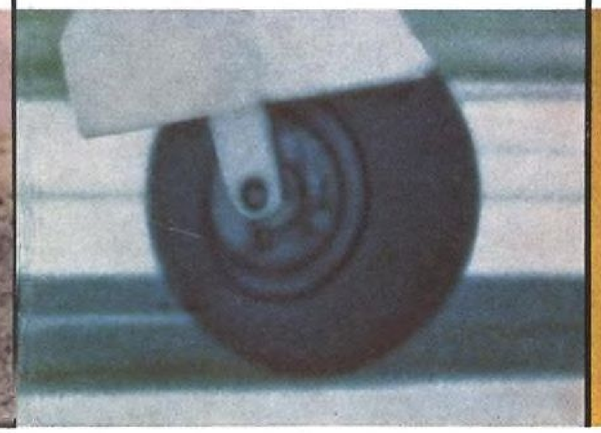
PROBLEM: Safer Light Plane Landings
SOLUTION: Goodyear 3-T Nylon Tire Cord Body

ADVANTAGES: Maximum strength for high-impact landings. Greater protection from breaks, bruises, heating, tread-cracking. Controls tire growth in service. Increases tire retreadability.

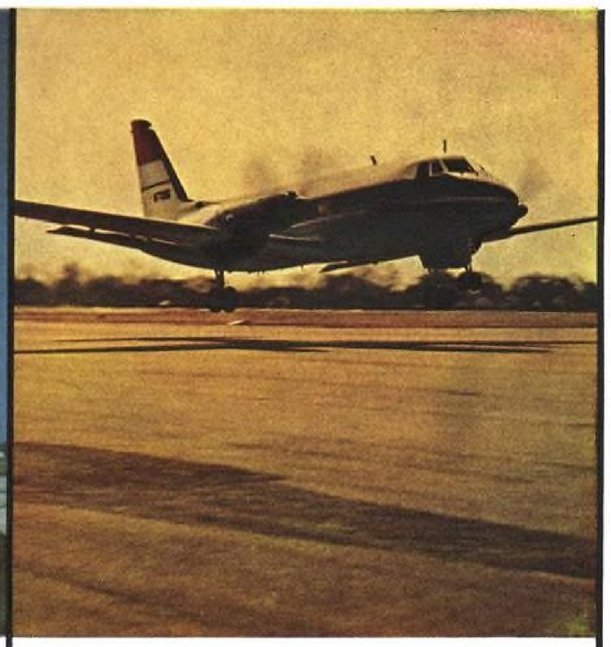
FOR THE AIR FORCE

PROBLEM: Land a Mach 2 Fighter
SOLUTION: Goodyear Wheels & Brakes

ADVANTAGES: Compact. More braking capacity than any other unit its size. Fast tire changes. Easy to maintain. Wheel and brake may be changed separately or together. Near-instant anti-skid control.



FOR THE NAVY



PROBLEM: Develop a compact anti-skid unit
SOLUTION: Goodyear Proximity Anti-Skid Detector

ADVANTAGES: New skid-sensing device eliminates generator and mount, saves space. Unit, seen at right below, is 72% smaller than regular unit shown at left. Extremely efficient at high temperatures.

"Engineered Value" is a Goodyear exclusive. It means extra value in products developed through the unmatched capabilities of one of the world's largest, most experienced manufacturers of aircraft components—Goodyear. Since Kitty Hawk, Goodyear scientists, engineers and researchers have been solving flight problems with "engineered value" products. They stand ready to solve your problems, too. For full information write Goodyear, Aviation Products, Dept. H-1715, Akron 16, Ohio.

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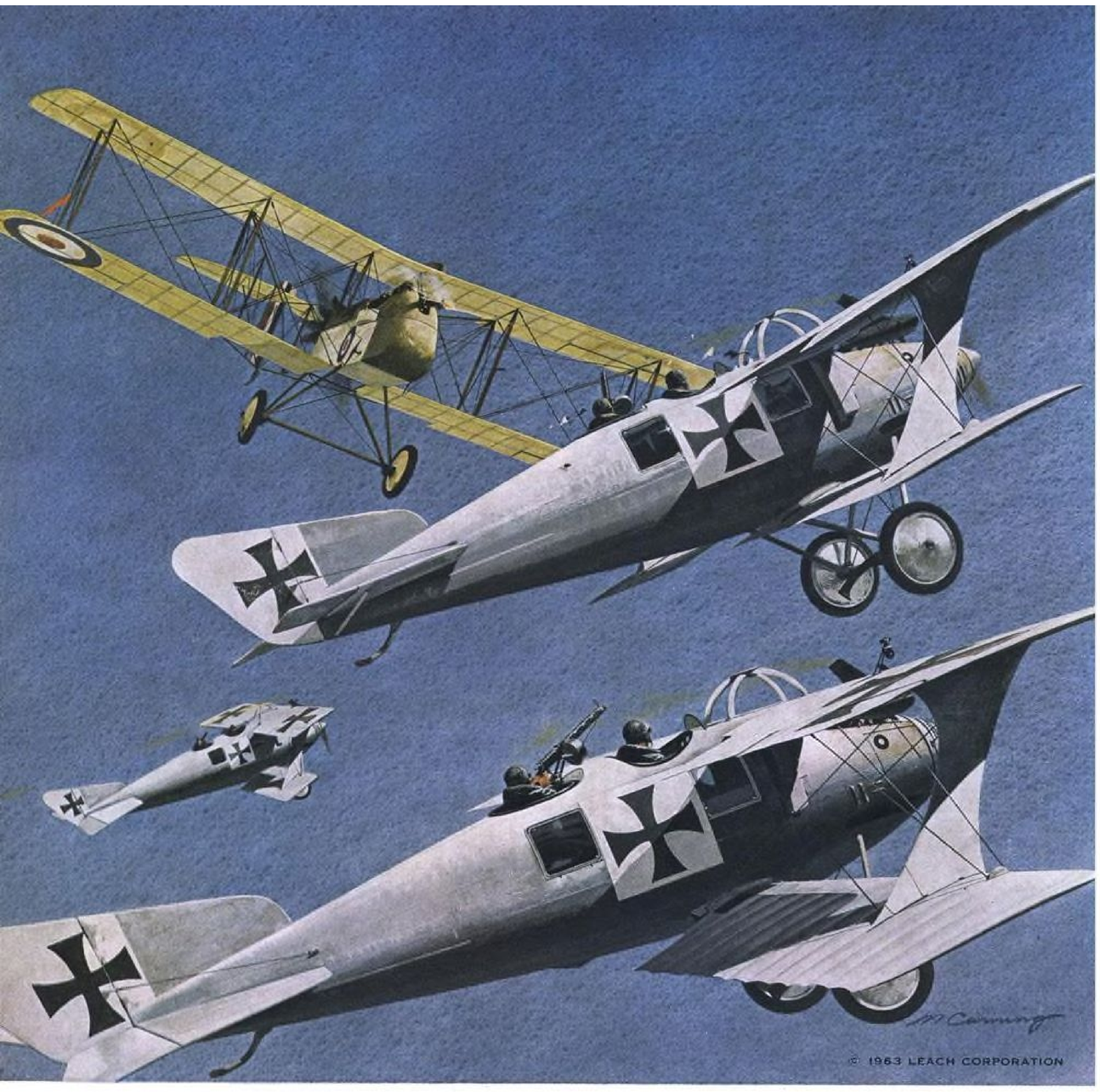

REES AND THE TEN WALFISCHE

LEACH HERITAGE OF THE AIR—27

Ten German Roland C-II Bombers crossed the British lines near Festubert, Belgium on the morning of July 1, 1916. They were headed for another crippling raid on an Allied city. Which one? St. Omer? Calais? Dunkirk? Boulogne? No one ever found out. The Germans never got there.

They were first met by a very brave young pilot in No. 32 Squadron of the Royal Flying Corps. Second Lieutenant J. C. Simpson attacked the German formation single-handedly. But in a matter of minutes he was shot down.

Soon after that, the same formation was spotted by Major L. W. B. Rees, Commander of No. 32, on a routine patrol. Mistaking the C-IIs for British planes coming home from a raid, Rees flew over to join them. He didn't know they had just killed one of his own men.

Rees was piloting a De Havilland 2. Powered by a 100 h.p. Gnome Monosoupape rotary pusher engine, the two-bay biplane was designed around the stationary Lewis machine gun fixed in the very front of the cockpit. Instead of aiming the gun at a target, pilots aimed the airplane.

The planes Rees mistook for friends were the most unusual bombers ever seen up to that time. Instead of sporting the usual maze of wires, struts and square corners, the Roland C-II broke all the rules.

Ingenious engineering made the new two-seater lighter, stronger and faster than its prototype. The C-II had 33½-feet-long equal span biplane wings and a deep, gap-filling fuselage which gave it an over-all length of 24 feet 1 a 9¾ feet height. Biggest innovati. .ıe top wing was flush with the top of the fuselage!

Pilots of the Roland C-II poked their heads out of their cockpits by only a few inches. To see downwards, they looked out of huge cutouts in the trailing edges of both wings joined at the fuselage. Both pilot and observer had two large side windows that were probably the first escape hatches in the history of aviation.

Powered by a Mercedes 160 h.p. engine, the Roland C-II could reach a top speed of between 103 and 105 mph and could stay in the air for three hours. Because of its great speed, it needed little fire power. The only machine gun on the plane was a Parabellum air-cooled weapon mounted on a revolving ring around the observer.

When one German official got his first look at a Roland C-II and its painted mouth, he said it looked like a whale. From that moment on, it was affectionately known as "der Walfisch."

Rees was almost on top of the ten Walfische when he realized they were less than friendly. He had two easy choices to make. Get out of there. Or attack. One of the Walfische made his choice easier. He attacked Rees. Rees hit him with a long burst at short range and sent him diving for home.

The daring Major aimed his D.H.-2 at another Walfisch and put 30 rounds into his belly. The wounded bomber went straight down and landed in the German lines.

The rest of the formation scattered like sheep before a yapping dog. The leader of the German group and two other Walfische kept on toward the British area. Rees followed them. He wouldn't give up the hunt.

One of the observers in a Roland C-II got lucky. He wounded Rees in the thigh and shot off part of the D.H.-2's rudder.

But Rees wouldn't quit. He kept up his fire until he was within ten yards of the rear Walfisch. He could see the wounded German observer firing like a wild man in all directions. The leader of the Walfische then gave up and turned for home. Rees kept after him until all his ammunition was gone. Then he flew for home.

For single-handedly upsetting a raid of ten German bombers, Rees received the Victoria Cross—highest decoration in the British empire. It was a good day's harpooning.

Did Rees stay in the RAF?

Yes. And he retired in 1931 as a Group Commander. That was just about the time that Leach developed its line of Balanced Armature Relays to meet the ever increasing environmental requirements of new aircraft.

Leach is now very big in Space Electronics, isn't it?

Right again...with tape recorders, telemetering equipment, relays, timing devices. In fact, we were in the space business long before it became popular!

What's your latest project?

Apollo. Leach has been given the contract to develop lunar flight tape recorders for the three-man spacecraft that will orbit the moon. The recorders will weigh half as much as the most sophisticated recorders now available, yet they'll have twice the capacity and require only one-third the power.

Where are they being developed?

At Leach's Azusa, California plant, which devotes all its efforts to aerospace electronics. Leach also has facilities in Los Angeles, San Francisco, New York, Washington, D. C., Dayton, Seattle, Boston, Huntsville, Zurich, Geneva and Munich. If you're thinking about space, maybe Leach can ease your mind. Why not give us a call?

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(Continued from p. 60)

Bell Aerosystems Co., Buffalo, N. Y., has signed a licensing agreement with the Anti-Friction Hull Corp., of Laurel, Md. for the rights to use, manufacture, sell and sub-license vessels employing the Hydrokeel principle. This principle, developed by Anti-Friction Hull, employs air, forced out between side keels to form an air pocket beneath the hull bottom and above the water surface thereby increasing performance by cutting water resistance.

Swedlow Inc., Los Angeles, Calif., has broken ground for a new plant facility on its 22 acre site in the manufacturing district of Garden Grove, Calif. First unit, about 50,000 sq. ft., will house the company's aircraft transparencies facilities. When all units are completed, the 150,000 sq. ft. facility will consolidate segments of the firm's aircraft and missile plastics activities.

Lockheed-California Co., Burbank, is developing study techniques and analytical methods for five future space missions under contract from Jet Propulsion Laboratory. Missions under study include orbiting manned space station, manned lunar base, unmanned flyby Jupiter probe, unmanned vehicle to return samples from Venus, and a manned Mars landing and return.

Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif., has a $400,000 contract from NASA's Lewis Research Center to study the interactions of liquid alkali metals such as lithium, sodium or potassium when used in systems fabricated of refractory metals such as tungsten, tantalum, hafnium or niobium.

General Dynamics/Convair will continue engineering studies on a Ground Effect Takeoff and Landing (GETOL) aircraft under a $128,000 contract from Bureau of Naval Weapons. A GETOL aircraft would be supported by a ground effect air cushion during vertical takeoff and landing or acceleration over an unimproved land or water service. It would then cruise conventionally.

Bell Aerosystems Co., Buffalo, N. Y., has received follow-on production orders from Lockheed Missile and Space Co. totaling more than $5 million for its Agena rocket engine.

Beckman Instruments, Fullerton, Calif., has an $89,778 contract from Marshall Space Flight Center for development of techniques and associated instrumentation for the rapid quantitative detection of hydrogen in oxygen, nitrogen and inert gases. The instrumentation would be used to detect hydrogen leaked around missile installations.

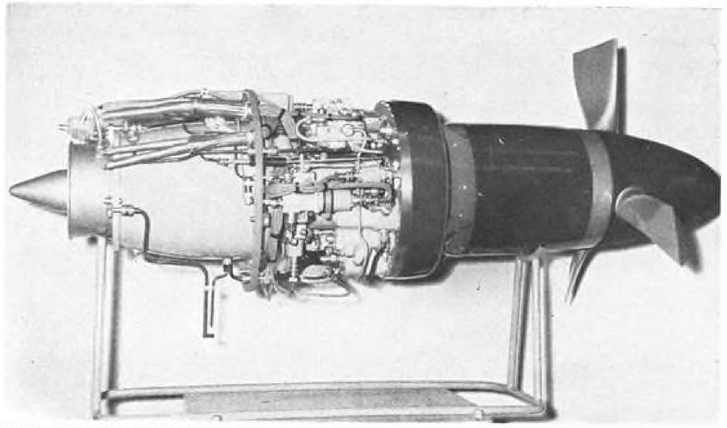
Turbomeca Planning Lightplane Turbine

By Warren C. Wetmore

Bordes, France—Oredon 3, newest and smallest of the Turbomeca gas turbines, is scheduled to be built in prototype form next year. Turboprop version of the engine, rated at 318 eshp., is aimed at the lightplane market, while the 300-shp. turboshaft variant is designed for small helicopter application.

Unit price for the Oredon 3 in mass-production is expected to be in the vicinity of $6,000—which would place it in a competitive position with comparable reciprocating engines. Production is slated to begin in 1965.

Estimated specific fuel consumption for the turboprop Oredon 3 is 0.520 lb./eshp./hr. at maximum takeoff power and 0.545 lb./shp./hr. for the turboshaft engine. Takeoff and sea-level maximum continuous ratings are identical, while the turboprop version will develop 204 eshp. at an altitude of 19,600 ft. and a speed of 310 mph. Specific fuel consumption corresponding to these conditions is 0.495 lb./eshp./hr.



NEW OREDON 3 ENGINE, shown in turboprop version, is Turbomeca's smallest gas turbine, with a takeoff power rating of 318 eshp. The engine is designed for application to lightplanes and small helicopters, according to the company.

Design Features

Oredon 3 is basically a scaled-down Astazou 2 and employs many of the tested design features of that engine, according to the company.

Compressor consists of two axial-flow stages between which are mounted two sets of vane-type flow straighteners, followed by a single centrifugal-flow stage. Theoretical pressure ratio is 7.5 at maximum shaft speed of 60,000 rpm.

Diffuser aft of the compressor is made up of a radial and an axial section which distributes air to the direct-flow annular combustion chamber. Fuel is injected radially from a centrifugal distributor located in the hollow shaft connecting the compressor and turbine shafts—a standard Turbomeca technique—and ignited by a torch igniter. Entire shaft rotates on four main bearings made up of ball and roller bearings. Three-bladed electric variable-pitch propeller—an optional item—is driven at a nominal 2,500 rpm. by a coaxial propeller reduction gear. Output shaft speed for the turboshaft engine is 6,000 rpm.

Dry weight of the turboprop Oredon 3 with standard equipment is 143 lb., while the turboshaft engine is about 11 lb. lighter. Over-all length of the turboshaft is 3.5 ft. and that of the turboprop is 4.3 ft., including propeller. Both versions have the same maximum diameter of about 1 ft.

Engine power in the turboprop engine is controlled by the propeller pitch control lever, which is operated as a conventional throttle—a forward movement toward high pitch increases power. This is possible through the use of an isochronous governor, which maintains a constant turbine speed by actuating a fuel-metering device downstream from the fuel pump. Turbine rotation speed is determined by the pilot by means of a lever which adjusts the governor balancing spring.

Since the power delivered by the engine at constant turbine rpm. and airspeed is defined by the propeller pitch, a change to higher pitch slows the engine by increasing the resisting torque. The governor responds by automatically augmenting the fuel flow—and therefore the engine power—until the preselected turbine speed is restored.

Propeller pitch limiter is incorporated into the system to keep the engine power within the authorized limits. This device prevents the propeller pitch from exceeding the maximum acceptable value for a given airspeed by lessening the pitch if the airspeed happens to decrease once maximum pitch has been achieved. Conversely, if the propeller is set at the minimum pitch corresponding to the existing airspeed and the airspeed is then increased, the limiter effects an immediate increase in the propeller rpm. to preclude excessive propeller drag or turbine over-speeding.

Turbomeca says that the system's self-stabilizing capability will be particularly useful during final approach. Once the propeller pitch has been set to give the desired approach angle, any change in airspeed will result in an opposite power variation and hence a change in the rate of descent. The pilot is thus able to maintain the proper slope only by adjusting the angle of attack.

Another feature of the power control system is the automatic maximum power mode, which is operated by a pushbutton in the cockpit. Propeller is maintained automatically at maximum pitch corresponding to the actual airspeed, thereby enabling the aircraft to fly at any airspeed with maximum deliverable power. This feature should be most useful during takeoff run, optimum climb-out and aborted approaches. Manual override is accomplished by pulling back the pitch control lever.

Isochronous governor is used to maintain turbine speed at a constant level in the turboshaft Oredon 3.

Time between overhauls (TBO) for both versions of the Oredon 3 has been set tentatively at 750 hr., a figure which Turbomeca hopes to increase after sufficient test hours have been logged.

Other Developments

Latest model of the Artouste 2 turboshaft engine, designated the C3, is rated at 530 shp. at takeoff, yielding a SFC of 0.830 lb./shp./hr.

Total production of all models of the engine to date at the Bordes plant amounts to more than 1,300 units. The majority of these—with the later models derated to 406 shp.—equip the Sud SE 3130 Alouette 2 helicopter, while the remainder are used in industrial power applications.

Artouste 2 gas section consists of a single stage centrifugal-flow compressor giving a compression ratio of 3.88:1 at 34,000 rpm. Radial-axial diffuser precedes the annular combustion chamber, which employs centrifugal fuel injection and torch igniters.

Two-stage axial-flow turbine with integral blades is followed by the exhaust diffuser. Shaft has two ball-and-roller bearings. Reduction gear at the forward end of the shaft reduces the shaft speed to 5,860 rpm.

Fully equipped for the Alouette 2, the engine's dry weight is 315 lb. Over-all length is 4.5 ft., height is 1.8 ft. and width is 1.4 ft.

Time between overhauls for the Artouste 2 C3 is currently 1,000 hr.

