Aviation Week & Space Technology

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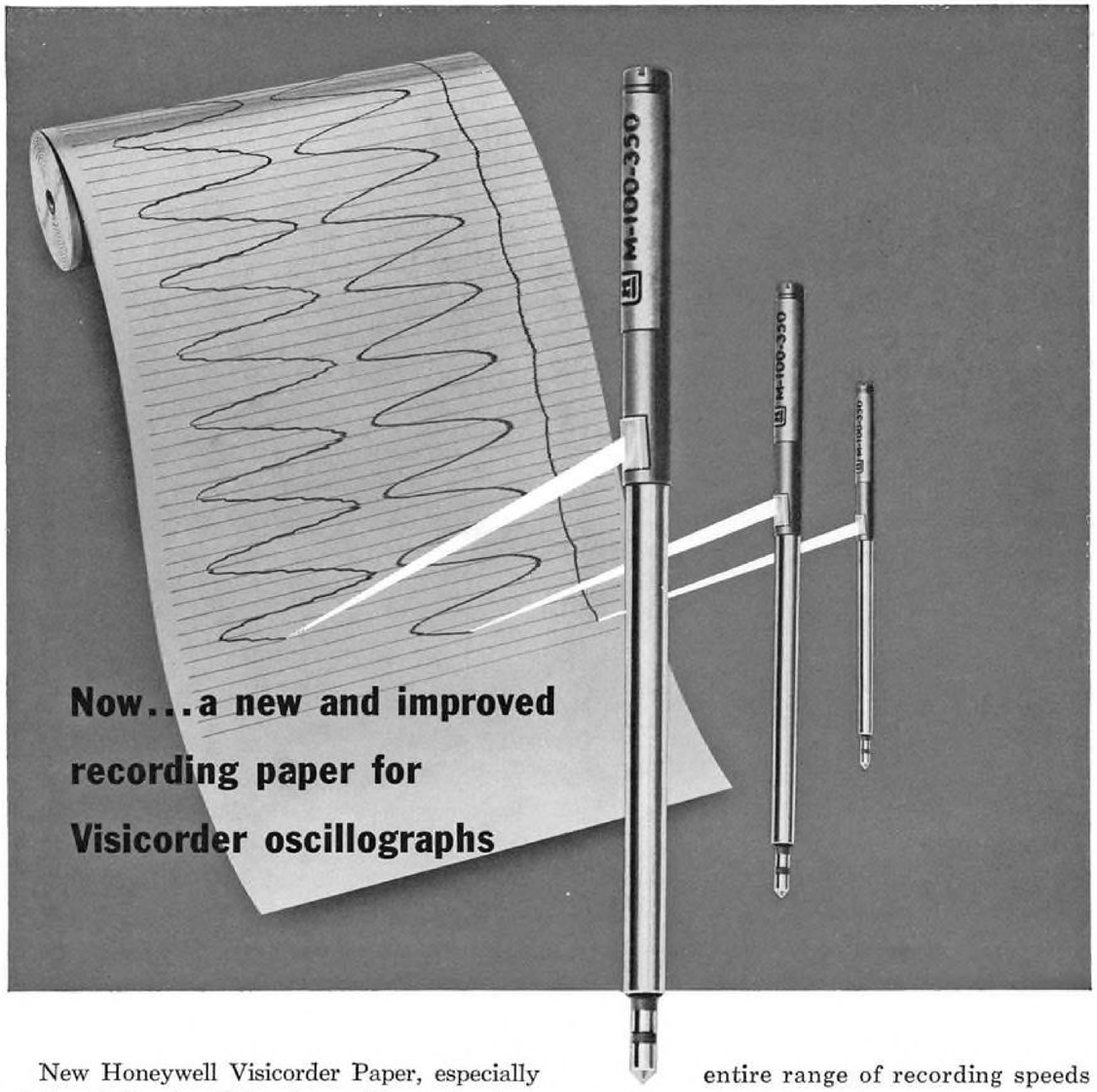
July 23, 1962

Lunar Orbital Rendezvous Mission Details

New Wide-Band Antenna



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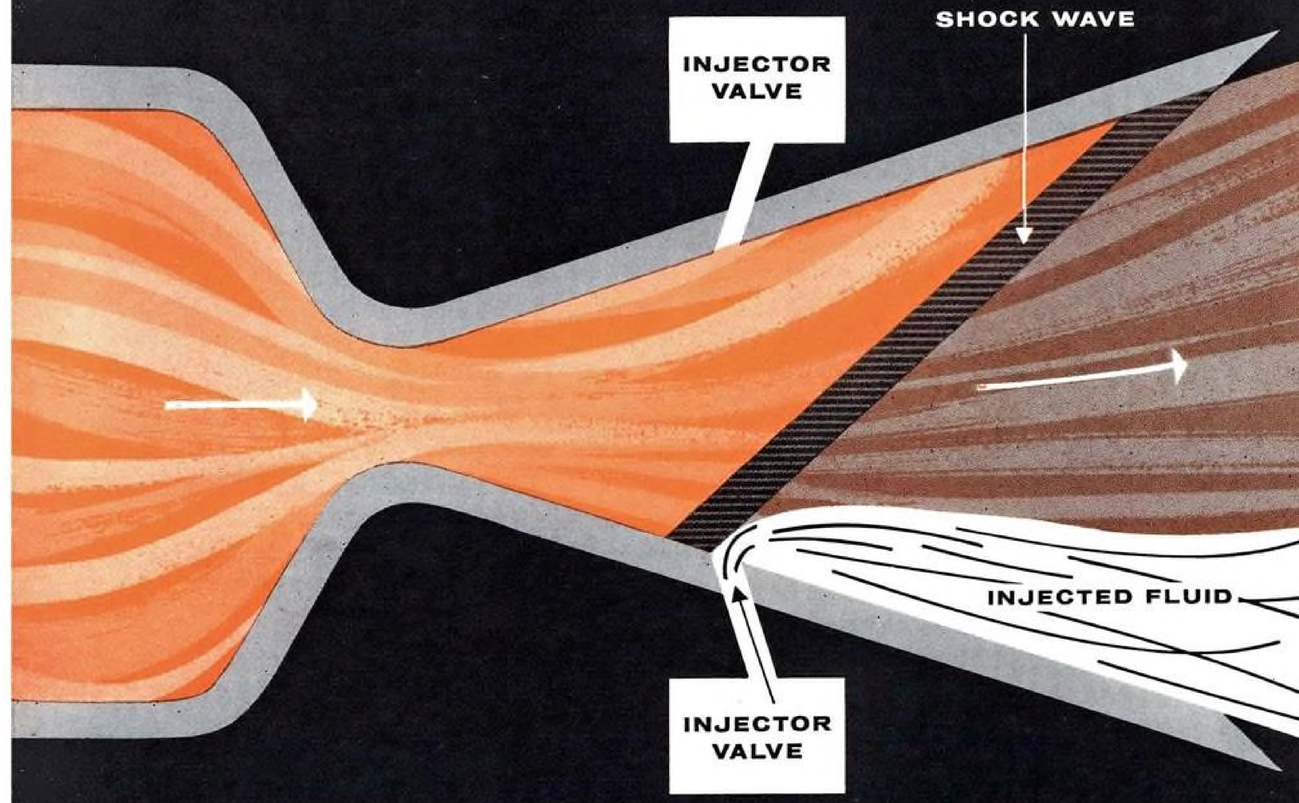

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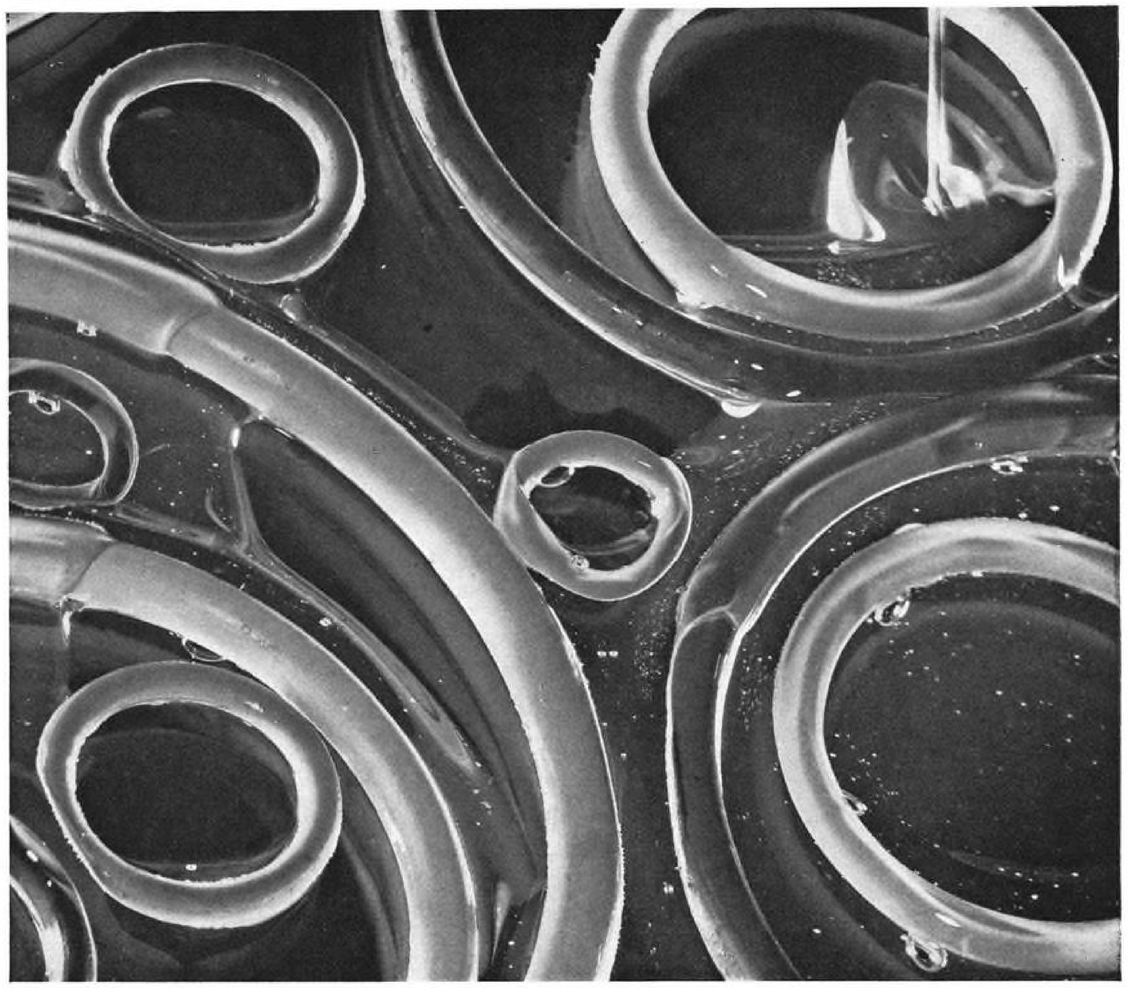

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AEROSPACE CALENDAR

Aug. 1-3—Engineering Foundation's Research Conference on Composite Materials, Tilton School, Tilton, N. H.
Aug. 1-5—Experimental Aircraft Assn. Fly-In, Rockford Airport, Rockford, Ill.
Aug. 6-10—7th Annual Technical Symposium, Society of Photographic Instrumentation Engineers in cooperation with the Air Force Systems Command, Statler Hilton Hotel, New York, N. Y.
Aug. 7-9—Low Level Wind Conference, Texas Western College, El Paso, Tex. Sponsors: American Meteorological Society; U. S. Army Signal Missile Support Agency. (Aug. 9 session in Dallas.)
Aug. 7-9—PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) Seminars, ITT Data Processing Center, Paramus, N. J.
Aug. 7-9—57th Meeting, National Aerospace Standards Committee, AIA, Benjamin Franklin Hotel, Seattle, Wash.
Aug. 8-10—1962 Standards Laboratory Conference, National Bureau of Standards' Boulder Laboratories, Boulder, Colo.
Aug. 10-11—IAS National Specialists Meeting, Man-Machine Competition, Olympic Hotel, Seattle, Wash.
Aug. 11-Sept. 3—Sixth World Parachuting Championship, Orange, Mass. Sponsors: National Aeronautic Assn.; Parachute Club of America.
Aug. 13-16—Pacific Energy Conversion Conference, American Institute of Electrical Engineers, Fairmont Hotel, San Francisco.

(*Continued on page 7*)

AVIATION WEEK and Space Technology

July 23, 1962

Vol. 77, No. 4

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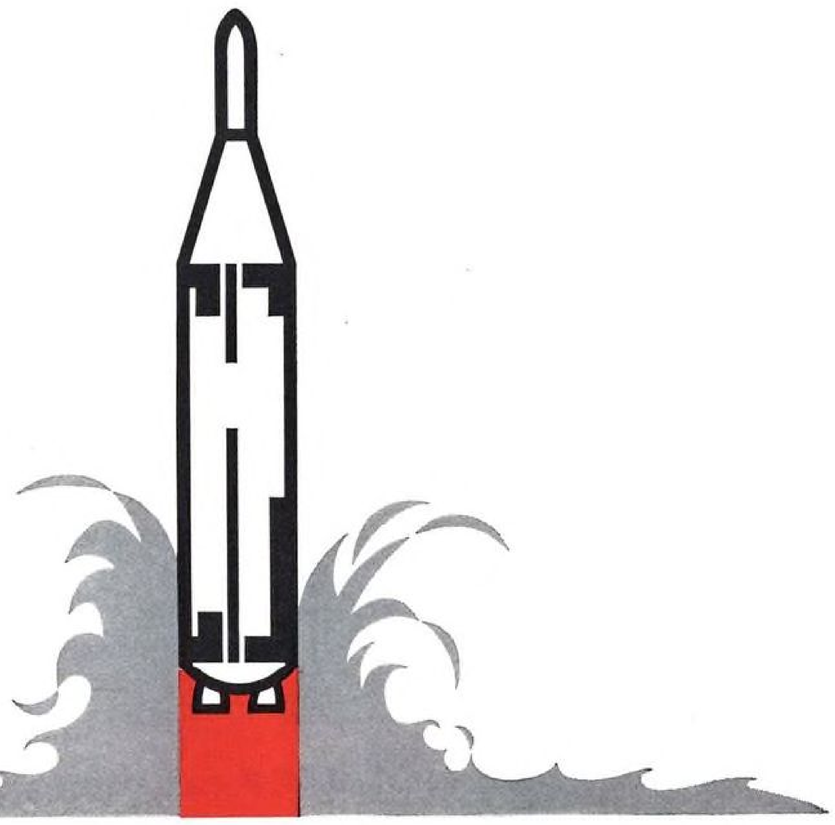

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AEROSPACE CALENDAR

(Continued from page 5)

Aug. 13-16—Seventh Symposium on Ballistic Missile and Space Technology, U. S. Air Force Academy, Colorado Springs, Colo. Sponsors: USAF; Aerospace Corp.

Aug. 14-16—Cryogenic Engineering Conference, University of California of Los Angeles, Los Angeles, Calif.

Aug. 14-17—International Conference on Precision Electromagnetic Measurements, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

Aug. 15-17—Nuclear Propulsion Conference, Monterey, Calif. Joint Meeting: Institute of the Aerospace Sciences; American Rocket Society; American Nuclear Society. (Classified.)

Aug. 15-17—Third International Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 18-19—Lafayette Escadrille, Lafayette Flying Corps and Americans of the French Foreign Legion, 1st Reunion Airshow, Battle Creek, Mich.

Aug. 19-25—Annual Meeting and Conference, Airport Operators Council, Princess Kaiulani Hotel, Honolulu, Hawaii.

Aug. 20—Technical Symposium, Precision Potentiometer Manufacturers Assn., Statler Hilton Hotel, Los Angeles, Calif.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

Aug. 21-24—International Symposium on Far Infrared Spectroscopy, Sheraton Gibson Hotel, Cincinnati, Ohio. Sponsor: Materials Central, Aeronautical Systems Division, Air Force Systems Command.

Aug. 21-Sept. 17—14th Session, International Civil Aviation Organization Assembly, Rome, Italy.

Aug. 23-24—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

Aug. 23-24—Conference on Thin Films, Colorado Hotel, Glenwood Springs, Colo. Sponsor: Solid State Electronics Laboratory, University of Denver's Research Institute.

Aug. 27-29—AIME Technical Conference on Advanced Electronic Materials, Benjamin Franklin Hotel, Philadelphia, Pa.

Aug. 27-Sept. 1—Third International Congress, International Council of the Aeronautical Sciences, New Congress Hall, Stockholm, Sweden.

Aug. 27-Sept. 1—Second International Congress, International Federation of Information Processing Societies, Munich.

Aug. 28-30—Fourth Conference on Maintainability of Electronic Equipment, Electronic Industries Assn. (in cooperation with Department of Defense), University of Colorado, Boulder, Colo.

Sept. 3-7—National Advanced Technology Management Conference, Institute of Radio Engineers, Seattle, Wash.

Sept. 3-7—International Symposium on Information Theory, Institute of Radio Engineers, Brussels, Belgium.

Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-7—National Advanced-Technology Management Conference, Opera House,

(Continued on page 9)

Four important questions you should ask before selecting any scientific or engineering computer.

They lead to the one sure way
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(2) What software is available?

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(3) Will you have to hire specialized computer personnel?

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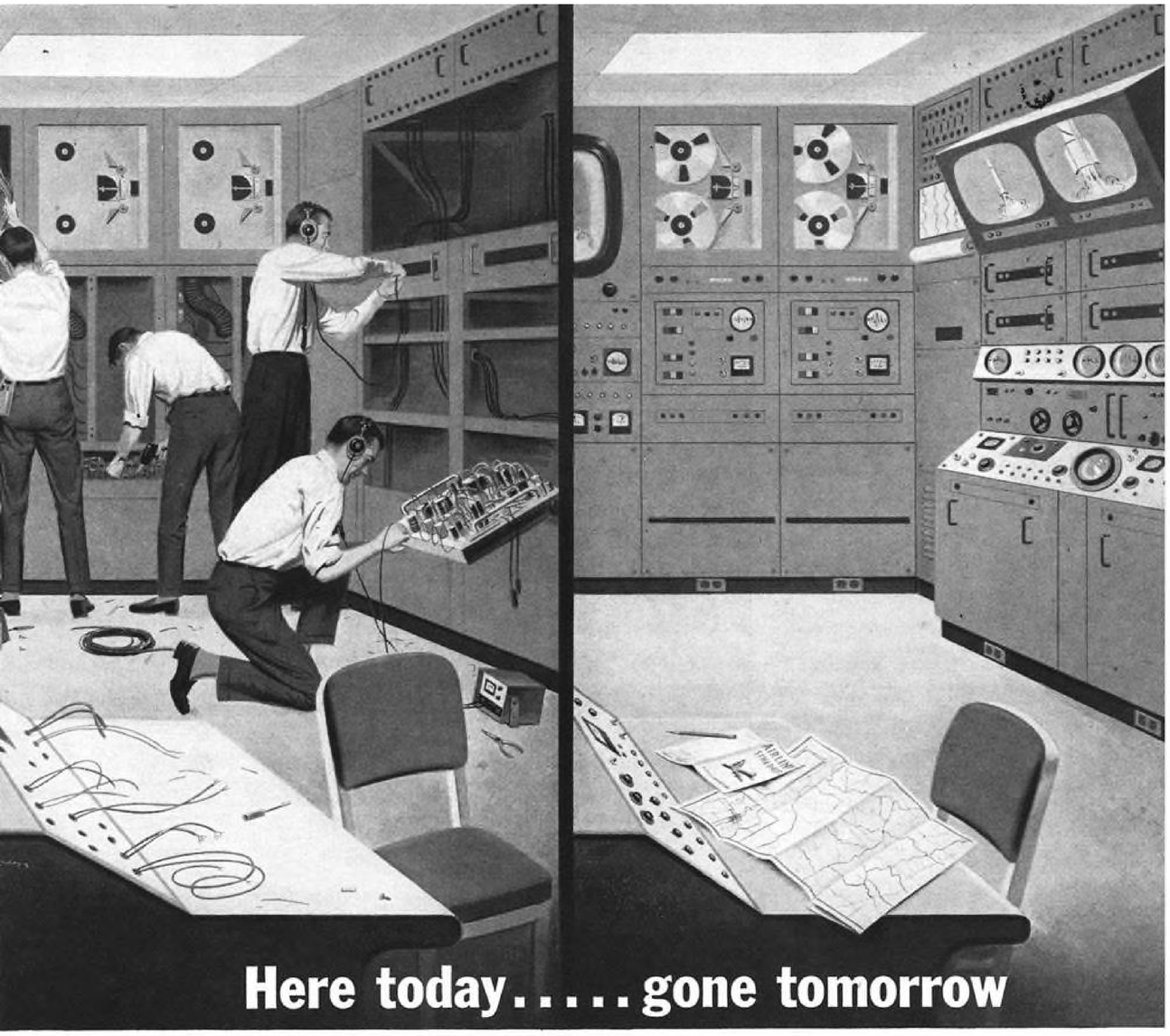

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AEROSPACE CALENDAR

(*Continued from page 7*)

Seattle World's Fair grounds, Wash. Sponsors: University of Washington, professional engineering groups and technologically oriented business firms.

Sept. 5-7—Symposium on Measurement of Thermal Radiation Properties of Solids, Biltmore Hotel, Dayton, Ohio. Sponsors: Aeronautical Systems Division USAF; National Bureau of Standards; NASA.

Sept. 10-14—Fourth National Conference on Applied Meteorology, American Meteorological Society, Hampton, Va.

Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin.

Sept. 13-14—10th Annual Engineering Management Conference, IRE, Hotel Roosevelt, New Orleans, La.

Sept. 17-18—Hydrofoil & Air Cushion Vehicles Meeting, Institute of the Aerospace Sciences, Shoreham Hotel, Washington.

Sept. 18-20—Ordnance Environmental Research Symposium, El Tropicano Hotel, San Antonio, Tex. Sponsor: Environmental Research Office of the Office of the Chief of Ordnance. Arranged by Southwest Research Institute.

Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.

Sept. 19-20—Technical Manpower Utilization Meeting, Institute of the Aerospace Sciences, Hotel Commodore, New York.

Sept. 19-20—Operations & Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 19-21—Sixth National Conference on Tube Techniques, Western Union Auditorium, New York, N. Y. Sponsor: Advisory Group on Electron Devices.

Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.

Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.

Sept. 24-Oct. 12—International Air Transport Assn. Traffic Conferences, San Marcos Hotel, Chandler, Ariz.

Sept. 25-28—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Sept. 26-Oct. 2—1962 General Conference, Federation Aeronautique Internationale, Athens, Greece.

Sept. 28-29—Society of Experimental Test Pilots' Sixth Annual Awards Banquet & Symposium, Beverly-Hilton Hotel, Beverly Hills, Calif.

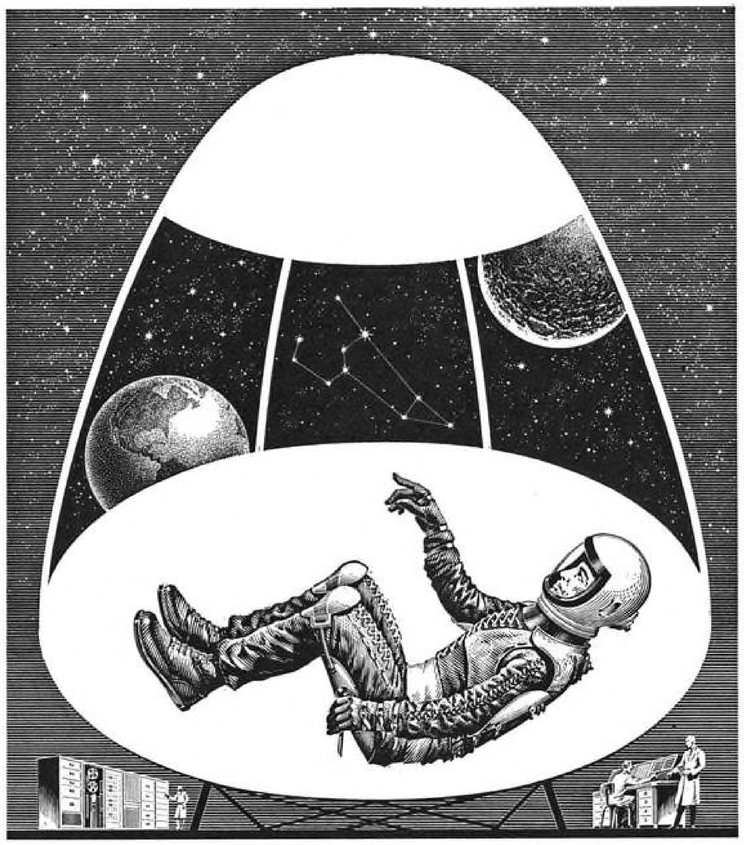
Oct. 1-3—Seventh Annual Exposition & Symposium, Air Traffic Control Assn., Flamingo Hotel, Las Vegas, Nev.

Oct. 2-4—Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio. Co-sponsors: AFOSR, General Electric.

Oct. 2-4—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Fontainebleau Hotel, Miami Beach, Fla.

Oct. 8-12—National Aeronautic & Space Engineering & Manufacturing Meeting & Display, Society of Automotive Engineers, The Ambassador, Los Angeles, Calif.

Oct. 15-17—ASW Meeting, Somerset Hotel, Boston, Mass. Sponsors: Institute of the Aerospace Sciences; U. S. Navy.



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COVER: Telscom automatic tracking antenna, developed by Radiation, Inc., can be used over extremely wide frequency range, from 215 mc. to 2,300 mc., providing 20 to 40 db. gain, respectively. Antenna employs a four-aperture Williams array, consisting of four closely spaced parabolic reflectors in combination with log-periodic feeds which are interconnected to produce error signal information for tracking purposes.

PICTURE CREDITS

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EDITORIAL

Telstar Shining

This afternoon, Telstar, the American Telephone & Telegraph Co.'s privately financed communication satellite, is scheduled to add to its already considerable lustre with a formal transatlantic television program carrying President Kennedy's press conference from Washington to Europe and bringing European programs to American viewers. Just about two years ago (AW Aug. 8, 1960, p. 19) we wrote:

"Within several years, millions of people around the earth will witness the first live global television via communications satellites. Recognizing the powerful political and social influence that domestic television has already demonstrated, global television may well be the most significant peaceful application of space technology for at least the next several decades."

Telstar's successful performance since it blasted off the launch pad at Cape Canaveral on July 10 has certainly authenticated the first half of this prediction and opened the way toward fulfillment of the rest.

Triumph of Technical Skill

In its brief orbital existence, Telstar has become one of the brightest lights in the U.S. space program. It has achieved a significant and dramatic first for this nation in space performance that can readily be grasped and understood by everybody. It is also further dramatic proof, along with the Tiros weather satellites, of what space technology can offer to improve life on earth in the immediate future. It is a significant triumph for the technical skill and management foresight of U.S. private enterprise working in unique partnership with its government.

When laurels are distributed for Telstar's performance, as indeed they must, it would be well to start with Dr. John Pierce of the Bell Telephone Laboratories, who was the first in this country to suggest the use of space satellites for a communications system and to analyze the design possibilities of such a system. AT&T's management and its Bell System affiliates have invested at least $3 million in direct launch costs; another $10 million in the ground terminal at Andover, Me., and many more millions in research on the new technology that made Telstar possible. In addition to this U.S. corporate investment, the initiative displayed by AT&T in taking full advantage of former President Eisenhower's facilities offer stimulated England and France to build ground stations in time to participate in the initial experiments, with Germany and Italy also committed to build their own facilities and Japan almost sure to follow.

Credit must also be given to the Bell Labs for their initial work in creating the transistor and the silicon solar cell, without which Telstar and many other types of satellites would not be possible. And the old reliable Douglas Thor Delta booster with upper stages by Aerojet and Allegany Ballistic Lab registered its tenth straight successful space mission by boosting the Telstar into orbit. Telstar Project Director Eugene F. O'Neill and his associates also merit an accolade.

One of the initial Telstar surprises to the laymen who recall the early scratchy, whistling days of radio was the amazing clarity of its voice transmission and transatlantic television broadcasts. In fact, this high quality transmission so surprised electronically sophisticated Philip Klass, Aviation Week & Space Technology avionics editor, that he inadvertently became the first to bounce profanity back from space through a satellite. No one who watched the initial television from Telstar on its sixth orbit could avoid experiencing the eerie impact of the satellite relay station or fail to feel its significance for the future. And a pardonable surge of national pride was in order when the first transmission through space showed the American flag and played "The Star Spangled Banner."

Even during its experimental period, Telstar will forge a major new communications link between the people of North America and Europe and will certainly lay a sound foundation for the operational global network that we envisaged in our editorial of two years ago. Though the impact on the people of England and France has already been marked, the global communications network can probably play its most significant role in shedding light on the undeveloped and backward countries of the world far faster than would be possible with conventional communications systems.

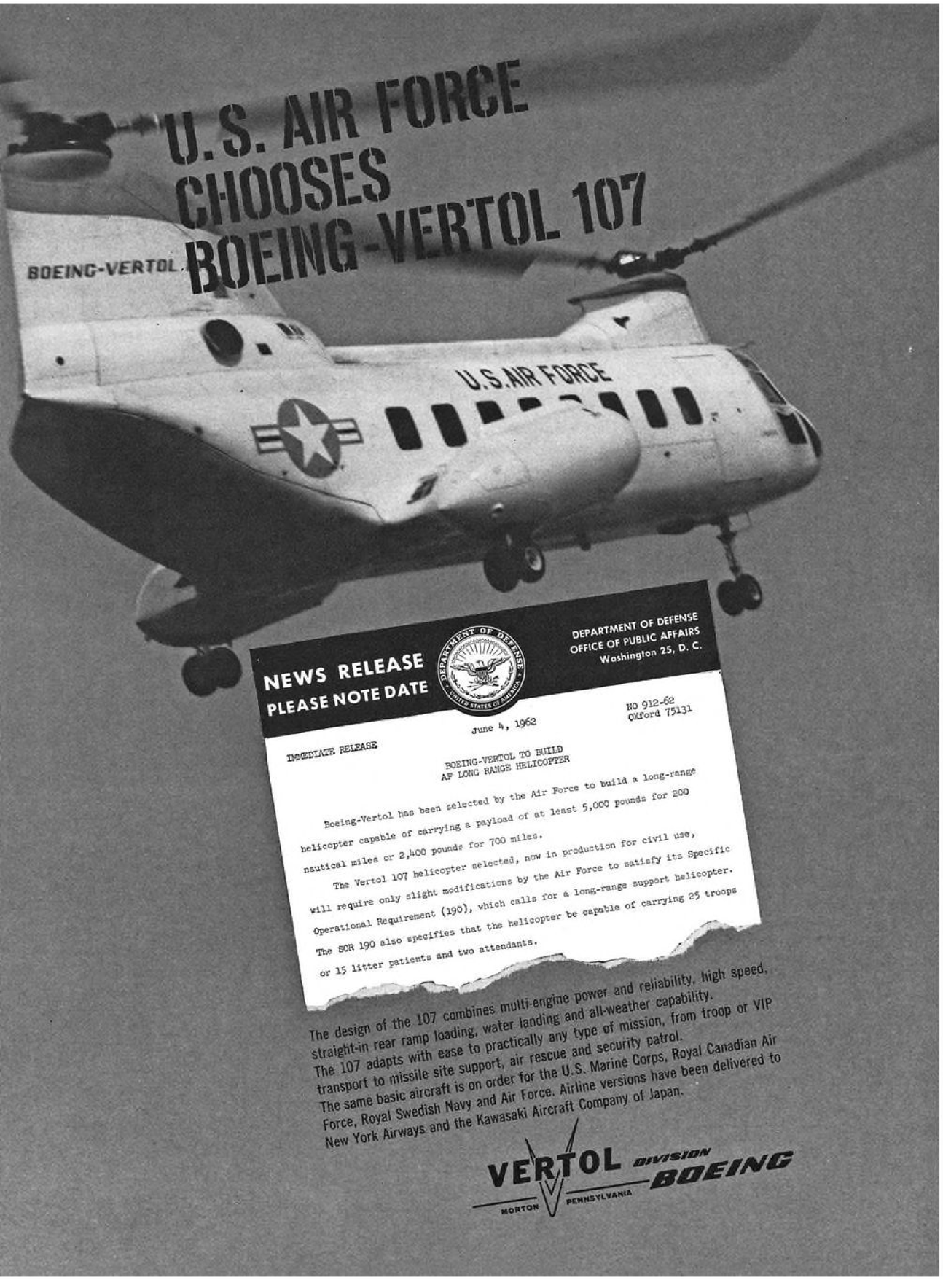
Intelligent Programing Required

While American industrial enterprise, as typified by AT&T's Telstar program, has given the world a fine example of how the U.S. system can really function, it behooves the television network executives to display considerably more statesmanship and intelligence than they have yet exhibited in their domestic programing to provide people around the world with the very best examples of what this country really has to offer. If all Telstar serves to accomplish is to spread domestic television program trash on a global scale, it will indeed prove to be a sorry subversion of the American image.

Politically, the fate of the U.S. communication satellite system's corporate structure and operational substance is still being debated in Congress. We think the amended version of the Kennedy Administration's bill on this subject is about as good an approach to the problem as is possible at this time. We think private ownership with opportunity for public participation and provision for a watchful government observation is far preferable to complete public ownership of this type facility.

So Telstar has now joined Mercury and Tiros as the shining successes of the U.S. space program and offers further proof that the conquest of space is really hitched to the pace of a galloping technology.

—Robert Hotz



WHO'S WHERE

In the Front Office

Textron's Bell Aerosystems Co., Buffalo, N. Y., has announced the following appointments: **Norton C. Willcox**, vice president-finance; **John M. Schweizer, Jr.**, a vice president; **Richard H. McKee**, treasurer; **Joseph E. Conners**, secretary; **Ramon J. Hartung**, controller.

B. S. Sauter, president, Deutsch Fastener Corp., Los Angeles, Calif. Also: **P. E. Holzman**, a vice president; **E. R. Schochet**, secretary; **F. J. Zern**, treasurer.

Roy P. Jackson, vice president and assistant general manager, Northrop Space Laboratories, Hawthorne, Calif. Jackson was assistant general operations manager of Aeronutronic's Space Systems Operations.

Dr. Robert G. Ulrech, vice president-engineering, and **Robert O. Johnson**, vice president-field sales, Consolidated Vacuum Corp., Rochester, N. Y.

Russell A. Hedden, vice president and general manager, The Sheffield Corp., Dayton, Ohio, a subsidiary of The Bendix Corp.

W. Neal Brown, assistant treasurer, Lockheed Aircraft Corp., Burbank, Calif., succeeding **Erle M. Constable**, now executive vice president of Lockheed Aircraft International.

Edward L. Dashefsky, a vice president, Raytheon Co., Lexington, Mass. Mr. Dashefsky continues as division manager of the Microwave and Power Tube Division.

Joseph P. Tumminaro, vice president-manufacturing, Standard Kollsman Industries, Inc., Melrose Park, Ill.

William R. Sweeney, vice president-government operations, Daystrom, Inc., and in charge of the Washington, D. C., office.

Dit-Mco, Inc., Kansas City, Mo., has appointed the following vice presidents: **William C. Comer**, sales; **Fred N. Epperson**, manufacturing; **Price D. Wickersham**, engineering.

Charles A. Sereno, vice president-marketing, GPL Division of General Precision, Inc., Pleasantville, N. Y.

Robert A. Marshall, vice president, Federal Electric Corp., Paramus, N. J. Mr. Marshall continues as director of marketing.

Alfred Strogoff, executive vice president, Adler Electronics, Inc., New Rochelle, N. Y. Also: **Lawrence I. Marks**, vice president, Finance Division; **Charles P. Johnson**, vice president, Government Products Division.

Brig. Gen. Allman T. Culbertson, vice commander, Aeronautical Systems Division, Wright-Patterson AFB, Ohio, will become deputy commander, Air Proving Ground Center, Eglin AFB, Fla., on Aug. 18.

Honors and Elections

Philip C. Garratt, vice president and managing director of de Havilland Aircraft of Canada, Ltd., has been named an Honorary Fellow in the Canadian Aeronautics and Space Institute.

Carter L. Burgess, president of American Machine & Foundry Co., has received the U. S. Air Force Ballistics Systems Division Commander's Award for outstanding service to the Division. AMF is an associate contractor in the Titan 1 program.

(*Continued on page 81*)

INDUSTRY OBSERVER

► Kaman Aircraft Corp. is flying a testbed version of its K-600-3 Huskie 3 twin-engine follow-on to the firm's H-43B helicopter. New version, developed with company funds, is designed for troop-carrying missions, especially in counter-insurgency operations. Huskie 3 has a single-boom empennage instead of the H-43B's twin boom. Changes are contemplated in the dynamic system, but the current model is flying with a standard H-43B rotor system. Cabin of the Huskie 3 has been enlarged over previous versions and windows have been added.

► **Feasibility of using a portion of a spacecraft structure itself as a rocket motor nozzle is being investigated by National Aeronautics and Space Administration. Standard current practice is to use a separate, non-structural nozzle.**

► Adaptive flight control system proposals for TFX bi-service tactical fighter design have been requested by General Dynamics/Ft. Worth. Such systems provide uniform control responses over a wide range of speeds and altitudes without reference to atmospheric environmental data which is difficult to measure at extreme speeds and altitudes. Four companies were invited to bidders' conference: Bendix, General Electric, Minneapolis-Honeywell and Sperry-Rand.

► **Navy's Mailbuoy satellites, lightweight UHF communications packages being developed by Ford's Aeronutronic Division and intended to extend fleet communications (AW Mar. 5, p. 15), are expected to be available for test launch late this year. Specific launch vehicles have not been assigned.**

► Flight tests of laminar-flow wing section based on research by Handley Page team led by Dr. G. V. Lachmann are scheduled to start this week at Britain's Cranfield College of Aeronautics. Project is being financed by Ministry of Aviation. The wing section is mounted vertically on the fuselage top of an Avro Lancaster bomber.

► **Single-crystal photoconductor detectors, which could have application to ballistic missile launch sensing systems, are being developed by Texas Instruments, Inc., for Air Force Systems Command's Space Systems Division.**

► Development of small air-cushion vehicle to carry land-mine detection equipment is planned by Army Transportation Research Command, Ft. Eustis, Va. Air cushion vehicle is to measure approximately seven feet square and to carry 10-lb. payload; it will be attached to conventional land vehicles but will extend about 20 ft. ahead. Command hopes to attract industry interest, has set a July 26 deadline for interested companies.

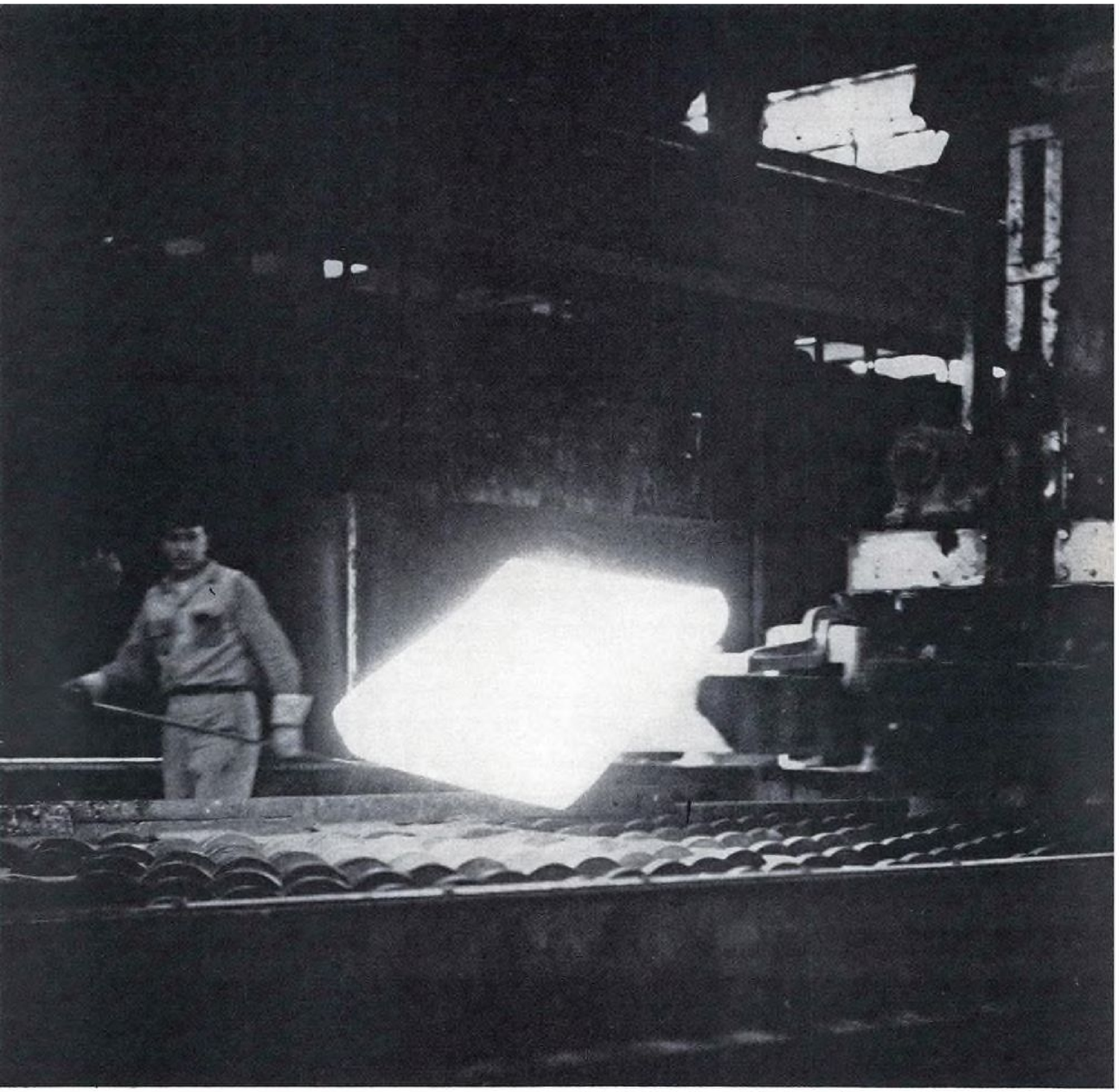
► **Folland Aircraft has dropped work on its GERM (ground-effects research machine) (AW Dec. 26, 1960, p. 51) after Hawker Siddeley board decision that the GERM has no immediate commercial future.**

► Modified version of adaptive control system being tested in the North American X-15 is being developed for West Germany's VJ-101 VTOL aircraft by Minneapolis-Honeywell Regulator Co.

► **Ford's Aeronutronic Division is producing decoy sets for application to Titan 2 ICBM re-entry vehicles.**

► Expandable nozzle designs for application to large liquid-propellant rocket motors are under investigation by Aerojet-General. Study program, under Air Force contract, is to be completed early next year.

► **Hunting 126 jet-flap research aircraft, originally scheduled by the British to fly at the end of last year, probably will not make the Farnborough display this year. Single-seat airplane, powered by a Bristol Siddeley Orpheus turbojet, is in an advanced stage of construction. Taxi tests may start in August, but the first flight date has not now been scheduled. Plane was formerly designated Hunting ER-189D.**



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Washington Roundup

Space Policy Statement

President Kennedy's anger over reports that the Air Force was about to embark on a greatly expanded space program has put the National Aeronautics and Space Council's proposed statement of national space policy on the back burner. The statement would have delineated the status of the military portion of U. S. space effort (AW June 18, p. 26) but there is a good chance now that it may never even be issued by the White House.

Split between the Air Force and the Defense Department over the military value of large solid-rocket motors is expected to show itself next month when a special House subcommittee demands to know why more emphasis has not been placed on the development of the 156-in. and 240-in. motors (AW July 9, p. 17).

Rep. David King of Utah, where Thiokol and Hercules Powder Co. have solid-rocket facilities, persuaded Chairman George Miller of the House space committee to hold the hearings. Rep. King, who is running for the Democratic nomination for senator, will charge that the Air Force and National Aeronautics and Space Administration broke faith with the committee by failing to accelerate large solid-rocket development. Air Force leaders favor faster development but key people in Defense's research and engineering office question whether large solids are practical for weapon systems. The hearings are scheduled for Aug. 1 and 2.

Appropriations Status

Budget decisions on a number of aerospace issues will follow the settlement last week of the dispute between the House and Senate appropriations committees. Chairman Albert Thomas of the House Independent Offices Appropriations Subcommittee, who represented the House in discussions of procedure with the Senate, predicts that all the snagged money bills will be sent to the Senate within three weeks. One of these is NASA's Fiscal 1963 budget, a bill on which Rep. Thomas is in an uncomfortable position.

Rep. Clarence Cannon, chairman of the full appropriations committee, is pressing Rep. Thomas for cuts in the NASA budget, while on the other side the House space committee threatens to retaliate for any heavy cuts by refusing to authorize money next year for NASA's Manned Spacecraft Center at Houston, in Thomas' home territory. Appropriations committees can cut but cannot increase amounts authorized by the space committee. Indications are that Rep. Thomas' subcommittee will go ahead and cut about $40 million from the $3.7 billion authorized by the space committee.

RS-70 Issue Unresolved

Main issue left to be resolved in the Defense Department appropriation bill for Fiscal 1963 is funding for the RS-70. President Kennedy asked for $171 million, the House appropriated $224 million—with most of the increase earmarked for development of radar for supersonic reconnaissance—and the Senate appropriated the $491 million asked by the Air Force for full development of six RS-70s. Both houses have passed the bill but the House-Senate conference has been delayed until now by the procedural fight. Defense is completing the study it made to placate House Armed Services Committee Chairman Carl Vinson, who feels the Administration is underestimating the importance of the aircraft.

