Aviation Week & Space Technology

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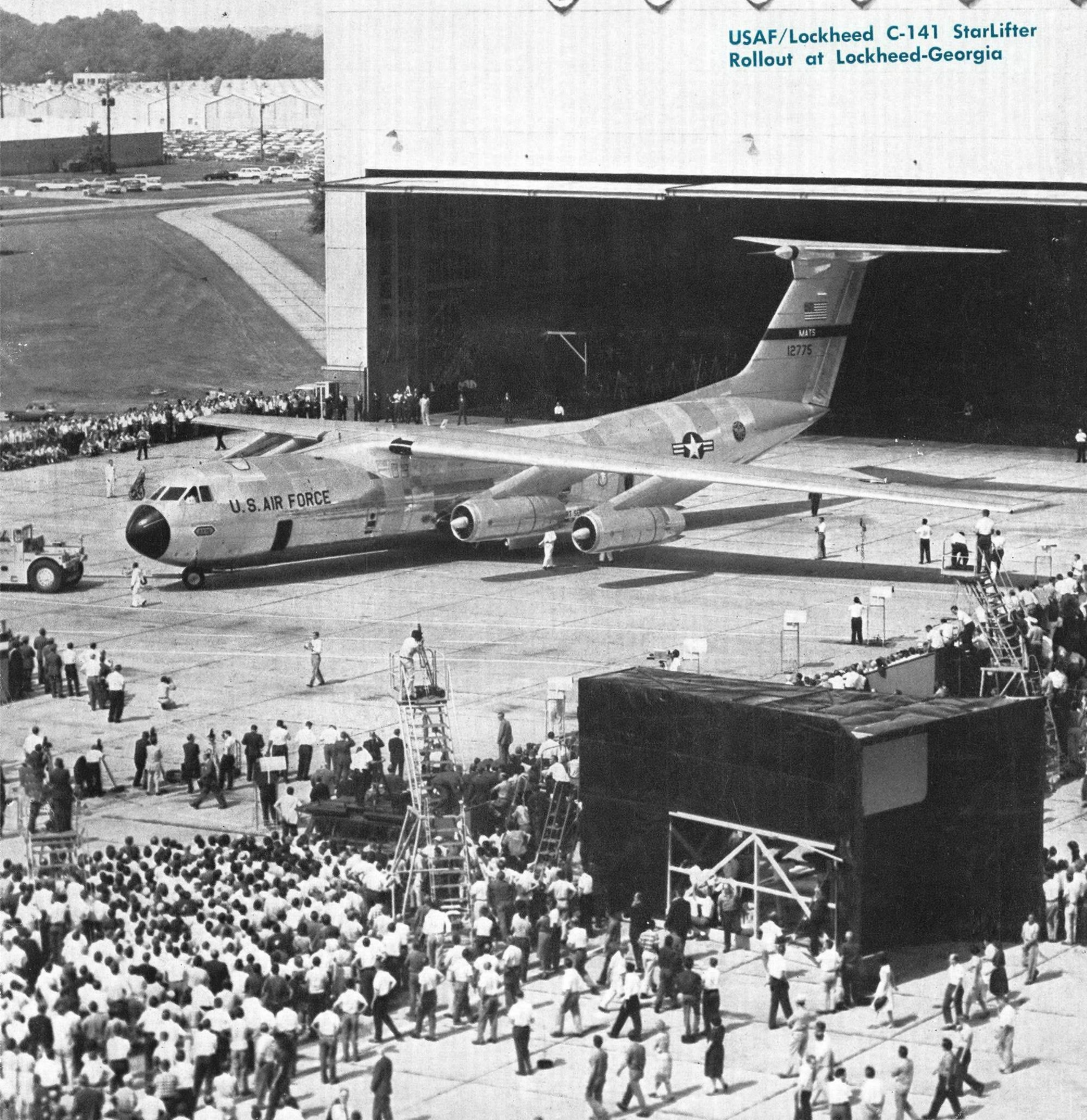
September 2, 1963

SPECIAL REPORTS:

- Military Comsat
- DOD's New Profit System

USAF/Lockheed C-141 StarLifter Rollout at Lockheed-Georgia



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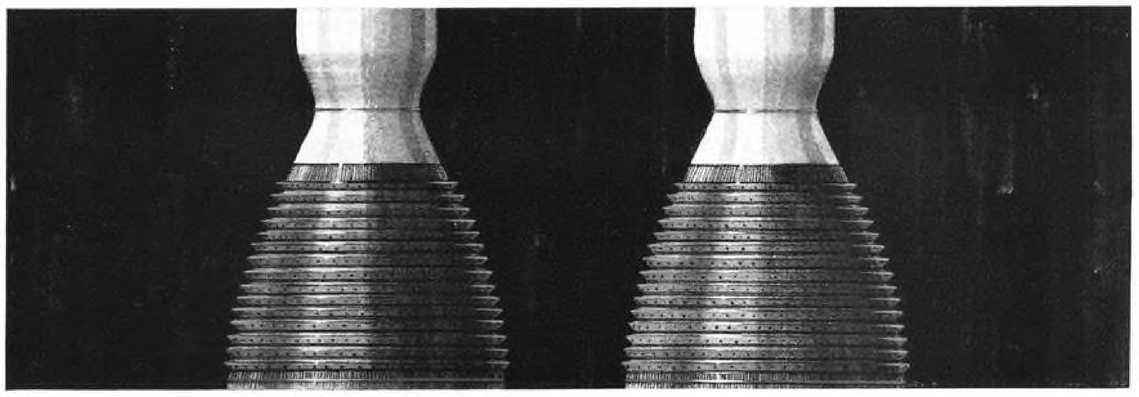

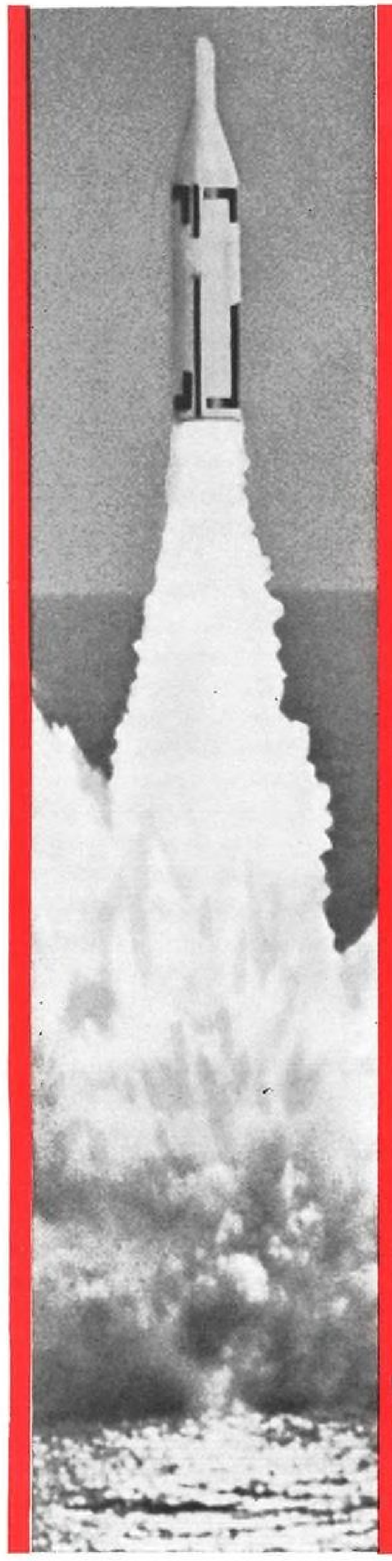

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AEROSPACE CALENDAR

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

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

Sept. 9-12—International Conference on Production Engineering Research, Carnegie Institute of Technology and Webster Hall Hotel, Pittsburgh, Pa.

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

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

Sept. 11-14—East Coast Convention, Navy League of the United States, Boston, Mass.

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

Sept. 12-13—11th Annual Joint Engineering Management Conference, Hotel Biltmore, Los Angeles, Calif.

Sept. 14-20—1963 National Parachuting Championships and 1964 U.S. Parachute Team Tryouts, Seattle, Wash. Sponsor: Parachute Club of America.

(*Continued on page 7*)

AVIATION WEEK & Space Technology

September 2, 1963
Vol. 79, No. 10

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Shelton Fisher, President; Vice Presidents: George H. Reppert, Jr., Operations; John R. Callaham, Editorial; Ervin E. DeGraff, Circulation; Donald C. McGraw, Jr., Advertising Sales; Angelo R. Venezian, Marketing. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

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Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

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Second class postage paid at Albany, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

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AEROSPACE CALENDAR

(*Continued from page 5*)

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

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

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

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

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

Sept. 21—Project Beacon Meeting, Electro-Sonics Hangar, Port Columbus, Columbus, Ohio. Sponsored by FAA and State of Ohio Div. of Aviation in cooperation with the National Aviation Trades Assn.

Sept. 23-25—12th Annual Meeting, Standards Engineers Society, Statler-Hilton Hotel, Washington, D. C.

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

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

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

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

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

Sept. 25-26—Seminar and Exhibit, American Assn. for Contamination Control, Sheraton-Atlantic Hotel, New York, N. Y.

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

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

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

Sept. 30-Oct. 2—Canadian Electronics Conference, Inst. of Electrical and Electronics Engrs., Exhibition Park, Toronto.

Oct. 1-2—Project Mercury Summary Conference, NASA Manned Spacecraft Center, Houston, Tex. (Admission by invitation.)

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

Oct. 1-4—First National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M.

(*Continued on page 9*)

AEROSPACE CALENDAR

(*Continued from page 7*)

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

Oct. 1-3—Symposium on Physics and Nondestructive Testing (unclassified), San Antonio, Tex. Sponsored by Southwest Research Institute.

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

Oct. 5-20—10th International Aircraft Display, Genoa International Fair, Genoa, Italy.

Oct. 7—Second Annual USAF Contract Aerospace Services Symposium, Dayton Biltmore Hotel, Dayton, Ohio. Sponsor: National AeroSpace Services Assn.

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

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

Oct. 7-14—William Tell 1963, USAF Interceptor Weapons Meet, Tyndall AFB, Fla. Host: Air Defense Command.

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

Oct. 8-10—National Airport Conference, Norman, Okla. Sponsors: American Assn. of Airport Executives & University of Oklahoma with the cooperation of the Federal Aviation Agency.

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

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

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

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

Oct. 15-17—World Magnesium Congress, Queen Elizabeth Hotel, Montreal.

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

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

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

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

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Aviation Week & Space Technology

Volume 79
Number 10

September 2, 1963

CONTENTS

COVER: First USAF/Lockheed C-141 StarLifter rear-loading jet transport is shown during the rollout ceremony at Lockheed-Georgia Co. (AW Aug. 26, p. 30). The C-141 is powered by four Pratt & Whitney TF33-P-7 turbofan engines producing 21,000 lb. thrust each. For additional photos and technical details on StarLifter development and construction see p. 68.

PICTURE CREDITS

Cover—Pat Lanier, Lockheed-Georgia Co.; 20 (top)—Aerojet-General Corp., (bot.)—NASA; 21—Goodyear Aerospace Corp.; 25—General Electric; 27—Northrop; 37—Vickers-Armstrongs, Ltd.; 45—Centro Richerche Aerospaziale, University of Rome; 46—USAF; 52, 53 (bot.)—de Havilland; 53 (top)—Ron Appelbe; 57—Piper Aircraft Corp.; 60—NASA; 61—Bede Aircraft Corp.; 68, 69 (top), 73, 77—Lockheed-Georgia Co.; 69 (bot.)—Rohr Corp.; 80, 81, 83, 85—TRG-West; 89—USAF.

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EDITORIAL

Industry's Growth Problems

(Technology and government procurement policy continue to work hand-and-hand to forge changes in the aerospace industry. Some of these changes were discussed recently by Reginald I. McKenzie, vice-president and treasurer of Aerojet-General Corp. before the California Group of the Investment Bankers Assn. In the light of Defense Dept.'s new policy on determining profits (see p. 60), his remarks, excerpted below, provide background commentary from an industry viewpoint.)

Looking ahead to the next few years, it has been reliably estimated that total R&D will reach $30 billion in 1967, and of this, $20 billion will be for the government. You can appreciate the effect of all this on the aerospace industry if government continues to insist, as it is beginning to do now, that industry finance its own facilities and personnel for such an extensive R&D program.

Let me now outline a few of the problems which changing circumstances have brought to the industry in the last few years. . . . they include:

- **Rising high cost** of space boosters and space vehicles, which is bound to restrict the number of types to be developed.
- **Rapid obsolescence** of these devices, which puts new emphasis on Research and Development work.
- **Multiplication of aerospace firms,** both prime and subcontractors. . . .
- **A certain amount** of public or political reaction against spending hitherto fantastic sums for "moon landings or similar projects.
- **Effect on profits** as competition for available programs increases and additional pressures mount for geographical distribution of aerospace jobs.

. . . The main problem is the proliferation of bidders out of all proportion to the increase in the size of the business, spectacular as that has been.

The same kind of thing happened once, of course, in the early days of the automobile industry, in aircraft between the two World Wars, and in radio between the mid-1920s and the mid-1930s. But in those instances government "controls" were negligible factors and in good old free enterprise style, the more alert, better-managed companies survived.

But the conditions which made for the growth and prosperity of the surviving automobile, aircraft, and radio companies do not exist in the aerospace industry today. There can never be a "popular" market; there is only one customer, the government. . . .

As a percentage of our Gross National Product, major space programs and Research and Development of Aerospace Systems have tended to increase—but not nearly in proportion to the number of new firms competing for the business.

In 1946, immediately after World War 2, it was estimated there were 41 major prime contractors in what is now the aerospace business. Of these, a dozen were engaged in missile work and another dozen in propulsion. The rest were aircraft contractors.

Today it is estimated there are more than 100 primes, of which at least 50 are involved in missile programs and 30 in propulsion, the remainder combining aircraft, missiles and propulsion programs.

It follows from this that there is intense competition for available appropriations. The choice of programs has narrowed down considerably from a decade ago when dozens of types could be developed and produced and everybody was sure to get a piece of the business.

. . . While people are just beginning to grasp the significance of chemical rockets and their potential, the industry must move on to new methods of propulsion, nuclear, ion, or some other. The amount of Research and Development work which this calls for is beyond the capacity of private enterprise alone to provide.

This is getting to be one of our major problems. The government is more insistent upon the private financing of research facilities and the personnel to man them. Financing these facilities means that there must be greater depreciation allowances if companies are going to survive.

The question of profit is another problem for which no solution mutually satisfactory to government and industry has yet been found. Perhaps incentive contracts will bring about greater stability in the industry by weeding out companies ready to "buy" a development contract with a fixed fee with the hope of eventually making out on contract changes or cashing in on a follow-on production contract. But even these opportunities are going to be very limited because for a long time to come, aerospace will not be a production-line or volume-production industry. It may never be.

As I have indicated earlier, the growth and complexity of the aerospace industry has brought about new relationships between government and the industry. . . .

Whereas formerly the government more or less simply stated what it wanted and let competition among private companies provide the best answer, today there is much broader control of industry by the procurement agencies. Moreover, because of the complexity of missile and space programs, the government has had to hire "management firms" to run the programs, and these in turn are anxious at times to take over parts of various programs.

More and more the industry feels it is becoming in fact a closely controlled agent of the government. There is increasing pressure for spectacular technological achievement. There is centralization of decision making in Washington. There is socio-economic pressure for geographical distribution of the available business.

From the investment point of view, the mounting demand of the government that private industry finance costly and to some extent risky R&D facilities, without reasonable assurance of a profitable payoff is perhaps the most serious problem.

All of these facts indicate the range and breadth of the problems which growth has nurtured in the aerospace industry. None of them are insoluble and none of them need be fatal; but they must be taken into account, not only by management but by investors as well.

WHO'S WHERE

In the Front Office

Kurt R. Stehling, assistant to the president of Electro-Optical Systems, Inc., for Astronautics, and director of the company's newly formed Washington, D.C., Operations. Formerly, Mr. Stehling was a senior staff scientist in NASA's Plans and Program Evaluation Office. Also: **Jack Davis,** manager, Electric Propulsion Flight Test Program Office, Electro-Optical Systems, Inc., Pasadena, Calif., succeeding **Leslie J. Cook** (AW May 6, p. 19).

Sanford S. Maremont, president of Rocket Power, Inc., Mesa, Ariz., succeeding **Charles E. Bartley,** who has resigned. Also, **Frank A. Marion,** executive vice president, has resigned.

Dr. Bruce H. Billings, a vice president, Aerospace Corp., and general manager of the Laboratories Div., El Segundo, Calif., succeeding **Dr. Chalmers W. Sherwin** (AW Apr. 15, p. 23).

Thomas B. Nichols, vice president and secretary, Astropower, Inc., Newport Beach, Calif., a subsidiary of Douglas Aircraft Co.

Renville H. McMann, Jr., vice president, Military and Industrial Systems Dept., CBS Laboratories, Stamford, Conn.

Vice President Mansfield D. Sprague, Deputy Group Executive, Advanced Products Group, American Machine & Foundry Co., Greenwich, Conn.

John S. McCullough, vice president and general manager, Electron Tube Div., Litton Industries, San Carlos, Calif.

Edward F. Manion, vice president-marketing, Ford Instrument Co., Long Island City, N.Y., a division of Sperry Rand Corp.

Earl Ray Skaggs, a vice president, Palomar Scientific Corp., Palo Alto, Calif., a subsidiary of United Control Corp. Mr. Skaggs continues as general manager of Palomar.

George L. Loomis, vice president-operations, Power Equipment Div., Lear-Siegler, Inc., Cleveland, Ohio.

Richard A. Lenon, vice president-finance, Westinghouse Air Brake Co., Pittsburgh, Pa.

Robert E. Lindstrom, a vice president, Space Craft, Inc., Huntsville, Ala., and head of the new Astran Div.

William H. Habblett, corporate director of special events, Northrop Corp., Beverly Hills, Calif. Mr. Habblett continues as special assistant to the president and chairman.

Dr. William J. Price has been named Executive Director of the Air Force Office of Scientific Research, Washington, D.C.

Honors and Elections

Dr. Frederick E. Terman, vice president and provost of Stanford University, has received the 1963 Western Electronic Medal of Achievement for his "distinguished service to the electronics industry as scientist, educator and counselor."

Amrom Katz, a physicist in the Electronics Department of The Rand Corp., has received the George W. Goddard Award from the Society of Photographic Instrumentation Engineers for "outstanding individual contributions to aerospace photo-optical instrumentation engineering."

INDUSTRY OBSERVER

► Flight test plans for the Air Force Dyna-Soar boost glide vehicle may be delayed by cost over-runs affecting such key systems as instrumentation, guidance and communications. As a consequence of the cost difficulties and resulting cutbacks, USAF may not be able to meet its projected schedule for drop tests beginning in mid-1965 and orbital flights in early 1966 (AW July 22, p. 233; Aug. 19, p. 34). Stepped-up funding on a crash basis may be necessary to meet current flight test plans. Contractors experiencing schedule difficulties—which apparently stem from program changes and forced funding—include Boeing, Martin, Electro-Mechanical Research and Radio Corp. of America.

► **Specifications for a reconnaissance version of the F-111 (TFX) are being prepared by USAF's Aeronautical Systems Div. for a possible industry study program.**

► Federal Aviation Agency has invited 18 companies to bid on development of an integrated avionics system for general aviation aircraft which would provide 360 communications channels, omni, distance measuring equipment, and ILS localizer and glide slope in a package weighing less than 20 lb. and costing less than $5,000. Prototype equipment is to be delivered within 12 months. Bids are due Sept. 25.

► **Program for General Dynamics/Astronautics SATAR satellite for aerospace research (AW July 15, p. 69) contemplates use of Allegany Ballistics Laboratory X258 solid propellant motor as the vehicle's jettisonable rocket for injection into a 500-naut. mi. orbit. Program may receive about $2 million from USAF for one static test article and one satellite which may not be launched before the summer of 1964.**

► India has formed a government-owned company, Aeronautics India, Ltd., to manufacture Russian-designed MiG and other types of aircraft and control and manage the complex of factories to be built by the government. Aircraft Manufacturing Depot at Kanpur has turned out its first two Avro 748s and two more are to be flown by March. Production will be about 30 aircraft.

► **An 18-month investigation of different electronic scan techniques suitable for use in forward area surveillance radars which are hardened to withstand nuclear blasts is planned by Army Electronics Materiel Agency. Request for industry proposals is expected to be issued Sept. 9.**

► Rollout and first flight date for the North American B-70 Mach 3 bomber remains indefinite. Tank sealing problems continued to delay the assembly during August, but these are now reported to have been overcome. Mismatches were being checked last week, but actual welding of the wing to the fuselage had not begun.

► **Program to develop advanced electromagnetic deflection technique for application to image amplifier aerial cameras to obtain image motion compensation control is being sponsored by USAF's Aeronautical Systems Div. Industry will submit proposals for the program by Sept. 12. Involved will be the fabrication of a simple breadboard model.**

► Procedures to accomplish accelerated life testing of space guidance components will be established under a 10-month contract from Aeronautical Systems Div., proposals for which were submitted last month. Study is predicated on the estimate that a guidance system with 95% probability of successful operation for a one-year mission must have a mean-time-to-failure, assuming random time-to-failure distribution, of 171,000 hr. Demonstration of such MTF in a real-time acceptance test would not be feasible.

► **Study of photo-emission of electrons at the metal-insulator interface of thin film composite systems will be sponsored by Aeronautical Systems Div. Thin films of tantalum pentoxide, tantalum nitride, niobium oxide and beryllium oxide will be involved in the investigation, for which industry proposals will be submitted by Sept. 11.**

Washington Roundup

Space Budget Attitude

Vast change in Congress' attitude toward space budgets since last year was illustrated last week by votes on the compromise $5.35-billion NASA authorization figure agreed on by a House-Senate conference (see p. 18). When the figure reached the House floor, an amendment to send it back to conference with instructions to cut the total to $5.2 billion was defeated only by a 200 to 176 vote. The bill finally was passed, by 249 to 125. By contrast, last year's NASA authorization was approved unanimously.

Voting this year was generally along party lines, with Republicans against. Five Republican members of the House space committee—Reps. Richard Roudebush (Ind.), Thomas Pelly (Wash.), James Weaver (Pa.), Edward Gurney (Fla.) and Donald Rumsfeld (Ill.)—voted against the bill.

Project 60, Defense Dept.'s study of ways to place all military contract management under one head, has been completed. It would not centralize procurement, but would put all plant representatives and their regional offices under a single defense staff and commander. Whether Defense Secretary Robert McNamara will go ahead with the plan probably depends more on his estimate of the congressional climate than on results of the study.

Russian Anti-Missiles

The present and former directors of defense research and engineering are not concerned over indications that the Soviet Union has installed anti-missile missiles— which the Pentagon is now calling "anti-ballistic missiles," or ABMs—in the area around Leningrad. Dr. Harold Brown, who holds the job now, said there is "evidence of possible ABM activity" but the U. S. does not consider it consequential.

Dr. Herbert York, Brown's predecessor, unhesitatingly discounted a statement by Sen. Strom Thurmond that the Leningrad missiles "were capable of knocking down American missiles." Why, then, would Russia deploy such a system? Sen. Frank Lausche asked.

". . . Some of their scientists sold them a bill of goods," York said. "That happens here, too."

Vice President Lyndon Johnson recently asked Defense Dept. and NASA for reports on what they are doing and what they plan to do about manned space stations—apparently to assure himself that the agencies are not duplicating study efforts. Replies were classified, but the question remains whether new studies will be contracted for before current studies are evaluated. NASA has 15 or more under way now. Defense Dept. has been holding up Air Force requests for proposals on space station studies, which were due to be issued some time ago (AW July 8, p. 18).

TFX Cost Estimates

One reason why Sen. John L. McClellan didn't mind recessing the TFX investigation for a while was that he hopes to get hold of new cost estimates for the entire program. Estimates have increased significantly despite Air Force's insistence on sticking to the $7-billion figure (see p. 18). Sen. McClellan would like to see the new estimates before he calls Defense Secretary Robert McNamara and Deputy Secretary Roswell Gilpatric as witnesses.

The only Program Change Package (PCP) that has not been submitted to McNamara's office for approval is the one for the TFX. Others were completed and approved June 1 for use in preparing Defense Dept.'s Fiscal 1965 budget requests.

Proposed Federal Communications Commission procurement regulations for the Communications Satellite Corp. and its prime contractors (AW Aug. 19, p. 33), will be eased. Minimum contract size under which the contractors must notify FCC of the intended recipient and the procurement procedure used will be raised from the original $2,500 figure to $10,000. An FCC spokesman emphasizes that the notification is intended only to assure adequate competition in major procurements, and not to involve the agency in the choice of contractor.

Life Among the Stars

Life Magazine and the 16 NASA space pilots are expected to sign a contract later this month which would give the pilots $25,000 each for their personal stories, with payment to be made over a four-year period. Any new astronauts also would receive that fee.

Field Enterprises, which withdrew its offer of $3.2 million for the package of personal stories because it could not agree with NASA on details (AW July 15, p. 28), still is bidding for book rights.

Crossing the T

The 500-word statement that President Kennedy read on a closed-circuit television broadcast to the USAF-Lockheed C-141 rollout ceremonies at Marietta, Ga., recently (AW Aug. 26, p. 30) mentioned a famous Navy strategist, the late Adm. Mahan, and the Army's current chief of staff, Gen. Earle Wheeler. It did not mention the Air Force or Lockheed.

—Washington Staff

$5.35-Billion NASA Budget Authorized

Compromise restores $147 million of $489 million cut by House from original space agency request.

By Alfred P. Alibrando

Washington—House and Senate last week approved and sent to the President a conference bill authorizing an appropriation of $5.35 billion for the space agency in Fiscal 1964, restoring $147.1 million of the $489 million cut by the House from the agency's budget request (AW Aug. 26, p. 25).

Most important restorations in National Aeronautics and Space Administration programs (see accompanying chart) were:

• **Manned spacecraft systems**—$60 million for Apollo command and service module development.

• **Launch vehicle and propulsion systems**—$9 million restored for the Aerojet-General M-1 hydrogen engine.

• **Lunar and planetary programs**—$20 million restored for Surveyor orbiter.

The conference committee reported that increased funding for the Apollo manned lunar landing program was agreed upon as a result of "more concrete" programing and signing of a formal NASA-North American contract (AW Aug. 26, p. 32), which followed House passage of the original NASA authorization bill.

The House space committee eliminated the Surveyor orbiter program for which the agency had requested $28.2 million. The committee said the program had not been clearly defined or justified or considered urgent by NASA. The Senate restored the entire amount after NASA made a persuasive argument that the program was needed to gather new scientific information on the moon as well as data vital to Apollo. The House conferees agreed to restoration of $20 million, provided that the funds be used only for Surveyor orbiter.

Total of $42 million was restored for construction of facilities, including land- and ship-based tracking facilities. Major items for which funds were restored:

• **Mississippi Test Facility**—A total of $7.5 million restored, including $3.5 million more for the static test facility for the Boeing S-1C first stage of the Saturn 5; $1.5 million for a North American S2 second-stage test facility and $2.5 million more for a Rocketdyne F-1 engine test stand.

• **Launch Operations Center**—Conference bill restores $5.2 million. Work on Saturn 5 launch facilities will not be slowed down by the remaining reduction, which was general and not a denial of any specific projects.

• **Flight Research Center**—House eliminated all funds requested because at the time there were no "firm future projects assigned to this center involving high-speed research aircraft beyond the current X-15 program." A NASA request for $1,157,000 to build a high temperature loads calibration facility was restored because of the decision to go ahead with the supersonic transport program.

• **LEM test facilities**—NASA had requested $15 million to build a second block of facilities at the White Sands Missile Range to check Lunar Excursion Module engines. All but $500,000 was restored after NASA convinced members of congressional space committees that reliability of the engine in the Lunar Excursion Module is one of the most critical items in the Apollo program.

• **Manned space flight tracking facilities**—All but $1.5 million of the $21 million originally requested for construction of three 85-ft. tracking antenna stations at foreign locations was restored to avoid jeopardizing negotiations for the sites.

• **Instrumentation ships**—NASA had asked for $90 million to modify and equip three ships from the reserve maritime fleet for Apollo tracking operations. The conference bill restored $3.3 million of the $10 million House cut but urged that NASA and the Defense Dept. make a joint study to determine the possibility of creating a tracking ship usable by both NASA and defense agencies.

• **Electronics Research Center**—NASA requested $5 million to begin work on an Electronics Research Center in the Boston area. The House cut this to $3.9 million and required that NASA provide a more complete justification for the center and its location before committing any funds to construction or purchase of land. The Senate approved a bill providing for the full $5 million and removing the restrictions. House conferees insisted on maintaining both the $1.1 million reduction and the restrictions. Both were accepted in the conference bill.

Both the Senate and House space committees had recommended new restrictions on the reprograming of funds by NASA. The conference bill adopted some of these tightened restrictions, which include a decrease from 3% to 2% in the amount of research and development funds which may be transferred for construction of facilities, and a 30-day waiting period for such transfers after notifying Congress, unless the space committees have indicated earlier that they have no objections.

The conference bill also requires NASA to adopt General Services Administration, Navy or Army Corps of Engineers design and construction standards until the agency establishes its own standards.

House Independent Offices Appropriations Subcommittee has finished hearing NASA witnesses (AW Aug. 26, p. 25) but other legislative traffic probably will delay House consideration of the NASA appropriation bill until about the second week in September.

Since the Senate Appropriations Committee will not hold hearings on the NASA appropriation until after the House approves a bill, it now appears that the agency's Fiscal 1964 appropriations legislation will not clear Congress until Oct. 1 or later.

Congress is expected finally to vote a NASA appropriation of about $5.3 billion—some $400 million less than the Administration requested.

Zuckert Discusses TFX, Follow-on Aircraft

Washington—Air Force has begun preliminary work on a manned aircraft which will follow the General Dynamics F-111 (TFX). Air Force Secretary Eugene M. Zuckert said late last week. Zuckert gave no details on the aircraft, but he said he does not "like to use the word 'bomber'" to describe it.

Zuckert mentioned the follow-on aircraft at a Pentagon press conference, which he described as "a status report" on the F-111 program, but would not elaborate. Zuckert was the final Defense Dept. witness before the Senate Investigations Subcommittee recessed its probe of the F-111 award on Aug. 21 (AW Aug. 26, p. 34).

Zuckert said the press conference was not a "victory celebration" after his testimony and that it was held only "because I'm back at work."

Highlights of the F-111 status report were:

• Research and development program will include 23 aircraft—18 for Air Force and five for Navy. First F-111 flight will be in January or February, 1965.

• Program is on schedule, is moving rapidly and has top U. S. priority.

• Letter contract with General Dynamics has not been signed but will be soon.

• Zuckert conceded that he had not read the fourth source evaluation report before he made a tentative recommendation that General Dynamics be selected, but that he had the same briefing—a condensed version of the evaluation—as the Air Council and technical discussions with his experts before he reached his conclusion.

• Congressional hearings into the F-111 decision have not affected the program schedule. Zuckert's assessment of the hearings: It doesn't "do any harm" to have someone look at procedures, and hearings have been extended because of the complexity of the subject. Zuckert said he could not answer as to whether Defense Dept. "has emerged clean" from the hearings.

• Cost of the F-111 program, including research, development, test engineering and 1,700 production aircraft is "about $7 billion." In the development phase, 12% of engineering man-hours already have been expended, as have more than 60%—or more than 9,000 hr.—of the 15,500-hr. wind tunnel program. Another 5% of tool design man-hours and 6% of tooling man-hours have been expended.

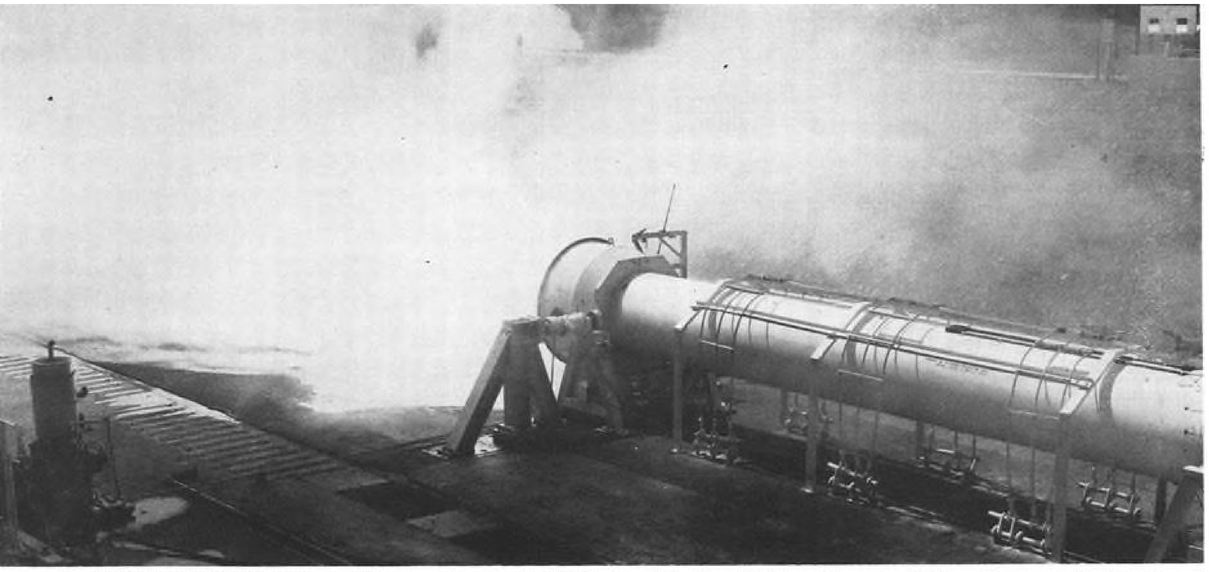
• Grumman will design and manufacture Navy aircraft nose and main landing gears, aft fuselage, horizontal stabilizers, arresting gear and tail bumper. Decision has not been made on whether Grumman will manufacture the entire Navy version.

• Subcontract list has grown to 18 major companies responsible for subsystems (AW Aug. 26, p. 55). Government-furnished equipment will include the Pratt & Whitney TF-30, Navy missile system being developed by Hughes with General Dynamics as integrator, IFF transponder, instrument landing system, intercommunications system, TACAN, UHF radio, UHF omni-navigator. Most will be off-the-shelf items.