Artouste 3B, which powers the Sud SE 3160 Alouette 3 helicopter, differs considerably from the 2C version. Power rating is 586 eshp. for takeoff and maximum continuous power for a SFC of 0.71 lb./eshp./hr. Engine is 6 ft. long over-all, 1.65 ft. wide and 2.05 ft. high.

Differences in the gas section include the following:

- **Axial-flow compression stage** precedes the centrifugal compressor. Two rows of flow straighteners are mounted between the two stages. Compression ratio is 5.2:1 at 33,500 rpm.
- **Third stage** is added to the axial-flow turbine.
- **Shaft has four** ball-and-roller bearings.

Dry weight of the Artouste 3B with standard equipment is 287 lb., and TBO is 750 hr. Approximately 250 of these engines have been produced to date.

More than 150 Astazou 2 engines have been produced in both turboprop and turboshaft versions, which develop a takeoff power of 555 and 546 eshp., respectively.

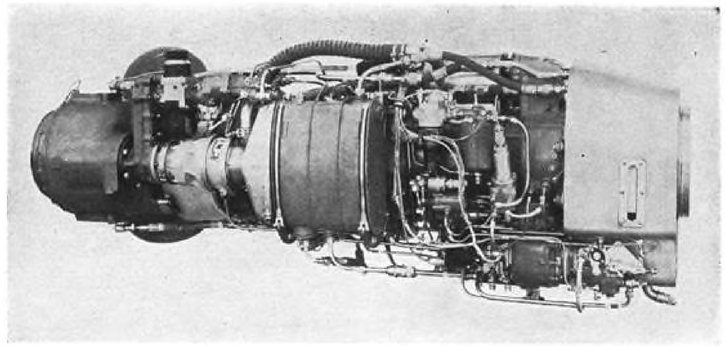
Turboprop Astazou 2 is employed in the Potez 840, the SFERMA Beech Marquis and the Pilatus Turbo-Porter. In addition, the U. S. firm of Riley Aircraft, Inc., is considering establishment of a program for re-engining de Havilland Doves with the Astazou 2 engine.

Sud Alouette 2 has been experimentally retrofitted with a derated turboshaft version of the engine, known as the Astazou 2A, resulting in a reported 40% increase in the range or payload capability due to the improved specific fuel consumption. Turboshaft Astazou 2 is also used in the Italian Agusta Model 115 helicopter.

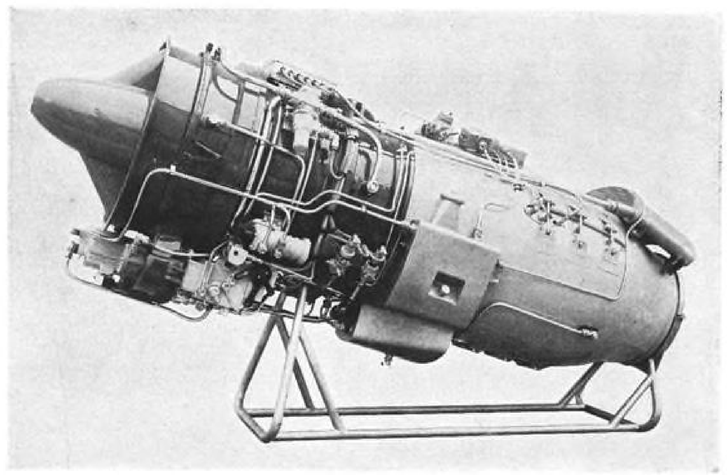
Gas section of the Astazou 2 has essentially the same configuration as the Oredon 3, except that axial flow compressor possesses only one stage and the shaft rotates on three bearings. Compression ratio is 6:1 at maximum speed of 43,500 rpm. This rate is geared down to 6,000 rpm. in the turboshaft engine and to either 2,200, 2,080 or 1,800 rpm. in the turboprop version, depending on the reduction gear used.

Maximum power SFC is 0.586 for the turboprop version and 0.599 for the turboshaft version. Over-all lengths are 6.36 ft. and 4.15 ft., respectively; maximum diameter is 1.5 ft. for both. Turboprop version has a dry weight of 272 lb. with standard equipment, while the comparably-equipped turboshaft version weighs about 2 lb. less.

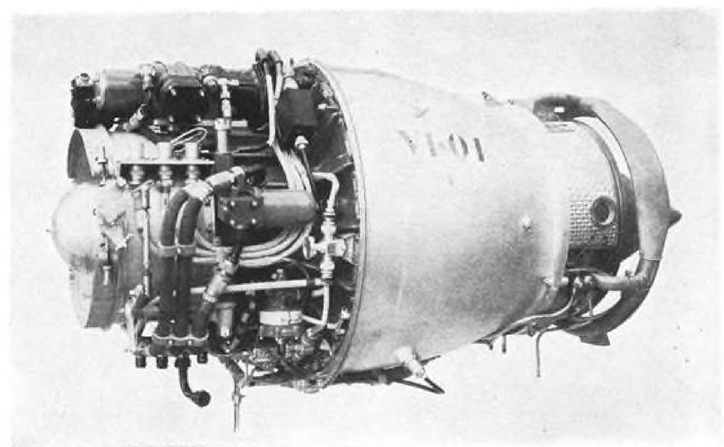
Engine control systems in the two Astazou 2 versions are identical in prin-



TURMO 3C-3, above, is powerplant for Sud's SA 3210 Super Frelon heavy turbine helicopter. Three 3C-3s on Super Frelon are free turbines and produce 1,500 shp. each. Aubisque turbofan engine, center photo, is the most powerful Turbomeca jet engine in production, generating 1,550 lb. thrust at takeoff. Saab 105 trainer and light attack aircraft, which made its maiden flight recently, is equipped with two Aubisque engines. Aubisque's over-all length is 6.6 ft., width is 2.12 ft. and height is 2.45 ft. Engine's provisional time between overhaul is currently 750 hr.



MARBORE 6 TURBOJET, below, shown in first production model, is designed to be interchangeable with the Marbore 2 and will eventually replace it on the Turbomeca production line. Thrust of the Marbore 6 is 1,060 lb. at takeoff. Marbore 6 is now flying in the Morane-Saulnier Paris 2 and Potez-Heinkel CM.191.



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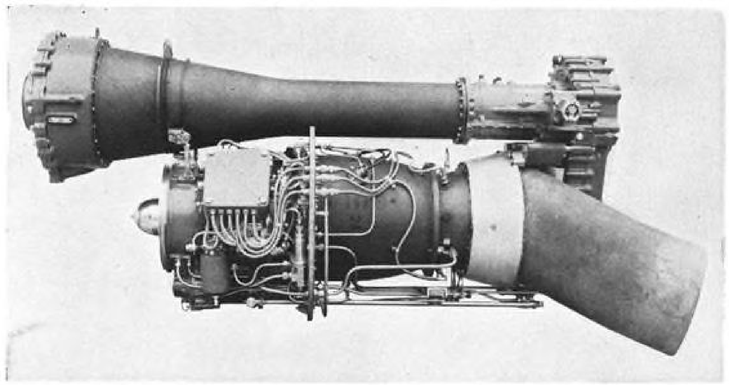
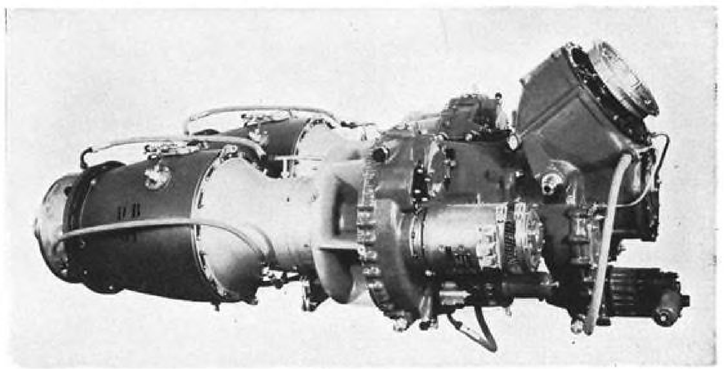


TURMO 3D-3 1,500-shp. turboprop engine, above, is based on the 3C-3. The 3D-3 will be used in the production versions of the Breguet 941/942 STOL transports. Bi-Bastan turboshaft engine, below, is composed of two Bastan 6s coupled through common reduction gear. It develops 1,500 hp. at takeoff and has been flown in Sud-built Sikorsky S-58 helicopter, giving substantial performance increase.



ciple to those in their respective Oredon 3 counterparts.

Turbomeca is presently developing the Astazou 10, an improvement on the Astazou 2 embodying a second stage in the axial flow compressor. Compression ratio is 7.5:1 at 43,000 rpm.

Astazou 10 will develop 666 eshp. at takeoff while consuming fuel at the rate of 0.510 lb./eshp./hr. Dimensions are the same as in the Astazou 2, and dry weight with standard equipment is 281 lb.

Astazou 10 is under consideration as a replacement for the Astazou 2s used in the Potez 840, Turbomeca said.

Further evolution of the Astazou 10 is being studied. Desired performance for this engine includes a 715 eshp. takeoff rating and an SFC of less than 0.514 lb./eshp./hr. TBO of the Astazou 10 is 750 hr., compared with 500 hr. for the Astazou 2.

Bastan 4 turboprop engine, which powers the Nord 260 Super Broussard light transport, has been phased out after a production run of approximately 100 engines.

Its successor, the Bastan 6, is the powerplant for the Nord 262 pressurized Super Broussard. Latest and most powerful models of the Bastan 6, the A2 and B2—which differ only in the propeller reduction gear ratios of approximately 18.5 and 21.1, respectively—deliver a takeoff power of 1,080 eshp. Corresponding SFC is 0.58 lb./eshp./hr.

Compressor for the Bastan 6 has an axial-flow first stage and a centrifugal-flow second stage with two rows of flow-straightening vanes between them. Compression ratio at 33,500 rpm. is 5.5:1.

Radial-axial diffuser precedes the annular combustion chamber using torch igniters and centrifugal fuel injection. Provision has been made for the installation of a water-methanol injection system.

Three-stage axial flow turbine is followed by a welded sheetmetal exhaust diffuser. Turbine blades are machined intergrally with their discs. Reduction gear output shaft speed is 1,811 rpm. in the A2 and 1,588 rpm. in the B2 version.

Ready-to-fly dry weight of the Bastan 6 is 860 lb., including the three-bladed Ratier-Figeac propeller. Enclosed in its nacelle, the engine measures 2.32 ft. in height and 2.25 ft. in width. Over-all length from the tip of the propeller hub to the exhaust plane is 5.95 ft.

Controls for the Bastan 6 consist of two levers. For takeoff, the turbine speed lever—which maintains the desired rpm. by adjusting the propeller pitch—is set at maximum and the power lever is advanced to its takeoff stop. The latter governs fuel flow as a function of the pressure and temperature variations at the air intake.

During maximum continuous power and cruise regimes the turbine speed lever is set at maximum rpm. The power lever is positioned to obtain the desired fuel flow, which is read from a manometer measuring the pressure differential across the compressor and calibrated in fuel-flow units.

Time between overhauls for the Bastan 6 is anticipated to increase from the present 750 hr. to 1,000 hr.

Bi-Bastan turboshaft engine consists of two Bastan 6 engines mounted in parallel and coupled by means of a common reduction gear. Output shaft of this gear, which turns at 2,710 rpm., is canted at an angle of 30 deg. 46 min. to the plane defined by the axes of the two engines.

Power of the Bi-Bastan—which theoretically could be as high as 1,860 shp.—has been limited to 1,500 shp. to permit flight with one of the component engines out. SFC is 0.875 lb./shp./hr.

Two engines have separate fuel systems and are mechanically isolated from each other by a free-wheel located between the engine reduction gear and the common reduction gear. Thus, if one engine or one engine reduction gear fails the other will continue to operate at its maximum continuous power.

Output shaft speed is held constant by means of an isochronous speed governor in conjunction with a double fuel-metering device.

Fully-equipped dry weight of the dual engine is 1,065 lb. Over-all length is 6.5 ft. and width is 3.48 ft.

Sud Aviation has re-engined a Sikorsky S-58 helicopter with the Bi-Bastan, a modification which required only a 2.2-ft. lengthening of the engine compartment in the nose.

Though the new engine is 25 hp. lower in power than the original Wright reciprocating engine, the helicopter's maximum speed has been increased 7 mph. to 130 and the service ceiling raised to 11,500 ft., a gain of 2,000 ft.

Major gains were realized in hovering capability. Hovering ceiling in ground effect was increased to 11,150 ft. in comparison to 4,900 ft. and hovering ceiling out of ground effect rose by 2,500 ft. to the new figure of 4,900 ft. Still-air range was increased from 182 mi. to 248 mi.

Another addition to the Bastan family, the turboshaft Bastan 7, is now being developed. Designed to develop 1,300 shp. at takeoff, the engine is slated to power the Sud SA 330 assault helicopter (AW July 29, p. 46).

Most powerful of Turbomeca's turboshaft and turboprop engines is the free-turbine Turmo series, of which two models are ready for production:

• **Turmo 3C-3 turboshaft engine** is designed to power the Sud SA 3210 Super Frelon helicopter. Takeoff power rating is 1,480 shp. for a SFC of 0.596 lb./shp./hr.

• **Turmo 3D-3 turboprop engine** is derived from the 3C-3 and has the same power and fuel consumption figures. Production models of the Breguet 941 and 942 four-engine STOL transports will be equipped with this engine.

Production of the two engines hinges on orders for the Super Frelon and Breguet 941/942. Turbomeca now feels that, for budgetary reasons, the orders for the aircraft—and hence for the engines—will be smaller than originally anticipated.

Gas generator is identical for both engines and comprises a two-stage axial-flow centrifugal-flow compressor giving a 5.5:1 compression ratio, and annular combustion chamber with centrifugal fuel injection and a two-stage axial-flow turbine with integral blading. Turbine speed at takeoff is 33,700 rpm.

Exhaust gases turn a two-stage free turbine at a nominal speed of 19,000 rpm., which is geared down to a 5,700 rpm. output shaft speed in the 3C-3. For a description of the 3D-3 power transmission train, see AVIATION WEEK & SPACE TECHNOLOGY, July 15, p. 73.

Dry weight of the Turmo 3C-3 with standard equipment is 484 lb. Over-all length is 6.5 ft., width is 2.25 ft. and height is 2.38 ft.

Dimensions of the Turmo 3D-3 include an over-all length (less propeller reduction gear and propeller) of 6.33 ft., a width of 3.69 ft. and a height of 3.05 ft. Dry weight including tail pipes is 694 lb.

TBO for the 3C-3 is 1,000 hr., compared with 750 hr. for the newer 3D-3.

Turbomeca's entry in the small turbofan engine arena is the Aubisque, which, with a takeoff thrust of 1,550 lb., is the company's most powerful jet engine now in production. Maximum thrust SFC is 0.600 lb./lb. thrust/hr. Two Aubisques power the Saab 105 trainer and light attack aircraft, which made its maiden flight recently. Engine has prompted considerable interest within the airframe industry, one company official said. Queries have also been received concerning the feasibility of conversion of present aircraft to the Aubisque. Aubisque has a de-iced air intake and de-iced variable incidence guide vanes. Single-stage axial-flow fan—which is also the first compressor stage—is driven at a lower speed than the turbine shaft by means of a coaxial reduction gear.

Two flow straightener grids precede the separator casing, which divides the airflow from the fan into the hot and cold flows. The latter passes through the annular by-pass duct surrounding the hot section. Second stage axial-flow compressor is located at the inlet of the low-flow section preceding two rows of vane diffusers.

Third compressor stage is a centrifugal-flow type, and is followed by the radial-axial diffuser. Compression ratio across the three stages is 6.9:1 at 32,500 rpm.

Fuel is injected centrifugally into the annular combustion chamber and ignited by means of two torch igniters energized by a double ignition coil.

Aubisque turbine consists of two axial-flow stages with attached blades. Exhaust diffuser also serves as the tailpipe for the hot flow. Cold-flow tailpipe is separate; at the exhaust plane the two flows are unmixed.

Standard equipment for the Aubisque includes separate oil pumps for normal and inverted flight, as well as the usual fuel and starting system. Dry weight of the engine thus equipped is 510 lb. Over-all length is 6.6 ft., width is 2.12 ft. and height is 2.45 ft.

Provisional TBO for the Aubisque has been set at 750 hr.

Perennial best seller among the Turbomeca engines is the Marbore 2 turbojet, which is rated at 880-lb. thrust. More than 3,500 units have been produced at the Bordes plant for installation in the Fouga CM.170 Magister air force trainer and the CM.175 Zephyr naval trainer, the Morane-Saulnier Paris and the Nord CT.20 target drone.

Variant of this engine, the Marbore 4, is manufactured under license in the U.S. by Continental and bears the designation J69. Cessna T-37 trainer and the Ryan Firebee target drone are equipped with the J69.

Marbore 2 has a SFC of 1.15 lb./lb. thrust/hr. at maximum thrust.

Engine's gas section employs a single stage centrifugal flow compressor giving a compression ratio of 3.9:1 at 22,600 rpm. This is followed by the unusual radial-axial diffuser, annular combustion chamber with centrifugal fuel injection, and a single-stage axial-flow turbine with integral blades. Exhaust diffuser has cone and a flange for mounting the tail pipe.

Dry weight of the Marbore 2 with standard equipment is 310 lb. Engine is 5.15 ft. long over-all and 1.87 ft. in diameter. TBO is presently 400 hr.

Marbore 2 is scheduled to be phased out of production in favor of the more powerful Marbore 6, although Turbomeca says that a substantial backlog of Marbore 2 orders still exists.

Marbore 6 generates 1,060 lb. thrust at takeoff for an SFC of 1.11 lb./lb. thrust/hr.

Weight and dimensions are identical to those of the Marbore 2—the engines are meant to be interchangeable—and the gas section is essentially the same, except that detachable blades are used in the turbine.

Morane-Saulnier Paris 2 and the Potez-Heinkel CM.191 are both powered by the Marbore 6, as will be future Fouga Magisters. Company said that there is a possibility that the Magisters now in service will be retrofitted with the engine. About 100 Marbore 6s have been built.

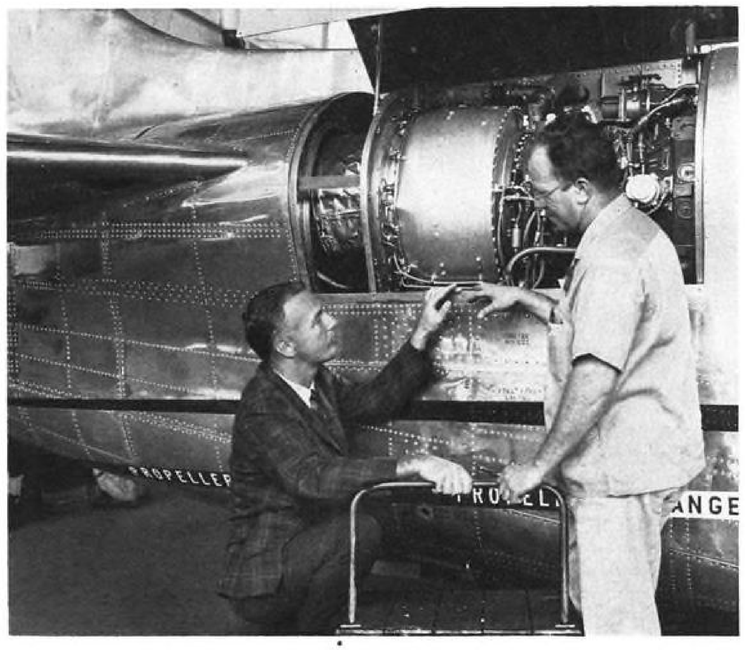
Turbomeca's present monthly production rate is 70 to 90 engines. Breakdown of the figure can vary considerably, but on the average Marbore 2 and 6 turbojets account for approximately 45, with the balance being divided among the remaining engines.