Fireworks may be produced in Senate appropriations subcommittee hearings on Federal Aviation Agency's budget, which also had been delayed by the procedural fight. Chairman Warren Magnuson has been critical of the agency lately and has some misgivings about its research activities.

French KC-135 Buy

Negotiations between France and the U. S. for French purchase of 10 Boeing KC-135 tankers for refueling Mirage 4 bombers reflects a modification of U. S. policy against the creation of separate nuclear deterrent forces by NATO nations. Defense Secretary Robert McNamara said last May that he would not object to the sale and Secretary of State Dean Rusk recently has indicated no objection to a separate French deterrent force. He also expressed a hope that France's nuclear forces would be closely integrated with others in the West.

Defense Department's attempts to cut the flow of U. S. dollars overseas by another $900 million a year should result in increased purchases of U. S. military equipment by allies, but it also may increase the defense budget, since the department will buy as much as possible at home rather than abroad. From now on, Secretary McNamara will personally review all proposed purchases abroad to see whether they are "in the national interest." He also doubled the differential barrier for foreign firms bidding against U. S. firms in military procurements. U. S. firms now may win competitions if the cost of hardware, transportation and handling of the item is not more than 50% above the cost figure presented by a foreign company.

Maritime Administration planning chief W. T. Potter apologetically told the House space committee that he could not keep his artist from painting a name on the picture of the agency's experimental ground effects machine (see p. 21). Then he flashed on the screen a picture of the craft emblazoned: "Columbia—a GEM of the ocean."

—Washington Staff

Lunar Bug Bids Sought From Eight Firms

Apollo excursion module limited to manned airframe firms; ARS lunar meeting hears design details.

Cleveland—Eight airframe companies will be asked to compete for development and construction of the Apollo lunar excursion module as the U.S. manned lunar landing program continues to be accelerated with critical decisions being made on components, major hardware items and methods of operation. The module is the only major hardware component in the Apollo mission not under contract.

National Aeronautics and Space Administration will request proposals from Boeing, Douglas, General Dynamics/Convair, Grumman, Ling-Temco-Vought, Lockheed, Martin and Northrop for the lunar excursion module (LEM) to be used by two astronaut-scientists for descending to the surface of the moon (see p. 40). Proposal requests were prepared immediately after NASA selected the lunar orbit rendezvous method of landing men on the moon (AW July 2, p. 89; July 9, p. 25, and July 16, p. 21).

Bidders' list for the LEM was learned here during the American Rocket Society lunar missions meeting, which was organized to underscore the systems aspect of the lunar program. Technical presentations covered the operational mission phases and the fundamental philosophies dictating the decisions being made on the Apollo program.

A number of new Apollo system details were disclosed during the meeting, including the basic characteristics of the LEM, also called the bug.

Exterior structure will be light, high-strength airframe materials, probably titanium, magnesium and aluminum.

NASA is understood to be limiting the competition to companies with previous experience in development of manned aircraft airframes.

Propulsion System

The agency currently prefers a propulsion system using earth-storable hypergolic propellants. The engine will be throttleable, with ratios under discussion ranging from 3:1 to 10:1. Systems with both one and three nozzles are under consideration. Maximum thrust will be 20,000-30,000 lb.

First Apollo manned landing mission will probably result in a lunar stay of no more than 24 hr., according to D. Brainerd Holmes, director of NASA's Office of Manned Space Flight. Decision to use the lunar orbit rendezvous technique limits the stay in early flights to about four days. This could be extended in later flights by use of a lunar logistics vehicle (LLV), essentially an unmanned truck containing emergency supplies, fuel, navigation aids and scientific instruments. NASA anticipates that caches can be established on the moon which will permit astronauts to remain there as long as desired.

During the initial flights, astronauts will carry with them about 200 lb. of scientific instruments, Holmes said. National Academy of Sciences and other scientific organizations are advising NASA on the most promising instruments and experiments.

Backup Method

Keynote speaker for the meeting, Dr. Robert C. Seamans, Jr., associate NASA administrator, confirmed that even though the agency has selected the lunar orbit rendezvous mode for Apollo, it is retaining flexibility by giving serious study to a backup approach: use of a two-man Apollo-type capsule launched directly to the moon with an uprated Saturn C-5 launch vehicle (AW July 16, p. 32).

Dr. Seamans said the U.S. is still behind Soviet Russia in launch vehicles, but that this nation ranks first in the space sciences and in the peaceful application of space technology.

He also said that as a result of the 25-deg. re-entry yaw error in the Mercury Atlas-7 flight of Lt. Cdr. Scott Carpenter (AW June 11, p. 31), a yaw reference system may be added to the MA-8 capsule to be flown by Cdr. Walter M. Schirra. Cdr. Carpenter was able to orient his pitch accurately by visual horizon reference, but he had no reference for yaw.

In relating manned and unmanned flight programs, Dr. Joseph F. Shea, Holmes' deputy for systems, characterized unmanned programs as "making straight the way" for Apollo manned missions.

Spacecraft design, he said, is dictated primarily by micrometeoroids and radiation and data on these influences will be obtained from unmanned flights.

Radiation Belts

Dr. James A. Van Allen of the State University of Iowa, theorized that the trapped protons in the inner Van Allen belt might be dissipated by nuclear explosions, but he cautioned that such a project would require perhaps 100 times the energy expended in the recent Johnston Island high altitude nuclear tests, and even then there would be no assurance that the area would be safe for extended manned flight.

He theorized that a project to clean out the protons with nuclear explosions could last up to a year. He bases this on the measurements made by the Injun satellite over Johnston Island, where the detonation had only a slight effect on the proton count but markedly increased the number of electrons in the lower belt.

Dr. Van Allen, who has questioned the emphasis being given manned space flight, said cislunar radiation caused by solar events is significant and must be listed among other known hazards. Dr. Shea said better means of predicting solar storms must be developed.

Landing Site Selection

U.S. Geological Survey Astrogeology Branch has recommended 15 possible landing sites for Apollo, Dr. Shea said. He pointed out that use of the bug limits the initial landing area to a belt 10 deg. on either side of the equator bounded by the 270-deg. and 360-deg. longitudes.

Much more detailed reconnaissance will precede selection of the precise Apollo landing site, which will be chosen chiefly for its scientific potential, Shea said. Best lunar maps available today have 1:1,000,000 scale. NASA requires maps to a scale of 1:250,000 over a 10-mi. square area with ±150-ft. vertical accuracies and 800-ft. horizontal accuracies. At the selected landing site, the agency wants a 1:25,000 scale over 1 mi. square, with 80-ft. horizontal and 15-ft. vertical accuracies.

Supplementing the lunar map requirements is demand for photography so detailed that it can relay to earth usable pictures of half-inch objects 10 ft. from the camera, Shea said.

Surface Characteristics

The lunar landing site will be strongly influenced by the surface characteristics, major factors of which are roughness (see p. 22), slope, dust, surface strength and sinkage, and electromagnetic reflectivity in the L, S and C bands.

NASA will bank on the Ranger and Surveyor programs to provide this data, and the agency will probably add five more Rangers to the nine already authorized in order to furnish and verify data for Apollo.

In his report on the Apollo system, Robert R. Gilruth, director of NASA's Manned Spacecraft Center, said the lunar landing mission requirements are these:

- **Reliability** of basic design and crew.
- **Performance margins,** in weight control, mission velocity maneuvers and propulsive systems and propellants. The normal Apollo mission will require 11 velocity maneuvers which will result in changes in velocity amounting to 100,000 fps.
- **Mission operations,** including operations analysis, on-board command, ground support and progressive mission experience. Crewmen will be in tactical command of the spacecraft; the Apollo control center, which will probably be located at the Manned Spacecraft Center in Houston, will be in strategic command.

Gilruth emphasized that strict discipline must be maintained in Apollo decision-making because of the technical challenges the program faces. Primarily, mission operations are remote, and many of the vital maneuvers must be conducted near the moon. Real-time navigation equipment, operating within the spacecraft, is required. Confidence in the mission depends to a large degree on propulsion, and there are approximately 50 separate rocket motors for the spacecraft. Finally, crew protection is needed on the lunar surface.

Maxime A. Faget, Gilruth's assistant director for research and development, said the earth will be used as a relay point between the bug and the Apollo command module because of the brief time the two craft will be in line of sight.

Faget said the Apollo design concept will permit the bug to land at any time of the day or night, and NASA wants to retain this flexibility.

He added that the natural light from the earth's albedo will provide the equivalent of a 100 watt bulb at a distance of nine feet.

Rendezvous Reasoning

Cleveland—Lunar orbit rendezvous method for the Apollo manned lunar landing mission (see p. 40) was selected over earth orbit rendezvous and direct ascent modes after eight factors were analyzed in depth by the National Aeronautics and Space Administration and Ling-Temco-Vought.

Factors were: performance margins, guidance accuracy required, ease of communications and tracking, development complexity, probability of success, safety, schedule and cost, according to D. Brainerd Holmes, director of NASA's Office of Manned Space Flight.

Lunar orbit rendezvous was judged as cheapest, fastest, and having the least number of development complexities, and was equal in success probability to direct ascent and equal to both other methods in safety. Although direct ascent was rated best in performance margins, ease of guidance and tracking, it was not selected because of the time, cost and complexity involved in developing the Nova booster.

Earth orbit rendezvous, which had been NASA's first choice, did not rate first in any of the factors.

Astronaut Candidates

Cleveland—Final 32 candidates chosen from the 250 applicants for the next group of astronauts last week began taking physical examinations at the USAF School of Aviation Medicine, Brooks AFB, Tex., and selection of about 10 will be made before the end of August (AW Apr. 23, p. 25).

The group includes some National Aeronautics and Space Administration and Federal Aviation Agency test pilots, but most are from USAF and Navy.

GD, Martin to Study Nova Design

Washington—General Dynamics/Astronautics and The Martin Co. have been selected by National Aeronautics and Space Administration to define preliminary design and systems of the Nova launch vehicle, which NASA has decided will be several times more powerful than as last conceived (AW July 16, p. 32).

In an unusual step, NASA's Marshall Space Flight Center said the two companies are to make "parallel, coordinated studies" of the preliminary Nova design and meet periodically with each other and NASA officials to ensure a unified development plan. Forthcoming contracts, which will include limited experimental hardware investigations, will each be valued at about $1 million and cover an eight-month period. They are to be signed in August.

Of 15 firms invited Mar. 28 to submit proposals, General Dynamics and Martin were among five who responded Apr. 26.

Nova, as now envisioned, is to have up to three times the weight-lifting capability of Saturn C-5, which will be able to place 90,000 lb. in earth orbit or 240,000 lb. to escape velocity.

In other awards, Beech Aircraft Corp. has been selected by North American Aviation to build the system for storing super critical gases—those stored at cryogenic temperatures and extremely high pressures—in the Apollo spacecraft. Contract will be for more than $4 million, Beech said.

Weber Aircraft Corp. has been awarded a subcontract by McDonnell Aircraft Corp. to design, develop and test the ejection seat escape system for the Gemini two-man spacecraft.

System is to provide for safe ejection on the launch pad, during initial boost phase and after re-entry.

Echo Test Succeeds

Washington—National Aeronautics and Space Administration last week successfully tested in suborbital flight the system that will be used later this year to inflate the 135-ft. balloon of an Echo 2 passive communications satellite.

The 510-lb. balloon reached its peak altitude of 950 mi. about 12 min. after lift-off from Cape Canaveral, Fla., then burned up when it re-entered the earth's atmosphere about 600 mi. down range. A recoverable capsule containing a motion picture camera that filmed the inflation was jettisoned and recovered by a para-rescue team 250 mi. north of San Salvador.

Sphere of the balloon was rigidized by Mylar plastic bonded with soft aluminum foil. After the sphere lost its inflation gas, the aluminum foil was to overcome forces in space that would tend to collapse it. Inflation was achieved by 52 lb. of benzoic acid powder, which burned to gas when the balloon unfolded in space.

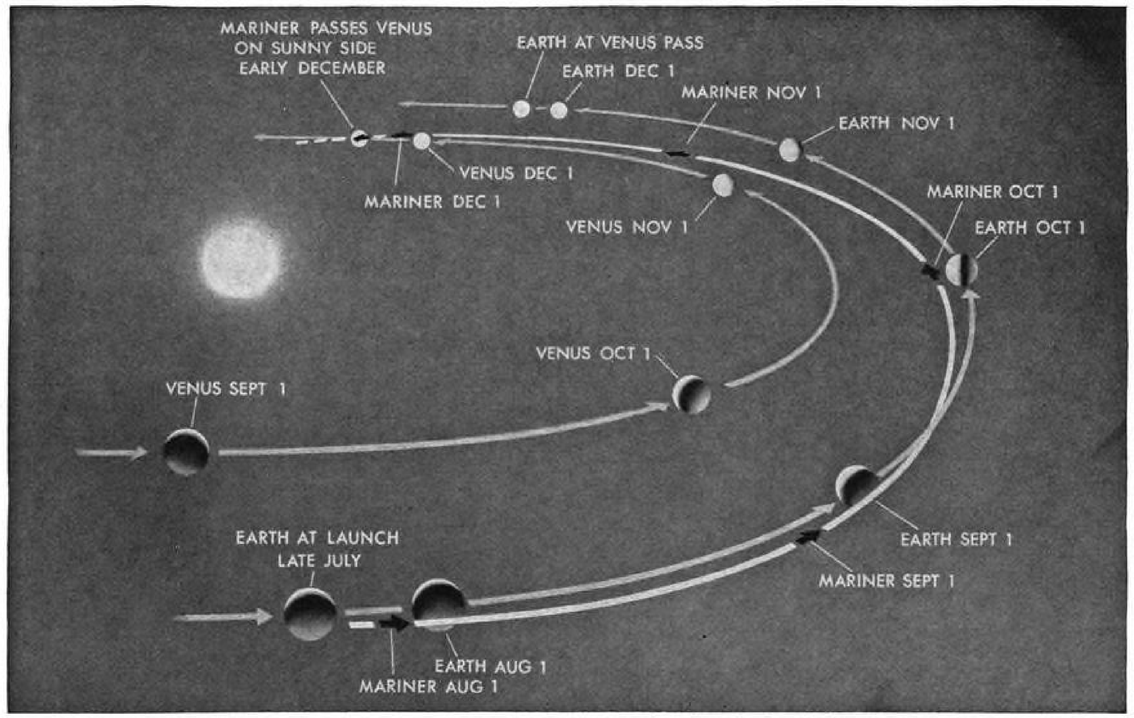
During an earlier test in January, a similar balloon was ripped when it was inflated too rapidly by excessive pressure. In last week's test, the inflation system was modified to slow this process.

Zeus Intercepts Atlas

Washington—Army Nike-Zeus anti-missile missile launched from Kwajalein Island in the mid-Pacific successfully intercepted the nose cone of a USAF Atlas missile launched from Vandenberg AFB, Calif., 4,500 mi. away, Defense Department said last week. Defense also said an earlier attempted intercept "was not a complete success." It is department policy not to announce Zeus tests until a success has been achieved.

Coincidentally, Soviet Premier Nikita Khrushchev told a group of visiting U.S. newspapermen in Moscow that Russia has an anti-missile missile that "can hit a fly in outer space." Russia had considered showing a film of the anti-missile missile in action at a recent disarmament conference in Moscow, Khrushchev said, but decided that it might be misunderstood.

Khrushchev also told the editors that high-altitude nuclear explosions were no defense against Soviet intercontinental ballistic missiles.



TYPICAL TRAJECTORY for the Mariner 1 spacecraft shows entire mission from launch through Venus flyby. Flight time will vary from 100 to 140 days depending on launch date. Closest approach by the spacecraft to Venus will be about 10,000 mi.

Mariner 1 Prepared for Venus Flyby Shot

By Barry Miller

Initial attempt to launch a lightweight Mariner spacecraft on the first leg of a 36 million mi. journey past the planet Venus was scheduled to be made from Cape Canaveral during the early morning hours of July 21.

Spacecraft, designated Mariner 1, is instrumented to gather electromagnetic data about Venusian temperature and atmosphere, data which are expected to help unravel the many mysteries that shroud the planet (AW July 2, p. 167).

The 446-lb. hexagonal-shaped spacecraft was to be launched by an Atlas D-Agena B launch vehicle into a trajectory which would be corrected about eight days later to bring Mariner 1 to roughly 10,000 mi. from the planet at their closest proximity. Distance from the earth at this point would be about 36 million mi.

Second spacecraft, called Mariner 2, a virtual carbon copy of the first, was in waiting at the Cape at the weekend and will be launched from the same pad on a similar course as soon after the first firing as possible to enhance the likelihood of mission success.

Since the time required for the spacecraft to reach the planet tapers from 140 days at the start of the favorable 50-day duration firing period to 100 days at the end of this 50-day interval —figures determined by the complexities of planetary orbits—both Mariner 1 and Mariner 2, should they be successful, would arrive in the vicinity of Venus at about the same time. The optimum 50-day firing period occurs at 19-month intervals as Venus and earth approach their closest proximity, when the heaviest possible payload for a given launch vehicle requires the least velocity to achieve desired trajectories (AW June 12, 1961, p. 52). During each day of this 50-day period a suitable launch time, or launch window, exists for less than 2 hr., covering a period from 4.44 to 6.38 EDT.

Both Mariner 1 and 2 are of the vehicle type previously called Mariner R, developed since last summer when delays in Centaur development (AW Oct. 2, p. 26) forced cancellation of the heavier Mariner A spacecraft, originally intended for this year's Venus flyby mission. All of the Mariner spacecraft were developed by Jet Propulsion Laboratory, which manages National Aeronautics and Space Administration's unmanned lunar and planetary exploration programs.

Forty pounds of experiments to be carried on Mariner 1 (AW Feb. 5, p. 57; July 2, p. 167) include microwave and infrared radiometers, magnetometer, ionization chamber, solar plasma spectrometer and cosmic dust detector.

Mariner 1 and 2 are heavily reworked versions of the hexagonal-shaped Ranger lunar spacecraft, measuring 5-ft. in diameter at the base (in launch configuration) and 9 ft. 11 in. in height. Once it is in the cruise, and the solar panels unfold and a high-gain antenna extends, the solar panel span of the spacecraft measures 16.5 ft. with vehicle height at 11 ft. 11 in.

Hexagonal frame contains a liquid-fueled rocket motor for correcting trajectory and six modules housing attitude control subsystem, electronics for the instruments, power supply, battery and charger, command subsystem, digital computer and sequencer and RF transmitter and receiver.

Ten cold gas jets and three gyros in the attitude control system accept inputs from four sun sensors on legs of the hex, two on the back of solar panels and an earth sensor on the spacecraft's high-gain parabolic antenna. This stabilizes the spacecraft in yaw, pitch and roll. There is sufficient nitrogen to operate gas jets to hold attitude control for a minimum of 200 days, according to JPL calculations.

For transmitting to the NASA/JPL Deep Space Instrumentation Facility (DSIF), the spacecraft's high-gain parabolic antenna can be pointed to the earth on command and can be kept pointed in that direction by an earth sensor situated on the rim of the antenna. This antenna is supplemented by an omnidirectional antenna.

Communications to and from the spacecraft will be in digital form, with the command subsystem on Mariner decoding incoming signals and properly routing them and accepting and encoding analog signals from the experiments and sensors for transmission to DSIF.

In the projected launch sequence, the Atlas D-Agena B launch vehicle will boost the Mariner into a 115-stat.-mi. parking orbit at a speed of 17,450 mph. The Atlas engines will be commanded from the ground guidance system to cut off about 5 min. after liftoff. The shroud protecting Mariner is jettisoned, and Agena B separates from the first stage Atlas. After a short coast period, Agena will ignite and accelerate itself and Mariner into the parking orbit.

Agena-Mariner will travel southeast over the Atlantic toward the South African coast, before which—at a point determined by launch date, launch time and desired flight path—Agena engines will restart and accelerate the spacecraft out of the parking orbit to a speed of 25,820 mph.

After Agena shuts down, Mariner is separated at a speed exceeding escape velocity by 1,215 mph., and it moves off in a hyperbolic orbit with respect to earth, with its rate of movement about the earth dropping until it is traveling in a straight line outward.

Upon reaching a distance of about 600,000 mi. after three days, Mariner's velocity has reduced from 25,820 mph. to 6,550 mph. due to the earth's gravitational pull before escape. The second Agena burn time is calculated to give the spacecraft a speed about the sun slower than that of the earth by an amount equal to its speed with respect to the earth.

Roughly eight days after launch, Space Flight Operations Center at JPL will compute Mariner's trajectory from data gathered by DSIF and compare it with a trajectory necessary to bring about the Venus flyby. A 7090 computer system will compute necessary commands for in-course correction.

Mariner will then curve in toward the sun. Its speed will increase, exceeding that of the earth and permitting it to pass the earth and catch up with Venus, approaching the planet on its dark side at a speed of 83,000 mph. relative to the sun.

Gravitational pull from the planet will deflect the spacecraft's path. Its speed increases as it passes Venus on the planet's sunny side.

House Science Committee Moves To Spur Development of GEMs

By George C. Wilson

Washington—Chairman George P. Miller (D.-Calif.) of the House Science and Astronautics Committee has opened a campaign to prod both industry and government into spending more money on the development of ground effect machines (GEMs).

In the first round of hearings on GEMs, Rep. Miller said that so far they "have been more or less orphans of the government." He said his committee would take both GEMs and hydrofoils "under its wing," adding that a primary purpose of the hearings is to stimulate industrial and government interest in the vehicles.

The hearings so far have focused on what other countries are doing in the GEM field compared with the U. S. Capt. J. J. Stilwell, director of design for the Navy Bureau of Ships, said Britain was about one year ahead of the U. S. in hardware.

Several committee members asked why U. S. had not shown more interest in GEMs. Cdr. William E. Ditch of the Office of Naval Research in London theorized that the British are ahead because they "envision a greater world market than we do" and had stimulated private industry by emphasizing the commercial rather than the military uses of GEMs.

Maj. Gen. Chester W. Clark, Army research director, told the committee that his service was evaluating GEMs from the standpoint of their ability to provide better surface mobility. He said the Army intends to spend $563,000 this fiscal year and $643,000 in Fiscal 1964 on GEMs. The Army is especially interested, Gen. Clark said, in building an experimental 30 ft. x 60 ft. GEM which could carry troops from a ship off shore to a point well inland.

Capt. Stilwell said the Navy's chief interest is in determining whether GEMs can operate satisfactorily in rough seas. Navy research efforts are concentrated on the GEM being built by Bell Aerosystems Co. of Buffalo, N. Y., for the Bureau of Ships under a $2-million contract (AW Nov. 27, p. 30). The Bell GEM is scheduled to be finished next April, with trials to follow in Lake Erie and in Chesapeake Bay. Navy's long-range budgeting calls for spending $35 million on GEM development over the next six years.

The Bell GEM, which will weigh about 22 tons, probably will be followed by a contract for a much larger vehicle weighing 150 to 250 tons, Capt. Stilwell said. The Navy plans to award a design contract for the large GEM in Fiscal 1964, and the construction contract in Fiscal 1965.

Bell recently announced it has acquired an option to purchase all patents and patent applications on GEM designs of National Research Associates, Laurel, Md.

W. T. Potter, acting chief of Maritime Administration planning and development, said his agency plans to continue its GEM research program by extending its contract with Vehicle Research Corp. of Pasadena, Calif. The firm, under a $370,000 contract, has drawn a preliminary design of a 100-ton GEM and is now conducting developmental testing. Potter said this testing phase will be completed August, 1963, and steps are being taken to provide an additional $300,000 for further tests. He said construction of the GEM would cost between $5 and $6 million.

The Maritime Administration GEM is being designed to carry four 8 x 8 x 20 ft. containers or 150 passengers and some cargo. Target operating speed is 100-120 kt. and maximum speed 150 kt. Design payload is 40 tons. Potter said the GEM will be able to skim over 10 ft. waves because the body of the vehicle will be seven feet off the surface. The hull is designed to get supplemental lift from the air flowing over it. Potter said Vehicle Research Corp. believes the stability and lift problems connected with this aerodynamic shape have been solved.

Conventional GEMs are supported by an air cushion built by the downward thrusts of air. One set of propellers shoots the air downward while another set is mounted like aircraft propellers to supply propulsion. Potter said shaping the GEM to get lift from the air flow as the vehicle moves forward is an especially promising development. Theoretical test results, he said, "appear so promising that hopes of a breakthrough have been excited." Model tests will be made soon.

Potter said the GEM "is a new tool of considerable promise," especially for countries whose transportation systems are primitive. He predicted GEMs eventually would be used for intercity passenger traffic, to link cities separated by water and provide quick transportation to remote airports.

Rep. Miller said GEM development today is comparable to the time when the U. S. was pioneering the use of the truck. The committee plans to call industry witnesses to testify on GEMs sometime in August. Philip B. Yeager is the staff director of the hearings.

Lunar Orbit Photo Mission Wins Approval

By Barry Miller

Pasadena, Calif.—Lightweight lunar orbiting spacecraft to assist the Apollo manned lunar program by obtaining stereoscopic photographs of parts of the moon's surface has won approval after two years of delay and indecision, and development of camera payloads will get under way later this year.

Lunar orbiter, or Surveyor orbiter, will be a stripped-down version of the Surveyor soft-landing lunar spacecraft with a special camera and control instrumentation payload mated to it. Principal mission of the orbiter will be to take and transmit to earth pictures of the lunar surface bounded by 50 deg. east and west selenographic longitude and 20 deg. north and south selenographic latitude. This area encompasses the likely landing points for the manned Apollo lunar bug. Previous intended mission for the orbiter was primarily that of photographic and thermal mapping of the moon, with the greater emphasis on the hidden side of the lunar sphere (AW Oct. 17, 1960, p. 27; Mar. 6, 1961, p. 32; July 2, p. 160).

While the orbiter will hardly resemble the Surveyor soft lander outwardly, it will utilize essentially the same spaceframe, attitude control and communications gear, minus the lunar landing gear, most of the superstructure of this complex spacecraft, and about half of the spacecraft propulsion system.

Elliptical Orbit

Initially intended to be placed into lunar orbit by the Atlas-Centaur, the orbiter now may be separated into two versions both based on Surveyor.

- **Lightweight orbiter,** weighing a minimum of 800 lb. not including its payload and capable of being launched into an inclined, elliptical lunar orbit approximately 200 to 500 km. above the moon by an Atlas-Agena B. This would be a minimum performance version, the one likely to be tabbed for first shots in view of Centaur development problems.
- **Growth version orbiter,** weighing about 2,000 lb. and intended for Atlas-Centaur launch.

Main orbiter payload will be the visual instrumentation subsystem (VIS) for which Jet Propulsion Laboratory, which manages National Aeronautics and Space Administration's unmanned lunar program, currently is conducting an industry competition (AW July 16, p. 23) to select a design and development contractor.

The payload-orbiter interface would be roughly the same so that the visual instrumentation system could be mated equally satisfactorily to either orbiter version. Expected camera payload lifetime will be 30 days. A $132-million request for five orbiters and associated boost vehicles and launch costs are included in the current NASA budget (AW July 2, p. 165).

Hughes Aircraft which is building the Surveyor spaceframe is barred from participating in the competition but will work closely with the contractor whose selection is anticipated by Oct. 1, with the long-delayed project expected to begin immediately thereafter.

VIS will consist of two monoscopic camera systems controlled by a single camera programmer and controller, so that together the two cameras can provide stereo views of the lunar surface or in the event of failure of one system, the remaining camera can function as an independent monoscopic camera. A third high-resolution camera, with telescopic lens, may be included in VIS although this does not appear likely within the constraint of the 80 lb. allotted to this mission package.

About 80 watts of power (64 regulated, 16 unregulated) will be available to the payload when the spacecraft, which will be powered by solar cells, is in sunlight, and 16 watts of unregulated power when the spacecraft is not.

If there are no snags to retard the present procurement plans, the first of six flight versions of VIS is programed for delivery by May 6, 1964, with the remaining five models to be delivered on a staggered schedule through Feb. 2, 1965. The end of 1964 probably would be the earliest possible initial launch date. A working breadboard version is scheduled for delivery as early as Mar. 25, 1963 with a prototype, mockup, thermal model and dynamic model scheduled for delivery on Oct. 7, 1963, May 13, 1963, Sept. 10, 1963, and June 24, 1963, respectively. One of the flight models will be a spare.

In addition, the VIS contractor will be expected to supply one prototype and two flight model development support equipments (DSE) for evaluating VIS.

Keen Competition

Competition for the single VIS and DSE contract will be keen as the program may develop into one of the largest out-of-house developments (with the exception of the Surveyor spacecraft itself), which JPL has had in the unmanned lunar program to date. This would certainly be true if the project unfolds from its present limited mission to the more elaborate goals ultimately expected of it by NASA headquarters (AW July 2, p. 160).

Many of the 44 aerospace companies which attended a bidders briefing here on July 11 are expected to submit proposals, quite a few of them jointly in team efforts by the Aug. 8 deadline.

The 44 include Aerojet, Aeronutronic, Autonetics, AMF, Avco, Bendix, Boeing, CBS Labs, Chicago Aerial, Eastman Kodak, Electro-Optical Systems, Fairchild Camera, FMA, General Electric, General Motors, Gertz, General Precision, Hycon, International Business Machines, Itek, International Telephone & Telegraph, Kalway, Kentel, Kollsman, Librascope, Ling-Temco-Vought, Link, Lear Siegler, Lockheed, McDonnell, Norden, Nortronics, Perkin-Elmer, Philco, Raytheon, Radio Corp. of America, Space General, Sperry Rand, Space Technology Laboratories, Systron-Donner, Texas Instruments, Thompson Ramo Wooldridge and Westinghouse. RCA, which has worked closely with JPL on camera payloads for the Ranger spacecraft, in one case as mission payload contractor for four vehicles, is regarded as a prime contender.

Because of its light weight, the orbiter will not be able to carry any photographic storage equipment, which precludes the possibility of taking photographs of the backside of the moon, storing the image signals and then transmitting them when the vehicle is on line-of-sight with the deep space instrumentation facility. Like Ranger, the orbiter will transmit its photographic data in real time.

Flight sequence for the orbiter will include launch from Atlantic Missile Range into a parking orbit, restart of the Agena B into a lunar trajectory, a midpoint spacecraft propulsion correction point, braking into lunar orbit.

Lunar Roughness

Pasadena, Calif.—Experiments aimed at determining the roughness of the lunar surface, an important parameter in designing landing gear for a lunar spacecraft, are being conducted jointly by Jet Propulsion Laboratory and Goddard Space Flight Center in a series of instrumented Aerobee rocket firings from White Sands Missile Range.

Rockets are equipped with 1-kmc. radar whose returns from the White Sands area in southern New Mexico can be compared with available data on radar returns from the moon obtained with radar operating on similar wavelength. This would indicate roughness of the moon relative to the land area on the range, which is widely believed to be similar to the lunar surface. Second firing in the series was conducted earlier this month.

Ranger Camera Package Installed

Ranger lunar spacecraft model is shown with tubular-shaped mission package containing six TV cameras made by Radio Corp. of America's Astro Electronics Division. Ranger 6, first of at least four spacecraft to use this 350-lb. camera payload for obtaining high-resolution pictures of given areas on the moon, is scheduled to be launched early next year, followed in 1963 by Rangers 7 through 9 (AW July 2, p. 160). Dual channel transmitter is expected to separately return wide and narrow angle picture data. Cameras start operating in last 10 min. of descent. Two wide-angle cameras switch off 2 min. before impact.

Other characteristics of the VIS system include:

- **Scale resolution**—Camera system is to be capable of providing scale resolution of 10 meters, where scale resolution is defined as minimum linear width of individual lines that can be resolved on appropriate test targets at a viewing distance of 100 km.
- **Base to height ratio**—As a stereo system, VIS will provide a base-height ratio of one, where base to height ratio is twice the tangent of half the effective angular separation of the camera optical axes between any pair of stereoscopic images.

Each of the monoscopic cameras will consist of the optics necessary for imaging the lunar surface at the required scales, resolutions and fields of view; image sensor or sensors (such as vidicons) for transducing optical images into suitable electrical signals, and electronics needed to boost the gain of signals obtained from the photosensor to levels needed by the spacecraft's telemetry system. In addition, devices required to control operation of the camera from internally generated control signals and from command signals received via the spacecraft command and control system will be included. Other gear would comprise power converters and devices for generating auxiliary information such as electrical image identification and synchronization signals to be transmitted with image signals to earth by telemetry.

Camera programmer which is to control the two cameras will consist of the electronics needed for this operation. It will accept data input from the cameras, accept commands from spacecraft command and control system, and provide data outputs to spacecraft telemetry and provide joint and/or independent commands to the cameras.

Nearly two years ago, JPL placed three short-term studies with industry to investigate camera techniques suitable for an orbiting lunar spacecraft, under a study called Visual Observation Instrumentation Subsystem, VOIS, (AW Oct. 17, 1960, p. 27) from which the VIS development evolved. Eastman Kodak investigated film techniques, which probably would be ruled out for this lightweight orbiter because of the comparatively large weight need for scanning films. RCA investigated electrostatic tape and Fairchild Camera looked at an advanced vidicon with a fiber optics faceplate. Resolution for VOIS mapping was pegged at 100 meters for the entire map, 9-10 meters acceptable for selected areas with 1 meter desirable.

VIS effort will comprise:

- **Phase 1**—Analysis, design, development, fabrication, testing, documentation and delivery of a breadboard VIS (X-1), a prototype VIS (P-1), a prototype DSE (T-1), an operational model DSE (T-2), an engineering VIS mockup (X-2), a thermal model VIS (X-3) and a dynamic model VIS (X-4).
- **Phase 2**—Design, development, fabrication, testing, documentation and delivery of two prototypes VIS (P-2 and P-3) and one operational model DSE (T-3).
- **Phase 3**—Fabrication, testing, documentation and delivery of six flight models of VIS (F-1 through F-6) and two sets of spare subassemblies for a flight model.

British Cabinet Shuffle Boosts Thorneycroft

London—Julian Amery, 43, secretary of state for air, last week became the new minister of aviation, succeeding Peter Thorneycroft, who was promoted to minister of defense.

Changes came in a major shakeup of the British Cabinet by Prime Minister Harold Macmillan. One of the first to go was Harold Watkinson, defense minister, who now returns to his parliamentary seat.

Amery's appointment, in one sense, is a downgrading of the post of minister of aviation, since he will not actually sit in the Cabinet, as did Thorneycroft. His successor at the Air Ministry is Hugh Fraser, 44, former parliamentary under secretary of state in the Colonial Office.

Thorneycroft's promotion reflects the Macmillan policy of further emphasis on closer cooperation between the United Kingdom and Europe. The new minister of defense has spearheaded a number of Anglo-European agreements, among them the British-French supersonic transport project and the European space launcher organization based on the de Havilland Blue Streak.

Watkinson's position became precarious when he insisted that the British control of its nuclear deterrent was completely independent, but at the same time said the V-bomber force was inextricably linked with the United States and NATO forces.

Thorneycroft's takeover at Ministry of Defense probably will lead to few immediate changes. It is expected that he will continue to be aviation's spokesman at cabinet level.

Amery, however, inherits a batch of Thorneycroft's problems at the Ministry of Aviation. Among them are:

- **Acceptance or rejection** of findings of a commissioner appointed by Thorneycroft to hear appeals by British European Airways, the state-owned airline, against award of various U.K. routes in competition with BEA.
- **Cementing the financial** deal between France and Great Britain on construction of a supersonic transport. At the moment, ministry has awarded only a small study contract to British Aircraft Corp. to keep the supersonic transport team intact, pending top-level governmental action.
- **Consideration of almost constant** complaints by the British aviation industry that government support is inadequate in both basic research and production of aircraft and engines.
- **Preparation of legislation** to set up a central airport authority which would take over London-Heathrow, Gatwick, Stansted and Prestwick facilities from the Ministry of Aviation.
- **Starting machinery** to determine where a third major airport for London will be located, to handle continental and international traffic by 1970.

India Rules Out P.1B Lightning, Widens Search for Strike Fighter

India will extend its search for a supersonic all-weather fighter to Sweden and its Saab J35 Draken, seeking low-level strike capability that has ruled out the English Electric P.1B Lightning.

Object of the Indian air force is to surpass the low-level strike capability of Pakistan's Lockheed F-104. U.S., with at least a tacit commitment to Pakistan not to provide F-104s to India, finds itself in the middle.

As a way out of the dilemma posed by strong interest India has shown in the Soviet MiG-21, the U.S. had supported selection of first the P.1B, and later the French Dassault Mirage 3, which India also declined.

Possible further complication for the U.S. is a reported exploratory approach by India to the State Department for obtaining McDonnell F-101 Voodoos.

Current visit to England by an Indian air force evaluation team is largely regarded as political window dressing there since India had rejected the P.1B after a full evaluation after it was proposed a year ago.

Talks with British Aircraft Corp. now center more on purchase of the Bloodhound surface-to-air missile as an interim weapon until India's air force is re-equipped with a modern fighter. India also is seeking air-to-air missiles in Britain since the U.S. refused last year to sell them.

British concern over the purchase of a Russian fighter had become so intense that Duncan Sandys, now Commonwealth minister with the responsibility to convince the Commonwealth that Britain should enter the European Common Market, offered the P.1B to India at a unit cost of $750,000, about half the going price. The British government would have subsidized the program, since BAC would have received full price for the airplane.

Britain also offered to discuss India's building the airplane under license. Russia's MiG-21 price, reportedly as low as $250,000 per aircraft, with payment in rupees accepted, outscales British magnanimity by far.

Reports in India indicate that a primary Indian goal, manufacture of the new fighter air frame and engine by India under license, was acceptable to the Soviets.

But British sources feel the Russians may be hedging on this point and helping to keep India shopping in the Western market. As a minimal demand, India wants at least an Indian-staffed major overhaul facility as a means to build up know-how.

The U.S. might have been the real subsidizer if the P.1B deal was accepted. When the MiG-21 situation arose, the U.S. proposed as an alternative that India buy the Lockheed C-130 from Lockheed-Marietta, and that the U.S. in turn would ask the British to establish a P.1B production line in India with the U.S. guaranteeing the British against any loss. A similar proposal was made substituting the Mirage 3, though both ran counter to U.S. policies to reduce its gold outflow.

India's search for a new fighter began when it found itself without an engine for the Hindustan HF-24 supersonic fighter, designed by Dr. Kurt Tank as an all-Indian venture.

The fighter was scheduled to use the Bristol Siddeley Orpheus 12 turbojet engine, rated at 8,170-lb. thrust with afterburner and India had built 25 of them in India virtually by hand.

Bristol Siddeley was willing to put another $1 million into development of the engine, after already putting in $7 million of its own money. Another $10 million was necessary to complete development but India declined to take a substantial share itself or ask the British government to sponsor development of the engine for a neutral country. An effort by Britain to compromise by offering India a loan for the general purpose of aviation development and not publicly specifying the Orpheus project as beneficiary was rejected by India's Defense Minister, Krishna Menon.

Engine development had been started with U.S. mutual defense funds, but these were cut off when Menon first approached Russia to buy Mi-4 helicopters and An-12 transports.

India then turned to Russia for an engine to replace the Orpheus and two Klimov VK-7s were obtained for evaluation and are still on bench test at Hindustan Aircraft. The VK-7, in the same power class as the Orpheus 12, cannot be fitted readily to the HF-24 airframe without major changes.

India then began looking at the Russian RD-9 engine, identified in India as powerplant of the MiG-21, and when India showed interest the Russians proposed the whole airframe-engine package deal. Indian air force officers reportedly were impressed by the MiG-21's performance and as "the rough-wearing machine demanded by Indian conditions."

Switch from the 8,000-lb. thrust class of the VK-7 centrifugal flow engine to the RD-9 axial flow powerplant with small frontal area might have entailed a major redesign of the HF-24, converting it from a twin- to a single-engine airplane. Thrust for the MiG-21 engine previously has been reported at 22,000 lb.

French Rocket Site

Paris—French government plans to start construction late this year on a $40-million rocket-launching station on the Atlantic coast about 50 mi. southwest of Bordeaux.

French hope to have their site operating by the end of 1964, according to a Defense Ministry spokesman. About 1,500 people will be employed at the station initially.

Site selected in the Landes Department stretches 15 mi. along the Atlantic Ocean between the hamlets of Biscarosse and Mimizan. It extends back from the ocean four miles.

Landes station will be the third French rocket-launching station but the first in metropolitan France. Under the Evian Agreement made with the Algerian provisional government, the French can continue to use their Sahara test range at Colomb-Bechar until 1967. But the French do not want to be caught short if the Algerians will not let them stay on after that.

Second existing station, on the Ile du Levant in the Mediterranean, does not have adequate range for the missiles the French plan to develop.

Renegotiation Change Effects Are Debated

Washington—Practical effect of a new amendment to renegotiation law explicitly authorizing a limited review of U.S. Tax Court decisions by the U.S. Court of Appeals is being debated among legal and tax experts.

The amendment, tacked onto legislation extending the law two years to June 30, 1964, was widely applauded in the aerospace industry as assuring companies for the first time of the appellate right.

Taking issue with this position, Sen. Paul Douglas (D.-Ill.), a member of Senate finance committee, maintains that the amendment merely codifies existing law as declared by the Supreme Court in the 1955 California Eastern Line case. In that case, as interpreted by Douglas, the Supreme Court ruled that the scope of review of renegotiation decisions is fixed by the same provision of the Internal Revenue Code that defines the scope for the review of tax decisions.

This equal appellate treatment for tax and renegotiation cases is the objective of the amendment. It limits the appellate review to affirming or reversing the decision of the Tax Court on questions of law and remanding the case to the Tax Court for further action.

DH-125 Executive Jet Transport Rolls Out

First photo of the de Havilland DH-125 executive jet transport, which rolled out July 23 at Hatfield, England, shows increase in vertical tail section over original design of pure T-tail. Runup tests of the two Bristol Siddeley Viper 20 turbojet engines, which will make their first flight with the DH-125, will start this week. Maiden flight will be in mid-August. For other details see p. 68.

X-15, Soviet Fighter Claim New Records

United States claimed a new world altitude record for manned aircraft last week with the No. 3 X-15 research vehicle but at the same time probably lost the world aircraft speed mark to the Soviet Union.

USAF Maj. Robert M. White flew the North American X-15 to 310,000 ft. on July 1, exceeding the previous unofficial X-15 record by 26,000 ft. The X-15 was launched over Smith's Ranch Lake, about 280 naut. mi. north of Edwards AFB, Calif.

Meanwhile, Tass, Russian news service, reported that on July 7, Soviet Lt. Col. Georgy Mosolov achieved an average speed of approximately 1,660 mph. in a two-way flight over a 15 to 25 km. course at an airdrome near Moscow. Mosolov's plane was identified as an E-166, believed by Western observers to be the MiG Flipper, a delta-wing, twin-jet aircraft with a rocket mounted between the jet exhaust pipes (AW July 17, 1961, p. 29).

Mosolov's mark topped the previous record of 1,606.342 mph., set last November in a McDonnell F4H jet by U.S. Marine Corps Lt. Col. Robert B. Robinson (AW Dec. 4, p. 33).

Both the U.S. and the Soviet Union are submitting the X-15 and Flipper flights to Federation Aeronautique Internationale (FAI) for confirmation as world records.

White's record altitude flight in the Air Force-National Aeronautics and Space Administration research aircraft was the seventh flight of No. 3 X-15, equipped with adaptive autopilot, and White's third time in its cockpit.

Burning time of the Thiokol XLR-99RM 57,000-lb.-thrust engine was 81 sec. Maximum speed was 3,784 mph., attained as the X-15 climbed through 156,000 ft. Total flight time was 11 min., covering the period from launch at 45,000 ft. through powerless touchdown on the Edwards Dry Lake.

One day earlier, July 16, NASA Test Pilot Joseph A. Walker flew another X-15 in a series of maneuvers programed to investigate re-entry maneuvers for the X-20 research vehicle (formerly called Dyna-Soar). Walker reached 107,000 ft. and 3,733 mph., and he used a skip-glide maneuver to decelerate from 2,200 to 1,100 mph. in 51 sec.

Air Force said White would receive astronaut wings for his altitude record flight. Eligibility requirements state that the wings are awarded to individuals flying higher than 264,000 ft.—50 mi.

White's mark of 310,000 ft., or approximately 59 mi., is only about 3 mi. short of the upper limit of 62 mi. which FAI recognizes for manned aircraft flight. Above that point, it is considered space flight, so breaking White's record will entail the difficult job of hitting within a 2-3 mi. window over his standard and below the FAI space flight regime. U.S. also plans to use X-15 to recapture the world aircraft speed record. The vehicle will be flown over a 100-km., teardrop-shaped closed course at Mach 3.5, starting the engine at the entrance to the course at 50,000 ft., flying a climbout to 80,000 ft., and cutting the engine on the turns.

Mosolov's flight over the 15-25 km. course included a maximum average speed of about 1,860 mph. during one lap. Average altitude throughout the Russian officer's flight was 47,000 ft.

Mosolov now holds the FAI-certified world altitude mark of 113,800 ft. Supporting data to FAI described the aircraft in this case as the E-66-A, a delta wing monoplane powered by a TDR Mk. 37F turbojet engine developing 13,200 lb. thrust and a GRD U-2 rocket engine rated at 6,600 lb. thrust. The E-66 probably is the MiG Fishbed.

FAI is expected to confirm Walker's flight to 284,000 ft. and then Maj. White's 310,000 ft. mark.

In another record claim, the U.S. Air Force said that in recent weeks, its Kaman H-43B Huskie helicopter has surpassed two international helicopter distance records now held by the USSR's Mi-1.