Conference Action on NASA FY1964 Authorization Request

	NASA Request	House Action	Senate Action	Conference Action
RESEARCH AND DEVELOPMENT				
Manned spacecraft system	$1,556,600,000	$1,436,600,000	$1,556,600,000	$1,496,600,000
Launch vehicle and propulsion system	1,168,500,000	1,138,500,000	1,153,500,000	1,147,500,000
Aerospace medicine	16,700,000	11,000,000	11,000,000	11,000,000
Integration and checkout	153,000,000	125,000,000	140,000,000	125,000,000
Systems engineering	37,000,000	37,000,000	37,000,000	37,000,000
Meteorological satellites	63,700,000	63,700,000	63,700,000	63,700,000
Communications satellites	51,100,000	42,175,000	44,175,000	42,175,000
Advanced applications satellites	1,000,000	.....	.....	.....
Industrial applications	3,500,000	3,500,000	3,500,000	3,500,000
Geophysics and astronomy	194,400,000	190,400,000	194,400,000	194,400,000
Lunar and planetary exploration	322,600,000	254,400,000	282,600,000	274,400,000
Bioscience	35,200,000	21,200,000	21,200,000	21,200,000
Launch vehicle development	130,700,000	127,700,000	127,700,000	127,700,000
Facility, training and research grants	55,000,000	30,600,000	50,000,000	40,000,000
Space vehicle systems	61,962,000	53,462,000	53,462,000	53,462,000
Electronic systems	30,362,000	30,362,000	30,362,000	30,362,000
Human factor systems	18,200,000	13,200,000	13,200,000	13,200,000
Nuclear-electric systems	68,768,000	68,768,000	68,768,000	68,768,000
Nuclear rockets	96,687,000	91,687,000	96,687,000	94,187,000
Chemical propulsion	22,497,000	24,497,000	24,497,000	24,497,000
Space power	16,524,000	16,524,000	16,524,000	16,524,000
Aeronautics	16,200,000	16,200,000	16,200,000	16,200,000
Tracking and data acquisition	231,500,000	216,700,000	220,200,000	218,200,000
Total	$4,351,700,000	$4,013,175,000	$4,225,275,000	$4,119,575,000
ADMINISTRATIVE OPERATIONS	$560,300,000	$508,185,000	$539,185,000	$518,185,000
CONSTRUCTION OF FACILITIES				
Ames Research Center	$13,076,000	$11,044,000	$11,044,000	$11,044,000
Flight Research Center	4,081,000	.....	1,157,000	1,157,000
Goddard Space Flight Center	20,932,000	17,032,500	20,332,500	17,032,500
Jet Propulsion Laboratory	7,000,000	2,998,200	2,998,200	2,998,200
Langley Research Center	9,768,000	8,204,700	8,204,700	8,204,700
Launch Operations Center	312,855,000	279,677,000	300,316,000	284,916,000
Lewis Research Center	25,835,000	18,634,000	18,634,000	18,634,000
Manned Spacecraft Center	37,736,000	35,102,000	35,102,000	35,102,000
Marshall Space Flight Center	38,496,000	28,980,000	28,980,000	28,980,000
Michoud Plant	10,003,000	8,688,000	8,688,000	8,688,000
Mississippi Test Facility	111,690,000	92,696,000	102,196,000	100,196,000
Nuclear Rocket Development Station	20,490,000	15,650,000	15,650,000	15,650,000
Various Locations	176,038,000	148,653,000	168,253,000	*159,953,000
Wallops Station	2,000,000	.....	505,000	505,000
Facility Planning and Design	10,000,000	15,000,000	25,000,000	20,000,000
Total	$800,000,000	$682,359,400	$747,060,400	$713,060,400
Grand Total	$5,712,000,000	$5,203,719,400	$5,511,520,400	$5,350,820,400
*Items in conference on various locations:				
Electronic research center	$5,000,000	$3,900,000	$5,000,000	$3,900,000
Instrumentation ships	90,000,000	80,000,000	89,000,000	83,300,000
LEM test facility	15,000,000	11,500,000	14,500,000	14,500,000
Manned space flight data acquisition and tracking facility	21,000,000	14,500,000	21,000,000	19,500,000

	Research & Development	Administrative	Construction of Facilities	Total
Total	$4,119,575,000	$518,185,000	$713,060,400	$5,350,820,400
Less than NASA request	232,125,000	42,115,000	86,939,600	361,179,600
Less than Senate approved	105,700,000	21,000,000	34,000,000	160,700,000
More than House approved	106,400,000	10,000,000	30,701,000	147,101,000



ALGOL ROCKET MOTOR, supplying approximately 100,000-lb. thrust for the Little Joe 2 launch vehicle, undergoes static test firing at Aerojet-General Corp.'s solid rocket plant, near Sacramento, Calif. Note altitude chamber covering the nozzle end of the motor.

First Little Joe 2 Launched Successfully

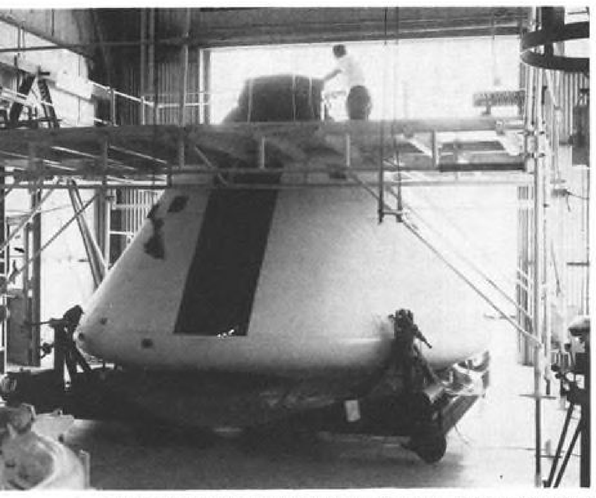
Failure to terminate thrust appeared to be the only flaw in an otherwise satisfactory first flight test Aug. 28 at White Sands Missile Range of the General Dynamics/Convair Little Joe 2 launch vehicle which will simulate flight conditions to be encountered during actual Apollo missions.

Early scan of data indicated that there should be no delay in continuing the test program. Next tests at White Sands should be pad abort trials, involving launch of Apollo command module boilerplates by means of the motors in the spacecraft's escape tower, and these will probably take place in the latter part of September. Little Joe 2 is then scheduled to boost two boilerplate Apollo and one flight configuration spacecraft to test the escape system under maximum aerodynamic pressure.

Launch followed a 6-hr. 10-min. countdown, with no holds encountered, at Army Launch Area 3 being used by National Aeronautics and Space Administration's Manned Spacecraft Center. The vehicle achieved programmed speed on the order of Mach 1.1 and a maximum altitude of 24,000 ft. Observers were "pleasantly surprised" at the lack of blast damage to the launch pad.

Program was to verify the performance of the solid-rocket-powered Little Joe 2 in flight prior to employing it to test Apollo command modules and the Apollo escape system under maximum aerodynamic pressures that will simulate abort escape conditions after launch of Apollo using the Saturn vehicle at Cape Canaveral.

Test involved launch of a fully-powered Little Joe 2, with its 103,200-lb. thrust Aerojet-General Algol sustainer and six 34,460-lb.-thrust Thiokol boosters being ignited at launch. Exact combination of Algol and Recruit motors to be used in future Little Joe 2 flights will depend upon thrust requirements for each particular flight.



APOLLO COMMAND MODULE boilerplate, BP-6 (left), will be used to qualify launch escape system in an off-the-pad abort test, expected to be next on the program at White Sands. Technician (right) puts protective covering over nozzles of launch escape motor.

Topping the vehicle during its first test was an Apollo dummy payload, consisting of a steel adapter 154 in. in diameter and 167 in. long, a steel simulated command module 126 in. long and 154 in. in diameter at the base and a dummy escape tower 33 ft. high, bringing total height of the vehicle and payload to 86 ft. and total weight to 56,500 lb.

The test was to prove the assembly's structural integrity, the vehicle's stability, propulsion system efficiency and effectiveness of instrumentation.

Plan was to terminate thrust after the vehicle achieved maximum aerodynamic pressure by sending a radio signal from the blockhouse which would rupture the Algol motor by having the destruct system make two longitudinal cuts in the motor case. Positive indication of the signal being sent from the blockhouse was noted, but the destruct system did not function. As a result, the vehicle impacted some 47,000 ft. downrange rather than the approximately 35,000 ft. planned. Thorough analysis of data and vehicle remains was being made to evaluate the test completely and attempt to determine the cause of the destruct system failure. About 100 sec. of telemetry recording was achieved during the trial.

Walter Williams, MSC deputy director for mission requirements and flight operations, acted as flight operations director for the initial Little Joe 2 flight. Sigmund Sjoberg, MSC Flight Operations Div., was test director. Launch was by a Convair crew consisting of test conductors J. Solheid, who actually launched the vehicle, and J. Lampman.

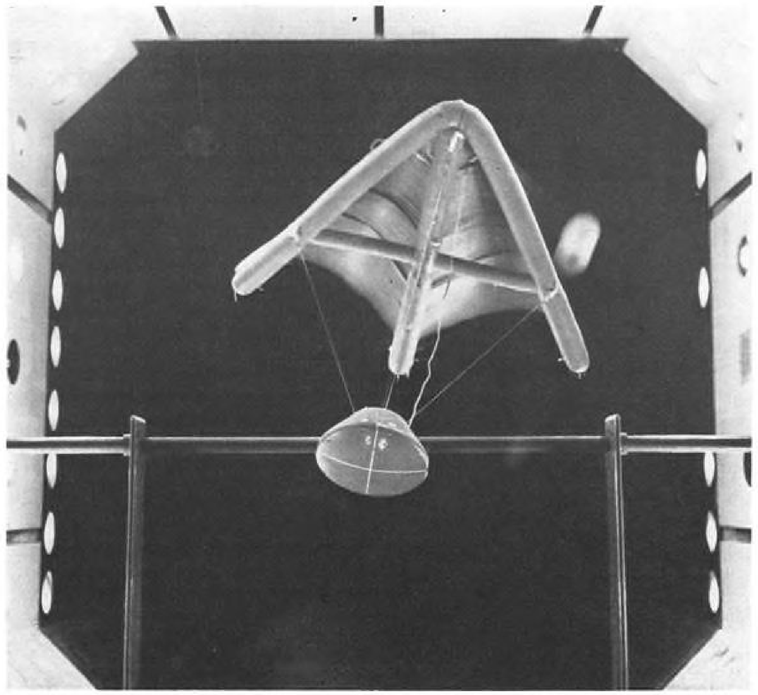
Germans Plan Merger

Weser Flugzeugbau GmbH and Focke-Wulf GmbH of Bremen are contemplating the merger of their development and production facilities before the end of the present calendar year.

The reason given for the impending merger is to increase efficiency in all areas of operation. Weser said that the move "is in line with the concepts of the appropriate German governmental departments" and "follows a trend in the international aviation industry."

Weser will make a new stock issue, with the shares going to Focke-Wulf in exchange for the contribution of its activities. Major stockholders in the new firm will be Krupp, United Aircraft Corp. and Focke-Wulf. The latter will continue to exist as a subsidiary company.

At the present time it is not clear how the merger will affect the Northern Development Group (ERNO), a Weser official said. ERNO is composed of Hamburger Flugzeugbau and the two merging firms.



Paraglider Evolves in Tests

Paraglider test model billows out above instrumented spacecraft model during wind-tunnel testing at National Aeronautics and Space Administration's Langley Research Center, Hampton, Va. The model, which has booms extending back 5 ft. from the nose, was developed by Goodyear Aerospace Corp. under contract to NASA. The company will develop an advanced model with curved booms under another contract. Preliminary studies indicate curved booms will significantly increase range. Under three previous contracts, the company studied characteristics of the structure and its integration with spacecraft. Paragliders are being considered for use on the Gemini and Apollo space capsules.

OH-4A Finishes Contractor Tests

Ft. Worth—Bell Model 206 prototype of the OH-4A light observation helicopter has completed the contractor flight test program and is starting Federal Aviation Agency certification trials in its latest configuration embodying modifications aimed primarily at improved flying characteristics. Start of FAA trials came less than nine months after the first Model 206 made its initial flight here.

Modifications include:

- **Addition of a vertical fin** above the tail boom aimed at improving static and dynamic directional stability.
- **Cabin nose has been lengthened** by about 10 in. to reduce drag and improve balance.
- **Horizontal stabilizer** has been moved forward 30 in. to improve longitudinal stability.
- **Narrow-chord external stiffener** has been added at the juncture of the underside of the fuselage and the tail boom.
- **Air vents on the sides** of the forward portion of cowling around the rotor mast have been deleted and replaced with vents in the front of the cowling to improve airflow and transmission cooling characteristics.

Of the three Model 206 prototypes involved in the Bell test program, one ship has accumulated approximately 160 hr. of ground testing and the other two a total of about 150 hr. of flight time, which has included speeds up to 120 kt. and altitudes of more than 18,000 ft. Machine gun and grenade launcher armament has also been fitted and checked out in ground and flight tests.

It is expected that FAA trials will be completed and five OH-4As handed over to the U. S. Army by the end of this year for evaluation against a similar number of Hiller OH-5As and Hughes OH-6As.

Outcome of this evaluation is expected to be orders for about 4,000 LOH helicopters with production starting in 1965.

York, Kistiakowsky Back Test Ban Treaty

By Katherine Johnsen

Washington—Two top science-military advisers of the Eisenhower Administration—Dr. Herbert York, former director of defense research and engineering, and Dr. George B. Kistiakowsky, former assistant to the President for science and technology—last week strongly urged ratification of the nuclear test ban treaty as "a first step" toward international arms control.

As three Senate committees concluded more than two weeks of public hearings in joint all-day sessions, only one witness from the scientific community stood in categorical opposition to the treaty, which would ban atmospheric, space, and underwater testing: Dr. Edward Teller, professor-at-large at the University of California, and a key figure in H-bomb development.

The Senate Foreign Relations Committee last week approved the treaty by a vote of 16 to 1. Full Senate action is expected this week.

Teller based his case on the contention that the USSR, during the 1961-62 period of intensive testing, gained information which will make possible the development and deployment of an effective anti-ballistic missile (ABM) system. Conversely, Dr. Teller stated, the ban on atmospheric testing will preclude U. S. development of an effective ABM system (AW Aug. 26, p. 28; Aug. 19, p. 27).

Dr. John S. Foster, director of the Atomic Energy Commission's Lawrence Radiation Laboratory, stated that "from purely technical-military considerations, the proposed treaty appears to me disadvantageous." He supported atmospheric testing of site vulnerability, penetration and defense to assure weapons performance and reliability. In spite of his concern over technical and military considerations, Foster did not flatly oppose the treaty. He said "uncertainties" of future technology "prevent a quantitative assessment."

Other developments last week were:

• **The 16-member** President's Science Advisory Committee (PSAC) and six consultants-at-large to PSAC gave their "strong support" on the basis of the treaty's potential effects "on the future military capabilities of this country relative to the Soviet Union. . . ." Participants in the PSAC statement included James B. Fisk, president of Bell Telephone Laboratories, which has worked extensively in the ABM field and is responsible for development of the two systems being worked on by the U. S.—Nike Zeus and Nike X.

"In fact, more extensive limitations under a comprehensive treaty with adequate safeguards could provide even greater confidence in our continuing . . . security," PSAC said.

• **The 2,500-member** Federation of American Scientists urged prompt Senate approval by a big majority to "demonstrate that the U. S. hopes to join in further steps toward the control of nuclear armaments."

The answer to the threat of Russian-developed ABM is a better offense, according to York, now chancellor of the University of California at San Diego, who served as director of Lawrence Radiation Laboratory from 1954 to 1958. He was succeeded in that post by Teller, then by Dr. Harold Brown, now director of defense research and engineering, and then by Foster.

An effective U. S. ABM system, York said, "is probably impossible." By comparison, development of offensive missiles which could penetrate a possible USSR defense system "is feasible and, in fact, relatively easy . . ," and would maintain the balance of power and continue the validity of the U. S. deterrent to attack, he added.

"I do not say . . . that there will be no progress in ideas or techniques in the field of anti-ballistic missile development," York said. "However, I am very much more optimistic with regard to what human ingenuity can accomplish in the way of designing ballistic missiles which can easily beat or penetrate any anti-ballistic missile system."

Foster raised the prospect that "the USSR [might] develop a defense such that our ability to penetrate might depend on a saturation attack." He warned that "for this application, specially-designed, hardened warheads might be required." Although considerable progress could be made with underground tests, Foster objected that the treaty would preclude "the crucial atmospheric experiments to determine if the warhead actually has the necessary hardness against combined radiation and shock effects . . . We might thereby be denied assurance of such a penetration capability. . . ."

Both York and Kistiakowsky stressed that warhead development—the aspect which would be affected by nuclear testing restrictions—is not the problem in development of an ABM system.

Dr. Norris E. Bradbury, director of Los Alamos Scientific Laboratory since 1945, testified that there are ABM warheads "on the shelf," and the question would simply be one of improvement.

The U. S. and USSR "are very likely to be in a situation for some time," Kistiakowsky testified, "where it will be comparatively easy for the defense to destroy incoming objects on a one object per warhead basis, and very difficult for it to do much better than that. The real advances are to be made in the domain of discrimination between decoys and incoming weapons—for which atmospheric nuclear tests are not needed." The treaty would not prohibit underground tests (see box above).

Individual attack on each incoming decoy and missile, makes defense "entirely hopeless," he declared.

The ABM problem is further complicated, according to Bradbury, because the U. S. would never know in advance the actual character of an incoming USSR attack. Any system deployed "would be a 'best guess' on the character of missiles, decoys, and the character of attack," he said.

Bradbury discounted the likelihood that the 1961-62 USSR tests developed any significant ABM breakthrough. Although a few indicated considerable sophistication, he said, the "air drop" type of tests usually used by USSR indicates that "they do not have a very elaborate diagnostic program." Bradbury commented that ABM development is not concerned with the very large yields emphasized in the USSR testing.

York differed with USAF Chief of Staff Gen. Curtis LeMay, who testified earlier that the U. S. should develop very large yield weapons—in the 50-megaton-plus range. Improvement of the accuracy and reliability of U. S. missiles would be much more effective than increasing the yield of the missiles, York said.

"I do not say that increasing the yield-to-weight ratio in any size range is valueless," York said, "but I do say that increasing the payload capability of rockets through applying up-to-date propulsion techniques, improving guidance, and improving penetration techniques and devices are all very much more effective . . ." Other witnesses have testified that bombs of very great yields could be developed with underground testing, if the U. S. decided it needed them.

The President's advisory committee gave this evaluation of technical aspects of the treaty:

• **"Detection technology** can make it extremely difficult to carry out significant clandestine nuclear tests . . . posing an exceedingly high risk of detection.

• **"Sufficient nuclear weapons** effects information exists to permit design of effective U. S. ballistic missile systems, including hardened launch sites, with acceptable capability of survival.

• **"The most difficult** problems of the anti-ballistic missile system are nonnuclear in nature and are being aggressively explored. The treaty itself will have only a minor effect on the possibility that an effective anti-ballistic missile system could be successfully developed by any nation.

• **"Weapons of very large** yield are in our stockpile. Weapons of still larger yield could have been produced in the past and can be produced without further testing if a military need develops.

• **"It is clear** that further improvement in nuclear warheads is no longer the dominant factor in advancing military technology. The central questions relate to the design of integrated weapons systems for both offensive and defensive purposes. . . ."

Anderson, Burke Concerned Over Treaty

Washington—Past two chiefs of naval operations—Adm. George W. Anderson and Adm. Arleigh Burke—expressed grave concern over the military implications of a test ban last week before the Senate Preparedness Investigating Subcommittee.

Gen. Nathan Twining, former USAF chief of staff and former chairman of the Joint Chiefs of Staff, testified in secret before the same subcommittee. Afterward, subcommittee member Sen. Stuart Symington (D.-Mo.) said Gen. Twining had opposed the treaty from a military standpoint.

Adm. Anderson, following a 10-page expression of apprehensions, ultimately endorsed Senate ratification of the proposal banning atmospheric, space, and underwater testing. In testimony given two months ago before the same subcommittee, the admiral noted, he had opposed a treaty which would also have prohibited underground testing.

Adm. Anderson said underground clandestine testing is the most difficult type of testing to identify, and added: "In the present treaty we are not placing unwarranted reliance on trust to avoid violations or depending upon inadequate inspection measures in this regard."

Adm. Burke presented a 54-page statement. He concluded that ratification is virtually inevitable, but said: "I have grave misgivings as to whether this will be a step towards peace or a step towards decreasing the security of the U. S."

To give the treaty "real meaning," all U. S. and USSR facilities for atmospheric testing should be dismantled, he said. "Our country would gladly live up to such a bargain, but would the Soviets?" he asked. "They should, and it is along such lines, in a treaty which contained the inspection elements to check on such action, that I would concur."

Adm. Burke argued that the USSR would get around the ban on underwater testing by interpreting large areas of waters on its shorelines as "internal waters." The treaty would ban testing "underwater, including territorial waters or high seas."

"Underwater testing, even in the very low kiloton range, could lead to improvement in the design of Soviet submarines and to the possible development of effective means of destroying, or countering, our Polaris submarines," Burke said.

Congress Given Test Ban Safeguard Details

Washington—Defense Dept. has sent Congress details of a $200-million plan to implement four basic safeguards in Fiscal 1964 that would reduce the risks of a nuclear test ban treaty.

The plan was specifically requested by Congress (AW Aug. 26, p. 28). Some details were outlined in a letter by Deputy Defense Secretary Roswell L. Gilpatric, which was endorsed by the Joint Chiefs of Staff. Secret annexes to the letter, also endorsed by the Joint Chiefs, went to the Senate Foreign Relations Committee and the Preparedness Investigating Subcommittee.

Key points of the plan:

• Expanded underground test program to add to knowledge and improve weapons in all areas. Underground test program will be increased to include as many objectives as possible of an unrestricted test program.

• Stimulation of nuclear technology in Atomic Energy Commission and Defense Dept. laboratories. The safeguard plan specifically mentions Los Alamos Scientific Laboratory, Lawrence Radiation Laboratory, Sandia Laboratory, Air Force Cambridge Research Laboratory, USAF Weapons Laboratory, Armed Forces Radio-biological Research Institute, Ballistics Research Laboratory, Naval Ordnance Laboratory, Naval Radiological Defense Laboratory and Nuclear Defense Laboratory.

The continuing programs in AEC laboratories are in design and development of nuclear weapons and in the research areas of chemistry, physics, metallurgy, computer technology, biological sciences, reactors, controlled thermonuclear reactions, peaceful uses of nuclear explosives, nuclear rockets and nuclear ramjets.

Defense Dept. activities are in nuclear weapons effects, including blast effects on ground and space systems, shielding, protective structures, biomedical, underwater, electromagnetic, and integrated effects.

• Standby facilities and resources to resume atmospheric tests if the treaty is "abrogated by the Soviet Union." This involves enlargement of Johnston Island, located 650 mi. southwest of Honolulu, as an aircraft and missile launch site, and renewal of the physical plant and enlargement of the harbor. About $55 million is earmarked in Fiscal 1963 and 1964 for improving facilities, which were over-crowded during last year's Dominic test series.

This safeguard phase also includes ready diagnostic aircraft that Dr. N. E. Bradbury, director of Los Alamos, said can be ready to go "on almost instant notice." Aircraft program also involves dropping techniques for weapons and instrumented sensors, sampler and other supporting vehicles (AW July 29, p. 16).

After any treaty abrogation, Defense Secretary Robert McNamara and AEC Chairman Glenn Seaborg said, the U. S. could resume proof tests within two months of the decision to test, conduct development tests a month later, and weapons affects tests three months later.

Joint task force nucleus and ready groups in the Defense Atomic Support Agency and AEC's Nevada Operations Office will be maintained. The task force will be larger than the current standby unit.

• Improved capability to detect treaty violations and to identify and diagnose clandestine tests in the prohibited areas—space, under water and in the atmosphere (AW Mar. 18, p. 36). Gilpatric's letter pointed out that U. S. has substantial capabilities for detection and analysis in its intelligence forces and in the Atomic Energy Detection Systems (AEDS).

Dr. George B. Kistiakowsky of Harvard, former presidential science adviser, said in testimony before the Senate Foreign Relations Committee that sensors on satellites and probes "could detect a megaton burst anywhere within the dimension of the earth's orbit." Such sensors on Mariner or Pioneer probes would make chances "discouragingly slim" of evading detection of even blasts shielded by the sun, planets or another object, he said.

F-111 Engineering Inspection Under Way

Ft. Worth—Comprehensive Development Engineering Inspection (DEI) of the General Dynamics USAF F-111A and Navy F-111B (TFX) tactical weapons systems is under way here, marking a significant phase in the new bi-service fighter program.

More than 200 USAF and Navy specialists, headed by Col. Charles Gayle, director of the F-111A/B System Program Office, Wright-Patterson AFB, are analyzing full-scale mockups of each of the two versions for the airplane and its systems to determine first-hand the configuration in detail.

Suggestions for changes will be submitted to the F-111 Review Board, which will resolve them after conferences with the prime and any subcontractors involved and the using agencies.

General Dynamics/Ft. Worth President Frank W. Davis calls the two-weeks DEI, which began Aug. 26, the most important and significant milestone achieved in the program since the company started F-111 work and notes that it will be the most complete and extensive DEI in the industry's history.

Physical location and arrangement of components, systems and other items are among the things examined in a DEI. Ease of servicing and maintenance of equipment, including quick-engine change and electronics and their ground support equipments, are also examined.

The full-scale wood and plastic mockups built by General Dynamics are realistic to the point where the variable-sweep wings can be actually moved through the positions that will be attained by the flight hardware, showing how the components involved move in relationship to each other.

Each mockup is configured exactly to the requirements of the service for which it is designed, including paint schemes. Other mockups in full-scale include a metal TF-30-P-1 engine provided by Pratt & Whitney Aircraft, items relating to the Hughes Aircraft Phoenix missile system and products of other major subcontractors.

Four Air Force Labs Join Research Unit

Washington—Four major Air Force scientific research laboratories composed of elements from 13 laboratories formerly under the Aeronautical Systems Div. of Air Force Systems Command have been placed under AFSC's Research and Technology Div.

Names of the new laboratories, all located at Wright-Patterson AFB, Ohio, are: Materials, Avionics, Aero-propulsion and Flight Dynamics. Formation of the laboratories is the last phase in the establishment of the Research and Technology Div., which began July 1, 1962.

Syncom Carries First Live Telephone Talks

Washington—Syncom synchronously orbiting communications satellite carried its first live telephone conversations on Aug. 23 and was scheduled to go into routine operation late last week.

Tracking ship Kingsport, anchored at Nigeria was out of commission about a week following the Aug. 23 transmissions because a cable struck the transmission wave guide of the 30-ft. Syncom antenna.

First telephone transmission was between President Kennedy and Nigerian Prime Minister Sir Abubaker Balewa. Other messages followed between U.S., Nigerian and United Nations officials.

The National Aeronautics and Space Administration-Hughes Syncom was launched July 26 (AW Aug. 5, p. 29 and p. 75) and was jockeyed on station in mid-August by means of reaction jets (AW Aug. 19, p. 30). Apogee is 22,239.7 mi. and perigee is 22,230.1 mi. Inclination is 33.1 deg. and period, 23.9 hr.

The satellite has a slight eastward drift, and adjustments to the orbit will be made about every 40 days to keep it on station.

In other communications satellite developments, the U.S. and Canada announced the signing of an agreement under which Canada will build a ground station to transmit and receive television, telephone and telegraphic signals using Relay, Telstar and Syncom satellites.

Similar agreements are pending with Scandinavian countries, India, Japan and West Germany.

House Research Group To Study Duplication

Washington—New House subcommittee on science, research and development is moving quickly to establish that it will examine possible duplication and waste in the nation's $15 billion-a-year research effort.

Subcommittee was formed Aug. 23 by Rep. George Miller (D.-Calif.), chairman of the House space committee. Subcommittee chairman is Rep. Emilio Q. Daddario (D.-Conn.) and members are Rep. J. Edward Roush (D.-Ind.), Thomas G. Morris (D.-N.M.), Joe D. Waggonner (D.-La.), Edward J. Patten (D.-N.J.), R. Walter Riehlman (R.-N.Y.), Charles A. Mosher (R.-Ohio), Alphonzo Bell (R.-Calif.), and James D. Weaver (R.-Pa.).

A group of representatives headed by Rules Committee Chairman Howard Smith (D.-Va.) has been pressing for a special House committee to investigate research expenditures (AW Aug. 19, p. 25).

House Armed Services Committee Chairman Carl Vinson (D.-Ga.) earlier this year created a subcommittee to study military research projects. The actions of Rep. Vinson and Rep. Miller have been interpreted as a move to head off Rep. Smith.

Rep. Daddario's subcommittee held a closed organizational meeting last week. Later he said the committee would seek the advice of the scientific community, industry and university elements on what areas should be examined.

He said the subcommittee's work would be aimed at disclosing and avoiding waste in scientific research and in stimulating efficiency and economy.

NASA Aeronautics Chief to Go to Army

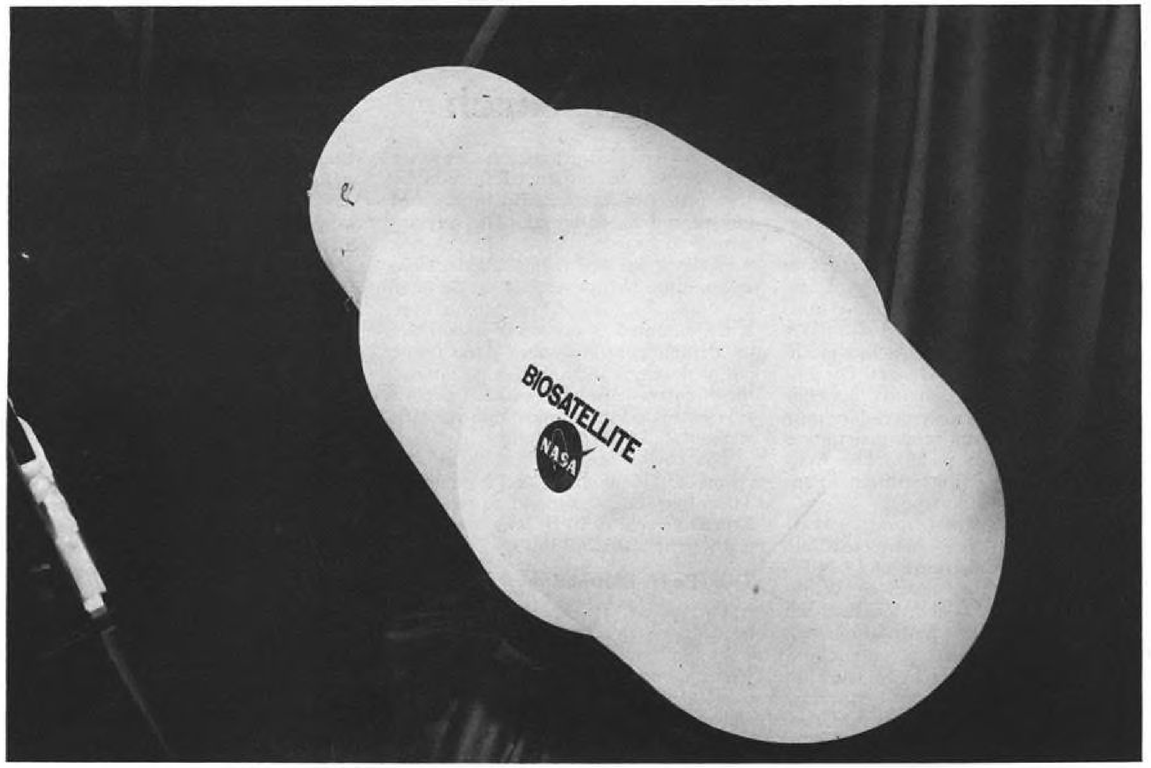
Washington – Charles H. Zimmerman has resigned as director of aeronautical research programs for National Aeronautics and Space Administration and will accept a top-level post in the Army Materiel Command's research and development directorate.

Zimmerman is a pioneer in aircraft research, both civilian and military, particularly in helicopters and vertical and short-takeoff and landing aircraft. He developed the Chance Vought XF5U flying wing and was instrumental in the development of the flying platform.

Zimmerman's Army position is expected to be in the area of air mobility research.

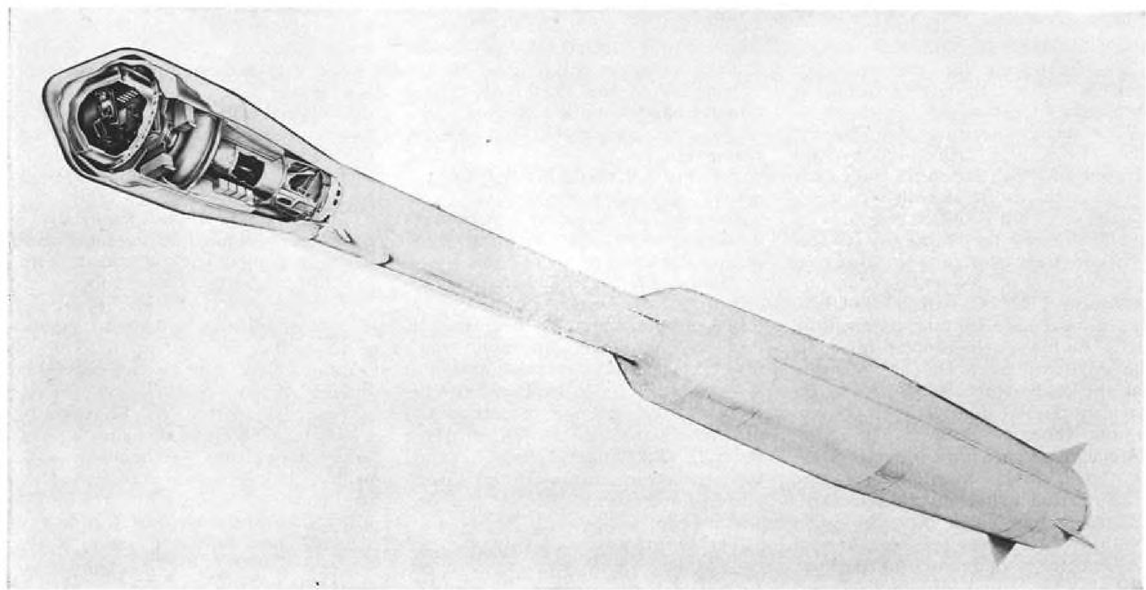
Zimmerman has directed NASA aeronautical research since June, 1962. His responsibilities have included the supersonic transport, X-15, V/STOL research and other NASA basic aircraft research programs. He replaced John Stack, who took the job when it was created and resigned after eight months to become vice president of Republic Aviation.

NASA has been subjected to both outside and in-house criticism on what some consider to be the dwindling amount of research effort going into aeronautics. The agency has attempted to answer this criticism (AW Aug. 5, p. 58) with the position that it is continuing to meet the needs of the aircraft industry.



Biosatellite Similarity to Discoverer Capsule Shown

Similarity between the National Aeronautics and Space Administration/General Electric Biosatellite payload with Discoverer re-entry capsules is evident in the model photo and drawing of Biosatellite. Recovery capsule is forward in the drawing (below), which shows the satellite inside the fairing of a Thor Delta launch vehicle. Biosatellite, to be built by GE under a $19-million NASA contract, is 7 ft. long and 44 in. in diameter. First launch is scheduled in mid-1965 (AW Aug. 26, p. 33). Biosatellite program calls for placing monkeys and biological specimens in earth orbit for periods up to 30 days. The satellite will carry about 25 separate experiments.