CH-113 Undergoes Sea Tests

Boeing Vertol CH-113 helicopter produced for the Royal Canadian Air Force is shown floating off Cape May, N. J., during recent water handling and stability evaluation tests. Tests were conducted in Sea State Three conditions in 3- to 5-ft. waves. Tests included a 360 deg. turn, taxiing into and out of the wave pattern and floating parallel to the wave pattern. CH-113 has been selected by RCAF for search and rescue operations.

Curtiss-Wright X-19 VTOL is beginning ground engine runs and taxi tests prior to the first flight scheduled for October. The research vehicle was rolled out recently (AW July 29, p. 25) at the company's Caldwell, N. J. facility.

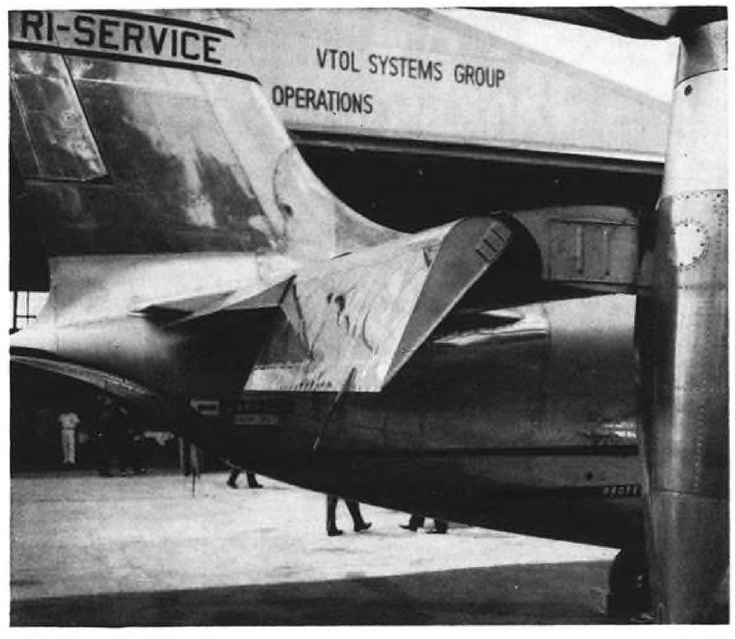
Curtiss-Wright X-19 VTOL Research Vehicle



X-19 is powered by two Lycoming T55 turboshaft engines mounted side-by-side in the upper rear fuselage. Engines are cross-geared to all four tilting glass-fiber propellers, and the X-19 is designed to be capable of achieving maximum performance on one engine. The cockpit of the X-19 has two-place, side-by-side seating with conventional airplane controls in the left seat and helicopter controls in the right seat. "Collective" control actually is a throttle to control engine thrust output. Pitch, roll and yaw are controlled by differential thrust from the four propellers.

Short-span wings, located fore and aft of the X-19's center of gravity, provide lift during high-speed flight. Lift in hover is provided by propeller thrust alone and during transition lift is provided by a combination of wing, propeller and radial propeller force.

Begins Ground Tests Prior to First Flight in Fall



Flaps are linked mechanically to the propeller tilt pods, and there is no independent flap control. Rear wing flaps are half-span, with ailerons inboard. Speed range will vary from hover to 400 kt. (460 mph.) (AW Aug. 6, 1962, p. 64). Flight tests are scheduled to move to Edwards AFB, Calif., in August, 1964, and be completed a year later.

Syncom 2 Succeeds in Early Experiments

By George Alexander

Cape Canaveral—Syncom 2 was slowly drifting into position over Brazil late last week as the National Aeronautics and Space Administration planned to halt its drift rate within the next 10-14 days and thus make it the first satellite to achieve synchronous orbit around the earth.

Syncom 2, developed for NASA's Goddard Space Flight Center by Hughes Aircraft Co. (AW Dec. 12, 1960, p. 52), appeared to be a major success for the U. S. space program. It returned "excellent quality" voice, teletype, music, facsimile and test-tone transmissions between a ship stationed on the west coast of Africa and land stations in Lakehurst and Ft. Dix, N. J. These stations are operated for NASA by the U. S. Army Satellite Communications (SATCOM) agency.

First Experiment

First communications experiment with Syncom 2 was successfully attempted July 26, the day of its launch, as the satellite flew upward on its long transfer ellipse to a circular and synchronous orbit. Subsequent experiments, which included two-way telephone conversations and a tape recording of the Star Spangled Banner, were conducted immediately after achievement of a circular orbit (about 6 hr. after launch) and at approximate 12-hr. intervals thereafter.

The only anomaly discovered by early last week was a below-normal operating temperature of 45F within the spacecraft. NASA and Hughes engineers had expected a range of 50-55F. Since the hydrogen peroxide in one of the satellite's two attitude and velocity control systems is less efficient at this lower temperature, the civilian space agency was considering changing Syncom's orientation to bring it more directly into the sunlight and thus raise its internal temperature. This reorientation, besides heating the peroxide, also would provide a better charge on the solar cells around the cylindrical walls of the spacecraft.

The active-repeater communications satellite was launched from here at 9:33 a.m. (EST) July 26 after three postponements earlier in the week (AW July 29, p. 27). The three-stage Delta launch vehicle, built by Douglas Aircraft Co., successfully orbited its 19th payload in 20 attempts; it missed its planned liftoff time by only 0.3 sec.

The first stage, a modified USAF Thor IRBM, developed about 170,000 lb. thrust and burned for 146 sec. The second stage, powered by an Aerojet-General liquid-propellant engine of 7,500 lb. thrust, separated and ignited about 4 sec. later, burning for about 166 sec. to about T + 316 sec. The fairing around the Syncom 2 payload was jettisoned at T + 180 sec., or about 30 sec. after second-stage ignition.

A 40-sec. coast period followed burnout of the second stage, during which time the Bell Telephone Laboratories radio-command guidance system made steering corrections. The Delta is guided by a Thor autopilot during first-stage burning.

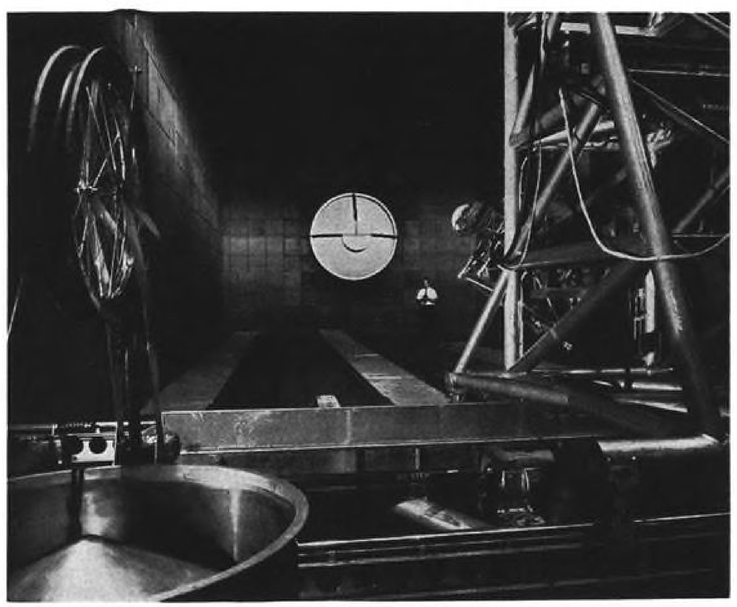
At T + 356 sec., small stabilizing spin rockets were fired to impart a spin of 150 rpm. to the third stage and the payload. Two seconds later, the exhausted second stage was dropped. The third stage, an Allegany Ballistic Laboratories solid-propellant motor, was fired at T + 372 sec. and burned for 40 sec., injecting Syncom 2 into a highly elliptical earth orbit with a perigee of about 140 mi.

The flight plan called for Syncom 2 to fly approximately half of this elliptical transfer orbit, transferring to a circular orbit at the apogee point. During Syncom 2's climb out to apogee (a 5 hr. 20 min. leg in the flight), the third stage was jettisoned at 9:42 a.m. (EST), and the tracking transponder turned on at 10:01 a.m. The transponder signals were fed into Goddard's computers at the center's Greenbelt, Md., facility, and computations were made on the optimum altitude for firing of the apogee "kick" motor, contained within the center of the spacecraft.

Apogee Motor

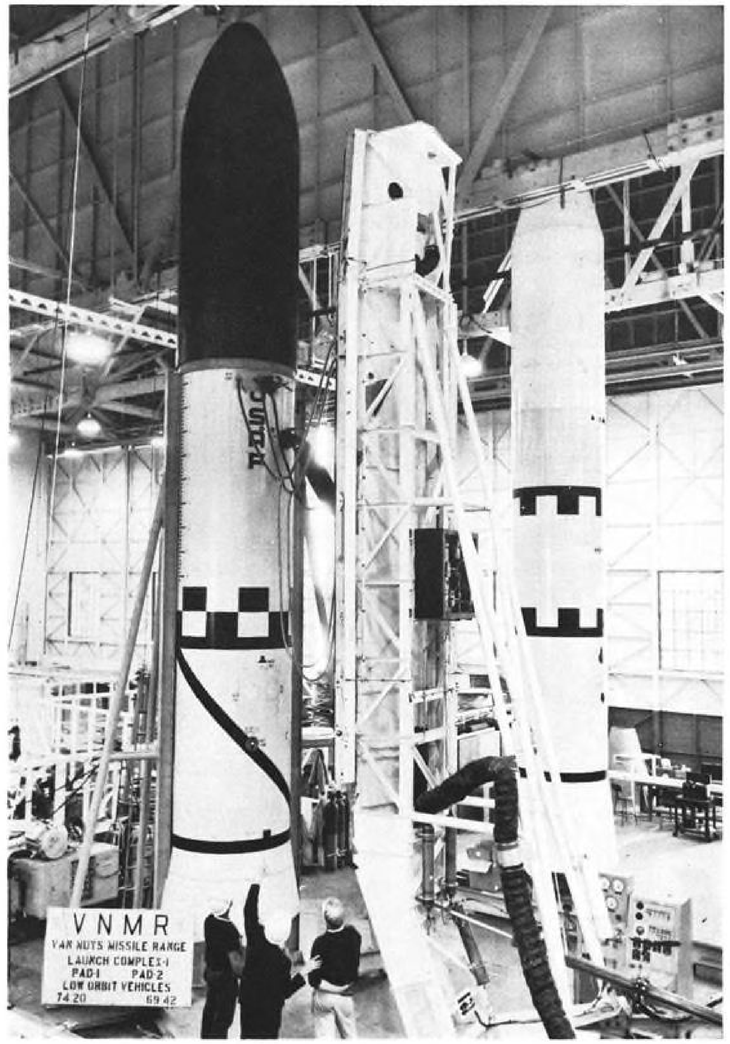
The Jet Propulsion Laboratory-developed solid-propellant apogee motor, developing nearly 1,000 lb. thrust, was fired at 3:06 p.m. by a preset timer nearly 6 hr. after launch. It placed Syncom 2 in a slightly eccentric circular orbit. The perigee, at 21,280 mi., was slightly lower than the planned 21,500 mi. Injection velocity was about 80 fps. higher than ideal figure of 10,087 fps.

The apogee, at 22,760 mi., also was lower than the planned 22,950 mi., and



Rendezvous Radar Used in Simulator Study

Prototype space rendezvous radar developed by Raytheon Space and Information Systems Div. installed in the Martin Co. rendezvous closure and docking simulator. Full-scale space flight simulator is being used to test and evaluate the phase-modulated, solid-state CW radar planned for use on advanced spacecraft systems.



Simulators Aid Launch Problem Study

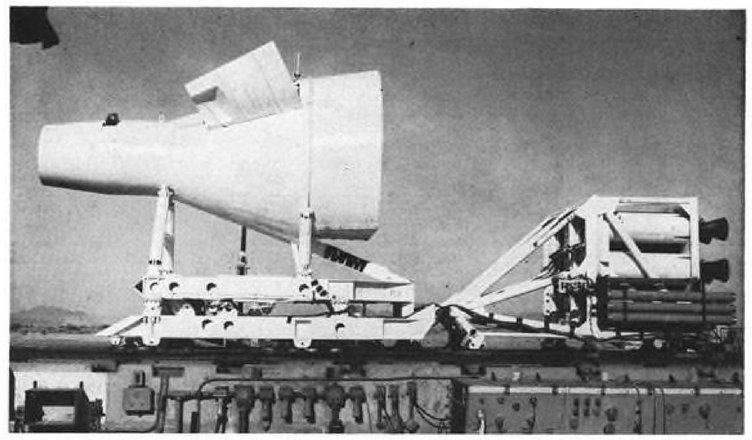
Intensive study and testing of typical launch problems is carried out on these simulators at Van Nuys Automatic Ground Equipment Facility, Lockheed Missiles and Space Co. Simulator at left has "boom" type mast similar to those found at Atlantic Missile Range and Point Arguello. Vehicle has vertical rise of 12 ft. at launch velocities and boom has a retract capability of about 8 ft. Nose cone configuration (black) is probably a recoverable re-entry type launched by an Atlas/Agena. Background simulator mast duplicates configurations at Vandenberg AFB, with vehicle vertical rise of 12 ft. and flag retraction of 30 deg. This Agena configuration probably would be boosted by a Thor.

the period, at 23 hr. 28 min., was less by 28 min. than planned. All actual parameters, however, were well within the spacecraft's corrective capability, NASA said.

Although true orbital circularity was and is regarded as optional, these initial orbital parameters and the consequent difference in relative velocities between the satellite and the rotating earth caused Syncom 2 to lead the earth by about 7.5 deg. per day in an eastward direction.

In order to take up a position over 55 deg. west longitude (approximately over Brazil), roughly 100 deg. from its circular orbital injection point over the Mozambique Channel off the east coast of Africa, Syncom 2 was to have drifted westward at a rate of 5-7.5 deg. daily.

The USNS Kingsport, in the Lagos



Gemini Ejection Test Successful

First test of Gemini seat ejection system (AW Apr. 29, p. 65) during a simulated boost phase of flight has been successfully completed with boilerplate hardware at Naval Ordnance Test Station, China Lake, Calif. The spacecraft, with hatches locked open, was mounted on a high-speed rocket sled and reached a speed of approximately 600 mph., providing a dynamic pressure of about 875 psf. The escape system is being developed by Weber Aircraft Corp., Burbank, Calif.

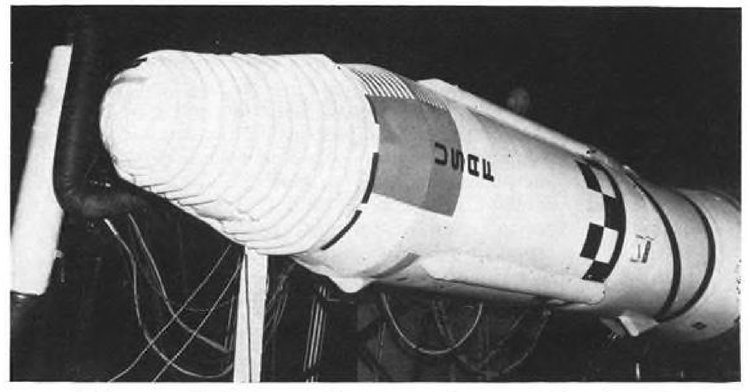
harbor of Nigeria, commanded firing of the hydrogen peroxide jet parallel to Syncom 2's spin axis on Saturday afternoon, July 27. The thrust vector of this little jet has the same direction as that of the apogee motor and caused the satellite to accelerate and go into a higher orbit. About 110 fps. of the peroxide sphere's total 299 fps. capability was expended to move Syncom 2 into an orbit with a perigee of 22,110 mi. and an apogee of 22,800 mi.

At this altitude, the relative difference between satellite and earth velocities was such that Syncom 2 now lagged the earth by about 4.5 deg. daily, and so began drifting westward.

Presently over about 10 deg. west longitude, it would take about another 10 days before the satellite finally arrives over 55 deg. west longitude. NASA could, however, fire the peroxide thruster again and increase the westerly drift to reduce this time still further.

When Syncom 2 is over the desired longitude, the peroxide thruster will be fired again to null out this drift rate. About 47-51 fps. will be required to halt the drift. At this time, the satellite's rotation should be synchronized with a point on earth. However, because Syncom 2's orbital plane is inclined approximately 30 deg. to the equator, a trace of the satellite's orbital plot would resemble a Figure 8, moving from 30 deg. north to 30 deg. south latitude.

At the same time, two compressed-



Thermal Paints Protect Agena Payload

Mosaic of thermal paints that maintain proper temperatures within satellite during its ascent through atmosphere and subsequent orbit is visible below thermal blanket used during countdown on this Lockheed Agena satellite.

nitrogen gas jets will be activated to tip the satellite 90 deg. so that Syncom 2's spin axis will be perpendicular with its orbital plane. With this orientation, the satellite's transmitting omnidirectional antenna—which lies in the plane of the spin axis—will always point toward earth.

Satellite-to-ground transmissions will be on frequency of 1,814-1,816 mc. and from ground-to-satellite at 7,316-7,360 mc. The tracking beacon operates at 1,820 mc. Gain of the coaxial slotted array antenna is 5.5 db., and the radiated beam is pancake-shaped. Beam covers roughly 120 deg. of the earth.

The 28-in.-dia., 15.5-in.-tall drum-shaped satellite was slightly modified from its sister version launched from here last Feb. 14 (AW Feb. 18, p. 34). Modifications (AW June 10, p. 115) included: rewiring of the electrical harness to provide additional paths for critical command and power circuits; addition of a small silver-zinc emergency battery for the telemetry transmitter and a backup beacon; addition of an accelerometer to measure g-loads during firing of the apogee motor; substitution of the JPL apogee motor for the Thiokol engine used on the first Syncom, and reduction of pressure in the sphere of gaseous nitrogen used for orientation control.

Tests conducted by Hughes after the failure of the first Syncom led the company to believe that the spherical titanium tank containing nitrogen under 3,600 psi. disintegrated under the acceleration of the 900-lb.-thrust apogee motor. Pressure, therefore, in the Syncom 2 nitrogen sphere was reduced from 3,600 psi. to 2,500 psi.

"The net result," according to Alton E. Jones, Syncom project manager for Goddard, "has been effectively to increase the gage of the sphere's skin thickness" and thus make it less vulnerable to acceleration loads.

These changes added about 4 lb. to Syncom 2's weight compared with Syncom 1. However, substitution of the JPL motor for the Thiokol engine provided a 7-lb. weight saving over the latter. Including the weight of the apogee motor's propellant, Syncom 2 weighed 147 lb.; Syncom 1 weighed 150 lb. After firing of the motor, Syncom 2 and its now-empty motor case weighed 90 lb.; Syncom 1 weighed 86 lb.

Like its predecessor, Syncom 2's cylindrical sides were covered with 3,840 silicon solar cells, which provided electrical power to the satellite's main nickel-cadmium batteries.

Syncom's antennas include a slotted-array for transmitting, a dipole for receiving and four turnstiles clustered around the nozzle of the apogee motor, for telemetry and command.

Liquid Hydrogen Test Facility Bids Requested

Huntsville, Ala.—National Aeronautics and Space Administration has requested bids on the construction of a liquid hydrogen test facility at the Marshall Space Flight Center here.

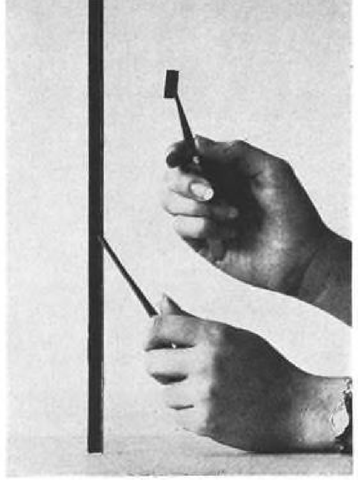
The proposed facility, which will include test stand and support equipment, will be used for static testing the Rocketdyne J-2 rocket engine and a non-flight version of the Saturn S-4B stage, employing one J-2 engine.