On July 5, Capt. Chester R. Ratcliffe flew an H-43B 900 mi. from Hill AFB, Ogden, Utah, to a small field near Springfield, Minn. USAF is claiming this is a new straight-line distance record, exceeding the existing mark of 761.027 mi. set Sept. 21, 1960, by a Russian Mi-1.

On June 13, Capt. Richard H. Coan flew a Huskie 656.258 mi. over a closed course near Mono Lake, Calif., establishing a claim to the closed-course distance record held by an Mi-1 which flew 625.464 mi. on June 24, 1960.

Test Failure

First of four high-altitude balloon flights planned by National Aeronautics and Space Administration to study the effect of cosmic rays on animals was only partially successful because failure of a life support system caused the death of two rhesus monkeys and four hamsters being used as subjects.

Another capsule on the balloon carrying a group of young flour beetles functioned properly and the beetles were recovered alive and they are now being studied at the University of California.

The 300-ft.-dia., helium filled balloon, designed to reach 128,000 ft., actually reached 131,000 ft. High winds cut the planned 55 hr. flight to 39 hr. during which the balloon traveled 1,900 mi. from Goose Bay, Labrador, to Prince Albert, Saskatchewan.

Altitude was controlled from an Aero Commander tracking plane. Biological data was stored on a 14 channel magnetic tape recorder.

Army Picks de Havilland STOL Transport

Washington—Army has chosen de Havilland Aircraft of Canada, Ltd., from a field of five competitors to develop a 5-ton-payload, short-takeoff-and-landing (STOL) tactical transport, but had not selected the turboprop powerplant by late last week. The aircraft will be called the Caribou 2.

Army originally wanted a larger version of the twin piston-engine de Havilland AC-1 Caribou for the STOL mission, but contractor complaints to Congress forced a competition (AW June 18, p. 34). Industry sources, including some of the losers, expressed no surprise at Army's choice.

Four test models will be built at an estimated cost of $21 million. Army estimated its contribution will be about $7 million. Generous cost-sharing proposals by both the Canadian government and de Havilland are understood to have played the key role in the Army's decision. Other factors included Army's operational experience with the AC-1 and the fact that a Caribou testbed has been flying for approximately a year with General Electric T64 turboprop engines, which de Havilland proposed—and prefers—for the Caribou 2.

Bidders were allowed to specify a choice of engines but were told to take a close look at the T64 because of the great development effort put into it.

Three other engines have been given varying degrees of consideration as possible powerplants for the STOL transport. They are Rolls-Royce Dart, Lycoming T55 and Allison T56. The T56 is considered large enough that it would require almost a new Caribou airframe design, which would mean new tooling, etc. The T55, while it offers some advantage over the T56, does not fit horsepower and specific fuel requirements closely.

Rolls-Royce is understood to have assured Defense Department and Army that Dart engines would be built in Canada if there were sufficient justification for it. The competition essentially was limited to airframes and engines built in North America. Whether Rolls-Royce would consider four test aircraft, plus a gamble on acceptance and final production, as sufficient justification for Canadian manufacture is not known.

Another influencing factor in the engine picture may be current Pentagon attempts to "buy American" when cost of domestic hardware, transportation and handling is not more than 50% above the cost of foreign-built hardware.

The Caribou 2 will be able to accommodate such loads as the Pershing missile system, 105-mm. howitzer and three-quarter ton truck—the same cargo compartment capability as the Army-Vertol Chinook HC-1B cargo helicopter.

The Caribou 2 will present an interesting contrast in approaches when it is ready for flight late in 1964—roughly the same time that the operational research version of the tri-service XC-142 VTOL transport, being developed by Vought-Ryan-Hiller team, is to fly.

Caribou 2 will be an extension of an existing, comparatively conventional short-takeoff aircraft, while the tilt-wing XC-142 will be a technically more ambitious attempt to get vertical-takeoff characteristics into a tactical cargo vehicle. If the XC-142, which is to be powered by the GE T64, should develop rapidly enough, it might even become a competitor for production for the tactical cargo mission. The Vought-Ryan-Hiller team proposed a limited tilt-wing version of this same aircraft in the competition.

Another rejected proposal that could still reach development under Air Force sponsorship for such missions as supply of troops in Vietnam is a modification of the twin-engine USAF-Fairchild C-123 that would have growth potential to 10-ton payloads and use 1,000-ft. rough fields. Although Army is understood to have a 10-ton payload requirement, Defense restrictions on what Army can purchase directly probably mean that Air Force would handle direct development of such an aircraft.

The modified C-123—which actually was Fairchild's primary proposal, although the company also offered a modified F-27—would use four GE T64 engines, double slotted flaps, a short-span aileron and spoiler system and have increased chord in the horizontal stabilizer to compensate for the slotted flap arrangement. The fuselage would remain essentially that of the present C-123. The modifications necessary would have been less than those required to fit the F-27 to the Army STOL mission.

This version of the C-123 could carry 3,300 lb. over 500 mi., operating in and out of 1,000-ft. fields, or carry 20,000 lb. over 1,700 mi.—for example, from Clark Field in The Philippines to Vietnam—still using rough fields of no more than 1,000 ft. It would use the same high-position tandem gear being installed on a C-123B at Fairchild's Hagerstown, Md., plant under a 90-day $900,000 USAF contract to see whether the aircraft can be used in limited-war.

This aircraft, called a C-123H is scheduled for rollout Aug. 1, flight testing from Aug. 6-15, and delivery to USAF at Eglin AFB, Fla., on Sept. 1 for evaluation there. Two GE CJ610-1 jet engines, rated at 2,850 lb. thrust each, are being suspended from pylons outboard of the present two Pratt & Whitney R2800 piston engines to provide the extra power needed for short, unprepared fields. Other modifications include installation of approach- and landing-drag parachutes in the fuselage.

Modification to the landing gear will use a previously-developed design with a 210-in. track width, compared with the normal 144-in. width, to improve stability on rough ground. Tires will use about half the current pressure.

The C-123B requires an average landing distance of 1,400 ft. when landing over a 50-ft. obstacle on a sod field at a 53,000-lb. gross weight. Normal takeoff distance at 42,000 lb. is 1,700 ft.

The STOL modification must operate from 1,000-ft. strips and must lift a maximum gross takeoff weight of 67,000 lb., which is 7,000 lb. above the normal. Maximum gross landing weight will be raised from 54,000 to 62,000 lb. Unrefueled range must be 1,000 naut. mi. with a 20,000 lb. payload.

Douglas Labor Pact

Los Angeles—Substantial progress toward two long-term union goals was conceded by Douglas Aircraft Co. last week in the first settlement between six major California aerospace companies and the two major aerospace unions.

Main points of the three-year contracts signed with United Auto Workers and International Assn. of Machinists:

- **Douglas plants and facilities will be "agency shops" in which all employes in the bargaining unit must pay the union the equivalent of dues whether or not they join the union.**
- **Douglas agrees to negotiate on supplemental unemployment benefits (SUB) in 30 months and will immediately start building a fund for some future SUB program at the rate of two cents per hour per worker.**
- **There will be pay raises of five to eight cents per hour in the first year of the contracts, six to eight cents per hour in the second year, and six to nine cents per hour in the third year.**
- **Cost-of-living escalator clause in the expiring contracts will be retained.**

Douglas considers the contract favorable—increasing wages and fringe benefits less than 25 cents an hour over the three-year period. Despite some grumbling, union ratification is expected this week.

The other five California aerospace companies now bargaining with the IAM and UAW—North American, Lockheed, Aerojet-General, Ryan and General Dynamics—say they do not plan to adopt the Douglas settlement as a pattern.

Telstar Transmits Color Television

Color television picture of a still photograph was successfully transmitted via Telstar between Britain and Andover, Maine, last week as the Bell System active communication satellite continued to perform perfectly (AW July 16, p. 26).

The first colored photo transmission attempted during the 60th orbit produced a washed out picture. On the next pass colors were received with full fidelity.

First formal exchange television program between U. S. and Europe is scheduled for July 23 at about 3 p.m. (EDT) when portions of President Kennedy's press conference will be relayed to European television station via Telstar. The program also will include a concert by the Mormon Tabernacle choir at Mount Rushmore, S. D., against the background of 60-ft. high stone heads of Presidents Washington, Jefferson, Lincoln and Theodore Roosevelt.

On the next orbit, the European Broadcasting Union is scheduled to transmit to U. S. television networks live scenes of the Sistine Chapel in the Vatican, the Champs Elysees in Paris, a blast furnace operating in Germany and reindeer in the Arctic.

On July 26, officials in 23 U. S. cities will carry on two-way conversations via Telstar with their counterparts in 23 European cities. Although the communication satellite has the bandwidth necessary to handle 600 simultaneous phone conversations, multiplex equipment presently installed at the Andover ground station limits the number of simultaneous conversations to 10.

The only problem reported during the first eight days of Telstar operation was the difficulty encountered during the 23rd and 24th orbits by a few of the National Aeronautics and Space Administration remote tracking stations in getting the satellite to respond to telemetry command signals when Telstar was at extreme ranges. The problem was not encountered by Andover or other major stations, and was resolved on the 25th orbit, according to Bell System spokesmen.

Telstar Fails to Sway Comsat Bill Opponents

Washington—American Telephone & Telegraph Co.'s successful Telstar experiment has apparently left unmoved the group of senators determined to block legislation establishing a privately financed corporation to operate the U. S. segment of a world-wide communication satellite system.

The excellent performance of the world's first active communication satellite (see box, above) brought a new wave of demands for Senate passage from sponsors of the measure. But the minority group of senators, protesting that the proposed corporation would be dominated by AT&T, showed no sign of straying from its plan to block action through a talkathon (AW June 25, p. 29).

The legislation, recommended by the Administration, has already passed the House 354 to 9 and been approved by the Senate space and commerce committees.

Sen. Estes Kefauver (D.-Tenn.), a leader of the opposition, told AVIATION WEEK that the Telstar satellite "will have no appreciable effect on the outcome of the legislation. . . . We still plan to talk at considerable length."

Pressing for quick Senate action, Sen. Robert Kerr (D.-Okla.), chairman of the space committee, told the Senate that "the debate here on the floor started nearly a month ago and has now boiled down to the question: government ownership versus private enterprise. Telstar proves the vigor and dynamics of private enterprise, not the prelude to its demise. . . ."

Kerr noted that in addition to AT&T work on the Telstar, 1,809 other business organizations participated in the Telstar project by furnishing hardware or services.

Of these 1,809 firms, Kerr declared, "a total of 1,387 are in the small business category . . . approximately $10 million worth of contracts, or approximately one-third of the total cost of the Telstar experiment, went to these small businesses."

P.1154 Production

London—British government is negotiating with Hawker Siddeley to put the Hawker P.1154 VTOL strike fighter into production as Hunter and possible Seavixen replacement, Julian Amery, new minister of aviation (see p. 23), said here last week. Aircraft, Britain's entry in the NATO competition, is powered by BS.100 vectored thrust engine (AW May 14, p. 30) with plenum chamber burning.

Engine company has ordered materials to build a Mach .92 scale version, at thrust rating of 33,000 lb. Design now has been frozen and U. S. funds for development have been made available from mutual defense funds, Amery said.

Government also will support two new versions of the de Havilland Trident—the 1D and 1E longer-range followons. Support, privately estimated at $2 million, also was earmarked for the Rolls-Royce Dart 12 for the Avro 748 military transport. Dart 12 is the uprated version of the Dart 10.

News Digest

USAF Thunderbirds aerial demonstration team will switch to Republic F-105 Thunderchief jet aircraft beginning next year. The team is presently flying North American F-100 jets.

Cessna 411 six-to-eight-place executive twin-engine aircraft made its first flight at Wichita, Kan., July 18. Aircraft is in the 6,000-lb.-plus class, with two 340-hp. turbosupercharged engines. Span is approximately 40 ft., height to top of tail fin about 11 ft., and over-all length about 33 ft.

Giant Navy radio telescope under construction at Sugar Grove, W. Va., was canceled last week by Defense Secretary Robert S. McNamara. Unforeseen advances in science and technology, he said, have provided better means of accomplishing the telescope's objectives: military research in ionospheric physics, space communications, navigation and radio astronomy. In addition, estimated cost of the project has risen from $80 million to nearly $200 million.

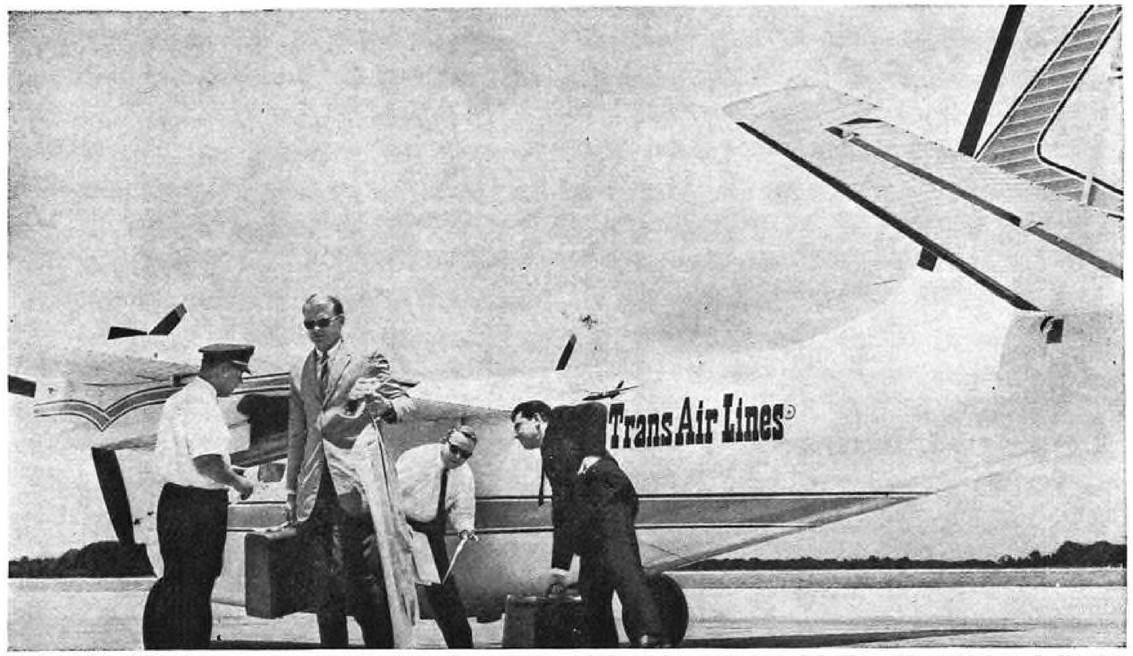
Westland SRN.2 Hovercraft (AW July 9, p. 56) will carry out an experimental passenger service in August between the Isle of Wight and Southsea. Vickers VA-3 Hovercraft began service in Wales last week, in cooperation with British United Airways.

Gen. Josef Kammhuber, chief of the West German air force since its formal inception in 1956, will step down this summer to be replaced by Gen. Werner Panitzki, who also has played a major role in re-building the Luftwaffe to its present strength.

Allegheny Airlines is converting its 11 Convair 540 turboprops back to CV-440 piston-powered aircraft (AW Apr. 16, p. 50). Butler Aviation of Washington, D. C., will modify six aircraft, replacing the Napier Eland powerplants with Pratt & Whitney CB-16 piston engines. Contracts for conversion of the others are under negotiation.

Dr. Jerome B. Wiesner, President Kennedy's scientific adviser, was confirmed without debate by the Senate last week as director of newly created Office of Science and Technology.

American Airlines has reported a net profit of $3.2 million for the first half of this year, compared with $2.5 million for the same 1961 period. Total revenues of the airline were $228.8 million for a gain of $27 million over the first half of last year.



PASSENGERS DEPLANE from Aero Commander at Baton Rouge, which receives three times daily Trans Air service in each direction.

Light-Twin Carrier Gains Public Approval

Trans Air Lines bids for third-level certification; traffic shows steady growth between dozen points.

By Erwin J. Bulban

New Orleans, La.—Public acceptance of light-twin business aircraft as third-level airliners is being demonstrated by Trans Air Lines, whose daily scheduled service to a dozen communities in Louisiana has carried more than 5,300 passengers in the first six months of 1962.

Since Trans Air started service with Aero Commanders in April, 1961, it has carried more than 6,800 passengers, shown steady traffic increases (see box) and constantly expanded its route network within the state. With its management convinced that the operation is well on the way towards being profitable, planning is under way to standardize its Commander fleet to the latest configuration airplane and also towards setting up maintenance as a completely integrated operation.

Trans Air currently has an application pending review by the Civil Aeronautics Board requesting certification in a new "third tier" category. This is a service philosophy aimed at providing regularly scheduled operations with light-twin aircraft to communities which have lost or will lose service by currently certificated local service carriers under the "use it or lose it" factor, under which CAB authorizes discontinuation on the basis that the stop generates fewer than five passengers daily.

The new carrier feels that this policy can be extended to provide substitute service at lower operating costs even at points where the locals are now getting minimum traffic.

If certification is granted, Trans Air Lines sees its operation extending beyond present state boundaries. Its application contemplates service eventually from Louisiana into Texas as far as Dallas, to Arkansas, Mississippi, Tennessee, Georgia and Florida. Such an operation would require adding up to 15 Aero Commanders to its present five-plane fleet.

Recent ruling by a CAB examiner denying an application by Hi-Plains Airways to conduct a third-level service serving six Midwest states (AW July 9, p. 29) is not considered by Trans Air Lines officials as a major setback to their planning.

Indications are that some participants in the third-level programs—there are 15 applicants—feel that the Hi-Plains case was ill-prepared and that Aero Commander, Inc., which has been actively promoting the concept, acted hastily and backed the wrong horse by encouraging hearings on the Hi-Plains case.

Trans Air Lines' President John Freiberg, who has backed the operation with money from his own pocket, emphasized that he prefers a conservative approach in seeking certification by first developing a firm foundation of experience, an organization closely patterned to actual certificated airlines and extensive documentation. He has insisted, for example, that Trans Air's operations utilize a uniform bookkeeping procedure tailored to CAB requirements.

Management feeling is that Trans Air would prefer to wait at least another six months before requesting a hearing on its own application, and that the prime target is actual receipt of a certificate rather than subsidy payments. Indications are that the latter would be foregone if it could receive the former.

A certificate, it is felt, would provide many worthwhile benefits aside from subsidy. A certificate could be useful in establishing the carrier's growth and putting the operation on a level of respectability, so that its dealings with scheduled certificated airlines would be enhanced. The certificate might help in easing interline agreements providing for through ticketing.

Trans Air's operation basically links communities having important business ties with each other or requirements for business travel to key airline terminals, such as New Orleans International, for jet or piston connections on the major scheduled carriers. The carrier estimates, for example, that 75% of passengers deplaning from its Commanders at International Airport here transfer to a certificated airline.

The light-twin carrier covers Houma-Patterson-Morgan City, communities embracing offshore oil and gas equipment and supply facilities; Lafayette, the new oilfield sales and service center; Lake Charles, a leading Gulf port; Baton Rouge, focal point in Louisiana's new petroleum-chemical complex; Monroe, in northern Louisiana, and nearby Ruston and Opelousas, one of the state's agricultural complexes.

Some of these service points not only have local or southwest U. S. common areas of business interest, but also have ties to industry in other parts of the country and abroad. Yet some lack local airline service, or have few means of public transportation connecting them.

Modest Beginning

Freiberg, who also owns Trans Air Corp., an Aero Commander distributorship and business aircraft service center at nearby New Orleans Airport, started planning his current airline operation in 1958-1959, beginning operations in a modest way with Grumman Widgeon amphibians on a three-times-daily schedule serving several petroleum industry focal points south of New Orleans.

Actually, the industry's requirements were such that they could not be tied to a scheduled service. When they needed specialist personnel or equipment, they needed them immediately, and Freiberg realized that such a requirement was counter to developing a substantial airline operation in this area.

Trans Air then began branching out west and north and putting Aero Commanders in service because of their better performance and lower operating costs. Low operating costs are the key to growth of "third tier" type operations, since building business is directly related to frequency. Load factors, points out Trans Air Manager Richard Barber, are not the basic criteria in this type operation. With operating cost of $17.52 per hour estimated for the Commander 500-B, overhead is so low that the carrier can often dispatch an extra section to handle one or two passengers.

Trans Air Lines Traffic
January—June 1962

Month	Passengers	Seat-Miles	Revenue Passenger-Miles	Load Factors
January	498	216,305	49,970	34%
February	530	273,216	83,001	30.3%
March	645	304,340	103,063	33.8%
April	855	381,749	141,087	36.9%
May	1,356	515,426	206,628	40.09%
June	1,489	518,832	227,567	43.86%

Trans Air now operates five Commanders—a mix of one Model 500, a 520 and three 500-Bs, one of which is a leased airplane which the carrier added recently pending delivery of a 500-B from the factory. It aims to standardize on this model, getting an additional airplane in August, another in September and another in October.

The airplanes are six-place configuration, with an extra door by the pilot to simplify loading. One passenger sits in the right-hand seat, two behind the front seats and three abreast aft behind the other entrance door. In the program is an eight-place configuration, providing room for seven passengers, with the pilot sitting in the right seat.

The airplanes provide 10 departures and arrivals daily from and to New Orleans International. The carrier's circuit encompasses route segments of 26 to 253 mi. Departures start at 4:35 a.m. Although this picks up some passengers off night coaches, it is actually planned to position an airplane downroute. Return flights to New Orleans start with the 4:35 a.m. departure returning at 7:15 a.m. and the last flight getting back at 10:55 p.m. Services vary from two flights daily to four times daily each way.

Frequent Scheduling

Frequent scheduling has been the key to service growth, and Barber notes that Trans Air experience shows that a city of 8,000-10,000 population will provide up to 125 passenger boardings per month. Public demand has forced the carrier to increase its frequencies at some stops, and Trans Air is being asked regularly by communities to extend service to them. An example of the latter is the community of Ruston, with a population of 12,000, which initiated such a request with Trans Air and in the first month of service generated 150 passengers. Current service there is four times daily each way.

Short turnaround time—as little as two minutes at some stops—and quick maneuvering capability contribute to high block speeds. Schedules represent block speeds of 180 to 200 mph., depending on the model, with the 500-B scoring highest. The six pilots, mostly with Logair contract flight experience, log approximately 100 hr. monthly. Minimum requirements include commercial rating with instrument card and 4,000 hr. multi-engine time. Five of the six hold air transport ratings.

Passenger reaction to the service is generally favorable, and constantly increasing load factors and return business appear to prove Trans Air Lines' popularity.

Extreme care is taken by Trans Air to impress the public with its similarity to certificated airline operations. All personnel who have contact with the public are uniformed; departure announcements are made via public address systems at the terminal; baggage is ticketed and taken by cart to the airplane for loading before the passengers are boarded, and airplanes use regular gates.

Aircraft Performance

Although the airplanes were basically designed for private business use, they appear to stand up well to day-in-day-out scheduled service requirements, although their utilization and greatly increased landings and takeoffs sharply increase item replacements. Indications are that replaceable items—such as tires, starters and generators—experience half their usual life.

Trans Air Lines utilizes Trans Air Corp. as its maintenance agent, and the progressive maintenance concept is used. The schedule provides for two airplanes to undergo periodic checks every other night, and four mechanics and a supervisor are assigned to the program, working from 7 p.m. to 2 a.m. readying the airplanes. The carrier's plan is to completely divorce the maintenance operation from Trans Air Corp. by moving it from current facility to a new one at New Orleans International, saving some ferry time and providing closer liaison.

Tu-114 Completes First Moscow-Havana Flight

Soviet Aeroflot Tu-114 is greeted by a rain-soaked crowd at Havana at the conclusion of the first Moscow-Havana proving flight. Cuba and Russia signed an agreement last week covering non-stop service between the two capitals (AW July 16, p. 40). Blocked from the great circle route over Scandinavia and the North Atlantic, Russia is presumably operating the route via Belgrade, and African points as far south as Conakry, Guinea. Soured Russian-Albanian relations have cost Russia its former gateway to Africa—the Albanian capital, Tirana.

FAA Accelerates Attack on Noise Problem

Washington — Federal Aviation Agency, tackling the aircraft noise problem with new vigor, probably will make noise abatement procedures less taxing for pilots and may favor legislation that would empower it to prescribe how much noise can be made at U.S. airports.

In addition, FAA and National Aeronautics and Space Administration are drafting final details of a program aimed at reducing noise generated by the compressors of currently used turbojet engines.

Which agency will fund the program has not yet been decided, but FAA's new Aircraft Development Service plans to solicit industry proposals.

Another anti-noise measure under consideration within the agency is development of a "disturbance annoyance curve." This project, to be based upon a survey of 10 representative airports, would help predict community acceptance of various noise levels. Aircraft noise would be plotted against the background noise that exists in communities zoned for different uses.

FAA's eastern region has responded to an eight-point proposal formulated by Air Line Pilots Assn. to ensure that anti-noise procedures do not compromise flying safety (AW June 11, p. 47). It directed that noise abatement turns after takeoff "should be accomplished as soon as possible after passing 300 ft." The agency's earlier standard, contained in its Red Book on noise (AW Apr. 16, p. 36), permitted 5-10 deg. bank turns to "adjust heading" at any altitude.

ALPA's board of directors, the union's governing body, has instructed member pilots to refuse to accept anti-noise procedures if the rules should require the following:

Low-altitude heading changes; turns at altitudes of less than 600 ft.; other than standard power reductions on takeoff; climbout at any airspeed less than maneuvering speed; any in-flight anti-noise measures when weather is worse than 1,000 ft. ceiling and 3 mi. visibility; preferential runway use when runways are wet or more than 10 kt. of crosswind exists; steep approaches above glide slope altitude, and communications with noise monitoring stations during takeoff and approach.

In a July 4 letter to Capt. E. J. Bechtold, ALPA's eastern region safety chairman, Oscar Bakke, who heads FAA's eastern region, refused to suspend anti-noise procedures when ceilings and visibilities were lower than those specified by ALPA. Nor would Bakke endorse the union's recommendation that use of preferential runways should be suspended during rainy weather.

"We believe," Bakke said, "that the preferential runway system should be used except when there exists any condition which would render the runway unsuitable . . . and this includes conditions which would affect the coefficient of friction, resulting in a significant effect on runway length."

However, the FAA's associate administrator did say the entire question of climb and takeoff power reduction was being re-evaluated by the agency. So-called "Test Able" procedures—in which ground-based noise monitors tell pilots when to reduce thrust over noise-sensitive areas—may be scrapped or modified as a result.

Although FAA's original target date for completion of this re-evaluation was July 15, it was still unfinished late last week.

According to Bakke, additional flight tests may prove necessary because any decision to limit takeoff power reductions probably would affect noise-troubled areas all over the world. For this reason, he said, FAA will not hurry the process of selecting an optimum anti-noise takeoff profile.

However, he told Aviation Week "we're not entirely happy" with power reduction techniques now being practiced.

ALPA's recommendation that preferential runway use end when crosswind components exceeded 10 kt. was "extremely conservative," Bakke said. A 15 kt. component should not present "any undue requirement for the pilot" on takeoff, he added.

Consistently, Administrator N. E. Halaby has held that under the Federal Aviation Act, FAA is denied power to set an upper limit on the noise generated by jet transports in an airport's vicinity. But FAA also has refused to recommend that Congress grant the agency this power by amending the act in question.

Testifying before a joint meeting of two House subcommittees last week, Charles H. Williams, FAA's principal noise abatement officer, did not touch on whether such a recommendation would be forthcoming. However, he told Aviation Week that the agency would not be averse to accepting power to regulate noise if it were bestowed by Congress. This, Williams said, was not true last year.

Williams also disclosed that FAA, "in an effort to increase understanding and dispel fear," was preparing an exhaustive handbook covering all aspects of aircraft noise.

The transportation and aeronautics and regulatory agencies subcommittees last week heard suburban Chicago civic officials testify that FAA regards its duties in the noise abatement area as a strictly secondary function. According to the mayor of Park Ridge, Ill., a community of 35,000 that abuts O'Hare International Airport, it is also questionable whether "Congress ever recognized the rights of the people on the ground to be reasonably free from noise." Noise abatement, he suggested, should be one purpose for FAA's existence and this fact should be legislated. In addition, a noise abatement office under the administrator should be organized and a noise abatement officer, with the power to punish offenders, stationed at every major airport.

Park Ridge, as a municipal enterprise, has purchased a glass-domed panel truck and equipped it with a VHF radio tuneable to any frequency used by O'Hare tower, a General Radio No. 1551B noise meter and a triangulation device for measuring aircraft altitude. This vehicle is stationed near the ends of O'Hare active runways in order to record turbojet noise.

A "very noticeable difference" exists in the noise generated by American's turbofan-powered Boeing 707s and those of TWA that lack fan power, according to Park Ridge officials. On the average, the American 707 is 10 decibels quieter, they said. United's twin-jet Caravelle is "the noisiest jet that is flying," the Park Ridge mayor told the subcommittee, adding: "If the federal government were truly interested in noise abatement and was truly concerned with the rights of the people on the ground, the Caravelle would not be permitted to fly today."

ATA Settlement Bid

Washington—Air Transport Assn. last week filed an 11-point program with the Civil Aeronautics Board offering a settlement designed to terminate the current Board inspection and review of the ATA, which began in early 1959 (AW Mar. 16, 1959, p. 25).

ATA said it would not surrender its attorney-client privileges, a right that has been upheld by a federal judge, but that the proposed settlement will satisfy all of the Board's other reasons for opening the investigation.

ATA said it would allow CAB to inspect its papers in the same manner the Board inspects carrier papers, permit all members of the association to have an equal vote and acknowledge CAB jurisdiction over association by-laws.

Goldberg Fails to Solve Eastern Strike; Engineers Given Ultimatum

Washington—Labor Secretary Arthur Goldberg withdrew from negotiations between the Flight Engineers International Assn. and Eastern Air Lines last week. At the same time, Eastern issued an ultimatum to the striking engineers to accept the terms of a new company offer by July 24 or face a possible loss of their jobs.

Goldberg explained that his office withdrew because neither party had been able to reach an agreement, but said he would continue talks with the FEIA, Air Line Pilots Assn., American, and Pan American World Airways over similar crew complement issues between the two unions.

Crew Complement

FEIA officials said late last week that the union and Eastern generally agreed to a settlement of the crew complement issue over occupation of the third seat position on the company's jet aircraft, but that the talks had stalled on the matter of wages and a guarantee of union representation.

Eastern's offer, which was rejected by the union, carries the job security provisions contained in the Feinsinger Report on crew complement (AW Oct. 22, p. 35) and an immediate pay raise of 11%, which it noted could not be made retroactive because of Eastern's losses from the strike, which began on June 23.

Meanwhile, Congress delayed action last week on legislation calling for compulsory arbitration of jurisdictional airline labor disputes in hopes that the Administration may yet succeed in settling the jet crew complement issue.

Senate labor committee spokesmen said that the measure, introduced by Sen. A. S. Mike Monroney (D.-Okla.), is not scheduled for early consideration and that it is unlikely any action will be taken unless the Administration requests it.

Need for Bill

Labor Secretary Arthur Goldberg, whose suggested settlement terms are still being considered by Flight Engineers International Assn. members at Trans World Airlines (AW June 25, p. 45), has consistently rejected the idea of compulsory arbitration, but indicated that a continuation of the FEIA strike at Eastern or new engineer walkouts at TWA or Pan American World Airways, could convince the Administration of the need for the Monroney bill.

The measure, designed to block strikes involving jurisdictional disputes between different unions on the same airline, calls for the National Mediation Board to rule on whether or not the threatened strike is a matter of jurisdictional disagreement. If so, the matter would then go before a special Jurisdiction Disputes Board appointed by the President. A final decision by the ad hoc dispute board would be binding on all parties and strikes would be prohibited during the 60-day deliberations by either board.

Earlier last week, Eastern had indicated that it might attempt to resume service, using pilots with engineer training as flight engineers. Eastern was reported to be determining how many of its pilots had the 200 hr. of command time necessary to qualify for a flight engineer examination. The airline also was believed to be considering a return to limited service with its fleet of 39 Martin 404s and 20 Convair 440s which require only a two-pilot crew.

Meanwhile, Pan American continued to operate under court injunction scheduled to expire Aug. 1, and FEIA awaited the outcome of an appeal to the court order.

American Airlines and FEIA chapter officials also met with Goldberg and indicated that union members tentatively approved the labor secretary's settlement terms and would accept them as a bargaining basis during future contract talks.

High Helicopter Costs Halt Sabena Service

Brussels—Sabena Belgian World Airlines, operator of the world's only regularly-scheduled international helicopter airline since 1953, will suspend the 11-city service at the end of the current summer season to await the availability of high-density helicopters with relatively low seat-mile costs.

Largely because of the high seat-mile cost of the 12-seat Sikorsky S-58s now used by Sabena, and their S-55 predecessors, the helicopter service has lost money since its inception. It served a number of purposes, however, feeding European passengers into Brussels from the network cities to connect with regular transatlantic flights and attracting U. S. customers who could fly to Belgium and then on to Paris by helicopter at no extra cost.

As an economy measure, the Sabena board of directors has now decided to suspend the service indefinitely, although airline spokesmen say it will be resumed when and if a suitable helicopter appears on the market.

NEW YORK AIRWAYS VERTOL 107 taxies on water following forced landing in New York Harbor. Ingested debris from broken forward rotor transmission pylon door caused total stoppage of one engine and power loss on the other. Remaining power enabled the pilot to taxi toward NYA Wall Street heliport, 1½ mi. from landing point. Smoke is from burning oil, which leaked into combustion section after ingested salt water cracked oil bearings.

HELICOPTER CONTINUES TAXI (above) under own power after a tow line was attached as safeguard against total engine failure, which would leave aircraft adrift in tide. Rotors were stopped (below) as the helicopter was towed the last few yards to the dock. Left sponson is slightly low in the water, list resulting from the weight of its full fuel cell. The engine was run off the right sponson fuel tank during taxi. Some water leaked into an electrical compartment through access doors atop the left sponson, and also into the rear baggage compartment, which is not totally watertight. Nineteen passengers and three crew members suffered no injuries, and were evacuated after the helicopter was docked.

Ingestion Causes V-107 Water Landing

By James R. Ashlock

New York—Malfunction of both engines, resulting from ingestion of glass fiber siding and soundproofing insulation which broke away from the forward rotor transmission cowling, caused the forced landing July 16 of a New York Airways Vertol 107 helicopter in New York Harbor.

No injuries resulted among the 19 passengers and three crew members aboard. The aircraft floated on its waterproof hull almost 2½ hr., and was taxied 1½ mi. under partial power.

No. 1 (starboard) engine stopped completely when a plastic-covered packet of glass fiber, wool-type soundproofing insulation, measuring 10 x 14 in. and ½-in. thick, clogged the air intake. No. 2 was reduced to between 75-80% power after ingesting glass fiber debris. The Vertol is powered by two General Electric CT58-110 turbine engines of 1,250 shp. each.

The ingested material came from a maintenance door on the forward rotor transmission pylon, 23 ft. directly in front of the engine intakes. The door, of glass fiber construction, is part of the pylon's aerodynamic fairing when closed, and is a maintenance platform when open. The glass fiber siding tore on the door's aft side and the insulation blew out after the door came partially open in flight.

Investigators are uncertain about what caused the door to open. A New York Airways official said that a foreign object may have struck the pylon in flight, as there was a dent forward of the door. Tearing of the siding and subsequent release of the insulation apparently resulted from slipstream and vibration. Civil Aeronautics Board officials said they had no opinion yet on cause of the door opening.

"So far as the emergency situation itself is concerned, the pilot handled it very well," a CAB investigator said.

A spot examination revealed no evident damage to the stalled engine, the insulation packet having stopped just inside the air intake. Compressor blade damage was evident on No. 2 engine, and later inspection was expected to reveal further fouling in view of the engine's power loss during flight. Parts of the glass fiber siding were found in No. 2, indicating heavy ingestion.

No. 2 engine sustained cracked oil bearings after salt water was sucked in following the landing. Heavy blue smoke resulted during taxi as oil from the cracked bearings leaked into the combustion section.

The accident occurred shortly after 4 p.m. while the helicopter was en route from Newark Airport to Wall Street, first stop on its flight to LaGuardia and Idlewild. The Newark-Wall Street leg, 7 mi. long, normally takes 4 min.

Capt. George King, 43, was preparing to make a log notation as Robert Burns, 45, the copilot, flew at 600 ft. They were in a gradual climb toward an 800-ft. cruise altitude when the No. 1 engine quit abruptly as they neared the Statue of Liberty on Liberty Island in New York Harbor.

Verifying that there was no fire, King and Burns attempted an air restart. The engine started, but would not accelerate above idling speed, or 56% of gas generator speed. Then power loss was noted on No. 2.

King at first considered landing on Liberty Island, site of the statue, but changed his mind upon seeing numerous sightseers on the ground. He altered course for nearby Governor's Island, an Army installation with a large drill field.

"We seemed to pick up the ground cushion effect as we neared the water, as we were able to hold altitude for a while," King said. "We were getting about 80% power out of the remaining engine.

"But then the power started dropping off further and we lost altitude. It was low tide, and we couldn't clear the Governor's Island sea wall."

King notified the passengers of the impending water landing, then set the aircraft down in Buttermilk Channel, separating Governor's Island from Brooklyn. The landing, made with moderate flareout and forward speed, was termed "gentle" by passengers. It was a power setdown, without autorotation. Passengers donned life vests after landing, but did not evacuate the helicopter until an hour later when it reached the dock.

King, who had already notified New York Airways of the situation and touchdown point, attempted to coax enough power and rotor speed from the operating engine to lift out of the water onto Governor's Island. Failing in this, he began taxiing toward the Wall Street heliport, 1½ mi. away.

The aircraft floated and taxied well, King said, his only apprehension arising when it was rocked by the wake of passing boats. The Coast Guard was notified and cleared the area.

A tow line from a boat was attached, but the helicopter continued toward the pier under its own power. The tow line was a precaution against complete failure of the No. 2 engine, which would have left the aircraft adrift in heavy tides. King shut down just off the heliport. The boat towed the 107 in, and passengers were unboarded.

After another 1½ hr. in the water, the helicopter was hoisted aboard a barge and ferried to the airline's maintenance facility at LaGuardia.

Some water leakage occurred in the Vertol's aft-section baggage compartment, which is not completely sealed. A small amount of water also got into the d.c. electrical compartment in the left sponson. This was due to submersion of the sponson during the docking operation, with water seeping in around the maintenance access doors. Otherwise, the aircraft interior remained dry.

The left sponson settled lower in the water as taxi proceeded because fuel was being burned from the right sponson fuel cell, with the left cell remaining full. During docking, one of the inactive rotor blades was temporarily wedged underneath the dock, aggravating the list of the left sponson.

The Vertol, serial number 6673D, was delivered to the carrier June 1, as the second of three now in use by NYA. It has a total time of 257 flight hours, approximately 140 of which have been in scheduled operation. King, the captain, has been flying helicopters since 1956, has 7,000 hr. of rotor time and has been with NYA seven years.

Had one engine been fully operative, the Vertol could have maintained safe flight and even taken off from the water. Conditions at the time of the accident were 71F temperature, a 10-15 kt. wind and gross weight of 17,000 lb. The Vertol's performance curve shows that with one engine fully operative, the aircraft could have initiated a 300 fpm. climb with 10-deg. yaw at 60 kt. and 94% rotor speed.

Merger Plans

Washington—Major planning for the formal filing of the proposed merger between Pan American World Airways and Trans World Airlines with the Civil Aeronautics Board has been completed (AW May 7, p. 47).

During recent weeks, Pan Am officials, including President Juan T. Trippe and Vice President Samuel F. Pryor, have contacted heads of all federal agencies and departments which might be concerned with the merger, including the Attorney General's office. Purpose was to test top government reaction to the plan and to smooth the way for presenting the proposal to the CAB.

The response prompted Pan Am to move ahead with the proposed combine, although top Administration officials are not granting the plan any official blessings until all issues have been aired in public CAB hearings.

AIRLINE OBSERVER

► Negotiations are under way for acquisition of four Canadair CL-44 turboprop cargo aircraft by Lufthansa. West German government is participating, as it may finance a major part of the purchase and lease the aircraft to Lufthansa. Canadair is also close to agreement with BOAC for two CL-44s initially, and a larger number later (AW June 18, p. 39). Major factor in the continuing orders for CL-44s is that the Canadian government is insuring up to 80% of loans extended purchasers of the aircraft.

► **At least one foreign flag carrier is currently re-evaluating job requirements of ticket agents. In addition to selling tickets, a complicated procedure by itself, agents of international carriers must be equipped to provide overseas travelers with information about political, economic and social conditions they will encounter in foreign countries.**

► Transport Workers Union settlement with American Airlines centers on a new type of job security issue within the airline industry. TWU, which called off a threatened strike by 10,000 members after appointment of a presidential emergency board, claims that the airline has been substituting TWU fleet service personnel for union mechanics at line stations in at least four major cities and planned to spread this practice to most of the carrier's system. Mechanics feel this threatens their jobs. TWU members were still ratifying the settlement last week.

► **Federal Aviation Agency this week will circulate within the government a 758-page report containing a proposed implementation program for Project Beacon recommendations, to obtain both FAA and Defense Department comments prior to public release. This report was prepared by FAA's system design team (AW Mar. 19, p. 40), headed by Albert Brown, after nearly a year's study. The plan, in accordance with original Beacon recommendations, does not propose to make widespread use of Sage computers, which may draw some fire from the Air Force.**

► Industry proposals for an airline interline reservations system, a switching-computer center to interconnect individual airline reservations computers (AW Aug. 14, p. 45), were due late last week. Companies invited to submit proposals to the Air Transport Assn. include: Collins Radio, Ferranti-Packard, International Business Machines Corp., ITT Federal Laboratories, Radio Corp. of America, Remington Rand Univac, and Teleregister Corp.

► **Ansett-ANA Chairman R. M. Ansett, will visit Britain, The Netherlands and U. S. to study turbojet transport markets. Ansett currently is chiefly interested in the Boeing 727 and the BAC 111 and will also look at the Fokker F-28 small jet transport as a possible replacement for the Vickers Viscount. Under Australia's Airlines Re-equipment Act of 1958, the country's two airlines, Ansett and Trans-Australian Airlines, cannot place orders for new aircraft before next November (AW Nov. 11, p. 46).**

► British Ministry of Aviation will tighten regulations covering airworthiness of older aircraft, such as the Douglas DC-3, Hermes and the Viking, which are operated by British independent airlines. Parliamentary Secretary Christopher Woodhouse recently said the move may involve "economic penalties," and emphasized that the airplanes, although safe, do not measure up in all respects to International Civil Aviation Organization standards applied to all new aircraft produced since 1951. Particular stress will be placed on Navaid equipment and engine-out performances.

► **Key concern among purchasers of the Boeing 727 over new systems in the airplane is reliability and maintenance of the aircraft's complex flap and leading-edge flap arrangement. Operation in wintertime runway slush is viewed as potential problem, although Boeing has included design and structural strength features specifically aimed at the slush threat.**

SHORTLINES

► **Alitalia Airlines** reported a 50% increase in eastbound transatlantic passengers during the first six months of the year. Passengers totaled 29,138. June was a record month, with 10,410 passengers representing a 59% increase over the same month last year. June load factor was 80%, compared with 69% in June, 1961.

► **Bonanza Air Lines** credits a stepped-up advertising and promotion program for its 27.4% gain in revenue passenger miles during the past six months over the last half of 1961.

► **British United Airways** said it will inaugurate trial service across the Dee Estuary with its Vickers VA-3 Hovercraft on July 20. Round-trip fare will be $5.20. Costs during the eight-week period will be shared by BUA, Vickers-Armstrongs and British Petroleum.

► **Central Airlines** says its 29,270 passenger boardings in June represented a 31.9% increase over June, 1961, but 600 less than May's record high.

► **Continental Air Lines** has ordered its fifth Boeing 720B. The airplane is slated for delivery in May, 1963.

► **Ethiopian Airlines** has gained Spanish government approval to serve Madrid from Accra and Athens. The new service is expected to begin this fall with Boeing 720B turbofan aircraft, making Madrid a gateway to the Middle East and East and West Africa.

► **Federal Aviation Agency,** effective June 13, granted Trans World Airlines a 2,200-hr. time between overhaul for the General Electric CJ-805-3 turbojet engines that power TWA's Convair 880s. This is highest allowable TBO to date for this engine in airline service.

► **Local service airlines** reported a 17.5% increase in revenue passenger miles during the first six months of 1962, compared with the same period last year. During June, traffic climbed 12% over June, 1961. Load factor for the year's first half was 42.1%, compared with 41.4% in the same 1961 period. Load factor for June was 44.7%, slightly over the June, 1961, mark of 44.3%.

► **United Air Lines** said 62.4% of its regular customers, in response to a recent questionnaire, indicated they agreed with UAL policy against the sale of liquor in jet coach accommodations. Of the remainder, 32.8% took the opposite view and 4.8% took no position.

Look quick! That's TWA's new StarStream jet!

The dependable, fast-moving TWA StarStream* is the nation's newest transcontinental jet. Its four DynaFan* jet engines generate more power than any engines in use by any other airline flying across the U.S.A. In First Class you'll enjoy the new StarStream Royal Ambassador service, gourmet dining patterned on TWA's famous European service. Whether you fly First Class or thrifty Coach, you're always TWA's guest at mealtime.