Athena Rocket Launches to Begin In Air Force Re-entry Research

Washington—First of 77 Athena rockets is scheduled to be launched next month at White Sands Missile Range, N. M., in Air Force's advanced ballistic re-entry systems (ABRES) program, which is designed to provide trajectory dynamics data on a wide variety of missile re-entry bodies and penetration aids.

The program is part of USAF's 627A re-entry research effort which also includes 20-30 flights of General Dynamics Atlas F missiles carrying payloads of new materials, maneuverable nose cones and decoys and other penetration aids (AW Dec. 10, p. 27). The Atlas flights are being conducted from Atlantic and Pacific missile ranges.

Phase 1 of the Athena rocket portion of the program was completed last month. It involved launch of 15 Nike-Apache sounding rockets from White Sands and Wallops Island, Va., to check ground and flight instrumentation.

Phase 2 of the rocket program could be expanded beyond the 77 launches now scheduled. Total program cost through the firm schedule is $40 million.

Plan is to launch payloads ranging in weight from 50-300 lb. to altitudes up to 500,000 ft. and then to drive them downward into the atmosphere at re-entry velocities up to 23,000 fps. Design payload weighs 50 lb., and design re-entry altitude is 250,000 ft. Re-entry angles will be varied from 18-45 deg.

Athena Integration

The Athena rocket is being integrated by Atlantic Research Corp., which also is test conductor and facilities contractor for this phase of ABRES. The four-stage Athena has these characteristics:

- **First stage,** consisting of a Thiokol XM33-E8 Castor augmented by two Thiokol XM19-E1 Recruits. Castor has a 54,000 lb. thrust and 40 sec. burning time. Thrust of the Recruits is 34,000 lb., and they burn for 2.3 sec.
- **Second stage** will come in two configurations. For low-angle re-entries, a Thiokol TX261-2, with a 63,000 lb. thrust and 13 sec. burning time will be used. In high-angle re-entry missions, the stage will be a Hercules-Allegany Ballistic Laboratory X259-A4, which produces 21,000 lb. and has a 35 sec. burning time.
- **Velocity package** has an Aerojet 8,000 lb. thrust, 30-sec. burn motor as the third stage. The fourth stage is an ABL Ranger motor, which produces 5,000 lb. thrust and burns 9.5 sec. Also in the velocity package are the payload, attitude control and telemetry systems.

In a typical mission, the velocity package will be carried to altitude by the first two stages, which are unguided and fin-stabilized. The fins are canted to impart a spin. The velocity package is ejected while the vehicle is coasting to apogee. It is de-spun by means of a yo-yo device, pitches over and is oriented by means of a cold gas jet attitude control system. After burnout of the third and fourth stage motors, the re-entry shape and warhead decoys are ejected and reach maximum velocity at about 250,000 ft. altitude.

The payload is contained in an envelope 25 in. in dia. and 72 in. long. The four-stage, all-solid propellant Athena vehicle is 50 ft. long and has a pad weight of 15,750 lb.

Two Pads Planned

Two pads, with rail launchers, will be employed for the Athena launches. They are located near Green River, Utah, about 470 mi. from the impact point at White Sands. FPS-16 radars will position track the vehicle during first and second stage burning and the launch site will be equipped with destruct command capability because the vehicle flies over some sparsely-populated areas.

Air Force has modified K, C and X-band radars for re-entry signature measurements. These measurements also will be made in UHF, VHF, L and S bands. A 24-megawatt S-band Rampart radar and a 30-megawatt combination L/UHF radar will be used for frontal viewing and are located at the southeast corner of the impact range. A similar radar combination will be used for side viewing from the northwest corner. Other ground stations will make measurements in the visible and infrared frequencies.

An instrumented Boeing KC-135 aircraft, flying along the payload trajectory, will measure payload signatures in visible, ultraviolet and infrared frequencies.

Athena fundamentally is an outgrowth of National Aeronautics and Space Administration's Trailblazer re-entry research rocket program, which utilized a spherical rocket as both fourth stage and payload to study re-entry detection, tracking, communications and nose cone materials (AW Jan. 16, 1961, p. 102). Trailblazer 2 had the same booster stage as Athena. It also was engineered and fabricated by Atlantic Research Corp.

The Athena program is being directed by the Ballistic Systems Div. of Air Force Systems Command, through BSD's Ballistic Missile Re-entry Systems Office. ARC's Space Vehicles Div., El Monte, Calif., will conduct the tests, which will use payloads provided by a large number of industry contractors. Others in the management structure are Aerospace Corp., systems engineering; Lincoln Laboratories of Massachusetts Institute of Technology, consultation; Navy and Advanced Research Projects Agency, several experimental payloads; Army, range support, and Systems Command's Electronics Systems Div., range instrumentation.

Honeywell to Develop Passive-Scan Telescope

A passively-scanned star telescope for use on a small, spin-stabilized rocket research vehicle will be developed by Honeywell under a $69,200 contract from National Aeronautics and Space Administration's Langley Research Center.

The telescope will be used to determine instantaneous spin-axis attitude with respect to celestial coordinates. It will detect the radiation from stars of third magnitude and brighter and supply a coded electrical signal from which the position and the approximate photoelectric magnitude of a star may be determined.

The telescope will be mounted in the pressure-sealed payload compartment of a four-stage, solid-propellant launch vehicle, and will observe out of the side of the rocket probe during a free-fall trajectory. The non-guided launch vehicle will be spin-stabilized at 600 rpm. during the launch phase, and will be de-spun to 15 to 20 rpm. before the data-gathering period, which will occur at altitudes between 100 to 400 naut. mi.

The spin of the vehicle will scan the telescope field of view over a portion of the celestial sphere. A 3-in. clear aperture and a square 6-deg. by 6-deg. field-of-view will be required to obtain probability of star acquisition and identification.

The star image will be scanned over a coded reticle located on the focal plane which will modulate the radiation received by a photomultiplier tube.

The telescope will be capable of operation under daylight conditions and will be fitted with provisions to shield it from sunlight which is not directly in the field of view.

Telescope aperture will be sealed by a blowout plug during the launch phase to provide protection from aerodynamic heating and prelaunch debris. A flashing light source will be mounted on the rear surface of the blowout plug to give a rough check of the operation of the telescope's photomultiplier assembly before and during launch.

First Production F-5A Enters Flight Test Program

First production version of the Northrop F-5A fighter is fitted with seven external stores stations, including Sidewinder wingtip mounts, instead of five as on the prototype versions. Internal strengthening of the wing and rearrangement of systems was required for the change, but the external planform remains the same. Low pressure tires for sod field operation and two 20-mm. cannons in the nose also are production version additions. Previous aircraft, carrying identification numbers FA-987 and FA-988, were prototypes built under the N-156 program. The production airplane now has entered flight testing at Edwards AFB, Calif. First increment of 1964 funds—$3 million—has been released for the program, in which U. S. military assistance funds will be used to develop the aircraft for U. S. allies.

News Digest

White House last week asked the Senate to confirm the appointment of Willis M. Hawkins, Jr., Lockheed Aircraft Co. vice president, as assistant secretary of the Army for research and development (AW Aug. 26, p. 25).

Minuteman ICBM first-stage solid-propellant motor was successfully test-fired recently at Thiokol Chemical Corp.'s Wasatch Div. after 32 months of simulated operational storage. The motor was stored at 70F ±10 deg., with a relative humidity ranging from zero to 45%.

Two Polaris A2 fleet ballistic missiles were successfully fired 40 min. apart recently by the submarine USS Alexander Hamilton, submerged off the shore of Cape Canaveral, Fla. The Hamilton was the 12th submarine to launch Polaris missiles successfully down the Atlantic Missile Range. Navy plans to conduct submarine firings from the Cape every month beginning next year.

Thiokol has received $5 million and Aerojet $3 million in follow-on awards for continued development in Air Force's solid-propellant development program. Thiokol funding covers work on both 260-in. and 156-in. motors, and Aerojet's money is for the 260-in. dia. motor.

First Project Fire velocity packages have been delivered to NASA at Cape Canaveral by Ling-Temco-Vought's Astronautics Div. Package will carry an Apollo-shaped, Republic Aviation-built payload, entire system being lofted some 510 mi. by an Atlas launch vehicle.

Jet Commander business plane is undergoing flight testing at Edwards AFB, including airspeed/altitude calibration, full-power thrust calibration, speed vs. power and fuel consumption trials. Prototype airplane completed 82 hr. of preliminary flight testing at its Norman, Okla., base prior to being sent to the West Coast.

Goodyear has won a $191,849 space agency contract to study and design a 50-ft. inflatable lenticular communications satellite (AW May 13, p. 37). The Scout-launched vehicle will use gravity-gradient for earth orientation, using three-40-ft. booms, also inflatable, to attain stability.

Avco Corp.'s Research and Advanced Development Div. has received an $83,000 contract from the Jet Propulsion Laboratory to study three families of vehicle shapes for entry and landing on Mars and Venus.

U.S.-European Air Transport Rift Widens

Exclusion from Stockholm meeting increases discord centered on transatlantic fare issue and traffic control.

By L. L. Doty

Washington—Decision by European nations to exclude U. S. and Canadian governments from their civil air transport meeting in Stockholm last week underscores the widening rift between the two blocs.

Two elements have emerged in the past year as the reason for the split between European aviation groups and the U. S., in particular—the fare issue and differences over the interpretation of the Bermuda principles of bilateral agreements. While the meeting in Stockholm was devoted to problems embracing bilateral rights on the North Atlantic, the fare issue now looms as the most immediate of all problems facing the international airline industry.

Real significance of the Stockholm meeting is the opportunity it provided European governments to consolidate their opposition to U. S. moves to introduce some measure of control over traffic moving to and from the U. S. Conciliatory atmosphere that prevailed during the recent Ottawa meeting of governments (AW July 29, p. 38) now appears to have been temporary, prompted by the poor public image some European carriers created by their stand against a U. S. demand for lower fares.

Civil Aeronautics Board has carried the brunt of responsibility on both issues. It is under virtual congressional mandate to bring about lower fares (AW June 3, p. 38) and is under constant pressure from its own staff and U. S. carriers to persuade foreign nations to accept a stricter interpretation of bilateral agreements.

Unfortunately, the Board receives little support from the White House on international air transport matters. The present Administration appears to view these problems as a necessary nuisance.

For example, when newly elected Canadian Prime Minister Lester Pearson raised the issue of Canadian-U. S. civil aviation relations at a meeting with President Kennedy earlier this year at Hyannis Port, Mass., the President shunted the question aside with the suggestion that civil aviation matters should and can be settled expeditiously to make way for more significant issues.

He later named J. Kenneth Galbraith, former ambassador to India, to meet with Canadian officials in attempts to smooth the way for negotiations on the current bilateral agreement between the two countries scheduled to begin next month (AW Aug. 19, p. 25). But the two allies on rates and fares (AW May 20, p. 39) are at odds over route extensions for Canada into the U. S. Canadian negotiators, with the force of Parliament behind them, can be expected to hold rigidly to their demands for more route concessions.

European governments do not take their flag carrier operations lightly either, and air transport problems fall under the jurisdiction of top-level government officials. A move was made last spring (AW May 6, p. 38) to upgrade the stature of the aviation division of the U. S. State Dept. but its diplomatic ranking is still far below that set by European governments for comparable departments.

On the bilateral issue, the CAB staff still continues to press for some form of control of sixth freedom traffic, even though interest in this issue is dwindling as U. S. carriers' share of the traffic volume on the North Atlantic improves (see pp. 29, 34).

The staff is primarily responsible for the distribution of memoranda of understanding offered to at least three European nations last month (AW Aug. 12, p. 38). There is a feeling in airline circles that the first drafts of the memoranda might have won the assent of a number of European nations, but staff insistence on tighter restrictions over traffic and on the exchange of traffic statistics made the documents unacceptable.

Subsequent negotiations so water down the memoranda that they are now being set aside as ambiguous and useless. There are no signs that new attempts will be made to gain European acceptance of this stronger interpretation of the capacity clauses of the Bermuda agreements. But the initial effort served only to create some mistrust abroad of U. S. intentions.

It is now clear that there will be strong resistance to a major cut in transatlantic fares at the International Air Transport Assn. traffic conference slated to begin next week in Salzburg, Austria (AW Aug. 5, p. 52). It is also clear that the U. S. will continue to press for sharp rate reductions in spite of this resistance.

Many observers now feel that this discord will block any agreement at the Salzburg conference and that its sessions will end in deadlock. There will be warnings that an open-rate situation will ensue, but this is not likely to happen since terms of bilateral air transport agreements would prevent it.

Best possibility is that the traffic conference, for the first time, will lay the entire problem in the hands of delegates who will attend the IATA annual general meeting in Rome, which begins Oct. 7. Although unprecedented, this would be a logical move, since the dissension on rates and fares stems from different operating philosophies of the various air carriers and delegates to the annual general meeting are the heads of these carriers.

Since European carriers' philosophies reflect government policy, any subsequent meeting of government representatives who attempt to settle fare differences will be faced with the same problems as IATA.

The U. S. front is split on the fare issue, with Pan American campaigning for its low thrift fare and Trans World Airlines seeking a far more modified fare reduction. The CAB has endorsed the Pan American rate and the carrier has mustered support in recent weeks from at least two foreign flag carriers.

Nevertheless, if any settlement is reached at Salzburg, the moderates are likely to win. Pan American is considered to have little chance of getting the unanimous vote necessary for its plan. In recent weeks, a proposed single-class fare that calls for complete elimination of both first-class and economy rates is gaining some foothold in Europe. But this plan will collide with Pan American's basic marketing principles, which call for low fares as a means of attracting new traffic, and the firm belief that there continues to be a demand for first-class space.

One outcome of the Salzburg conference which can be anticipated with some certainty will be a decision to tighten restrictions on charter operations and to eliminate group fares. Both types of travel have caused widespread industry dissatisfaction because of their depressing effect on gross revenues.

Airspace Rights Ban

Washington—Bans on airspace use have been placed against Pan American World Airways and South African Airways on flights serving Portugal and the Union of South Africa because of the rigid Portuguese stand on colonialism and the Apartheid issue in South Africa.

Mauritania has advised Pan American that any flights operating to and from Lisbon will not be allowed transit rights over Mauritanian territory. South African Airways has been denied landing rights at a number of newly-independent African nations and has been prohibited from flying over Egypt and Guinea.

As a result, routes between South Africa and Portugal are now dog-legged from a straight line across the Greenwich meridian to as far west as 15 deg. over Cape Verde. The bans stress the importance many nations are placing on the correlation between air transportation and political issues.

Jamaican Airline

New York—Jamaican government last week ratified the agreement with British Overseas Airways Corp. and British West Indian Airways for operating Air Jamaica, a national airline for the independent Caribbean island (AW Mar. 18, p. 40).

G. Arthur Brown, the government's financial secretary, was named chairman of the board for the carrier. Air Jamaica will lease aircraft from BOAC, placing its own markings and passenger service personnel on the airplanes.

BOAC will concentrate on directing long-haul service into Kingston, with BWIA managing some Caribbean routes and also Jamaica Air Services, an internal airline flying de Havilland Herons. BWIA has increased its low-fare Viscount service between Miami and Kingston from two flights weekly to one each night.

Cunard Steamship Lines is also a party to the ratified agreement, and will participate where combination air-sea tour packages are involved.

TWA Purchase of Six 727s Dims Prospect of Caravelle 10A Order

New York – Prospect of a Trans World Airlines order for the Sud Caravelle 10A has faded with the carrier's latest purchase of six additional Boeing 727s.

Presence of TWA engineering teams at Sud's facility at Toulouse, France, aroused industry speculation that TWA might purchase Caravelles, powered by the General Electric CJ805-23, for short-to-medium haul service.

However, Charles C. Tillinghast, Jr., president of TWA, said in announcing the latest Boeing order—which included five 707-131Bs and one 707-331B in addition to the 727s—that the carrier's principal jet requirement is fulfilled through 1970. TWA now has 150 jets in service or on order.

TWA's next most likely order is for an aircraft smaller than the Caravelle 10A. The BAC 111 and Douglas DC-9 are the most readily available airplanes in this category. Tillinghast sees a possible need for 20 such aircraft, but said no decision in this area is expected until next year.

Arrangements are under way between TWA and its financial backers for provision of capital to cover the latest Boeing order, which involves $69.5 million. Tillinghast said that the financing may involve a direct bank loan plus equity financing, either through a stock issue or debenture sale (AW Aug. 26, p. 50).

TWA is in a good position to obtain additional financing, since it has accelerated repayment of existing debt and is recording a potentially profitable year, its first since the current management took over in 1960. By the end of 1964, TWA expects to have paid off $91 million of a $111-million bank loan obtained in 1960, the repayment being made from both cash flow and depreciation.

In the current year, TWA's revenue passenger miles increased 18.9% domestically in the first seven months over the corresponding period in 1962, and its international revenue passenger miles rose 32.4%. In the first six months its share of the domestic trunkline market rose to 25.1%, compared with 23.1% in the same period a year ago, and its share of the transatlantic market increased from 13.7 to 16.9%.

If an adequate profit results this year, TWA will resume interest payments in 1964 on $100 million in 6½% subordinated income debentures sold in 1961 to cover equipment acquisition. By June 1, 1964, accumulated interest on the debentures will total $16.25 million.

The debentures were sold to enable TWA to buy aircraft it was using in 1960 on lease from the Hughes Tool Co. Transfer of title on the aircraft involved a cash payment to Hughes Tool, plus $100 million in notes that would be covered by debentures sold the following year.

In the actual sale on June 1, 1961, stockholders other than Hughes Tool bought $19 million of the debentures, and the tool company acquired $81 million. Payments were to be on Dec. 1 and June 1 of each year through June 1, 1978.

Because the debentures were subordinated to the debt held by TWA's principal financial backers, interest on them could be paid only if adequate funds to cover it were available from revenues realized in the calendar year preceding each scheduled payment date.

Consequently, only one payment has been made—on Dec. 1, 1961. But the debenture agreement specifies that if the airline makes a profit, it must pay off not only the current amount of interest due but also that which has accumulated.

With its improved business and equipment status, TWA is reflecting a new confidence and appears less than enthusiastic about continued efforts toward a merger with Pan American World Airways. TWA is now in a strong second-place position on North Atlantic routes behind Pan American.

This winter, TWA will offer 94 flights weekly across the Atlantic, providing 13,348 seats. This is an increase of 10 flights and 1,600 seats over the same period last year. The airline's advance bookings for lower-fare winter travel are up 33% for September, 56% for October, 107% for November and 173% for December.

Frontier Service

Washington—Frontier Airlines' traffic growth under new management last year has caused Civil Aeronautics Board attorneys to recommend retention of service to five Nebraska communities that had been scheduled for deletion from Frontier's route system.

In April, 1962, a board examiner recommended that Frontier drop service to Alliance, Chadwick, Hastings, Kearney and McCook, communities which failed to meet the CAB "use it or lose it" traffic formula of five passengers per day. Goldfield Co., which assumed ownership of the line just prior to the examiner's findings, replied that it thought traffic could be increased and requested a delay in any final board action. CAB extended service to these points for one more year last June.

Traffic tabulations at the end of the period showed that daily passenger boardings, on a comparative second quarter basis, increased at Alliance from 2.26 in 1962 to 5.59 this year; Chadwick, 2.6 to 5.10; Hastings, 5.7 to 7.47; Kearney, 4.6 to 7.22 and McCook, 3.06 to 6.37.

BEA Shows Loss for Fiscal Year, Links Deficit to 'Social' Services

London—British European Airways Corp., the state-owned short and medium haul airline, last week reported a loss of $742,000 for the fiscal year ended Mar. 31, and blamed its inability to show an over-all profit on losses in flying the so-called "social services" in Scotland.

Lord Douglas of Kirtleside, BEA chairman, said BEA lost $932,860 on its Scottish routes and again pressed for a special government grant to BEA to cover the social services.

However, it is known that BEA temporarily withdrew its application for subsidy when Ministry of Aviation said its position is that if a grant or subsidy is offered for Scotland, the matter should go out for bidding by all British airlines.

Despite its over-all loss, BEA showed a strong comeback from the loss of $4.1 million in the previous year. Lord Douglas, noting that the airline has earned $9.8 million in the first four months of the current fiscal year, said BEA has budgeted for a profit of $4.2 million by Mar. 31 of next year.

His prediction followed an announcement by Minister of Aviation Julian Amery that the financial objective of BEA in the next five years, based on principles laid down in a 1961 government White Paper on financial aims of nationalized industries, will be for an average return of 6% a year on its net assets after provisions for depreciation but before taking account of interest charges.

Amery said similar objectives have not yet been set for British Overseas Airways Corp., which is expected to report another large loss this year. Future prospects of BOAC will be dealt with in a White Paper which will be presented to Parliament this fall, the aviation minister said.

In his report, Lord Douglas emphasized these points:

• **Net loss was arrived** at after meeting full amortization and depreciation of aircraft and stores and after paying interest on all BEA capital. Introductory costs of Vickers Vanguard turboprops and de Havilland Comet 4B jets in the past two years amounted to $17.5 million, of which about $9 million was incurred in 1962-63. Of this figure, $3.6 million has been capitalized and changed to reserves.

• **BEA output in capacity** ton miles went up in 1962-63 by 16.3%. Traffic increased by 16.2%, so that revenue load factor remained at same level as previous year.

• **Due to a 10% reduction** in operating costs per capacity ton mile, the break-even load factor was reduced from 61.7% to 60.2%.

• **Corporation lost about** $1 million in April and May of 1962 when airline electricians struck, forcing cancellation of more than 800 flights. Severe winter of 1962-63 forced cancellation of more than 1,000 flights. Due to both factors, plus slump in passenger demand, BEA revenue fell short of budget by about $10 million.

• **BEA carried total** of 4,914,927 passengers during the year. Total revenue went up 9.6% to $143.3 million but total expenditure increased by 6.9%. Freight traffic increased 17%.

Lord Douglas said BEA will increase capacity provided by Comets and Vanguards and will provide Comet jet services to 33 of the 59 destinations on the airline's international routes.

New de Havilland Trident will enter service next year, and Anthony Milward, BEA chief executive, last week said the airline will soon announce a further order for 10 of the larger Trident 1E versions. BEA now has 24 Tridents on order.

BEA's continuing warfare with Britain's independent airlines, and primarily with British United Airways, was underscored by Lord Douglas, who warned:

"BEA's future prospect of successful and profitable expansion could be completely destroyed by an undue licensing of duplicating British services, either domestic or international. All available evidence demonstrates that an excessive degree of competition, or the licensing of parallel services on routes of inadequate traffic potential to support two British airlines, must inevitably lead to deterioration in the financial results of airline operations."

TWA Develops Vane Straightener

Trans World Airlines has developed a new technique for reworking warped turbine nozzle guide vanes which it expects will save as much as $500,000 a year in jet engine overhaul costs.

The system is the result of two years' research by TWA engineers, undertaken to prevent the discarding of vanes which warp after subjection to intense heat and pressures. Because of the toughness of the metals used in the vanes, no economical method had been found for straightening the warped trailing edges. It has been estimated that inventories of unserviceable vanes held by military and commercial jet engine users currently total more than $12 million.

Under the new technique, vanes are removed from the engine in the disassembly overhaul operation and, after cleaning, are inspected for condition, class, bend and bow. Warped vanes are preheated in an electric furnace for 15 min. at 1,900F.

They are then placed in a die in a hydraulic press which is closed under 1,800 lb. pressure. An 8-lb. weight in the press is then released to strike the die with a sharp impact. Vanes requiring stress relief are placed in an inert gas oven for 2 hr. at 1,600 F.

Successful bidder for the press, which sells for $5,650, was Product Development Group of Wichita, Kan. The firm has been given exclusive manufacturing and sales rights by TWA. Cost of dies average $1,000 each and only one die is required for each vane stage.

Press has a capability of straightening an average of 40 vanes per hour at a total cost of $2 each. During an overhaul, an average of 100 vanes per engine require rework. Before the development of the press, new vanes had to be installed at a cost ranging from $39 to $132 per vane. Under the old system, the vanes represented approximately $5,000 of the total engine overhaul cost.

TWA research program was headed by F. L. Spruill, director of powerplant overhaul. R. T. Kalen, general foreman, headed a machine shop group that developed the dies.

In another technical development, TWA is working toward installation of the Lockheed Maintenance Recording System on the carrier's jets.

TWA has already evaluated the system in 800 hr. of testing on a Boeing 707 flying regular schedules. Federal Aviation Agency is supervising the evaluation program, since TWA will likely seek certification for installation of the system on all its jets.

The system automatically monitors engine, instrument and flight systems performance, recording their condition on a magnetic tape. Lockheed Aircraft Service Co. developed the system, supplementing its own components with data recording and playback equipment provided to it under license from Royston Instruments, Ltd., Byfleet, England.

TWA ground stations can be equipped with transmitters that send the taped data to a central computer system at the airline's Kansas City maintenance base. Personnel there evaluate the data, and inform those where the plane is located of any required maintenance.

CAB Approves Pan Am-Qantas Joint Fare

Washington—Civil Aeronautics Board last week outflanked an International Air Transport Assn. deadlock in international airline fares by approving a joint fare agreement between Pan American World Airways and Qantas Empire Airways, Ltd.

Still smarting from foreign criticism of its stand against an IATA-imposed fare increase on North Atlantic flights and powerless to block any further proposals by the international group, CAB broke an "open rate" situation which has existed for more than a year in the South Pacific by approving the joint fare application filed by the two airlines as individuals.

Pointing out that the open rate situation existed because of IATA members' inability to agree upon a proper fare in the area, the Board said the Pan American and Qantas fare agreement set a rate similar to that already established by IATA for the North and Central Pacific areas. Since the agreement was "apparently adopted outside the framework of the IATA machinery" and filed by the individual carriers, CAB said it was subject to consideration under sections 102,204(E) and 412 of the Federal Aviation Act.

Terms of the agreement provide for reduced round-trip fare for groups of 15 or more traveling together in economy class service. They represent a reduction of about 26% from the round-trip fares for travel between the West Coast, Honolulu and Sydney, Australia.

The Board also criticized the two airlines for failing to follow required CAB procedures by asking permission to discuss the fare proposals before filing an application.

The Board said it has encouraged a policy of such fare reductions, but warned: "We intend, however, in the future to withhold our approval and the anti-trust immunity it conveys from intercarrier agreements on rates and fares unless we have given advance authorization to the discussions leading to such agreements."

Boyd Favors Quality Competition Instead of Quantity in Some Areas

Washington—Alan S. Boyd, Civil Aeronautics Board chairman, last week gave some clue to his thinking on the competitive problems facing the airline industry by stating that he favored quality rather than quantity competition in a number of markets.

Testifying before the House Aeronautics Subcommittee, Boyd stressed that the jet aircraft had changed the competitive picture of the industry and said many markets in the U.S. could be "well served" by two competitors rather than three or more. He emphasized that the philosophy was his own and that he had no idea whether the other members of the five-man Board agreed with him.

During the hearings, Boyd again came under fire for his part in the majority decision in the New York-Florida Route Renewal Case in which Northeast Airlines' operating certificate between New England and Florida was withdrawn (see p. 32). Rep. Torbert H. Macdonald (D.-Mass.) charged that Boyd had "sounded the death knell" for Northeast with the decision and charged the Board with inconsistency in reaching the decision.

In a hostile attack on the Board, Rep. MacDonald said that there were 13 other markets in the U.S. with three or more trunk carriers. He criticized the Board for failing to enunciate the "new rules" he said are implied in its opinion in the Northeast case with respect to the effect jet operations have on airline competition.

Boyd held that the policies of the Board must necessarily change from time to time, and noted that the route structure for the Douglas DC-3 was entirely different from that which will be required when the supersonic transports are introduced in 1970. In response to a charge that the majority decision was a "bureaucratic" decree, Boyd said the "system is your system . . . set up by Congress. It is not my decision."

Rep. MacDonald charged the Board with a further inconsistency by noting that it had submitted a formula to the White House for a sharp reduction of subsidy (AW Aug. 19, p. 38), and then, on the same day, offered a $3.7-million subsidy to Northeast.

The CAB chairman, in answering the charge, said that the Northeast issue "was outside the scope" of the recommendations for subsidy cuts.

Boyd admitted that the Board would have difficulty in revoking permanent certificates on other routes where competition is excessive. He added that, from a legal standpoint, Northeast held no prior claim to a permanent route certificate on the New York-Florida route.

Pakistan, Red China Sign Air Service Pact

New York—Pakistani and Red Chinese governments last week signed an air service agreement between the two countries (AW June 24, p. 40).

By the act, Pakistan would ignore U.S. State Dept. suggestions that it not sign the agreement, which in effect provides Red China with its first access into the free area of Southeast Asia (see p. 34). U.S. government is concerned that the breach may be the first link in a route system that could eventually reach into Africa and Latin America.

Pakistan International Airlines gains rights into Shanghai and Canton under the agreement, a routing it needs for service to Tokyo. Service through China was sought after the British repeatedly refused Pakistan landing rights at Hong Kong. The Communist Chinese airline, operated by the Civil Aviation Administration of China, receives reciprocal rights to operate into Karachi and Dacca.

Pakistan plans eventual use of its Boeing 720B aircraft on the route, although this must await runway improvements at both Chinese points. However, Vickers Viscounts, of which the airline has three, could operate from existing facilities. The Chinese airline will probably fly Viscounts into Pakistan, having received five of an $11,500,000 order for six Viscounts from the British.

Riddle Will Use Two DC-8F Jet Traders

Washington—Riddle Airlines has signed a lease-purchase agreement with Douglas Aircraft Co. for two DC-8F Jet Traders.

Terms of the agreement cover a five-year lease of the aircraft and spares and an option to purchase at price of approximately $7,200,000 each, with credit for previous lease payments made by Riddle.

First of the two aircraft will be delivered in less than 30 days and the second is scheduled for delivery by March, 1964.

Riddle recently concluded a $2,600,000 refinancing program with Walter E. Heller & Company, Inc., and the Chemical Bank New York Trust Co., in cooperation with Douglas and General Dynamics Corp. The Miami-based, all-cargo airline, has concluded negotiations for military contracts which will total $8,697,206 in Fiscal 1964.

Early delivery of the first aircraft will make Riddle the first all-cargo carrier to provide pure jet service, President James B. Franklin said.

CAB Objects to Alaskan Route Sale

Washington—Pan American World Airways' sale of an Alaskan route segment to Wien Alaska Airlines, Inc., was temporarily delayed last week when the Civil Aeronautics Board objected to the $71,000 sale price because it includes a charge for intangibles.

Previously approved by a Board examiner, the sales application involves a Juneau to Fairbanks route via Whitehorse, Canada. Pan American has found the route unprofitable for turbojet operations. Sales price includes $21,662 for related ground operating equipment and property and $49,338 for franchises, leases and good will.

Board members took exception to approximately 70% of the sales price, representing the sale of intangibles, and stated that the final sale would be approved only on condition that it would not include such a charge.

Wien, with smaller aircraft and operations centered in Alaska, should be able to provide better service, according to CAB, which added: "We cannot lose sight of the fact that Wien already requires substantial subsidy support." While the examiner found that the new route probably will not cause an increase in the carrier's subsidy needs, he recognized the possibility of error in computations which could result in a need for more subsidy during the actual operation, CAB said. Pan American is preparing a reply to the Board's opinion.

N. Atlantic Area Concept Urged

Washington—Trans World Airlines last week told a Civil Aeronautics Board examiner that its proposal for an area concept of competition over the North Atlantic would increase load factors by two percentage points and would enable both Pan American World Airways and TWA to expand services into previously neglected markets.

Testifying at CAB Transatlantic Route Renewal Case hearings, E. O. Cocke, TWA senior vice president, proposed that his company be named exclusive U.S. flag carrier to Ireland, Southern Europe, the Mediterranean basin and Africa. In turn, Cocke urged that Pan American be granted exclusive carrier rights to the United Kingdom, and Northern and Eastern Europe, including Iron Curtain countries.

The board staff is supporting an area concept in the case and has been opposed in its stand by Pan American, which has attacked any division of existing routes between the two carriers. Richard M. Jackson, president of Seaboard World Airlines, has supported the area concept but has criticized the Board's failure to propose a limited European market passenger franchise.

New York-Paris Market

Cocke cited the New York-Paris market to back his proposal for area concept competition. He said both TWA and Pan American now operate two daily, eastbound, non-stop flights on the route —one in the morning and one in the evening, and "the load factor on our morning flight is not good."

He said under the TWA plan, his company would operate three daily nonstop flights, one in the morning and two in the evening. The morning flight, he said, would easily absorb traffic now carried by Pan American, and the same number of evening flights would be operated under the area concept as are now being operated.

On the subject of foreign competition, Cocke claimed that the two U.S. carriers "dissipate much of their energies and strength in competing against one another."

"The area concept would eliminate this unnecessary competition and permit TWA and Pan American to concentrate and marshal their resources against their foreign competitors," Cocke said. "It would also permit both carriers to increase their services in markets which heretofore have been somewhat neglected because of the concentration of schedules in markets where we compete with one another."

Seaboard Requests

Jackson asked for these adjustments in Seaboard's operating authority:

• **Permanent certificate.** Jackson said this was required to ensure continued development of international air cargo markets.

• **Route structure.** Jackson termed Seaboard's present system "clumsy and uneconomic." Specifically, Jackson wants more flexibility in serving the European area without being restricted to fixed markets.

• **Passenger franchise.** Jackson held in his testimony that supplementary revenues from passengers on each flight would permit the scheduling of more flights to more destinations, thus providing an expanded cargo service.

Jackson said passenger carriers draw supplementary revenues from cargo to support more passenger service. "Without cargo in their belly compartments, the number of passenger flights would have to be reduced substantially to yield an economic operation," he said.

MacIntyre Gives View On Northeast Finances

Washington—Malcolm A. MacIntyre, president of Eastern Air Lines, last week gave his views on the financial effects that the withdrawal of Northeast Airlines from the Florida market (AW Aug. 26, p. 38) will have on the Hughes Tool Co.

In a supplemental statement filed with the Senate Aviation Subcommittee, MacIntyre held that Hughes Tool's interest in Northeast "may be best understood as motivated by a desire to effect substantial tax savings." He said Toolco's "investment" in Northeast is not as large as generally believed, and gave this background of the Northeast-Toolco relationship to explain his stand:

• **Toolco loaned Northeast** $9.5 million in May, 1960, in exchange for 6½% debentures convertible into Northeast common stock.

• **Toolco agreed to buy** from the Atlas Corp. its majority interest in Northeast in December, 1961, for $5 million and to take over Northeast notes to Atlas totaling $16,251,744. Thus Toolco's investment in Northeast totaled $14.5 million, MacIntyre said.

• **On June 25, 1962,** Toolco agreed to cover cash operating deficits of Northeast. Last July, prior to the CAB decision to pull Northeast from the New York-Florida route, Toolco advised the airline that it was converting its $9.5 million of 6½% debentures to Northeast common stock and was "cancelling" the $16 million debt.