Project has been set aside for award to a small business, according to the Mobile District, Army Corps of Engineers, construction agent for the job.

Single-position test stand will consist of a braced steel superstructure 34 x 68 ft., with the highest portion about 156 ft. high. Support will be a rigid concrete mat resting on firm soil.

Stand will have a flame deflector with a water deluge system, a rolling steel deck with two roll-up doors, and two stiff-leg derricks, one 50 ton and one 75 ton.

New facility will be operated in conjunction with blockhouse facilities being constructed under a $599,294 contract awarded by the Marshall center last October.



Long Solar Cell

Elongated silicon solar cell (left), 15 times the size of conventional 1 x 2 cm. cell (right), is being produced by Westinghouse Electric using company-developed dendritic growth process. Cell is formed by growing two small dendritic crystals simultaneously. As they emerge, thin web forms between the two which becomes flat surface of solar cell. Company has delivered panels of 12-in. long solar cells to USAF's Aeronautical Systems Div. for testing.

S-66 to Measure Electron Density Profile

Ionospheric beacon satellite designated S-66 by National Aeronautics and Space Administration will be launched into a circular near-polar orbit from Pt. Arguello, Calif., aboard a Scout launch vehicle no sooner than Aug. 15.

The satellite's orbit will be inclined 80 deg. with the equator at an altitude of about 600 mi., with a period of approximately 105 min., permitting the S-66 to view each area of the earth's ionosphere every 24 hr.

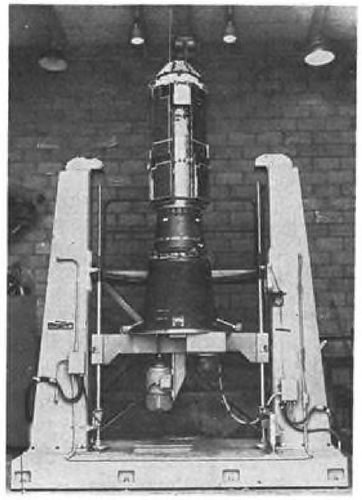
Adapted from Transit

The S-66 was designed and built for NASA by the Applied Physics Laboratory of Johns Hopkins University. It is adapted from the Navy's navigational satellite, Transit, also engineered by the Applied Physics Laboratory of Johns Hopkins.

Objectives of the experiment are to measure the total number of electrons between the satellite and earth as related to latitude, season and diurnal time. Vertical profiles of electron density and small-scale irregularities in the ionosphere and their geometry will also be obtained. Other objectives will be to study bulk behavior of the ionosphere as it varies in space and time with incoming solar ultraviolet and X-ray radiation.

In addition, personnel at Wallops Station, Va., will try to illuminate 360 one-inch fused silica prisms attached to the octagonal-shaped satellite by reflecting a laser beam mounted on a tracking telescope off the array of prisms. The reflected laser beam will return to the telescope to be amplified by a photo multiplier tube. A digital counter will record the total time the light took to reach the satellite and return to the ground. Precise position of the satellite can be obtained from this information by a combination of elapsed time of laser beam and azimuth/elevation angles.

This will be the first time a laser experiment has been conducted with a satellite, but NASA scientists say chances of success are marginal for this experiment.



UNDERGOING SPIN TEST at Pacific Missile Range, ionospheric beacon satellite will measure electron density variations from polar orbit.

Ruby Laser

Goddard Space Flight Center will use a 6-in. synthetic ruby rod laser system fabricated by General Electric's Missile and Space Div., Valley Forge, Pa. The ruby rod becomes highly energized by energy it receives from a xenon gas-filled flash-lamp mounted closely parallel to it in a special barrel-like metal housing.

Both ends of the ruby rod are polished and act like mirrors. The green light from the flash-lamp excites chromium atoms within the rod which re-emits red light. A fraction of a millionth of a second later, the laser beam passes through the end of the rod which has been made more transparent than the other.

The S-66 weighs about 120 lb. Its shell is made of honeycomb nylon and glass fiber. It is 18 in. in diameter by 12 in. high. Satellite spin is decreased from 40 to 4 rpm. by changing the spin axis moment of inertia. This is done by erection of four blades held in place by de-spin assembly cables that are timed to release 7 min. after motor burnout and injection of the satellite into orbit.

Electron Probe

The ionospheric beacon satellite is equipped with an electron probe extending from top to bottom of the shell.

Two 5-ft. whip antennas and two dipole antennas for the transmitter extend from the ends of opposite blades and another whip antenna for the S-66 command receiver projects from the bottom of the satellite.

Electron density measurements will be made using the Doppler shift and Faraday rotation methods. The Doppler shift in signal frequency sent out by the satellite varies with the satellite's velocity and electron density through which the signal passes.

As the ionospheric beacon satellite moves toward the ground station, the signal frequencies it sends out are slightly higher than the transmitted signal frequencies.

The opposite effect occurs as the satellite moves away from the ground station.

By comparing Doppler shifts at several frequencies, it will be possible to determine total electron content and densities.

Faraday Rotation

The Faraday rotation technique depends upon measuring the number of times the polarization plane of radio waves from the S-66 are rotated as they pass from the satellite to earth. The number of rotations are measured at several frequencies from which electron densities are calculated.

A worldwide group of 40 U.S. and foreign scientists have volunteered to read out data sent by the satellite's radio beacon, making possible a global survey of the earth's ionosphere. A global survey of this kind would result in information necessary to predict communication blackouts from geomagnetic storms and radio frequency variations caused by changes in the ionospheric layers.

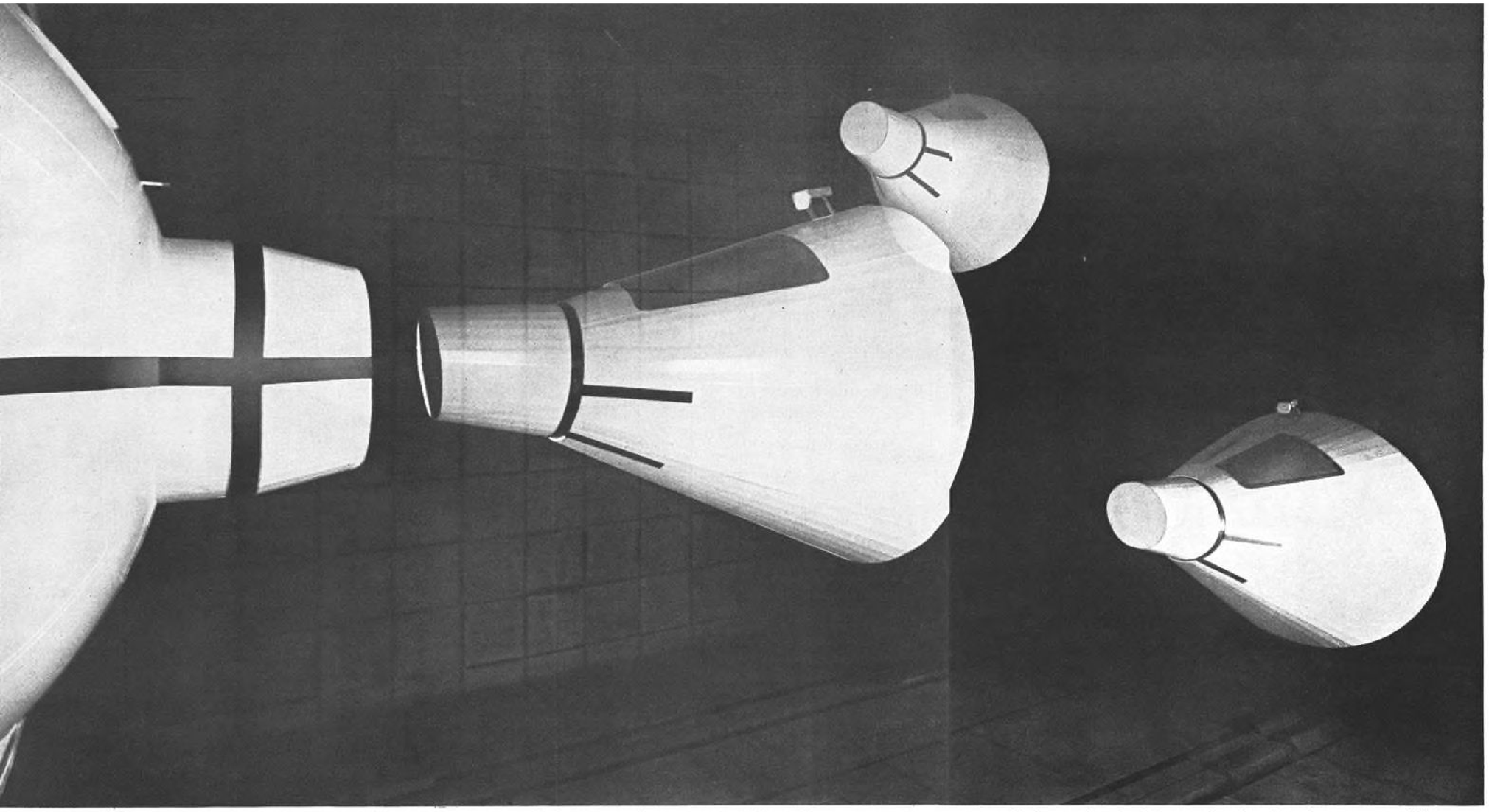
MANNED RENDEZVOUS:

New Rendezvous Laboratory at Martin investigates closure and docking techniques

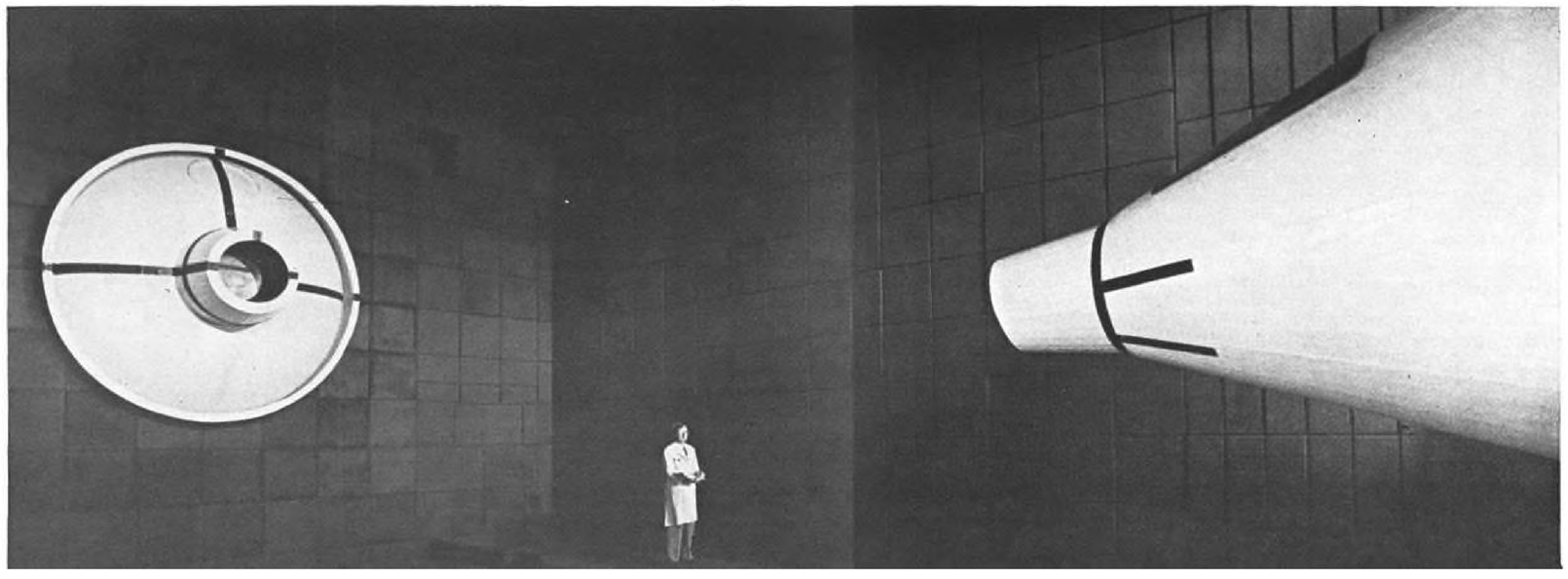
Rendezvous of orbiting spacecraft is an indispensable technique in future space planning. It is a science of precision without precedent, dependent largely on booster accuracy and extremely sophisticated closing and docking techniques.

To enhance the nation's capabilities in this vital science, Martin has built a unique Rendezvous, Closure and Docking Laboratory. It simulates for technicians and astronauts all the sensor and control problems of orbital rendezvous, and it utilizes full-scale hardware. It simulates both manual and automatic closure from 100 miles out to lock-on.

This Martin facility will speed the nation's development of rendezvous techniques for manned space systems. At Martin, systems management means the best possible product, in the shortest possible time, at the lowest possible cost.



Triple exposure photograph in new Martin Rendezvous Laboratory shows spacecraft making approach and closure for docking under simulated space conditions.



New 100-foot-long laboratory simulates complete closing and docking for both manned and unmanned missions. Visual and television surveillance can be used during manual operation, radar and laser sensors in fully automatic exercises.

A bank of analog computers supplies effects of space to the mobile module. All room walls are anechoic to free sensors of interfering noise.

MARTIN MARTIN MARIETTA

Centaur Flight Stage Readied for Delivery

Centaur flight stage for the next Atlas-Centaur test flight will be delivered to Cape Canaveral this month, as called for in the revised schedule established last March.

The test launch of the Atlas-Centaur has been scheduled for the end of September.

The Atlas booster for the flight test was delivered to the Cape earlier this month and has been erected on launch pad 36.

The new Centaur flight configuration incorporates significant design changes, including modifications to the tanks, external insulation and the mode of separation from Atlas. Shaped charges, combined with retrorockets on the Atlas, are expected to give a cleaner separation than would have been possible with the latches specified earlier, according to G. L. Hansen, vice president and Centaur program director for General Dynamics/Astronautics.

Previous Flight

In its only previous flight test in May, 1962, the liquid hydrogen-oxygen-fueled Centaur stage exploded (AW May 28, 1962, p. 33). Hansen said however that the main technical problems of the next Centaur flight have been solved.

GD/A is developing the Atlas-Centaur vehicle for the National Aeronautics and Space Administration, under supervision of NASA's Lewis Research Center, Cleveland, Ohio. Primary mission now set for Atlas-Centaur is launching of the Surveyor soft-landing lunar probe. This mission initially calls for only a single Centaur burn, but later versions of the Centaur stage are expected to be of the two-burn configuration.

Originally, Centaur was programed for a three-burn flight mission, but a change in the mission has permitted design simplification.

Tests Ended

The test program on an Atlas-Centaur flight configuration which was used for ground tests only has been completed at the Cape. The Atlas booster from its combination now is at General Dynamics San Diego plant undergoing modification. It will be shipped in a few weeks to NASA's Plum Brook Research Station near Sandusky, Ohio. There it will again be mated with the Centaur test stage for vehicle dynamics testing and familiarization training. The Centaur test stage, which does not incorporate the extensive design changes being made in the flight vehicle, presently is undergoing altitude tests at Lewis.

AFOSR Awards

Air Force Office of Scientific Research recently awarded grants and contracts for more than $3 million to universities and research firms in the United States and Europe.

Grants:

University of British Columbia, Vancouver, Canada—$16,240 for the study of spectral problems for elliptic operators.

Massachusetts Institute of Technology, Cambridge, Mass.—$23,800 to investigate applications of global analysis to modern theoretical physics; $49,192 for the study of algebra, analysis and topology and their applications; $30,000 for research on heat transfer in a plasma.

Yale University, New Haven, Conn.—$163,980 for study of operation of research center for celestial mechanics; $29,598 for research in algebra; $72,000 for research on functional analysis; $58,365 to investigate electron nuclear interactions and related problems.

University of North Carolina, Chapel Hill, N. C.—$9,657 for investigation of bounds for characteristic roots of matrices.

University of Maryland, College Park, Md.—$65,086 for mathematical research in fluid dynamics and applied mathematics; $34,785 for detection and generation of gravity waves.

Rensselaer Polytechnic Institute, Troy, N Y.—$17,069 for the study of mathematical programing.

University of California—$17,265 for investigation of some problems in matrix theory.

University of Minnesota, Minneapolis, Minn.—$23,842 for research on the problems in hydrodynamics and partial differential equations; $97,862 for the study of analysis and stochastic processes; $37,137 for research on categories, rings and complex analysis.

American Mathematical Society, Providence, R. I.—$16,000 for summer seminar in applied mathematics on the topic "Space Mathematics."

William Marsh Rice University, Houston, Tex.—$81,876 for research on analysis and functional analysis; $11,195 to investigate mathematical techniques for electric potential problems.

Harvard College, Cambridge, Mass.—$40,600 for the study of algebraic linear systems; $122,784 for research on classical analysis.

Catholic University, Washington, D. C.—$17,511 to investigate analytical probability theory.

University of Iowa, Iowa City, Iowa—$27,048 for the study of relations between the calculus of variations and boundary problems.

Institute for Advanced Study, Princeton, N. J.—$67,600 for studies in mathematics; $45,000 for research on analysis in the large.

University of Oregon, Eugene, Ore.—$12,092 for research on laplace and generalized laplace operators.

Arizona State University, Tempe, Ariz.—$38,562 for the study of continued fraction and linear operations.

Wheaton College, Norton, Mass.—$2,850 for investigation of probability statistics and mechanics.

University of Sao Paulo, Sao Paulo, Brazil—$36,000 for research on deuteron and proton reactions at 3.5 mev.

Washington University, St Louis, Mo.—$72,050 for low and medium energy nuclear physics research; $42,316 for the study of heavy primary cosmic ray composition.

University of California, Berkeley, Calif.—$143,523 for investigation of time variations of cosmic radiation at high altitudes in the polar regions; $63,000 for research on theoretical physics of elementary particles.

University of Rochester, Rochester, N. Y.—$170,150 for studies of primary cosmic ray interactions and high energy physics; $8,090 for a seminar in unified theory of elementary particles.

Propellants, Propulsion Systems Studied to Boost Apollo Capability

Los Angeles — High-energy propellants and advanced propulsion system designs to extend Apollo spacecraft mission capabilities are being analyzed by North American Aviation's Rocketdyne Div. An 8½-month study is being conducted for National Aeronautics and Space Administration's Manned Spacecraft Center under a $139,000 contract (AW May 27, p. 19).

The investigation is being conducted in two phases, essentially similar except for operational target dates. Initial phase involves propellant combinations and systems which could be operational by 1970—two years after Apollo is scheduled for operation. Second phase involves propellants and advanced system designs which could be operational by 1975.

Under Phase 1, Rocketdyne is conducting a survey of high-energy propellants and will select four of the best candidates for NASA's approval. These will be further evaluated with relation to availability, experience, performance and operational problems. Under Phase 2, six propellants will be selected for further evaluation.

Following the survey in each phase, a detailed analysis will determine the propellant combination best suited for each of the Apollo propulsive systems (for service module, lunar landing, and lunar launch), with reference to reliability, maximum payload gain, vehicle design, and operational problems.

Preliminary design of the system will be in sufficient detail to allow system evaluation which will include consideration of pressure- and pump-fed schemes, and regeneratively cooled and ablation-cooled thrust chambers.

A detailed vehicle design study will include only that portion of the vehicle affected by the new propulsion system configuration. Affected areas include the supporting structure for the propulsion system, repackaging of other systems (such as electrical power supply) in the propulsion module, and redesign of the lunar landing gear because of a change in vehicle weight and the location of the center of gravity.

The command module (manned capsule) configuration will remain similar in concept to the present configuration.