Nationwide
Worldwide
depend on

TWA

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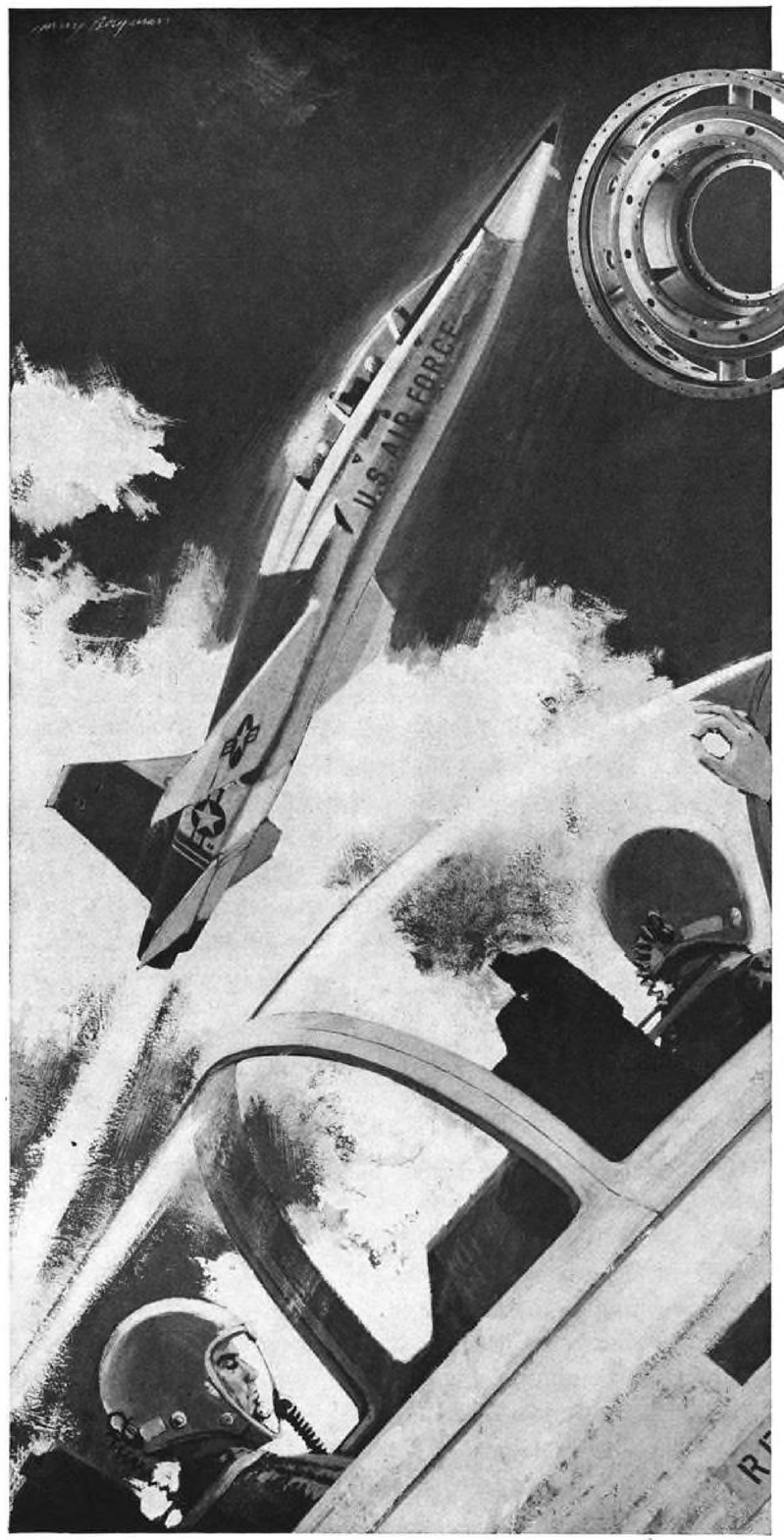

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The Northrop T-38 . . .
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. . . is powered by twin General
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Automotive, Aviation and Agricultural Parts
Hand Tools for Industry and Home

SAS Plan Offers Travel Agents Added Incentive of Trading Stamps

New York—New market expansion program involving trading stamps, designed to give private travel agencies a counteraction against the entry of large mail order firms into the tour business, has been launched by Scandinavian Airlines System.

Geared as an incentive for travel agents, the program offers merchandise credits amounting to 1-3% more than the agent's standard 10% commission.

SAS estimates that the program will generate between 1,000 and 2,000 new transatlantic travelers this year, with greater increases in 1963.

The airline initiated the program in cooperation with the Gold Bond Stamp Co., of Minneapolis, and Maupintour Associates, Lawrence, Kan., one of the nation's major tour agencies.

European Tours

Five European tours are offered, priced from $512.40 to $1,237.70 and ranging from 16 to 22 days' duration. When an agent books one of the tours, he receives a certificate equal to three stamp-filled Gold Bond books. The certificate, worth $10 to $12, may be redeemed from a selection of 2,000 merchandise items from the U.S. and 20 foreign nations. The larger the tour the group booked, the more gift certificates the agent receives.

Although the program is relatively simple, SAS views it as one of the most practical market expansion efforts to arise at a time when the industry is pondering how to develop new business.

"The main advantage is that it helps the private agent overcome the effects of the tours now being sold by the large mail order firms," an SAS spokesman said, referring to the overseas tours being merchandised by Sears, Roebuck & Co. and Montgomery Ward.

SAS' role in the program is solely that of the transporting carrier. Gold Bond and Maupintour granted SAS a 5-year exclusive on the arrangement through first-refusal rights. However, it is planned to offer the program to other carriers in the future.

Primary advantage to SAS is that the airline receives the business in return for a very small investment of its own money. Expense of arranging the tours and promotion is absorbed almost wholly by Maupintour and Gold Bond.

The tours were drawn up by Maupintour, which, in addition to being a standard tour agency, is also a tour "wholesaler." As a wholesaler, Maupintour receives a commission for arranging transportation, accommodations and itineraries for other agencies which book tours. Gold Bond handles the tour promotion and awards gift certificates on the same basis as it does to its regular accounts.

SAS says the program will unquestionably stimulate more business than other stamp programs, in which persons accumulate their own stamp books until they have enough to pay for a tour. The airline said several stamp-distributing companies were approached with the program idea, but Gold Bond was the first to accept it.

"The program is especially attractive to SAS when you consider the vast market reached by advertising the tours," an SAS spokesman said. "Gold Bond is making 15,000,000 mailings to individual households in the U.S. and Canada to familiarize travelers with the tours."

It is also being promoted through displays in the 250,000 retail outlets, such as drugstores and supermarkets, with Gold Bond accounts. The 4,000 to 4,500 travel agencies in the U.S. have also been familiarized with the program through personal visits and mailings.

SAS feels the program will be especially well received by smaller agencies which operate on a narrow profit margin.

"The prospect of obtaining something above the standard commission should stir extra effort in agencies such as those operated by a man and wife," an SAS official said.

Surveys Cited

Surveys cited by SAS indicate that even the small agency must gross $300,000 annually to justify operation, with $750,000 gross dealing nearer the practical point. The survey shows that 85% of an agency's business must be international to maintain these levels, SAS said.

"This will even reach right into the agent's own family," the SAS spokesman said. "If his wife is a stamp saver, or if she is attracted by the merchandise available through the gift certificates, that is all the more incentive for the agent to push these tours."

An elaborate program kit, listing both the tours and the gift catalog, has been provided for travel agencies. Cities in the Scandinavian countries and in Germany, France, Great Britain, Italy, Yugoslavia and Spain are included in the tours. Those who buy the tours are provided with a kit containing baggage name tags, a pen, passport and ticket holder and a currency converter chart.

UAL Doubts Small Jet Plane Need

New York—United Air Lines is studying the small short-haul jet transport, but W. C. Mentzer, United senior vice president of engineering and maintenance, doubts whether United will have a need for an airplane of this class.

Mentzer was in New York on the way to Europe to see the BAC 111 and to discuss supersonic transport technology with Sud Aviation.

United's fleet expansion plans are complete through 1965, Mentzer said, and his trip is not to be interpreted as an indication of United interest in any particular aircraft. United is also looking at the Douglas Model 2086, though Douglas will not proceed with this program without a minimum number of orders.

The Boeing 727, of which United has ordered 40, will meet the airline's medium-haul requirements for an indefinite time, Mentzer said. On short routes, such as New York-Washington, Mentzer doubted whether either the short-haul jet or V/STOL aircraft will be any more economical than United's current equipment family.

Although he will talk supersonic transports with Sud, Mentzer is not interested in any fast development of a Mach 2 or 3 transport.

"The SST is not something we should rush too much, considering the many problems it poses," he said. "The later it comes, the better."

He said that in United's estimation, 1970 was the earliest that anyone could expect a practical SST design to fly.

Despite evolvement of the BAC 111 and the Boeing 727, Mentzer said United has no target schedule for retirement of its 20 Caravelles. However, he added that the 727 order eliminated any likelihood that United would exercise its option for 20 more of the French aircraft.

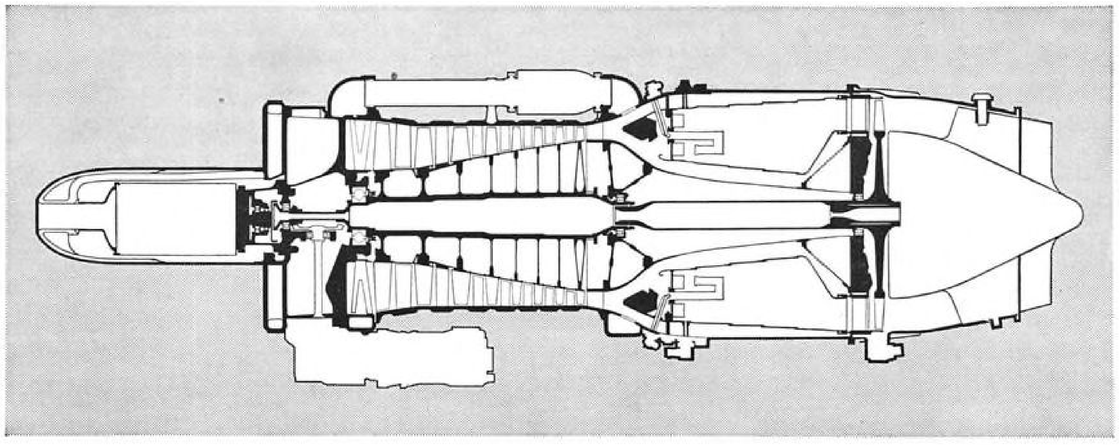
"We've always considered the Caravelle an interim airplane, needed to fill the time gap between the four-engine jets and the 727," Mentzer said.

He said the planes, which cost United $65 million, had each averaged 6-7 hr. daily utilization during the year. They carried 734,000 passengers, flying 9,313,000 mi. in 26,000 hr. Breakeven load factor for the fleet has been 60%, and as low as 50% on specific segments such as New York-Chicago.

United's 727s, with 99-passenger capacity in dual configuration, will be used system-wide. The Caravelles, with 67-passenger all first-class seating, have not been used farther west than Omaha.

BS
AERO POWER

New Viper provides reliable, low-cost power for executive jets



The Bristol Siddeley Viper 20 is now at an advanced stage of development for the next generation of light executive transports. This new version is basically a Viper 11 with a "zero" stage added to the compressor which gives a 20% increase in mass flow, a reduced turbine entry temperature and an improved specific fuel consumption. Like all its predecessors, the Viper 20 retains the basic design concepts of a simple, reliable engine with high thrust at high altitude and *low first cost*.

De Havilland 125 executive transport.

Delivering 3,000-lb thrust at take-off for a sea-level specific fuel consumption of 0.985 lb/lb/hr, the Viper 20 has potential for development to still higher thrusts and lower specific fuel consumptions.

SELECTED FOR TWO NEW EXECUTIVE JETS

The Viper 20 has already been selected as the power unit for both the De Havilland 125 and the Piaggio/Douglas 808 "Vespa-Jet" executive jet aircraft.

PROVEN POWER

Ranging from 1,640 to 3,000-lb thrust, the Viper series of turbojets has now been flying for over 8 years and has proved itself under a wide variety of strenuous operational conditions. Over 1,000 engines have been ordered and Vipers currently power three aircraft types in service—Hunting Jet Provost, Macchi MB 326 and Jindivik target drone.

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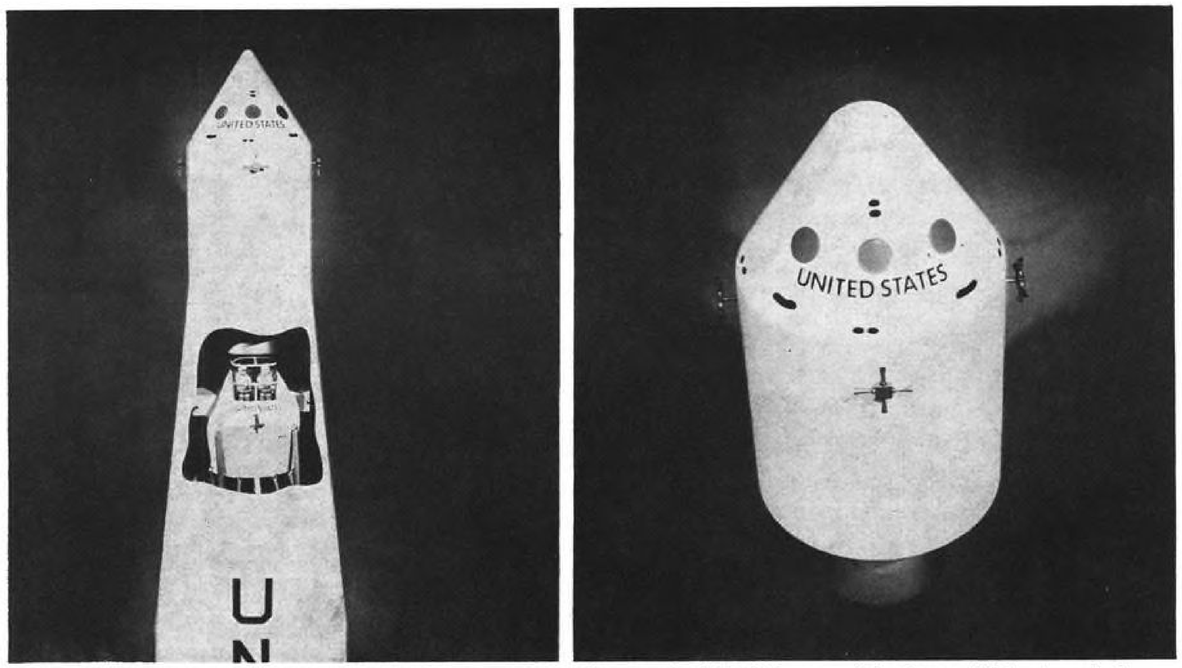
Airline Traffic—May, 1962

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNKS								
American	699,393	540,911	56.8	2,777,215	1,264,281	12,993,962	68,739,869	52.4
Braniff	200,826	93,777	53.3	497,890	197,814	1,205,381	10,888,428	44.7
Continental	108,909	69,085	41.8	343,621	117,930	957,861	8,039,154	37.4
Delta	330,010	207,004	56.7	959,671	428,946	2,369,852	23,662,552	49.2
Eastern	750,471	367,715	46.64	1,534,326	630,274	3,139,129	40,599,328	38.8
National	150,376	105,830	45.1	444,862	102,569	1,630,979	12,383,517	37.5
Northeast	114,868	48,346	39.9	158,781	56,178	311,606	5,146,137	34.4
Northwest	165,590	118,530	52.0	760,825	289,199	1,529,775	13,924,354	44.1
Trans World	404,877	355,721	52.0	1,661,600	726,814	5,208,176	41,670,079	43.9
United	995,505	669,624	51.7	4,336,996	1,428,845	10,991,288	80,871,112	47.5
Western	164,514	96,435	50.6	338,429	120,077	511,963	10,102,265	41.3
INTERNATIONAL								
American	8,241	8,613	48.8	7,809	530	255,063	1,191,686	54.0
Braniff	7,916	11,103	42.7	63,016	.....	217,856	1,489,414	39.7
Caribbean Atlantic	45,990	3,203	61.4	2,842	.....	23,148	332,272	60,6
Delta	1,386	2,335	31.5	496	.....	20,366	262,909	27.2
Eastern	44,726	64,310	45.5	1,771,118	8,849	597,813	6,712,148	41.0
Mackey	9,338	1,371	40.7	.....	260	5,898	140,617	36.0
Northwest	22,677	46,108	59.1	1,923,289	5,473	974,150	7,741,690	51.7
Pan American								
Alaska	6,361	6,108	26.9	44,552	3,034	282,092	949,906	31.1
Atlantic	193,762	248,809	55.6	3,034,513	.....	6,584,510	35,230,213	51.5
Latin America	95,899	129,528	52.9	641,654	7,688	4,217,660	18,339,919	57.3
Pacific	42,264	168,749	62.8	4,354,730	26,486	4,908,249	26,608,042	64.1
Panagra	11,126	19,478	60.6	95,787	.....	408,938	2,885,654	61.0
South Pacific	115	347	26.5	2,715	.....	3,869	42,187	31.0
Trans Caribbean	11,465	18,113	64.5	.....	1,831	342,510	1,866,126	62.8
Trans World	32,337	100,848	49.3	2,570,981	.....	2,867,507	15,823,340	52.2
United	14,608	36,390	56.4	397,360	11,651	348,294	4,466,710	51.8
Western	7,045	10,838	78.3	14,284	.....	54,919	1,182,227	67.8
LOCAL SERVICE								
Allegheny	80,705	16,911	41.4	34,273	47,883	102,758	1,798,291	44.9
Bonanza	34,559	8,936	50.4	8,055	3,235	18,002	887,019	51.3
Central	29,913	6,200	40.6	21,425	11,092	35,142	660,957	39.8
Frontier	29,389	7,744	34.8	25,146	12,409	78,045	858,040	38.0
Lake Central	37,793	6,091	39.8	11,816	31,017	29,134	653,162	42.0
Mohawk	90,634	18,114	46.4	26,178	31,338	49,925	1,834,521	45.1
North Central	85,792	15,471	39.6	50,953	55,938	79,150	1,655,804	41.4
Ozark	57,950	10,407	46.8	21,284	33,344	47,926	1,095,709	51.2
Pacific	40,101	9,062	48.6	19,932	5,380	12,771	902,679	49.5
Piedmont	52,030	10,624	42.1	17,561	21,845	35,351	1,091,935	43.7
Southern	41,233	7,571	35.5	27,684	20,123	30,536	803,359	38.5
Trans Texas	33,059	7,914	36.1	23,864	13,856	44,359	839,135	36.5
West Coast	34,242	8,435	41.6	16,259	5,414	27,099	854,309	42.13
HAWAIIAN LINES								
Aloha	29,067	4,325	62.1	4,147	.....	5,328	357,333	53.2
Hawaiian	34,751	5,267	57.6	6,052	.....	191,834	620,991	59.8
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	321,302	321,302	65.0
Flying Tiger	3,928	18,222	79.4	24,296	36,422	22,884,779	24,767,648	80.8
Riddle-Domestic	87	26	42.6	13,388	2,982	5,353,778	5,372,829	66.4
-Overseas	8,267	39,090	90.5	10,597	394	1,673,215	5,593,040	87.4
Seaboard World	2,102	8,293	98.7	1,039,651	.....	6,375,241	8,253,562	67.8
Slick	1,347	6,752	79.5	.....	.....	8,774,892	9,487,654	85.3
HELICOPTER LINES								
Chicago Helicopter	7,710	146	35.9	572	529	.....	15,036	27.5
Los Angeles	6,067	2,057	36.8	5,951	2,784	.....	28,365	38.2
New York	14,539	253	49.3	383	835	539	25,929	50.5
ALASKA LINES								
Alaska Airlines	9,030	7,423	41.8	66,208	1,493	1,220,394	2,037,020	54.2
Alaska Coastal-Ellis	11,187	909	57.9	6,851	.....	10,323	109,358	62.6
Cordova	2,787	397	47.2	2,974	.....	48,411	91,681	53.4
Kodiak	1,112	67	36.2	546	.....	742	8,028	37.9
Northern Consolidated	2,984	916	38.4	63,090	.....	60,626	223,371	58.6
Pacific Northern	13,287	12,578	34.8	166,783	8,839	583,246	2,111,425	49.7
Reeve Aleutian	1,772	1,521	43.3	78,395	.....	75,311	319,307	55.5
Western Alaska	723	36	47.4	899	.....	2,661	6,953	51.9
Wien Alaska	3,900	1,246	43.0	68,230	.....	231,753	427,005	52.9
Avalon	10,264	481	52.1	638	.....	378	46,683	53.2

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



TWO-MAN lunar excursion vehicle is seen in the cutaway model (left) between the S-4B third stage of the Saturn C-5 booster and the Apollo spacecraft with its service module. Although the model shows two pilots sitting in the "bug," they would not board it until ready to descend to the lunar surface. At right is a model of the Apollo spacecraft with its service module behind it.

Lunar Orbital Rendezvous Poses Biggest

By David H. Hoffman

Washington — Technical challenge posed by lunar orbit rendezvous dwarfs the already significant achievements of the U. S. in manned space flight.

Decision to employ this technique for Project Apollo (AW July 9, p. 25), means that the safe return of the first U. S. astronauts to explore the lunar surface will hinge on the precise execution of a rendezvous maneuver 240,000 mi. from earth.

The Gemini program, overshadowed until now by the pioneering Mercury flights and the preparations for Apollo, now assumes an even greater importance. In the long-duration Gemini flights, the spacecraft's two-man crew will attempt the first rendezvous of the U. S. space program in a circular, 150-mi. high orbit of the earth.

Intricacy of this maneuver is best explained in terms of the tolerances within which the pilots must work. During the final phase of docking, as the capsule is closing with its target at a rate of 1.5 fps., one foot of unintended lateral displacement or 10 deg. of angular misalignment will spoil the attempt. Similar tolerances probably will apply to rendezvous in lunar orbit.

In a unanimous vote, National Aeronautics and Space Administration's management council decided to concentrate priority on the lunar orbit rendezvous approach. An earlier but highly tentative decision to pursue earth orbit rendezvous as the prime mission mode had been reached following studies conducted by Marshall Space Flight Center. Recommendations made by the Golovin Committee on large launch vehicle planning reinforced this decision.

A few months ago, however, Marshall reversed itself and endorsed lunar orbit rendezvous—the technique that was favored by NASA's Manned Spacecraft Center in Houston.

Flexible Approach

NASA is careful to point out that six to eight years will elapse before the first Apollo mission, and that even its lunar orbit rendezvous decision may be changed. Nevertheless, as it is now defined, the U. S. manned lunar landing program will follow this pattern:

Launch vehicle will be a single Saturn C-5, with a Boeing S-1C booster stage powered by five Rocketdyne F-1 engines developing a total of 7.5 million lb. thrust. Its second or S-2 stage, built by North American, will house a cluster of five hydrogen-oxygen fueled Rocketdyne J-2 engines, each developing 200,000 lb. thrust. The Douglas S-4B third stage will incorporate a single J-2 engine.

The entire vehicle and Apollo spacecraft will be assembled in a vertical assembly building at Cape Canaveral. Design criteria for this structure will have been developed by NASA by this fall. After assembly and systems checkout, the entire vehicle will be carried to its launch complex by a rubber-wheeled, crawler-type transporter-launcher, which NASA has decided is superior to barge or rail transportation systems for this purpose.

By using the vertical assembly building and the crawler, NASA hopes the time Saturn vehicles must spend on the pad prior to launch will be cut from several months to a week or less. As a result, launching schedules, which now must allow for possible missed launch windows, will gain new flexibility.

Standing vertically on its pad, the fully-fueled C-5 will be 325 ft. tall and weigh about 6 million lb. The over-all spacecraft, tipped by an escape tower very similar to those employed in Mercury flights, will consist of these units:

• **Command module,** weighing about five tons and 12 ft. high, will house the Apollo crew during lift-off and the translunar phase of the mission. It will have a 154-in. base diameter and a 33 deg. side wall slope.

• **Service module,** weighing 23 tons and 23 ft. high, will contain the propellant for mid-course corrections and earth return. Diameter also will be 154 in. Propulsion system probably will incorporate limited engine-out capability.

• **Lunar excursion module,** weighing about 15 tons and 20 ft. tall, will carry two astronauts to and from the lunar surface. It will use earth-storable, hypergolic propellant in a system independent from that of the service module.

North American's Space and Information Systems Division is contractor for the command and service modules. Design of the excursion module will be defined during the next three months by industry proposals solicited by NASA.

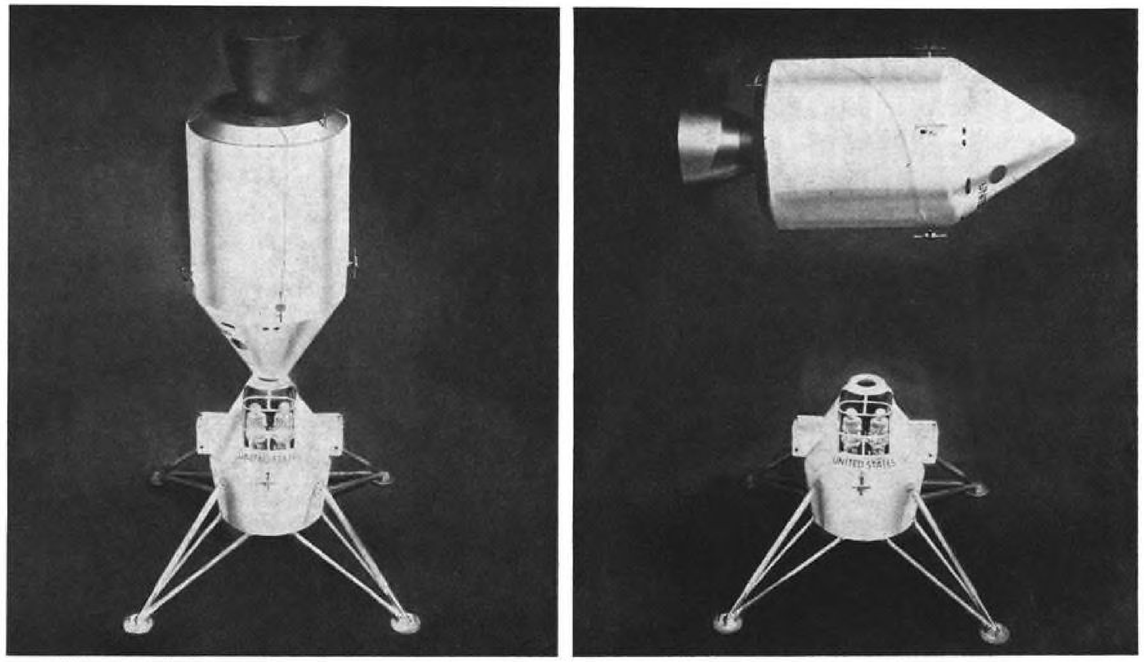
An ideal launch will result in total burn of the S-1C and S-2 stages and a partial burn of the S-4B upper stage. This sequence will establish the S-4B and the three modules of the spacecraft in an earth-orbiting trajectory. After at least one half revolution, during which the crew and Apollo controllers on earth will decide whether to undertake translunar flight, the spacecraft will approach its launch window.

Once a decision is reached, re-ignition of the S-4B engines will give the spacecraft a nominal escape velocity of 25,000 mph. Total spacecraft weight at that point is predicted to be about 85,000 lb. Even if this increases slightly, as is expected, C-5 has an ejection capability of about 90,000 lb., thus affording some design latitude.

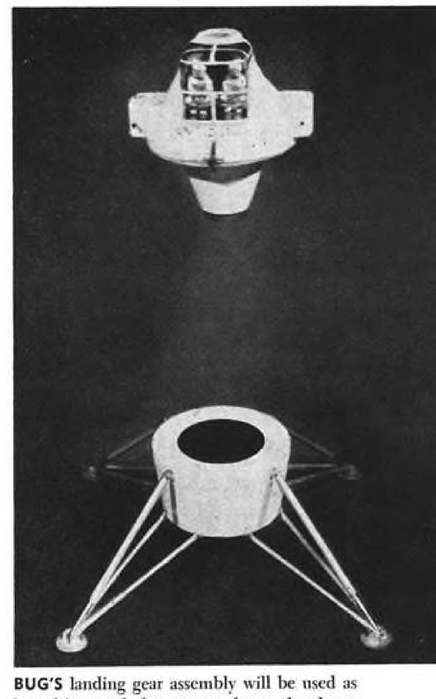
When the spacecraft is on its translunar trajectory, the lunar excursion module, still housed in the upper section of the S-4B, is mated to the command-service module combination by one of two techniques. The method now preferred by NASA involves total separation of the command-service modules from the S-4B stage and their reorientation in space.

During this maneuver, the S-4B fairings that enclose the bug would drop away. The command-service module combination, its conical end now pointing back toward earth, would mate with the exposed bug. When the attachment was complete, the empty S-4B stage would be jettisoned, freeing the service module's propulsion system for use in possible aborts. Thereafter, the bug would form the upper module of the spacecraft.

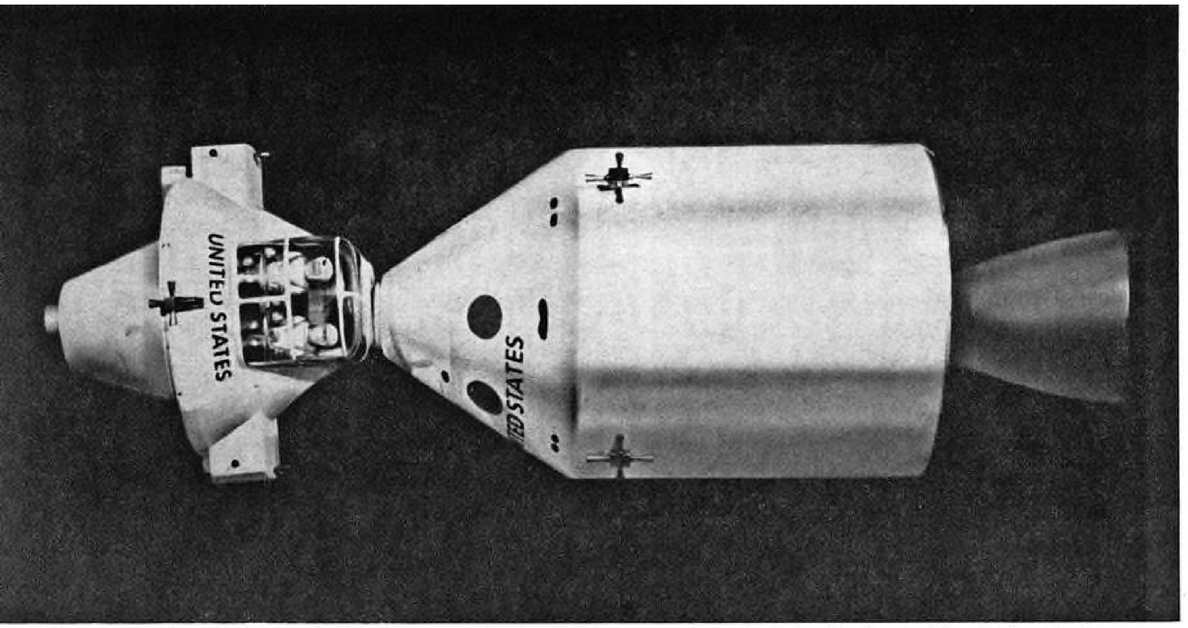
An alternative technique would utilize a mechanical arm attached to the service module to extract the bug from



AFTER SEPARATION of the Apollo command and service modules from the S-4B, this combined unit will execute a turn-around maneuver (left) and mate to the lunar excursion craft. The three-component Apollo vehicle—command module, service module and bug—then will separate from the S-4B and fly on to lunar orbit. In lunar orbit, two crewmen will enter the bug through an air lock.



BUG'S landing gear assembly will be used as launching pad for ascent from the lunar surface to the orbiting spacecraft. Throughout rendezvous phase, astronauts in the bug will maintain voice and radar contact.



SERVICE MODULE will contain, in addition to various spacecraft systems such as the fuel cells, the propellants and engine for return flight and mid-course corrections. It will be jettisoned prior to earth re-entry. Typical mission will consume 7 days—2.5 days en route, 2 in lunar exploration and 2.5 in the return flight to earth.

the S-4B stage and position it on top of the spacecraft (AW July 2, p. 92).

During the en route phase of the mission, the Apollo crew would complete its systems checkout. To accomplish mid-course corrections, the astronauts would rely primarily on the command module's guidance system and entirely on the service module's propulsion system.

Velocity Gain

At an appropriate point in space, still another burn of the service module engines would give the entire spacecraft a 3,000 fps. velocity gain, dropping it into lunar orbit. Its velocity in orbit would be about 5,000 fps. The orbit itself would approximate a band ±10 deg. in latitude from the lunar equator. It would be circular and have an altitude of about 100 mi.

Dr. Joseph F. Shea, deputy director of systems in NASA's Office of Manned Space Flight, offered this description of the next step:

"After determining that all the subsystems are working and that we are ready to commit to the mission, two of the three astronauts will transfer from the command module to the lunar excursion module. Once they are transferred, we will then, using the propulsion aboard the lunar excursion module, put the excursion module on a trajectory which has the same period as the circular orbit of the command module-service module combination, but has a much lower perigee, a perigee of approximately 50,000 ft. This will enable us to go down and in effect examine from an altitude of something like 10 mi. the intended launch (and landing) site."

Elliptical orbit assumed by the bug would have an apogee of several hundred miles. Its actual period, as well as that of the spacecraft, would be about 2 hr. Bug's thrust-to-weight ratio would be about .6 to .7.

If the two astronauts in the bug decided to land, a second burn of the module's engines would bring them down into a hovering position above the moon's surface. The bug's landing gear, stowed in a flush position along its sides, would then be extended.

From the bug's glass dome, the touchdown point on the lunar surface can be selected by the astronauts. Up to 1 min. can be spent hovering while the area around the excursion module is examined visually.

In addition, the bug can be translated as much as 1,000 ft. in any direction while in hover.

For the rendezvous phase of the mission, the bug's landing gear and the housing for its lower fuel tanks would be used as a launch pad, then abandoned on the lunar surface.

Ascent from the moon must begin during a 6-7 min. window, which probably would reoccur every two hours. When the orbiting spacecraft was still about 3 deg. away from a point directly over the landing-launching site, the bug's engine would be re-ignited and the bug launched on an intercept trajectory. Repeated sitings taken earlier by the astronauts from the lunar surface would have plotted the spacecraft's precise orbit.

Half way up the ascent trajectory, pilots in the bug would execute a mid-course correction. Final docking phase would begin when the bug was 3-6 mi. from the mother spacecraft, a distance that could be calculated by radar or optical observations. When the velocity and plane of the spacecraft's orbit virtually was duplicated by the bug, the bug would be reoriented and steered to an airlock on the command module.

The two astronauts on board the bug would enter the command module through this lock and the bug would be jettisoned in the lunar orbit. Service module's propulsion system, with more than 20,000 lb. thrust remaining, would kick the spacecraft onto its return trajectory.

Re-entry Procedure

Prior to re-entry, the service module would be jettisoned, and the command module, weighing between 8,500 and 10,000 lb., guided to its 40-mi.-wide re-entry corridor. Angle of attack during re-entry would be about 30 deg. When maximum pressure and deceleration are experienced, no propulsion would be needed except for attitude control. NASA also is hopeful that, by the first Apollo flight, it will be able to retain capsule communication throughout the re-entry phase.

Lift/drag ratio of the command module is designed to be about 0.5 at supersonic speeds and about 0.7 at subsonic speeds. Gemini capsule, by contrast, has a comparable ratio of about 0.25, while the Mercury capsule's ratio is effectively 0.0.

By exploiting only this inherent lift through attitude control during the re-entry, Apollo pilots should be able to land within a footprint 10 mi. square. Final braking of the capsule may be provided by three 85-ft. parachutes,

unless the Gemini program proves that a paraglider or Rogallo wing is feasible.

With the control made possible by such landing aids, NASA hopes the command module can be landed within an area the size of a large airport. Several much larger sites in U. S. plains states have been considered by the space agency, which is seeking a flat area with generally good visibility and few of the restrictions posed by a dense population.

At this early stage of lunar orbit rendezvous planning, there is a possibility that the C-5's third stage and the spacecraft it carries will have to describe as many as 1.5 earth orbits while waiting for the lunar window. If this proves true, the Apollo crew probably can complete a preliminary checkout of command and excursion module systems before committing themselves to the 72-hr. translunar flight. Otherwise, systems checkout would take place en route to the moon.

Abort Possibilities

Crew-saving aborts can be initiated during almost any phase of the mission, even after re-ignition of the S-4B engines has given the spacecraft escape velocity. For example, should a critical system malfunction during the translunar phase, return to earth could be accomplished in either of two ways:

- **Continuing to the moon** in a long coast and then using lunar gravity to slow and turn the spacecraft back toward earth. The spacecraft then would use the command module guidance system and the service module propulsion system to return. Effect of midcourse corrections could be cross-checked with NASA's deep space communications network. As in a normal mission, only the command module would re-enter the earth's atmosphere. This is the most probable method.
- **En route abort technique,** which would entail reversing course short of the moon's gravitational field.

Because the bug's elliptical orbit is to have the same lunar period as the circular orbit of the mother spacecraft, the two should pass close together once per revolution. Should an abort prove necessary after the bug has disengaged, this merging of the two orbital paths affords a natural opportunity for re-rendezvous.

According to Shea, the two trajectories will be so constructed that at all times during the bug's retro-maneuver, hover, translation and touchdown on the lunar surface, the astronaut in the command-service module combination will retain line-of-sight communication with the two astronauts on board the bug. Two-way radar contact also will be continuous during these critical maneuvers. As a result, Shea said, "a very simple series of trajectories" will enable the bug to abort and rendezvous with the overhead spacecraft at any point prior to touchdown.

In addition, the mother spacecraft would carry redundant guidance and sensing systems that would enable it to "chase" or "summon" the bug and effect rendezvous if necessary. Thus, the actual rendezvous could be controlled either from the bug or by the single astronaut at the controls of the orbiting spacecraft.

Control From Earth

As a further safeguard, NASA expects that its deep space instrumentation facility (DSIF), which then will consist of three station complexes located about 120 deg. apart on the earth's surface, will be able to plot the command-service module's lunar orbit with precision. This means that almost the entire lunar orbit rendezvous, with the exception of its final docking phase, could be commanded from stations on earth.

Similarly, the bug's initial elliptical orbit would be monitored from the deep space net.

Life-sustaining equipment and supplies probably will be positioned on the lunar surface prior to the astronauts' arrival. Before the space agency decides to develop the unmanned lunar logistics vehicle that would carry such stores to a point near an intended landing site, it says it will complete a six to eight month study of the entire concept. But many believe this study will only reinforce an earlier decision.

It would be relatively simple, NASA officials have said, to adapt the logistics vehicle for the unmanned lunar exploration mission assigned earlier to the Prospector program. Even though Congress deleted almost all funding for Prospector from NASA's Fiscal 1963 budget, it is expected to approve funds for the logistics vehicle if they are requested by the space agency.

Priority NASA will attach to this program is reflected in the comments of its ranking officials.

"It would appear," NASA Administrator James E. Webb said recently, "that if we go forward with a lunar excursion vehicle, a logistic support vehicle would be very important to use in conjunction with it. It would also appear that this might be expanded into a direct ascent vehicle.

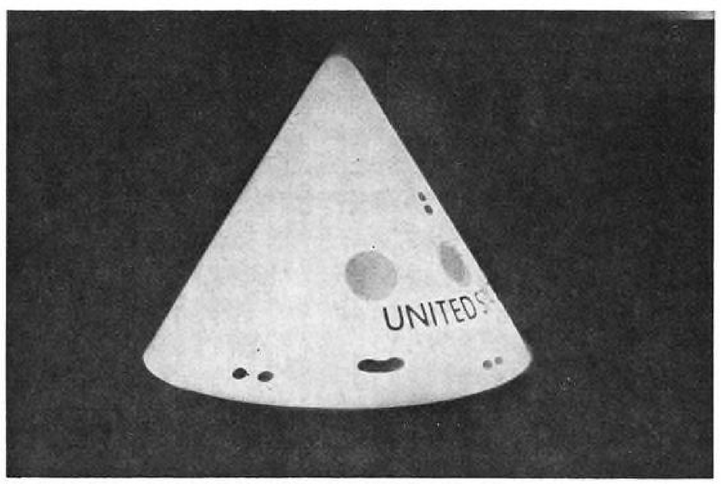
"We expect to do this with very great care," Webb said, "because this means a line of development of unmanned lunar landing equipment, which is quite an undertaking."

D. Brainerd Holmes, director of NASA's Office of Manned Space Flight, said that if the rendezvous attempt fails, the two astronauts would be lost unless they could return to a logistics vehicle waiting on the moon's surface.

Lunar Exploration

Using only equipment carried by the manned spacecraft, the astronauts could spend up to four days exploring the moon's surface although early Apollo missions will be programed for stays of only 24 hr. or less. Nevertheless, through development of a direct ascent logistics vehicle, NASA could perfect the technology of packaging and landing support systems on the moon. When more ambitious, manned planetary landings are undertaken in the future, mission success may hinge on the pre-positioning of such supplies.

If NASA initiates development, the vehicle slated to launch the first logis-



COMMAND MODULE will weigh 8,500 to 10,000 lb. at re-entry. Blunt-side-first, it must penetrate the earth's atmosphere within a corridor 40 mi. wide. During descent, crew will maneuver the capsule toward a land recovery area about 10 mi. square. Either three parachutes or a Rogallo-type wing will be employed to brake its touchdown.

tics package will be the Saturn C-1B, which can land up to 2,500 lb. on the lunar surface. Later attempts will make use of C-5, which could place a 27,000-lb. package on the moon in this mission.

Applying rendezvous techniques pioneered in the Gemini program, testing of Apollo's command-service-excursion module combination will begin about 1965. Again, NASA will utilize the C-1B vehicle, which can inject these three modules, unfueled, into an earth orbit without using several thousand pounds of its lifting capability. Still under study is how much fuel can be carried by the bug and service modules to permit rendezvous practice in earth orbit.

At this point, NASA's thinking calls for injection of all three modules into earth orbit during tests. Several rendezvous operations will follow each successful injection. During the first of these, however, NASA probably will not allow astronauts to enter the bug and disengage it from the other two modules.

Command Module

Instead, early rendezvous will be controlled from the command module, as it could be during a live mission. Later in the program—NASA has not yet decided how many test flights will be necessary—astronauts will be committed to the bug. Its orbit, in turn, will be altered by as much as 50 mi. before rendezvous is attempted, both from the command module and from the bug.

"It is our intention," Shea said, "to exercise completely the rendezvous maneuver in the same manner in which it will be performed in the vicinity of the moon." Ultimately, this will involve sending the bug out to the limit of its acquisition box, plus giving it a variety of velocities and displacements relative to the spacecraft.

Possibility of connecting the bug and the spacecraft by cable during the first few rendezvous operations has been discussed and tentatively discarded by NASA.

After studying for the better part of a year the three competitive techniques for manned lunar landing, NASA says its choice is based on these assumptions:

- **Lunar orbit rendezvous** could land men on the moon about 20 months earlier than direct ascent, or six to 15 months earlier than earth orbit rendezvous. Although it would cost 10 to 15% less than either of these two modes, this does not mean there will be a 10 to 15% saving in the over-all cost of the Apollo program, which will involve spending $20 to $40 billion.
- **Earth orbit rendezvous,** primarily because it would entail launching two C-5s instead of one, would have only half the probability of mission success as does the lunar method. It also would require funding and developing a tanker version of the C-5 plus a 50-ton pair of braking and touchdown modules, which could ease a 48,500 lb. payload onto the lunar surface.
- **Direct ascent** would require development of the Nova booster, as well as the braking and touchdown modules, in a parallel program. As a result, NASA funding needs probably would peak during the mid-1960s, when other financial demands imposed by the Apollo program will be at a high level. Hurrying Nova development would produce a vehicle with a payload capability only 60% greater than that of C-5. C-5, by comparison, will be able to launch 10 times the weight of the earlier C-1 Saturn.

It follows that NASA will defer Nova development for at least two years, postpone development of the lunar braking and touchdown modules indefinitely and aim for a Nova booster with up to three times the lifting capability of C-5. Meanwhile, General Dynamics and Martin Marietta are to be awarded what NASA calls "predevelopment study contracts," each worth about $1 million, to help define the advanced Nova's configuration. Studies will cover a period of about eight months.

Apollo Radome

North American Aviation's Space and Information Systems Division is evaluating radome materials suitable for Apollo re-entry regime of about 30,000 fps. Radar window projected for Apollo is a truncated cone with a domed top and having a base-diameter of about 3 ft. and height of about 2 ft. Located at the end opposite to the Apollo heat shield, in a region of separated flow, the radome will present difficult thermodynamic problems, with temperatures expected to depend on three main factors—joint configuration on the over-all Apollo vehicle, the thermal conductivity of the radome material, and its emissivity.

Facilities

Decision to go lunar-orbit, rather than earth-orbit with tanking, will give the Launch Operations Center more time to finish construction of four Saturn C-5 launch stands at Cape Canaveral, Fla. Two stands will be adequate for the initial lunar landing attempt, since only two launch vehicles probably will be involved—one for the logistics carrier and one for the manned Apollo spacecraft. Launch of the logistics carrier will precede the manned vehicle by several days to weeks, so that a back-up manned vehicle can be mounted on the second stand at flight time.

Earth-orbit approach called for four stands—one for the tanker, two for manned vehicles and one back-up for either tanker or manned craft—with two stands built initially and the other two following close behind on a tight construction schedule. Now, with the requirement of launching two C-5 vehicles within a day of each other eliminated, the first two stands will be built with dispatch but the third and fourth might lag by as much as several years.