MacIntyre said neither the conversion nor the cancellation would provide Northeast with additional funds. But he said "there appear to be good tax reasons for Toolco's actions." He explained that the 82% ownership of Northeast permitted Toolco to file a consolidated tax return with Northeast, offsetting Northeast's losses against Toolco's profit.

Thus, MacIntyre said, "since Northeast in 1962 lost over $8 million, filing a consolidated return would reduce Toolco taxes by over $4 million. In these circumstances, Toolco could cover Northeast's cash losses of about $4 million annually at no cost and could cover its cash operating losses of some $2 million annually at a tax profit of over $2 million annually and at a tax savings of some $4 million a year."

If Northeast's losses were to continue in the future on the same scale as in the past, MacIntyre said, the consolidated return would enable Toolco to recover through tax savings its total $14.5 million investment in Northeast in seven years and still continue to cover cash operating expenses of $2 million a year. Total tax savings to Toolco would be some $30 million, he said.

Opposition May Kill Aircraft Lighting Plan

Washington—Federal Aviation Agency may be forced to shelve its plans to require a new system of aircraft lighting as a safeguard against mid-air collisions because of bitter opposition from the military services and a majority of the airline industry.

An FAA rule change proposed six months ago emphasized that a more powerful lighting identification system was needed to offset a higher probability of night mid-air collisions which is caused by the increase in speed and increase in traffic resulting from the use of turbojet aircraft.

Rather than await the results of any further research or experimentation on substitute systems, FAA said, the simplest and most economical answer would be to require all aircraft certificated on or after Jan. 1, 1965, to be equipped with a system of red, white and green, high-intensity, flashing lights that are designed to show both forward and side movement.

A flashing red light would be carried on the left wing tip sector. Since the regulation would not be retroactive, all aircraft certificated before this date would be required to remove their existing systems of a red light in each sector. Although FAA said the change should not await further research on other high-intensity systems, it said it would encourage further experimentation.

Immediate Impact

Immediate impact of the proposal was to deepen the rift between FAA and two groups of light users—airlines and general aviation users who have already invested heavily in the more sophisticated, high-intensity, strobe light system manufactured by the Minneapolis-Honeywell Regulator Co. and would add it to present lighting; and those who prefer to maintain the status quo on aircraft lighting.

Objectors to the proposal said the suggested system was rejected by most of the industry four years ago, although it is currently being used by United Air Lines.

American Airlines, which has ordered the Honeywell Atkins system for use on its Boeing 727s and BAC 111s, is leading the opposition. This includes Delta, Northwest, North Central, Ozark, Pan American and Piedmont. Favoring the proposal are Continental, United, Mohawk, National and Trans Canada. Trans World, Eastern and Braniff submitted "no comment" answers in their replies to the FAA. American called FAA's idea a "retrogression in safety," contending that it does not provide the configuration or directional identity offered by the Atkins system of white lights with a high flash-frequency in the front of the aircraft and a low flash-frequency in the rear. In particular, the FAA system lacks the ability to clearly outline aircraft in hazy, daylight conditions, American contended.

American criticized former FAA Flight Standards Director George Prill for reassuring it that FAA did not intend to make any revision to the existing light system regulations until the completion of tests at the agency's experimental test center at Atlantic City. This reassurance was obtained before American signed the order for the Atkins light system, American said.

FAA has been evaluating aircraft lighting systems for several years, but the airline industry has yet to receive any report on the projects "paid for by taxpayers' money. FAA has apparently accomplished nothing with all of the money spent," American stated in its reaction to the FAA proposal.

Honeywell's Complaint

Defending its product, Honeywell complained that FAA ignored a successful Air Force test last year of the Atkins system involving 1,087 test flights at Enid, Okla. The manufacturer said that FAA regional officers last January approved the use of the Atkins system for day and night use on North Central Airlines' Convair-340 and 440 aircraft, but this proof of its capability was ignored by FAA headquarters in the proposed rule change. In addition to American and North Central, users of the Atkins system include 60 executive aircraft. The company claims the Atkins lights can be seen at distances from 8 to 15 mi.

Particularly strong objection to the FAA proposal—and strong support for the Atkins system—came from the Air Force, which cautioned that adoption could force significant redesign of its C-141-A StarLifter cargo jet (AW Aug. 26, p. 30). Air Force said it favors use of the Atkins system, with filters, on Military Air Transport Service aircraft. But it cited the high retrofit costs which could be involved in any lighting change and asked FAA to extend the effective date of any new lighting regulation from January, 1965 to January, 1966.

Army and Navy both urged that the current system be retained as the most practical compromise for weight and economy. The Navy added that adoption of the proposed regulation would cause confusion between the new system and the old one until older aircraft were phased out.

Another Rejection

Aero Data Corp., one of the major supporters of a more sophisticated light system, also rejected the FAA proposal on the grounds that, while it would make the airplane more conspicuous, it would fail to indicate the flight path clearly.

The Aero Data lighting system employs a chain of high intensity lights, flashing forward at high frequency from the tail assembly to the nose.

Air Line Pilots Assn. comments were particularly conspicuous because they represented almost the only support for FAA's proposal. ALPA said the suggested FAA system is not the "ultimate" that could be realized, but it would be a forward step toward greater safety.

The pilots' union said FAA should shorten its proposed implementation date to January, 1964 and make the regulation apply to all aircraft, including military.

FAA said it is still evaluating all comments and does not know yet whether it will adopt, amend or drop the proposal. Since the overwhelming majority of comments submitted were strongly opposed to the FAA suggestion, however, many observers believe the lighting system proposal will be abandoned.

Taxi Requests Refused

Washington—Air taxi operators' ambitions to attain third-level air carrier status have received a sharp setback from the Civil Aeronautics Board, which has refused operators' requests to permit the use of larger aircraft.

National Air Taxi Conference and the National Assn. of State Aviation Officials have received a flat rejection to their proposals that CAB lift the present weight limitation of 12,500 lb. for air taxi aircraft to 20,000. The organizations contended that changes in the industry justified the requests for increased weights.

Alan S. Boyd, CAB chairman, replied that the original purpose of the weight limitation was to minimize competition with certificated carriers, particularly subsidized local service airlines.

Emphasizing that the Board's blanket exemption grants air taxi operators the right to serve any points served by certificated airlines, limited only by the aircraft weight, Boyd suggested that taxi operators could improve their competitive position by examining several new aircraft within the weight limitation, but with greater capacities.

AIRLINE OBSERVER

► Drive to increase tourism in Alaska by granting foreign flag carriers traffic rights in Anchorage on Tokyo-Europe polar flights has been launched by Sen. E. L. Bartlett (D.-Alaska). Passengers now flying the route on foreign airlines are not given stopover privileges in Anchorage, nor may these airlines pick up passengers for continuing trips. Civil Aeronautics Board has advised Sen. Bartlett that it will test the reaction of U. S. carriers to the plan before investigating the proposal. Last year, Northwest violently opposed a similar plan on grounds that foreign carriers would drain traffic from its U. S.-Japan North Pacific route.

► Several key airline industry officials are promoting Gordon M. Bain, Federal Aviation Agency deputy administrator, as a candidate for the top FAA post. Bain's handling of the supersonic transport program has made a strong impression in industry circles.

► New early retirement policy at British Overseas Airways Corp. (AW Apr. 22, p. 52) last week resulted in retirement of 19 captains, all in their fifties and most commanding BOAC's Bristol Britannia turboprop transports, which are being phased out. The 19 captains will receive cash compensations and pensions. The airline said its total staff has been reduced by 867 employes in the last year. As of July, BOAC's work force totaled 21,368 employes.

► National Capital Airport bill, calling for the operation of Washington, D. C. airports as a corporation, has been shelved in the House because of White House irritation over the addition to the bill of a provision requiring arbitration of fees and rentals between the corporation and airport users. Provision was sponsored by the airlines. Speculation is that the White House feared the setting of a precedent that might spread to other agencies.

► National Airlines took first place from Continental Air Lines during the first six months of 1963 in utilization of turbine-powered aircraft. National reported a 10 hr. 45 min. average utilization per plane with its fleet of Douglas DC-8 transports compared with Continental's 10 hr. 34 min. with the Boeing 720 and 10 hr. 12 min. with the Boeing 707. Eastern Air Lines reported 10 hr. 28 min. with the Douglas DC-8 and 9 hr. 14 min. with the Boeing 720. No other trunklines passed the 10-hr. mark during the period.

► Watch for Eastern Air Lines to complete financing soon with banks and insurance companies for its Boeing 727 order. The plan also will include arrangements for meeting or extending maturity of a $20-million installment due this year on an $80-million bank loan that is part of Eastern's current debt structure. Leasing of some 727s is under discussion as part of the plan.

► Senate Commerce Committee met last week to prepare legislation that will give the U. S. control over international air fares. Sen. Warren G. Magnuson (D.-Wash.) said the bill will be expedited but chances appear slim that the act will be passed during the current congressional session.

► Watch for a renewed concerted drive by foreign flag carriers to prove that their investments in aircraft, engines, spares and parts largely offsets revenues earned from U. S. air passengers to give the U. S. a highly favorable balance of trade in airline operations.

► Red China has advised Pakistan to ignore "U. S. dictation" of Pakistan's civil aviation policies. The weekly "Peking Review" said that "Washington resorted to its usual pressure tactics" when a State Dept. spokesman openly expressed "disquiet" over Pakistan International Airlines' successful negotiations with Chinese authorities for a Pakistan-China air transport agreement (AW June 24, p. 40).

► Boeing Co. last week began a two-month series of demonstration flights with the Boeing 727 transport that will cover 41 cities in 23 countries.

► Pan American World Airways has reported a 25.1% share of transatlantic traffic for the first seven months of 1963, compared with a 21.9% share in the same period last year. Pan American said the additional 55,600 passengers provided an estimated $17 million in revenues.

SHORTLINES

► **American Airlines** has begun construction of additional space at its cargo terminal at Idlewild. Additional facilities also are planned for its cargo terminals at San Francisco, Los Angeles, Chicago, Detroit and Boston.

► **Austrian Airlines** has reported a 46% increase in the number of passengers carried in July, compared with the same month last year. Air freight in July increased 41% over the previous July.

► **Civil Aeronautics Board** will hold a special meeting Sept. 5 for a discussion between the Board's staff and local service carriers on the amendment of existing class subsidy rate.

► **Continental Air Lines'** three-class fare system has been marked a success by the company after the first full year of experience with the plan. Carrier says revenue passenger miles for the period rose 24% compared with the previous 12 months. Coach-business class climbed 38% compared with coach traffic in the previous period, the airline reported.

► **Fairchild Stratos Corp.** is demonstrating the company's latest production version of the F-27 turboprop transport in Venezuela, Brazil, Uruguay, Argentina, Bolivia and Peru.

► **Iberia Air Lines** of Spain has taken delivery on its sixth Douglas DC-8 transport. Carrier's turbine fleet also includes six Sud Caravelle transports, which are used on its domestic and European route system.

► **Pan American World Airways** will begin its fall and winter schedules on the transatlantic and transpacific routes without a single piston-engine aircraft. Last piston-engine flight will be operated Sept. 28 from Lisbon to New York.

► **Russia's Aeroflot** had its biggest monthly traffic volume in history during July when it "averaged more than 132,000 passengers daily," indicating a total of around 4.1 million passengers for the month. Goal for the year, which Aeroflot still hopes to achieve despite a below-plan first six months, is 35 million passengers.

► **Trans World Airlines** last week began showing motion pictures in the first-class cabins of U. S. transcontinental non-stop flights. TWA has been showing inflight movies on transatlantic first-class flights for two years and in economy sections of these flights since May.

Airline Traffic—June 1963

	Revenue Miles (000)	Originating Passengers (000)	Revenue Passenger Miles (000)	Revenue Passenger L/F (%)	Total Revenue Ton Miles (000)	Average Over-all Load (Tons)	Scheduled Miles (000)	Performance Factor (%)
DOMESTIC TRUNKS								
American	11,369	793.0	690,316	65.5	82,587	7.26	11,357	98.7
Braniff	2,575	217.6	109,399	57.9	12,237	4.75	2,573	99.4
Continental	2,260	158.0	116,572	58.5	12,854	5.69	2,254	99.6
Delta	4,956	423.1	265,744	66.1	29,360	5.92	4,971	98.8
Eastern	8,798	837.6	399,766	52.5	43,229	4.91	8,736	97.9
National	2,653	184.1	144,389	53.6	15,795	5.95	2,680	98.6
Northeast	1,273	119.2	50,089	53.6	5,103	4.01	1,376	90.2
Northwest	2,871	225.8	154,615	59.7	17,269	6.01	2,890	99.0
Trans World	8,547	531.3	518,570	60.2	58,501	6.84	8,513	99.4
United	16,229	1,156.9	855,715	60.0	98,022	6.04	16,101	98.5
Western	2,228	233.0	130,349	56.8	13,385	6.01	2,272	97.8
Domestic Trunk Total	**63,759**	**4,879.6**	**3,435,524**	**59.8**	**388,342**	**6.09**	**63,723**	**98.5**
INTERNATIONAL								
American	152	9.2	8,533	50.3	1,118	7.35	151	100.0
Braniff	270	9.6	13,243	51.5	1,731	6.42	270	99.8
Caribair	149	49.9	3,868	61.7	405	2.72	141	96.7
Delta	109	3.5	6,003	64.8	665	6.13	109	100.0
Eastern	1,100	60.4	87,675	60.4	8,566	7.79	1,093	97.9
Mackey	163	14.6	4,833	43.7	477	2.92	79	99.2
Northwest	987	24.7	62,829	58.0	9,420	9.54	914	98.7
Panagra	327	11.3	18,392	57.9	2,704	8.28	326	96.5
Pan American	10,683	440.2	828,467	62.2	107,910	10.10	9,948	98.0
South Pacific	27	0.3	852	38.0	87	3.17	27	100.0
Trans Caribbean	386	22.0	42,530	68.1	3,940	10.20	288	100.0
Trans World	2,647	60.3	187,004	54.6	24,401	9.22	2,626	99.4
United	879	29.1	72,768	69.5	8,090	9.20	883	99.5
Western	181	8.1	12,346	68.1	1,323	7.29	183	99.3
International Total	**18,060**	**743.2**	**1,349,343**	**60.8**	**170,837**	**9.46**	**17,038**	**98.4**
LOCAL SERVICE								
Allegheny	988	100.0	20,063	46.1	2,141	2.17	957	99.1
Bonanza	499	43.3	11,213	59.1	1,109	2.22	500	99.5
Central	597	34.6	6,990	42.5	739	1.24	595	99.3
Frontier	954	45.7	13,122	42.8	1,399	1.47	955	99.2
Lake Central	574	42.2	6,832	41.8	728	1.27	570	99.3
Mohawk	1,031	111.4	23,322	52.7	2,375	2.30	1,020	99.2
North Central	1,280	103.0	19,051	43.8	2,038	1.59	1,261	99.8
Ozark	868	71.3	13,619	53.7	1,434	1.65	869	99.8
Pacific	452	47.2	10,208	53.9	1,016	2.25	454	99.2
Piedmont	914	73.8	17,070	48.4	1,761	1.93	907	98.9
Southern	841	52.3	10,047	37.7	1,063	1.26	830	99.1
Trans-Texas	654	36.7	8,606	43.1	906	1.39	657	99.2
West Coast	598	37.3	9,109	46.0	915	1.53	597	99.1
Local Service Total	**10,250**	**798.8**	**169,252**	**47.1**	**17,624**	**1.72**	**10,172**	**99.3**
ALASKA & HAWAIIAN								
Alaska Airlines	237	7.4	6,118	41.1	1,393	5.88	159	88.9
Alaska Coastal	167	12.0	884	56.2	107	0.64	121	98.5
Aloha	200	36.4	5,440	67.1	444	2.22	189	96.7
Cordova	128	4.0	401	46.5	122	0.96	65	93.0
Hawaiian	310	52.3	7,736	61.9	804	2.59	277	90.6
Kodiak	49	1.3	88	33.3	10	0.20	22	99.5
No. Consolidated	175	3.3	1,018	42.3	288	1.64	114	98.6
Pacific Northern	400	18.8	17,547	48.4	2,746	6.86	377	100.0
Reeve Aleutian	159	2.1	1,744	38.5	591	3.72	80	87.2
Western Alaska	33	1.4	67	77.0	8	0.25	15	98.8
Wien Alaska	390	6.1	2,236	41.3	522	1.34	195	95.3
Alaska & Hawaiian Total	**2,248**	**145.1**	**43,279**	**49.8**	**7,035**	**3.13**	**1,614**	**95.2**
HELICOPTERS								
Chicago	29	6.0	124	43.1	12	0.42	29	99.3
Los Angeles	67	16.0	634	53.2	68	1.02	72	92.1
New York	42	25.7	498	51.3	50	1.19	42	84.0
Helicopter Total	**138**	**47.7**	**1,256**	**51.3**	**130**	**0.95**	**143**	**91.2**
CARGO & OTHERS								
Aerovias	Not Available							
Avalon	27	8.1	263	73.7	26	0.98	16	99.6
Flying Tiger	1,197	9.6	40,018	84.3	17,675	14.77	283	100.0
Riddle	898	3.1	14,485	93.9	6,486	7.22	183	93.2
Seaboard	607	7.9	30,778	97.8	10,221	16.83	355	93.4
Slick	582	1.8	5,852	79.7	8,042	13.83	167	99.8
Cargo & Other Total	3,311	30.5	91,396	89.5	42,450	12.82	1,004	96.4
Industry Total	**97,766**	**6,644.9**	**5,090,050**	**59.8**	**626,418**	**6.41**	**93,694**	**98.5**

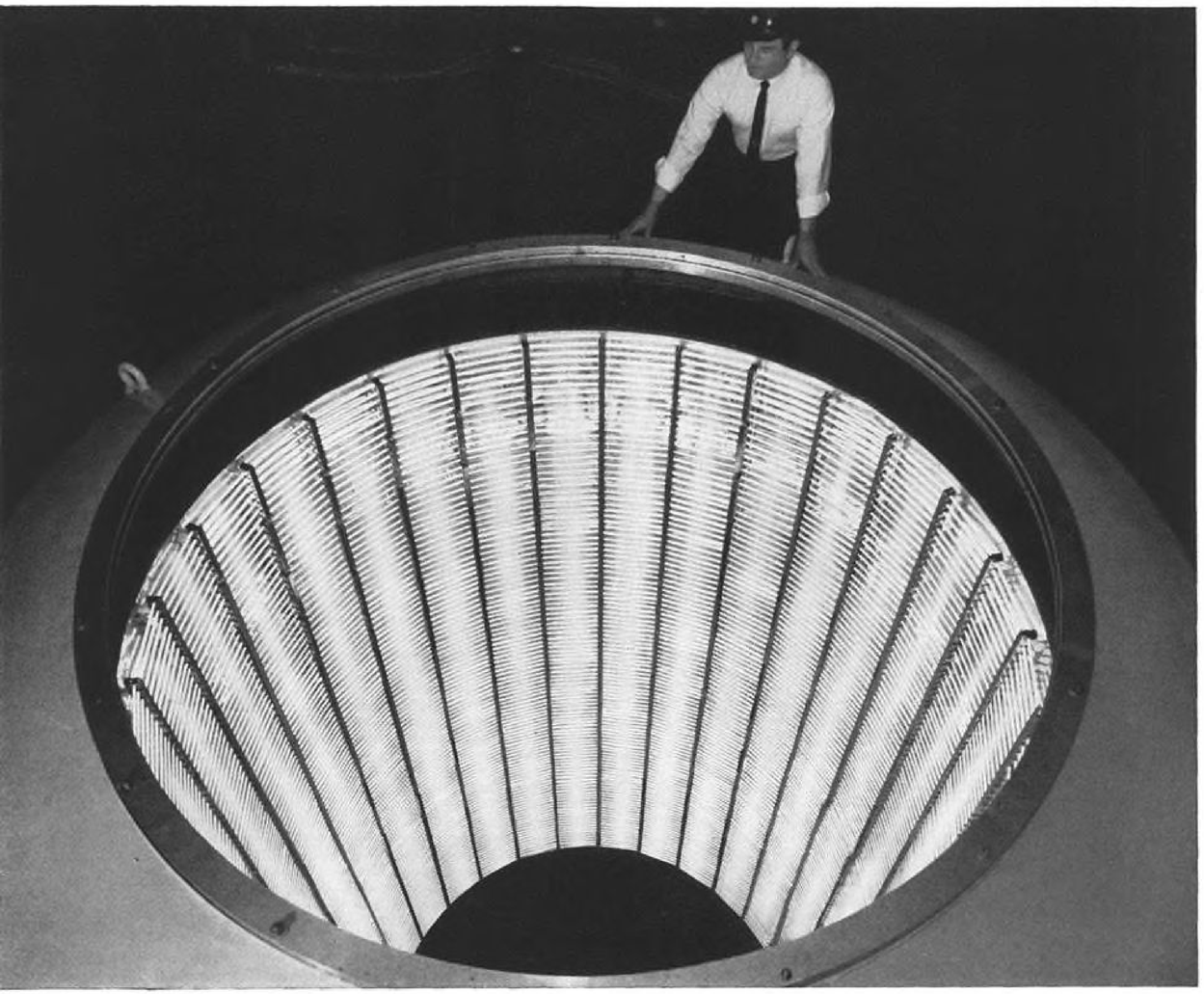
Prepared by Ray & Ray

British Aircraft Corp.'s BAC 111, which made its maiden flight recently at Hurn, England, main assembly plant (AW Aug. 26, p. 39) is shown (above) as BAC chief pilot G. R. (Jock) Bryce lifted the aircraft after a ground run of about 3,000 ft. Gross takeoff weight was 59,000 lb. Tailhook-like extension from the fuselage is a proximity warning rod to provide cockpit warning if rotation is too steep.

BAC 111 Shown in First Takeoff and Approach

Starting climbout (above) with takeoff flap setting of about 15 deg., BAC 111 begins 27-min. maiden flight. Note slight upward deflection of the elevators on aircraft's moving tail plane. Landing (below), BAC 111 is shown crossing the runway threshold at Hurn, prior to full-flap touchdown. Note Hunting Provost chase plane in background. Six BAC 111s will soon enter a flight testing and certification program.

Beech *"Imaginuity"* in TESTING



This is where Beech puts the heat on major space age problems

Nation's largest transient heat laboratory is a vital part of a comprehensive systems management capability

Inside this six-story building, temperature ranges from −423°F. to +1,500°F. may be achieved. 3,000 quartz lamps, programmed and operated from a remote control center, can simulate elements of standby and boost phases of flight.

Today, this transient heat laboratory is part of the vast Beech complex that has been put to work to design, develop, manufacture and test the super-critical gas storage systems that will sustain life and supply electric power for the command module of Project Apollo. Beech has prime responsibilities for these systems as a major sub-contractor for North American.

A pioneer in Cryogenics, Beech has designed, developed and tested many tankage and propellent control systems for missiles and rockets. A constantly expanding complex of facilities coupled with highly trained and experienced personnel makes Beech a natural choice for systems management projects. In addition to this transient heat facility...

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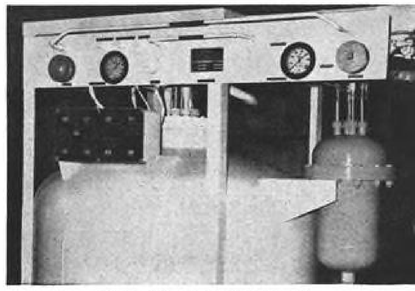
R & D...

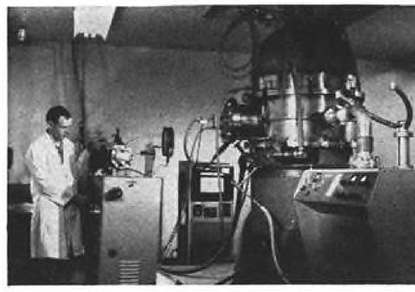
Propulsion...



Auxiliary Power...

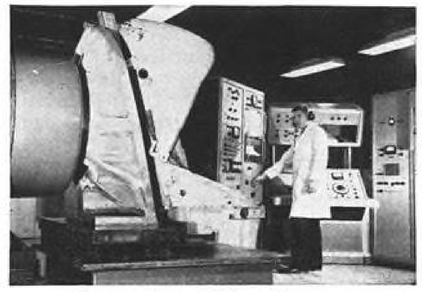
GSE...

Manufacturing...



Space Simulation...

Facilities...



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DDR&E Ponders Military Comsat Future

By Irving Stone

Los Angeles—Future of the military medium-altitude communication satellite (MACS) will be charted by the impending decision of Dept. of Defense Research and Engineering (DDR&E), following review of the program's Phase 1 results.

Interested industry and military personnel see three possible courses:

- **Approval for go-ahead** with Phase 2, involving development and production of the satellite as originally planned under Air Force Space Systems Div.'s Program 369, as a quickly-available, minimum-risk, minimum-survivability communication system.
- **Reorientation of the program** to include state-of-the-art advances relative to attitude stabilization techniques.
- **Cancellation of project** in view of the success with the NASA/Hughes synchronous-orbit Syncom communication satellite (AW Aug. 19, p. 30).

Apprehension exists that DDR&E may follow either of the last two. It is felt that reorientation for inclusion of advanced state-of-the-art will delay the projected 1965 operational target date and confuse the aim of the program. Cancellation, these sources feel, will push aside a promising and soon-realizable technique for what they believe is the more complex Syncom system with its difficult trajectory and much later operational date. Both the medium-altitude and synchronous-orbit satellites are regarded as necessary, at least in the early stages of space relay systems, for an efficient and reliable network.

The more than 4,000-page reports of General Electric/Motorola and Philco/Space Technology Laboratories competitive teams, which completed the Phase 1 program definition and preliminary design on Aug. 1, have been evaluated by a group composed of three Air Force officers and one Aerospace Corp. technical manager, aided by sub-groups comprised of Air Force and Aerospace personnel. Findings of the evaluation group have been submitted to the source selection board, composed of four military officers of two-star rank, for selection of a single contractor for Phase 2. This is being followed by review of the evaluation findings and the contractor selection by Air Force Systems Command, Air Council, Defense Communications Agency, and DDR&E. Final review and decision is expected to be made at White House level.

A decision on the course of the program likely will be firm by mid-September, with Oct. 1 as the go-ahead date for development and fabrication if the original program plan is followed. Meanwhile, GE and Philco are proceeding under Phase 1 with funded development of hardware for a sequential dispenser projected for use in successive ejection of the random-orbiting multiple satellites each Atlas/Agena D will loft to a 5,000-6,000 naut. mi. orbit.

MACS would be the first communication satellite system, as opposed to individual communication satellite experiments, such as Telstar, Syncom, Relay, Courier and Echo. The MACS program has these features:

- **Approximately 50 to 75 satellites** will be built initially, with perhaps 15 satellites per year introduced into the program, as required.
- **Satellite configuration,** depending on contractor selected, might be a symmetrical polyhedral or a vertical canister type. The satellite's largest dimension probably will not exceed 3 ft. Solar cells would cover almost its entire surface.
- **Satellites will be deployed** in four polar orbits and the system is projected to give 99% availability of communications between critical military sites.
- **The satellite dispenser** will eject six to eight 100-lb. satellites in each payload boosted. The Agena guidance system will determine the correct orbital altitude (5,000 to 6,000 naut. mi.) for successive satellite ejections. A sufficient quantity of satellites will be ejected to assure that 20 to 30 working satellites will be available. Dispenser could be in the form of a vertical truss, with satellites stacked on either side of center spring-ejection mechanisms.
- **Typical boost trajectory** would involve a launch in a southerly direction from Pt. Arguello over the Pacific Missile Range. The second-stage Agena would place the payload into a transfer ellipse with an apogee corresponding to the desired orbital altitude. At this apogee, Agena second burn would be initiated for additional impulse to circularize the orbit. Almost immediately the sequential dispenser would eject the satellites from the Agena, giving each a speed increment to spread the satellites along the orbital plane. Time required to attain the 5,000-naut.-mi. ejection altitude will be about 1½ hr.; orbital period will be about 5 hr.
- **Early operational target** (1965) for MACS is tied to the use of air-transportable ground stations utilizing reflectors not exceeding 30 ft. in dia. Complexity and sensitivity of receivers will be in keeping with easy-support capability for remote areas.

DOD Denies Comsat Change Plan

Washington—Defense Dept. is denying that any changes are contemplated in the present configuration of the military communication satellite system.

Nearly two months ago, the Pentagon suggested that General Electric and Philco, finalists in the program definition phase studies, consider the possible growth potential of a satellite using gravity gradient attitude stabilization. The Defense Dept. more recently has asked the National Aeronautics and Space Administration to evaluate this technique at an altitude of 6,000 mi. to determine its effectiveness for a space communication system.

If such a technique is introduced, according to a Defense Dept. spokesman, it is not likely to occur until after several dozen non-stabilized military communication satellites already are in orbit, in order not to delay the system by introducing additional unproven techniques beyond the multiple-satellite launch already planned.

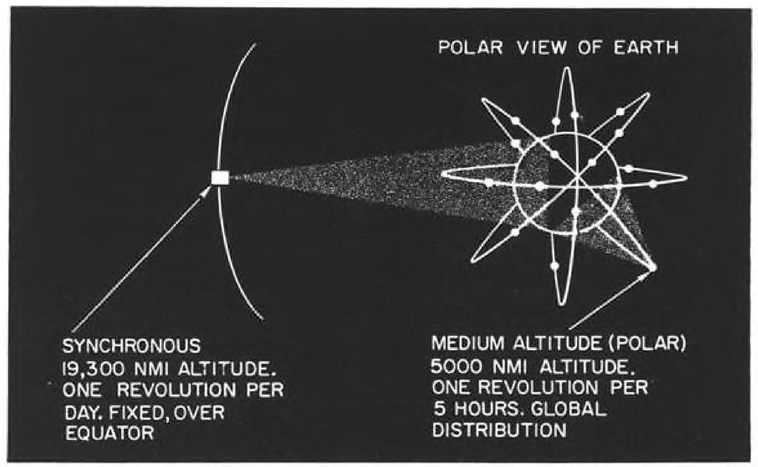
Military-industry speculation over a possible Pentagon shift to a synchronous system may have resulted from public statements by DDR&E officials indicating that the ultimate optimum military system is likely to be a combination of both medium-altitude and synchronous satellites, and the recent success of the NASA-Hughes Syncom 2 synchronous satellite.

An uncertainty hanging over the present medium-altitude military space communication system is the question of how much money will be authorized by Congress for Fiscal 1964. Level of funding presently contemplated by Congress, which is below that requested by the Pentagon for the medium-altitude system, is expected to delay first launch of the military system by nearly a year. If Congress should authorize far more money than the Pentagon has asked for, the excess might be used for a synchronous system, but this possibility seems remote.

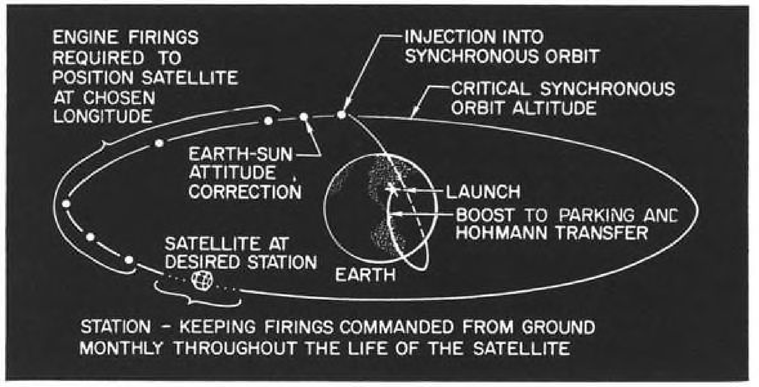
- **MACS will be spin-stabilized** and will be fitted with a dipole antenna omnidirectional in one plane and with about a 48-deg. earth-coverage in the other plane.

MACS has been projected entirely as a state-of-the-art program to meet what is considered a modest, but critical requirement for military global communications. From approximately May, 1962, until early January, 1963, Aerospace Corp., which is responsible to the Air Force's Space Systems Div. for the program's general technical direction and systems engineering, planned the MACS system, its dispensing technique, orbital mission and other factors in keeping with existing technology. Aerospace invited briefings by industry contractors to ensure that detailed information on the limits of existing state-of-the-art would be available.

Industry feeling is that trying to keep up with the state-of-the-art during a program with a definite goal results in substantial delay and additional expense and, frequently, confusion. Almost immediately after any program is firmed it begins to lag the state-of-the-art. By the end of a one- or two-year development period the state-of-the-art lag may be deemed substantial. The critical question is whether the level of technology to be attained at the end of a specific development period is adequate to meet the program requirement initially established.



PATTERN OF DISPERSAL is indicated (above) for medium altitude communication satellite in four polar orbits. Shaded pattern indicates coverage for MACS and synchronous satellite. Trajectory factors to achieve equatorial synchronous altitude and maintain the station are shown (below). Inclination change is accomplished with injection into synchronous orbit.



MACS Reorientation

DDR&E may re-orient the MACS program to include a state-of-the-art advance by introduction of a gravity gradient-stabilization system, on the basis of partial success attained by Navy and Johns Hopkins University's Applied Physics Laboratory with a Transit-series satellite launched on June 15. Its orbit had an apogee of 415 naut. mi. and a perigee of 390 naut. mi. Orbital inclination was 90.02 deg. and eccentricity 0.003.

Whereas the Navy/APL experiment indicated a fairly high stabilizing effect to achieve antenna directivity, the results may not have been as successful as anticipated, and refinements could be funneled into the Navy program to produce expected results.

Both DDR&E and NASA are considering advisability of conducting experiments to apply the gravity gradient-stabilizing technique for service in a satellite orbiting at higher altitudes than the Navy satellite, such as the 5,000 naut. mi. projected for MACS. This could result in re-orienting the MACS program to sidetrack Phase 2 development while experiments are conducted to establish the validity of the gravity gradient technique for medium altitude satellite application.

Industry observers close to the MACS program advocate proceeding with the program as originally planned, with gravity gradient-stabilized satellites phased into the launchings, on a progressive basis, without disturbing the time schedule for MACS, which military planners feel is critical for their communications needs. Using a progressive approach, it is felt that the entire battery of 6 to 8 satellites in the MACS payload ultimately could be converted to all gravity gradient-stabilized satellites, if the validity of the technique is established either before or during operational deployment of the MACS system. Industry observers feel that prime consideration in the gravity-gradient stabilization technique is to establish that it will work equally as well at the 5,000-naut.-mi. altitude, where gravity effects are about an order of magnitude less than those experienced in the 400-naut.-mi altitude where the Navy/APL satellite was deployed.

The gravity-gradient technique simply is a means of utilizing the earth's gravitational pull to maintain a satellite oriented towards earth, so that its beam could be directed only at the earth for maximum gain. A simple configuration to illustrate this technique could be a dumbbell-shaped unit having one of the ball ends heavier than the other and with a pivot in the shank connecting the two ball ends. On earth the heavier end would swing down to provide a stabilized configuration.