System criteria include these velocity increment requirements:

Service propulsion system	
Translunar midcourse correction	300 fps.
Retro into lunar orbit	3,130 fps.
Plane change	100 fps.
Rendezvous with LEM	523 fps.
Lunar escape	3,610 fps.
Transearth midcourse correction	300 fps.
Lunar Excursion Module landing stage	
Separation from service module	5 fps.
Retro to elliptical orbit	375 fps.
Retro to hover	5,961 fps.
Hover, translate and land	700 fps.
Lunar Excursion Module launch stage	
Launch to 50,000 ft.	5,885 fps.
2-deg. plane change	75 fps.
Abort capability	100 fps.
Rendezvous	196 fps.

A 10% velocity increment reserve is to be added to requirements for each category.

Booster capability and weights to be used in the study include these values:

Booster capability to escape	90,000 lb.
Command module	9,500 lb.
Support equipment in service module	4,500 lb.
Lunar Excursion Module capsule	3,700 lb.
LEM payload on lunar surface...maximum for system chosen	
Payload returned from lunar surface to command module	1,000 lb.

Additional payload realized by use of a high-energy propellant will be considered as payload which is brought from lunar orbit to the lunar surface and remains there. Packaging for the additional payload will be included in the lunar landing stage. The additional payload will be considered as having a density of 25 lb./cu. ft.

NASA Signs Contract For 49 RL-10 Engines

Huntsville, Ala.—National Aeronautics and Space Administration has signed a contract for $14,879,831 with Pratt & Whitney Aircraft Div. of United Aircraft Corp. for the production and delivery of 49 RL-10 rocket engines.

Contract is a definitized version of a letter contract issued last October. It was signed by Marshall Space Flight Center, technical director of the work.

RL-10, developing 15,000-lb. thrust, will be used on operational Saturn 1 and Centaur space vehicles, with six engines each in Saturn 1 second stages and two engines each in Centaur second stages. Delivery to the stage contractors, Douglas Aircraft Co. and General Dynamics/Astronautics, respectively, will be made throughout 1964.

Pratt & Whitney will do the work at East Hartford, Conn., and West Palm Beach, Fla. Engine uses the high-energy propellant combination of liquid hydrogen and liquid oxygen.

NASA also announced the award of a $1,727,221 contract for the construction of foundations for two test stands at the Marshall Space Flight Center's Mississippi Test Operations in Hancock County, Miss. Contractor is Greenhut Construction Co., Inc., Pensacola, Fla.

Stands will be used for static firing the first and second stages of the Saturn 5 moon rocket.

Remember the Twin Mustang?

THE WORLD'S FIRST TWIN-FUSELAGE MILITARY AIRPLANE . . .

(North American Aviation, Inc. Photo)

. . . and Barber-Colman was there!

Remember the P-51 Mustang? This fast fighter was so hot during World War II that in 1945 North American Aviation made a radical departure from its long series of single-fuselage models . . . joined two fuselages by the wing and a horizontal stabilizer to form the P-82 Twin Mustang.

Designed for ultra-long-range, high-altitude duty, the versatile P-82 could be adapted as a long-range escort, fighter, night fighter, attack bomber, rocket fighter, interceptor, or for long-range reconnaissance.

The Twin Mustang could fly over 475 miles per hour; had a combat range of more than 1600 miles when carrying full armament—more than 2500 miles using drop tanks. Its ceiling was 45,000 feet. Both 12-cylinder V engines and both propellers were controllable from either cockpit. The pilot's cockpit on the left contained normal flight and engine instruments. The copilot on the right had sufficient instruments for relief and emergency operation.

A man in each fuselage minimized the problem of pilot fatigue on ultra-long-range missions. Pilot comfort also was improved by a tilting, adjustable seat and Barber-Colman temperature controls that kept cockpit temperatures constant during the longest flights.

Like North American, we're always innovating with our proven models. If you are on the prowl for reliable temperature controls, actuators, or air valves—backed by experienced creative engineering—contact your nearest Barber-Colman office. Or, dial us direct—Area Code 815/968-6833.

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—VICTOR HUGO

THE MARK OF QUALITY

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BARBER-COLMAN COMPANY

Dept. S, 1422 Rock Street, Rockford, Illinois

AIRCRAFT AND MISSILE PRODUCTS: Air Valves, Electromechanical Actuators, Temperature Control Systems, Positioning Systems, Transducers and Thermostats, Special Ground Test Equipment, POLYFORM Electromagnetic Shielding

1 SYSTEMS ANALYSIS

Specify guidance equations and targeting programs. Investigate dynamics performance of guidance steering loops. Develop digital computer error analysis program.

2 GUIDANCE SYSTEM ENGINEERING

Project management including servo loop analysis and design specifications for sub-systems such as stable platform, airborne digital computer, star tracker, and gyro performance requirements. Task will be in both terrestrial and celestial modes in connection with land and sea deployment.

3 FLIGHT CONTROL SYSTEMS ENGINEERING

Adaptive and optimal flight control systems analysis and design for a mobile missile. Duties are concerned with aerodynamics stability, surface loading, reentry energy management, control systems simulations and servo feed-back control techniques.

4 SYSTEMS DEFINITION AND INTEGRATION

Study and define performance requirements of varity of guidance and control sub-systems and establish criteria upon which interface specifications are prepared. Particular emphasis is given to systems analysis of special purpose airborne digital computer and programming.

5 DIGITAL COMPUTER PROGRAMMING

Develop real time airborne digital computer special purpose programs. Heavy requirements for those experienced in numerical analysis, self test routines, diagnostic programs, acceptance test programs and time storage estimates.

6 ADVANCED PROGRAMS— PROGRAM MANAGERS AND SENIOR STAFF ENGINEERS

A newly formed branch of our Aerospace Systems Division is being staffed at senior levels and requires talented technical and managerial candidates who will be concerned with our product line of the future. Areas now requiring additional key engineers are: advanced systems R & D—aerothermodynamics—electronics and communications—astrodynamics—structures & materials—astro/aerospace physics—applied math & computing—reliability—human factors—advanced systems requirements and developments, guidance, computer, control & radiation systems engineering, system integration—mechanical systems.

7 SCIENTIFIC PROGRAMMING COMPUTATION

Translation of scientific mathematical expressions into FORTRAN and FAP languages for computer solution in IBM 7000 series or RPC 4000 machines. Scientific programs involve guidance equations, physical parameters, terrestrial deployment and trajectory simulations, adaptive flight control systems and hybrid guidance systems.

8 FIELD FLIGHT TEST

Conduct on-site flight-testing of prototype stellar-inertial guidance systems. Requires field experience with knowledge of inertial guidance equipment. (Location is Cape Canaveral, Fla., with initial training in Little Falls, N.J.)

9 TELEMETRY— INSTRUMENTATION

Plan and design airborne missile PCM telemetry and data reduction instrumentation systems for flight test programs.

10 CONTROL THEORY MATHEMATICS

Senior Staff Scientist will be responsible for advanced research programs in modern control theory. Work will involve utilization of calculus of variations, dynamic programming, Lyapunov's Second Method, and requires a background in ordinary differential equations.

11 FLIGHT TEST ANALYSIS

Create and design flight and sled test programs for ballistic missiles and analyze system performance data.

12 ELECTRO-OPTICAL SYSTEMS

Design and analysis of electro-optical instruments for integration in stellar-inertial guidance systems. Requires knowledge of astro-sensor in digital data handling and signal processing devices.

13 ANALYTICAL MECHANICAL DESIGN ENGINEERING

Conceptual design of guidance and control space environments simulator systems. Analytical and design capabilities should be in vibrations, acoustics, thermodynamics, vacuum analysis and electronic control instrumentation.

14 RADIATION STUDIES

Principal staff scientist's research will explore plasmas, wave propagation, energy conversion, and infrared technology. By studying areas such as field geometries, attenuation problems in differing fluids, thermo-electric effect, ferro-electric and thin films sensors, lasers and masers, and applications of new semiconductors, unique space technology applications will be developed.

15 INERTIAL SYSTEMS ELECTRONICS

Analysis and design of sophisticated electronics devices for inertial systems implementation. Requires background in one of more of the following: Guidance and control systems, analog computer electronics, network theory, information theory, solid state and microminiature circuit design and electronic packaging.

16 ANALOG-DIGITAL CONVERSION & COMPUTATION

Analysis and design of all electronic solid-state A/D and D/A converters; digital integrators, and hybrid computing equipment. Strong advanced circuit background necessary with knowledge in system analysis, digital logic, precision pulse generation and switching, multiplexers, digital and analog storage techniques, high speed sampling & sampled data theory.

17 ASTROPHYSICS

Responsibilities will include the coordination of reference systems integration with digital computer programs of various integration schemes in orbital and trajectory work, utilization of star catalogues and determination of stellar groupings and position. Experience in orbit and trajectory analysis is necessary.

18 GROUND SUPPORT EQUIPMENT

Direct technical development of electronic ground equipment to support advanced aerospace systems. Working knowledge in digital automatic checkout systems, automated data handling and/or test evaluation of guidance and control systems and components.

SALARIES: Fully competitive with Aerospace industry. An attractive fringe benefit program is consistent with this policy.

NEW FACILITIES: A new Aerospace Research Center has just been opened. This structure houses chemistry, physics and metallurgy laboratories; precision model shops staffed by experienced model makers; clean room experimental assembly areas; two computational centers and an astrodome.

A large Systems Engineering Building is now under construction on a 113 acre site. When completed, over 1,000,000 square feet of superbly equipped engineering facilities will make up the General Precision Aerospace complex in Northern New Jersey.

LOCATION: Only 40 minutes from Times Square, a pleasant suburban area close to Northern Jersey lake district and Atlantic Ocean beaches.

MILES M-100 STUDENT, ready for takeoff at Le Bourget Airport during the Paris Air Show, is two-place, side-by-side trainer which can be stretched to a four-place communications airplane by adding seat in equipment section.

Aviation Week Pilot Report:

Politics Cloud Future of Miles Student

By Herbert J. Coleman

London—Miles M-100 Student jet trainer, an uncomplicated and forgiving airplane, has several potential uses ranging from initial training to ground strike, but its future is still clouded by politics in Great Britain and South Africa.

The crux of the matter is a dispute between the minority British Labor Party and the South African government over the latter's adoption of apartheid white supremacy policies. In a number of bitter attacks, spearheaded by Labor Party leader Harold Wilson, the party has demanded cessation of all sales of arms to South Africa for fear they will be used against the black races.

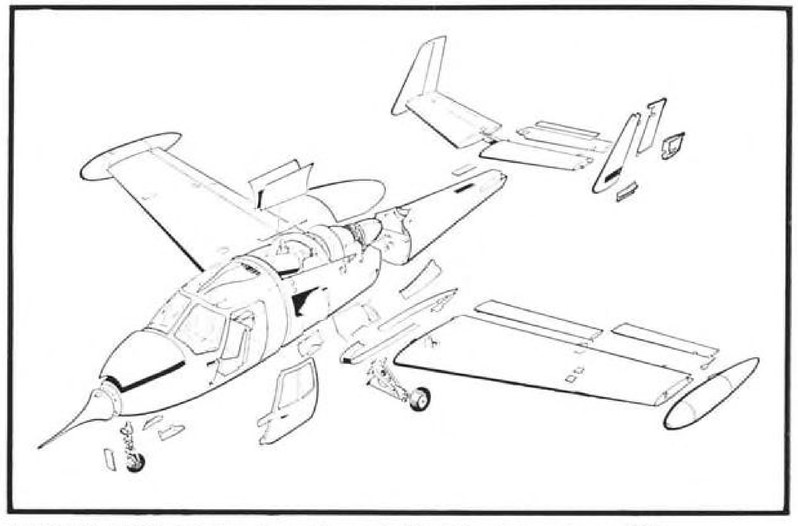
South Africa has, however, purchased 20 Blackburn Buccaneer naval strike fighters, under a 1955 agreement between Britain and South Africa for joint defenses of sea approaches. The Laborites insist that the contract be canceled, but this is doubtful even if the party regains control from the Conservatives in the next general election.

To circumvent the political squabbles—which already have probably cost Hunting Aircraft an order for the Jet Provost trainer—F. G. Miles, Ltd., builders of the Student, are "de-Anglicizing" the airplane as much as possible, and are negotiating for a license to produce it in South Africa.

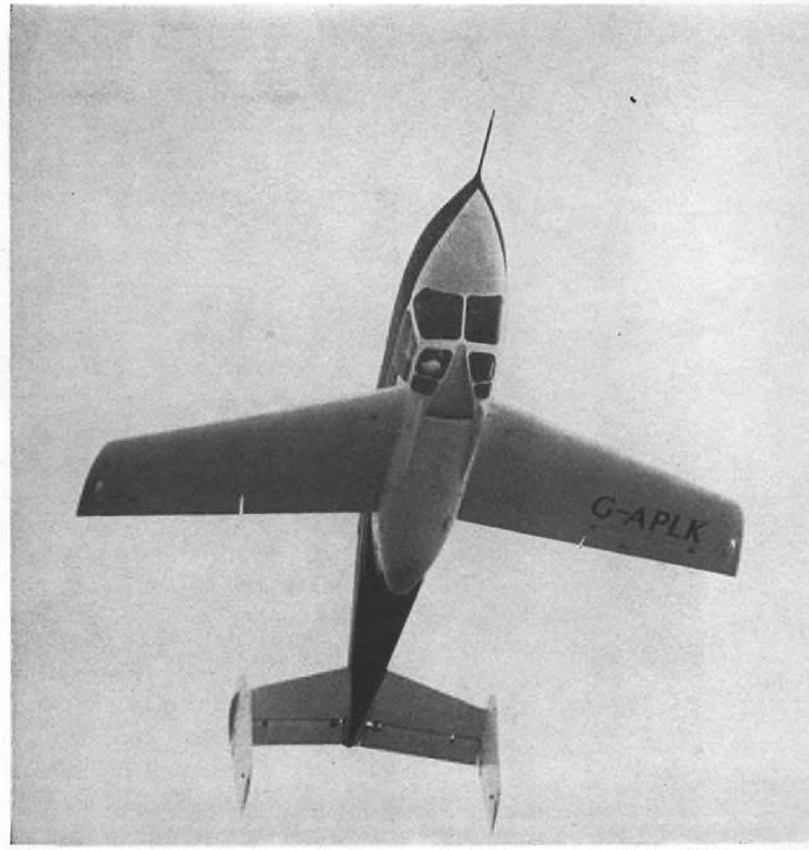
Chairman of the firm and designer of the Student, Frederick G. Miles, said the first move in this direction will be to refit the airplane with the Turbomeca Aubisque turbofan engine, using powerplants built in France despite the fact that Bristol Siddeley Engines, Ltd., has a production license agreement with the French company.

The trainer's instruments and components parts also will be French, although these are optional to South African desires. The landing gear probably will be built by a South African firm.

If the deal is consummated, South Africa will set up its own production facility, under the guidance of F. G. Miles, Ltd., which will staff the facility for in-house training and gradually



MILES STUDENT is broken down for production into above sub-assemblies.



FENCES ON EITHER SIDE of engine intake were added to improve directional stability during aerobatics. Miles Student is shown here approaching the top of a loop.

phase out British employes as the South African learning curve reaches the necessary point of technical competence.

The repowered Student will be called the Miles Graduate, although there will be few external changes, other than a redesign of the intake over the pilot's cabin. Since the power will be increased from the 880 lb. thrust now available with the Student's Marbore 2A turbojet to 1,550 lb. from the Aubisque, gross weight will be increased from 3,600 lb. to 4,150 lb.

Turbofan Design

Miles also has under consideration a twin turbofan design called the Miles Centurion, but no decision has been made on construction of a prototype, pending outcome of the South African talks. Pressurization will be an optional item.

The Miles Student was flown by this AVIATION WEEK & SPACE TECHNOLOGY pilot at Beauvais, France, Municipal Airport, about 40 mi. northwest of Paris, with Miles pilot Duncan McIntosh. The airplane was flown at 3,600 lb. gross weight, with 100 Imp. gal. of fuel in the internal tanks. Tip tanks can be fitted to take another 40 Imp. gal.

The weather was a solid overcast, with a 500-800-ft. ceiling and tops at about 3,500 ft. Wind was westerly at 20 kt. and temperature was about 55F.

Start Sequence

The Miles cockpit is roomy and instrumentation has been kept to a minimum, considering the airplane's trainer role. Starting sequence involves engaging the starter and at 1,500 rpm., after the Marbore's second stage has been heard to engage, pressing the igniter button. The engine lights up in 3 or 4 sec., but the starter remains engaged until rpm. rises to 6,000. If jet pit temperature exceeds 625C., the engine is immediately shut down.

The Student is taxied at about 10,000 rpm., using the nose wheel steering and occasional pressure on toe brakes. The nose wheel is steerable through 22 deg., but the pilot can select a "nose-wheel free" mode to turn about the Student's axis on the main landing gear.

For takeoff, flaps are set at 15 deg. and brakes are held on while the throttle is moved to takeoff power of 22,600

rpm. The takeoff run was short and climb-out was made at the recommended 170 mph. and 2,500 fpm. The Student is extremely stable and trimming presents no problem for the inexperienced pilot.

At a 230-mph. cruise speed, the Student is light on aileron control and extremely responsive in tight turns, both level and climbing, using slight rudder pressure. Visibility is excellent and noise level is not annoying.

Aerobatic Flight

The Student stall characteristics are mild, although there is little warning of the approaching stall, aside from a slight buffeting. In a clean stall, the Student is placed in a 10 deg. nose-up position and the throttle is reduced to idle speed. Stalls occur at about 68 mph., and reaction is a nose drop followed shortly by a dropping off on the left wing. Recovery is easy, with little altitude loss.

The airplane is cleared for a full range of aerobatics, including inverted flight. A recovery tank, holding 2½ Imp. gal., provides sufficient fuel for 15 sec. of inverted flight at maximum continuous power.

Loops are entered at 220 mph. at +4g, but if a roll at the top of the loop is planned, the maneuver is started at 240 mph. Rolls are completed almost exclusively with ailerons. Slight rudder pressure helps tighten the maneuver.

Spin Recovery

The Student also has good spin characteristics, entering a spin to the left easier than one to the right. First two turns in either direction are oscillatory and then the spin stabilizes into a fairly fast rotation at a steep attitude. Recovery is fast after full opposite rudder

Miles M-100 Specifications

Wingspan	29 ft. 2 in.
Length	31 ft. 6 in.
Height	6 ft. 3 in.
Wing area	144 sq. ft.
Gross weight	3,600 lb.
Wing loading	25 lb./sq. ft.

Performance

Takeoff distance (50-ft. obstacle)	2,220 ft.
Landing distance (50-ft. obstacle)	1,920 ft.
Maximum speed (sea level)	290 mph.
Cruise speed (10,000 ft.)	260 mph.
Still air range (100 Imp. gal.)	444 stat. mi.
Maximum duration (no allowances)	2 hr. 15 min.

POWERPLANT FOR MILES STUDENT is a Turbomeca Marbore 2A turbojet engine of 880 lb. thrust. Follow-on Miles Graduate will be powered by a Turbomeca Aubisque turbofan of 1,550 lb. thrust; no major changes to airframe are needed.

is applied. Altitude loss in a clean spin of three turns is about 1,000 ft.

During the check flight, weather had disintegrated to a 400 ft. ceiling. For the landing approach, the downwind leg was entered at 150 mph. and was flown at about 350 ft. with no overt problems. The landing gear was lowered at 140 mph., followed by 15 deg. of flap. The final approach was flown at 100 mph., in this case at a fairly flat angle, using 15,000 rpm.

The threshold was crossed at 85 to 90 mph., and because of the 7 to 12 sec. lag in throttle response for a go-around, the throttle was not closed to idle until the pilot was sure of a safe landing in the first third of the runway.

The low height of the Student (6 ft. 3 in.) provides good ground handling characteristics. Fast turns are possible with little chance of tipping or dragging a wingtip. The airplane can be used quite easily on rough surfaces and grass runways, since the intake location above the cabin prevents ingestion of foreign objects into the engine.