Launch Operations Center presently is studying the ramifications of building assembly bays in the Vertical Assembly Building (AW July 2, p. 135) two at a time. Eventually, the building will have six bays. Because of doubts about the wisdom of putting in the massive foundations required for the 400-450 ft. tall structure on a piecemeal basis and the possible disruptive effect construction might have on work proceeding in adjacent bays, NASA is inclined to build the first four bays simultaneously. Fifth and sixth bays, which are expected to be taller than the first four because longer nuclear stages will be substituted as the third stage of Saturn C-5 instead of the S-4B, will be built later.

Launch center personnel emphasize that facilities being built at Cape Canaveral will be used for more than the lunar landing mission and that the decision to use the lunar-orbit technique only gives them more time in which to finish the work assigned to the center.

Decision also has been made by NASA to use the crawler version of transporter-launcher (AW July 2, p. 135) upon which the Saturn stages and the Apollo modules are to be assembled and checked out at Cape Canaveral. The crawler consists of two separate parts—a table, upon which actual assembly will take place, and a tracked locomotor, beneath the table, which will move the Saturn-Apollo vehicle from the assembly area to the launch stand.

After assembly of the launch vehicle and the spacecraft in the Vertical Assembly Building, the crawler will raise 80-in.-dia. piston-like arms to clear the table from the ground and then drive the entire unit out to a launch stand some two miles distant. Once properly positioned on the stand, the arms will be lowered, the table (with the Saturn-Apollo vehicle resting upon it) settled and the tracked locomotor driven out from underneath.

Digital computer system will be built into the table to check out assembly of the three booster stages and three spacecraft components and will be the primary piece of checkout equipment during the assembly phase. One of the two master digital computers in the launch control center will assume remote control of the vehicle after roll-out from the Vertical Assembly Building and will respond to data provided by the computer in the table's base.

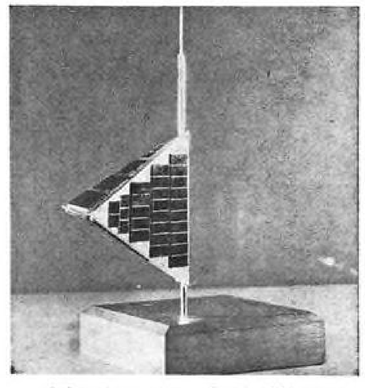
NASA Reports Top Industry Contractors

National Aeronautics and Space Administration has announced the 100 contractors receiving the highest net value direct awards from NASA during the period July 1, 1961 to Dec. 31, 1961.

Of direct awards of $25,000 or more, $136 million or 45% were placed in areas classified as depressed.

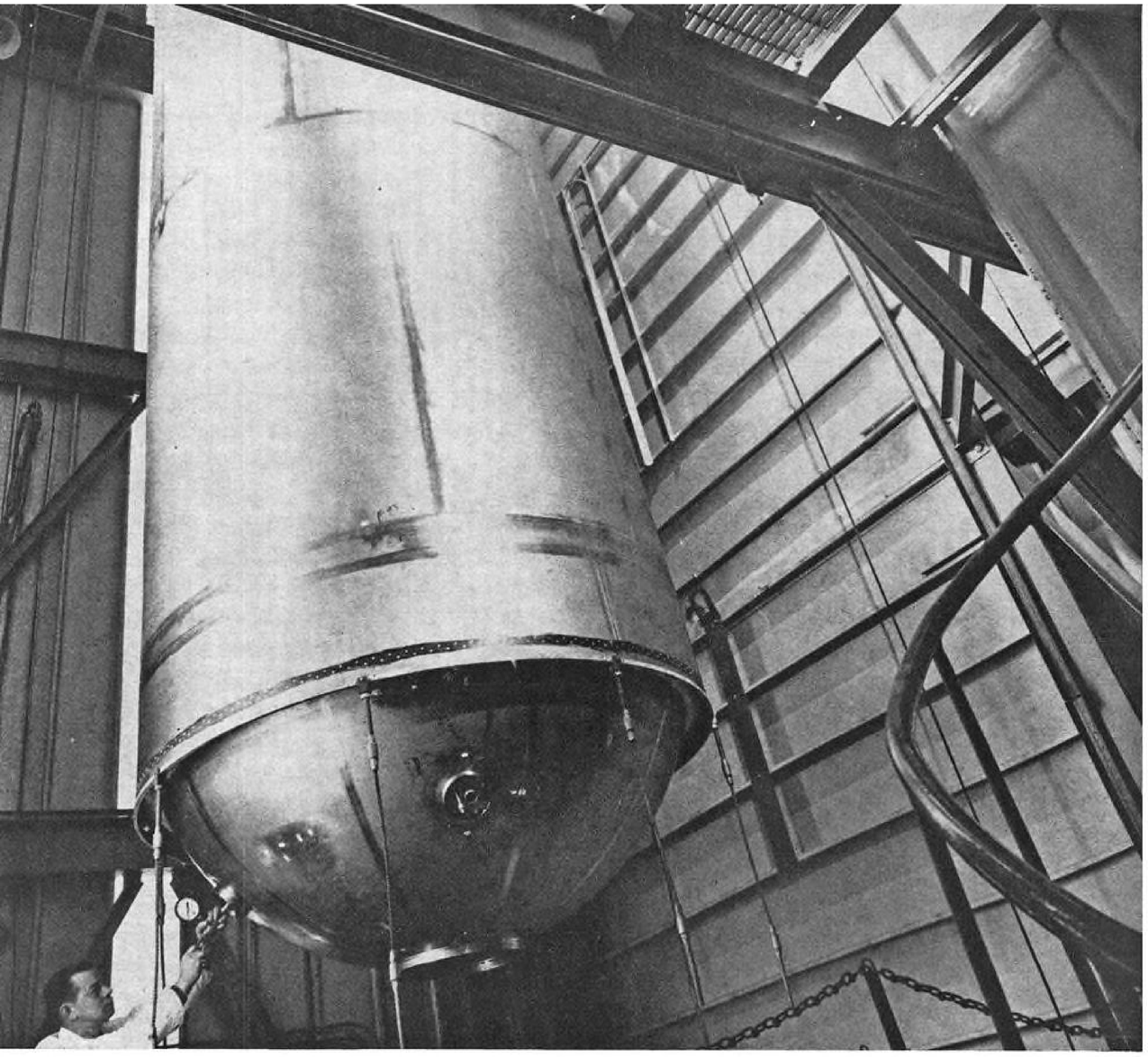
The 100 top contractors included:

CONTRACTOR	Dollars 000	Total %
Total awards of all contracts	$331,076	100
1. North American Aviation, Inc., Canoga Park, Calif.	47,631	14.4
2. McDonnell Aircraft Corp., St. Louis, Mo.	37,362	11.3
3. Douglas Aircraft Co., Inc., Santa Monica, Calif.	21,736	6.6
4. United Aircraft Corp., East Hartford, Conn.	18,428	5.6
5. Ling - Temco - Vought, Inc., Dallas, Tex.	11,431	3.5
6. Grumman Aircraft Engineering Corp., Bethpage, N. Y.	10,084	3.0
7. Aerojet-General Corp., Azusa, Calif.	9,478	2.9
8. Radio Corp., of America, Princeton, N. J.	7,311	2.2
9. Chrysler Corp., Detroit, Mich.	6,749	2.0
10. Bendix Corp., Baltimore, Md.	6,694	2.0
11. Int'l Business Machines Corp., Norfolk, Va.	6,546	2.0
12. General Electric Company, Philadelphia, Pa.	6,315	1.9
13. Western Electric Co., Inc., New York, N. Y.	5,001	1.5
14. Brown Engineering Co., Inc., Huntsville, Ala.	4,262	1.3
15. Electronics & Missiles Facilities, Inc., New York, N. Y.	4,050	1.2
16. Hayes International Corp., Birmingham, Ala.	3,864	1.2
17. Rust Engineering Co., Birmingham, Ala.	3,736	1.1
18. Hughes Aircraft Co., Malibu, Calif.	3,540	1.1
19. Blount Bros. Construction Co., Montgomery, Ala.	3,348	1.0
20. Thompson Ramo Wooldridge, Inc., Cleveland, Ohio	2,749	.8
21. Arthur Venneri Co., Washington, D. C.	2,476	.7
22. Air Products & Chemicals, Inc., Allentown, Pa.	2,451	.7
23. American Telephone & Telegraph Co., Washington, D. C.	2,138	.6
24. Calumet-Hecla Inc., Maywood, Ill.	2,100	.6
25. Minneapolis-Honeywell Regulator Co., Hopkins, Minn.	1,960	.6
26. Republic Aviation Corp., Farmingdale, N. Y.	1,825	.6
27. Westinghouse Electric Corp., East Pittsburgh, Pa.	1,815	.5
28. Management Services, Inc., Oak Ridge, Tenn.	1,547	.5
29. United Engineers & Constructors, Philadelphia, Pa.	1,400	.4
30. Computer Application, Inc., New York, N. Y.	1,322	.4
31. General Dynamics Corp., Fort Worth, Tex.	1,298	.4
32. Sperry Rand Corp., Bristol, Tenn.	1,220	.4
33. United Technology Corp., Sunnyvale, Calif.	1,106	.3
34. Space Technology Laboratories, Inc., Los Angeles, Calif.	1,065	.3
35. Doyle & Russell, Norfolk, Va.	989	.3
36. Plasmadyne Corp., Santa Ana, Calif.	970	.3
37. Lockheed Aircraft Corp., Marietta, Ga.	883	.3
38. Spaco Manufacturing Co., Huntsville, Ala.	867	.3
39. J. T. Schrimsher Construction Co., Huntsville, Ala.	866	.3
40. Vitro Corp. of America, New York, N. Y.	854	.3
41. Radiation Inc., Melbourne, Fla.	848	.3
42. F. J. Stokes Corp., Philadelphia, Pa.	830	.3
43. Redstone Machine & Tool Co., Huntsville, Ala.	829	.3
44. CompuDyne Corp., Hatboro, Pa.	817	.2
45. Electronic Associates, Inc., Long Beach, N. J.	776	.2
46. Minnesota-Mining & Manufacturing Co., Los Angeles, Calif.	705	.2
47. Kollsman Instrument Corp., Elmhurst, N. Y.	700	.2
48. Gurtler-Hebert Co., New Orleans, La.	695	.2
49. Progressive Welder & Machine Co., Pontiac, Mich.	652	.2
50. Electro-Mechanical Research Inc., Sarasota, Fla.	626	.2
51. A. O. Smith Corp., New York, N. Y.	625	.2
52. Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.	609	.2
53. Federal - Mogul - Bower Bearings, Inc., Long Beach, Calif.	601	.2
54. Philco Corp., Philadelphia, Pa.	598	.2
55. Electro Optical Systems Inc., Pasadena, Calif.	589	.2
56. Packard Bell Electronics Corp., Los Angeles, Calif.	589	.2
57. General Mills, Inc., Minneapolis, Minn.	582	.2
58. Litton Industries, Inc., College Park, Md.	579	.2
59. Ampex Corp., Washington, D. C.	560	.2
60. Telecomputing Corp., Monrovia, Calif.	552	.2
61. Int'l Telephone & Telegraph Corp., Paramus, N. J.	537	.2
62. American Optical Co., Pittsburgh, Pa.	536	.2
63. Collins Radio Co., Richardson, Tex.	506	.2
64. Washington Technological Assocs., Rockville, Md.	501	.2
65. Geophysics Corp., Boston, Mass.	482	.1
66. Martin Marietta Corp., Baltimore, Md.	476	.1
67. Noble Company, Oakland, Calif.	466	.1
68. E. C. Coston Co., Birmingham, Ala.	427	.1
69. Bount-Todd, Cape Canaveral, Fla.	419	.1
70. Epsco, Inc., Cambridge, Mass.	298	.1
71. Parker-Hannifin Corp., Los Angeles, Calif.	393	.1
72. Beckman Instruments, Inc., Fullerton, Calif.	382	.1
73. Federal Services, Inc., Atlanta, Ga.	375	.1
74. S & Q Construction Co., San Francisco, Calif.	375	.1
75. Union Carbide Corp., Birmingham, Ala.	368	.1
76. Arthur D. Little, Inc., Cambridge, Mass.	358	.1
77. E. C. Ernst, Inc., Denbigh, Va.	351	.1
78. Jackson & Moreland, Inc., Boston, Mass.	317	.1
79. Burroughs Corp., Atlanta, Ga.	313	.1
80. Arinc Research Corp., Washington, D. C.	301	.1
81. Reynolds Electrical Engineering Co., Freeport, Tex.	279	.1
82. MSA Research Corp., Callery, Pa.	269	.1
83. Solar Aircraft Corp., San Diego Calif.	268	.1
84. Consolidated Electrodynamics Corp., Arlington, Va.	265	.1
85. Ryan Electronics, San Diego, Calif.	265	.1
86. Consolidated Systems Corp., Monrovia, Calif.	262	.1
87. Isomet Corp., Palisades Park, N. J.	262	.1
88. Kahoe Company, Bel Air, Md.	261	.1
89. Barnes Engineering Co., Stamford, Conn.	255	.1
90. McDonough Construction Co., Atlanta, Ga.	254	.1
91. Warland Inc., Chicago, Ill.	243	.1
92. Thiokol Chemical Corp., Elkton, Md.	225	.1
93. Perkin-Elmer Corp., Norwalk, Conn.	222	.1
94. Plant Security Inc., Philadelphia, Pa.	220	.1
95. Sciaky Brothers, Inc., Chicago, Ill.	218	.1
96. Mount Vernon Research Co., Alexandria, Va.	217	.1
97. Santa Barbara Research Center, Galeta, Calif.	217	.1
98. Labko Scientific Inc., Stillwater, Okla.	214	.1
99. Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.	211	.1
100. Norair Engineering Washington, D. C.	202	.1
Others	55,134	16.7



Miniature Satellite

Tetrahedron-shaped satellite, developed by Space Technology Laboratories, will be flown piggyback aboard Midas or Samos spacecraft to measure radiation damage to solar cells on each of its four faces (AW June 18, p. 23). Tiny satellites, weighing less than 1½ lb. and measuring less than 6 in. along any base, contain their own telemetry and will separate and tumble freely from the parent vehicle in space.



Beech works wonders with titanium to save weight... increase space payloads

Largest titanium structure ever built, and Beech built it.

The large tank in this picture is made entirely of titanium. Built by metal-working experts at Beech to hold 7,000 gallons of pressurized liquid hydrogen, the tank is eight feet in diameter and 24 feet long. This remarkable tank weighs only 460 pounds.

This means more payload.

Fabricating titanium is an old story at Beech. And if it's something that's never been done before, that's not unusual. In this case the upper and lower hemispherical tank heads were chemically milled in a complex pattern to extremely close tolerances. Production welding of .012" titanium is S.O.P. at Beech. Much of the equipment used by the Aerospace Division is one-of-a-kind and must be designed and built under the most rigid controls. Other jobs make use of Beech's extensive metal bonding capabilities.

Sophisticated fabrication is one of the many elements that make up the comprehensive Beech capability. It's one reason Beech is well prepared to undertake complete systems management responsibilities for a wide range of space-age projects.

Other Beech Capabilities In Systems Management Include:

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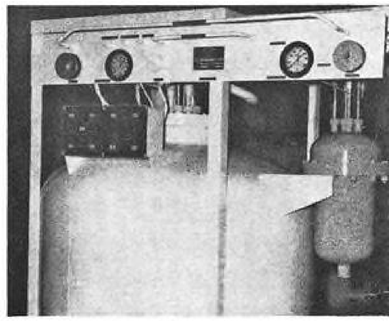
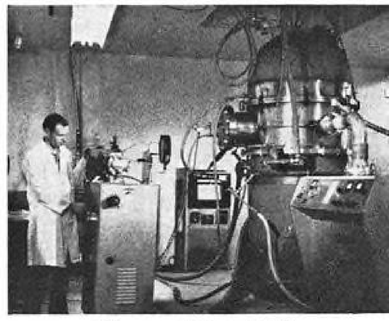
Propulsion...



Auxiliary Power...

GSE...

Manufacturing...



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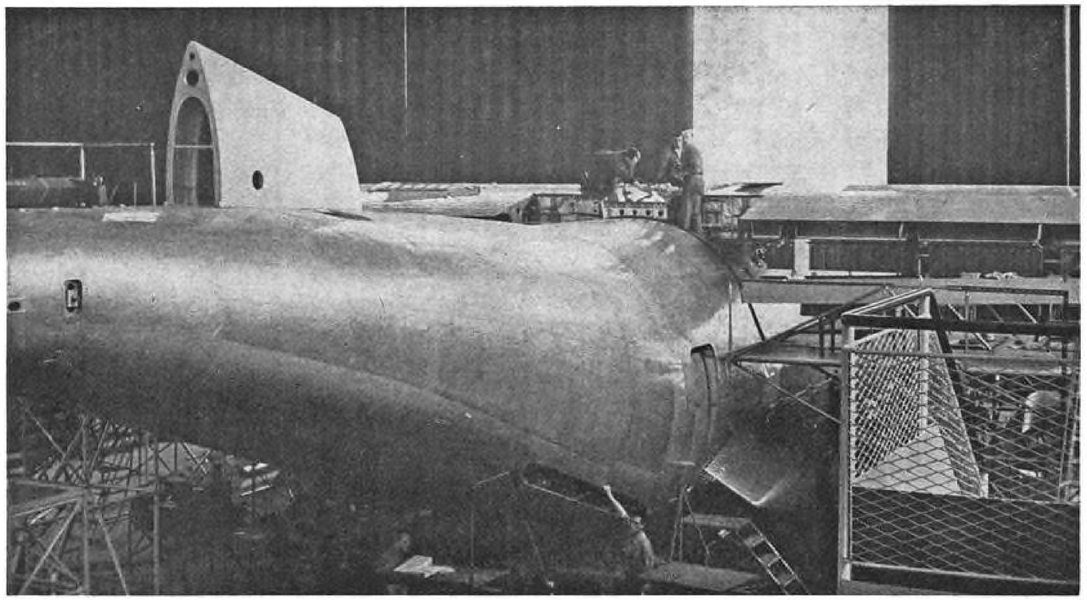
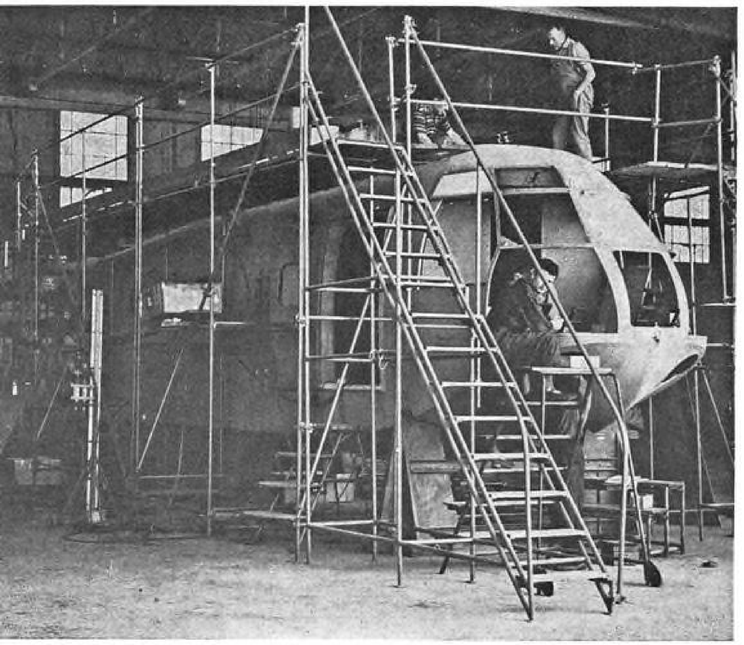
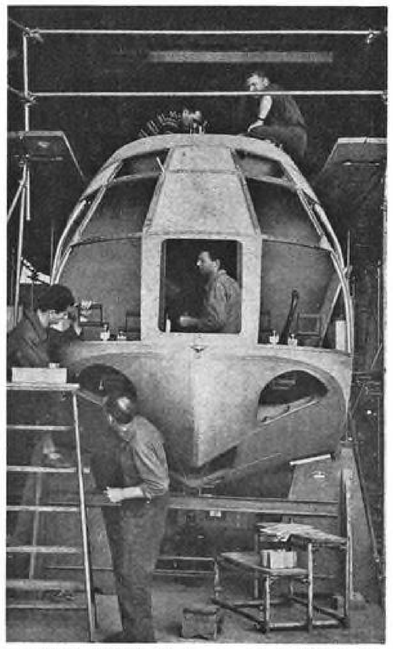


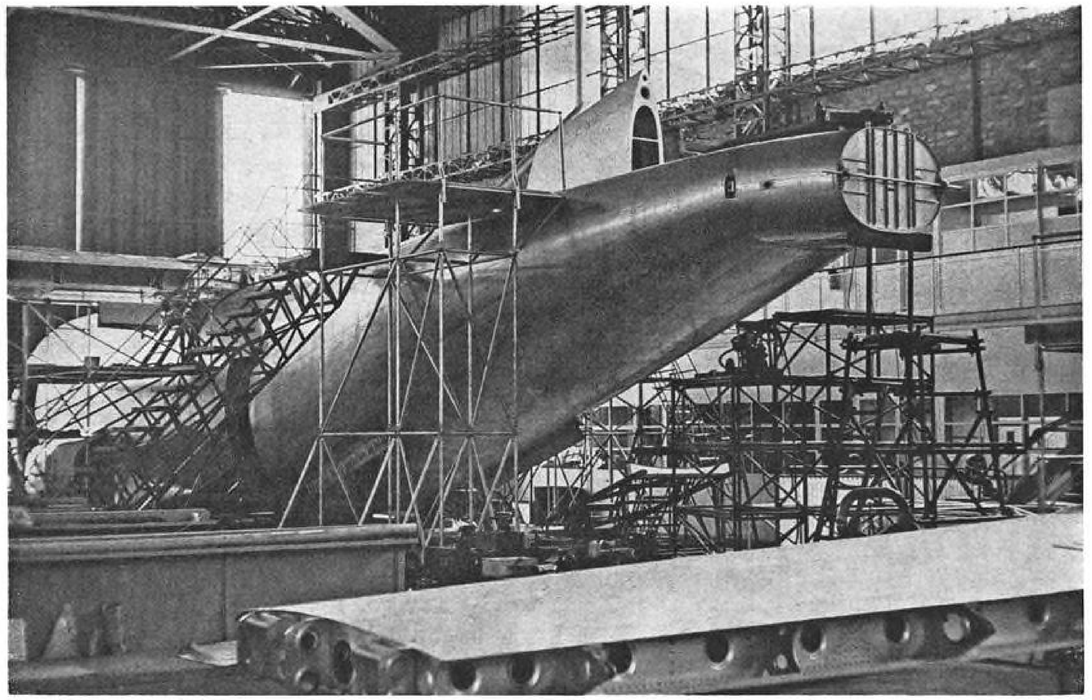
First prototype of the C-160 Transall twin turboprop transport, a joint French-German program, is assembled at Nord Aviation's facility at Melun-Villaroche for a Nov. 15 target for first flight. Nord, which builds the wing, is responsible for assembly of the first airplane.

French Assemble First C-160 Transall, Super Frelon

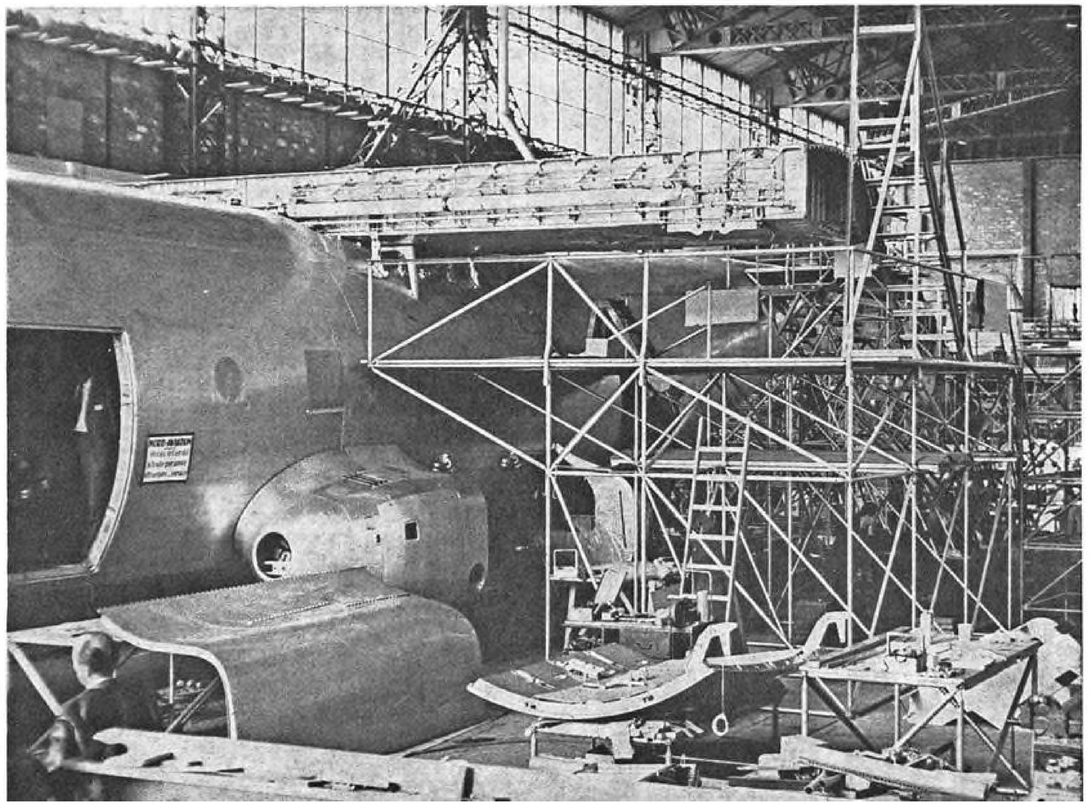




First prototype of the Sud 3210 Super Frelon helicopter, due to fly in December, is assembled at Sud's Marignane plant. Unlike the prototype 3200 Frelon, the Super Frelon has a flying boat hull like the Sikorsky S-61. Sikorsky has a technical assistance contract with Sud, largely concerned with dynamic components, and test of the first six-blade rotor system has begun on the Sikorsky whirl stand. Tail rotor whirl tests started last week and Sikorsky has shipped the first rotor assembly, less blades, to Sud for test. Powerplants are three Turbomeca Turmo 3C turbine engines developing 1,320 shp. Sud is tooling for a 100-helicopter minimum production run.



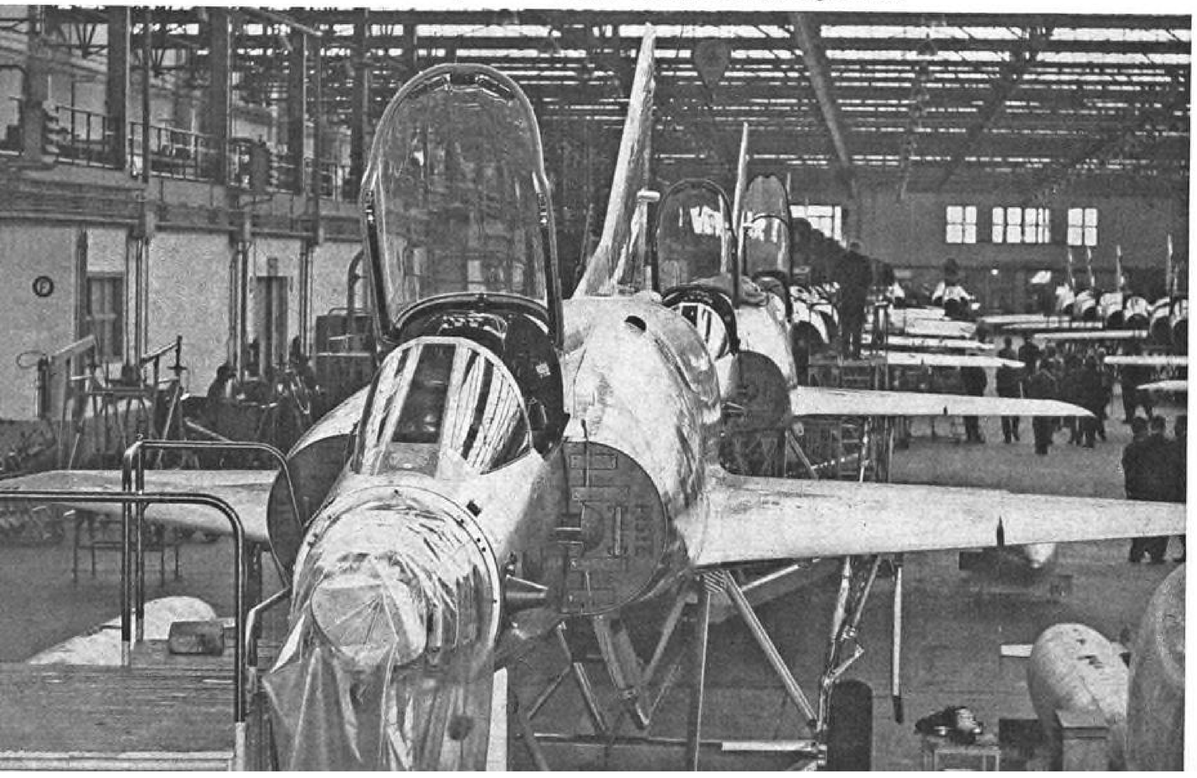
Center section wing box is mated to the fuselage of the first Transall prototype. Weser Flugzeugbau, one of three German companies taking part, is over-all project manager and builds the fuselage and tail section. Second and third prototypes will be assembled in Germany. Initial tail fairing undergoes assembly (top), and the landing gear fairings are joined to the fuselage (below). Powerplants for the Transall transport are two Rolls-Royce Tyne R.Ty 20 turboprop engines.



Production version of the Dassault Mirage 3B, the first delivered to the French air force in June, provides Mach 2 training or operational strike capabilities. Armament includes two 30 mm. DEFA cannons in fuselage pack, Matra R.530 (on higher stand, right) and Sidewinder (below, right) air-to-air missiles. Ejection seat is Hispano-built Martin Baker Type AM.4.

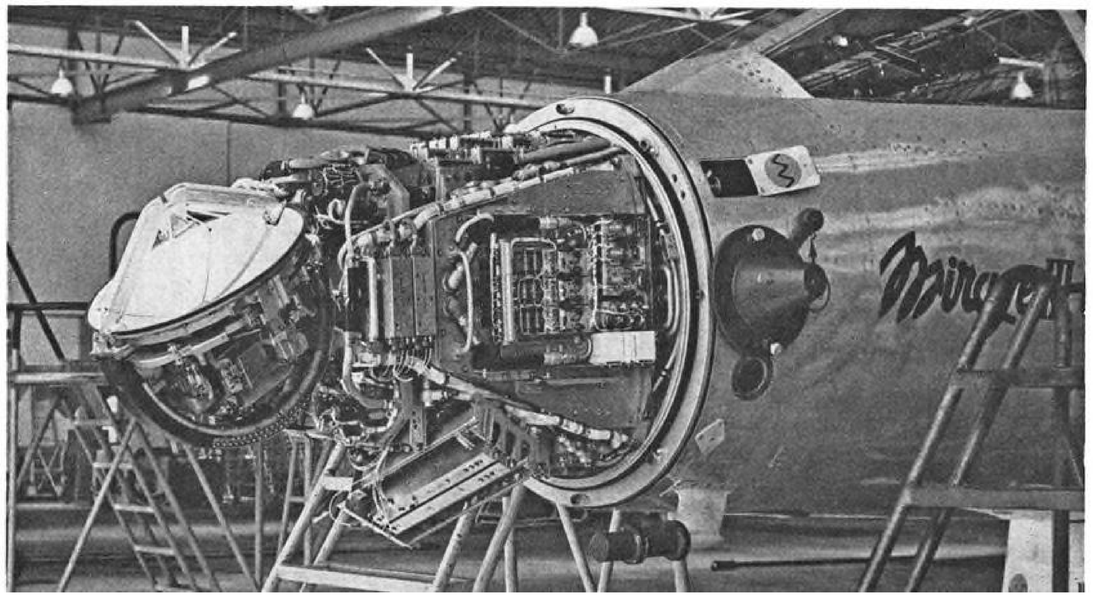
Mirage 3B Deliveries Begin; 3C in Production

Mirage 3s are shown on the line at Dassault's plant near Bordeaux. Production rate is nine per month.



SEPR 841 auxiliary rocket undergoes static test on a Dassault Mirage 3C, the production version of the Mirage 3A. The engine develops 1,500-lb. thrust for 160 sec. or 3,000-lb. thrust for 80 sec.

Stores for the Mirage 3B also include the Nord AS.30 air-to-surface missile (left) and wing-pylon-mounted pod housing unguided rockets and additional fuel. Nose-mounted C.S.F. Cyrano fire control radar (bottom photo) is used in the Mirage 3C.



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Air Force-Thiokol Plant 78 provides advanced production capability for the first stage motor of the large MINUTEMAN missile. This modern weapon system is a significant addition to America's substantial deterrent might and to the defense of the free world.

The technological advances incorporated into the plant design have been derived from Thiokol's 15 years of experience in solid propellant rocketry. The entire facility is new, and its automated materials handling and propellant processing equipment is the most efficient yet devised.

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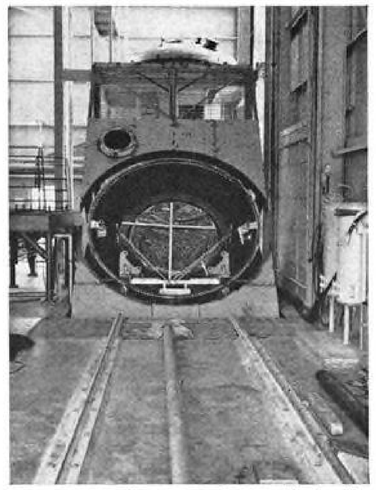

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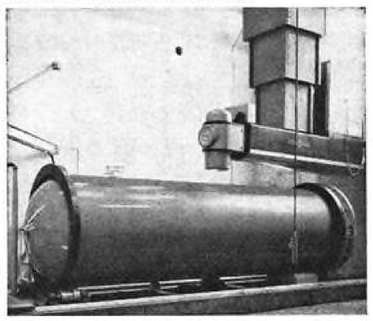
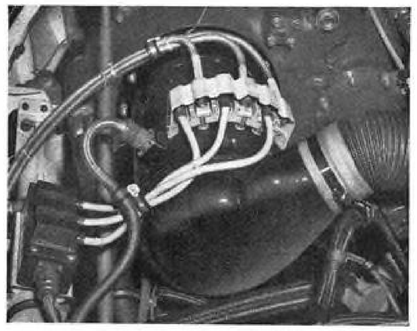


NON-DESTRUCT TESTING. Assures motor reliability without materiel loss.

This airplane detects, early warns, controls intercepts, and has a heart.



This is the heart.

The airplane belongs to the U. S. Navy. It is a Grumman W2F-1 Hawkeye. It is one of the largest carrier-based aircraft, is manned by a crew of five and was designed to perform airborne early-warning missions. Technically, for long range radar detection and control of intercepts with minimum reaction time.

The heart of the W2F-1 is its avionic-electrical system: two Bendix® Type 28B95-3, 60 KVA AC brushless generating systems direct-driven by the airplane's turboprop engines. These brushless systems—along with companion Bendix solid-state regulation and protection components—supply reliable, efficient electrical power to help the Hawkeye do its job. Which is a big one.

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DOD Group Studies Emitter Interference

By Philip J. Klass

Annapolis, Md. — Little-publicized problem with potentially grave consequences for the nation's military forces, resulting from the mushrooming numbers of radar and radio equipments now in use, is under attack here by the recently formed Defense Department Electromagnetic Compatibility Analysis Center (ECAC).

Mutual interference among radars, radio, telemetry and other radio frequency emitters is proving increasingly troublesome in peacetime, providing a warning of what could be expected in a wartime environment when many more equipments would be in operation.

ECAC, established last summer as a new joint service facility, represents a Defense Department effort to ease present interference problems and to achieve better control for the future in new equipment developments and implementation programs.

Managed by ESD

The new facility, headed by Col. Charles C. Woolwine, USAF, is presently managed by Air Force Systems Command's Electronic Systems Division.

The center is largely staffed by personnel employed by the Armour Research Foundation, which carries out technical operations under contract to USAF.

A few examples illustrate the scope of the problem which has been assigned to ECAC:

• **Rand Corp study** several years ago of the frequency division data link developed for guidance of the Bomarc missile revealed that it was extremely vulnerable to inference from other military equipments likely to be operating in the same environment. The Bomarc subsequently was changed over to use a time-division multiplex data link system.

• **Air defense radars** in the Southern California area have encountered a major interference problem because of their concentration and the topography of the area. New frequency diversity radars, being installed by Air Force for air defense use, are causing interference with civil services, such as television, in some locations.

• **Test facilities,** such as Eglin AFB and Cape Canaveral, have encountered such severe interference problems that it is necessary to halt work and shut down many equipments prior to a missile launch or space mission to assure proper operation of required telemetry and control systems.

The interference problem is almost staggering in its complexity. Electromagnetic radiation knows no boundaries. Frequencies normally limited to line-of-sight range can propagate over longer distances due to atmospheric disturbances, radio ducts formed by temperature inversion, tropospheric or ionospheric scattering, or knife-edge diffraction over mountain tops. Nor does radio energy respect differences between services, or between civil and military equipments. An Air Force radar can interfere with an Army teletype link or a civil television station.

Transmitters designed to radiate in one band often radiate spurious signals at other frequencies. Receivers that are designed for peak sensitivity in one band may be responsive also to other frequencies.

A recent investigation has revealed, for example, that the sensitivity of a radar receiver to signals outside the desired band may be significantly changed from original performance when equipment is re-tuned in the field.

In a typical area covering line-of-sight distances, there may be as many as 20,000 different emitters of radio signals, including both civil and military. The situation is fluid, with transmitters and receivers changing frequency and new emitters entering the area while others leave.

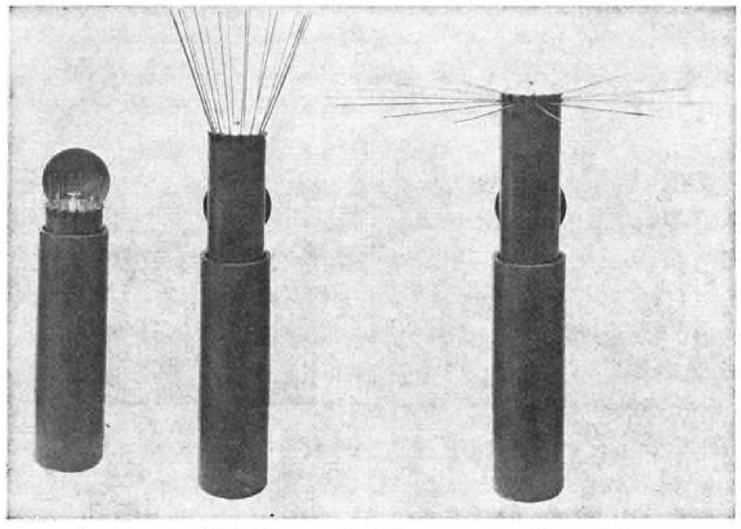
"Any attempt to determine interference problems by conducting 'electromagnetic war-games' would be prohibitively expensive, if not impossible," according to A. L. Hiebert, Rand Corp. scientist who serves ECAC as a consultant.

Simulation Sought

For this reason, ECAC seeks to develop techniques and gather data which will enable it to carry out mathematical analyses and simulation to predict interference problems and to devise methods for reducing interference, according to J. Paul Georgi, technical director here.

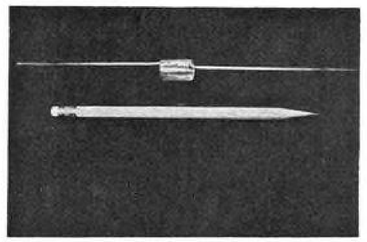
To accomplish this objective, ECAC currently is in the process of acquiring two basic types of information:

• **Spectrum signature,** a catalog of the electronic characteristics of all major types of military transmitters and receivers. For transmitters, this will include such things as output power, spurious emissions, emission spectrum, modulation characteristics, intermodulation, modulator bandwidth and carrier frequency stability. Receiver characteristics to be cataloged include: sensitivity, selectivity, spurious responses, over-all susceptibility, intermodulation,



Antenna Withstands Thermonuclear Blast

Model of 12-ft. antenna developed by Sylvania Electric Products, Inc., to withstand thermonuclear explosion rises from silo-like shell and spreads to full operational position. Antenna's performance would equal that of a 120-ft.-high conventional antenna.



Traveling Wave Laser

Traveling wave laser, consisting of coil of glass fiber optics doped with Neodymium reportedly achieves more efficient use of pump energy. Developed by Mosaic Fabrications, Inc., new laser consists of fused bundle of single optical fibers with total internal reflection characteristics. Less than 40 joules of pump power are needed to initiate laser action at room temperature.

adjacent signal interference, pulse desensitization, CW desensitization, dynamic range and oscillator radiation.

• **Environmental file,** a listing of every military transmitter-receiver, its location, type of terrain surrounding the transmitter/receiver, normal on-off duty cycle, operating frequency, antenna elevation above sea level, antenna aiming azimuth, etc.

Spectrum Signatures

Initially, ECAC is centering its data collection efforts on obtaining spectrum signatures and environmental files on pulse-type radars operating above 100 mc. in the Zone of the Interior.

Presently, ECAC has spectrum signatures on five pulse radars and hopes to increase this to approximately 150-200 by next summer. Because the measurements required to obtain a spectrum signature are costly and time-consuming, ECAC is using data available from equipment technical manuals for preliminary analyses until full spectrum signature data becomes available. It now has such limited data on approximately 35 additional radars, plus full spectrum signatures on about 25 communications equipments previously gathered by Georgia Institute of Technology.

Each of the military services is responsible for collecting environmental file and spectrum signature data for its own equipment and facilities, using either its own personnel, an outside contractor or both. Each of the services has, or will have, a deputy director assigned here to provide liaison.

Survey forms to gather data for the environmental file have just gone out to military facilities in the Middle Atlantic states. Survey forms will go out to each of five other Zone-of-Interior regions at two-month intervals, according to R. B. Wise, head of the information processing department.

To make use of the spectrum signature and environmental file data, it is necessary to devise mathematical models which describe conditions under which interference occurs and the factors which influence the severity of the interference. To speed the analyses, these models must be designed to permit their use in digital computers.

The Georgia Institute of Technology, under subcontract to Armour Research, currently is developing these mathematical models.

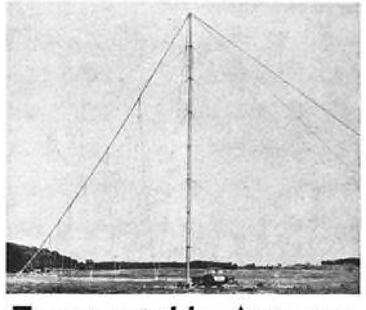
Basic Model

The basic model, called a one-for-one interference situation, considers a single transmitter as an interference source for a single receiver, taking into account such factors as aiming direction of transmitter antenna, its sidelobe pattern, power density spectrum of emitted energy, receiver sensitivity over the frequency band, its threshold setting, and in the case of a radar, the appearance which the interference will present on the radar scope. A few such models will be developed for basically different types of equipment.

A second type of model under development, called an "element model," will describe mathematically the operation of special circuit functions, such as moving target indicator and fast time constant components.

By combining an appropriate basic model with suitable element models, it should be possible to come up with a mathematical model equivalent of any specific operating equipment, according to Paul D. Newhouse, head of the ECAC analysis department.

Additional models are being developed to introduce the effects of propagation characteristics. Still another, called a system model, will cover a situation where two different types of equipment are involved, such as a radar and a communications equipment.



Transportable Antenna

Transportable high frequency log-periodic antenna, weighing less than 1,500 lb., uses 100 ft. pneumatic telescoping mast and can be installed in eight hours, according to manufacturer, Andrew Corp., Chicago. Antenna has horizontal plane beam width of 110 deg.

Finally, models will be developed to pinpoint which parameters in an equipment can most easily be changed to minimize interference.

By November, the center here expects to have installed a large, high-speed Univac 1107 which will be used to carry out analyses using the mathematical models and data obtained from current equipment and environment surveys.

To handle typical situations in which there may be 20,000 radio frequency emitters in an area under study, ECAC is developing a three-stage "separator program." From data on all 20,000 emitters, the computer will search out those, perhaps 10%, whose characteristics indicate possible interference.

In the next stage of separation, these 2,000 potential interference equipments will be analyzed in more detail to find perhaps another 10% which are probable interference problems. In the third stage, these remaining 200 would be analyzed in detail to obtain a statistical probability distribution of the likelihood of interference for any specific equipment, Newhouse said.

Model Validation

To prove the accuracy of the mathematical models, upon which future interference analyses will be based, ECAC is sponsoring three model validation tests, according to Herbert M. Sachs, ECAC deputy director for technical operations.

The validation tests are as follows:

• **Rome Air Development Center** has recently completed tests to check the propagation model and terrain effects upon a one-to-one radar model. Tests were run using two L-band surveillance radars, the AN/FPS-20 and the AN/-TPS-1D.

• **Naval Air Navigation** Electronics Project, Patuxent River, Md., is checking the basic one-to-one interference model for two radars using two L-band surveillance radars, the AN/TPS-1D and the AN/SPS-6C.

• **Army Electronics Proving Ground,** Ft. Huachuca, Ariz., will test the model for multiple emitters, using five M-33 surveillance radars operating at S-band and one receiver. Tests will involve propagation over smooth terrain and reflections from mountains.

The Navy tests will include experiments designed to determine the effect on interference of using components made by different manufacturers. This involves the substitution of different makes of magnetrons, crystal diodes and local oscillators.