Orbital Weightlessness

By contrast, in orbit the configuration would be weightless and the gravity gradient effect would be minimized. If, however, the dumbbell configuration were given sufficient length, it would be possible to establish a slight difference in "weight" of the two ball ends, because one end would be appreciably closer to the center of the earth than the other. Result would be that the g-pull would tend to straighten the configuration and align it with the local vertical. A damping device also would be needed to counteract perturbation

effects which otherwise might cause the satellite to tumble.

The size of the gravity gradient restoring force that would cause the satellite to orient itself along the vertical at 5,000 naut. mi. is only about one tenth of that present at the 400-naut. mi. altitude of the Navy satellite. Industry members close to the MACS program feel that it would be risky to re-orient the program on the assumption that the Navy-APL system would be effective at high altitude to the degree demonstrated at the low altitude.

Spin-Stabilized Satellite

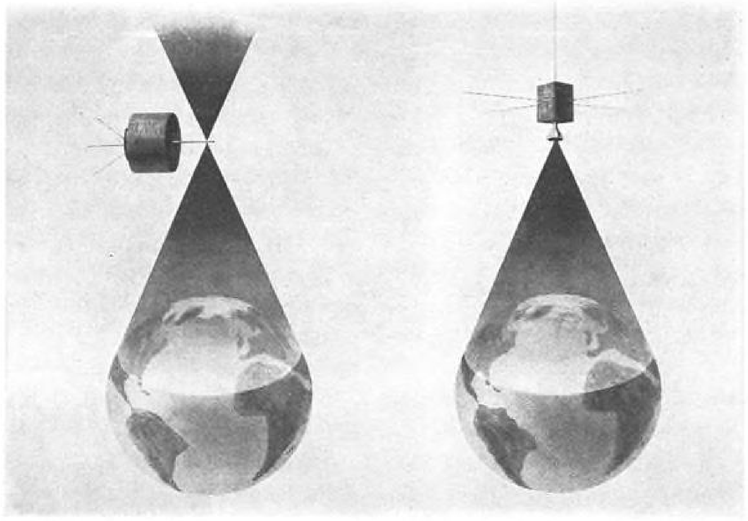
It is felt that the MACS program should proceed with development of a spin-stabilized satellite to meet military communications needs as early 1965. The MACS multiple dispenser stack could be modified without difficulty to accommodate a gravity gradient-stabilized satellite for comparison to MACS in the same mission. If feasibility of the technique for the deployment altitude were established, the gravity gradient-stabilized units could be used to substitute for spin-stabilized satellites which cease to function in the MACS orbit. With successful gravity gradient stabilization established for MACS, its communication capacity would be increased many times because of the antenna gain.

Proponents of the MACS system feel that successful achievement by Syncom of synchronous altitude and its subsequent transmission might dim, in the DDR&E review, the attractive features and relatively early availability of MACS for the military, to the extent that its cancellation might be considered in favor of a military synchronous satellite system.

Rotation Period

The synchronous system operating at an altitude of 19,300 naut. mi. has a period of rotation equivalent to one sidereal day. If the orbit is in the plane of the earth's equator, the satellite remains over a fixed point on the earth's surface and, in effect, serves as a fixed relay tower. Ideally, three such deployments, spaced 120 deg. apart, would afford almost world-wide communications. Concept of a satellite which remains fixed relative to the earth appears to offer greater flexibility and more communication capacity than the MACS system, which involves the requirement of tracking and the need for ground stations to change from one satellite to another as they progressively appear and disappear over the horizon. Both systems could be used together advantageously, it is felt, with ground stations operating for either or both of the systems.

Ultimately, limitations imposed by booster capability and satellite reliability will diminish to an extent that would make the synchronous system the preferred communication technique. With the introduction of big boosters such as Titan 3, it will be economically feasible to orbit satellites of substantial weight, and attendant communication capacity. Large payload capability also will permit the launch of multiple satellites, to make deployment of an operational synchronous system more attractive economically.



SATELLITE STABILIZED with gravity gradient technique (right) would increase communications capacity because antenna gain is limited only by angle subtended by earth.

Reduced Requirement

Use of the MACS system in conjunction with a synchronous satellite array could work to reduce the number of satellites required for each system. Estimates are that while, from a geometric aspect, only three synchronous satellites would be needed to cover most of the earth (except for polar regions), a single failure in this synchronous system arrangement would result in a gap in communications capacity for as much as six weeks, considered to be the turnaround time for a launch pad to put a replacement satellite in orbit.

This means that a minimum requirement would be two satellites at each synchronous station, or a total of six satellites, to ensure communications reliability. If additional coverage were required for specific polar regions—and this is extremely important from a military aspect—another pair of satellites might be needed at specific longitudes, increasing the system requirement to eight satellites.

Another authoritative estimate for a synchronous system, with adequate allowance for failures and long replacement time, indicates that 9 to 12 satellites would be required.

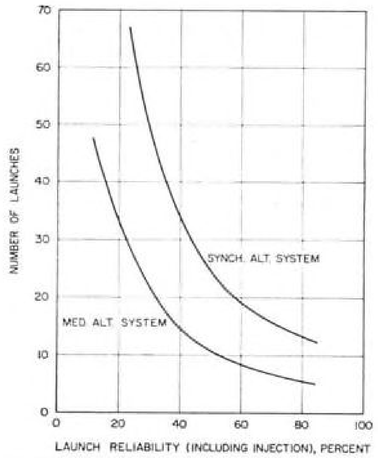
To attain synchronous orbit, the booster and possibly a first burn of the second-stage would be used to inject the satellite into a parking orbit. This would be followed by second stage second-burn for a Hohmann transfer orbit with apogee at the synchronous altitude. Here, a third burn changes inclination to the equatorial plane and circularizes the orbit.

Placement of a satellite at a specific longitude around the equator imposes another complication in attainment of the proper orbit. Also, small, circumferential components of the gravitational field at the equator make it necessary for a synchronous satellite to be fitted with station-keeping equipment.

One approach to attainment of synchronous orbit is for first apogee-burn to leave a speed deficiency which puts the satellite into a slightly elliptical near-synchronous orbit. Successive burns appear to "walk" the satellite around the sub-synchronous orbit because of the relative rotation of the earth. These successive burns raise the perigee and finally place the satellite into synchronous orbit at the desired longitude.

Launch Requirements

Estimates of launch requirements for establishment of the synchronous altitude system and the medium altitude system indicate a favorable advantage for the latter. Comparison of a six-satellite synchronous system with 1½-year mean time to failure, one satellite per launch and pad turnaround time of about six weeks, with a 24-satellite MACS system with a three year mean time to failure and eight satellites per launch, indicates that, for an 80%



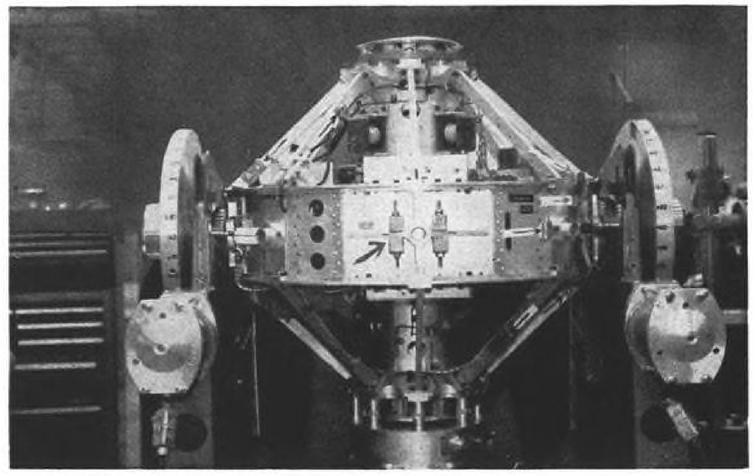
PLOT OF LAUNCH requirements to establish medium-altitude and synchronous-altitude systems.

launch reliability (including injection), the synchronous altitude system will require about 14 launches as against six for the MACS system. For a 60% launch reliability, the synchronous system will require about 19 launches as against about 9 for the MACS system. Actually, launch reliability of the synchronous satellite should be appreciably less because of the complex trajectory to attain synchronous orbit and precise longitude.

The requirements to maintain the two systems indicate that for a 70% launch reliability, five replacement launchings per year would be required for the synchronous system as against two for the MACS system. The synchronous satellite, with station-keeping and altitude control, should have about ten times as many parts as MACS, hence life in orbit should be less than the MACS.

Consideration of average down-time per sector for a synchronous altitude system indicates that because elapsed time for liftoff to orbit position may be from four days to several weeks, duration of outages will be measured in days rather than in minutes as for MACS. For example, with a launch reliability, including injection, of 35%, to 40%, which is not unrealistic for a synchronous mission, one satellite per sector could give a down-time of 7%. This, coupled with an outage measured in days, means that the time would be appreciable in which no communications would be available in that sector. It also underscores that no less than two satellites per sector could be deployed realistically. In this situation, the down-time would be about 3%.

By contrast, the waiting times in the MACS system would be very short—measured in minutes. For example, the total outage on a Washington-to-Paris link would be 1% for a 24-satellite deployment.



San Marco Prototype Tested at Goddard

San Marco satellite No. 3 prototype is seen undergoing tests at Goddard Space Flight Center prior to its recent suborbital launch from Wallops Island, Va. (AW Aug. 26, p. 76). Spherical outer shell has been removed in this photo for access to components. The satellite weighs approximately 250 lb. in launching configuration. Test launch was rated only partially successful because of a malfunction of the booster de-spin system. A later launch was considered successful. Project San Marco, involved the first satellite designed and built in Western Europe, and is a result of collaboration between Italy's National Research Council and the National Aeronautics and Space Administration. Program will undertake a previously unattempted continuous measurement of air density. Operational launch is expected in late 1964 or early 1965.

Fubini Urges Military Space Role Analysis

By Philip J. Klass

Washington—Critics of the Defense Dept.'s policy on manned military space programs have been challenged to explore and demonstrate a useful role for military men in space by means of simulation and tests conducted on the ground and from aircraft.

The new Pentagon approach to manned military space programs—which does not, however, represent a basic change of philosophy—was revealed by Dr. Eugene Fubini, who recently was named assistant secretary of defense for research and engineering. The speech, made here recently before the National Rocket Club, was Fubini's first since he became assistant secretary. He formerly was deputy director for research and information systems.

Mission Analysis

What is needed, Fubini said, is not the conception of new roles for military observers in space but a thorough analysis and evaluation of those which have already been proposed. Some missions in which man might excel unmanned satellites "include reconnaissance, inspection, warning and perhaps repair. As technology advances, man might play an important role in recovery of spacecraft and boosters," he said.

"I am by no means sure that a man can perform in these roles better than a machine, but I am also not sure that he cannot," Fubini said. "We should resolve these issues by examining these functions, modeling them, and trying them in an aircraft and on the ground . . . if the results look good we can take the decision to go ahead with space tests."

Asked for specific examples, Fubini said it has been suggested that "eyeball reconnaissance" from space might be a useful military function. But he noted that practically all of the Air Force's aerial reconnaissance now is done by camera. He suggested that tests be conducted from aircraft to determine what useful military information can be obtained by "eyeball reconnaissance," and how difficult it is, for example, for a man to keep a telescope pointed at one particular spot on the earth.

Presumably, the Pentagon might apply the same philosophy to the question of manned inspection of unknown satellites to determine their possible hostile intent. For example, fly-by tests could be conducted, using aircraft to determine effectiveness as a function of closing speed. Usefulness of physical contact with the unknown satellite might be evaluated in a ground space chamber, using a man in a space suit to evaluate functions of satellite models.

"We must roll up our sleeves and work harder to validate the reasons for and feasibility of manned military space missions," Fubini said.

Fubini pointed out that space tests are the expensive way to conduct preliminary investigations which can be carried out on the ground or in the air. Manned launches in some future programs are expected to cost as much as $40 million per shot, he said.

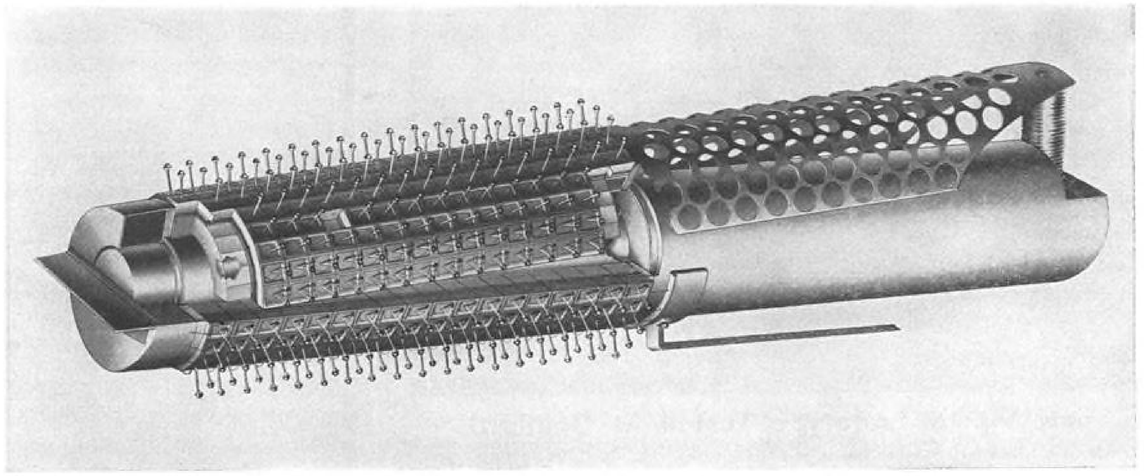
Fubini expressed concern over contracts awarded for the study of manned spacecraft "with no concept whatever as to what equipment we are going to put in them." He said it is not customary to begin the design of an airplane without first determining its intended mission.

Current Programs

To those who charge that U. S. has "not a single military space program," Fubini cited current efforts in reconnaissance, communications, weather, navigation, geodetic, inspection and intercept-warning satellites. "We are doing a pretty good job in many of them," he added.

The only military space project that has been proposed with any degree of definition that is not being supported today by the Pentagon, Fubini said, is the suggestion of placing thermonuclear warheads in orbit.

"I don't see why anybody should be more worried about a bomb brought down from orbit onto the U. S. than



GE Studies Thermionic Auxiliary Reactor

Artist conception of General Electric space thermionic auxiliary reactor (STAR-R) being studied under a $65,000 contract from the Air Force System Command's Weapons Laboratory. Design consists of identical doughnut-shaped diodes around the reactor. A cesium reservoir tube is shown protruding from the outer surface of each diode. Power outputs of 100 kw. with a specific weight of 15 lb./kw. for 800 days may be possible, according to GE. High operating temperature diodes allow elimination of coolants and radiators. Powerplant startup in space may be accomplished by moving two halves of the reactor and positioning the end neutron reflectors to achieve criticality. As a safety precaution prior to launch, the powerplant would be divided into two subcritical parts. Diode emitter temperature is about 3,630F, the collector temperature is about 2,012F.

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GOODYEAR AEROSPACE

SURPRISE PARTY

LEACH HERITAGE OF THE AIR—28

Three planes had left Belfort, France two hours before. It was 12 o'clock straight up, November 21, 1914. The visitors to this northeast shore of Lake Constance, near the German city of Friedrichshafen, came uninvited. Their object: destroy the hated enemy Zeppelins moored in giant wooden sheds.

Preparations for this surprise visit began almost a month before. Lieutenant Pemberton Billing of the Royal Naval Volunteer Reserve arrived in Belfort from England on October 24th to plan the raid.

Belfort was crawling with German spies. So arrangements were made to bring in the British pilots and planes secretly at night. The pilots would hide in a dirigible shed until the moment the raid was to begin.

Once this was arranged, Billing drew up a flight plan and detailed map of the Zeppelin complex. The French wanted a crack at the Zeppelins, too. But they acquiesced to the Royal Naval Air Service. After all, these Zeppelins were meant to destroy the British fleet.

On October 28th, Billing returned to England. He picked four pilots for the raid: Squadron Commander E. F. Briggs, Flight Commander J. T. Babington, Flight Lieutenant S. V. Sippe, and Flight Sub-Lieutenant R. P. Cannon.

The planes they were to fly were Avro 504s. Powered by an 80 h.p. Gnome rotary engine, the Avro biplane was used primarily as a trainer, yet it out-matched most of its contemporaries in design, construction and performance.

Four Avro 504s, four pilots and 11 mechanics arrived secretly in Belfort on the night of November 13th. But on the morning of the 21st, only three planes took off. Cannon's Avro broke its tail-skid and was grounded.

Briggs, Babington and Sippe flew the 125 miles to target a few miles from each other. They first went northeast above the Rhine to Schaffhausen, then dog-legged to the right to Lake Constance. They carefully avoided Switzerland's neutral air space. Arriving at the lake, they flew a mere 10 feet above the water.

Five miles from Friedrichshafen, the pilots began climbing to 1200 feet, then dove to 700 feet and dropped their 20-pound bombs on target. They crossed back and forth so fast, that the hundreds of panicked soldiers and civilians on the ground thought there were six of them.

While the bombs were dropping, ack-ack shells burst around them. The Germans kept up steady machine gun and rifle fire in spite of the panic. Sippe made two direct hits, one on the gas works, the other on a Zeppelin shed. When his fourth bomb failed to release, he headed home for Belfort the same way he came.

Babington dropped his bombs with equal damaging effect and followed Sippe back to Belfort.

Briggs wasn't so lucky. The murderous enemy fire forced him to land near the Zeppelin works. As soon as he stopped, an angry mob of Friedrichshafeners dragged him out of his plane and carried him off to be lynched. But German officers rescued him and brought him to the Weingarten Hospital in Friedrichshafen. Surprisingly enough, the German military treated Briggs like a hero.

The three uninvited guests did extensive harm. Their bombs fell within an area of 700 square yards in and around the Zeppelin sheds and gas works. One Zeppelin was almost completely destroyed, others were seriously damaged. The gas works lost thousands of cubic feet of precious hydrogen in an explosion which sent flames hundreds of feet in the sky.

As a result of this one raid, the Germans went to great pains to guard Friedrichshafen from further attacks. The Bavarian regiments and night sentinels were doubled in strength. More anti-aircraft guns and machine guns were set up. Powerful searchlights were installed. A strict curfew went into effect. And two more gun boats were moored near the floating Zeppelin shed on the lake.

But Friedrichshafen was never attacked again. And all these preparations were in vain. The Germans should have figured there wouldn't be any more raids, though. After all, a surprise party isn't a surprise party if people know you're coming.

about a bomb launched [as an ICBM] from a pad in the Soviet Union," Fubini said. "For a given booster the size of the bomb is larger in the ICBM, the accuracy is greater, the possibility that the command can be given in a timely fashion is higher . . . if the enemy were to choose to put the bomb in orbit . . . he would weaken rather than strengthen his position. This is so clearly, so obviously a wrong strategy that no intelligent man can have any doubt about the technical issue." However, he acknowledged the possibility that an orbital weapon might have some psychological impact on less knowledgeable peoples.

In reply to those who suggest that a thermonuclear weapon exploded in orbit could "sear" major U.S. cities, Fubini said that from unclassified data it is possible to compute that a 2,000-megaton bomb would be needed to set fire to frame houses from an altitude of 150 mi. Such a bomb would weigh "hundreds of tons," which is far beyond the capabilities of any existing booster. To destroy New York by plane would take an 8,000-megaton warhead, Fubini said, requiring a booster capable of putting "very many hundreds of tons in orbit" and a spacecraft "100 times larger" than the biggest spacecraft the Soviets have yet launched. "I certainly will not propose that we race headlong into the development of an ineffective bombs-in-orbit program," Fubini concluded.

Orbital Guidance

Cambridge, Mass.—Avco Corp.'s Research and Advanced Development Div., Wilmington, Mass., is studying a precursor orbital guidance system utilizing aerodynamic braking to attain orbit around a planet in the terminal phase of an interplanetary trajectory.

Difficulty in knowing the atmospheric density of nearby planets results in large uncertainties in the density vs. altitude characteristics of planets such as Mars or Venus as well as the conventional retro-propulsion fuel requirements for successful mission objectives.

The Avco precursor orbit guidance system deploys four or five 40-lb. entry vehicles to define the re-entry orbit corridor to within ±3 deg. The precursors would pass through the planetary atmosphere, either impacting or skipping out prior to spacecraft entry with a controlled range of entry conditions.

Telemetry data is relayed from an onboard accelerometer on each precursor. The spacecraft's computer receives the telemetered information and can then determine an appropriate adjustment to the spacecraft velocity vector to give favorable initial conditions upon entry into the atmosphere.

FIRST DE HAVILLAND DH-125 to be delivered to a customer is this aircraft, owned by Bristol Siddeley Engines, Ltd., builders of the two Viper 20 powerplants. The plane is to be used as an executive transport and as a flying testbed for work on engine improvements.

Aviation Week Pilot Report:

DH-125 Stresses Operational Simplicity

By Herbert J. Coleman

London—De Havilland Aircraft—acutely conscious of the development lead its DH-125 holds over the rival Dassault Mystere 20 executive jet transport—is accelerating flight testing of the DH-125, an aircraft that should pose no problems for pilot transition from piston power to jets.

With four planes now flying, and a fifth due to roll out in November, the development test team is concentrating on operational simplicity, aiming at ease of handling but resisting the "fighter type" of control on the basic theory that the DH-125 is a light transport and should be flown as such.

One technical advance has been a considerable lightening of aileron loads, a vast improvement for pilots who had complained of heavy handling characteristics in traffic patterns and other maneuvers.

Another important emphasis is on flight safety. De Havilland has developed a thrust sensing device which automatically compensates in rudder deflection if an engine loses power (AW July 1, p. 23).

In other recent moves:

• **De Havilland has reopened talks** with Bristol Siddeley on the possibility of developing the Viper 20 powerplant into an aft-fan version which could also compete with the General Electric CF-700 aft-fan engine powering the Mystere 20 (AW Aug. 12, p. 43). So far, the talks have not determined who will pay development costs, although Bristol Siddeley has indicated that it would fund the program if a firm, long-range order were in sight.

• **Mark 2 version** of the DH-125, a slightly larger version featuring an aft-fan engine (with the CF-700 not completely ruled out) is in very early stages of development under the direction of Chief Designer C. T. Wilkins. The aircraft also would include increased fuel tankage.

• **Bristol Siddeley** is working on another version of the Viper 20 which, by running hotter, would allow better DH-125 field performance at high-altitude airports and in hot climates. In effect, the engine would hold its thrust rating to 5,000 ft. (ISO plus 68F), obviating the present necessity for throttling back during the climb. The project involves considerable exploration in high-heat metals.

Since taking delivery of its own DH-125, Bristol Siddeley has become closely associated with de Havilland in a flight and ground noise reduction program. The engine company is working on bearing modification and inlet vane design to cut noise during taxiing. The airframe itself has been soundproofed about as much as possible, according to Wilkins.

An early problem of high noise level in the cockpit has been solved by adding a balsa aerodynamic bulge atop the cockpit.

On production versions, the balsa cap will be replaced by plastic, and will also house radio antennas.

Wilkins said the company has dropped plans to re-engine the Mark 1 DH-125 with the CF-700. The main reason, and one that figured importantly in talks with Pan American before that airline ordered 40 Mystere 20s (AW Aug. 12, p. 41), is that engineering costs to use the U. S. powerplant would have been about $1.5 million. Wilkins said the aft fuselage and tail section would have been redesigned and the time involved would have appreciably cut the DH-125's lead time over its competitors.

Because of this concentration on protecting and advancing the program toward certification, the company has decided not to exhibit the executive jet at the National Business Aircraft Assn. convention Sept. 24-26 at Houston, Tex.

However, Timmins Aviation, the Canadian distributor, will show a full-scale mockup and a technical team will fly from England to attend the show.

Flight characteristics of the DH-125 were reviewed by this AVIATION WEEK & SPACE TECHNOLOGY pilot in a series of flights from de Havilland's main production plant at Hatfield, England. The first flight was cut short when the left Viper 20 failed to relight after a deliberate shutdown at 35,000 ft., due to an ignition plug failure.

DH-125 TENDS TOWARD flat approach on landing, due to swept wing. Pilot does not have to begin flareout until reaching the runway lip. The aircraft requires a short ground run after settling on its main gear.

After a flight in the No. 1 airplane, G-ARYA, in which aileron control was decidedly stiff, another evaluation flight was made in the No. 2 DH-125, registered G-ARYB and fully instrumented for aileron load and flutter tests. The pilot in command was Geoffrey H. Pike, development test pilot, flying in the right seat. Weather was good, with about 9/10th cloud coverage at 4,000 ft. and a surface temperature of about 63F. Wind was from 280 deg. at 15 kt.

Engine starting is accomplished after the usual external visual checks are completed and the main entry door has been closed and locked. Throttles are closed and low-pressure fuel cocks opened. With the No. 2 engine high-pressure cock and fuel pump on, the starter is operated until a "fail" light goes out and jet pipe temperature and rpm. indications are in the green. The same procedure is followed for No. 1; the cabin altitude switch is set to manual for checkout, and then set on automatic for the remainder of the flight.

Low silhouette and wide gear make taxiing easy and fast; nose wheel steering is controlled by a wheel on pilot's side and allows taxiing on grass and rough surfaces, a practice that is common at Hatfield.

Lined up on the active runway, brakes are set and the two Vipers run up to 100% power before the brakes are released. Acceleration is fast, and directional control is maintained by manipulation of the nose steering wheel until about 60 kt., when rudder control becomes available. Takeoff flap is set at 15 deg.

The DH-125 rotated at about 70 kt. and was airborne at 85 kt. Flight speed built up rapidly after the gear and flaps had been retracted and climb power

FIRST FOUR DH-125s are lined up on the ramp at Hatfield. The fifth aircraft will be rolled out in November. No. 1 aircraft, G-ARYA, is at far right in photo, with the second, third and fourth planes lined up from right to left.

was set at 98%, once Hatfield radar control had cleared the plane through the overcast. The airplane climbs at 275 kt. to 5,000 ft. and then climb speed is reduced to 245 kt. to 28,000 ft.

After a series of steep turns to demonstrate the improved aileron loads, the DH-125 was put into a clean stall, approaching it at a fairly steep attitude to kill off the cruise speed. At 100 kt., a slight buffet was felt, and the airplane stalled out at 90 kt. with the nose dropping off and only a slight loss of altitude experienced.

With the flaps set at 50 deg. and the landing gear down, the airplane stalled at 78 kt. with no evidence of wing drop; in the same configuration, but in 20 deg. turn to the left, stall was attained at 80 kt. In the latter stall, the DH-125 tends to come out of the turn at stall, rather than to tighten it up.

The airplane is also fitted with a stick shaker which will be a production modification and gives sharp warning at airspeeds about 10% ahead of stall.

At high altitudes, single-engine procedures are markedly simplified with adaptation of the thrust sensor device. When one throttle is retracted, the device takes over automatically from the first indication of thrust reduction. The immediate reaction to the loss of the engine is a drop in airspeed, rather than usual yawing motion.

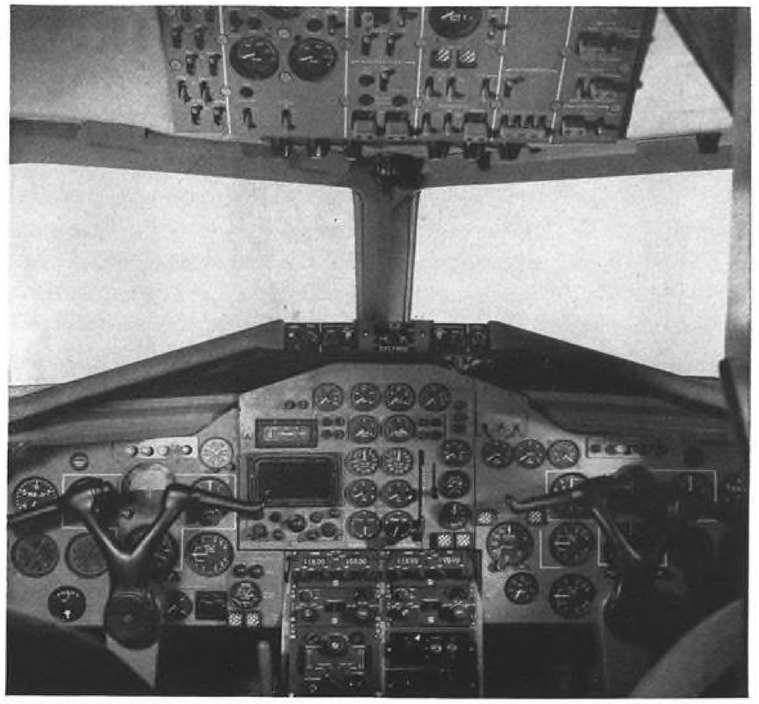
Primary value of the device, of course, is on engine loss on takeoff. It allows the pilot to control his plane without excessive stick and rudder corrections.

DH-125 U. S. Price

London—Firm price for the de Havilland DH-125 executive jet transport, delivered duty paid in the United States, will be $575,000 for a bare hull which includes pilot seats and basic instruments, according to Hawker Siddeley Aviation.

Price for the equipped airplane, fitted with nose radar, radios and navigation aids, will be $730,000, again with import duty paid. Hawker Siddeley, in collaboration with United Dominions Trust, Ltd., is setting up an installment buying and lease plan aimed at reducing the cost by spreading terms over several years. Under the installment plan, United Dominions Trust will meet almost the entire first cost, with repayments spread over a 10-year schedule on a contract that will include break clauses. On a lease deal, the aircraft may be acquired for 10 years on a rental basis.

United Dominions Trust, through arrangement with the Amstel Club Group house, will finance the airplane in 11 European countries—Austria, Belgium, Denmark, Portugal, France, Federal German Republic, Holland, Italy, Norway, Sweden and Switzerland.



DH-125 COCKPIT MOCKUP shows standard layout for production aircraft. Note Y-shaped wheel and locations of radio and navaid equipment, with autopilot, on center console.

The first landing was made in a one-engine-out condition, with the right engine throttled back and the sensor device operating. No rudder trim is needed and, as far as flight control is concerned, the pilot's most important problem is reminding himself that one engine is not delivering thrust, necessitating pattern speeds higher than normal to compensate for the loss.

In this case, the downwind leg was flown at about 170 kt. with gear down and 15 deg. of flap. Speed was reduced to 140 kt. on the base leg, and final was flown at 115 kt., instead of the usual 110 kt. The landing was quite normal, except for the use of some aileron to compensate for a gusty crosswind that had developed since takeoff.

On a conventional landing, the airplane tends toward a flat approach, due to its swept wing, but 110 kt. gives ample airflow for solid control. The pilot finds it unnecessary to start flareout until reaching the runway lip, and the DH-125 settles on its main gear.

The nose wheel is held off as long as possible, but the ground run is short and steering when rudder forces disintegrate is no problem.

An advantage to the pilot, in addition to excellent cockpit visibility, is the DH-125's "Y" stick, developed to give ample knee and leg room even during the most sharp maneuvers. The stick also presents a minimum interference in checking various panel instruments.

The aircraft is designed around a cylindrical fuselage. The decision to keep the cruising airspeed to about 500 mph. eliminated the necessity for extreme wing sweep and airfoil thinness, and also avoided the complexity involved in installing power controls (AW Dec. 3, p. 110).

The passenger cabin features a recessed aisle, made possible by running the wing under the fuselage, which allows ample headroom. One airplane has been fitted out in executive style, with six seats, but de Havilland is not satisfied with the interior decor and probably will modify this considerably before delivering the aircraft in quantity. Air conditioning outlets also will be simplified.

Cockpit instrumentation varies widely in each of the four flight-test airplanes, depending on the program mission, but has been firmed up in the production mockup at Hatfield. Collins radio and navaid package, ordered in quantity for all DH-125s, eventually will include a solid-state radio unit not yet delivered to Hatfield.

Another cockpit change will be the grouping of warning lights on the center panel, eliminating the present "attention getting" lights on the upper panel which merely tell the pilot that some system is failing, necessitating his tracing the fault.

PRIVATE LINES

Fuel injection system, replacing the carburetor of earlier models, and a twin axial-flow impeller cooling system are the major changes made in the latest Brantly B2B two-place helicopter. Cooling impeller allows longer sustained hovering in hot weather and has increased the service life of the engine to a minimum of 750 hr.

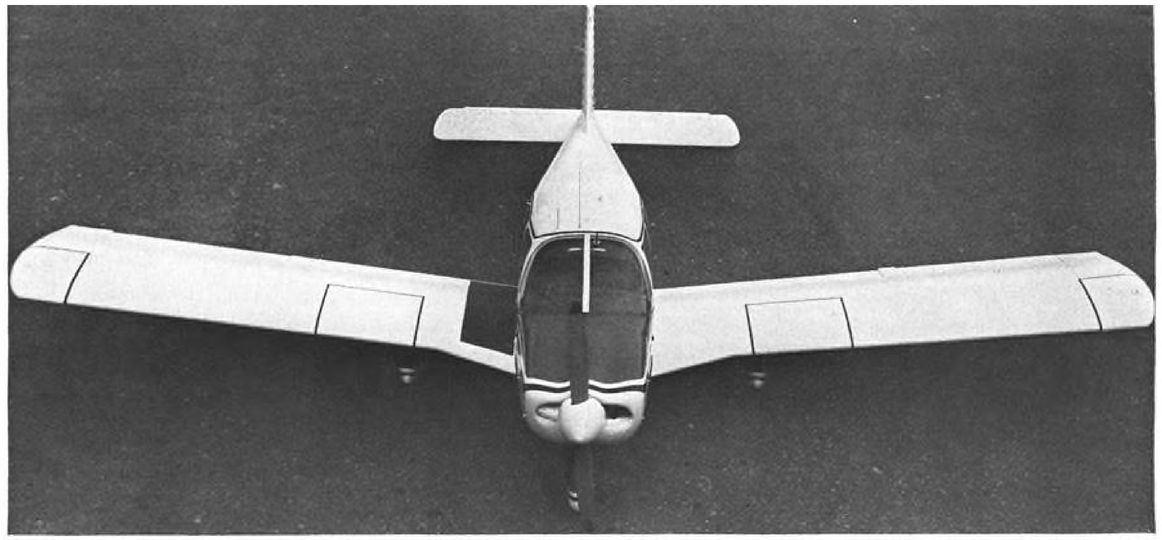
Airwork Corp. of Millville, N. J., has reported a 41% increase in net income and a 20% gain in sales for the first nine months of Fiscal 1963, ended Apr. 30, compared with the same period in Fiscal 1962. Earnings in the 1963 period were $536,979 on sales of $14,570,233, compared with earnings of $380,272 on sales of $12,126,386 during the comparable period in Fiscal 1962.

USAF has purchased 25 Model 185 Skywagon utility aircraft from Cessna and contracted with the manufacturer for training of flight and ground personnel. The aircraft will then be sent overseas to several foreign countries under the Military Assistance Program. Hawthorne Aviation, Charleston, S. C., will provide flight training.

Federal Aviation Agency is studying the possibility of tightening regulations governing sport parachuting and skydiving because of the growing number of accidents and fatalities. FAA personnel met with members of the Parachute Club of America in Washington recently to discuss possible steps. FAA presently is schooling some of its field employes in parachute design, fabrication and packing.