For its ground support and attack role, the Student can be fitted with two Oerlikon pods carrying 31 5-cm. rockets which can be fired two at a time from each side, or in a simultaneous 62-rocket salvo. Other armament alternatives include eight 25-lb. bombs, six rockets with 25-lb. warheads and two .303 cal. machine guns with 350 rounds each.

Miles said the space behind the two pilot seats, normally used for equipment storage, can be designed to take another two-passenger seat. This version would be for use in communications or personnel transport roles. The cabin is 48 in. wide, with 45 in. of headroom. The space behind the seats is 23 in. deep.

The Student is built around a central keel which extends from the nose wheel attachment point to a point just aft of the main landing gear. This member acts as a skid in case of a wheels-up landing. All parts of the airframe which could affect pilot safety in an accident are stressed to 25g.

Automobile type doors on each side of the fuselage measure 46 in. × 41½ in. and give direct access to the seats. Value of this feature, combined with high mounted engine air intake, is in speeding training turn-around without shutting down the engine.

Fuel is carried in four tanks in the wing and is controlled by three fuel valves, two directing feed from port and starboard tanks and the third controlling the supply between the booster pump and the engine. In case of an in-flight flameout, an emergency air bottle is fitted forward of the left seat. When activated, it will operate all services twice.

FINANCIAL BRIEFS

Douglas Aircraft Co. earned $6.8 million—$1.64 per share—on sales of $374.3 million during the first six months of the fiscal year ended May 31. Comparable figures for last year showed earnings of $4.3 million—$1.05 per share—on sales of $359 million. Order backlog stood at $781.2 million compared with $874.6 million on May 31, 1962.

McDonnell Aircraft Corp. earned $17 million—equal to $4.74 per share—on sales of $565.3 million for the fiscal year ended June 30. Figures for last year showed $13.9 million—$3.90 per share—earned on sales of $390.7 million. Order backlog totaled $938.9 million on June 30 compared with $316.8 million the previous year.

North American Aviation, Inc., reports a net income of $27.9 million on sales of $1.3 billion—$3.33 a share—for the nine month period ended June 30. Same period last year showed $24.5 million earned on sales of $1.2 billion—$2.94 per share. June 30 order backlog stood at $1 billion compared with $1.1 billion the year before.

Aeroquip Corp., had sales of $45.8 million with earnings of $1.9 million — $1.43 a share — for the first nine months of its fiscal year ended June 30. Comparable period last year showed sales of $43.9 million with earnings of $2.6 million—$1.94 per share.

Westinghouse Electric Corp. earned $26.6 million, equal to 72 cents a share, on sales of $1 billion during the first six months of 1963. First half of 1962 showed earnings of $25.5 million, equal to 69 cents a share, on sales of just over $956.9 million.

B. F. Goodrich Co., had sales totalling $411.2 million with earnings of $14 million for the first six months of 1963. Figures for the first half of 1962 showed sales of $406 million with earnings of $14 million. Per share earnings for both years were $1.53.

Hawker Siddeley Group reports it earned $56 million in 1962 compared with $53.2 million earned in 1961. The group says it has written off about $28 million in R&D costs for the de Havilland Trident, DH-125, Avro 748 and Whitworth Gloster 650 transports. From now on the company reports that all Group-built aircraft will have Hawker Siddeley numbered designations.

Thompson Ramo Wooldridge, Inc., reports sales of $240.1 million with profits of $7 million equal to $1.84 a share for the first six months of 1963. Same period last year showed TRW with sales of $231.6 million with profits of $6.4 million or $1.68 a share.

High Voltage Engineering Corp., earned $758,000, 32 cents per share, on sales of $9.4 million for the first half of 1963. Comparable figures for last year showed $544,000 earned, 23 cents per share, on sales of $7.5 million.

Vitro Corp. of America, had net income of $438,444—36 cents per share—on sales of $25.2 million for the first half of 1963. For the same period last year, Vitro had profits of $471,692—39 cents per share—on sales of $24 million.

United ElectroDynamics, Inc., has instituted a major reorganization of its corporate and divisional structure to strengthen its operations after a net loss of $294,415 for calendar 1962. The reorganization and cost reduction program will combine the United AeroSpace Div. and the United Testing Laboratories Div. into a new AeroSpace Div. under the direction of D. D. Mallory, vice president and manager. A Manufacturing Div. and a Marketing Div. have also been created.

Hercules can haul almost anything–almost anywhere

U.S. Air Force C-130B takes off from jungle clearing between Amazon and Andes for one-hour flight to Lima, Peru. Heavy freight must otherwise be hauled 7,000 roundabout miles by river, sea, and rail.

Trucks, tractors, troops. Jet engines, jet fuel, jet pilots. Missiles, rockets, guidance systems. Air Force, Army, Navy, Marines, Coast Guard. Whatever, whoever, wherever—Hercules has what it takes to get the job done.

Destination may be a crude landing strip freshly hacked out of the jungle. Or a snow field at the South Pole. Makes no difference. The Lockheed C-130 Hercules can land and take off on just about any reasonably flat, clear spot on the face of the earth—so it can take its vital cargo close to the action without delay.

Hercules is the true airlifter—built for the big work. Its huge rear doors swallow tons of freight in seconds—straight onto the truck-bed height cargo floor. And these doors can be opened in flight to permit king-size paradrops.

Five hundred of the big propjets, eighteen different versions, are now in service, for the U.S. Air Force, Navy, Marines, and Coast Guard—and for the air forces of many free world nations.

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Loads from the rear

Carries 92 troops

Refuels fighters

Drops big equipment

Launches target drones

Lands on snow & ice

AMR Cable Enhances Tracking Reliability

By Philip J. Klass

Aboard Cable Ship Neptun—A combination of 19th and 20th Century technologies has been used to provide rapid and reliable communications link for the Atlantic Missile Range to the tracking/telemetry station at Antigua, several hundred miles southeast of Puerto Rico.

A 60-channel two-way submarine cable recently laid by the Neptun between Grand Turk and Antigua will replace marginal and sometimes unreliable tropospheric scatter and single-sideband radio links. It will permit real-time transmission of data during the early post-launch period when spacecraft and missiles are more than 1,500 mi. southeast of Cape Canaveral.

At present, the full 60-channel duplex capability can not be utilized because older submarine cable north from Grand Turk has only a 12-channel capacity. However, AMR hopes to replace this with 60-channel cable.

At a time when advances such as communication satellites and tropospheric scatter seemed to suggest that the submarine cable was doomed to early obsolescence, space technology finds it expedient to resort to one of the oldest communication techniques. Despite the potential threat from communication satellites, there has never been more submarine cable activity. American Telephone & Telegraph Co's. newly commissioned cable ship Long Lines currently is beginning to lay a new 120-channel transatlantic cable between the U. S. and England which will double the existing cable capacity.

Despite significant advances in the performance of submarine cable, a surprising number of the cable handling and laying procedures used today differ only slightly from those described in books published in the 19th Century. Yet the Neptun, commissioned in 1962, is the largest-capacity cable layer ever built and one of the most modern.

The new 715-mi. cable laid for the Atlantic Missile Range is only the second to provide 60-channel two-way communications within a single cable. The first, laid last fall by the Neptun, connects Canada and Iceland.

Despite the differences in age, submarine cable and space technology share some common problems. The cable, buried in a sometimes hostile environment at great depths is almost as inaccessible for repairs as a spacecraft payload. The underwater repeater-amplifiers are designed for an unattended operating lifetime of 20 years. Since the first transatlantic telephone cable with repeaters was laid in 1955, there have been no repeater failures. Although such repeaters are far less complex than spacecraft payloads, space technology might profit from the experience of this relatively old art.

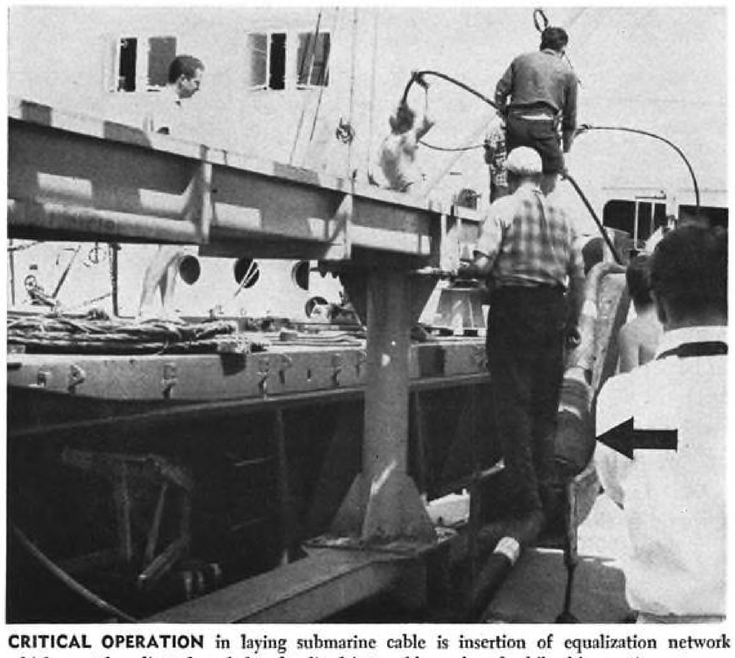
The new AMR cable between Grand Turk and Antigua cost the Air Force approximately $6 million, installed. But roughly $4 million of this amount was paid for in surplus wheat in an unusual barter arrangement devised by Maj. Donald Cahall, project procurement officer at the AF Missile Test Center when the contract was awarded in mid-1961.

Agricultural surplus can be used to barter for strategic materials procured overseas without violating international agreements against "dumping" agricultural surpluses. The new AMR cable and its repeaters were produced by West German companies and the Neptun is the same nationality.

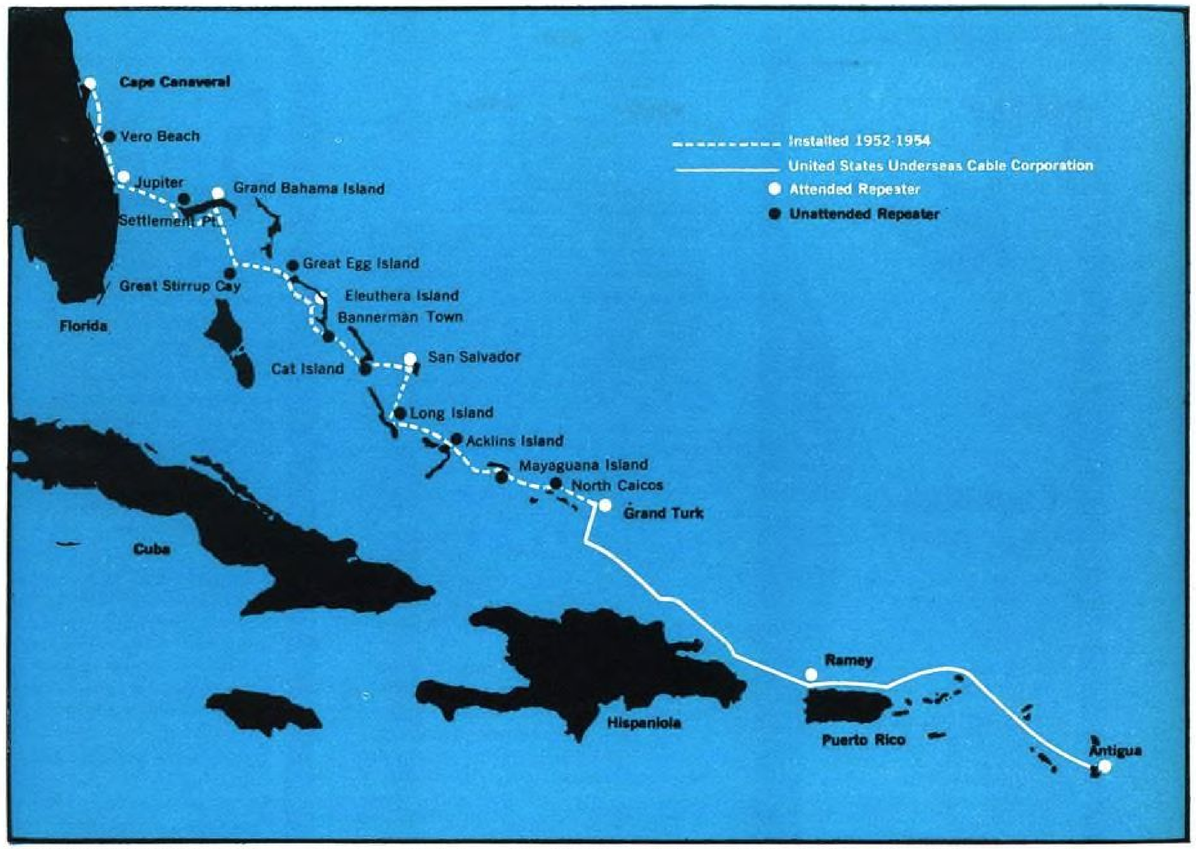
The AMR cable project was carried out under the direct supervision of the United States Underseas Cable Corp., formed in 1959, which is jointly owned by Northrop Corp., Phelps Dodge Co., and Felten & Guilleaume Carlswerk of West Germany with each owning one-third. All four companies were signatories to the contract. The surplus grain was sold through a broker so that the West German company and its affiliates were paid in cash.

The design and laying of a broadband submarine cable is far more difficult than would appear to the uninitiated. The cable is a co-axial type with a single 0.16-in. diameter inner copper conductor enclosed in polyethylene insulation having an outer diameter of 0.62 in. This in turn is wrapped with copper tape to form the outer conductor. This active portion of cable then is wrapped with tape and jute, encased in one or two layers of stranded steel armor (depending upon character of ocean bottom) and finally wrapped with impregnated jute.

Multiple channels are achieved by means of carrier frequencies, similar to radio channeling techniques. In the AMR cable, carriers operating from 24-264 kc. provide 60 one-way channels for downrange transmission while 312-552 kc. is used to provide 60 channels for uprange transmission. All channels are 4 kc. wide. The band of 264-312 kc. serves as a buffer zone during regular operation and can also be used to check the performance of each repeater in the series string to isolate a faulty unit.



CRITICAL OPERATION in laying submarine cable is insertion of equalization network which must be adjusted, sealed and spliced into cable on board while ship continues to pay out the cable. Photo shows equalizer housing (arrow), already spliced into cable, being readied to feed back to bow of Neptun.



ATLANTIC MISSILE RANGE'S new submarine cable between Grand Turk and Antigua (solid line) will provide reliable communications link for real-time transmission of tracking and telemetry data during the early post-launch phase of manned space shots. New cable replaces tropo scatter and single-sideband radio links. AMR hopes to replace older cable north from Grand Turk.

Two-way repeater amplifiers, used to compensate for cable attenuation, are inserted at approximately 17½ mi. intervals. There are 19 such repeaters in the 339-naut. mi. link from Grand Turk to Puerto Rico and 21 repeaters in the 377-naut. mi. run from Puerto Rico to Antigua.

Ideally, the cable and its repeaters should provide uniform frequency response across the range from 24-552 kc., except for the buffer zone. Based on measurements of the ocean floor profile and ocean bottom temperature measurements made during a preliminary survey by the cable ship Omega in 1961, the filter networks within each repeater are set at the factory. The units then are sealed, tested to a pressure of 1,000 psi. and spliced into the cable before it is loaded onto the Neptun.

However, significant changes in the cable characteristics occur during laying as a result of stresses developed as the cable pays out and due to pressure and temperature effects on the ocean floor. Because the repeaters are inaccessible at this stage for further adjustment, an equalizer is used which can be adjusted aboard the ship and spliced into the cable to compensate for actual variations experienced.

In the AMR installation, a single equalizer is used at the half-way point between Grand Turk and Puerto Rico while another is inserted at the midpoint between Puerto Rico and Antigua.

The two segments of cable between which the equalizer is inserted are called Block A and Block B.

If it were feasible to halt the Neptun at these midway points, measure cable attenuation, adjust and splice in the equalizer and then resume laying operations, the task would be relatively easy. But once a cable ship begins to pay out its load, it dare not stop for any reason short of a threat to the safety of the ship itself. A stop poses serious risk of twisting, distorting and possibly breaking the cable.

From the moment that the Neptun left Grand Turk until three days later when it arrived off Ramey AFB, where the intermediate terminal station is located, laying operations continued around the clock. During this period, as the Neptun steamed toward Puerto Rico at a speed of about 6-7 kt., the integrity of the cable and the operation of all repeaters, both on-board ship and those already payed out, were tested. Every hour the attenuation of the cable was measured at 180 kc. and 552 kc. and approximately every five hours attenuation measurements were made across the full frequency spectrum of cable operations.

Tests and measurements are made from the Neptun's air conditioned test room, outfitted with laboratory type standards, using single sideband radio to communicate with technicians at the Grand Turk terminal, under the direction of Dr. Leo Waldick of Felten & Guilleaume.

Approximately 105 mi. out of Grand Turk, after the sixth repeater had payed out, the Neptun slowed to about 2½ kt. for the most critical phase of the operation—equalization. During the next 24 hr., before the end of Block A

cable emerges from a 55-ft.-dia. tank, Waldick and his associates must measure the performance of the cable laid so far and predict what the attenuation will be for the remainder of the run to Puerto Rico. This must be done at a time when less than 40% of the run has been deposited on the ocean floor. They must take account of ocean depth temperature measurements made in winter by the Omega and summer measurements made during the Neptun's run to Grand Turk.

Work Around Clock

Working around the clock, Waldick and his group must then adjust the equalizer, attempting to balance the attenuation so it is evenly distributed across the 500 kc. bandwidth to be used. The equalizer next is tested for performance, subjected to insulation resistance and high-voltage tests, and then placed in its stainless steel housing. The latter is welded, checked for integrity, using an electronic leak detector, and filled with dry nitrogen through small holes which finally are plugged and welded.

The equalizer then is spliced into the end of Block A, and the characteristics of the equalizer and cable back to Grand Turk are measured. Finally, the other end of the equalizer is spliced onto the beginning of the Block B cable.

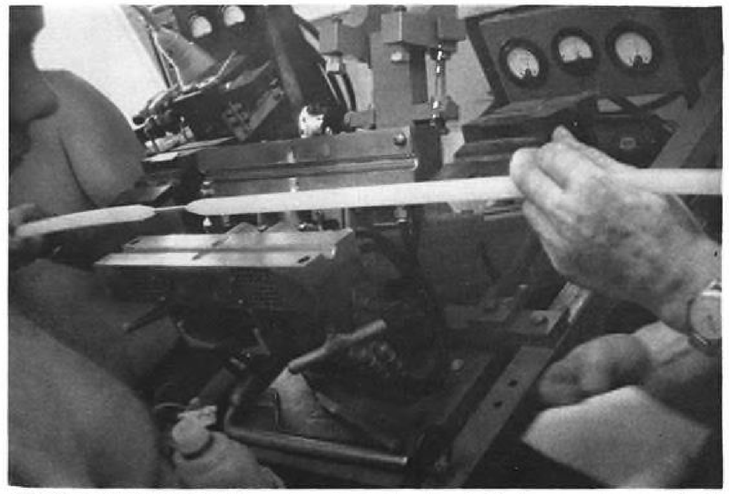
The 24 hr. allotted for this entire operation include about one hour of slack time to accommodate unexpected troubles. If more serious difficulties occur, the ship must slow down below 2½ kt., risking possible damage to the cable.

Fortunately, during the Grand Turk to Ramey run all went well and the job was easily completed within the allotted time. Equalization achieved was twice as good as required by specifications.

Contrast Old and New

Cable splicing operations show an interesting contrast of the modern and the old. Splices must be made at each terminal, to short cables laid earlier by the Omega, and again when the equalizer is inserted. Precision welding machine is used to join the copper conductors and injection molding encases the conductor in polyethylene insulation, after which the insulation is X-rayed for voids or other defects. But the remainder of the splicing operation, involving the copper tape, jute, spiral wire armor and jute covering, together with additional wire and rope binding, follows procedures which date back to the earliest cables laid nearly a century ago.