The Defense Department has given a number of specific, troublesome interference problems to ECAC either to obtain solutions or to double-check proposed solutions. This gives the new center practical experience in current

PRECISION WITH SIMPLICITY
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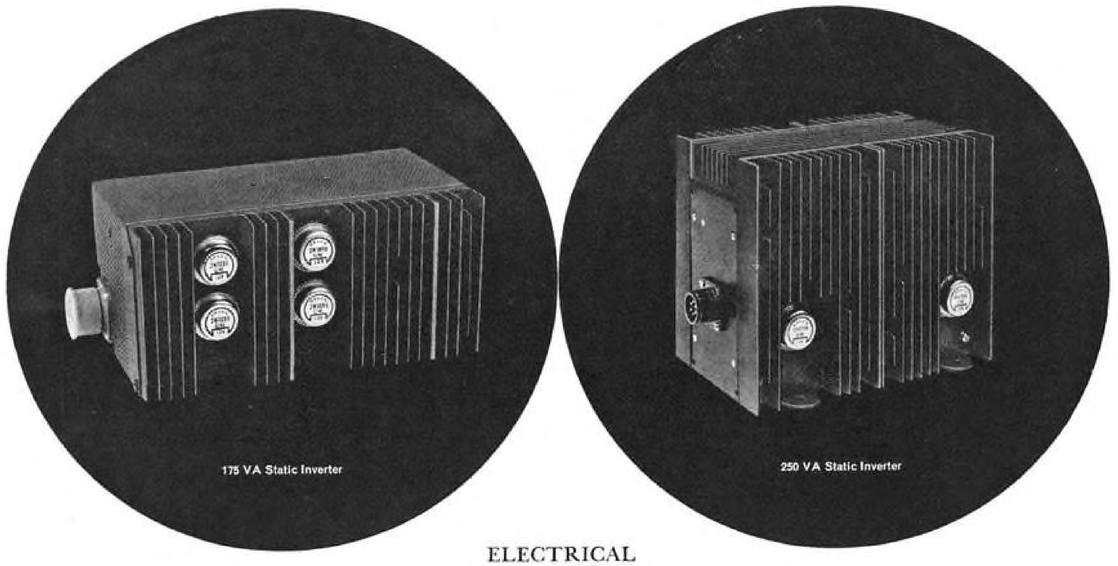
That's the big feature in Delco Radio's new 175 VA and 250 VA static inverter power supplies. These *all-transistor* units offer increased reliability through simplified circuits. Both static inverters are designed for either airborne or ground applications and will withstand overload and output short circuit conditions indefinitely, delivering at least 110% of rated output before going into overload protection. Units automatically recover to full output upon removal of overload and short circuit. Units are designed to meet the environmental requirements of MIL-E-5272C. For further information on military electronics write Delco Radio's Military Sales Department.



ELECTRICAL SPECIFICATIONS

175 VA STATIC INVERTER

Input
Voltage: 27.5 VDC ± 10% per MIL-STD-704

Output

Power:	175 VA single phase 0.5 lag to 1.0 power factor
Voltage:	115 V adjustable from 110 to 120 volts
Regulation:	1-volt change for any variation of load between zero and 110% of full load, and input voltage between 25 VDC and 30 VDC
Frequency:	400 ± 1 cps. Frequency changes less than 1.0 cps. for all environment, load and input voltage variation
Distortion:	Less than 5% total harmonic
Efficiency:	80% at full load

250 VA STATIC INVERTER

Input
Voltage: 27.5 VDC ± 10% per MIL-STD-704

Output

Power:	250 VA single phase 0.6 lag to 1.0 power factor
Voltage:	115 V adjustable from 110 to 120 volts
Regulation:	0.7 volt for any variation of load between zero and 110% of full load, and input voltage between 25 VDC and 30 VDC
Frequency:	400 ± .5 cps. Frequency changes less than 1.0 cps. for all environment, load and input voltage variation
Distortion:	Less than 5% total harmonic
Efficiency:	80% at full load

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A NEW CHALLENGE

— of significance to United States ballistic missile programs

— of unusual interest to engineers and scientists

DURING THE NEXT FEW MONTHS the U. S. Air Force Ballistic Systems Division will shift its operations from Los Angeles to Norton Air Force Base near San Bernardino.

Concurrently, there is being established the San Bernardino Operations of Aerospace Corporation, the unique public trust organization formed in June 1960 to serve the U. S. Government. This action will insure continued and effective technical progress in the advanced programs of the Ballistic Systems Division.

Several of the principal ballistic missile programs plus advanced programs of the future will be shaped at San Bernardino. Concentrated in this friendly community a significant number of the nation's best brains will function in close interdisciplinary teamwork. *San Bernardino will be a place of challenging assignments and deep satisfaction for people concerned with America's drive for aerospace supremacy.*

The San Bernardino Operations will work closely with the established and growing Aerospace organization at El Segundo, where approximately 3600 are now working in a broad, interdisciplinary spectrum. The El Segundo staff provides advanced systems research and planning, general systems engineering and technical direction of many established ballistic missile and space programs, and laboratory research to anticipate and encourage significant state of art developments.

The San Bernardino staff will include hundreds of people, with a large proportion of engineers and scientists, widely known for their technical ability, experience, imagination and leadership. Opportunities for achievement and promotion can be expected to be considerably above average for senior engineers experienced in and capable of *program management, technical direction, advanced systems development and analysis of ballistic missile systems.*

Similar opportunities exist for engineering specialists in such fields as *propulsion, fluid mechanics, solid mechanics, performance analysis and integration, guidance and controls, communications, data computation, orbital mechanics, trajectory analysis, radars and optics.*

The new modern facilities will be located within ten minutes' drive of several attractive neighborhoods. People working here will have a choice between living in warm dry country or higher, cooler hill country. Yet Los Angeles is within an easy drive on a non-stop freeway.

Aerospace looks forward to staffing its new offices with motivated qualified individuals who can contribute to the work of strengthening national defense. The opportunity is immediate. Applications are being reviewed now. Write to Mr. Charles Lodwick, Room 101, Aerospace Corporation, Box 95081, Los Angeles 45, California. Aerospace is an equal opportunity employer.

Organized in the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government.

AEROSPACE CORPORATION

problems and an opportunity to test some of its concepts. Currently assigned operational problems include the following:

• **San Diego problem,** involving interference between air defense radars in the Southern California area. Initial field measurements have been completed and a more detailed set of measurements is scheduled to get under way in August. This will include statistical data on pulse amplitude, frequency, separation and pulse width distribution.

• **MOADS problem,** involving interference from radars in the Montgomery Air Defense Sector of Sage. Equipment involved in the analysis includes radars operating in the 225-400 mc. band, FM telemetry, FM ground relay, and ground-air voice communications at Eglin AFB, Fla.

• **Chesapeake Bay problem,** involving interference among radars over the spectrum from X-band to P-band.

• **Spadats problem,** a short-term analysis of possible interference from Air Force's new electronically scanning space detection and tracking radar under development by Bendix Radio.

Technical Director Georgi emphasizes that ECAC's role is that of a consultant and adviser to the Defense Department, the individual military services, and to industry designers. The center has no responsibility to resolve interference conflicts.

Data and knowledge acquired by the center will serve as one data source for the Interdepartmental Radio Advisory Committee (IRAC), which makes frequency allocations to government users.

In addition, ECAC expects to serve as a consultant to individual services in planning new equipment programs to minimize possible interference with other equipments used by other services. ECAC also expects to help operational commanders devise optimum trade-offs to minimize interference problems.

This service also should be of value to industry designers developing new equipment, to minimize the likelihood of interference problems.

The Defense Department's program to reduce this problem encompasses other areas beyond the scope of ECAC's operations.

For example, Defense intends to emphasize reduction of spurious emission in the development of new tubes and components.

ECAC is located at the Naval Engineering Experiment Station in Annapolis. The center expects to have a staff of about 150 by August, the majority of them professionals.

Deputy directors on duty with ECAC from three services include Lt. Col. John A. Gahr, USA, Cdr. Albert M. Brouner, USN, and Maj. Gilbert O. Nicholson, USAF.

FILTER CENTER

► **Boost for Transistor Reliability**—Hughes Semiconductor is adopting for all its transistor products a processing technique which replaces the potentially troublesome thermal-bonded contact leads inside the transistor can with metal alloy connections. The bonded connections between the three active regions of a transistor and bonding posts on a header have long been a source of difficulty which should be eliminated with this technique, according to the company.

► **Liquid Laser Operation Reported**—First successful operation of a liquid laser, using new terbium compound which radiates in the green part of the spectrum, has been reported by Semi-Elements, Inc., Saxonburg, Pa. When pumped with an ultraviolet source, the new terbium liquid laser radiates in the 5,100 to 5,800 angstrom region, a wavelength which penetrates ocean depths permitting application for underwater communication and detection. Previous attempts to achieve liquid laser action using other materials were unsuccessful because host lattice liquid and container absorbed too much pump energy. Semi-Elements does not reveal the host liquid used but says it has applied for patents for its new technique for putting rare earth elements into solutions and vapors for laser use. The company is offering new terbium liquid laser material for sale at $1.50 per cc. in minimum quantities of 25 cc., with lower prices on larger quantities.

► **Infrared for Aircraft Communications**—A system for aircraft-to-aircraft communications using infrared instead of radio frequencies to provide privacy and prevent jamming, is being developed by Santa Barbara operation of Raytheon's Missile and Space Division. Using a 10-watt infrared source, the company expects to achieve communication ranges of up to 100 mi. To establish initial contact between two moving aircraft, each will turn on an infrared beacon while automatically scanning for the IR radiation of the other. Once acquisition has been made each aircraft infrared "antenna" will automatically lock on to radiation of the other to permit communications despite maneuvers and motions of the aircraft.

► **British, Japanese Exports Up**—Japanese exports of electronic products to the U. S. totaled nearly $120 million in 1961, an increase of 28% from previous year, while United Kingdom exports to the U. S. were $22.3 million, an increase of 14% over 1960, according to figures released by Commerce Department's Business and Defense Services Administration.

► **Display Systems Bibliography Released**—An extensive bibliography of published information on display techniques and systems, including human engineering studies and some previously classified reports, is listed in a 319-page book entitled "Display Systems," identified AD-265-432, now available from the Commerce Department, Office of Technical Services, Washington 25, D. C. Price is $5.00.

► **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **General Precision, Inc.,** GPL Division, will investigate use of lasers in airborne and spaceborne tracking devices under a $91,000 contract from USAF's Aeronautical Systems Division. The company's Librascope Division reports a $1.9-million ASD contract to build automatic digital navigation computers for the USAF/Lockheed C-141 transport.

• **Hazeltine Corp.,** Little Neck, N. Y., will supply a newly-developed Spedac 220 digital differential analyzer to Army's White Sands Missile Range. The computer has a 200-kc. iteration rate, making it much faster than a digital general purpose computer in solution of differential equations, the company says.

• **ITT Federal Laboratories,** Ft. Wayne, Ind., will design and build a boresighted star tracker and control logic unit for use in the Orbiting Astronomical Observatory (OAO) under contract awarded by Grumman, OAO prime contractor.

• **Minneapolis-Honeywell,** Heiland Division, will supply magnetic tape recording and reproducing systems for use in Project Vela (nuclear detection) under contracts totaling more than $1 million received from several contractors participating in the Defense Department program. The recorders will operate at tape speeds of 0.6 in./sec.

• **Martin Co.,** Electronic Systems & Products Division, Baltimore—contract from the Office of Naval Research for an infrared background discrimination study using the company-developed, multi-element infrared detector array. The project is part of ONR's program to develop improved aircraft detection systems. The division also reports a $110,000 contract from NASA to fabricate ten infrared horizon sensors and power supplies for sensing attitude of the second stage of the Saturn space booster.

URGENT:

PACK ONE MILLION COMPONENTS IN ONE CUBIC FOOT!

Shrinking the size of modern electronic gear to simplify the nation's work in space explorations gets top priority at Sylvania Electronic Systems.

Recently, our scientists developed a microminiature module consisting of a series of circuit wafers, hermetically sealed. Each wafer contains many parts, and completed modules incorporate approximately 60 electronic components in only 93/1000ths of a cubic inch! Now we are rapidly approaching the day when more than one million individual components can be packed into one cubic foot!

How would such equipment perform in outer space? Laboratory tests show that circuitry employing Sylvania's microminiaturization techniques can survive and perform unattended for over 36,000 hours! What's more, these modules permit circuit stage interconnections *without the use of wires!*

Making advances that promote the nation's position in the race for space is just one of many areas of talent concentration among the scientists and engineers of the General Telephone & Electronics corporate family. The vast communications and electronics capabilities of GT&E, directed through Sylvania Electronic Systems, can research, design, produce, install, and service complete electronic systems. These systems cover the entire range from detection and tracking, electronic warfare, intelligence and reconnaissance through communications, data processing and display.

That is why we say—the many worlds of defense electronics meet at Sylvania Electronic Systems, a Division of Sylvania Electric Products Inc., 40 Sylvan Road, Waltham 54, Mass.

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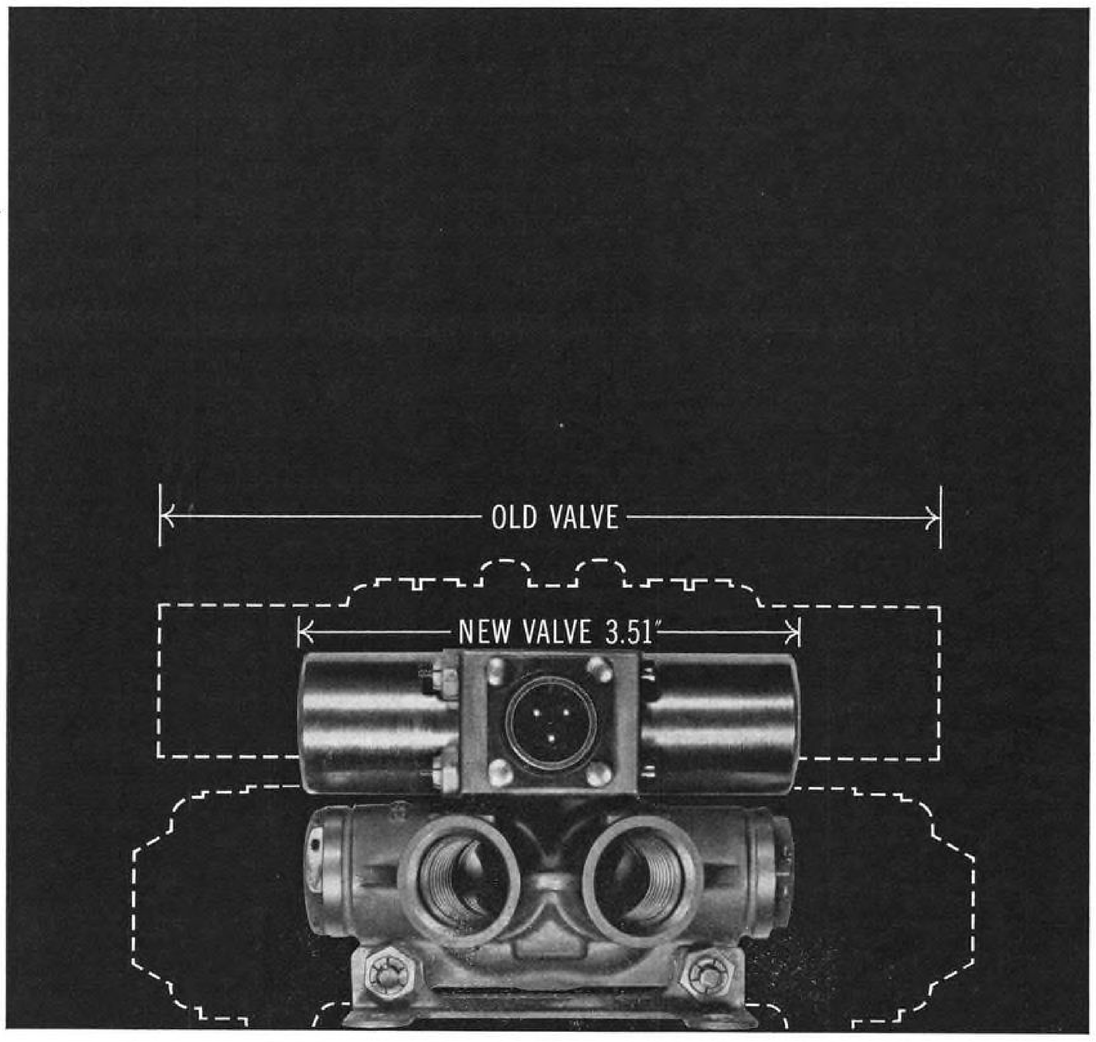

ADEL CUTS YOUR VALVE PROBLEMS DOWN TO SIZE

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The corrosion resistant steel body means far longer wear. The integral metering lands do away with the internal sleeve and its numerous "O" ring packings. You can get 2 and 3-position, 3 and 4-way arrangements with cylinder ports blocked or open to return as your specifications require. Our basic steel valve can vary to fit almost any fluid control system. And our standard steel valves, in ¼, ⅜ and ½-tube sizes, work in systems of various fluids.

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Power Interruption Slashes Gyro Drift

Minneapolis-Honeywell has cut the drift rate of its integrating gyros over a ratio range from 10:1 to as much as 40:1 by the simple technique of interrupting power flow to the spin motor periodically in a precisely controlled cycle.

The new approach, called spin motor interruption technique (SMIT), will be employed in Honeywell gyros used in the Dyna-Soar (now called the X-20), Gemini, Centaur and the SD-5 drone. The company has applied for a patent on the idea.

The SMIT concept resulted from an investigation by Honeywell's St. Petersburg, Fla., inertial facility to discover why gyros would drift excessively in use shortly after they had been calibrated (trimmed) to take out such drift.

The symptoms were those of mass unbalance of the gyro rotor, but study of gyros returned from the field failed to disclose such rotor unbalance.

Drift Tests

Extensive tests at St. Petersburg revealed that drift occurred as a result of power interruption or transient in the power supply. Interruption occurs during periodic run-up and shut-down of the gyro during pre-launch tests, and when gyros are switched from launch site power to missile/booster power supply.

From these investigations came the idea, credited to Ralph Fenton and William Isley, of intentionally interrupting the power to the spin motor for precisely controlled intervals in precisely controlled cycles. Instead of aggravating the situation, this averages out the random drift from this source, according to Fenton.

Honeywell has tried a variety of different SMIT cycle times and has adopted the following as optimum for current gyros: Power on for 2.56 sec., followed by power off for 0.275 sec., followed by repetition of the cycle.

Platform Tests

To illustrate the improvement obtained through application of SMIT, Honeywell ran tests on stabilized platforms in which gyros were run up and shut down a number of times, as they would be in normal use, and compared drift rates both with and without the new technique.

In one platform, maximum gyro drift rate experienced during 13 start-up, shut-down operations without spin-motor interruption technique was 0.40 deg. per hour, compared with only 0.01 deg./hr. when SMIT was employed. Another gyro, after six shut-down, start-up operations had a maximum drift rate of 0.35 deg./hr. without SMIT, but a drift rate of only 0.04 deg./hr. when the new technique was used.

Still another gyro had its maximum drift rate slashed from 0.4 deg./hr. to only 0.02 deg./hr. when the new technique was employed, according to Honeywell.

Fenton says the improved stability resulting from use of SMIT should eliminate the need for pre-launch calibration for many applications, and assure reduced drift after launch despite transients in the missile power supply.

Additionally, Fenton foresees higher yield in gyro manufacturing operations because a major source of drift is eliminated.

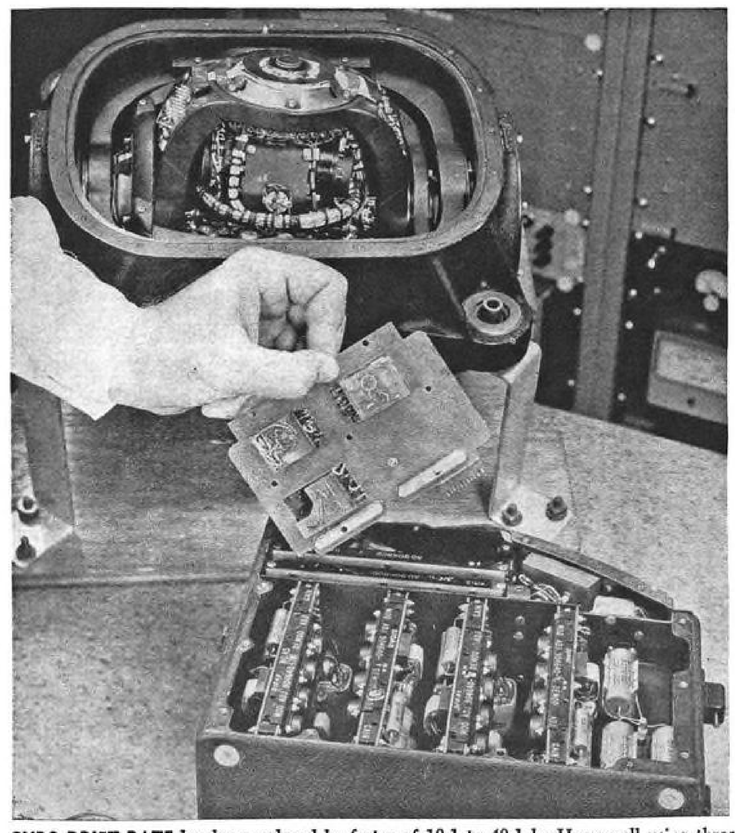
Principle of Operation

The basic cause of previous instability in gyros, and the explanation of the spin motor interruption technique, involves the fundamental principles of operation of the synchronous hysteresis motor used to spin the gyro rotor.

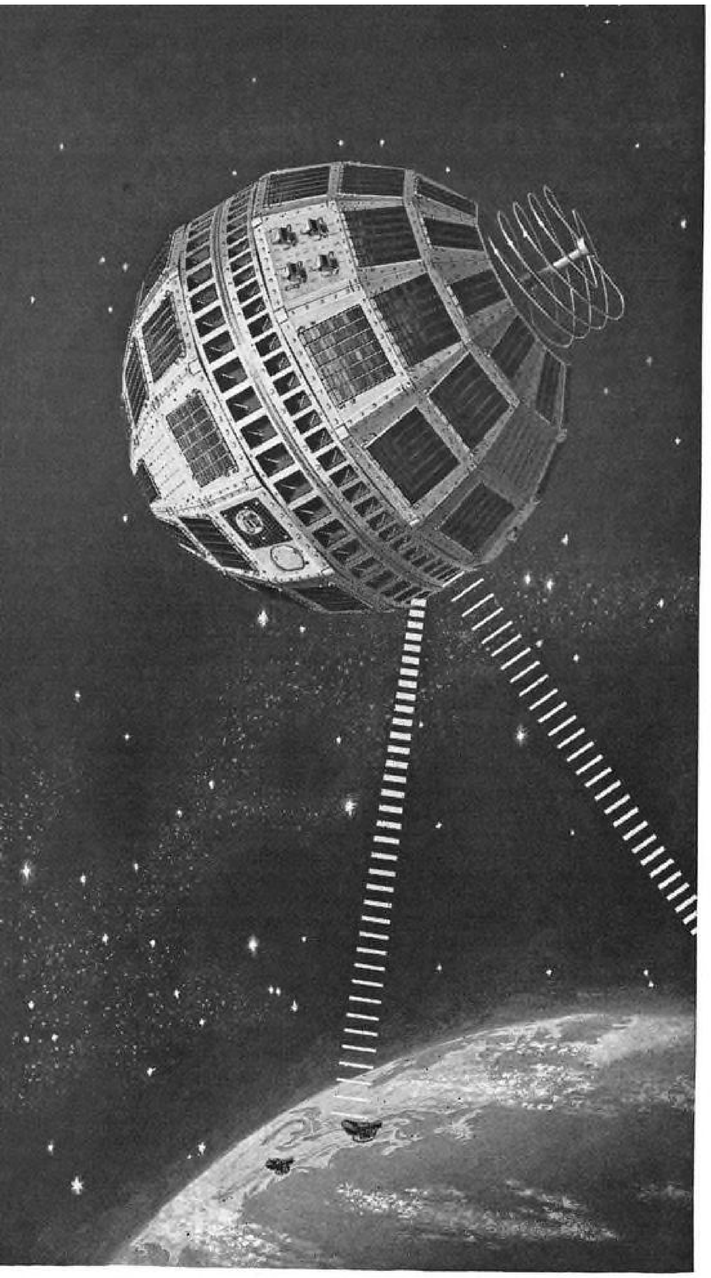
In a hysteresis motor, when the spinning rotor comes up to speed it is magnetically locked into synchronism with the rotating field created by the stator and will remain in synchronism so long as there are no transients or power interruptions.

The rotating field produced by the three-phase stator winding, excited from a three-phase a.c. supply, appears to the rotor to be a bar magnet which is rotating at the frequency of the a.c. supply, although in reality the stator is fixed. This rotating field induces hysteresis currents in a steel ring and windings which line the inner circumference of the spinning rotor. The fields produced by these hysteresis currents react with the stator field to cause the rotor to spin.

When the rotor is spinning at synchronous speed, the stator field produces magnetic poles in the hysteresis ring which are opposite the poles of the stator bar magnet. For example, as



GYRO DRIFT RATE has been reduced by factor of 10:1 to 40:1 by Honeywell using three small modules shown above which periodically interrupt power to gyro spin motors for precisely controlled intervals, averaging out effects of transients. The company calls the new process SMIT (spin motor interruption technique).



New "TELSTAR" relays phone calls and TV pictures for first time!

Bell System microwave-in-sky satellite is latest communications triumph for America arising from telephone research

The world's first private enterprise communications satellite is now being used for dramatic experiments in relaying telephone calls and television internationally.

Its name: Telstar. It was launched from Cape Canaveral at Bell System expense by the National Aeronautics and Space Administration.

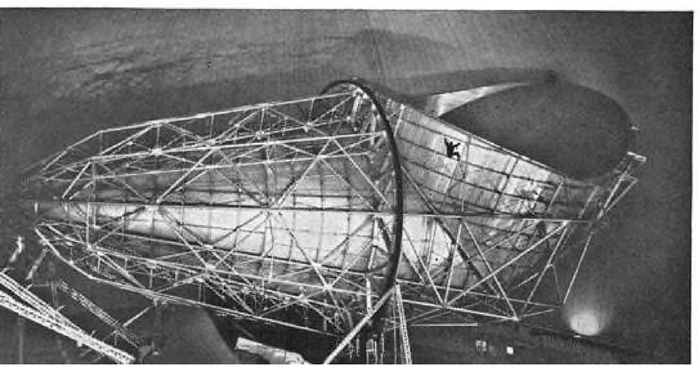
Telstar receives signals beamed to it from a ground station, amplifies them and transmits them to another station on the ground below—perhaps an ocean away from the first one. The new satellite thus acts as a microwave relay station in the sky, enabling voices, TV pictures and data messages to leap thousands of miles in a new and exciting way.

The ground stations in the U.S. now being used for Telstar were built by the Bell System at Andover, Maine, and Holmdel, New Jersey. Organizations abroad have built stations in England and France. The latter, a near replica of the station in Maine, was assembled with Bell System cooperation. A receiving station in Italy will be ready late this year, and another in West Germany next year.

Telstar is a major experimental step toward a world-wide satellite communications system that was first proposed as a practical venture at Bell Telephone Laboratories. Progress toward such a system has depended on many contributions by the private communications industry, including six basic components—the transistor, the solar battery, the traveling wave tube, ruby masers, the waveguide, and new antennas for the ground stations with innovations in circuitry—direct outgrowths of Bell System research and development.

Above all else, Telstar is the latest achievement in an unending Bell System quest to develop ever better communications for both civilian and military applications.

INSIDE GROUND STATION "RADOME" AT ANDOVER, MAINE. Giant antenna (note man near rim of horn) concentrates signals to Telstar in a narrow, powerful beam. The same antenna also receives extremely weak signals coming from Telstar and amplifies them billions of times.



BELL TELEPHONE SYSTEM

AMERICAN TEL. & TEL. CO. / WESTERN ELECTRIC CO.
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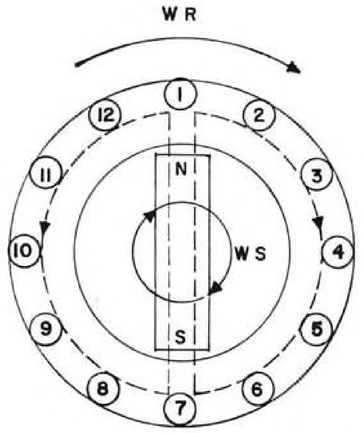


SPIN MOTOR interruption technique, for slashing gyro drift, is based on fact that rotating field produced by stator (center) induces poles at two points in surrounding rotor—(1) and (7) in example shown. Random transients or interruption of gyro power causes rotor to lock in at different points, causing shift of mass balance and drift.

shown in the accompanying sketch, these poles are located at points (1) and (7) on the hysteresis ring.

So long as there is no power interruption or transient, points (1) and (7) will always be aligned with the direction of the rotating stator field (bar magnet). But if there is even a brief loss of power, such as switching over from launch pad to missile power supply, then the rotor will briefly drop out of synchronism with the stator.

When power is restored, the rotor will again return to synchronous speed, but when it locks into the stator's rotating field, the location of the poles produced in the rotor will be at a different location. For example, they might be at points (3) and (9), or at (4) and (10).

Idealized Conditions

If a rotor were perfectly homogenous and perfectly balanced, and if its bearings were identical and perfectly balanced, it should make no difference where the new lock-in occurs. But in practice, these idealized conditions can not be achieved to the precision required for extremely low-drift gyro tolerances. The result is similar to that caused by mass unbalance of the rotor.

Even with a steady power supply source, slight changes in motor load can cause a slow drift or migration of the rotor poles, producing a slow, long-term drift of the gyro, Fenton says.

This means that a gyro can be carefully trimmed during pre-launch calibration to take out drift, but when the gyro is switched from launch site to missile internal power source, the rotor will lock in at a different position. This largely nullifies the effect of the previous calibration.

Honeywell's tests confirmed that drift rate was a function of the particular rotor lock-in (pole) position, and this was something which could not be controlled in gyro use.

The solution, as devised by Fenton and Isley, was to intentionally force the gyro rotor to slip through a complete revolution every 20 sec. so that the induced poles would appear regularly around the rotor periphery, thereby averaging out the drift for all such points.

This approach bears some similarity to the technique known as Rotorace, devised by Sperry Gyroscope Co. to cope with spurious torques in gyro gimbal bearings (AW Feb. 17, 1958, p. 78). This involves the use of a small motor to rotate the outer races of gyro gimbal bearings in opposite directions, with periodic reversal of direction. The unpredictable spurious torques are thus applied briefly around the entire gimbal axis shaft, first in one direction and then in another, to average them out.

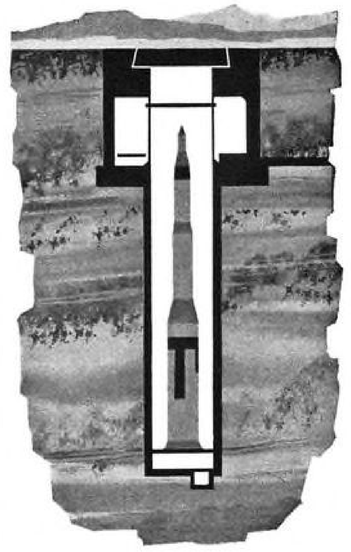
Honeywell's first design approach to SMIT has been to use a small transistorized switching device to remove excitation from one phase of the three-phase stator winding for the 275-millisec. interval, after which power is again applied for approximately 2.56 sec. The SMIT circuitry for three gyros occupies approximately 6 cu. in. and weighs a few ounces, not including the cycle timing clock. Where the inertial system uses a digital computer for computation purposes, its clock can be used to control the timing sequence.

A more sophisticated SMIT control technique, now under development, is expected to achieve more precise control of the rotor slip and thereby improve drift rate. It will shift the phase of the a.c. power supplied to all three stator windings in 30-deg. increments, thereby causing the rotor to lock in precisely at 30-deg. increments around its circumference, according to Fenton.

Mosaic Radome

Industry proposals for mosaic radome for 1,000F service on future aerospace vehicles maneuvering at high speeds in the atmosphere will be submitted July 31 to manufacturing technology branch of AFSC's Aeronautical Systems Division. Contract award—to cover three phases—is not expected before October.

First phase will be a three-month survey of state-of-the-art literature. Second phase, spanning nine months, will cover development and selection of materials. Third phase will be a six-month effort on the construction of either a prototype or scale-model dome.



for the Minuteman:

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The isolated underground silos of the USAF Minuteman present extreme environmental problems. Yet the missiles must remain operational continuously—ready to perform instantly at all times. Helping the Air Force meet this Reliability challenge, American Air Filter developed and is producing and installing the environmental Operational Ground Equipment required.

American Air Filter maintains a total capability to design and produce such environmental control systems—keeping current both in engineering know-how and in research, testing, and manufacturing facilities. For example, AAF has mastered compliance with Specifications Mil-R-27542, GM-07-59-2617A, and S-133-2.

Can this kind of capability help solve an environmental control problem for you? Inquire: **Defense Products Division, *American Air Filter Co., Inc., 310 Third Street, Rock Island, Ill., Phone 788-9311.***

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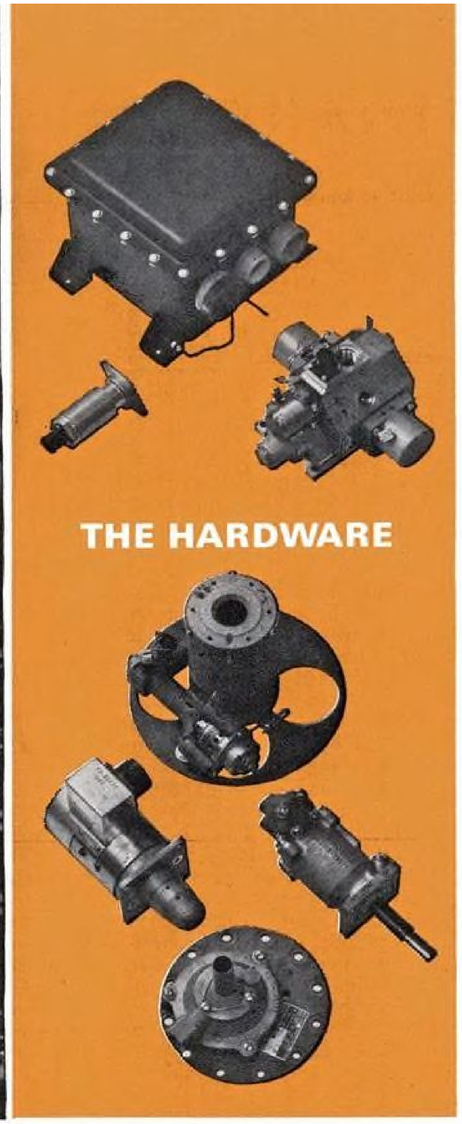

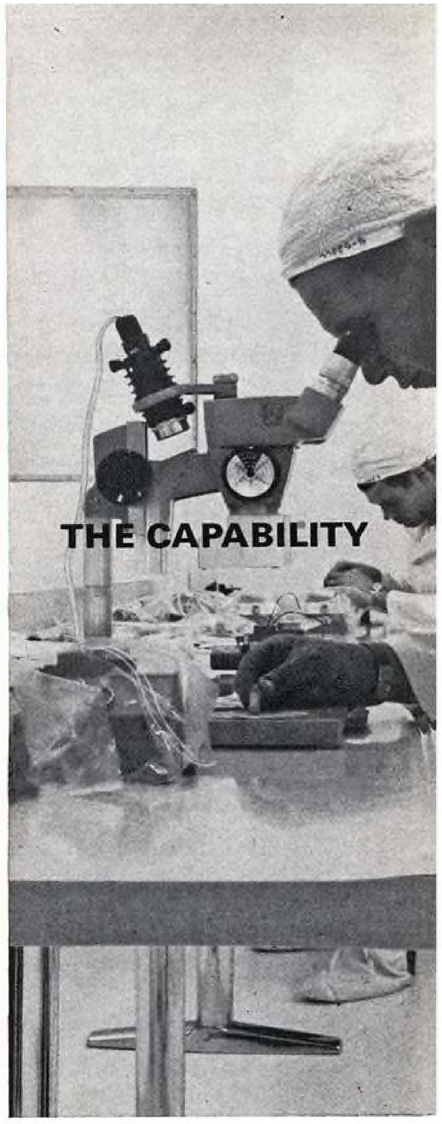

It takes an understanding of all 3 to build a hydraulic system

It takes systems engineering experience. The solution to the problem may depend on hydraulics knowledge, but it is hardly ever restricted to that one engineering discipline. At Crane's Hydro-Aire Division, unique problem-solving experience is available in two ways. First, the engineering disciplines range from hydraulics to electro-mechanical, electronics and pneumatics. Second, there is continuous practice in combining these disciplines in system design. Recent outstanding example: the complex relationship of electronics and advanced hydraulics in our HYTROL MARK II automatic brake torque control system.

It takes system-oriented hardware. Hydro-Aire's record as a developer of airborne hydraulic controls stretches over two decades. We built our first hydraulic valve in 1943. Tens of thousands of valves, pumps, motors, actuators and other controls have followed this contribution. Recent developments include servo valves, variable displacement hydraulic pumps, a new rotary-valving development for hydraulic motors, a new lightweight turbine-driven pump. Today, a whole family of "second generation" hydraulic controls and components from Crane's Hydro-Aire Division performs in integrated systems—in GSE, space vehicles, missiles and jets.

It takes up-to-date facilities. Hydro-Aire's newest "clean room"—just completed—can control dust count to Class III standards (1.0 micron). Our high temperature hydraulic test facility contains equipment suitable for operation at temperatures more than one-third higher than the limitations of present hydraulic fluids. It also includes six dynamic test systems, an Oronite 8200 test system, four static test systems and two "Skydrol 500" test systems. For the development and test of complete systems, this equipment is supplemented as required from Hydro-Aire's Electronics, Cryogenics and Pneumatics Laboratories.

A detailed report on our products, facilities and capabilities in advanced hydraulics has just been completed. May we send you a copy?

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Aerospace Industry Financial Results – 1961

Three-year comparative financial results are shown for major aerospace companies. Those in the avionics and aerospace equipment categories are only a small portion of those included in the industry, but are chosen in an effort to show a useful cross-section. Sampling of how sales broke down for various types of systems is shown in accompanying table below. Red figures in parentheses indicate losses.

	SALES (in millions)			EARNINGS (in millions)			PROFITS PER SHARE			BACKLOG (in millions)			PROFIT MARGIN SALES %			PROFIT MARGIN NET WORTH		
	1961	1960	1959	1961	1960	1959	1961	1960	1959	1961	1960	1959	1961	1960	1959	1961	1960	1959
AEROSPACE VEHICLES																		
Boeing	1,800.9	1,554.6	1,648.8	35.6	24.4	12.7	4.47	3.07	1.60	1,869.0	2,139.0	2,018.0	1.98	1.57	0.77	13.8	10.2	5.8
Douglas[4]	791.3	1,174.0	883.8	5.9	(19.4)	(33.8)	1.56	(5.09)	(8.86)	759.4	1,030.1	1,317.2	.75	(1.65)	(3.83)	4.7	(16)	(24.5)
Fairchild Stratos	76.0	85.0	114.0	3.1	(5.9)	1.5	1.03	(1.97)	.90	37.0	43.0	76.0	4.1	(7.0)	1.3	16.5	(38.0)	7.0
General Dynamics	2,062.3	1,987.7	1,811.8	(143.2)	(27.0)	31.0	(14.32)	(2.71)	3.12	1700.0	2,550.0	2,555.0	(7.0)	(1.3)	1.7	(122.0)	(9.4)	9.4
Grumman	316.7	325.5	288.9	6.1	7.1	4.9	2.76	3.27	2.24	295.0	327.5	260.0	1.93	2.21	1.70	10.7	13.2	9.9
Kaman	59.7	54.5	34.7	0.9	0.7	0.5	1.92	1.63	1.50	.....	.....	.....	1.5	1.3	1.7	14.0	13.6	15.0
Lockheed[4]	1,444.5	1,332.2	1,304.2	26.1	(42.9)	8.7	3.46	(5.82)	1.21	1,638.7	1,221.3	1,155.1	1.8	(3.2)	.7	20.0	(42.0)	6.0
Ling-Temco-Vought[4]	193.7	148.4	148.7	(13.1)	3.0	3.0	(4.99)	1.25	1.22	300+	100.0	.....	(6.8)	2.0	2.0	(73.0)	10.5	12.4
Martin-Marietta[1]	1,213.1	1,019.3	863.8	44.8	41.2	39.6	2.04	1.91	1.86	.....	.....	.....	3.7	4.0	4.6	14.0	13.0	13.0
McDonnell[4]	344.4	436.9	435.8	12.1	12.0	10.0	3.54	3.55	2.94	250.5	320.0	524.1	3.52	2.77	2.30	16.8	19.0	18.8
North American[4]	1,262.3	964.0	1,044.8	27.7	23.3	30.7	3.38	2.87	3.80	931.0	873.0	662.0	2.2	2.4	2.95	12.0	11.0	15.0
Northrop	267.4	233.6	262.8	8.6	7.7	7.3	4.22	4.22	4.01	293.0	309.0	204.0	3.24	3.31	2.79	14.0	15.0	16.0
Republic	354.5	215.2	198.0	10.7	4.7	3.4	3.72	1.64	1.19	529.0	637.0	511.0	3.0	2.2	1.7	17.0	8.3	6.4
Ryan	89.4	122.7	84.7	3.3	2.9	2.8	1.89	1.68	1.86	81.0	100.0	145.0	3.7	2.3	3.3	11.0	11.0	11.8
Textron[2] (Bell Aerospace)	473.1	383.1	308.2	10.5	14.1	16.6	2.06	2.93	3.37	.....	.....	.....	2.2	3.7	5.4	9.0	13.0	15.4
BUSINESS FLYING																		
Beech	72.0	98.8	89.5	2.5	4.8	3.9	.94	1.80	1.50	.....	.....	.....	3.5	4.9	4.4	8.0	16.0	15.0
Cessna	87.6	103.2	105.7	5.2	7.2	7.9	1.58	2.24	2.47	16.4[3]	23.7[3]	33.6[3]	6.0	7.0	7.5	12.7	19.0	24.0
Piper	31.4	40.2	34.2	.8	3.5	2.7	.80	3.50	3.00	.....	.....	.....	2.7	8.8	8.1	4.5	18.0	26.0
AVIONICS and AEROSPACE EQUIPMENT																		
American Machine & Foundry	440.0	297.9	241.1	27.5	24.3	20.1	1.70	1.53	1.29	129.6	193.2	158.3	6.2	8.2	8.3	17.8	17.6	16.4
Arma	133.6	125.4	119.9	2.0	1.0	3.5	1.04	.51	1.83	84.0	109.0	.....	1.5	.8	2.9	6.7	3.6	12.4
Bendix[4]	757.9	792.2	689.6	23.9	26.1	27.4	4.45	4.88	5.11	439.0	452.0	511.0	3.2	3.3	4.0	9.4	10.8	12.0
Burroughs	401.2	389.2	359.7	10.4	9.2	7.1	1.58	1.39	1.07	.....	.....	.....	2.6	2.4	1.9	8.0	7.3	5.8
Collins Radio	215.7	190.5	117.8	3.0	6.5	3.7	1.15	3.02	1.87	157.0	190.0	210.0	1.43	3.44	3.16	5.5	15.6	12.6
FMC Corporation[12]	414.5	363.8	342.9	23.4	21.0	20.5	3.26	2.98	2.92	91.0[3]	66.5[3]	88.4	5.7	5.8	6.0	11.9	11.5	12.1
General Electric[5]	4,456.8	4,197.5	4,349.5	242.1	200.1	280.2	2.72	2.26	3.19	.....	.....	.....	5.4	4.8	6.4	15.0	13.2	19.4
General Precision	234.6	244.4	215.5	5.8	5.3	4.1	3.45	3.46	2.63	.....	.....	.....	2.5	2.2	1.9	7.1	7.7	6.3
Goodyear	1,473.0	1,551.0	1,580.0	76.1	71.0	76.0	2.20	2.05	2.19	.....	.....	.....	5.2	4.6	4.8	11.6	11.7	13.5
IBM	1,694.2	1,436.0	1,309.7	207.2	168.1	145.6	7.52	9.18	7.97	.....	.....	.....	12.2	11.8	11.2	17.0	17.0	17.2
Lear[14]	92.1	90.9	87.0	3.2	2.8	2.4	1.16	1.03	0.91	71.0	78.0	76.0	3.5	3.1	2.7	13.0	13.4	13.6
Litton Industries	259.1	187.7	125.5	10.1	7.4	4.9	2.30	1.72	1.30	.....	.....	.....	4.0	4.0	3.9	15.8	14.8	14.4
Mallory, P. R.	85.2	83.6	86.5	4.5	4.3	4.3	2.88	2.78	2.76	14.2	8.2	.....	5.3	5.2	5.0	11.6	12.0	12.6
Minneapolis-Honeywell[8]	470.1	426.1	381.4	24.9	26.2	29.3	3.48	3.74	4.20	.....	.....	.....	5.3	6.2	7.7	10.5	13.0	15.7
Motorola	298.2	301.0	293.0	9.5	12.6	14.1	2.36	3.14	3.59	.....	.....	.....	3.18	4.2	4.8	9.2	13.0	17.0
Raytheon[14]	562.9	539.9	494.2	6.8	8.1	10.4	1.69	2.09	3.01	360.0	288.0	300.0	1.2	1.5	2.1	7.6	10.1	14.9
Sperry Rand Corp[13]	1,182.5	1,177.0	1,173.0	24.3	27.8	37.2	.81	.93	1.25	604.0	550.0	.....	2.1	2.4	3.2	7.0	7.5	10.0
Texas Instruments	233.2	232.7	193.2	9.4	15.4	14.1	2.36	3.91	3.59	.....	.....	.....	4.0	6.7	7.2	11.4	21.5	25.0
Thompson-Ramo-Wool[4]	409.0	420.4	417.7	6.4	10.1	9.7	1.88	3.13	3.02	.....	.....	.....	1.6	2.4	2.3	4.8	8.2	8.4
Varian Associates	57.9	46.4	38.4	2.8	2.8	2.5	.73	.85	.82	30.2	32.3	19.2	4.8	6.2	6.7	5.4	10.3	18
Western Electric[7]	2,607.8	2,640.8	2,315.3	122.2	124.5	102.1	6.30	6.60	5.92	.....	.....	.....	4.7	4.7	4.4	10.6	11.4	...
Westinghouse[9]	1,913.7	1,955.7	1,910.7	45.4	79.0	85.9	1.23	2.22	2.43	.....	.....	.....	2.4	4.0	4.5	4.6	8.2	9.3
Gen'l. Telephone & Elec.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Defense Only	150.0+	138.9	148.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
All mfg.	702.4	701.2	705.9	25.0	33.6	37.2	.....	.....	.....	.....	.....	.....	3.5	4.8	5.3	.....	.....	.....
PROPULSION																		
Aerojet	479.4	425.0	364.4	11.7	10.0	8.2	2.57	2.20	1.78	.....	.....	.....	2.4	2.3	2.2	16.0	16.2	15.5
Avco[9]	323.1	322.7	306.0	12.9	10.0	9.5	1.24	.97	.95	.....	.....	.....	4.0	3.1	3.1	10.4	9.0	9.0
Continental Motors	127.8	138.0	139.9	1.4	1.4	2.6	.43	.43	.80	101.0	.....	.....	1.1	1.0	1.9	2.8	2.8	5.2
Curtiss-Wright	203.4	270.5	329.1	5.9	10.0	14.3	.62	1.15	1.71	.....	.....	.....	3.0	3.7	4.4	3.0	4.9	7.0
Hercules Powder[10]	380.2	336.9	283.6	27.9	27.1	23.3	3.05	3.05	2.73	.....	.....	.....	7.3	8.0	8.2	13.0	14.1	...
Marquardt	48.6	66.0	69.3	.8	1.3	1.5	.61	.94	1.17	26.3	39.6	.....	1.7	2.0	2.1	7.0	11.0	16.0
Thiokol[11]	193.8	171.5	190.1	5.3	3.5	5.5	1.11	.75	1.17	.....	.....	.....	2.7	2.1	2.9	13.0	12.0	22.0
United Aircraft	1,094.7	987.8	1,080.9	10.0	13.8	28.6	1.35	1.95	4.25	1,100.0	1,150.0	1,000.0	.9	1.4	2.6	3.5	4.8	9.9

Footnotes

* Consolidated with Chance Vought after merger. Previous years not consolidated and are Chance Vought only.
[1] Consolidated on basis of merger last year. Martin aerospace sales for 1961 totaled more than $830 million.
[2] Defense Product group sales 29% of total in 1961.
[3] Military only.
[4] See below for sales breakdown.
[5] 1961 Defense sales 25% of total.
[6] Military sales for 1961 32% of total.
[7] Defense sales for 1961 totaled $634 million, a decline of 12% from 1960.
[8] Nuclear and defense sales 1961 were 20% of total.
[9] Government sales 1961 are 63% of total.
[10] 1961 sales for space, missiles and defense 15% of total.
[11] Rocket operations sales: $177 million in 1961; $158 million in 1960; $173 million 1959.
[12] Latest Fiscal year ending Mar. 31, 1962; Defense sales for Fiscal 1962 were 49% of total; 48% in 1961; 52% in 1960.
[13] Defense sales $414 million 1961; $363 million 1960; $342 million 1959.
[14] All income and related figures are net operating income.