Prices of most aeronautical charts prepared and sold by the U.S. Coast and Geodetic Survey have been increased. Prices for Instrument Approach Procedure charts have been reduced from $32 for nation-wide coverage to $27, the only reduction in the series. Sectional and local aeronautical charts were increased from 25 to 30 cents each and Aircraft Position Chart 3094, covering the North Pacific, has been increased from 10 to 20 cents. The prices of radio facility charts have been increased 40 to 60% when delivered by mail on a subscription basis.

Piper is extending the warranty on all new aircraft sold by it to six months or 150 hr. flying time. The warranty period previously was 90 days or 50 hr. New warranty period is effective immediately. Warranty does not include trade accessories which normally are warranted separately by their respective manufacturers.



LONGER WINGSPAN of the new Piper Cherokee 235 is shown with additions to wingtips beginning at black lines, which indicate 17-gal. wingtip fuel tanks. Standard 25-gal. tanks are outlined on inboard leading edge of wing.

New Cherokee Features Payload Increase

Gross weight increase of 750 lb. and a useful load of 1,490 lb. are among the major features of Piper Aircraft Corp.'s new 235-hp. Cherokee four-place airplane.

Newest Cherokee variation, now in production at the company's Vero Beach, Fla., facility (AW Apr. 29, p. 33; Aug. 12, p. 37), is powered by a 235-hp. Lycoming O-540-B2B5 engine which gives it a top speed at maximum gross weight of 166 mph. and a cruise speed of 156 mph.

The Cherokee 235 has a wing span of 32 ft., two feet longer than previous models. Increase has been made possible by the addition of glass fiber wing tips, which double as tip tanks each containing 17 gal. of fuel.

This increases the fuel capacity of the Cherokee 235 from the 50 gal. of earlier models to 84 gal., giving an optimum cruising range of 1,130 mi. at 55% power at 10,000 ft.

Basic price of the aircraft will be $15,900.

In addition to the other changes, a new cowl design has been adopted to fit the new engine. Cowl is made in two pieces of glass fiber and can be completely removed to expose the entire engine.

Landing light is located in the nose and the ram air scoop for the carburetor is offset to accommodate the exhaust system.

Engine drives a fixed-pitch McCauley propeller.

Gross weight of the Cherokee 235 is 2,900 lb., up from the 2,150-lb. gross weight of the original Cherokee 150. Useful load of 1,490 lb. is about 80

PIPER CHEROKEE 235, latest addition to the company's four-place, fixed-gear airplane, has a distinctive contoured glass-fiber cowl to accommodate the 235-hp. Lycoming O-540-B2B5 engine. Gross weight has been increased to 2,900 lb. and useful load is 1,490 lb.

lb. greater than the empty weight of the Cherokee 235.

Piper says the useful load is so great in Cherokee 235 that the AutoFlite model—most elaborately equipped of the several versions offered—can carry four 170-lb. passengers, full fuel, oil and 200 lb. of baggage and still not be up to maximum gross. Accordingly, the company also quotes performance figures at what it believes is a more normal operating weight of 2,400 lb.

The engine will burn 80 octane fuel and a four-way selector valve on a center console in the fuselage allows any of the four tanks to be used individually. Sump valve is cockpit-controlled.

Besides the cowl and the wingtips, glass fiber has been used in the tail surface edges.

Structural members of the aircraft have been strengthened, Piper says, to accommodate the higher speeds and weight of the Cherokee 235.

Landing gear remains unchanged from the Cherokee 180. It has a 10-ft. main wheel base and uses three 6:00 x 6 wheels. Brakes are hydraulic.

Introduction of the Cherokee 235 will not affect the production of the other three aircraft in the line—the Cherokees 150, 160 and 180, Piper says.

Cessna, Piper, Beech Report Sales Boosts

Cessna, Piper and Beech all reported increased sales for the first nine months of Fiscal 1963, ended June 30, compared with a similar period in Fiscal 1962. Cessna and Piper also reported greater net earnings.

Beech's earnings were down, due to start-up costs on several new programs, including the Model 90 King Air (AW Aug. 19, p. 29) and military programs.

Total sales reported by Beech were $52,884,143, an increase of approximately 7% over last year's $49,473,721. Net earnings were $1,579,680, equal to 56 cents per share, compared with $2,133,224, or 76 cents per share, in the first nine months of Fiscal 1962.

Cessna had total sales of $74,398,000 during the first nine months of Fiscal 1963, compared with sales of $72,053,000 during the same period last year. Net earnings for the period were $4,528,000, or $1.37 per share, compared with $4,448,000, or $1.35 per share, for the Fiscal 1962 period.

Piper reported sales of $26,978,735 for the nine-month period, compared with sales of $26,408,151 for a similar period last year. Net income for the period was $1,732,630, or $1.61 per share, an increase of 24.4% from the $1,391,939, or $1.30 per share, reported during the first nine months of Fiscal 1962.

Industry Mixed on DOD's Profit System

By William H. Gregory

New York—Reaction to Defense Dept.'s weighted guideline profit system, which incorporates incentives and past performance evaluation, is partly elation within industry at the tone of the basic policy statement and partly skepticism as to its translation into reality.

Nub of the mixed sentiments is typified in two contradictory responses:

• **Profit objective of 19.36%** is listed in one example in Armed Services Procurement Regulation 3-808 covering the system. Granted the example given involves a purely hypothetical firm, fixed-price type contract, the mere fact that the regulation deals in such cosmic terms could portend an end to the era of consistently declining defense industry profits, one industry source said.

• **Little hope exists** that actual profits will reach or even approach the theoretical maximums permissible.

As one industry contracting executive explained, his company might be entitled to ask a maximum 15-16% profit (before taxes) on a research and development contract now in the proposal stages, but the company would not even begin by asking more than 12½% for fear of causing panic among the government negotiators.

Industry itself is divided in opinion on the degree of increased profits to expect. The optimists, though doubting that the maximums will ever be attained, feel there will be significant improvement. The pessimists fear that, despite the good intentions, profit levels will rise little or not at all, or that any increases will be lost in review—by Renegotiation Board action, for example.

Administration of the policy is the essential ingredient, and industry can only wait for experience to provide the answers. Caution in this respect stems from industry feeling that existing ASPRs that espouse policies favorable to industry sometimes lose these benefits in practice.

To measure the administration element, industry has turned to incentive contracts awarded under DOD's new policy stressing use of them to replace cost plus fixed fee contracts. Favorable results with them would bode well for the weighted guideline system.

Few major PERT milestones have been reached in these programs, so that any indication of profit results are well down the road.

Early indications, though, are that DOD's contractor stimulation goals are being achieved. As an industry source commented: "Mention a program that's on an incentive contract and everyone in the plant stands up to salute."

PERT milestones—called PERT bubbles in some places because of their appearance as circles on PERT networks—have been met in early-stage programs, but these are minor milestones that probably would have been met without difficulty in any event, and are easy-to-measure kinds.

Generally conceded by those with incentive experience is that, at least initially, the system has broken cost-plus lethargy. Search is under way, for example, for paper pushers on staffs that grew to fulfill level-of-effort types of contracts.

Secretary of Defense Robert S. McNamara's efforts in these new programs to use profits, a relatively minor 3% when measured against the other 97% for procurement costs, to attack the cost side of the ledger also is being watched with mixed feelings by industry. So is his campaign to present a concerted picture to Congress, and the public, of successful cost efficiency in the Defense establishment. Awareness of the complexities and difficulties of the task has left industry both sympathetic and skeptical.

Language of the policy statement that leads off the new regulation profoundly impressed industry, not merely for its support of the profit motive but even more for what is regarded as its realistic evaluation of profit and inclusion of risk as deserving reward. This included such phrases as:

"Profit generally is the basic motive of business enterprise. The government and defense contractors should be concerned with harnessing this motive to work for more effective and economical contract performance.

"Negotiation of very low profits, the use of historical averages, or the automatic application of a predetermined percentage to the total estimated cost of a product, does *not* provide the motivation to accomplish such performance.

"Furthermore, low average profit rates on defense contracts over-all are detrimental to the public interest. Effective national defense in a free enterprise economy requires that the best industrial capabilities be attracted to defense contracts. These capabilities will be driven away from the defense market if defense contracts are characterized by low profit opportunities.

"Consequently, negotiations aimed merely at reducing costs by reducing profits, with no realization of the function of profits, cannot be condoned.

"For each contract in which profit is negotiated as a separate element of the contract price, the aim of negotiation should be to employ the profit motive so as to impel effective contract performance by which over-all contract costs are economically controlled."

By realistic, contractors mean that this language seems to take into account the consequences of squeezing profits as "buying into" contracts, a practice that usually results in a cost overrun later. As one industry source said:

"Beating down price in negotiation with a contractor who has a plant to keep busy and overhead to meet will often result in his taking business a good businessman shouldn't take. This usually means going back later, hat in hand, to ask for more money to cover the overrun."

Caution over the new program falls generally into two categories:

• **Misgivings over functioning** of the equally new DOD contractor performance rating system. Ratings derived in this system are one element that must be incorporated as a numerical value in computing weighted guideline profit objectives.

• **Questioning** as to the response of the contracting officer, who retains his traditional responsibility for negotiating profit under the new regulation.

Apprehension about the performance rating system is strong, but not always specific. As one industry source explained, there is distaste for the prospect of having as tenuous a subject as company performance reduced to a grade on a report card and spewed out of a computer.

Another contractor feared performance evaluation will mean more paperwork and more justification, two requirements already the cause of much industry grumbling. Still another raised the point of the usefulness of performance rating as part of the weighted guideline system. If a contractor had to be rated at the bottom of the scale on the basis of his past record, why would the government even consider him for another program to begin with?

Subcontractor performance was regarded as another potential danger area for contractors. In any major system development, subcontractor performance can make or break the prime contractor's record.

Government attitudes are tending more and more toward holding the prime contractor fully responsible for subcontractor failures, a tendency given a hard push by the McClellan subcommittee hearings on the "pyramiding" of profits (AW Apr. 23, 1962, p. 24).

"We don't have the same control over subcontractors that the government has over the prime," one industry contracting official observed. "We aren't their sole customer, as the government is in our case."

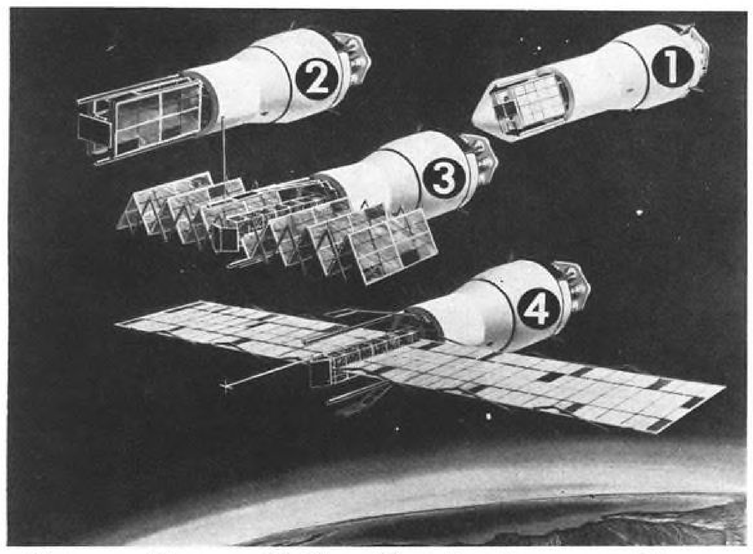
But more shadowy doubts also concerned this same official. The spectre was raised of a contractor being blackballed in Kafka-like fashion, without ever knowing why.

Overregulation and paperwork were two points also raised in dealing with the role of the contracting officer. Opinion here varied, both pro and con.

Some see the explicit guidelines as a harbinger of overadministration, straitjacketing and bureaucratizing of the negotiation process. Others see the guidelines as one of the most favorable features of the system. Instead of the vague and cloudy environment that is now often the rule, these sources feel the contracting officer will have specific precedents at hand.

That the contracting officer keeps his profit negotiating responsibility itself was termed a plus factor in at least one instance. Such negotiation can best be handled by the man close to the scene, not by higher authority, or a board of review, in this opinion.

More often, industry questioned whether the contracting officer, to protect himself, will be forced to hew to the lower end of the scale. Considerable personal judgment may be required in evaluating the many factors that combine to produce the final profit ob-



Saturn Meteoroid Satellite Deployment Shown

Meteoroid detection panels, having a total span of about 100 ft. will unfurl from the Saturn meteoroid detection satellite after launch, scheduled for next year. Cutaway view (1) shows stowed panels. Cover is jettisoned (2) and panels are extended by folding arm (3). Presence of particles in space will be detected as they strike sensors on the panels (5). Satellites will be launched by Saturn SA-8 and SA-9 flights. Fairchild Stratos is developing the satellite for National Aeronautics and Space Administration.

Two-Place Bede BD-1 Makes First Flight

Bede BD-1, low-cost, two-place aircraft being developed by Bede Aircraft Corp. of Springfield, Ohio, is shown during its first flight. The BD-1 is designed to sell as low as $2,495 with a rebuilt 65-hp. engine, minimum instruments and no radio. More completely equipped versions will sell for about $4,200. Company hopes for certification by spring. The BD-1 has a slab-sided fuselage of metal honeycomb panels. Wings are detachable for ease of ground transportation.

jective, and even assuming that the contracting officer's figure passes scrutiny within the Defense Dept., industry wonders what happens if there is objection by Congress or the Renegotiation Board.

Those industry sources who feel the new program will mean little advantage to industry, or will be absolutely worthless, tend to be pessimistic on the contracting officer question. Observing elementary prudence, they feel, the contracting officer will have to avoid high profit levels.

The optimists feel incorporation of profit principles into a written document, with examples included that show higher profits to give them a mantle of official sanction, will mean a marked improvement. Expectation here of realistic levels for profits in the new program is 7% on cost-plus incentive contracts and 10% on firm fixed-price contracts, both pre-tax margins. This would mean a marked reversal of the pattern of profits on renegotiable business—before renegotiation and before taxes—which have declined from 6.3% in 1956 to 3% in 1962, according to Renegotiation Board figures.

Regardless of sanguinity of the individual, there is a clear eagerness on the part of many in industry to put the new system to immediate test, which will be on a permissive basis at first.

Mandatory Method

The weighted guidelines method, after the initial test period, will become mandatory for all contracts where cost analysis is required. Such contracts are relatively few in number, but represent a disproportionate share of funding—estimated at more than 50%—since they would include many aerospace type development programs.

"Where adequate price competition exists . . .," the regulation adds, "firm fixed price contracts will be awarded to the lowest responsible offerers without regard to the amount of their profits. Under these circumstances, the profit which is anticipated, or in fact earned, should not be of concern to the government. In such cases, if a low offerer earns a large profit it should be considered the normal reward of efficiency in a competitive system, and efforts should not be made to reduce such profits," the regulation says.

Contracting officers are instructed to establish a profit objective, using the weighted guidelines, prior to beginning negotiation but only after thorough review of proposed contract work, contractor past performance, and cost analysis.

The contractor may also be asked to develop a profit objective using the same technique.

Profit factors are broken into four general areas, the first of which—Contractor's Input to Total Performance—is divided into six subdivisions each with individual ratings to be assessed. These are:

- **Direct materials,** comprising purchased parts with a 1-4% weight range, subcontracted items with a 1-5% weight range, and other materials, 1-4%.
- **Engineering labor**—9-15%.
- **Engineering overhead**—6-9%.
- **Manufacturing labor**—5-9%.
- **Manufacturing overhead**—4-7%.
- **General and administrative expense**—6-8%.

Contractor's assumption of contract cost risk is the second general area, and it carries a range of 0-7%. Three factors—type of contract, reasonableness of cost estimates, and difficulty of contract task—must be assessed, but they are not given any individual weights.

Limited Risk

Risk is specifically limited to cost. Loss of reputation, commercial markets, or profits in other fields, are beyond the scope of this regulation. So is the risk to the government purchaser in not acquiring an effective weapon.

Assuming proper contract type has been selected, the reward for risk by contract type would fall into the following percentage ranges, according to the regulation:

- **Cost plus fixed fee**—0.1%.
- **Cost plus incentive fee,** using cost incentive only—1-2%.
- **Cost plus incentive fee,** using cost, performance and delivery incentives—1½-3%.
- **Fixed price incentive,** cost incentive only—2-4%.
- **Fixed price incentive** including cost, performance and delivery incentives—3-5%.
- **Prospective price redetermination**—4-5%.
- **Firm fixed price**—5-7%.

Contract Types

Some latitude is called for in evaluating contract types. A fixed price incentive contract which is closely priced with a low ceiling and high incentive share may be tantamount to a firm fixed price contract. On the other hand, a high ceiling price and low incentive would more approximate a cost plus incentive fee type.

Contractor performance record, the third general area, is assigned a weight range from −2 to +2. Seven factors are to be considered in this category, but none are given individual weights. These are:

- **Management.** Stability and competence of management personnel is to be evaluated, as are their ability and willingness to adjust to meet changing defense requirements, and their cooperation, both in business and technical areas, with objectives of the government.
- **Cost efficiency.** This covers wide areas of efficiency in use of facilities and manpower, purchasing methods, subcontract procedures, and inventory control. Improvements through plant modernization are to be recognized, and so is the effectiveness of make-or-buy programs.
- **Reliability of cost estimates.**
- **Timely deliveries.** Excusable delays and contractor efforts to overcome them are to be considered in this context.
- **Quality of product.** Reliability, rate of rejection, and contractors' acceptance of responsibility for continuing support are specified in this category.
- **Inventive and developmental contributions.** This includes such areas as contractor-initiated and financed research and development, design work, product engineering, value engineering, and manufacturing processes and techniques.
- **Small business and labor** surplus participation. Any unusual efforts in subcontracting in this area, especially for developmental type work that is likely to result in later production opportunities, are included as criteria.

The final general area—selected factors—also carries a −2 to +2 weight. This includes:

- **Source of Resources.** Reliance on government facilities, tooling or equipment will receive less favorable profit consideration. Commercial facilities leased by contractors will be evaluated as contractor furnished. Customary progress payments and guaranteed loans with normal guarantees—90% or less—will not be weighed, but other financial assistance will be considered a minus factor. This would include extraordinary progress payments, guaranteed loans with abnormal guarantees, or advance payments.
- **Special achievement.** This would include extra profit consideration when outstanding performance is required—a major technical breakthrough, or an extraordinarily fast delivery schedule, for example.

Above and beyond these categories—and one of the most significant clauses in the regulation—is a special profit consideration. This provides for a range of additional profit of 1-4% of contract cost.

Development of items without government assistance is recognized here, and the clause calls for a profit above and beyond that derived through the weighted guideline system.

How the system works can best be understood by providing a hypothetical case, one of those listed in the regulation.

To begin in process, the contracting officer assigns a weight value, within the limits specified, to each item of contract cost in the contractor input category. An important change in the regulation is that certain categories of allowable cost that had been previously excluded from profit computation—travel, subsistence, test equipment, special tooling, federal manufacturer's excise tax, royalty expense—now must be included in the weighted guidelines method.

The cost estimates in each category are multiplied by the percentages to give dollar profit figures, and these are added. Recognized costs are also added, and a percentage figure derived from dividing the total costs recognized into the profit total.

To this composite percentage, the contracting officer adds the percentage values assigned for risk, performance and other special factors, to arrive at a total profit percentage. By multiplying the total recognized costs, by the total profit percentage, the profit objective for the contract is derived.

"A cardinal principle of the weighted guidelines method," the regulation says, "is that the specific percentages assigned for cost risk, performance, and other factors are applied to total recognized costs in establishing the profit objective."

In one example in the regulation, the method is demonstrated for a hypothetical fixed-price incentive contract covering the 100 missiles and 300

Reward Potential Kindles Industry Response

Substitution of a higher-potential reward for risk in exchange for a lesser reward for conventional development and production, and addition of a special profit consideration for company-financed development—both made in the final version of Defense Dept.'s new weighted guideline profit system—were largely responsible for kindling increased enthusiasm for the plan in an originally lukewarm industry.

Many industry skeptics on the usefulness of the Defense Industry Advisory Council are also being converted in the process because of the degree of industry-defense coordination that led to the final adoption of the new Armed Services Procurement Regulation.

Enthusiasm for the new system runs highest in industry among those who have followed the program closely. And a large share of their enthusiasm stems from belief that Secretary of Defense Robert S. McNamara and Deputy Secretary Roswell L. Gilpatric were architects of the final version and that an effective channel of communication with industry was of significant help.

Genesis of the regulation was a Logistics Management Institute report asked for by the Defense Dept. The gist of the plan was broached formally to industry for the first time in September, 1962, at a meeting of the Electronic Industries Assn. in New York.

Comment was sought from other industry groups as well, and the plan was put before the Defense Industry Advisory Council last January. The council was established by Roswell L. Gilpatric, deputy secretary of defense, in the spring of 1962 to serve as a focal point for industry contact with the Defense Dept.

At that time, the council's attitude reflected industry's widespread coolness to the initial version of the system. Because the system at that time was all weighted on individual cost elements, industry felt customary business landmarks for determining profit would be lost.

A subcommittee of the council was formed, composed of five industry members and of representatives of defense agencies. The subcommittee reported in May and the final regulation was issued last month. The subcommittee is expected to remain in existence to aid in solving operational problems of the system.

In the final version, the preamble was added—regarded by industry as going a long way toward taking "profit" out of the dirty word book and bringing it back to respectability. The weight range for risk, which had been 0-5% earlier, was raised to 0-7%. Effect of this is to place increasing emphasis on the traditional role of business—risk-taking—and de-emphasize more mechanical parts of contracting.

Most significant, perhaps, was adding the special category for company-initiated development, which calls for addition of 1-4% profit in special cases. Criteria for this consideration include importance of the development to defense, demonstrated need in determining the development and application of it, extent of the contractor's cost risk, and whether development capital was recovered directly or indirectly from the government.

Industry-government relationships have been worsening over the last five years, and the problem was formally recognized at the Air Force Systems Command Management Conference at Monterey, Calif., in May, 1962 (AW May 14, 1962, p. 26).

The new regulation is viewed by some as the first significant shift in this pattern. At the same time, industry seems also to be clearly aware of the need to perform under the new system.

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launching sets. It is assumed to be the third production run of a continuing program in which the prime contractor has over-all system compatibility and operation responsibility, but in which the missile, except for guidance system and launching equipment, will be subcontracted to a single subcontractor. Both prime and major subcontract contain cost and delivery incentives. The arithmetic follows:

	Estimated Costs (000) (Omitted)	Assigned Weight	Profit Dollars (000) (Omitted)
Contractor's Input: Direct Materials			
Purchased Parts	$4,000	3%	$ 120
Other Materials.	1,000	2.0%	20
Subcontracted Items	50,000	1.92%	960
Engineering Labor	300	11.50%	34
Engineering Overhead	200	8.85%	17
Manufacturing Labor	1,000	5.6%	56
Manufacturing Overhead	1,500	5.62%	84
General and Administrative.	6.000	6.96%	417
Totals	$64,000		$1,710
Composite Weight		2.67%	
Risk		2.5%	
Performance		2.00%	
Selected Factors		−.5%	
Profit Objective		6.67%	$4,268

In assigning weights for the contractors' input category, the contracting officer broke down the subcontract costs into those of great complexity, which received the top 5% weight, those for components manufactured to prime contractor design, given a 4% weight, and the major subcontract for the missile and support equipment requiring little supervision, which got the bottom 1% rating.

Composite Weight

Since the latter was 70% of the recognized cost in the over-all direct materials category, the composite weight worked out near the bottom of the scale at 1.92%. Similar considerations governed other contractor input weights.

Engineering labor, with a substantial portion of senior engineers, received a middle ground weight of 11.5%. Manufacturing labor, most of it unskilled, was just above the minimum percentage of 5%.

Because of the high ceiling, 120%, proposed by the contractor, and because the incentive reward or penalty would be passed along to the major subcontractor, the percentage weight for risk was near the minimum end of the scale: 2.5%.

Previous performance of the contractor in developing, producing and fielding a complex missile system in a short time was assumed as outstanding, and so was a high degree of cooperation in small business and labor surplus programs. Operating an R&D laboratory that had produced significant state-of-the-art advances for the defense effort also was considered. This accounted for a maximum rating of 2% in this category.

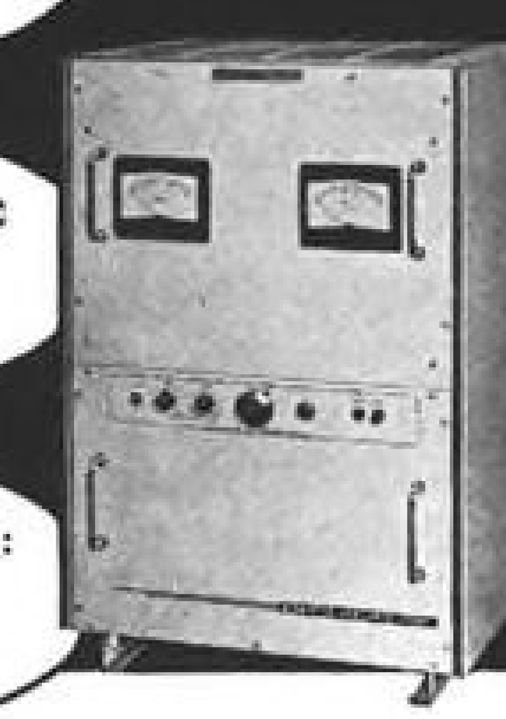
Because both prime and subcontractor progress payments were applied for, and because 30% of the total facilities were government furnished, a −0.5 weight was allocated here.

Final Objective

The sum of the four major category profit figures — 6.67% — multiplied against total costs, produced the final profit objective of $4,268,000.

Some change is expected in profit negotiations, but any significant departure of the final negotiated profit from the contracting officer's original profit objective must be documented in detail for inclusion in the contract file and use by reviewing authority.

Because of incentive provisions, disallowances, contract changes, etc., the actual profit earned will probably vary from that anticipated at the time of negotiation.



CLEAN FEATURES OF THE C-141 are evident in external view. Ground clearance at maximum gross weight is 19 in.

Air Force Minimized Engineering Changes on StarLifter

By James R. Ashlock

Atlanta—Lockheed C-141 StarLifter jet transport has been subjected to rigid Air Force restriction on engineering change proposals during its 2½ years of development, resulting in an aircraft built basically within the existing state-of-the-art to satisfy requirements for both military and commercial operations.

Approximately 50 design changes were proposed on the airplane, but less than half of these were approved by the Air Force System Program Office (SPO) for C-141 development at Wright-Patterson AFB, Ohio.

Reduction of change orders has become a prime goal in USAF procurement, and the C-141 is one of the first major programs to feel its effects. In the past, military transports have been subjected to as many as 150-200 engineering design changes in the period before rollout.

Accepted Design

"One of the first objectives we set up for the C-141 was to hold the aircraft as close as possible to the accepted design," a System Program Office spokesman said.

Of those changes approved for the C-141, none affected the basic design. This is evident when comparing design-competition drawings with the first aircraft, which was rolled out here recently (AW Aug. 26, p. 30).

Design changes were further restricted by the Federal Aviation Agency's participation in C-141 development. The FAA's role is to blend as much commercial utility as possible into the aircraft, and the agency's approval was required before the military could initiate any design features.

"We soon learned that while we could change military specifications to meet our needs, we could not change FAA regulations," Col. M. B. Hammond, director of the C-141 SPO said.

Despite the complications inherent in any joint military-civil venture, Hammond said he now favors the FAA's participation.

Transport Development

"I am convinced that this is the way for the Air Force to go in the development of transports," he said. "Through the FAA's contributions, I believe we've come up with a better airplane."

The C-141 rolled out here bears the earmarks of commercial consideration. It is a relatively clean, uncomplicated airplane, free of such innovations as leading-edge slats, ventral fin or dominant attention to military detail.

"Every decision we made, we cranked in the effect it would have on commercial utility," Hammond said. "Even if this aircraft had been built strictly on commercial consideration, I don't think the basic airframe could have been made any lighter."

Air Force does have approximately 7,000 to 8,000 lb. of equipment aboard the C-141 that would not be required in commercial operation. But all of it, including the heavy-duty floor, is positioned so that it can be left out of the civil version, designated the L-300, without affecting the airplane's basic design.

Most obvious external feature that indicates the emphasis on simplicity is the C-141's wing, which covers 3,228 sq. ft. in its 160-ft. span. Lockheed swept the wing back only 25 deg., as opposed to 30 or 35 deg. on other U.S. jet transports now in both military and commercial use.

"This enabled us to maintain good takeoffs and landing performance without resorting to such things as leading-edge slats," R. D. Gilson, C-141 project engineer, said.

Moderate sweepback also allows use of a single aileron near the tip of each wing, rather than a dual aileron system wherein outboard controls are inactive during cruise to prevent wingtip warping. Rear wing area inboard of the ailerons is devoted totally to spoiler for aerodynamic braking and Fowler flaps.

Wind Tunnel Tests

Original design of the C-141 proved out well in wind tunnel tests, but an alteration was necessary in the fairing around the horizontal and vertical stabilizer connection point. A flutter tendency arose around the original bullet-shaped fairing, and it has been replaced by a larger hour-glass shaped unit which engineers call the "bumble bee." A weight addition of 40 lb. resulted from the change.

Original drawings show a uniform height to the fuselage, but the final aircraft features a turtleback where the dorsal fin is joined. This resulted from changes to the aft cargo door hinge arrangement and in the positioning of the aft ramp, which forms the aft pressure bulkhead when retracted.

Lockheed engineers say the turtleback brought an added benefit in providing more fuselage structure to which they could attach the stabilizer, giving it more strength.

The C-141's most distinctive feature is its flight deck, where the vertical presentation flight and engine instruments contrast with the round dials found on earlier aircraft. Adoption of vertical presentation was one of the engineering design changes approved during C-141 development.

"We adopted the vertical instruments not only because they are extremely accurate, but also because they require less panel space," Hammond said. "For example, with this system five engine instruments will provide the data formerly presented on 20 round dials."

Air Force sought the most accurate instruments to assure precise positioning on such missions as airdrops. For that reason, the C-141's flight instruments are electrically powered and linked with a computer system.

"The old pressure altimeter simply isn't good enough for the service we envision with the C-141," Hammond said.

The elaborate central air data computer system regulates not only the flight instruments, but also the artificial-feel system built into the controls and the C-141's air conditioning system. The computer system receives inputs on the pressure and temperature forces affecting the aircraft, analyzes them, then presents them as altitude, true and indicated airspeed and Mach number. The computers also analyze aircraft performance, and signal via a warning light when malfunctions exist.

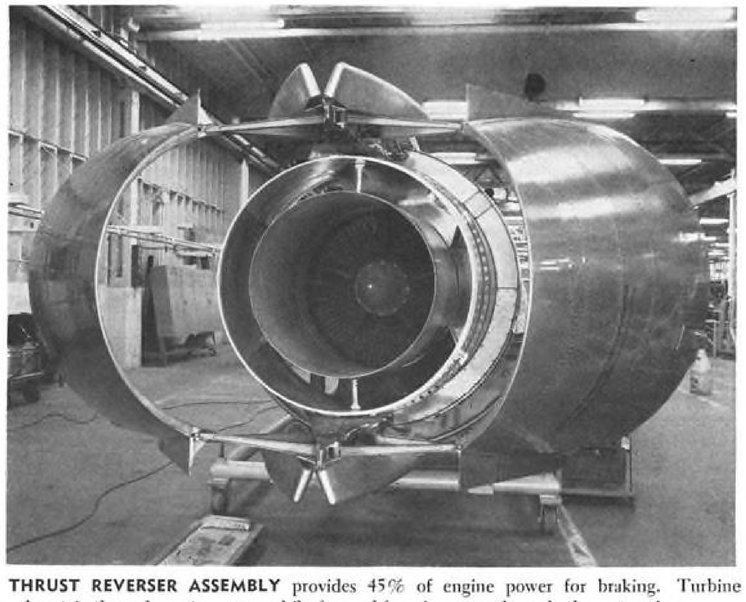
The C-141 contains much more cockpit equipment than would ever be needed in commercial use, particularly on domestic routes. The area below the flight deck is packed with navigation and communication gear, and fully-paneled stations are on the flight deck for the navigator and flight engineer. In addition, there are bunks and seats for a second four-man crew and a galley.

The fuselage is studded with 21 antennas, the most noticeable of which is the high-frequency probe extending forward from atop the vertical stabilizer.

Lockheed engineers originally planned to install the C-141's air conditioning system in the landing gear pods, but decided later to place it in the wing center section, which otherwise would have been vacant. The dual air system works off an air turbine powered by engine bleed air. Each of the dual units provides 110 lb./min. cooling capacity.

Left in the gear pods was the aircraft's auxiliary power unit, which eliminates the need for ground aid in start-

FOWLER FLAPS are the only high-lift devices on the C-141 wing. Horizontal stabilizer trim axis is 12½ deg. down and 4 deg. up.



THRUST REVERSER ASSEMBLY provides 45% of engine power for braking. Turbine exhaust is through center cone, while forward-fan air passes through the outer ring.