Human ingenuity, muscle and ropes play a dominant role in grappling for



MODERN TECHNOLOGIES have important place in cable-laying procedures. Electric welding, injection molding and X-ray equipment are used to join inner cable conductor, insulate it and examine the splice for flaws.

the terminal station end of cable at a depth of several thousand feet and transferring it from the bow to the stern once it has been hauled on board. During these difficult cable handling operations, a ship must be extremely nimble on the waves. The 493-ft. long Neptun, which weighs about 20,000 tons when loaded with cable, is outfitted with a 500 hp. active rudder (containing its own powered screw) and a 400 hp. transverse propulsion tunnel in the bow which enable it to turn on the proverbial dime or to move laterally to the left or right.

Auxiliary Bridge

Ship can be steered either from the main bridge or an auxiliary one located in the stern near the pay-out sheave. Added touches of modernity include closed-circuit television which enables the bridge, test room and cable control room to watch cable coming up from the hold and paying out over the stern.

But a contrasting touch from the distant past is the method for measuring and introducing the necessary slack into the submarine cable as it is payed out. The slack must be sufficient to allow the cable to conform to the underwater terrain, which often includes mountains thousands of feet high, yet not too much slack which will permit the cable to twist itself into a knot.

Piano Wire Used

At the time that the cable laying begins, steel piano wire which is weighted at the loose end begins to pay out from the stern. Because the piano wire lacks the weight of the submarine cable, it does not sink to the ocean floor and the length payed out is roughly proportional to the linear distance travelled by the ship. Using this as a reference, the submarine cable is payed out at a slightly higher rate, providing between 4% and 7% slack. The lower limit is used when the ocean floor is extremely flat while the higher value is used over extremely mountainous underwater terrain.

The repeaters used in the AMR

CONTRAST with modern technology is provided by these cable-wrapping operations on deck of Neptun involving techniques dating back to 19th century.

cable each contain two three-stage amplifiers operating in parallel to provide additional reliability. Failure in one amplifier results in loss of about 2-3 db. gain which is not sufficient to disrupt service. The amplifiers use triode vacuum tubes especially made for submarine cable repeater service.

Approximately 10 months are spent in assembling and testing each tube to assure its reliability. Solid tungsten filaments are used instead of more common coated filaments for long life.

Other components that go into the repeaters and equalizers are tested for approximately six months before selecting those which will be used, based on changes in their characteristics during the test period. The complete repeater then is subjected to operation for one month under pressures higher than those which will be experienced.

Power for the repeater amplifiers is supplied through the center copper conductor with the ocean serving as the return path since sea water penetrates the cable to the outer copper (tape) conductor. The direct current power for the new AMR cable is from the midway terminal at Ramey AFB.

The Neptun's recent cable laying operations were carried out under the over-all supervision of Derk Aits, vice president and chief engineer of the German Atlantic Cable Co. with the ship under the command of Capt. Simon Hofer.

Space Parts Specifications Are Prepared

By Barry Miller

Los Angeles—Space Parts Working Group, an industry advisory committee which recently began counseling the Air Force Space Systems Div. on high-reliability components, is preparing recommended specifications on 16 types of avionics components needed by future military satellites.

The working group is an outgrowth of an effort begun nearly two years ago by Lockheed Missiles & Space Co. The company tried to establish a uniform parts testing program among the various tiers of subcontractors on the Midas missile alarm satellite program to insure that all components, particularly avionics parts, would survive hostile space environments. For space use, many components lack the life and reliability necessary for long-duration operation—especially the five-year period expected by the Air Force from future space hardware.

Augmented Specifications

In the absence of uniform specifications, individual contractors were forced to augment military parts specifications to meet their needs, particularly in the areas of radiation resistance and ability to survive in pressure free environments.

Lockheed's initial parts efforts on the Midas program faltered because subcontractors frequently were suppliers to other programs, which required different testing procedures. The group continued, enlarged its interest beyond the single space program and late this spring received formal approval from Air Force Secretary Eugene M. Zuckert.

As it is now constituted, the Space Parts Working Group will review all Air Force specifications on components applicable to space satellites. Its interest is in establishing criteria for parts that will be required for space hardware several years hence.

Where necessary, it may suggest additional test methods or recommend altering tests spelled out in a military specification to satisfy space demands. In this way it may arrive at proposed specifications which will meet the minimum criteria used by all space system contractors.

The proposed specifications will be forwarded for approval to the Air Force. Should they get necessary approvals, they become Air Force limited coordination specifications and are sent to the Defense Dept. and industry groups, like Electronic Industries Assn. and Aerospace Industries Assn., for additional approvals.

Space parts group will attempt to use experience gained by USAF's Ballistic Systems Div. in developing reliable parts for the Minuteman ICBM program. Parts specifications that evolved from this program will constitute a starting point for space parts committee work. These specifications probably will have to be improved or augmented to meet space requirements, but essentially the format of the so-called Minuteman specifications will be followed.

Consistent with this approach, the space parts group is working closely now with the Minuteman Parts Control Group, a predecessor and parallel group composed principally of Minuteman ICBM contractors, which led to a series of high-reliability parts specifications for that ballistic missile.

At present, 28 space contractors are participating on a voluntary basis in the Space Parts Working Group. These are equipment or systems manufacturers, or major non-industrial government contractors like Jet Propulsion Laboratory or the Applied Physics Laboratory. Some of the companies represented on the committee have component subsidiaries or divisions, but these are not permitted to play any role in the group.

Each participant has one or more designated representatives in the working group. These representatives usually are managers of reliability, specifications and standards or design engineers at the contractor's facilities. Each of these contractor representatives will be given the status of a government consultant in an arrangement for which the details are still to be worked out.

Steering Committee

To conserve time and travel expenses, participation is divided along geographical lines into six separate subgroups which meet on occasions specified by a governing steering committee that convenes bi-monthly. The steering committee is composed of one representative from each of the subgroups with Lt. Col. James R. Golden, USAF, chief of reliability and quality control for Space Systems Div., serving as chairman.

There are also observers from National Aeronautics and Space Administration and Army Electronics Command. General meetings of the entire working group, the first of which was held in May, are expected to be called several times a year.

The working group's attention currently is centered on 16 generic types of parts, such as resistors, capacitors, connectors, semiconductor devices, transformers, coils, chokes and relays. Eventually, it plans to broaden into mechanical parts and hopes to get into microcircuits as well, according to Golden.

Each subgroup has a separate subject or area of interest which is its principal topic of concern. The subjects encompass such matters as lead materials, new test methods and environmental requirements. Additionally, every company within each subgroup is preparing specifications on a separate component, selected on the basis of the company's previous experience with parts of this type.

In some instances, the subgroup's topic and the individual company's part coincide.

Present plans call for specifications to be prepared in a "tree" type document, with several individual documents consistent with Minuteman specifications of the Mil-P-38100 series. A cover document would prescribe projected space environmental requirements, tests and test methods, such as leak tests and shock, a general requirement common for all space parts.

Second Document

Second in the series would be a document specifying requirements for each class of components, such as relays, transistors, etc. Finally, a third document would contain specification sheets with specific requirements of a particular component.

A sample of this tree document is being prepared by one subgroup. A resistor specification probably will be the first specification completed as a trial effort.

The 28 participants in the program are:

- **Group 1 (Northeast)**—Airborne Instruments Laboratory, American Bosch Arma, Sperry Rand, Avco, Laboratory for Electronics and Raytheon.
- **Group 2 (East)**—Eastman Kodak, International Business Machines, Sylvania, Radio Corp. of America, General Electric, Kearfott Div. of General Precision and Applied Physics Laboratory of Johns Hopkins.
- **Group 3 (Central)**—AC Spark Plug, Minneapolis-Honeywell and McDonnell Aircraft.
- **Group 4 (Northwest)**—Boeing, Lockheed Missiles & Space Co., Philco Western Defense Laboratory and Aerojet-General.
- **Group 5 (Southwest)**—Philco's Aeronutronic Div., General Dynamics/Astronautics and North American Aviation, Inc.
- **Group 6 (Southwest)**—Hughes Aircraft, Aerospace Corp., Douglas Aircraft, Engineering Magnetics and Jet Propulsion Laboratory.

FILTER CENTER

► **Laser Display Effort Planned**—USAF's Aeronautical Systems Div. is seeking qualified sources to investigate techniques for design of a television type display which would be produced by a laser instead of an electron beam.

► **Solid State Transceivers Sought**—Rome Air Development Center plans to sponsor development of an airborne VHF and UHF transceiver for ground-air communications using all solid-state construction and weighing less than 10 lb. each. The VHF unit is to provide 1,120 channels in the 100-156 mc. band while the UHF transceiver is to provide 3,500 channels in the 225-400 mc. band. Industry responses should be identified S-4-95 and U-4-94, respectively.

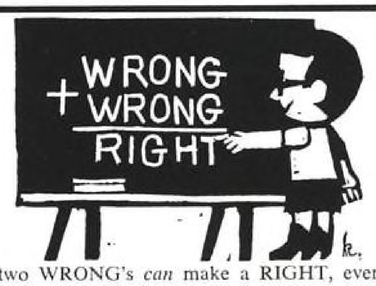
► **Optical Transceiver Study by RADC**—Study program to determine over-all characteristics required in a laser communications transceiver designed to operate over path length of more than 50 mi., with a channel capacity of one billion bits per second, is planned by Rome Air Development Center. Responses should be identified U-4-15.

► **Phased Laser Array Planned**—Rome Air Development Center is seeking qualified sources for feasibility demonstration of a coherent optical array consisting of laser oscillators, power amplifiers, electronic phase shifters, power dividers and beam steering provisions. RADC also is seeking sources to investigate techniques for development of continuous-wave laser oscillators, power amplifiers and heterodyne detectors all operating at a compatible frequency, using solid or gaseous materials.

► **Navy Seeks Field Effect Microcircuits**—Navy Bureau of Ships plans to sponsor program to develop semiconductor microcircuits using field-effect active devices. Rome Air Development Center is seeking sources to develop techniques for vacuum deposition of thin-film thermoelectric cooling devices on thin-film microcircuitry.

► **MMRBM Getting New Microcircuit Computer** – Stellar inertial guidance system being developed for the mobile medium-range ballistic missile (MMRBM) by General Precision may employ a new digital computer constructed largely of semiconductor microcircuits. A number of the new computers, 24-bit versions of its "microtronic" system (AW Dec. 24, p. 43), have been delivered by the Univac Div. of Sperry Rand to General Precision.

PROBLEMATICAL RECREATIONS 182



Show that two WRONG's *can* make a RIGHT, even with the additional restriction that 0 = zero. —*contributed*

A random check of the new products list from our RADCOM-Emertron division revealed the following development: a new, modified, lower-cost version of the standard Air Force electronic altimeter set. Accurate to ±2 feet from 0-40 feet and 5% from 40-5000 feet. Meets all military specifications, of course. They call it Model 1380. Direct an inquiry to RADCOM-Emertron, 1140 E. W. Highway, Silver Spring, Maryland.

ANSWER TO LAST WEEK'S PROBLEM: If we let the widths of the three farms be A, B, and C, we have A (A + 8) = B (B + 28) = C (C + 34). The equation A (A + 8) = B (B + 28) has solutions A = 8, B = 4 and A = 40, B = 32. Only the latter satisfies the third equation, yielding the value C = 30. The farms are, therefore, 40x48, 32x60 and 30x64, all containing 1920 sq. mi.

USS VANCOUVER (LPD-2), shown under way above, features a landing deck for six to 10 helicopters, an approach control tower (port side amidships) and a crane for lowering boats. Ship carries 900 Marines and landing craft for heavy equipment.

Navy Building Helicopter-Attack Vessels

By Ward Wright

New York—New class of Navy transports (LPDs)—designed from the keel up to deliver a complete combat unit with its tanks, artillery, vehicles and equipment by a landing craft-helicopter combination—will become part of an amphibious fleet of fast attack vessels planned for the mid-1970s.

Plans for such a fleet to satisfy Marine Corps requirements for simultaneous delivery of two reinforced Marine divisions—one each in the Atlantic and Pacific—by helicopter and landing craft, have been approved by the chief of naval operations and the secretary of the Navy. Defense Dept. is now studying the plans for inclusion in the Fiscal 1965 defense budget.

Present Navy plans call for 10 to 14 LPDs by the early 1970s. Newest of the class is the USS Vancouver (LPD-2) commissioned in May and commanded by Capt. Thomas C. Harbert, Jr.

USS Raleigh (LPD-1), was commissioned Sept. 1, and joined the Amphibious Force, Atlantic Fleet in April. USS La Salle (LPD-3) is under construction at New York Naval Shipyard, Brooklyn, and is scheduled for christening early this month. La Salle has an additional deck for flag facilities. The class is named for U. S. cities named after explorers.

Keels were laid simultaneously at Brooklyn for USS Austin (LPD-4) and USS Ogden (LPD-5) last February. Both are scheduled for completion in late 1964. LPD-6 is slated for keel laying at Brooklyn in November, and LPD-7 and LPD-8 are under construction at Ingalls Shipbuilding Corp., Pascagoula, Miss. LPD-9 and LPD-10 are being built at Puget Sound Bridge & Drydock Co., Seattle, Wash.

Vancouver, typical of her class, is 521 ft. over-all, has a beam of 84 ft., displaces 14,000 tons, and draws 21 ft. fully loaded. She can quarter more than 900 fully equipped combat troops in addition to a ship's company of 430 men and 27 officers.

Her helicopter platform occupies just less than half her topsides. Beneath the helicopter platform is a floodable well deck containing landing craft which are launched through the stern. Superficially, she resembles Navy's LSD (Landing Ship, Dock) class which has no built-in helicopter capability.

While the full measure of LPD capability is still unknown, due to newness, present thinking is that LPDs won't be assigned permanent complements of helicopters. Most likely, helicopters operating from LPHs (AW Apr. 29, p. 28), which carry about 2,000 troops and as many as 30 helicopters, will be ferried to the LPDs where they will remain for the duration of a specific mission.

Depending on the mission, LPDs will be assigned eight to 10 Sikorsky UH-34Ds, or six Sikorsky CH-37C, CH-53A or Boeing Vertol CH-46A helicopters.

On-board helicopter facilities include pressure fueling and a shop to perform limited maintenance. No provision is made for bringing helicopters below decks. A flight approach control installation on the port side facing aft gives an unobstructed view of the landing platform during takeoff and landing.

Below, major engineering considerations center around rapid loading of helicopters and landing craft, and flooding and emptying the well, or dock.

The well deck itself consists of a hangar-like, rectangular room below the helicopter deck. At the forward end is a vehicle storage area, serviced by elevators from the two cargo holds below. This area also serves as an equipment assembly area for gear arriving from the holds.

The vehicle storage area gives way to a ramp leading to the well or dock. The well is shallower near the ramp and deeper near the stern where it is closed off from the sea by doors hinged top and bottom. In the well, pre-loaded landing craft rest on their bottoms until the stern doors are opened, flooding the dock, and then they are released. Tracked vehicles can be driven out without flooding.

Around the perimeter of the well deck, six bridge cranes riding around an overhead track laid out like a horseshoe, pick up cargos of weapons and supplies from the vehicle storage area and deposit them in landing craft. These cargos are brought up from the holds in a truck-sized elevator or in a smaller elevator for lighter loads. The smaller elevator services both the vehicle storage area and the helicopter deck.

Two pallet conveyors are used to bring additional cargos from the forward holds back to the vehicle storage area where the bridge cranes can reach them. During an operation, fork lift trucks help move loads on both the well and helicopter decks.

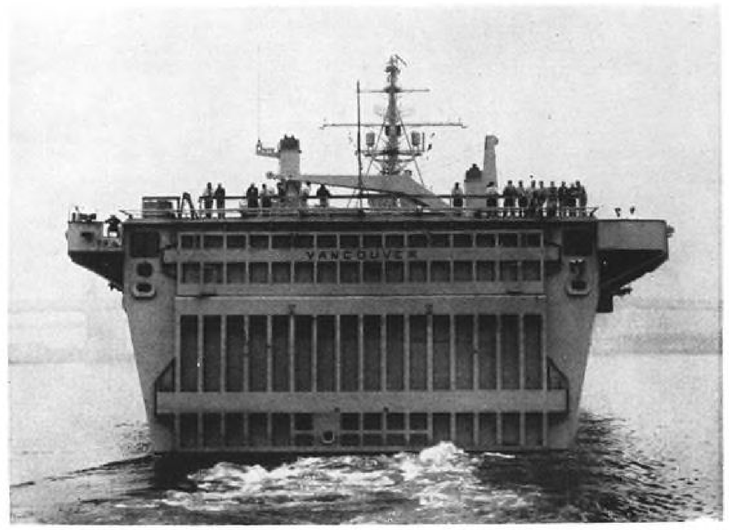
Since some missions may call for a deck load of extra vehicles instead of helicopters, a retractable ramp has been provided so they can be driven from the helicopter deck to the vehicle storage area.

In a landing operation, pre-loaded landing craft would run into the beach, unload, and return through the stern to the ramp. Equipment and vehicles from the vehicle storage area would be conveyed or driven directly into the waiting landing craft for the second wave. The process is repeated until the desired amount of equipment is ashore.

Meanwhile, if helicopter lift is part of the operation, infantrymen would be continuously lifted from the helicopter deck to their objective. For some missions, however, all troops might be landed from boats.

Vancouver carries a mixture of landing craft, which like the helicopters, is determined by mission. Boats carried in the well deck include one LCU (Landing Craft, Utility), and three LCM-6s (Landing Craft, Mechanized), or six LCM-6s, or four larger LCM-8s, or 20 LVTs (Amtracks) or a combination of any of these. She also carries two LCM-6s or two LCPLs (wave commander's boats) on the boat deck which are lowered by crane.

All of Vancouver's boats and auxiliary machinery are modified to burn JP-5 turbine fuel for simplicity and ease of supply. Her main boilers can be fired by JP-5 in an emergency situation.



VANCOUVER'S STERN shows the hinged doors leading to the well or dock, through which landing craft carrying equipment are launched while troops are airlifted ashore.

The other major design consideration, rapid filling and emptying of the well, is achieved with a submarine-type ballast system. The older LSD ships pumped water from the ballast tanks mechanically, but Vancouver blows it out with air from five rotary compressors.

Fully flooded, Vancouver's well holds about 6,550 tons of sea water at a depth of 4 ft. near the ramp and 10 ft. near the stern. By pressurizing her 32 ballast tanks holding 5,200 tons of sea water to 15 psi., Vancouver can blow to a dry well in 15 min. raising her high enough to shut her stern doors and get under way. The remainder of the ballast is pushed out of her tanks in about 55 min. by the compressors. Diesel exhaust can be diverted to the ballast tanks to supplant the compressors in an emergency.

Vancouver's troop compartments are spartan by civilian standards but are an improvement over World War 2 and Korean War vintage transports. The ship is effectively air-conditioned throughout, the tiered canvas bunks are furnished with 2-in. thick foam rubber mattresses, and music can be piped to troops over a separate address system.

Collapsible writing tables and benches can be attached to stanchions which support the bunks. Troops have small individual lockers for personal effects and larger lockers in adjacent compartments for packs, sea bags and uniforms. Mess halls are fitted out with seats so troops do not have to stand to eat as aboard older transports.

Vancouver contains a complete combat information center (CIC) to keep Marine and Navy commanders abreast of troop progress and the total air-surface picture. The center houses a Navy Tactical Data System, radar viewing equipment, and electronic countermeasure and communications equipment.

Her machinery—two 12,000-shp. General Electric steam turbines pressurized by Babcock & Wilcox boilers and coupled to twin screws through Westinghouse reduction gears—gives Vancouver a sustained speed in excess of 20 kt.

Vancouver's armament consists of eight 3 in. 50 cal. automatic guns in twin mounts.