	SPACE AND MISSILE (in millions)			ELECTRONIC AND OTHER (in millions)			AIRCRAFT (in millions) Military			AIRCRAFT (in millions) Commercial		
	1961	1960	1959	1961	1960	1959	1961	1960	1959	1961	1960	1959
Bendix	197†	182†	103†				295	325	325	58	73	63
Douglas	317	318					178	307		295	548	
Lockheed	736	692	508				563	506	508	86	93	273
McDonnell	92	86	31	25	24	12	226	325	391			
Thompson-Ramo-Wooldridge	114	121	103	69	73	62	101	104	132			

† Includes avionics.

DE HAVILLAND DH-125, first model of which was rolled out July 23, is designed primarily as a simple, robust aircraft slanted toward use as an executive jet transport and a military trainer and administrative liaison aircraft.

DH-125 Faces U.S., French Competition

By Herbert J. Coleman

London—De Havilland Aircraft, facing intense competition in the world's executive jet market, rolled out its DH-125 aft-mounted twin-jet transport July 23, the first of an initial batch of 30.

The airplane has been primarily designed for simplicity and robustness. Designers readily admit there are no radical innovations in aircraft design and construction methods.

Built as a private venture by de Havilland, at a development cost of several million dollars, the DH-125 is being strenuously pushed as a military trainer, liaison plane and NASARR (North American Search and Radar Ranging) trainer, to a number of world air forces. Initial customer probably will be the Royal Air Force, now pondering the purchase of about 30 airplanes in varying internal configurations. The deal is believed to be near consummation, with talks down to component parts and placement.

In this field, the DH-125 faces heavy competition from the North American T-39 twin-jet trainer, which has been shown in Europe. On the other hand, de Havilland executives insist that, in the civil version, the prime competition will come from the Sud-Dassault Mystere 20 and, they say, this airplane is still in the mockup stage.

Major DH-125 features include:

• **Customer price of $430,000** in the standard version and about $75,000 more for radio and radar gear.

• **Large cabin and luggage area** which, in what probably will be the most popular executive version, includes a 24 cu. ft. forward luggage hold, another of 13 cu. ft. at the rear, and six seats.

• **Performance** of the Bristol Siddeley Viper turbojet and the engine's extensive operational experience. However, the Viper Mk. 520 powerplants will fly for the first time with the DH-125. This version is a follow-on to the Viper 11 and includes addition of a zero stage and higher temperature rating to produce 3,000 lb. thrust (AW May 29, 1961, p. 74). Bristol Siddeley currently is working on uprating the Mk. 520 (Viper 20) to 3,500 lb. and plans to accomplish this mostly through higher temperatures. Blades now are made of Nimonic 90 and will be constructed of Nimonic 105 for this version.

In view of what de Havilland considers its foremost market, the United States, the company has strongly considered tandem development of the airframe with intention of installing General Electric CJ610 engines if customers so desire, according to Sir Aubrey Burke, de Havilland's chairman. A license line exists between General Electric and Bristol Siddeley, through the latter's acquisition of de Havilland Engines, Ltd., now completely absorbed into Bristol Siddeley.

Sir Aubrey feels the DH-125 has a long future, an opinion based on the airplane's configuration, price, de Havilland's reputation in the jet and piston field and world-wide sales and service backup capability. So far, de Havilland has built 520 Doves and considers the owners potential customers although Sir Aubrey emphasized that the DH-125 is not a Dove replacement. He said several orders for the DH-125 have already been booked.

He told AVIATION WEEK the airplane probably will make its first flight by mid-August to ensure its participation in the annual Society of British Aircraft Constructors Show at Farnborough Sept. 3-10. Airplane must have flown 10 hr. to qualify for Farnborough showing; test pilot will be Chris Capper, assisted in the right seat by Geoffrey Pike.

Initial project will be certification under Air Registration Board airworthiness rules, and Sir Aubrey said the airplane will be aimed at full transport approval.

Certification for U.S. requirements will be made under CAR Part 4b, again up to the air transport category. The latter achievement will give de Havilland a competitive edge if other jet executive planes concentrate on Part 3b, less exhaustive but with its accompanying restrictions.

At the moment, however, de Havilland is not pushing the DH-125 too strongly as a feederliner for the obvious reason that it does not believe a market for an eight-seater in the field is yet a reality. Certification to full air transport category is more an expression of company confidence in the airplane's ability to fill a well-rounded role.

The DH-125 went onto the drawing board in April, 1961, based on the 30-plane batch program and has undergone few design changes since that date. Main reason has been tandem pilot and designer work on the de Havilland simulator, a device that saved considerable expense in development of the Trident three-jet transport now flying (AW May 14, p. 107).

When de Havilland first decided to go ahead in the jet executive field, the DH-125 was considerably smaller, with a 43.5 ft. over-all length, a wingspan of 44 ft. and a gross weight of 18,000 lb. But market surveys, along with cost estimates based on working drawings, resulted in the slightly larger airplane now frozen for production. New length is 47 ft. 5 in.; wingspan is 47 ft. and gross weight increased to 19,000 lb.

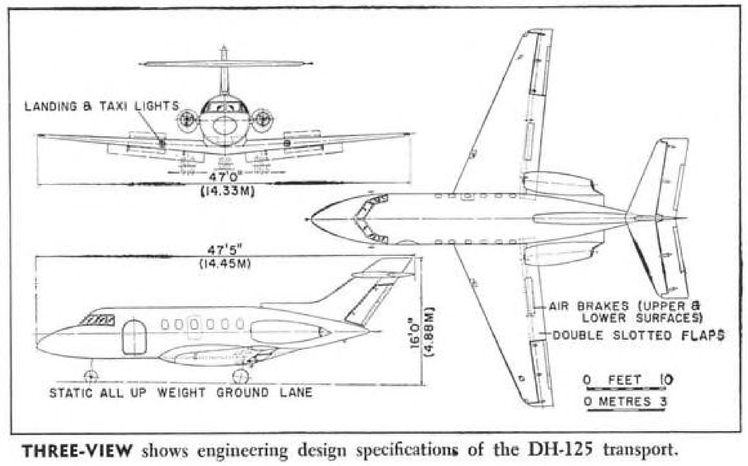
One result of simulator tests, along with wind tunnel testing of models, was to increase the size of the vertical stabilizer by about 5 in. to a new height of ground to tip of 16 ft. The move increased directional stability at both high and low speed regimes.

Another design decision was to increase the fuselage 1 ft., to 47 ft. 5 in., to provide the larger forward compartment and to allow the forward passenger door to be widened. First two airplanes will have the narrow door but production versions will be built with the larger one. Another feature is that the door retracts inward, sliding around the top fuselage on rails. Air-stairs are hydraulic and lowered from a sill.

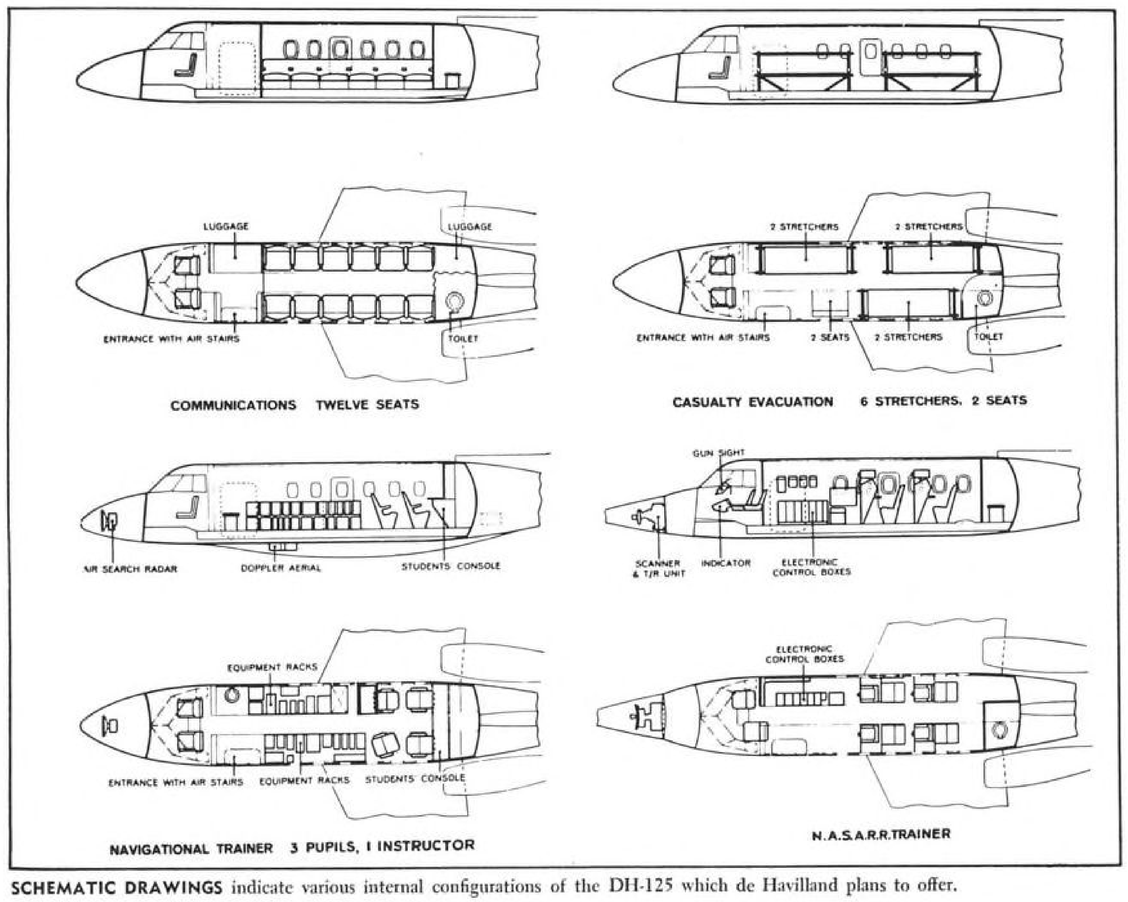
For additional versatility, de Havilland has designed a movable pressure bulkhead in the forward section which can be fitted to customer specifications.

Airplane itself is built in three sections—nose, center and tail. Wing is built singly and fitted to the center fuselage, with the center section passing under the belly and eliminating the need for a main spar to pass through the cabin flooring. Another reason was to increase the usable fuel storage space; the wing is virtually an entire tank, baffled into five sections to avoid sloshing. Feed is by gravity to two pumps in the center section and full crossfeed and fuel transfer provisions have been made. The DH-125 carries a total of 1,038 Imp. gal., or 8,300 lb. of fuel.

De Havilland has not revealed struc-



THREE-VIEW shows engineering design specifications of the DH-125 transport.



SCHEMATIC DRAWINGS indicate various internal configurations of the DH-125 which de Havilland plans to offer.

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tural changes in its military version, although a NASARR trainer mockup now is being built at the Hatfield production plant. This involves considerable stretch in the nose section to hold the scanner and related avionic equipment. Otherwise, the airplane remains virtually the same externally.

One-Pilot Cockpit

Depending on customer requirements, de Havilland also will offer the airplane in military and civil versions with a one-pilot cockpit layout.

Wing loading at maximum gross weight is 53.8 lb./sq. ft. and thrust-weight ratio at maximum gross is 0.316. Wing is fitted with upper and lower brakes on center sections of each wing and the pilot is provided with an inching control on the main console.

De Havilland is predicating DH-125 over-all performance on a normal operating speed (V_{no}) of 290 kt. below 25,000 ft. Above this altitude, normal speed will be Mach 0.725. Design diving speed (V_d) is 362 kt. below 21,000 ft. and Mach 0.825 above that altitude.

Maximum gross weight is 19,000 lb. and landing weight is 17,500 lb. In six-seat configuration, with payload computed at 1,400 lb., the visual flight rule range would be 2,800 naut. mi., based on long-range cruise at 36,000 ft. and fuel reserve for 45 min.

Weight breakdown, using the six-seat version, is structure, 4,580 lb.; two Viper 520s, 1,900 lb.; fuel system, 198 lb.; services, 1,442 lb.; safety devices, including icing provisions, 152 lb.; instruments, including radio compass, 144 lb.; furnishings of cockpit, cabin and toilet, 488 lb., and passenger seats, 160 lb., for a total empty weight of 9,010 lb. Optional items, such as radios and navaids and autopilot would boost empty weight another 590 lb.

Pressurization System

Air-conditioning is automatic and controls are operated by the copilot. Sea level pressure can be maintained to 21,000 ft., and at the maximum operating height of 36,000 ft., the cabin pressure will be kept under 7,000 ft.

The company's target date for certification is mid-1963 with deliveries following in the last quarter of that year. Main production will be concentrated at Hawarden Airport, near Chester, although the prototypes are built at Hatfield, site of the Trident and Comet production lines. A second prototype, now well advanced and with wings mated to main fuselage, is scheduled to fly in October.

The first airplane will be used exclusively for certification testing. Second prototype will be used to build up flying time on the Viper 520 and probably will be based at Bristol Siddeley's Filton plant.

Israel Aircraft Considers Private Financing for B-101C Development

By Arnold Sherman

New York—Israel Aircraft Industries factory at Lod, Israel, will resume development of the B-101C turbojet executive aircraft this year, according to an official of the company.

Stiff international competition in the executive plane market, plus lack of anticipated capitalization for the project, led to abatement of original development plans (AW Oct. 9, p. 26). Original configuration of the aircraft, a prototype mockup of which was on display at Israel's Lod Airport facility (AW Apr. 10, 1961, p. 108), will doubtlessly undergo some modification, but the basic design will probably remain the same, according to Director of Personnel and Administration Zvulun Yarry.

Israel Aircraft management decided to curtail development of the six-to-nine-place transport last October. At that time the company insisted that the reason for the curtailment was that design changes were needed in order to permit the aircraft to compete more effectively in the world market by improving the projected range and speed of the plane. The PD-808, the SAAC 23 and the DH-125 were all aimed at the same market. Tight governmental purse-strings added to the dilemma.

Basic reason behind resumption of the plane's development, according to Yarry, is that the company is now considering private investments to complement government funds. The firm was organized as a government-owned and operated corporation, but a tight financial budget plus studies indicating that a private investment potential exists, both on a domestic and international level, have heightened private investment interest. Undoubtedly, an appreciable amount of the expected funds would come from American investors. According to Yarry, research has indicated that the potential and interest both exist.

In addition to its design work on the T-tail B-101C, Israel Aircraft is expanding its ground-handling equipment manufacturing facilities with an eye toward export. The firm has negotiated an agreement with the C. S.F. company in France to manufacture aircraft electronic equipment, is producing the Potez-Air Fouga CM.170 Magister trainer for the Israeli air force, overhauls U.S. and European engines, performs overhaul and modification work for the air forces of Portugal, France, Cambodia and Burma. Israel Aircraft also handles line maintenance work for Air France, TWA, BOAC, BEA, Alitalia, Swissair and Olympic Airways.

Major facility enlargements and increased aircraft handling accommodations are planned by the firm which now employs 3,300 people. The machine shop area is to be expanded and the construction of an additional large hangar to handle added airframe overhaul work is projected. The engine shop will be expanded to facilitate handling of France's Snecma Atar 9 and Rolls-Royce Conway engines.

In line with the firm's growth, real and potential, Israel has sent Yarry to the United States to recruit the technical and professional personnel which, according to the Israeli executive, are lacking domestically.

Yarry said that Israel Aircraft spends roughly 10% of its over-all budget on technical training for its personnel but despite this, a critical shortage of skills continues.

Part of the problem appears to be that a significant percentage of the newly arrived Israelis are from African countries and few of these immigrants enter Israel with any technical or professional proclivities.

Yarry said that lack of technically capable personnel has been a prime pacing item in the growth of the company. "If it is at all possible," Yarry said, "we intend to recruit the personnel we need in the United States, Canada and Europe." Yarry said that to date "considerable interest has been shown by the American engineers he has contacted.

Israel Aircraft sees its future involved in two hard historical facts:

• **Improved relations with African** and Asian nations. Israel is making an intense effort to cultivate the friendships of the newly emerging nations in Africa and Asia. Yarry pointed out that while at the moment there is very little business potential for his firm in these nations, his country anticipates that as these countries progress, technically and economically, Israel's geography and competitive cost factor will stand it in good stead.

• **Peace with the Arabs.** Yarry stressed that as far back as 1951, a year before the official creation of Israel Aircraft Industries, company growth was related to eventual peace with the still hostile Arab nations. "We are realistic enough to admit that Arab embargoes, the economic constraints imposed upon us, and the denial of overhaul and maintenance work by our closest neighbors, has an unfavorable effect on our growth. When a lasting Middle East peace is achieved, the growth potential of the company will increase immeasurably."

Private Aircraft Sales Show Spotty Rise

By Erwin J. Bulban

Dallas, Tex.—Business aircraft industry's experience in the first half of Calendar 1962 bears out earlier indications (AW Mar. 12, p. 257) that unit deliveries and total dollar volumes are likely to exceed those of last year, but the situation presently looks spotty for some companies and all may not share in this increase.

All indications point towards Cessna leading the field this year in units delivered and dollar volume by a healthy margin. Beech and Aero Commander are less optimistic than they were earlier this year, and Mooney is showing increases in both units delivered and dollar volumes.

Part of the sluggishness is attributed by some companies to the Administration's so-called tough attitude towards business and part to the recent sharp decline in the stock market. The latter, they say, has not only reduced customer interest, but also put a damper on some distributors who suffered paper losses in the plummeting market and who feel that their capital position is such that they should curtail inventories.

As a result factory personnel this year are working hard with field sales outlets urging their distributors and dealers to take advantage of any vacuum created by the competition's slow-down in efforts, while those experiencing a decline are out trying to prevent this from happening.

Most optimistic of the big companies is Cessna. Marketing Division Manager Frank Martin feels that the company will do at least 10% better in dollar volumes this year than last, with factory billings running $4-$5 million higher. Although he told AVIATION WEEK that he thinks units delivered might only be a fraction higher than last year, indications are that if the company's rate of sales continues at the pace shown so far, Cessna will have to increase production rates to meet retailers' demands for new airplanes.

Martin noted that, although all figures have not yet been fully tallied, it appears that through June of this year, Cessna will have accounted for approximately 48% of units delivered by what it considers the major companies—Aero Commander, Beech, Cessna, Mooney and Piper.

Tallies through May indicate that Cessna had delivered $22.5 million, retail value, in single-engine business planes, accounting for 50.6% of the market. In the multi-engine market, the company, in the same period, garnered 24.4% of the total business, accounting for $8.5 million in sales. In both areas, according to Cessna, these totals exceed those of the same period last year, with its percentages of dollar volume being up more than four points in the single-engine types and nearly six on multi-engine airplanes, for an increase of $4.4 million and nearly $2 million, respectively.

Beech expects retail business plane sales will be about the same as last year, although thus far its business has been down about 6-8%. Factory sales force members are being sent out in the field to bear down on distributors and dealers and press them to boost sales efforts and place orders with the factory for demonstrators. Beech claims its field inventories are down substantially—actually far lower than they should be—with the result that this is a subject of considerable concern at the factory, whose favorite axiom is that airplanes are sold on the basis of taking the prospect up and demonstrating the hardware, rather than leafing through a brochure with him. As Frank Hedrick, Beech executive vice president, put it: "Some dealers still want to do business as brokers."

Beech is working hard to enlarge its distributor-dealer organization, but a major bottleneck exists in this field because of the lack of experienced sales personnel. It hopes to accelerate the process with introduction of its new four-place $13,300 Musketeer this fall, which, because of its price, should enable new dealers to join the Beech organization that have been unable to come in because of the cost of inventory units of the company's higher-priced line. The company, in fact, is planning a major promotion campaign, built around the Musketeer, aimed at potential dealer prospects.

Aero Commander indicates similar disappointment over the turn of business this first half and flatly admits that it has not been up to expectations in the past six months. Company spokesmen feel that many of its distributors have been shaken by the turn some of their investments in the market took during the big slide, and are waiting for customers to come and see them. The factory is undertaking several measures to spur business—but it notes that actually this is doing the job its distributors should be doing, including sending teams of factory sales and demonstrator personnel into a distributor's area to work with customer prospects, and opening sales offices, staffed by factory personnel, in areas it feels should be serviced. Recently, the company opened such an office at Wichita (Kan.) Municipal Airport, and plans further expansion of this effort, to fill gaps it feels the distributors are neglecting, or where it is not covered.

The industry generally is making continued gains in exports, although business probably will not show the same rate of increase as the past year. Changes in this area are not due so much to a decrease in interest on the part of customers as the constant change in geographic market patterns—what was a good market one year, suddenly becomes a poor one the next because of changing dollar exchange problems and local political situations.

JetStar Demonstrated at Reading Air Show

Lockheed JetStar executes low-level fly-by at the Reading, Pa., Air Show. More than 600 aircraft ranging in size from early Piper Cubs to Fairchild F-27s crowded the airport's grass parking areas during the event.

Jack Zook, Cessna export manager, reports that generally the company's international business in the first five months of this year tallied better than $6.5 million compared with just under $4.5 million the same period last year, and the division projected delivery of 62 units in June, 13 to 14 ahead of the same time last year. Sales of twin-engine aircraft are up markedly, with 41 sold in the first half of 1962 compared with only 9 last year in this period.

The company expects business to be good again in the European market this year, particularly since it has good demonstrator representation in this area. It has 310G or Skyknight twins available in France, Denmark, Switzerland, Germany, England, Norway and Sweden and this month participated in a major showing by its Swedish distributor, Solberg Cessna Flyg A.B., in Stockholm. The distributor purchased 15 new airplanes for static display and immediate flyaway delivery.

South American Market

In the South American market, the political situation has slowed operations somewhat, although Zook believes it possible to as well as 1961 there. Brazil and Mexico, which appeared to be slow markets earlier this year, look much more favorable, and he expects sales in those two countries to be up 15-20% over 1961. African market appears favorable in 1962 and Cessna business there should be up 25%, while Australia should show a 10% increase. New Zealand seems on the verge of lifting local dollar restrictions, and since this country has been closed to imports for 15 months, demand is expected to be high. The Philippines also are looking up—Cessna put a 310G demonstrator into Manila early this year and the distributor there already has taken orders for a dozen various types of airplanes since the first of the year.

The company also has expanded its dealer representation abroad. In addition to The Philippines, it has established direct factory sales outlets in Malaya, Liberia, Angola and Spain.

Beech also reports export gains—business overseas expected to be up 5 or 10% providing net billings of $13 million in 1962—with major activity in Europe, the Middle and Far East. South America has tapered off. Largest percentage increase of foreign business plane sales is expected to occur in the Far East area.

The company has re-arranged its European representation—taking out three distributors in the Scandinavian, Belgian and Austrian areas and making them dealerships under Travel Air GmbH, Bremen, Germany, and extending Trans Air's territory to cover France, Italy and North Africa.

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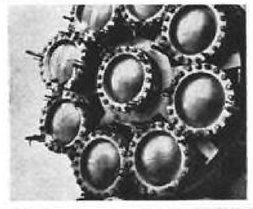
Photograph shows a safety head with full throated opening for instantaneous release of pressure. Lightweight construction, fixed dimensional openings, together with compact design, make this unit ideal for the missile and aircraft industry.

The safety head shown here in this tiny fitting protects against over pressure in a missile's hydraulic system.

Rupture disc acts as a quick opening valve in the nozzle of "Jato Bottle"—retaining thrust until the propellant develops a specified pressure.



Large diameter (in this case 24") Safety heads are fitted in a manifold to provide over pressure protection on this engine test chamber.

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Antonov Criticizes Soviet 'Quota' System

(Soviet aircraft designer O. K. Antonov has emerged in the last year as a leading spokesman for improvements in the over-all Soviet industrial system—especially in respect to quality. His comments in two separate articles in Izvestia pertain largely to general industry, though aircraft engines are discussed in terms of service life. In the light of operational problems encountered along this line by Ghana Air Lines with its Il-18s (AW Dec. 12, 1960, p. 38), it is possible to visualize other parallels. Key excerpts from the articles follow, and the box on page 75 deals with another Antonov criticism, this one concerned with Soviet aeronautical engineering education.)

What stimuli make Soviet man work—and work well? It seems to me that all stimuli—both moral and material—should, on the basis of their effects, be divided into three main groups.

The most important stimuli must, in my opinion, relate to the first group. This is the purely moral stimulus—the growing ideological consciousness of Soviet man, his desire to serve society, the inner need to work which our socialist reality has already bred into him.

In the second group of stimuli I would place discipline, the feeling of responsibility, the desire to fulfill the plan, schedule or instructions of one's senior comrades or of an organization's higher management.

Self-Interest

In the third group of stimuli one should place direct material self-interest as determined by piece-rate wages or a progressive wage scale, a premium system or other forms of encouragement.

Stimuli of the first group operate correctly and unfailingly in accordance with the interests of society because they are engendered by an understanding of these interests. But, unfortunately, one can't in every instance say the same about stimuli in the second and third groups. These stimuli are not emotional in character.

The criteria for plan fulfillment and the methods used in determining material reward for work can sometimes lead to entirely unexpected results when there is a poor choice of control "indices." Such faulty "indices" make some people act against their consciences and, to some degree, even against the interests of society as a whole.

These "indices" encourage people to be wasteful, to manifest an uneconomical attitude toward socialist property, and to expend working time and materials foolishly.

Recently I was walking along Moscow's Bolshaya Maslovka. I stopped near a truck from which two nimble girls were unloading bricks for construction of an apartment house. Actually, the term "unload" is hardly accurate in this case.

They simply threw the bricks on the ground in a huge, disorderly pile. I estimated that about 30% of the bricks were broken in this process.

Oversimplified Instructions

This happened because the workers' instructions were oversimplified. They were just told to unload the truck as fast as possible. Probably the girls were paid by the hour, while the truck driver was paid a wage plus a bonus per ton of bricks hauled or, possibly, according to the number of kilometers he drove each day. In addition, they were all probably told to hurry so as to fulfill the "plan".

In all these cases, work was evaluated by some sort of abstract indices that are divorced from the realities of life and from the ultimate usefulness of the task in hand.

If these two girls had been paid on the basis of each 1,000 undamaged bricks delivered to the construction project, it can be stated confidently that the breakage would have been cut by at least two-thirds. This undoubtedly would have permitted a considerable wage raise for both the girls and the driver, would have provided the project with a better supply of building materials, and would have allowed the state to save money.

O. K. ANTONOV

But why is this not being done? It would seem that it is all so simple! However, the fact of the matter is that careful unloading of the bricks would require more time. The truck would be standing still for, let's say, half an hour, not ten minutes, during unloading. This would mean that the truck driver would, for example, make only five trips daily instead of six. This would quickly affect his wages. Secondly—and this may be the main difficulty—the work indices of the truck pool would decline (!) because the number of tons hauled and the number of ton-kilometers traveled would be reduced.

Therefore, it is more "profitable" for the truck pool to haul six loads of brick, even though 30% of them end up broken, than to haul five loads with 10% breakage.

Is this sensible? An elementary arithmetical calculation provides the answer to this question.

One "fast" truck trip to the construction project brings only 70% of the whole bricks loaded at the factory. Multiply 0.7 by six—the number of trips—and you get 4.2 truck loads a day. This is the number of whole bricks actually delivered to the construction project.

Alternative Cited

Now assume that the girls carefully pile the bricks in a neat pile and the breakage is reduced to 10%. Multiply 0.9 by five trips and you get 4.5 truck loads of whole bricks. As you see, the number of good bricks is increased. In addition, an entire truck load of bricks will remain at the brick plant. Something will also be saved in truck fuel and depreciation, making it possible to increase the wages of both the girl workers and the truck driver.

Is this sort of work organization reasonable? Yes, it is. But the trouble is that such reasonable indices for evaluating various types of production activity, while clearly beneficial for society as a whole, sometimes lead to a reduction in "gross output" and, consequently, to an apparent drop in the work tempo.

This is what in many cases also prevents the State Planning Commissions, economic councils and individual plants from shifting over to new and more progressive indices which obviously would improve industry's work and accelerate our movement forward toward communism. True, an economic council would have to explain to the republic's State Planning Commission why output dropped suddenly. The republic's State Planning Commission would, in turn, have to explain to the USSR's State Planning Commission, etc., etc.

The situation is sometimes the same with regard to improving product quality. It happens like this: You increase quality and you decrease output. And even though the increased quality is very profitable to the state, a plant will, with the blessing of the economic council, strive for gross output. Unfortunately, gross output is still one of the main indices of plan fulfillment, and the plan is a matter of honor for the plant's employes and directors. What's more, the plant's personnel have, as a rule, a material interest in the existing bonus system because of the notorious gross output index.

Let us take a simple example:

- **A factory makes aircraft engines** which can operate 1,500 hr. before complete amortization.
- **Man-hours required** to make an engine with a service life of 3,000 hr. would require not twice as many, but only 20% more man-hours of labor.

Even so, despite the obvious advantage of making a better quality product, no economic council and no aircraft engine factory will do this on its own initiative. Gross output, you see, would fall by the same 20%.

There is only one way to eliminate this contradiction, and that is to change over to new, more progressive indices for evaluating a factory's work. After all, what is important is not the number of engines built—taken by itself and isolated from their quality and service life—but the total number of hours they will operate in the airplanes.

If a factory's work is evaluated according to motor hours, then the changeover to a new and more labor-consuming type of engine would be profitable not only to the state as a whole but also to the factory manufacturing the engine.

If, indeed, we assume that a factory makes a thousand old-type motors per year, then their total service life will be 1,500 times 1,000, or 1,500,000 motor-hours.

Suppose, now, that the factory changes over to the new engine having a 3,000-hr. service life but also requiring 20% more man-hours to build. In this instance, the engines produced

'Book Learning' Engineers

(Besides his comments on industrial efficiency, Soviet designer O. K. Antonov also has spoken out against some facets of Soviet aeronautical engineering education. Major parts of his comments follow.)

There was no aviation institute in the city where I completed secondary school. I had to enroll in the university's railroad and highway department so that, in due course, I would get the chance to move closer to aviation. However, the railroad and highway department was soon discontinued. For two years I tried to enroll in other institutes—it was more difficult then than now. In the meantime, some friends and I built a glider of our design and took it to the All-Union Glider Meet at Koktebel'. True, on our own initiative, we first had to acquire an understanding of material strengths and aerodynamics and also had to learn to be carpenters and mechanics.

Then, when I was studying at the Leningrad Polytechnic Institute, our student group managed to build five more gliders of various designs. As a result, I easily passed special subjects almost without preparation. On the other hand, I just "sneaked by" the course on elasticity theory, which I didn't need. This simply cannot be done under the present, (more-rigid) educational set-up in our institutes.

And so it went. We studied what was essential and, at the same time, we mastered many practical skills. But now, alas, it is almost impossible for students to build not only a glider but even simpler structures. Doesn't this lack of opportunity to engage in creative labor because of the enormous academic overload result in bookworm-type students who become automatons for rote learning?

How many impregnable barriers, for example, are thrown up in front of students trying to build small, simple airplanes of their own design! Here the college authorities advance dozens of assorted reasons why such a project should not be undertaken. Won't it interfere with studies? Who will be responsible if there is an accident? And so on, and so forth.

On the basis of many years of experience, I assert: No, it won't interfere with studies! We must not only permit but encourage and support every kind of sincere, reasonable initiative in this direction. We must not trim their wings but strengthen them. Building even a small technical structure by their own efforts will provide future engineers with experience and schooling that cannot be replaced by any kind of "practice" at a plant, in narrowly-specialized workshops or departments. It will provide skill in teamwork, knowledge, and the opportunity to obtain an over-all, first-hand understanding—not a paper one—of a wide range of complex problems. Construction of a light airplane in college workshops doesn't cost much. It is 10 to 20 times less expensive than when ordered at a factory. And a glider would cost still less. Furthermore, such construction can be coordinated in all its parts with the academic process; with laboratory work and with research.

The Kharkov Aviation Institute is one of the most advanced in the nation. But even there they have hampered flight tests of a light plane built by students. As a result, the student designers, although barely knowing how to fly, decided to test the airplane themselves. It was destroyed. The tireless designer and his friends built another airplane. This time he smuggled it out of the workshop at night and tested it at the bottom of a ravine. And, of course, the result was the same. How much more useful the tests would have been if the Institute had taken a more sympathetic part in them, if those who knew about the project had not been afraid of what the director would say, and if they had not put a spoke in the wheels!

As for the attempt to prevent our students from showing initiative because of the "danger" involved, persons using that excuse are wrong and have no basis for their stand. Prior to 1938, amateurs in all parts of the country built tens of gliders and airplanes. Accidents were very infrequent, and even these took place mainly where, instead of receiving help and cooperation, the enthusiasts were hampered in their work and had unnecessary obstacles put in their way. Since then we have made giant strides technically. We have become much more competent and advanced. Why, then, are we now afraid of initiative and technical creativity? If a college is unable to guarantee the stability, controlability and structural strength of a small airplane or glider built in its workshops, then how can it graduate aeronautical engineers?

The problem must be put more broadly. Students must build not only airplanes and gliders but also automobiles, machinery, hydrofoil boats, rockets, calculating machines, radar equipment, small engines, and many other things.

If we help students in the right way to prepare themselves for creative work, I believe that the number of mediocrities who honestly "pass" tests will decline sharply. And the number of people who love their work passionately—to the point of selflessness—will inevitably increase. It will then become simply impossible to evaluate a student's "progress" by his grades alone.

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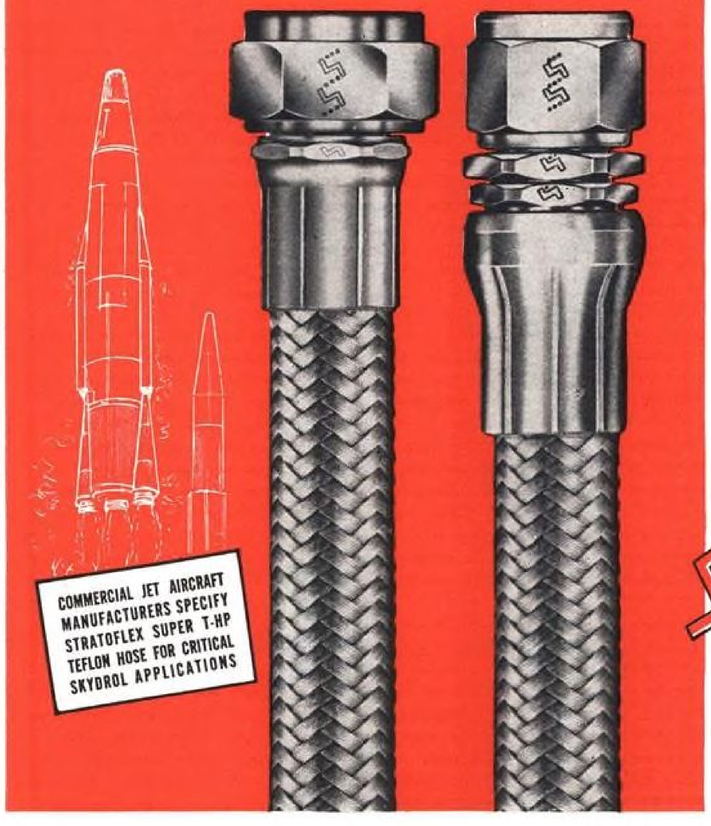

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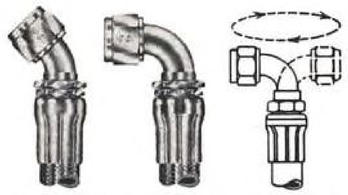

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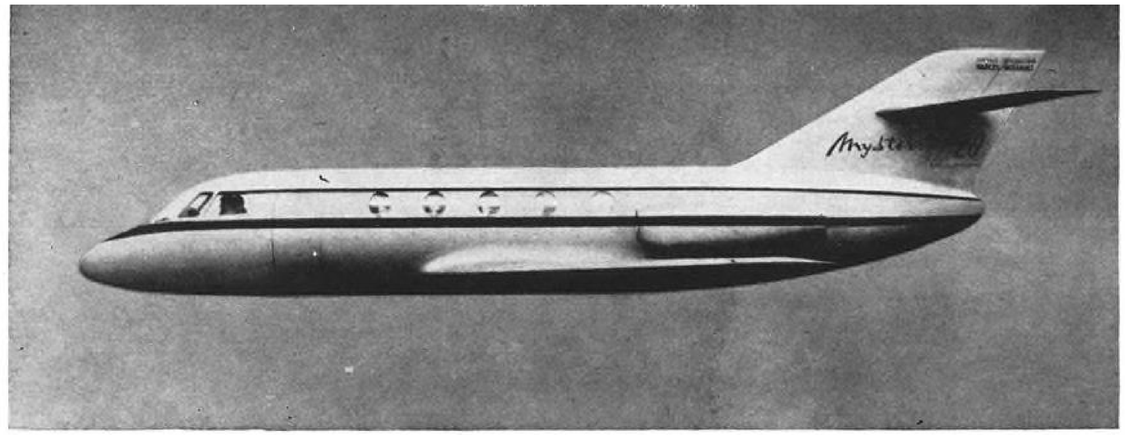


First Mystere 20 Flight Set For 1963

French Dassault Mystere 20 twin-jet liaison and executive transport will make its first flight sometime in 1963. Aircraft can cruise at 445 kt. at 40,000 ft., is powered by two Pratt & Whitney JT12-A-8 engines equipped with thrust reversers.

annually by the factory with the same number of man hours will fly 3,000 times 1,000 divided by 1.2, or 2,500 motor-hours.

This is equivalent to increasing engine output by 67%. It would permit planes equipped with these engines either to increase flying time by this amount or, if less than a 67% increase in flying time is planned, it would permit the factory to reduce engine output, thus saving a great deal of labor and materials.

The number of examples could be multiplied. But one must note a very important circumstance which is frequently overlooked. Incorrect and irrational factory work indices not only harm the national economy but also create conflict between high moral stimuli on the one hand and the demands for plan fulfillment and material self-interest on the other.

In the second article, Antonov took notice of the many comments received on the initial one. He continued:

As was noted in most of these comments, the reason for many of the shortcomings in the work of our plants is the imperfection—the faultiness of production planning.

What, indeed, is it that, for example, induces a factory in Zaporozhe to seek to produce as much as possible of any kind of metal and at any price instead of turning out more high-quality metal at minimum expense? What is it that, as a rule, makes builders put up buildings under conditions of primitive chaos, and only then lay out roads at the project? Everyone knows that besides being backward, such a work sequence makes construction more expensive and damages the state's interests. Why are the results of a worker's labor evaluated according to the number of tools made rather than according to the total amount of useful work these tools can perform? Why is it that at the Upper Serginskoye factory the introduction of new bits that considerably increase the speed and reduce the cost of drilling is regarded as "unprofitable" for the factory? Finally, why does the sugar factory at Ol'khovatka discharge a sugar solution into the river in order to fulfill the "indices" established by the plan? Why is it that barren rock is being added to ore when it only lowers the ore's quality?

All these and other such "whys" boil down to the same thing—the harm which is done to our production when we evaluate the results of labor by utilizing one-sided, inadequately-thought out "indices."

In their letters, the readers of "Izvestia" have cited striking examples of how certain plants, in order to fulfill these "indices," are forced to expend unnecessary labor, materials and machine-hours while, at the same time, delivering products which are not the best.

What is better for the state—to produce ten automatic lines which make 10 million pistons annually or five lines that make just as many pistons. Obviously it is more advantageous to build fewer but more productive lines. However, in reality, it works out like this: you make five lines—even though they are twice as productive—and it means you haven't fulfilled your plan. So is it worthwhile to seek to perfect the design of an automatic line?

The prevailing "gross output" system of indices doesn't, for example, encourage a ball bearing factory to work hard to increase service life of the bearings. If the service life of the bearings were doubled, the demand for these bearings would be cut almost in half. That would be very good for the national economy, but frankly the factory is not interested in this because the price of the bearings is not tied to their service life.

It must, unfortunately, be noted that part of the existing system of indices used in our industry to determine the fulfillment of plan at many factories was uncritically borrowed from the political economy of the capitalist period. Very few of us are engaged in research into new, socialist attitudes toward production which have originated in our country.

The capitalist is interested in indices which determine future profit. He is not concerned with the national welfare. Therefore, gross output is also a suitable index for him, since it is closely associated with earnings obtained from the products being sold. But for us, gross output is not the principal index. It can be regarded only as a secondary index—and even then with reservations. Some district economic councils have found an easy way to raise gross output: they have begun to extend production of simple items, which formerly were manufactured at one factory, to two or three factories. Each factory along the line buys the unfinished product from the previous factory, adds something to it, sells it to the next factory. As a result, gross output doubles or triples.

A factory director told how mountains of parts and components are kept in the warehouses of some plants. Why? Because, in the first place, the plant director does not trust the operating efficiency of the supply network and, in the second place, because, when he finds himself in a tough spot and he is in danger of failing to meet his plan, he can take various parts and components from the warehouse in somewhat larger numbers, list them as production, and the plan for gross output will be fulfilled.

And what real advantage does the national economy get from this poor excuse for management? Inflated figures, a mess—if one is to avoid using stronger terms.

Under conditions in our socialist economy, indices for counting and evaluating the results of a plant's work must be set up in such a way as to induce both the managers and all of the plant's personnel to achieve the maximum national advantage. The principal work

INTERNATIONAL AIR TRANSPORTATION ISSUE SEPTEMBER 10, 1962

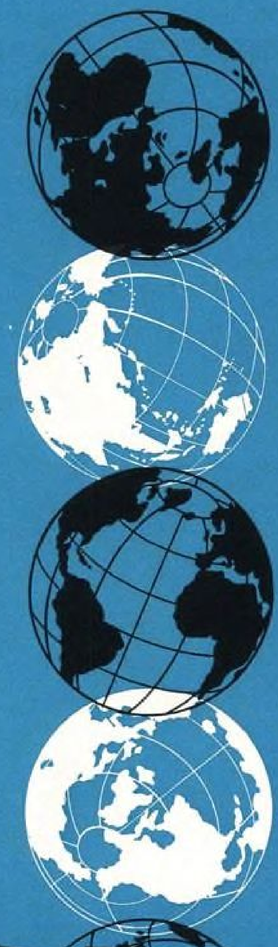
The impact and challenge of recent trends and developments in international air transportation will be the subject of AVIATION WEEK & SPACE TECHNOLOGY'S *International Air Transportation Issue,* September 10, 1962.