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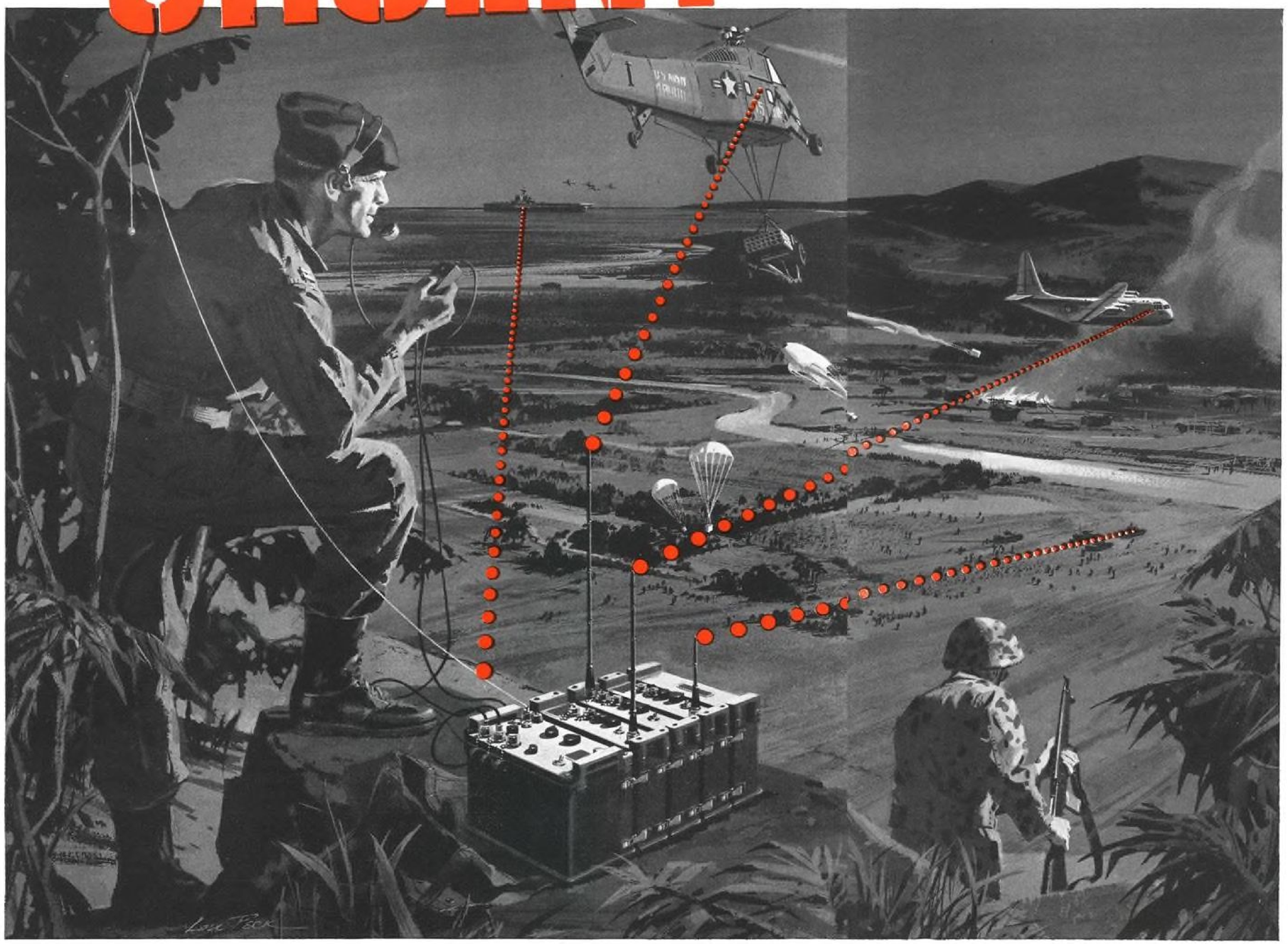

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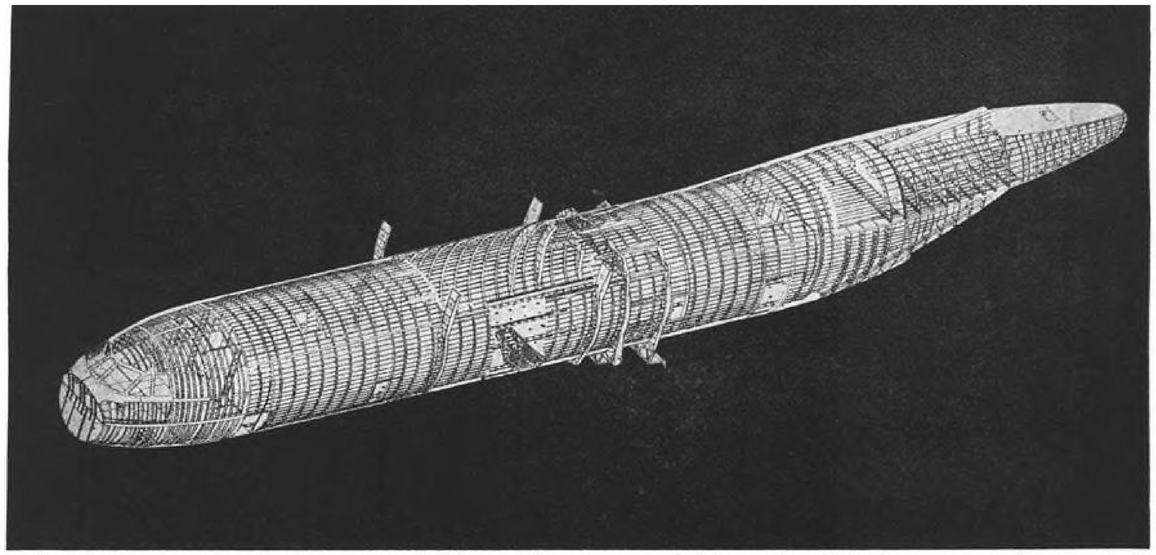


HEAVY CENTER-SECTION FORGINGS of the C-141 are evident in structural skeleton view. Vertical extensions are for wing attachment. Landing gear attach point is shown on underside. Large area forward of cockpit houses a 30-in. radar antenna dish.

ing engines. The C-141 is fueled at 900 gal./min. through easily accessible inlets located in the rear of the right gear pod. Crossfeed pumps are in the wing box. Each wing has five fuel cells.

Air Force insisted on every effort to make the C-141 as independent as possible from ground support equipment. The vertical stabilizer carries a ladder inside it for accessibility by maintenance personnel. The aft loading ramp rests 50 in. above the ground, the average height of truck-trailer beds, to eliminate the need for fork lifts and other cargo hoists. The ramp also lowers to ground level for direct access by troops or vehicles.

Initial specifications included a wide cargo door in the left forward area of the fuselage. However, Air Force experience with the Lockheed C-130 Hercules shows infrequent use of this door. It has been left off the C-141 and also was discarded on C-130s now coming off the production line.

Studies were made on placement of the C-141 landing gear on the wing to provide some ground support for the wings' heavy engine and fuel load. But an excessively long gear strut would have been required because of the high wing, and placing the gear on the fuselage resulted in the gear assembly being 25-30% lighter because of the shorter extension.

Wing construction represented the largest subcontract among the 1,334 companies in the U.S. and Canada which supplied components for the C-141. Avco Corp.'s Aerospace Structures Div., Nashville, Tenn., built the wing boxes and shipped them by rail to Lockheed's facility here. Avco's contract alone in the C-141 program has topped $65 million for tooling and wing box assembly.

The aircraft's entire 23,080-gal. fuel capacity is within the wings, another plus-factor toward FAA certification of the C-141 for commercial application.

The wings are not joined directly through the wing box, but are mated individually to the forged fuselage rings. Four horn-like extensions from the rings comprise the wing junction, providing a rigid connection. Wing loading is 97 psi.

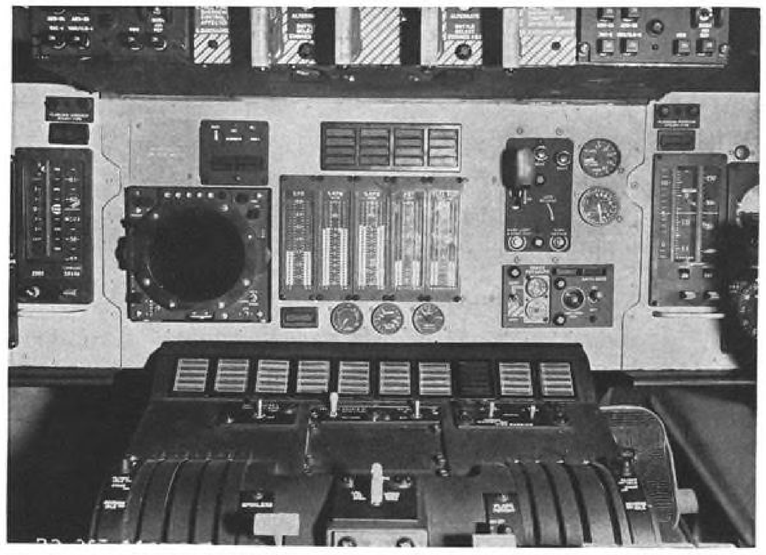
Negative dihedral of 1.2 deg. is designed into the wing to offset any Dutch Roll tendency, placing the wing tips 42 in. below the root. The wing tips rise 20 in. in flight, but this fluctuation is absorbed in the outer wing and brings little stress to bear on the fuselage attachment point.

Anti-icing of the wing leading edge is achieved with hot air circulation. The wing is twisted 3 deg. root-to-tip to offset wingtip stalling.

Positioning the horizontal stabilizer atop the vertical fin required special attention to weight, and 100 lb. was saved by using glass fiber rather than metal for the leading edge. General Dynamics/Convair built this unit, imbedding the anti-icing wiring within the fiber.

The horizontal stabilizer, with a 50-ft. span, is longer than the wing on Lockheed's JetStar executive aircraft.

Lockheed was able to incorporate some features of the C-130 into the C-141, including the a.c. electrical system, boost power control for the ailerons, the nose landing gear and certain



VERTICAL TAPE PRESENTATION on engine instruments gives data on exhaust pressure ratio, rated rpm. of high- and low-pressure rotors, exhaust gas temperature and fuel flow.

USAF/Lockheed C-141 StarLifter

Dimensions and Weights

Length	145 ft.	Max. takeoff weight	316,600 lb.
Height	39.3 ft.	Max. landing weight	257,500 lb.
Wing span	160 ft.	Max. payloads:	
Wing area	3,228 sq. ft.	Military	70,000 lb.
Wing sweep	25 deg.	Commercial	96,000 lb.

Performance

Max. cruise speed	550 mph.
Long-range cruise speed	506 mph.
Airdrop speed	135–230 mph.
Rate of climb, sea level	3,400 fpm.
Military takeoff distance, max. gross weight over 50-ft. obstacle	5,300 ft.
Military landing distance over 50-ft. obstacle	3,700 ft.
Military max. range with 70,000-lb. payload	4,163 stat. mi.
Military payload at max. fuel	32,200 lb.
Military range, max. fuel and payload	6,244 stat. mi.
Military ferry range	7,084 stat. mi.
FAA takeoff field length, max. gross weight	6,000 ft.
FAA landing field length, max. gross weight	6,550 ft.
Civil domestic range, 80,000-lb. payload	3,573 stat. mi.
Civil domestic payload, max. fuel	37,650 lb.

Capacity Ratings

Cargo hold:		Personnel:	
Length (inc. ramp)	81 ft.	Troops	154
Height	9.1 ft.	Paratroops	127
Width	10.25 ft.	Litter patients, with 8 attendants	80
Clear cube volume (inc. ramp)	7,357 cu. ft.	Crew	4
Palletized volume (inc. ramp)	5,484 cu. ft.	Fuel	23,080 U. S. gal.
No. of pallets	10		
Loading opening:			
Height	9.1 ft.		
Width	10.25 ft.		
Height from ground	50 in.		

Powerplants: Four Pratt & Whitney TF33-P-7 turbofans, 21,000 lb. thrust each.

fuselage structure. The fuselage diameter is identical on both aircraft.

However, officials are quick to insist that the C-141 is much more than merely a jet-powered version of the C-130. But it isn't considered an assault aircraft in the sense of the C-130.

"While the C-141 could operate from what you would call moderately unimproved fields, it won't perform on as rough a terrain as the C-130," one Lockheed official said.

Three hydraulic systems are incorporated in the C-141. One is strictly for control system power. Another provides auxiliary power for the control system and also supports the third hydraulic unit in powering the brakes, spoilers, flaps, rear doors and other utility items.

Air intakes for the air conditioning system are in the wing leading edge near the root. Just below them, on either side of the fuselage, are the heat exchanger ducts, and the outlets for pressure release in event of a duct failure in the air circulation system. Twenty-eight blowout ducts are on the lower leading edge as a safeguard against blockage of the de-icing air. Hot air for de-icing is exhausted through vents under the wing tip.

Air Force and the FAA had to compromise in calculating the C-141's performance requirements. Each has different formulas for calibrating takeoff distances, obstacle clearance requirements and engine-out operation. But Hammond says the C-141 should pose no problems in meeting the criteria of both parties.

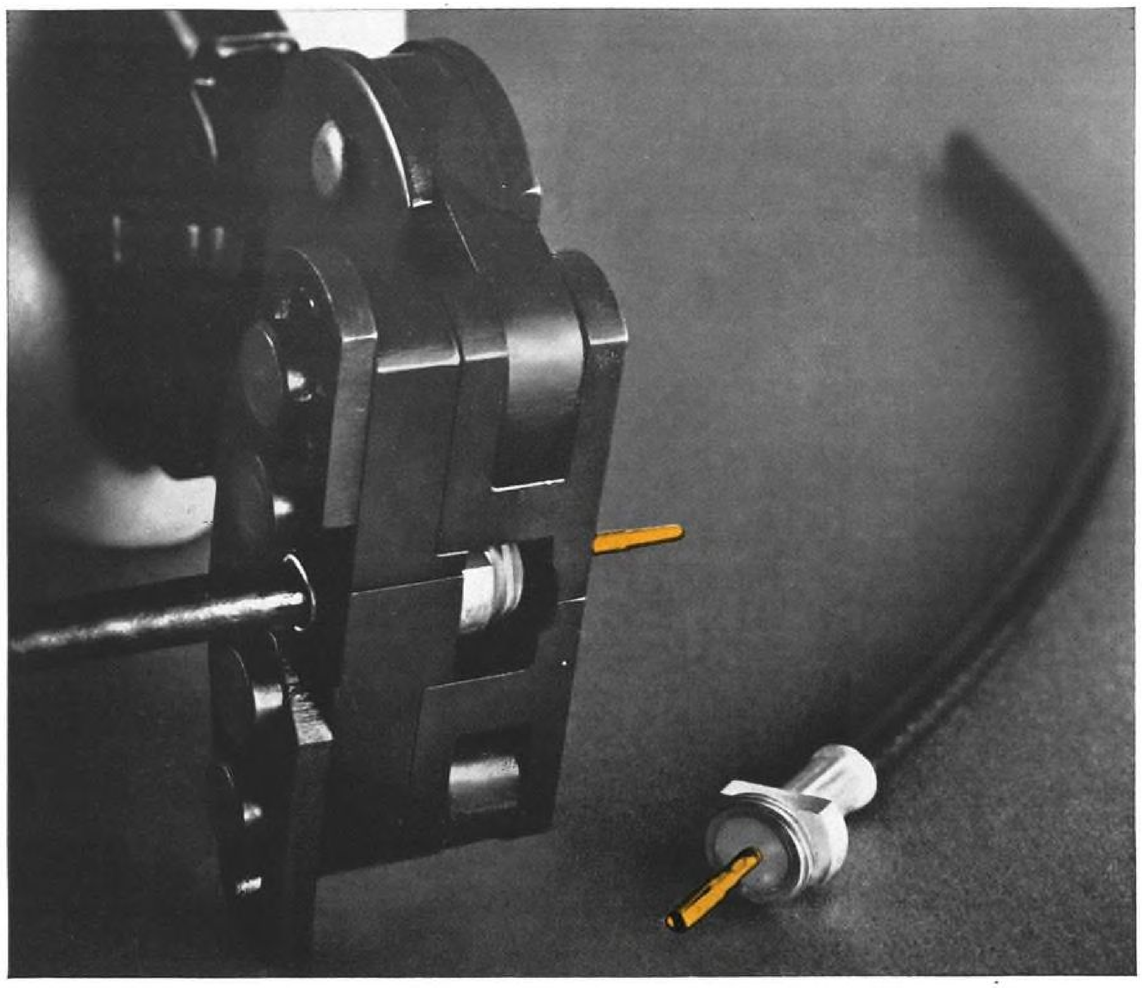
Lockheed generally has been left with a free hand in building the StarLifter. Although Hammond's staff includes 40 engineers, they do no detailed design work. But they must approve everything Lockheed does to the airplane.

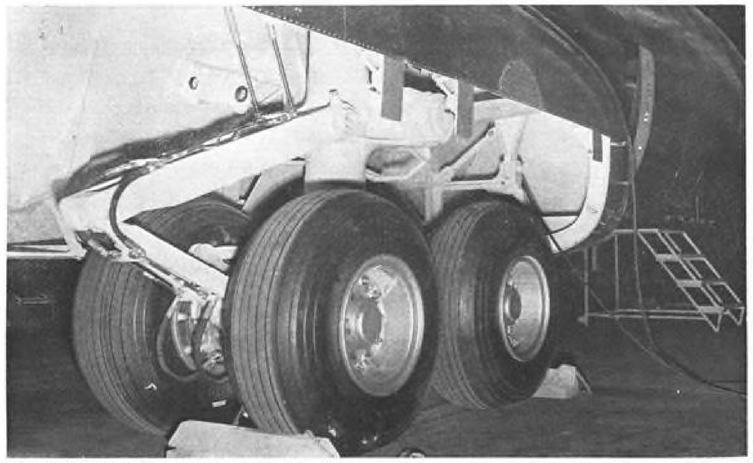
Lockheed was also left to set up its own development organization on the aircraft, but the Air Force did keep an eye on the manpower-cost ratio.

Because of its close cooperation with the FAA, the Air Force can't justifiably be saddled with complaints from potential commercial users about any feature of the C-141, Hammond feels.

Principal C-141 subcontractors include:

• **Rohr Corp.,** Chula Vista, Calif.—na-





SHORT COUPLING of the C-141 landing gear was made possible through mounting in fuselage pods. Main gear trucks are 210 in. apart and 636 in. behind the nose gear.

celles, pylons, thrust reversers; Riverside, Calif.—main landing gear door, gear pods, wing-to-body panels, petal doors.
• **General Dynamics/Convair,** San Diego—empennage.
• **Bendix Products Aerospace Div.,** South Bend, Ind.—main landing gear; Bendix Eclipse-Pioneer, Teterboro, N. J.—automatic flight control system; Bendix Pacific Div., North Hollywood—anti-skid system.
• **Cleveland Pneumatic Tool Co.,** Cleveland—nose landing gear, wing flap track.
• **Avco Corp.,** Nashville—wing box beam.
• **Twin Industries Corp.,** Buffalo—wing leading and trailing edge panels.
• **Brunswick Corp.,** Marion, Va.—nose radome.
• **Raymond Development,** Huntington Park, Calif.—Doppler radome.
• **Shawnee Industries,** Shawnee, Okla.—aft pressure door, crew door, metal emergency exit, wing tips and rear entry doors.
• **Bell Aerosystems,** Buffalo — floor plates.
• **Beech Aircraft,** Wichita—wing flaps, emergency exits, nose gear door, ailerons and wing spoilers.
• **Kaman Aircraft Corp.,** Moosup, Conn.—tail cone.
• **Brooks & Perkins,** Detroit—roller assembly.
• **Collins Radio Co.,** Cedar Rapids—high-frequency antenna.
• **Garrett Corp.,** Phoenix and Los Angeles—environmental system.
• **General Electric Co.,** Waynesboro, Va., Erie, Pa. and West Lynn, Mass.—electrical power system.
• **Jarry Hydraulics,** Montreal—wing spoiler actuation system.
• **Kelsey-Hayes,** Springfield, Ohio—flap actuation system.
• **Liquidometer Corp.,** Long Island City, N. Y.—fluid quantity gaging system.
• **Pesco Products Div.** of Borg-Warner, Bedford, Ohio—thrust reversers.
• **PneumoDynamics,** Kalamazoo, Mich.—power boost system.
• **Walter Kidde & Co.,** Belleville, N. J.—fire detection system.
• **Western Gear Corp.,** Lynwood, Calif.—stabilizer, pitch trim actuator.

PRODUCTION BRIEFING

Air Reduction Sales Co., New York City, will build an $8-million, 1,000 ton-per-day gaseous and liquid oxygen, nitrogen and argon plant in New Orleans, adjacent to National Aeronautics and Space Administration's Michoud facility. The plant, to be located on the intracoastal waterway, will transport liquefied gases in specially insulated barges, both along the waterway and up the Mississippi River.

Loral Electronics Corp., New York City, has concluded an extensive cross licensing agreement with Contraves AG, Zurich, Switzerland. Loral has exclusive U. S. rights to the Swiss firm's naval fire control systems, missile telemetry systems, and parallax computers. Contrave has rights to certain Loral navigation, display, aerospace and electronic warfare equipment, in six European countries.

Martin Co.'s Denver Div. has a contract from NASA's Launch Operations Center for a four-month study of rescue and escape problems associated with large space launching structures, with emphasis on the Saturn launch system.

Rocket Research Corp., Seattle, Wash., has a $49,270 research contract from Air Force Rocket Propulsion Laboratory, Edwards AFB, Calif., to study hypergolic ignition of gaseous propellants.

Garrett Mfg. Ltd., Ontario, Canada, has a development and production contract from RCAF for 15 self-contained cooling systems for electronic packages onboard the electronic countermeasures (ECM) version of the CF-100 aircraft. Coolant heat has to be dissipated at a rate of 19,000 BTU/hr.

General Dynamics/Pomona has received a $1.1-million follow-on contract for R&D work on Army's Mauler weapons system.

Systems Engineering Laboratories, Inc., Ft. Lauderdale, Fla., has been awarded a $500,000 contract from NASA's Lewis Research Center, Cleveland, Ohio, for design, construction, and installation of a digital data system at NASA's Plum Brook Station, near Sandusky, Ohio. The system will be used to obtain data from over 400 points at a rate of 30,000 measurements per second, primarily in connection with the Centaur program.

Bell Aerosystems Co., Buffalo, N. Y., has a follow-on contract for over $1 million from NASA's Lewis Research Center for production of reaction control systems for the Centaur upper stage vehicle.

American Petroleum Institute estimates a Mach 3 supersonic transport will burn fuel at about 14,000 gal./hr. Today's jets burn 3 billion gal. annually, the Institute says, and by 1970 the consumption is expected to reach 4.5 billion gal. SSTs should create a demand for another 2.9 billion gallons annually, exclusive of subsonic jets and military aircraft by 1975.

H. C. Smith Construction Co., Los Angeles, will install communication antennas and the missile suspension equipment in the underground launching silos in the fourth wing of Minuteman ICBMs, under a $1.7-million contract from Boeing Co. The work will be at sites near Whiteman AFB, Mo.

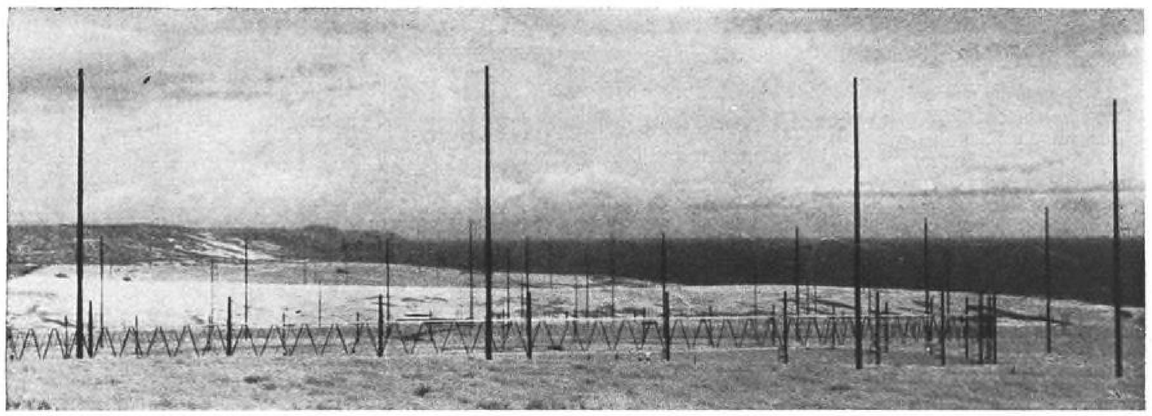
General Dynamics/Pomona has received a $138,000 Army contract for study of a periodically elevated radar system for battlefield surveillance. Company also has received a $50,000 Air Force contract for evaluation and recommendation of techniques and equipment relating to design of an air-launched rocketsonde to sense temperature, humidity, pressure and density at high altitudes.

French government has bought a Fairchild Stratos Electronic Systems Div. APT (automatic picture transmission) ground station for use with the Tiros 8 weather satellite this fall. The station will be installed at Lannion, Brittany.

Honeywell will transfer its manufacturing operations at Fall River, Mass., to its Industrial Products Group in Philadelphia. The Fall River facility manufactures industrial instruments.

Sylvania Electric Products, Inc., West Roxbury, Mass., will operate and maintain two underground communications networks totaling 600 mi. for Air Force's Titan ICBM program under a $440,000 contract. Work will be performed at Schilling AFB, Salina, Kan., and Warren AFB, Cheyenne, Wyo.

Atlantic Research Corp., Alexandria, Va., has a $2.5-million Air Force contract for an exploratory development program to demonstrate advanced technology in a very high performance solid rocket motor. Contract includes design, fabrication, and static test of experimental motors and delivery of two flight weight motors to Air Force. Prototypes will be delivered within 20 months.



WIRE GRID HIGH FREQUENCY Luneberg lens antenna being built by TRG-West at Molokai Island, Hawaii, for the Federal Aviation Agency is expected to lead to improved HF air-to-ground communications and large savings in land area required by ground antenna systems. Ring truss, which supports double wire grids of the lens, is assembled on the ground before being hoisted onto vertical poles.

FAA, Military Evaluate HF Grid Antenna

By Barry Miller

Menlo Park, Calif.—An unusual antenna concept which is expected to make possible high-performance high frequency (HF) communications from a single ground antenna simultaneously to widely divergent aircraft or ground stations soon may be evaluated jointly by the Federal Aviation Agency and the three armed services.

The new antenna, known as a wire grid lens antenna, occupies no more land area than is now required by a single large HF rhombic antenna transmitting and receiving in one direction only.

A giant antenna embodying the antenna concept, which is a high-frequency derivation of the Luneburg lens principle, is nearing completion on the island of Molokai in the Hawaiian Islands. It was designed and constructed for the FAA by TRG-West, a division of TRG, Inc., located here.

When it is completed and put into operation, the antenna is expected to provide for point-to-point HF communications with aircraft or ground stations on the routes from Molokai to San Francisco, Anchorage, Tokyo, Wake Island, Sydney, Nandi and Canton Islands and Samoa. At present, over-the-water air-to-ground communications from commercial airliners are accomplished by HF, at least partially explaining FAA's approximately $400,000 support for the wire grid lens antenna development at Molokai.

The wire grid antenna constitutes an application in the HF range of an optical technique invented fifteen years ago by the late Dr. R. K. Luneburg, Brown University optics professor. He proposed a lens made of a material the index of refraction of which varies parabolically from $\sqrt{2}$ at its center to unity at its perimeter. This lens, the so-called Luneburg lens, has the unusual property that it can focus parallel rays incident upon it from one direction to a point on its far side diametrically opposite the point of incidence. A spherical Luneburg lens is in focus for rays from any direction, a disk shaped lens for rays coming from all directions in the plane of the disk.

WEIGHTS ARE ATTACHED to wires of the horn surface strung over the ring truss to create proper tension before the wires are attached to the upper truss ring. Area between truss and outer perimeter of poles is bridged by wires comprising horn upper surface.

In the years since Luneburg's work, his ideas were extrapolated down into the radio frequencies, particularly microwave or ultra high frequency (UHF). The Nike Zeus acquisition radar (AW Apr. 17, 1961, p. 75) employs a spherical Luneburg lens.

Additional feeds placed at different points around the periphery of the lens where beams will focus make it possible to transmit or receive in as many directions as there are feeds. Movement of the feed around the lens effectively steers the beam.

Thus, many beams can be generated in many directions from the same antenna at the same time. This is the basis for anticipating that the single HF antenna at Molokai, using a variation on this idea, will save ground compared to a large conventional rhombic antenna.

In earlier applications of the Luneburg lens concept to radio frequencies, the desired variations in refractive properties of the lens were achieved by the use of an expanded dielectric foam. The refractive index of the lens is varied by careful control of the density of the foamed dielectric or metallic slivers or filaments imbedded in the dielectric. The latter is the procedure employed in the Zeus radars.

Lower Frequencies

For the larger antennas that would be necessary for operation at lower frequencies, such as HF, foamed dielectric in the required large sizes is impractical. To apply the technique to these lower frequencies, TRG-West designed an antenna in which a pair of wire grids, one above the other, replaces the foamed dielectric. Variations in the spacing between the two grids account for the necessary parabolic variations in the effective index of refraction.

Working from this wire grid lens concept, TRG engineers last month were completing for FAA an 850-ft. antenna installation on Molokai. FAA's twofold interest in this antenna, according to G. Victor Rodgers, agency project manager, is to:

- **Improve** HF communications.
- **Reduce** the size of the area needed for HF antennas.

At present, a separate rhombic antenna is necessary for HF communications in each direction. One wire grid lens antenna, occupying a land area roughly equal to that needed by a rhombic, could have an almost limitless number of feeds. Every additional feed on the lens antenna effectively replaces one rhombic antenna.

A practical limit to the number of feeds which could be used would be about 36, sufficient for complete azimuth coverage, according to Robert L. Tanner, TRG vice president. The first wire grid lens antenna installation at Molokai will have only seven feeds to link the seven cited locations, Tanner says.

Two such wire grid lens antennas, the second one to make diversity reception possible, could make unnecessary much of the land area of the FAA's antenna farm, Rodgers points out.

Although Rodgers was not specific about relative costs of a single wire grid lens antenna with multiple feeds, compared to an equivalent number of rhombics, he did indicate that should the forthcoming evaluation confirm anticipated antenna performance, he expects economies with this system. As a rough measure of what this may mean, Tanner estimates the wire grid lens antenna with ten feeds will be less costly than ten rhombics, and this excludes real estate costs, which would favor the wire grid even more.

Every feed in the lens antenna provides a narrow, high-gain, low side-lobe beam pattern in the direction opposite from it. With multiple feeds, one lens behaves as many single antennas pointed in as many directions. The side-lobe levels will be lower, Tanner says, than those generated by a rhombic. Tests conducted by TRG-West on a special scale model of the wire grid lens antenna support this. First side-lobe levels of patterns shown to AVIATION WEEK & SPACE TECHNOLOGY were about 20 db. down from the main beam, the average side-lobe level about 25 db. below. The main beam, at the 3-db. points, is about 5 deg. wide. Typically, the side lobes of conventional rhombic antennas are only 6 db. down from the main beam, which is on the order of 25 to 30 deg. wide. Performance of the Molokai antenna probably will not match that of the TRG model, but it should be better than the rhombic's, according to Tanner.

The bandwidth of the lens antenna is broad (10:1), spanning the entire HF range (3 to 30 mc.). A rhombic antenna, Tanner points out, performs over only a 2 or 2.5:1 bandwidth.

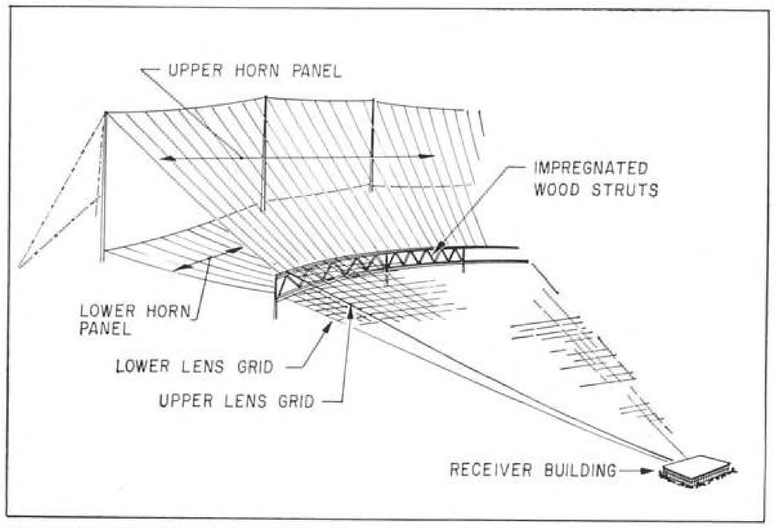
Joint Evaluation

In view of the interest expressed by the military services since the start of the program a year ago, FAA is now attempting to arrange a joint evaluation of the Molokai antenna with the Army, Navy and Air Force. A second antenna system of this type, but only about half as large, and to be used for direction finding, is being built by TRG for the Air Force at Rome Air Development Center.

Conceivably, one reason for military interest in the wire grid lens antenna would be its use for monitoring all HF communications, a possibility TRG declined to comment on.

As indicated in accompanying drawings (see below), the wire grid lens antenna, as constructed at Molokai, consists of a 600-ft.-dia. circular lens composed of two circular wire grids suspended one above the other. At the center of the lens the spacing between the grids is small (7 or 8 in.) with respect to the grid or mesh size (5 ft.), while at the edges the spacing grows large (12 ft.) compared with the mesh size.

Concentric with the lens is a diverging wire grid radial line horn which boosts the over-all dimensions of the lens antenna to 850 ft. The presence



ENLARGED SECTION of wire grid Luneburg lens high frequency antenna provides insight in the layout of wire grids of lens and horn. With multiple feeds, the single antenna can generate beams in many directions simultaneously, unlike a conventional rhombic HF antenna, which is used for communications in one direction.

Frequency mc.	Width of Illuminated Horizontal Aperture—(ft.)	3-db. Azimuth Beamwidth (deg.)	Approximate Elevation of Beam Maximum Above Horizon (deg.)	Elevation-Angle(s) Where Vertical Radiation Pattern Decreases by 3-db. (deg.)	Approximate Gain Over Isotropic at Beam Maximum—db.
3	600	38	10	≈5–49	13
6	600	19	10	≈5–35	17
10	600	11.2	10	≈5–30	21
20	600–300	5.6–11.2	10	≈5–25	24–21
25	600–240	4.5–11.2	10	≈5–25	24.5–21
30	600–200	3.7–11.2	10	≈5–25	26–21

GAIN AND BEAMWIDTHS are shown for a 600-ft. dia. vertically polarized wire grid lens antenna with a 90-ft. high horn.

of the horn increases the vertical aperture of the lens, thereby reducing its vertical beamwidth.

The grid wires are suspended from wooden supports, much like utility poles, arranged in concentric rings at the perimeters of the horn and lens and within the lens. The grid wires of the lens are supported by circular extruded aluminum rings forming the upper and lower chords of a circular compression truss which is fastened 18 ft. above ground to brackets bolted to the poles. Diagonal members of the truss are made of impregnated wood.

Construction Procedure

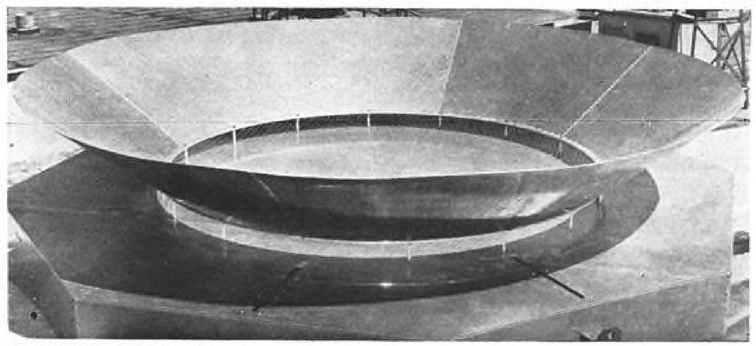
In constructing the antenna, the poles were first installed, followed by the assembly on the ground of the ring truss. Wires were strung in the top and bottom chords of the truss and tied in the form of the grid network. Dielectric spacers were then placed between the two grids to maintain their separation in the event that the wires expand or contract with changes in temperature. At this point the lens was complete and was lifted into position above the ground by hoists attached to the inner ring (lens) poles and fastened to these poles.

The horn was made by suspending cables between the tops of the 25 poles in the outer ring of poles and then draping 21 wires at 5-ft. intervals from each cable to the truss structure. Other wires were stretched from cables connected between the same poles only 7 ft. above the ground to the lower ring of the truss. The wires forming the horn surface were stretched to proper tension over the truss by attaching 50-lb. cement buckets to each, marking them and finally securing them to the top or bottom ring of the truss.