There are no hard and fast rules for the employment of helicopter-carrying vessels in an assault. Despite the publicity and glamour of vertical envelopment, Marines are quick to point out that the importance of landing troops, weapons and supplies on a beach from the sea has not been downgraded. As one Marine officer put it, "After we studied helicopter assault for awhile, we discovered the troops still had to eat."

What has happened to the amphibious concept since the Korean War is that future landings will have to work within the limitations posed by nuclear threat.

These limitations mean that warships and transports can not assemble off a beach and lie for days discharging men and materiel as they did during previous wars. A modern amphibious force will have to assemble quickly, unload what's needed, when its needed—not merely dumping a mass of materiel on the beach—and disperse.

At the same time, the ground commander will need support from the sea as he always has. Vessels such as Vancouver and the troop and helicopter

carrying LPH class give the ground commander two things: support from a dispersed position—25 to 50 mi. from the beach—and another dimension to his attack.

With helicopters, he can strike behind, or on the beach, or lift reinforcements to points where his troops are encountering difficulty. He can time his ship-based helicopter attack to come before, after, or at the same time as his waterborne assault. Or, he can hold his helicopter force in reserve miles away from the target.

While a vessel such as Vancouver combines the characteristics of four Navy ship classes: AKA cargo transports, APA troop transports, LPH helicopter aircraft carriers, and LSD dock ships, it is not meant as a replacement for any of these. Need still exists for improved versions of most of these types. What the LPD gives is a new measure of flexibility in tailoring the fleet to fit the mission.

Marines and Navy reached agreement for the first time this year on the type and number of amphibious and helicopter vessels needed for the 1970s. While the actual types and numbers planned are secret, the fleet will probably contain, in addition to other types, about eight LPHs, 14 LPDs, a new generation of 20 kt. LSTs (Landing Ship, Tank), and some fast roll-on, roll-off attack transports. The modernized fleet will probably have about 130 ships—the present total of the combined Atlantic and Pacific amphibious fleets.

Navy now has seven LPHs, four converted from aircraft carriers and three new construction ships built from the keel up for helicopters. An eighth-LPH-9, is slated for completion in late 1964. LPH-6, USS Thetis Bay, converted from a World War 2 "Anzio" class carrier, will be retired in the near future. LPH-4, -5, and -8—the USS Boxer, USS Princeton, and USS Valley Forge—all converted from "Essex" class carriers, will be retired and replaced by the early 1970s.

One problem of considerable concern to the Marines, which has not been resolved in plans for a modern amphibious fleet, is the growing shortage of Naval guns of all calibers for beachhead support.

At present, Navy has no ship in commission which can fire any shell larger than 8 in. and it has few of these. Despite the role of tactical air power, Marines feel that for pounding shore installations cheaply and accurately, naval gunfire is still best.

Rocket Engine Placement Shown on NF-104A

Throttlable AR-2 rocket of 6,000 lb. thrust is shown mounted in tail of one of three NF-104A trainers, converted by Lockheed-California Co. for Air Force's Aerospace Research Pilot School at Edwards AFB, Calif. Rocket will help boost aircraft to 120,000 to 130,000 ft., where hydrogen peroxide reaction jets in nose and wingtips will be used to simulate re-entry into the atmosphere (AW July 22, p. 253).

NEW AEROSPACE PRODUCTS

Static Inverter

Static 50-v. amp. inverter is designed to supply power to flight instruments.

Unit converts 28 v.d.c. to 115, 40, or 6 v.a.c. at 400 cps.

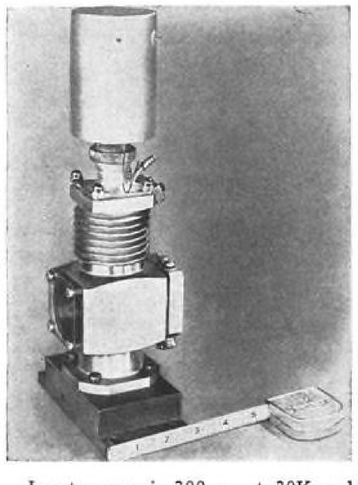
Inverter, Part No. 26130073, operates on input voltages as low as 20 v. and can withstand 80 v.d.c. transients. Input voltages down to 6 v.d.c. will not damage the unit.

Measuring 5 x 4 x 2½ in. and weighing 2.1 lb., the inverter has a 2,500-hr. minimum service life and operates in ambient temperatures from −31 to +71C.

Vapor Corp., 6444 W. Howard St., Chicago 48, Ill.

Cryogenic Refrigerator

Miniature cryogenic refrigerator, Model #42300, will operate from 25-300K, weighs 10-12 lb., exclusive of d.c. or a.c. motor and measures 4 x 5 x 12 in.



Input power is 200 w. at 30K and 100 w. at 100K.

Cold production of the refrigerator is approximately 1 w. at 30K and 10 w. at 100K.

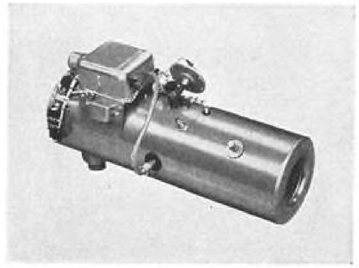
Cooling area size depends on temperature required and insulation. Unit is designed for contact cooling or remote cooling by recondensing, according to the manufacturer.

Cryogenerators Div. of North American Philips Co., Inc., Mendon & Angell Roads, Ashton, R. I.

Business Aircraft Heater

Heater is designed for single- and twin-engine business aircraft. It operates on the ground as well as inflight and requires no engine warmup, the manufacturer says.

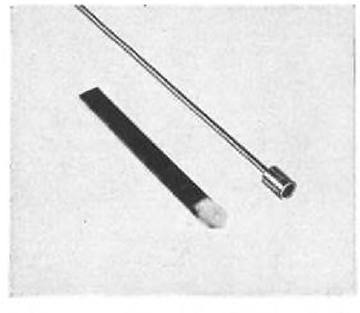
Heater comes in 15,000-50,000 btu/hr. outputs, weighs 18½-25 lb. and is 20-26 in. long, with a 5-6 ¼-in.-dia. casing excluding the electronic housing unit, depending upon which capacity heater is required. Heater is FAA-approved.



Janitrol Aero Div., Midland-Ross Corp., 4200 Surface Rd., Columbus, Ohio.

Heating Rate Transducer

Model C-1119 miniature transducer, with fast response time, is designed to measure transient heating rates on missiles and spacecraft. A small diameter of 0.125 in. permits its use on curved surfaces without disturbing aerodynamic configurations. Length is 0.165 in.



Transducer requires no power or reference junction. Full-scale output is 10 mv. at a heating rate level of 30 btu/ft.²-sec.

Hy-Cal Engineering, 12105 Los Nietos Rd., Santa Fe Springs, Calif.

WHO'S WHERE

(*Continued from page 23*)

Changes

Gordon Banerian, senior scientist, Aerojet-General Corp.'s Liquid Rocket Plant, Sacramento, Calif.

W. Robert Archibald, assistant to the general manager, Gyro Div. of Giannini Controls Corp., Duarte, Calif.

Dr. James W. Singleton, manager-Washington Div., System Development Corp., with offices in Falls Church, Va.

William D. Eikenberry, marketing director, Lear Jet Corp., Wichita, Kan.

Milton J. Berg, assistant director, Engineering Mechanics Laboratory, Space Technology Laboratories, Inc., Redondo Beach, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc.

Dr. Maurice Glicksman, director of research, Laboratories RCA, Inc., Tokyo, Japan, succeeding **Dr. Martin C. Steele,** who is returning to the David Sarnoff Research Center.

George J. Vila, manager of the newly established Cleveland (Ohio) office of General Dynamics Corp.

Dr. Edward A. Wolff, manager, Space Engineering Laboratory, Aero Geo Astro Corp., College Park, Md.

Lloyd B. Tribble, manager, Technical Coordination and Administration, Boosters and Field Tests Group, San Bernardino (Calif.) Operations of Aerospace Corp. Other San Bernardino Operations appointments: **Robert F. Newbold,** manager, Sub-Systems Studies, Advanced Planning Div.; **Dr. Robert G. Wilson,** head, Telemetry and Instrumentation Section, Radar and Communications Dept.; **Arthur O. Morse,** head, Arming and Fuzing Section, Radar and Communications Dept.; **Robert L. Smith,** assistant manager, Re-entry Vehicle Systems, Mobile Mid-Range Ballistic Missile Program (MMRBM); **William C. Yengst,** assistant director, Adaptive Systems Program, Engineering Div.

Robert Zwart, supervisor, Project Engineering Dept., Aerospace Div. of Haveg Corp., Wilmington, Del.

Dr. Herman I. Leon, director, Systems Research and Technology Center, San Fernando, Calif. (the California operation of ITT Federal Laboratories, Nutley, N. J.).

Thomas A. Fitzgerald, director of advertising and public relations, SKF Industries, Inc., Philadelphia, Pa.

Fielding G. Lucas, director, Federal Systems Marketing Div., Honeywell Electronic Data Processing, with offices in Washington, D. C., succeeding **Donald F. Brosnan,** now director of the newly established EDP Application Engineering Div.

Ira W. Kane, manager-telemetry tracking and control programs, WDL Div., Philco Corp., Palo Alto, Calif., and **Edward C. Buurma,** manager-field operations.

James M. McCarty, manager of engineering, West Coast Operations (Costa Mesa, Calif.) for Perkin-Elmer Corp.

Julian R. Levine, manager of public relations for the Washington (D. C.) office of Aerojet-General Corp.

Col. I. R. Perkin, Director of Maintenance, Oklahoma City Air Materiel Area, Tinker AFB, Okla.

Boeing has primary developmental, building and test responsibility for NASA's Saturn S-1C advanced first stage booster. Aero-Space Division's Saturn Booster Branch has immediate, long-range openings offering professional challenge and rapid advancement to graduate engineers and scientists.

This rapidly expanding program provides unique advancement advantages and ground-floor opportunities to physicists, mathematicians and engineers with the following specialties: electrical/electronics, propulsion, structural design, systems test, manufacturing, tooling, facilities, aerodynamics, cryogenics and high vacuum technology.

Salaries are commensurate with all levels of education and experience. Minimum requirement is a B.S. degree in any applicable scientific discipline. Boeing pays travel and moving allowances to newly-hired personnel.

Saturn assignments are in New Orleans as well as in Huntsville, Alabama. Other missile and space programs at Boeing's Aero-Space Division include the solid-fuel Minuteman ICBM and X-20 Dyna-Soar boost-glide vehicle.

Send your resume to Mr. L. Wendell Hays, The Boeing Company, P. O. Box 26088 - AXA, New Orleans 26, Louisiana. An equal opportunity employer.

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INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM Journal of research and development

Volume 7, Number 2, April 1963

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, AUGUST 5, 1963

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

AUTOMATIC CHECKOUT OF MANNED SPACECRAFT

North American Aviation's Space and Information Systems Division is developing a checkout system consisting of unique and highly versatile computer controlled digital command, data acquisition, and data transmission systems. State-of-the-art technologies are being employed with applications toward future requirements where microminiaturization and advanced systems design concepts will require new studies and techniques.

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All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

SPACE AND INFORMATION SYSTEMS DIVISION
North American Aviation

LETTERS

Thunderbird Vertigo

I suggest captions on Thunderbird action pictures (AW July 15, pp. 52, 53) had "dished-out" somewhere between Paris and New York.

If not, F-100s have maneuverability far beyond the designers' wildest dreams.

Picture top of p. 52 purports to be detail alternate angle of cover shot. One 100 has managed a direction reversal in the flick of a shutter. Also probes on right wing indicate both cover planes are inverted.

In the middle of p. 53 two F-100s are reported on top of loops. These tired old Mustang driver's eyes sees them inverted at hardly more than 500-700 ft., a tight loop to say the least. I think close scrutiny of the smoke trails will reveal barrel rolls—that's Travel Aire talk—rather than loops are in progress.

The pictures are great, and captions immaterial anyway. "Wow" under each would have sufficed.

Commenting on the trip to the moon (AW July 15, p. 98), all I can say is that history has shown time and again that the soldier looking up a hill at the enemy has always been at a disadvantage. Personally I'd rather be a Moondoggler looking down than a Carping Bushwacker looking up. If we can pick up a little scientific enlightening along the way, so much the better.

Thanks for a fine magazine.

HARVEY F. MACE
Sacramento, Calif.

(AVIATION WEEK & SPACE TECHNOLOGY caption writers were still suffering vertigo from following maneuvers of the seven aerobatic teams that performed at the Paris Air Show when they wrote the Thunderbird cutlines. Both F-100 Super Sabres are inverted on the cover. The top photo on p. 52 is another maneuver in which two F-100s made a low level pass in tight formation with one plane inverted.—Ed.)

I always thought Mr. Hotz had quite a high regard for the Royal Air Force, which costs us British taxpayers a lot of money and seems to me quite as good as ever it was in the dark days of 1940. Why then has he, in the July 15 issue, given a double-page picture-spread to the U.S. Air Force Thunderbirds, a double-page picture-spread to the Greek Air Force F-86 team and a double-page picture-spread to the Italian Air Force F-86 team, and not a mention of our 56 Squadron Lightning team (except for a single picture on p. 57 which got in only because somebody on AVIATION WEEK thought they were Italian F-86 Sabres)? Egad, sir, fellah ought to be shot.

NICK ARCHER
Saint Albans, Herts
England

(Mr. Hotz certainly retains his high regard for the Royal Air Force. AVIATION WEEK & SPACE TECHNOLOGY devoted the cover of its July 3, 1961, issue to the initial appearance of RAF Lightning formation aerobatic teams, in this case flown by No. 74 "Tiger" Squadron. Further photo coverage was devoted to Lightning formations in coverage of the 1961 SBAC show at Farnborough (AW Oct. 9, 1961, p. 88). Performance of No. 56 Squadron at Le Bourget added nothing new to this earlier coverage. Another look through the magnifying glass reveals that the middle picture on p. 57 of the July 15 issue is indeed the Lightning formation of 56 Squadron executing a maneuver similar to that which was part of the Italian F-86 team's performance. AW's apologies to the Italians.—Ed.)

At last. After years of diligent detective work I've discovered an error in one of your issues. (Or at least I think I have.)

On the cover and p. 52, 53 of your July 15 issue you refer to the USAF demonstration team at the Paris Air Show as the "Thunderbirds." I believe that the team shown is actually the "Skyblazers" who were a unit of the 36th Fighter Day Wing at Bitburg, Germany, in 1958.

Since the 36th was upgraded to the F-105, the 'Blazers probably are with another outfit, but I assume they still go by the same title.

At that time (1958) the Skyblazers gave demonstrations for European and Middle Eastern audiences, while the Thunderbirds out of Nellis AFB, Nev., performed primarily in this hemisphere.

Both teams epitomize precision formation flying and are to be congratulated for their fine work.

R. F. CASSARO, JR.
Formerly Lt., USAF 36th F.D.W.
Dallas, Tex.

(Afraid you missed again. USAF confirms that these were the Thunderbirds. —Ed.)

Sir Solly

In view of the academic and scientific qualifications of some of the top civilians now running the U.S. Dept. of Defense, I think your readers would be interested in the following article in the Financial Times of London entitled "From Apes' Harems." It was published July 18.

"One result of the Defense White Paper is to give to Sir Solly Zuckerman unprecedented powers. As head of both research and development in the defense sciences, he will enjoy an influence, firmly set down in the organization chart, which may possibly be even greater than that deployed during the war by Lord Cherwell, who relied on his personal pull with Sir Winston (then Mr.) Churchill. And there is no doubt that this confessedly ambitious man will enjoy it.

"Born in South Africa in 1904, he originally intended to be a doctor, and that was still his plan when he came here at 21. But his unusual scientific powers and energy were quickly noticed, and he was diverted into research.

"His first great scientific work was a study of the sexual and social habits of primates (apes, not archbishops), which led him to his Theory of Dominance—the fairly simple idea that the fiercest ape has the biggest harem, but one which has had a profound influence on subsequent theories of animal behavior. It may also be thought to have had some influence on his own conduct when after some important discoveries at Oxford in the field of endocrinology, the war first brought him close to the seats of power.

"A man of lightning intelligence and furious energy, he has never strayed far from Whitehall since. Besides defense work, he has also served on the Barlow Committee, and Advisory Council on Scientific Policy, the Scientific Manpower Committee, the Natural Resources (Technical) Committee and the Agricultural Research Council.

And he has the reputation of never missing a meeting. He still finds time for some academic work and for a full social life—as Lord Reading's son-in-law, as Prince Philip's close coadjutor at the Zoo, and above all as himself, all doors are open to him.

"His climb to the top has not been achieved without hurting some feelings. But he also has great powers of friendship; and he rules without starting the bitter policy quarrels which scientific moguls usually provoke. As a biologist dealing with the physical sciences he can approach the enormous problems of his post with few prejudices; so his own lack of the obvious qualification has made him the man best qualified for his terrifying job."

BRITISH READER
London

Navy's A-New Team

We in the A-NEW section at the Naval Air Test Center were very much pleased with the article by Mr. Philip J. Klass in your July 8 issue (p. 64) on the A-NEW ASW weapons system development. This development concept is a realistic approach to the challenging task of presenting the fleet with an ASW system which is truly integrated, reliable, maintainable, and capable of detecting and eliminating submarines.

We at the Test Center are proud to be part of the A-NEW team and we take very seriously the responsibility assigned to us in aiding in the development of this system. Our job, of course, is flight test and in this regard we will:

1. Provide fleet experienced pilots, tactical coordinators, and operators for both flight test and dynamic mockup operation.
2. Evaluate system functions and recommend improvements.
3. Perform system maintainability, operability, and compatibility evaluations.
4. Insure that the A-NEW weapons system is an operational advancement over current ASW systems.

To do this we will be utilizing the technical capabilities in the testing of avionics components for which our Weapons Systems Test Division is noted, and the operational experience of dedicated ASW crewmen who have recently been two or more years in a modern ASW VP or VS squadron.

Again, we thank you for your fine article and hope that you will continue to keep the aerospace complex aware of the challenging developments in anti-submarine warfare.

LCDR. E. C. WALLER, Project Officer
J. E. GARDNER, Project Engineer
Weapons Systems Test Division
Patuxent River, Md.

The C-141 gets its wings from Avco/ASD

The first of the U.S. Air Force's C-141's moved one step nearer completion at the Lockheed-Georgia Company plant at Marietta, Georgia, recently, when its wing-box beam assemblies were mated to the fuselage. Each assembly is 81 feet long; two of them carry the full weight of the 316,600-pound airplane in flight. The assemblies weigh almost 22,000 pounds. They have a surface area equivalent to the living space of two five-room houses, and inside are fuel tanks that can carry up to 23,000 gallons of jet fuel.

In a few weeks the C-141 will be rolled out of the plant, and it is scheduled to fly before the end of the year.

Avco's Aerospace Structures Division at Nashville, Tennessee, is subcontractor to Lockheed for C-141 wing-box beam assemblies. Avco got the contract in January, 1962, and delivered the first set of assemblies "on time" in February, 1963. Today, specially adapted rail cars that haul the long, angular assemblies from Nashville to Marietta, Georgia, are a regular sight along the rail line between the two cities.

Thus, Avco's Aerospace Structures Division marks another milestone in its successful fulfillment of work in aerospace structures. Other projects underway at the Division include: empennages for the C-130; upper-aft fuselage of stainless-steel honeycomb for the XB-70; fin tips, rudder, and stabilator aluminum honeycomb trailing edges for the F4B/F4C; fire-wall, instrument panels, and other components for the Saturn rocket booster; plus many programs that are classified.

Avco's Aerospace Structures Division is a specialist in the art and science of producing lightweight, high-strength, temperature-resistant structures for the space age. For more information, write: General Manager—Structures Marketing, Aerospace Structures Division, Avco Corporation, Nashville 1, Tennessee.

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