This major editorial effort will analyze the direction and problems associated with the growth and expansion of air transportation in all major world markets including Atlantic, Europe, South America, Africa and Asia.

Subjects slated for special emphasis are: Development of a new U.S. international air policy; World-wide impact of common market and African consortiums; New flag carriers of emerging nations; New trends in supersonic transport research; Communist bloc penetration in world air markets; 1962 traffic trends; and future international tariff and merger problems.

Copies of this issue will be airlifted to delegates at the opening session of the International Air Transportation Association (IATA) Conference in Dublin, Ireland. Here will be gathered the international leaders of air transportation whose attention and discussions will be focused on these and other major issues.

With AVIATION WEEK's reputation as the authoritative, respected voice of international aviation, the International Air Transportation Issue will receive world-wide readership and impact.



Aviation Week & Space Technology

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index of each plant must be the national benefit, the effect on the national economy which accrues to the state on an over-all basis when the production of a given factory is consumed.

To do this, it is necessary to combine harmoniously the categories of quantity and quality. In such case, the contradictory desire to produce a little more by reducing the product's quality will practically disappear.

The logical connection between quantity and quality must be such that, when changing over to manufacture of higher-quality products, even if made in somewhat smaller quantity, we necessarily will achieve growth in both quality and quantity of production in the national economy as a whole.

Reciprocal Connection

Economists must see clearly that under old social and economic structures, which developed spontaneously over a long period of time, a so-called reciprocal connection inevitably existed. Without this connection these economic structures simply could not exist.

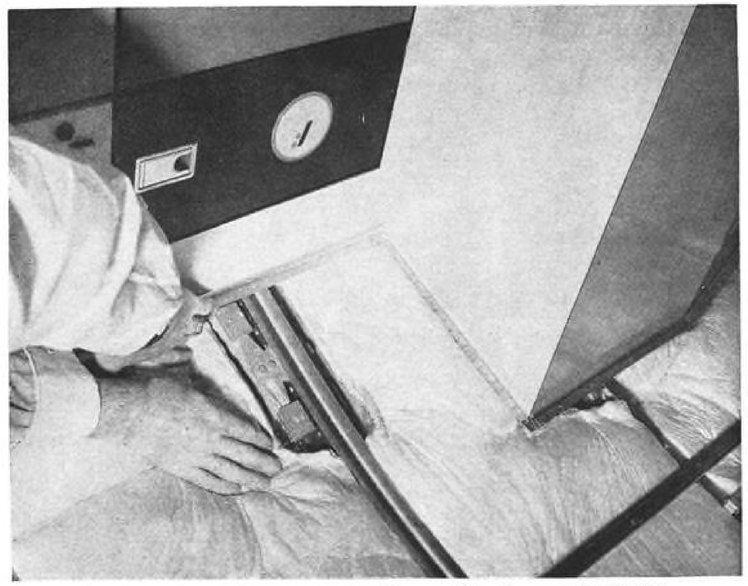
Thus, for example, in the system of capitalist production, the role of reciprocal connection is played by selling, by the market, and by competition. It is these factors that force the capitalist to make things better, more dependable and cheaper.

Under our socialist conditions—in an economic system built by society according to the laws of reason—the reciprocal connections must also be created through reason. They must be well thought out and must be in the required sequence.

The textile industry not only is not reducing but, to the contrary, is doubling (!) output of fabrics which have had no market for a long time. Such confusion is possible only because a reciprocal economic connection is completely missing here. The textile factory does not know its market and is not interested in the selling of its products. It turns over the fabric to the marketing organization and doesn't give a hang about anything else. The State Bank hands out money to the factory for wages, for procurement of raw materials, and for other expense. And so it is possible to keep on working not for the sales counter but for the warehouse.

That is why the warehouses sometimes are bursting with goods costing tens of millions of rubles which have no market. This is why many establishments cannot obtain necessary articles, tools, machines and semi-finished materials from their suppliers and the consumer cannot obtain clothing and shoes in the latest styles and colors.

The influence of consumers on their suppliers and on their production plans is extremely limited in our economy.



Vibration Dampers Installed on F-27F

Vibration dampers, designed and installed by Horton-Horton and Inter-America of Ft. Worth, Tex., are used aboard Fairchild F-27F. A total of 72 dampers, consisting of simple beams with two tip masses, are installed at various points around the inner fuselage frame.

Yet the nation-wide planning organizations and those in each Soviet republic are unable to plan the work of each factory in harmony with all the rest of the factories. This is a task that is still beyond their power to solve.

The existing methods of planning frequently lead to pursuit of the bare figures of the plan, and this inevitably leads to a situation wherein we borrow from tomorrow. These figures are, as a rule, achieved by adversely affecting the work of other establishments which are the recipients of products in future years. The figures are met by hurting the work of industry as a whole and by cutting into the output of future years. Examples of such borrowing from the future in the pursuit of a plan-fulfilling figure are, for instance, still fresh in the minds of everyone with regard to agriculture.

The changeover to computing the work of industry by new, more progressive and more complex indices which take the national welfare into consideration can be carried out without harming general indices applicable to the national economy as a whole. After all, we have stopped counting our tractor output in terms of hypothetical, 15-hp. units without disastrous consequences!

The work reserves in our industry which are not being used because of unfortunately-formulated and ideologically-obsolete indices for counting and evaluating the work of industrial plants are enormous. We can cite this example brought to mind by Comrade Shamson of Leningrad.

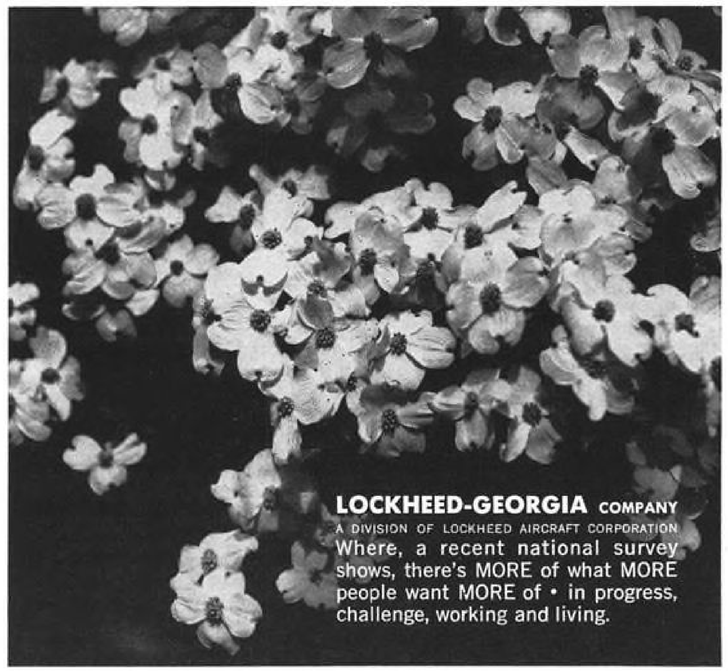
In manufacturing paper or cardboard, there is a tolerance which permits a variance in one direction or the other from the specified thickness. The results of the work at the paper-making plants are evaluated according to the weight of the product. Therefore, the paper makers stubbornly try to select the upper limit of tolerance—to make the paper a bit thicker and, consequently, a little heavier as well. Thus raw materials are expended wastefully and above norm.

But a simple calculation shows that if the upper tolerance is eliminated (modern technology makes this possible) the saving in raw material by just one paper-making machine of average productivity will permit the manufacture of 3,000,000 square meters of paper annually above the norm. We must make use of these reserves and provide an outlet for the forces lying idle in our economy.

The use of new and progressive in-

PERT/Cost Handbook

Washington—Handbook describing new standardized PERT/Cost procedures, recently adopted by Defense Department and the National Aeronautics and Space Administration (AW June 11, p. 31), is expected to be available from the Government Printing Office in Washington on or about July 20. Price has not yet been set. Approximately 15,000 copies are being printed in anticipation of widespread demand.



ENGINEERS . . . . . INTERESTED

Send complete resume to: Hugh L. Gordon, Professional Employment Manager, Lockheed-Georgia Company, Dept. QQQ-75, 834 W. Peachtree Street, Atlanta 8, Ga.

An equal opportunity employer.

PROBLEMATICAL RECREATIONS 128

Six grocers in a town each sell a different brand of tea in four ounce packets at 25 cents per packet. One of the grocers gives short weight, each packet of his brand weighing only 3¾ ounces. If I can use a balance for only one weighing, what is the minimum amount I must spend to be sure of finding the grocer who gives short weight? —*Contributed*

If you're a specialist in digital systems integration, waste no time getting to our Data Systems Division. Positions of responsibility are open for engineers who know design with one hand, hardware with the other, and can see that they both meet in a smoothly functioning digital tactical data system. If binary is your language, give Mr. Harry P. Laur a call.

ANSWER TO LAST WEEK'S PROBLEM: The rightmost digit of 7^N is 1, 7, 9 or 3 according as $N \equiv 0$, 1, 2, or 3 (mod 4). Since $7^7 \equiv 3^7 \equiv 3$ (mod 4), the rightmost digit of 7^{7^7} is 3.

An Equal Opportunity Employer

LITTON SYSTEMS, INC.
Data Systems Division
Canoga Park, California

dices of a socialist type should first begin at only certain plants. Then the indices should be extended gradually to industrial combines, branches of industry, and to entire district economic councils.

Broadening the prerogatives of plant directors and managers is of considerable importance in accelerating this process. Here it is difficult to expect important progress until this broadening of prerogatives is accomplished simultaneously for all management and in equal measure—that is, according to the level (category or class) principle. Such all-encompassing action forces the weakest and most unreliable managers to reorient themselves.

Director Categories

It seems to me that it would be advisable to change over to a system of categories or classes of directors. A director of the second class should have more prerogatives than a director of the third class. A director of the first class, being among the most able, sensible and experienced managers, should also have the broadest prerogatives, thus enabling him to strive for product output of the highest quality at the least cost. His prerogatives would include direct agreements with customers—agreements made without petty supervision by the district economic council.

With such an increase in prerogatives to the extent of each manager's ability, the district economic councils will be relieved of considerable responsibility, retaining only the most general control in a number of cases. But the plant directors will try to work the best they know how in order to merit confidence and, at the same time, in order to achieve a higher class and greater independence.

Company Stores

In the field of manufacturing and selling consumer goods, this would lead to the appearance of a broad network of firms having their own stores. The director would be kept constantly informed about the demand for goods produced in his plant. When the goods are marketable, you make more of them. When the people buy little and reluctantly, you either make improvements or change over to another model. Otherwise, you find yourself left high and dry.

Such a system would not preclude the existence of large marketing organizations operating in sensible cooperation with plants engaged in the direct sale of their products through their own factory stores.

The still-unused reserves of our production system are enormous. Putting these reserves at the service of the national economy is the task that N. S. Khrushchev [has] set forth. . .

WHO'S WHERE

(Continued from page 15)

Changes

Dr. B. Peter Leonard, assistant general manager, Aerospace Corp.'s Engineering Division, Los Angeles, Calif. Also: **Robert P. Egermeier,** appointed to organize and manage Aerospace Corp.'s White Sands, N. M., Flight Test Office, which will be located at the Air Force Missile Development Center, Holloman AFB, N. M.

ARO, Inc., has appointed **Richard Jackson** as assistant chief, von Karman Gas Dynamics Facility, USAF's Arnold Engineering Development Center, Tullahoma, Tenn.

Dr. Meredith C. Gourdine, chief scientist, Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J.

Dr. Maria Telkes, director of research and development, Cyro-Therm, Inc., Fogelsville, Pa.

Elmer E. Jones, Jr., assistant to the president, Trans World Airlines, Inc. Also: **John F. Murphy,** director of mail and express sales.

Cecil A. Crafts, director, Aeronautical Products Group, Robertshaw-Fulton's Aeronautical and Instrument Division, Anaheim, Calif.

Wenzel M. Wochos, general manager of Cannon Electric Co.'s Phoenix (Ariz.) Division.

John A. Scherer, manager, Advanced Systems Section, Sales Development, Hercules Powder Co.'s Chemical Propulsion Division, Wilmington, Del.

Don A. Drake, advertising manager, Giannini Controls Corp., Duarte, Calif.

H. E. Brown, manager of marketing, General Electric Co.'s Advanced Product Planning Operations, Electronic Components Division, Schenectady, N. Y.

Dr. James Franklin Sutton, director of research, Lockheed-Georgia Co., Marietta, Ga.

Joseph L. Zygielbaum, head of the newly formed Foreign Language Translation Department, Electro-Optical Systems, Inc., Pasadena, Calif.

Motorola's Military Electronics Division, Scottsdale, Ariz., has appointed **Robert McCarthy** as program manager and **William R. Talbert** as project leader for the Deep Space Instrumentation Facility S-band RF Subsystem program.

Everett A. Hayes, director of public relations, Lockheed Propulsion Co., Redlands, Calif.

General Dynamics/Electronics, San Diego, Calif., has announced the following appointments: **James H. Thompson,** manager of operations; **Ira D. Sykes, Jr.,** assistant to the general manager; **Arch Wisdom,** chief engineer-data processing product group.

Dr. George J. Mueller, chief, Applied Research Section, Research and Development Department, Cannon Electric Co., Los Angeles, Calif.

Dr. Robert S. Carlson, director of Space and Weapon Systems, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif., succeeding **Dr. Donal B. Duncan** (AW June 4, p. 23).

(Continued on page 83)

We're looking for men who can't let well enough alone

Northrop-Norair needs men who ask questions; men who aren't afraid to rock the boat. In the advanced areas we're exploring at Norair, you don't dare take anything for granted. If this kind of challenge appeals to you, put down the magazine now, while it's on your mind, and write us a letter. Positions are immediately available for:

Engineers in electronic checkout systems who have worked with advanced design and program development.
Engineers whose background is in supersonic aerodynamics, stability and control, inlet design, ducting, and performance analysis.
Engineers familiar with airframe structural analysis.
Scientists specializing in infrared, optics, and electronic research.
Engineers to work in data reduction.
Scientists who know structures research and dynamics.
Scientists who have done supersonic aerodynamic research.
Scientists experienced in working with information and sensing systems, platforms, infrared, sensors, flight controls, airborne computing and data handling systems.
Engineers familiar with programming, operations, and instrumentation for ballistic missile flight test.
Reliability Engineers to assess the reliability and to optimize the configurations and mission profiles of space systems.
Chemical Engineers to work on the development and applications of structural adhesives for aerospace vehicles.
Metallurgical Engineers for research and development on materials and joining.

If you'd like more information about these opportunities and others that may be available by the time you read this, write and tell us about yourself. Contact Roy L. Pool, Engineering Center Personnel Office, 1001 East Broadway, Hawthorne, California. **NORTHROP**
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circuit designers... is your appointment in space with Hughes?

Today at Hughes you will find one of the country's most active space-electronics organizations. Important new and continuing projects, including SURVEYOR, SYNCOM, ARPAT, BAMBI and POLARIS guidance systems are growing at unprecedented rates.

This vigor promises the qualified engineer or scientist more and bigger opportunities for both professional and personal growth.

Many immediate openings exist. The engineers selected for these positions will be assigned to the following design tasks: the development of high power airborne radar transmitters, the design of which involves use of the most advanced components; the design of low noise radar receivers using parametric amplifiers; solid state masers and other advanced microwave components; radar data processing circuit design, including range and speed trackers, crystal filter circuitry and a variety of display circuits; high efficiency power supplies for airborne and space electronic systems; telemetering and command circuits for space vehicles, timing, control and display circuits for the Hughes COLIDAR* (Coherent Light Detection and Ranging).

If you are interested and believe that you can contribute, make your appointment today.

Please airmail your resume to:
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Supervisor of Scientific Employment
Hughes Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 76, California
We promise you a reply within one week.

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HUGHES

HUGHES AIRCRAFT COMPANY
AEROSPACE DIVISIONS
An equal opportunity employer.

WHO'S WHERE

(Continued from page 81)

Walter E. Britton, chief, Airport Traffic Control Tower at the Federal Aviation Agency's new Dulles International Airport.

William J. Kuehl, general manager, Armament and Control Products Section of General Electric Co.'s Light Military Electronics Department, Johnson City, N.Y., succeeding **M. R. Johnson** (AW June 25, p. 92).

Brian R. Carter, supervisor of customer requirements, Westinghouse Defense Center's Systems Management Department, Baltimore, Md.

Dr. John E. Basinski has joined the Technical Staff of National Engineering Science Co., Pasadena, Calif., and **Dr. Serge Waiter** has joined the Senior Staff.

Raymond W. Fink, director of quality control, Electronics Operation, Avco Corp.'s Electronics and Ordnance Division, Evendale, Ohio.

Gerald Stolar, chief engineer-instruments, and **Robert Lender,** chief engineer-aerospace, Weston Instruments Division, Daystrom, Inc., Newark, N. J.

Dr. Carroll L. Zimmerman has joined the Douglas Missile and Space Systems Division, Santa Monica, Calif., as assistant to the Division vice president-director of product development.

Col. David B. O'Hara has replaced **Col. Charles A. Brown,** retired, as Air Force Flight Test Center information chief, Edwards AFB, Calif.

Alfred B. Bowman, director of dispatch, American Airlines, Inc., succeeding **Karl S. Day,** retired.

Charles F. Thomas, manager-staff marketing, International Defense Programs, Radio Corp. of America's Defense Electronic Products, Camden, N. J.

C. A. Smith, manager of technical liaison, Electronic Defense Laboratories of Sylvania Electric Products, Inc., Mountain View, Calif., and **Leonard M. Jeffers, Jr.,** manager of technical publications.

Harry W. Mitchell, chief electronics engineer, Bell Helicopter Co., Fort Worth, Tex., succeeding **Owen Q. Nichaus,** who becomes assistant to the vice president of Bell Aerosystems Co.'s Avionics Division, Buffalo, N. Y.

Arnold F. Kossar, director of corporate planning, Curtiss-Wright Corp., Wood-Ridge, N. J.

William J. Riley, chief project manager, Binghamton Laboratory, Link Division of General Precision, Inc., Binghamton, N. Y.

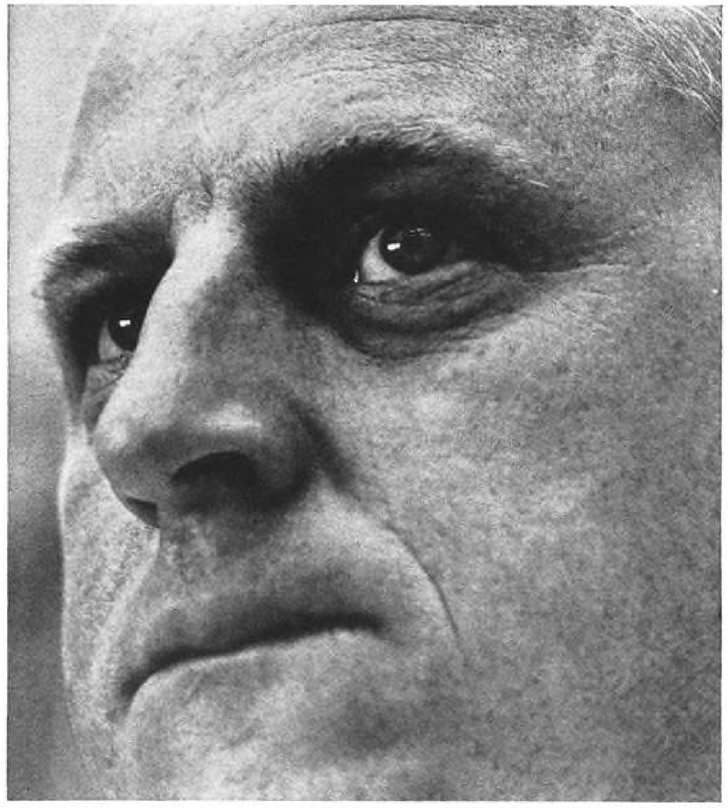
Michael A. Moscarello, operations manager for the newly established Palo Alto (Calif.) facility of Fairchild Camera & Instrument Corp.'s Defense Products Division.

National Aeronautics and Space Administration has established an office at Martin Co.'s Space Systems Division, Baltimore, Md., to serve as an information and coordinating center for the Gemini project, and **Harle Vogel** has been named manager of the office.

Dr. John D. Coakley, director of the newly established Operations Analysis Division of Photogrammetry, Inc., Rockville, Md.

James L. Brooks, customer relations director, Autonetics Division of North American Aviation, Inc., Downey, Calif.

Northrop Space Laboratories needs uncompromising men



It takes dedicated men to breathe life into a new undertaking. Determined men, to guide and guard its goals through the formative years.

Though newly organized, Northrop Space Laboratories is backed by the full facilities of the Northrop Corporation. It will grow. Yet it needs purposeful men to take up the challenge and grow with it. Will you be one of them? Key spots are now waiting for:

Solid state physicists, to conduct fundamental research on many-body problems as applied to an ultra high pressure program. The goals of this program are to study the electrical and physical behavior of materials under ultra high pressure, to investigate the origin, history and structure of the moon and planets, and to find ways to utilize their natural resources.

Scientists, to perform research in nuclear and radio chemistry, and to conceive and carry out investigations in the fields of activation analysis, dosimetry, gamma ray spectrometry, surface phenomena, and numerous other areas.

Stress analysts, to develop fresh analytical techniques and apply them to new space structural concepts; to do stress analysis and design optimization studies on advanced space vehicle structures.

A plasma physicist, to join our growing program in the measurement of plasma properties, spectroscopy, diagnostics, accelerators, and power conversion devices.

A mathematician-physicist, to concentrate on systems analysis and operations research applied to military and non-military space systems.

Physicists experienced in electro-optical imaging devices and laser theory; **engineering mathematicians** interested in detection theory, reconnaissance and tracking; **electronic engineers** who know their way around statistical communications theory and noise phenomena; for new and original work in satellite detection systems.

For more information about these and other opportunities, write to W. E. Propst, Space Personnel Office, 1111 East Broadway, Hawthorne, California. You will receive a prompt reply.

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GARRETT-AIRESEARCH

has immediate openings

in expanding aerospace programs

Environmental Systems Test Engineers

A responsible position is open in total system testing of space environmental control systems. This position requires a minimum of 3 years component, subsystem or system test experience in sophisticated test laboratory. Must understand system flexibility from safety standpoint. Work involves high pressure pneumatics, fluid and gaseous flows. Degree or equivalent essential.

Design Engineers & Checkers for Space Environmental & Cryogenic Systems

Openings exist for experienced board-type designers and checkers for work on complete environmental control systems, heat exchangers, pneumatic valves, CO_2 absorbers, ducting, etc. Degree required and cryogenic and pneumatic valve experience is highly desirable.

Design Engineers & Checkers, Electromechanical

Work on highly loaded gear trains, servomechanism systems for gear boxes and actuators. Requires a strong background in electromechanical board design, with emphasis on high temperature materials and requirements. B.S.M.E. or equivalent required.

Heat Transfer Development Engineers

Involves work on sophisticated heat transfer devices for space and aircraft environmental control systems. These precision systems require knowledge in manufacturing processes such as forming, welding and brazing. B.S. required.

Preliminary Design Specification Writers for Environmental Control Systems

Involves review and analysis of customer specifications for space and aircraft environmental control systems. Includes some specification writing. Engineering degree is highly desirable and a minimum of a 2 year engineering education is essential.

Aerodynamicists

B.S. to Ph.D. level aerodynamicists required for advance work in high speed radial compressors and turbines. Involves many new, as well as standard, aerospace applications using broad range of working fluids.

Stress & Vibration Analyst

B.S. to Ph.D. level needed for work on turbine and compressor design problems, cast and sheet metal structures, pressure vessels, critical speeds and temperature analysis. Knowledge of experimental techniques and problem solving with electronic computers is highly desirable.

- *Garrett is an equal opportunity employer*

Please send complete resume to
Tom Watson — Department 2

GARRETT

AIRESEARCH MANUFACTURING DIVISION
9851 So. Sepulveda Blvd., Los Angeles 45, California

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc. Look in the forward section of the magazine for additional Employment Opportunities advertising.

Positions Vacant	Selling Opportunities Wanted
Positions Wanted	Selling Opportunities Offered
Part Time Work	Employment Agencies
Civil Service Opportunities	Employment Services
	Labor Bureaus

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Subject to Agency Commission.

UNDISPLAYED

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Position Wanted Ads are ½ of above rate.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

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Classified Advertising Div. of AVIATION WEEK
P.O. Box 12, N. Y. 36, N. Y.

ENGINEERS
SCIENTISTS

A NEW DIRECTION IN AEROSPACE TECHNOLOGY thru

THERMAL PROTECTION RESEARCH

Investigations relate to orbital and space re-entry vehicles for several new R&D contracts. These studies at Republic's Paul Moore Research & Development Center encompass boundary layer convection, radiation heat transfer and other thermal protective techniques. Facilities include: Mach 14 tunnel; Mach 20 shock tunnel; 200,000 psi light gas gun. Advanced degree & 10 years experience required.

Write to Mr. George R. Hickman,
Technical Employment Manager, Dept. IG-4

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AVIATION CORPORATION

Farmingdale, Long Island, New York
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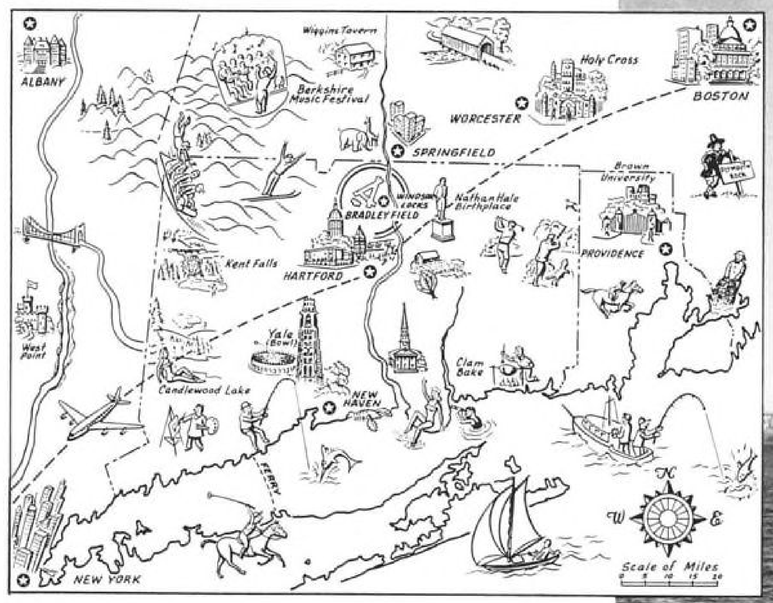

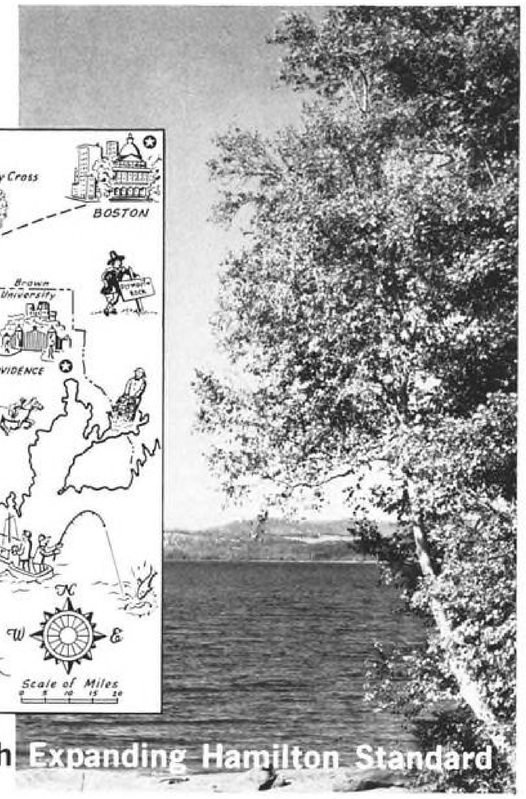

Build A Career In New England With Expanding Hamilton Standard

If once you have visited or lived in Connecticut . . . you will never forget its quiet country villages and hardy people . . . the historic shrines that echo America's past . . . the majestic universities that shed influence throughout the world. Recall, too, the endless recreational pursuits that make family living rich and varied.

Most important, consider the career positions available at United Aircraft Corporation's Hamilton Standard right now.

In the midst of a strong diversification program, Hamilton Standard has contracts for the design and development of propulsion controls, life support systems, other environmental control systems, automatic stabilization systems, propellers (V/STOL application and conventional), and ground support equipment. We have an immediate need for creative engineers to fill the following career positions:

PRODUCT DEVELOPMENT ENGINEERS—ME's or AE's. Should have experience in R&D testing of control systems involving engineering mechanics, fluid mechanics and/or servomechanisms. Assignment will be in one of our product engineering groups, planning, conducting and evaluating product development programs (missile, space vehicle, and aircraft control equipment).

DESIGNERS—to design new or improved high precision mechanical, electromechanical and/or hydromechanical missile and aircraft equipment. Involves linkages, turbines, and other turbomachinery. Assignments will include working with product development group; also design concepts and follow-through to final experimental test phase of program. Positions are open for several Senior Designers, ME's or AE's.

ELECTRONIC PRODUCT DEVELOPMENT ENGINEERS—EE's—to plan, direct, and carry out product development program in field of missile, helicopter, and hydrofoil flight controls components and systems—sensing devices. Duties will involve customer contact and engineering supervision.

ELECTROMECHANICAL DESIGNERS (Electronics Department)—create, design and analyze new or improved mechanical components of electronic control systems, e.g., static power inverter and converter; controls for helicopters, hydrofoil, and missiles, involving sensors, valves, activators.

Investigate these and other engineering positions now open at dynamic, growing Hamilton Standard.

TO ARRANGE AN INTERVIEW, please mail your resume, including salary requirements, to Mr. H. O. Wakeman, Personnel Department.

Hamilton Standard DIVISION OF **United Aircraft**

Windsor Locks, Connecticut

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NCR

MILITARY SYSTEMS ANALYSIS ADVANCED PLANNING

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An exciting and continuing program of signal data reduction requires the talents of experienced electronic engineers and mathematicians familiar with military communication and radar systems. The work requires persons capable of directing their own efforts as well as the efforts of others, and who have the ability to analyze complex data obtained from different types of systems so that meaningful conclusions and suggestions may result. These key positions require an appropriate degree and 7-10 years' experience. Intermediate level positions in similar work are also available.

ADVANCED PLANNING ENGINEERS:
Our Advanced Planning Group has need for creative individuals familiar with the advanced technology required for future military systems. Applicants considered for these positions must have technical capability equivalent to Ph.D. level in at least one pertinent area of study and be able to communicate intelligently with other specialists in various disciplines centering around military electronic systems. Applicants must have demonstrated the capability to direct the efforts of others on at least a project level.

NOTE: Backgrounds for the above areas of employment should include one or more of the following: measurement techniques, radar, infrared, telemetry, pulse techniques, information theory, mathematical statistics, weapons systems analysis, solid state circuitry, servomechanisms, microwave and antennas.

To Arrange Interview, Write To:
T. F. Wade, Technical Placement
The National Cash Register Co.
Dayton 9, Ohio

An Equal Opportunity Employer

NCR

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SCIENTISTS

A NEW DIRECTION IN AEROSPACE TECHNOLOGY thru

HYPERSONIC RESEARCH

Unusual opportunity for senior engineer to lead test programs in a newly constructed 36-inch-diameter pebble-heated hypersonic wind tunnel. Work is on several new R&D contracts involving hypersonic craft, orbital and lunar re-entry vehicles. Studies include instrumentation, data reduction and analysis of hypersonic flow tests. PhD with 10 years experience required. Also supporting positions for BS, 2-5 years experience.

Write to Mr. George R. Hickman,
Technical Employment Manager, Dept. IG-4A

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Farmingdale, Long Island, New York
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POSITIONS WANTED

Air Transportation Specialist desires position in Aircraft Operations of Air Transportation Sales. B.S. degree in Aeronautics. Currently Instructor and Check Navigator. Proven ability with excellent references. Age 28. Resume on request. PW-9322, Aviation Week.

Pilot Available, ATR MEL, DC-3, COMSEL, CFI Instrument & Airplanes, USAF Pilot 7½ years, civil flying since spring '55, business Pilot 5 years. 4800 hours, 1800 ME, 600 jet. PW-9346, Aviation Week.

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Dayton Area Representative, ten years ac/- missile experience in major proposals and Gov't contracts, good technical background. Not multiple rep. Reasonable travel. PW-9374, Aviation Week.

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TO EMPLOYERS

TO EMPLOYEES

Letters written offering Employment or applying for same are written with the hope of satisfying a current need. An answer, regardless of whether it is favorable or not, is usually expected.

MR. EMPLOYER, won't you remove the mystery about the status of an employee's application by acknowledging all applicants and not just the promising candidates.

MR. EMPLOYEE you, too, can help by acknowledging applications and job offers. This would encourage more companies to answer position wanted ads in this section.

We make this suggestion in a spirit of helpful cooperation between employers and employees.

This section will be the more useful to all as a result of this consideration.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., INC.

330 West 42nd St., New York 36, N. Y.

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To evaluate complete systems during simulated launch, space flight and manned re-entry and to design and operate advanced aerospace test facilities for ballistic missile and space programs.

Quality Assurance Engineers

To plan and direct acceptance tests including the development of non-destructive test techniques for space vehicles and the design of laboratory standards for space environments.

The Division is located in a superbly equipped $23,000,000 laboratory facility in the Boston suburbs. At Avco/RAD you will find a liberal benefits program including educational assistance.

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Mr. J. Bergin, Dept. AW

Avco/RAD is presently associated with Apollo, Titan, Atlas, Minuteman, Nike-Zeus and other classified space projects.

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A Division of Avco Corporation
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NASA

CAREER APPOINTMENTS

Apollo Manned Lunar Program

SYSTEM INTEGRATION
SYSTEM CHECKOUT
RELIABILITY ASSESSMENT

Office of Manned Space Flight, Washington, D.C.

The Office of Manned Space Flight has several outstanding career positions available in the Directorate of Integration and Checkout for electronic and aeronautical engineers with B.S. or advanced degrees. Selected applicants will receive permanent appointments as Assistant Directors, Branch Chiefs, and Project Engineers to NASA Headquarters Staff in Washington, D.C.

Space Vehicle System Checkout Electronic engineers are required to direct the development of an integrated system checkout equipment for the Apollo Manned Lunar Program. Respondents should have experience in computer, data processing, analog to digital, or computer input-output equipment development. Background in the design, development, and/or project direction of system checkout equipment is desirable.

System Integration Electronic and aeronautical engineers are needed to insure the integration of the Apollo space vehicle equipment development program. The assignments require several years experience in electronic or aeronautical missile systems implementation and direction.

Reliability Assessment The engineers in this group will develop and direct the comprehensive and unique reliability assessment project for the Apollo Manned Lunar Program. Applicants must be electronic or aeronautical engineers, mathematicians or physicists and should have six to ten years' broad experience in missile system reliability program implementation.

Send brief resume in confidence to:
Director of Manned Space Flight, Dept. 134-B
National Aeronautics & Space Administration
Washington 25, D.C.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

NASA

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AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.

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$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

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1049H SUPER CONSTELLATION AIRCRAFT

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- Special engineering on aircraft permits payloads of 45,000-pound cargo or 120 passengers for 2500 mile range
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Don't buy any large transport aircraft until you have looked at these aircraft for flexibility, payload capacity and economy in operation.

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LETTERS

Salary Levels

Regarding your editorial on the "Arsenal Concept" (AW July 9, p. 13) . . . , you speak of the "erosions into corporate management." I think that you should have been much stronger on this subject and pointed out that this is only one more step in what is obviously a planned series of steps by "big government" to gradually erode our "free enterprise" and "of the people, by the people, and for the people" system into a socialistic, and therefore, eventually, dictatorial system, possibly with the Kennedy dynasty at its head.

ROBERT T. WOOD
Simsbury, Conn.

Regarding your editorial in the 9 July AVIATION WEEK (p. 13)—Even more frightening to me than the federal arsenal concept implicit in the proposed government control of industry salaries is the apparent determination on the part of the Administration to complete the socialization of this nation started in 1933.

If you combine:

1. Government control of industry salary (p. 13),
2. Government control of union right to strike (p. 17),
3. Government control of industry operation (p. 30),

with such recent developments as government dictation of steel prices and proposed increases in government control of farming, you can see an unmistakable trend, the logical conclusion of which is reduction of industry to the status of a government bureau and reduction of the individual to peonage.

As a means of expediting this process I recommend the attitude of Mr. Ryan (p. 18). If you can just completely eliminate the profit motive, we will beat the Russians to the "workers' paradise."

F. NEWTON
Williamsville, N. Y.

I am a subscriber to your magazine and always enjoy reading your editorials. . . .

On June 23d, the Los Angeles Times newspaper carried a very, very disturbing article that would have a very vital effect on the defense industry and, I feel, eventually the whole country. The article reported that Mr. David Bell, director, Bureau of the Budget, had recently sent a recommendation to the President. It would limit, in certain R&D contracts, salaries paid to contractor executives to $25,000 per annum. The only excuse indicated for this was simply because Mr. Bell thought it should be done.

To make it even worse, this recommendation was endorsed by the Secretary of Defense, NASA administrator, AEC chairman and others. Apparently there is no legislation required for this tragic move. Government agencies would simply put another clause in the contracts and the contractor would have no choice but to accept.

To me, this is simply the beginning of another Office of Wage Stabilization. If they got by with it in R&D contracts, it would soon be extended to other defense contracts. And if it is right to so limit defense contracts, why shouldn't other government contracts be so written?

This is one of the most insidious steps I've seen attempted so far. If we are going to take this next step down the road to socialism, let's bring it out in the open and get people to think of the ultimate consequences. I earnestly suggest that you devote one of your editorial columns to a review and discussion of this matter.

JAMES C. SWEENEY, JR.
La Habra, Calif.

(We did! See AVIATION WEEK & SPACE TECHNOLOGY, *July 9, pp. 13 and 18—ED.)*

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Grousing It

Judging from the volume of telephone calls I've received, I made a sad mistake in identifying the grouse at Vandenberg AFB as von Braun's (AW July 9, p. 94). It is Le May's Grouse, which is considerably larger, but is most easily identified by its distinctive cry: "Bomba! Bomba!"

HUESTON WILMOT PITTENGER
Vice President
Fletcher Richards, Calkins & Holden, Inc.
Los Angeles, Calif.

Lost and Found

One of our Departments is missing!

We certainly appreciated your story "GE Elevates MSVD to Divisional Status" (July 9, p. 20) and thank you for the coverage. We would like to point out, however, that in your listing of the new departments in the new Missile and Space Division, the Re-entry Systems Department was omitted.

The Re-entry Systems Department, headed by Mr. Mark Morton, is the one responsible for design and production of nose cones, space probes, and experimental re-entry/recovery vehicles. It is headquartered in Philadelphia and will soon utilize additional facilities at our Evendale, Ohio plant.

As this is one of our most successful organizations, and one of which we are most proud, you can realize our chagrin at it being left out of the story.

RAYMOND E. FORBES
Field Representative
Product Information
Missile and Space Division
General Electric Co.
Washington, D. C.

(One of our paragraphs is missing, somewhere between our copy desk and the printer. Our apologies to Mr. Morton and GE.—Ed.)

Mystery Plane

May I suggest a candidate for DC-3 replacement?

The plane can handle a 2,800-lb. payload, which means about 15 passengers, or a mix of cargo and passengers. It is currently in service with several large scheduled airlines and with many non-scheduled operators, serving in climatic conditions that vary from Antarctic cold to desert heat.

It flies daily out of unprepared fields, using a ground run of less than 300 ft. It is flown off water on float gear, and off ice floes on skis.

Maintenance problems have been simplified by rugged construction and by basic design simplicity. Consequently, it can—and does—operate largely out of bush airports where mechanics work with hand tools in the open.

The airplane has been in production for almost 15 years, and several thousand have been built. Many have been exported, and many have been built under license in countries where there is a relatively low level of mechanical skills among the workers. Its engine is a proven powerplant in both airline and military service.

There's one drawback: The pilot's handbook and the maintenance manuals will have to be translated from Russian.

The airplane is, of course, the Russian An-2, designed by Oleg K. Antonov. It's a piston-engined biplane that the Russians use for all kinds of air transport.

In going one step beyond reader M. W. Martin (AW June 18, p. 114) who advocated the Ford Tri-Motor, I am not advocating retrogression. What I am suggesting is that feeder-liner design should resemble the inter-city bus and not the transatlantic transport.

The reason for the biplane is two-fold. First, it gives you tremendous control at the stall. The An-2 has slots, slotted ailerons and slotted flaps, and can hang on that prop like very few airplanes you've ever seen. So can some of the elderly crop-dusters converted from Stearman biplanes, and so can the newer Grumman AgCat. Second, the biplane has tremendous maneuverability, so that if you need to fly down a funnel, you can do so.

The An-2 will never win a prize for esthetic appeal nor for speed over long distances. But it could win prizes for its job as a workhorse in air transport, connecting the outlying areas of the Soviet Union with big-city airports, and working in a variety of jobs from crop-dusting to rescue.

I'm sure the Russians would be delighted to sell us some for trial, just as they bought a couple of our helicopters for the same purpose. I am equally sure that there is equivalent engineering talent hidden somewhere in our vast aerospace industry that could come up with a better aircraft. I'm just worried that everybody is so enchanted currently with swept wings and tail-mounted engines and 10,000 ft. of concrete that they can't see what a feeder-liner ought to look like.

DAVID ANDERSON
New York Engineer

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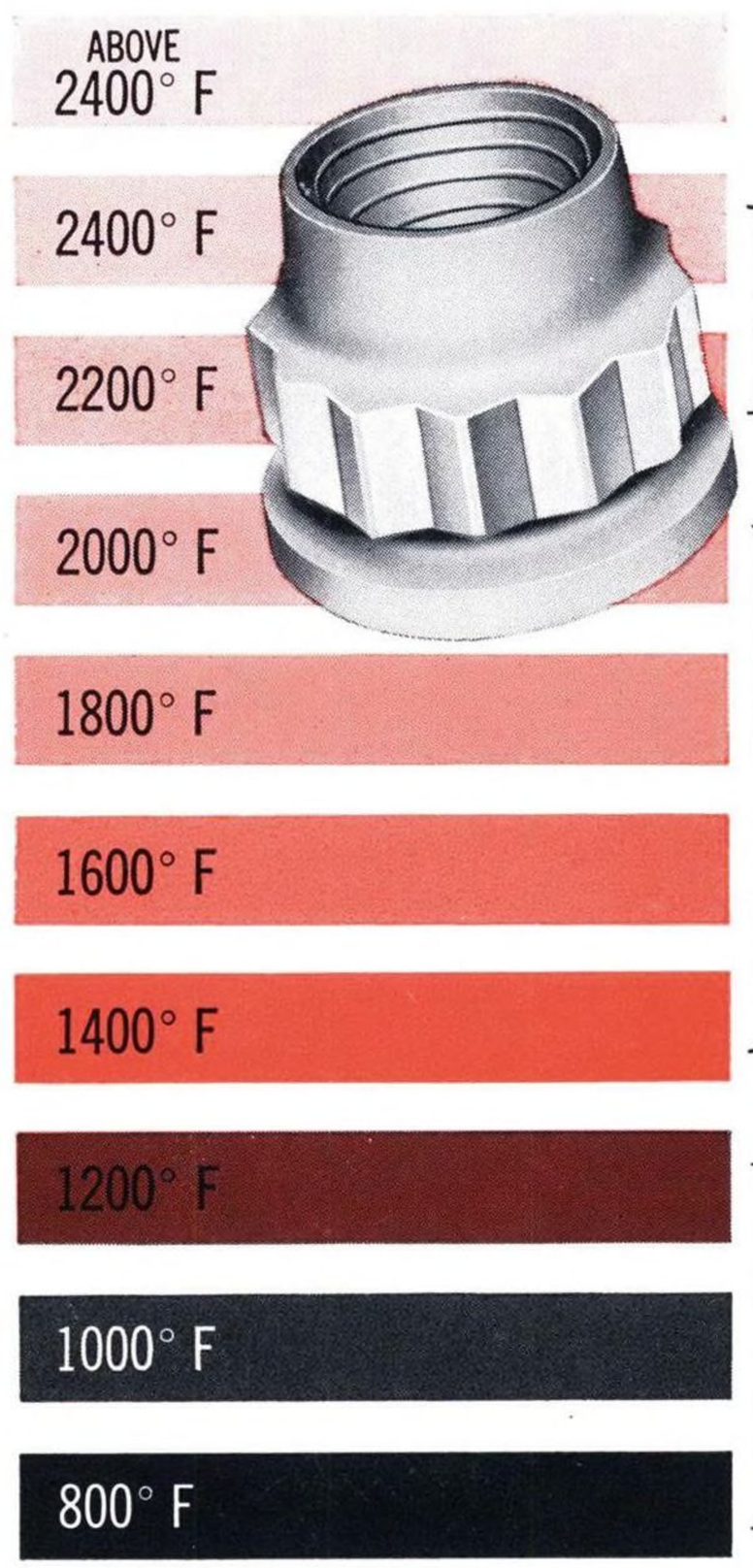

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