Traveling wave feeds will be situated on the periphery of the lens so beams can be generated in the desired directions. The present antenna was built as a receiving antenna, but it could serve equally as well as a transmitting site were this desired.

Tanner stresses that the techniques employed in building the Molokai antenna are not necessarily those TRG would use for future installations, implying that the company plans simpler, less expensive methods of constructing later wire grid lens antennas.

As in the regular Luneburg lens, the index of refraction for a wave propagating between the grids is 1.41 at the center of the lens, where in this case, spacing between the grids is small compared to mesh size. At the edge of the lens, where the spacing between the grids of the lens is larger, the equivalent index of refraction is unity.



SIMPLIFIED MODEL of a wire grid Luneburg lens antenna used by TRG-West in experimentally determining from suitable scaling laws that at HF the wire grid lens antenna would generate high-gain, low side-lobe beams. Scale model measures 5 ft. in diameter.

Grid Characteristics

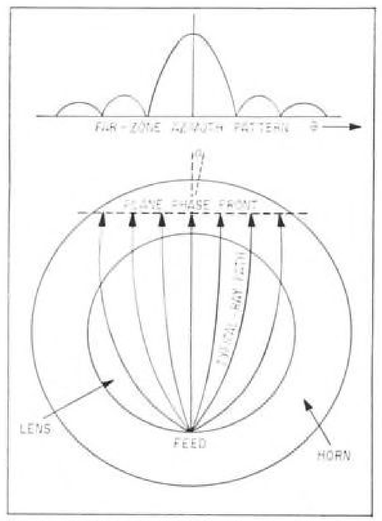
The pair of grid wires exhibits the characteristic of a parabolically-varying index, changing from 1.41 to unity, as would an optical Luneburg lens. The reason for unity index is that the grids behave as metal sheets when the mesh size is small compared to the wavelength and the grid-to-grid spacing is large with respect to mesh size. Under this condition, the region between parallel grids supports a quasi transverse-electromagnetic mode (TEM) wave propagating with velocity approaching the speed of light. The pair of grids thus has an equivalent index of refraction of unity.

When spacing between grids is small compared with mesh size, as it is at the center of the lens, the grids behave as a network of interconnected open wire transmission lines providing an effective index of refraction of 1.41.

Operation of the wire grid lens antenna may be illustrated by reference to the plan view drawing (see p. 85) of the lens showing ray paths and the far zone azimuth pattern. Radiation generated by a single feed on the periphery of the lens will follow the indicated paths. It will emerge from the horn at the far side of the lens and be radiated into space. The wave would have a uniform phase front over a length equivalent to the diameter of the lens.

Maximum beam intensity would be along the radial extending from the feed through the center of the lens. Should the feed be outside the lens a similar type of performance would be possible by modifying the index of refraction.

Gain and beamwidths of a 600-ft. dia. vertically polarized wire grid lens



PLAN VIEW DRAWING of wire grid lens antenna indicates ray paths for a single feed on the lens perimeter. Radiation will be generated from the horn on the side directly opposite the feed. Additional feeds around the perimeter can generate or receive separate beams in direction that is opposite the respective feeds.

antenna with a 90-ft. high horn over the decade of HF frequencies are tabulated in the table on p. 83. The smallest azimuth beamwidths shown for the higher range of frequencies are for full illumination of the horizontal aperture. Larger beamwidths are obtained when only a portion of the horizontal aperture is illuminated.

In the horizontal plane, half-power beamwidths when the lens is illuminated by a sine wave across its full diameter can be expressed in degrees as a constant (677) divided by the product of frequency in megacycles and lens diameter in hundreds of feet. Typically, for the 600-ft. lens, the beamwidth is 11.2 deg. at 10 mc.

The wire grid lens antenna can operate over the full HF band providing narrow beam patterns because the lens index of refraction, and consequent focusing properties, are independent of frequency. This condition will be true as long as the mesh size does not exceed 0.15 wavelength. Hence, at the extreme end of the HF band (30 mc. or 10 meters) the mesh size cannot exceed 1.5 meters, or 5 ft.

To check out its calculations, TRG built and tested a 5-ft. dia. vertically-polarized scale model of the wire grid lens over the frequency band from 750 to 2,250 mc. The model lens was a single grid mounted over an aluminum ground plane, providing the same electrical properties as the double grid lens at a lower fabrication expense in small model form. Similarly, to keep costs down, sheets were substituted for the wire grids of an 8 ft. dia. radial horn.

The vertically-polarized azimuth radiation patterns of the antenna measured at different frequencies within the band indicated side lobes were down on an average of 25 db. from the main beam. First side lobes were about 20 db. down.

The concept of the HF wire grid lens antenna dates back to work done by Tanner at Stanford Research Institute, where he was manager of the electromagnetic laboratory. The idea was expanded and further refined by him and a colleague, Mogens Andreasen, since founding TRG-West in late 1961. TRG-West now has a permanent staff of about 30 doing R&D and construction of this and related projects.

AEC is First Customer For Control Data 6600

Chippewa Falls, Wisc. – Control Data Corp. will deliver the first production model of its new 6600 computer to the Atomic Energy Commission's Lawrence Radiation Laboratories, Livermore, Calif. in the spring of 1964.

Cost of the machine, including a central processor, display console and keyboard, disc files, magnetic tapes, printers, central memory and ten peripheral and control processors is over $7 million, with monthly leasing costs of $150-175,000.

The Model 6600 general purpose computer will be used at Livermore for the solution of three-dimensional hydrodynamic equations and simulation studies.

According to Control Data, the complex calculations associated with meteorology, weather prediction and other scientific problems are the main areas in which the 6600 was designed to function.

Concurrent multiprogramming of the 6600 is possible using 11 independent computers internal to the machine. It will take 20 microsec. to switch over from one program to another, according to Control Data.

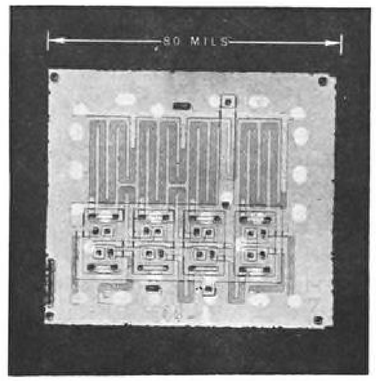
The random access central memory stores 131,072 60-bit words in 32 banks of 4,096 words each.

The read/write major cycle time is 1 microsec. The average instruction execution time is two major cycles with a minimum time of 0.5 microsec. possible provided that there is no central memory bank conflict.

The disc filing system stores 500 million bits.

Power consumption for the 6600 is 24 kw. or 6 kw. for each of four logic module wings.

Heat generated by the logic modules is dissipated by a circulating freon cooling system.



Hybrid Microcircuit

High-density hybrid microcircuit, a half shift register containing 24 transistors and metal thin-film resistors with total resistance of more than one megohm, is fabricated on silicon wafer measuring only 80 mils square —0.08 x 0.08 in. The device, fabricated by CBS Laboratories Div. of Columbia Broadcasting System, Inc., has electrically isolated transistors with beta values as high as 100 at collector current level of 1 microampere, a collector capacitance of 5 picofarads at zero bias and operates at power level of 1.5 microwatts per transistor. The device is protected by a silicon dioxide layer.

FILTER CENTER

► **Military/Space Systems Swinging to Microcircuits**—Growing number of new military and aerospace avionic systems, as well as equipments planned for retrofitting into existing systems, are expected to use semiconductor microcircuits for reasons of their potential reliability, small size or low power consumption. Among these systems are the Navy's Phoenix air-to-air missile system, the guidance systems of the Air Force's Titan 3 space booster and the Army's Pershing missile. Previously, similar efforts were reported (AW Jan. 14, p. 83) on improved Minuteman, Polaris and Apollo guidance computers and on many future naval airborne and shipbased systems.

► **Radiation Sells Subsidiary**—Radiation, Inc., has sold its wholly-owned subsidiary, Radiation at Stanford (formerly Levinthal Electronics), to Energy Systems, Inc., a new company, the principals of which are the former operating executives of Radiation at Stanford. Financing was arranged through Electronics Capital Corp.

► **Xerox Corp. Acquisition**—Xerox Corp. has purchased the assets of Electro-Optical Systems, Pasadena, Calif., research and development company. The present management of Electro-Optical will continue.

► **Microcircuit Sales Growth Charted**—Factory sales of semiconductor microcircuits for the first quarter of 1963 stood at 64,475 units for a dollar volume of $2,269,810, according to figures compiled by Electronic Industries Assn. This is the first quarter for which unit and dollar sales of microcircuits were reported by EIA, although it did estimate factory sales for the entire 12-month period last year at $5,782,319, suggesting that sales are sharply increasing. The association did not report unit sales for 1962 in line with a policy not to do so where one company accounts for over 50% of the total. All figures include value of government research, development, test and evaluation contracts that require delivery of devices.

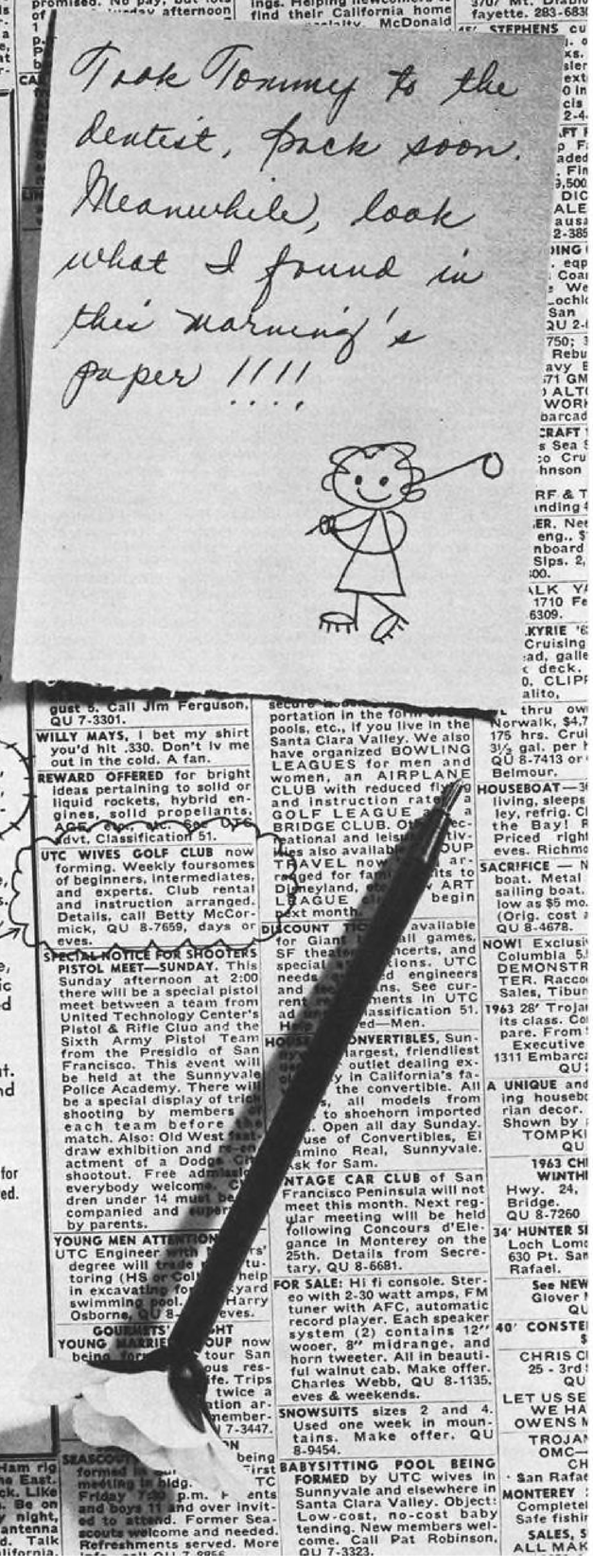
► **Litton Developing Multiple Microcircuit Sources**—To avoid sourcing difficulties it might otherwise encounter during a fabrication program, Litton Systems has initiated a program involving seven potential sources of semiconductor microcircuits for the Phoenix air-to-air missile computer and display systems. The seven, Fairchild, Motorola, Sylvania, Pacific Semiconductors, General Electric, Transitron and Philco, were given small development contracts to fabricate in microcircuit form a Litton-designed logic element. In this manner Litton hopes to encourage the availability of multiple sources once the computer system goes into full production.

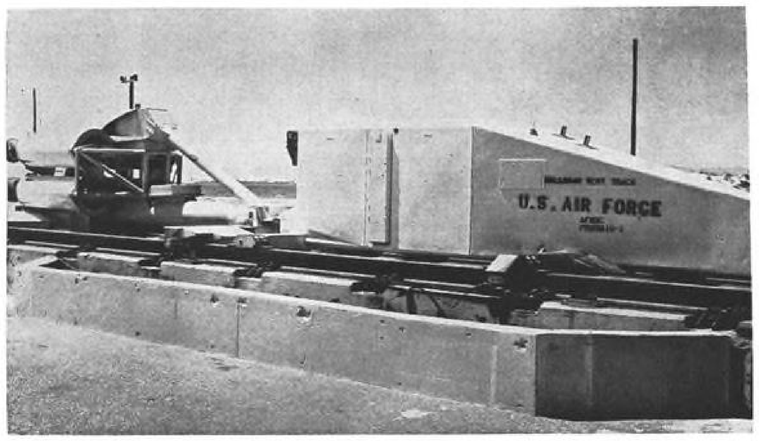
Multi-Use Computer

New York—Radio Corp. of America has introduced here what it calls an "all-purpose" digital computer system, Model 3301, which is said to function effectively as a scientific computer, business data processor, real-time management control or high-speed data communications processor, depending on the functional modules selected.

Features include a micromagnetic "scratch-pad" memory with 50 four-character locations operating on a 250-nanosec. split cycle. Core memory, accommodating up to 160,000 characters, depending on units ordered, has a cycle time of 1.75 microsec. A large-capacity disc file can be added to provide storage for up to 88 million characters with an average access time of 100 millisec.

For scientific use, addition of a high-speed arithmetic unit permits floating point additions in 10 microsec., multiplication in 38 microsec. In data communication use, the system could utilize six voice-grade channels equipped with digital subsets to handle data at 2,400-bit-per-sec. rates.





New Technique Separates Rocket Sled

Inertial guidance system testing methods have been improved by Air Force Systems Command by use of new techniques to separate a rocket sled from its rocket engine after a supersonic run on a high-speed test track. In tests conducted at AFSC's Air Force Missile Development Center, Holloman AFB, the pusher and forebody were separated by blowing apart their couplings with explosive squibs. Acid-engine sled develops 105,000 lb. of thrust.

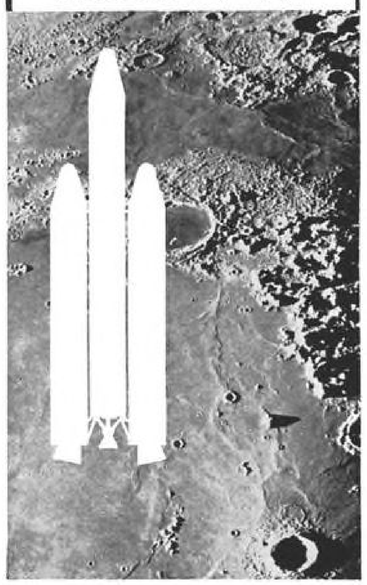
Six Aerospace Companies Report Officers' Compensations to SEC

Washington—Following is a list of aerospace industry directors and officers with 1962 salaries above $30,000, and their stockholdings, as they were reported to the SEC:

Grumman Aircraft Engineering Corp.—L. R. Grumman, chairman of the board, $65,400 salary, $13,304 from employees' retirement system, 100,000 shares of common stock; E. C. Towl, president and director, $82,167 salary, 7,900 shares of common stock; W. T. Schwendler, director and chairman of the executive committee, $74,667 salary, 45,200 shares of common stock; A. P. Loening, director, 12,500 shares of common stock; E. W. Poor, director and treasurer, 24,090 shares of common stock; C. A. Wight, director, 1,000 shares of common stock; J. L. Collyer, director, 100 shares of common stock. All stock beneficially owned, as of Feb. 1, 1963.

International Telephone & Telegraph Corp.—H. S. Geneen, president, $166,343 salary, $115,000 bonus, 2,999 shares of capital stock, 40 shares of I.T.T.'s cumulative preferred stock 4% convertible Series B; J. J. Graham, vice president, director (elected 1963), $70,523 salary, $50,000 bonus, 100 shares of capital stock; W. T. Marx, senior vice president, $77,200 salary, $45,000 bonus; W. L. Pierson, consultant, $43,280 salary, 200 shares of capital stock, $400 principal amount of 4¼% convertible subordinated debentures; E. W. Stone, vice president, $69,970 salary, $37,000 bonus, 2,363 shares of capital stock, 4 shares of I.T.T.'s cumulative preferred stock 4% convertible Series B; G. R. Brown, director, 23,242 shares of capital stock, $44,400 principal amount of 4¼% convertible subordinated debentures (capital stock and debentures are owned in part by the partnership of Herman Brown & George R. Brown, and in part by a corporation wholly owned by the partnership. George R. Brown is one of two equal partners in the partnership. The partnership also owns 12 shares of I.T.T.'s cumulative preferred stock 4% convertible Series B); A. M. Hill, director, 13,500 shares of capital stock; C. D. Hilles, Jr., 11,336 shares of capital stock, $2,500 principal amount of 4¼% convertible subordinated debentures; A. P. Kirby, director, 40,000 shares of capital stock (of which 600 shares are owned by a corporation of which Mr. Kirby is a stockholder); H. Knowlton, director, 2,000 shares of capital stock (of which 1,000 shares are held in a trust of which Mr. Knowlton is trustee and beneficiary); J. P. Lannan, director, 10,000 shares of capital stock (registered in the name of Lannan Bros., a partnership; Mr. Lannan's interest is 7,909 shares); R. S. Perkins, director, 1,000 shares of capital stock; W. T. B. Westfall, director, 100 shares of capital stock, 4 shares of I.T.T.'s cumulative preferred stock 4% convertible Series B. All stock beneficially owned, directly or indirectly, as of Mar. 1, 1963.

Kaiser Industries Corp.—H. J. Kaiser, chairman of the board, $230,000 salary, 1,846 shares of common stock, 2,980,100 shares of common stock held in trusts (E. E. Trefethen, Jr., W. Marks, and P. S. Marrin are the trustees of two of six trusts for H. J. Kaiser and, with D. Browne and G. E. Link, are the trustees of a third. The trustees have no beneficial interest in any of the trusts), 303 shares of common stock in Kaiser Aluminum & Chemical Corp., 1,480 shares of common stock in Permanente Cement Co., trustee of a trust fund for E. F. Kaiser (details given below), trustee of the H. J. Kaiser, Jr., trust fund (details given below); E. F. Kaiser, president, $230,000 salary, 43,840 shares of common stock, 5,295 shares of common stock held by E. F. Kaiser as custodian for minor children, 1,747,674 shares of common stock and 5,855 shares of preferred stock held in trusts (the trustees of these trusts are Messrs. H. J. Kaiser, E. J. Kaiser, E. E. Trefethen, P. S. Marrin, and W. Marks. E. F. Kaiser is the beneficiary of one of these trusts; otherwise the trustees have no beneficial interest in any of them. Each of the trustees is a director or



an officer of a charitable corporation which owns 22,936 shares of common stock. Mr. Marrin is one of the trustees, with no beneficial interest, of two trusts which own an aggregate of 280,964 shares of common stock and 2,413 shares of preferred stock); stock owned by Mrs. E. F. Kaiser as follows: 43,840 shares of common stock, holds 5,295 shares of common stock as custodian for minor children and 75 shares of common stock as trustee for minor children, 1,872,674 shares of common stock held in trust (in addition, E. F. Kaiser is a trustee for the H. J. Kaiser Trust, details of which are given below); (H. J. Kaiser Trust: until his death in 1961, H. J Kaiser, Jr., was beneficiary of a trust holding 3,941,742 shares of common stock of the corporation. After payment of taxes, expenses, obligations, and costs from the estate, the remainder of this trust is to be transferred by the trustees, H. J. Kaiser, E. J. Kaiser, E. E. Trefethen, P. S. Marrin, and W. Marks, to the trustees for the H. K. Family Foundation—see next item): (H. J. Kaiser Family Foundation, charitable trust, holding 3,538,798 shares of common stock of the corporation, and 20,429 shares of preferred stock. The trustees are E. E. Trefethen, P. S. Marrin, W. Marks, D. Browne, G. E. Link); E. E. Trefethen, Jr., executive vice president, $200,000 salary, 388,408 shares of common stock, 2,636⅔ shares of preferred stock, 1,450 shares of common stock held by Mr. Trefethen (with no beneficial interest) as custodian for minor child, 7,000 shares of common stock in Kaiser Aluminum, 9,000 shares of common stock in Kaiser Steel Corp., 15,000 shares of common stock in Permanente Cement Co., trustee for various trusts as previously noted; W. Marks, vice president and secretary, $150,000 salary, 25 shares of common stock, 310 shares of common stock in Kaiser Aluminum, 200 shares of common stock in Permanente Cement Co., 1,500 shares of common stock in Kaiser Steel Corp., reversionary interest in the corpus of a trust which presently holds 2,000 shares of common stock in Kaiser Aluminum and 800 shares of common stock in Permanente Cement Co., trustee of various trusts as previously noted; A. B. Ordway, vice president, $53,000 salary, 309,932 shares of common stock, 2,830 shares of preferred stock, 1,200 shares of common stock in Kaiser Aluminum, 1,500 shares of common stock and 100 shares of preferred stock in Permanente Cement Co.; P. S. Marrin, director, 3,228 shares of common stock in Kaiser Aluminum, 1,600 shares of common stock in Permanente Cement Co., 800 shares of common stock in Kaiser Steel Corp., trustee of various trusts as previously noted; F. A. Ferroggiaro, director, 2,000 shares of common stock, 500 shares of common stock in Kaiser Aluminum; George E. Link, director, trustee of various trusts as previously noted; H. Quinton, director (elected in 1963).

All stock beneficially owned, as of Mar. 2, 1963.

Kaman Aircraft Corp.—C. H. Kaman, president and director, $79,999.96 salary, 15,644 shares of class a common stock, 31,539 shares of class b common stock (owned jointly with Mrs. Helen S. Kaman); E. J. Odlum, senior vice president and director, $49,500.03 salary, 3,837 shares of class a common stock, 341 shares of class b common stock; B. F. Clark, senior vice president and director, $41,250.03 salary, 1,030 shares of class a common stock; W. A. Coolidge, director, 14,633 shares of class a common stock, 11,768 shares of class b common stock; K. E. Erickson, vice president and director; G. P. Gardner, Jr., director, 21 shares of class a common stock, 733 shares of class b common stock; M. H. Glover, director, 114 shares of class a common stock, 6 shares of class b common stock; E. S. Grant, director, 412 shares of class a common stock; E. B. Hotchkiss, director, 791 shares of class a common stock, 277 shares of class b common stock; G. H. Morrissey, director, 5,373 shares of class a common stock, 1,024 shares of class b common stock; J. S. Murtha, director and secretary, 1,603 shares of class a common stock, 30 shares of class b common stock.

Ling-Temco-Vought, Inc.—R. McCulloch, chairman of the board and chief executive officer, $77,115 salary, 14,876 shares of common stock, 5,719 shares of preferred stock, $174,000 5½% subordinated convertible debentures due 9/1/76; J. J. Ling, vice chairman of the board, chairman of the executive committee, $77,115 salary, 10,951 shares of common stock, 5,000 shares of preferred stock, $1,350,000 of 5½% subordinated convertible debentures due 9/1/76; G. K. Johnson, president and director, $77,115 salary, 1,000 shares of common stock, $250,000 5½% subordinated convertible debentures due 9/1/76; C. Skeen, executive vice president and director, $64,918 salary, 3,240 shares of common stock, 60 shares of preferred stock, $130,500 5½% subordinated convertible debentures due 9/1/76; R. C. Blaylock, vice president and technical director, director, $56,007 salary, $97,800 5½% subordinated convertible debentures due 9/1/76; L. D. Webster, vice president (resigned effective Sept. 14, 1962), secretary, treasurer, director (resigned these three offices effective Aug. 15, 1962), $24,792 salary (under employee termination agreement, Mr. Webster received in August, 1962, and January, 1963, additional payments aggregating $37,916); W. P. Thayer, president—Chance Vought Corporate Div., $58,707 salary, $217,000 of 5½% subordinated convertible debentures due 9/1/76; J. O. Weldon, president—Continental Electronics Manufacturing Co. (a subsidiary of Ling-Temco-Vought, Inc.), $58,700 salary, 10,000 shares of common stock, $522,000 5½% subordinated convertible debentures due 9/1/76; D. H. Byrd, director, 45,744 shares of common stock, 13,254 shares of preferred stock, $823,200 5½% subordinated convertible debentures due 9/1/76, $46,000 5½% subordinated convertible debentures due 10/1/71; V. A. Davidson, M. D., director, 5,087 shares of common stock, $10,000 5½% subordinated convertible debentures due 9/1/76; R. B. Gilmore, director, 110 shares of common stock; L. Griffis, director; W. O. Osborn, Jr., director (resigned as of 1/30/62, re-elected effective 5/10/62), 500 shares of common stock; T. V. Post, director; L. T. Potter, director, $4,400 5½% subordinated convertible debentures due 9/1/76; O. R. Moore, director, 25,760 shares of common stock, 6,804 shares of preferred stock.

All stock beneficially owned, as of Jan. 31, 1963.

Lockheed Aircraft Corp.—C. A. Baker, Jr., consultant and director, $38,200 salary, $17,800 payments of management incentive awards for prior years, 2,101 shares of capital stock; D. E. Browne, group vice president—finance and administration, director, $85,000 salary, $8,000 payments of management incentive awards for prior years, 8,353 shares of capital stock; C. Chappellet, senior vice president and director, $88,688 salary, 33,386 shares of capital stock; C. S. Gross, chairman of the board of directors, $122,117 salary, $11,000 payments of management incentive awards for prior years, 39,319 shares of capital stock; D. J. Haughton, president and director, $112,347 salary, 15,036 shares of capital stock; H. L. Hibbard, senior vice president and director, $88,688 salary, $8,800 payments of management incentive awards for prior years, 16,721 shares of capital stock; H. W. McCurdy, chairman of the board of trustees of a subsidiary, director, $30,000 salary, $8,822 payments of management incentive awards for prior years (this includes $3,822 paid to a trustee for the benefit of Mr. McCurdy pursuant to a profit sharing plan of a subsidiary), 12,441 shares of capital stock; W. A. M. Burden, director, 500 shares of capital stock; J. V. Carmichael, director; D. M. Cochran, director (elected Jan. 7, 1963), 100 shares of capital stock; C. E. Ducommun, director, 100 shares of capital stock; E. S. Dulin, director, 510 shares of capital stock; H. L. Dunn, director, 710 shares of capital stock; W. W. Keith, director, 2,000 shares of capital stock; R. Proctor, director (elected Feb. 4, 1963), 200 shares of capital stock. All salaries are for the fiscal year ending Dec. 30, 1962.

All stock beneficially owned, as of Mar. 1, 1963.

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AVIATION WEEK, SEPTEMBER 2, 1963

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LETTERS

MMRBM Queries

As a simple country boy with 13 years of experience (mostly in Europe) with the USAF in Intelligence, Targets, Weapon System Requirements, Vulnerabilities, etc., and now with a major aircraft-missile company, may I ask a few possibly stupid questions on the MMRBM?

Bearing in mind that NATO stated a valid requirement for this capability (and I can assure you it is desperately needed), what is this jazz about ". . . over-all technical feasibility . . ." mentioned in Industry Observer section of the Aug. 5 issue (p. 23)? Even an uninformed clod like me knows that it is feasible. Did the DOD or the diplomats or the politicians cut the thing back by $100 million? Whichever, who or whom was primarily responsible for the slash? Is this the muddy, mixed thinking of "Allah" McNamara who "has decided to have an MMRBM program" but "what its nature shall be is still not clear?" It's pretty obvious that this "not clear" problem didn't exist in the Soviet high command. Of course, they aren't saddled with McNamaras and cement-head "Hahvahd" boys!

ROBERT C. DONOVAN
Los Angeles, Calif.

MA-9 Sightings (Cont.)

Once upon a time there lived prophets who witnessed miraculous sights. These sights were called "visions" and almost everyone believed. Now there lives an astronaut who witnessed familiar sights. These sights were called "hallucinations" and even scientists don't believe. But, before classifying Astronaut Gordon Cooper's "observations" as hallucinations, or equivalently, as visions, the scientists might well have considered the following:

1. The scientists were being very unscientific in immediately rejecting reasonable observations by a competent observer.

2. Astronaut Cooper's eyesight must be presumed normal on the basis of his having been selected for the mission.

3. Although not a highly trained observer of optical phenomena, Astronaut Cooper must be regarded as capable of identifying familiar objects under most circumstances.

4. The criterion for visually resolving two point objects is usually regarded as one minute of arc (2.9×10^{-4} radian), not 1 to 3 sec. of arc (AW June 17, p. 34). Born and Wolf's 1959 classic "Principles of Optics" gives as the minimum angle of visual resolution 24 sec. of arc (10^{-4} radians) based, as is the one-minute limit, on the Rayleigh criterion. The Rayleigh criterion specifies that two identical point or line objects will be resolved when the central maximum of the diffraction image of one object is superimposed on the first minimum of the diffraction image of the other object. The Rayleigh criterion is mathematically convenient, easily described, and reasonably realistic. However, it is conservative in specifying practical resolution limits and is to be regarded only as providing an approximation to those limits. Moreover, the criterion constitutes an incomplete specification because it does not take into account contrast, spectral distribution, and coherence of the light, among other things.

5. In the Cooper report (AW May 27, p. 25) no mention is made of the diameter of objects observed. However, one of Cooper's detractors (AW June 17) mentions the impossibility of observing 10-ft.-dia. object from an altitude of 5×10^6 ft. The corresponding angle subtended is 2×10^{-6} radian, roughly one-tenth the limit determined by the criterion. Impossible? Of course not, especially if the object referred to were the "ground light" (AW May 27) or the city lights observed by other astronauts. Consider, for example, that the star Betelgeuse, which is easily observed by the naked eye, subtends an angle of 2.3×10^{-7} radians (Jenkins and White "Physical Optics"), a thousand times smaller than the minimum angle of resolution determined by the criterion! And this does not represent an extreme case. Obviously something is wrong with the interpretations of Cooper's observations, not with Cooper.

6. In speaking of resolution one usually is concerned with the ability to distinguish two similar objects, say points, closely spaced. But at all times, whether resolved or not, each object is presumed to be visible no matter what its angular subtense, that is, even if its angular subtense is infinitesimal, as it is for a point. Thus, as with a star, a point should be visible if it emits or reflects a sufficient number of quanta of energy to elicit a visual response, and it should be distinguishable from its surroundings if there is sufficient contrast between them. A similar, though weaker, argument may be made for a dark point against a bright background.

7. The effect of atmospheric disturbances on resolution is considerably less for an observer viewing the earth from orbit than it is for an observer on earth viewing an object in space.

8. It would appear that Gordon Cooper's problem was one of observing individual points and lines, not of resolving pairs of similar points and lines. Thus, the resolution argument appears improper, as it does in the problem of observing individual stars. Cooper observed points and lines which he interpreted as roads, rivers, railroads, houses, boats, trucks, and trains, not on the basis of distinguishing the detailed shape of these objects, but rather by inference from their general character and surroundings. For example, the roads were distinguished by straight lines for short distances, or as rectangular grids (towns). Trucks were specks on the roads. The railroads were long straight lines, and trains were identified by smoke. Boats were identified by wakes, etc. These conclusions are not incompatible with Cooper's statements.

I see no reason on the basis of present knowledge for rejecting Gordon Cooper's observations as hallucinatory. Rather, I would reject the scientist's interpretations. A little physics may be worth a thousand hallucinations.

WALTON HOWES
Rocky River, Ohio

BAC 111 System

Re: AVIATION WEEK, Aug. 19 (p. 42).

We at Bendix share the enthusiasm with the rest of the commercial aviation industry on the milestone reached by Vickers Armstrongs on the roll-out of the BAC 111 short-haul transport. We were extremely disappointed to see AVIATION WEEK report that Smiths Autoflare landing system is installed in the first aircraft. The present production configuration of the BAC 111 does not have a Smiths Autoflare landing system but rather a Bendix PB-20 Automatic Flight Control System. This system with exception of a small adaptive module and trim servo is identical to that installed in the Boeing 707/720 airplane.

Elliott Brothers of the United Kingdom and Bendix are jointly developing an All Weather Landing System scheduled for installation and flight test at a later date. This system is an outgrowth of the Bendix/Elliott effort on the VC-10 and will also include more recent developments from the Bendix Tall Program and the PB-60 Flight Control System.

R. R. HAMILTON
Assistant Sales Manager
The Bendix Corp.
Eclipse-Pioneer Div.
Teterboro, N. J.

Caption Error

Just received the July 22 issue and enjoyed the Aerospace Research Pilot School article.

The Test Pilot School didn't have F-104 aircraft when I graduated five years ago, and judging by the picture at the top of p. 255 they may not have them yet!

GUY C. CISCO, JR.
Captain, USAF
32nd Ftr.-Intcp. Sqdn.
APO 292, New York, N. Y.

(Capt. Cisco's inference is as good as his recognition. The airplane pictured was a McDonnell F-101, the only variable-stability aircraft at the school, although modification is under way of some Convair F-106s. Three Lockheed NF-104s with reaction control systems are being delivered to the school [AW Aug. 5, p. 116], but these are not variable-stability aircraft.—Ed.)

Back Issues

I've been a regular reader of AVIATION WEEK magazine since it first came out. Since I've used it as a reference, I've retained all issues from the first to the present.

Now I must dispose of my collection since I will shortly be moving to California. Please advise me whether you would have need for a complete set of AVIATION WEEK (less two or three issues). If you cannot use this set, can you suggest someone who can?

MOSES ARONSON
67 N. Nancy Pl.
Massapequa, N. Y.

(Any takers?—Ed.)

For reprints of this symbolic Artzybasheff illustration of an early Voyager concept, write: Avco, Dept. AW-4R, 750 Third Avenue, New York 17, N. Y.

Let's take a look. What's behind the cloudy veil of Venus? Or beneath the red sands of Mars? Or on the Moon's pock-marked plains? What's out there in space? NASA is finding out. With Voyager, the Venus/Mars orbiter-lander . . . with Gemini, the two-man rendezvous spacecraft . . . with Moon-bound Apollo . . . with Mercury, the one-man earth orbiter. NASA is extending man's vision to new frontiers in space. Focusing the keen minds of science and industry on the big "Out There." Inspiring studies and projecting plans for perfecting aerospace techniques, shapes, materials, and manufacturing processes. Avco is proud to lend a hand.

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