Aviation Week & Space Technology

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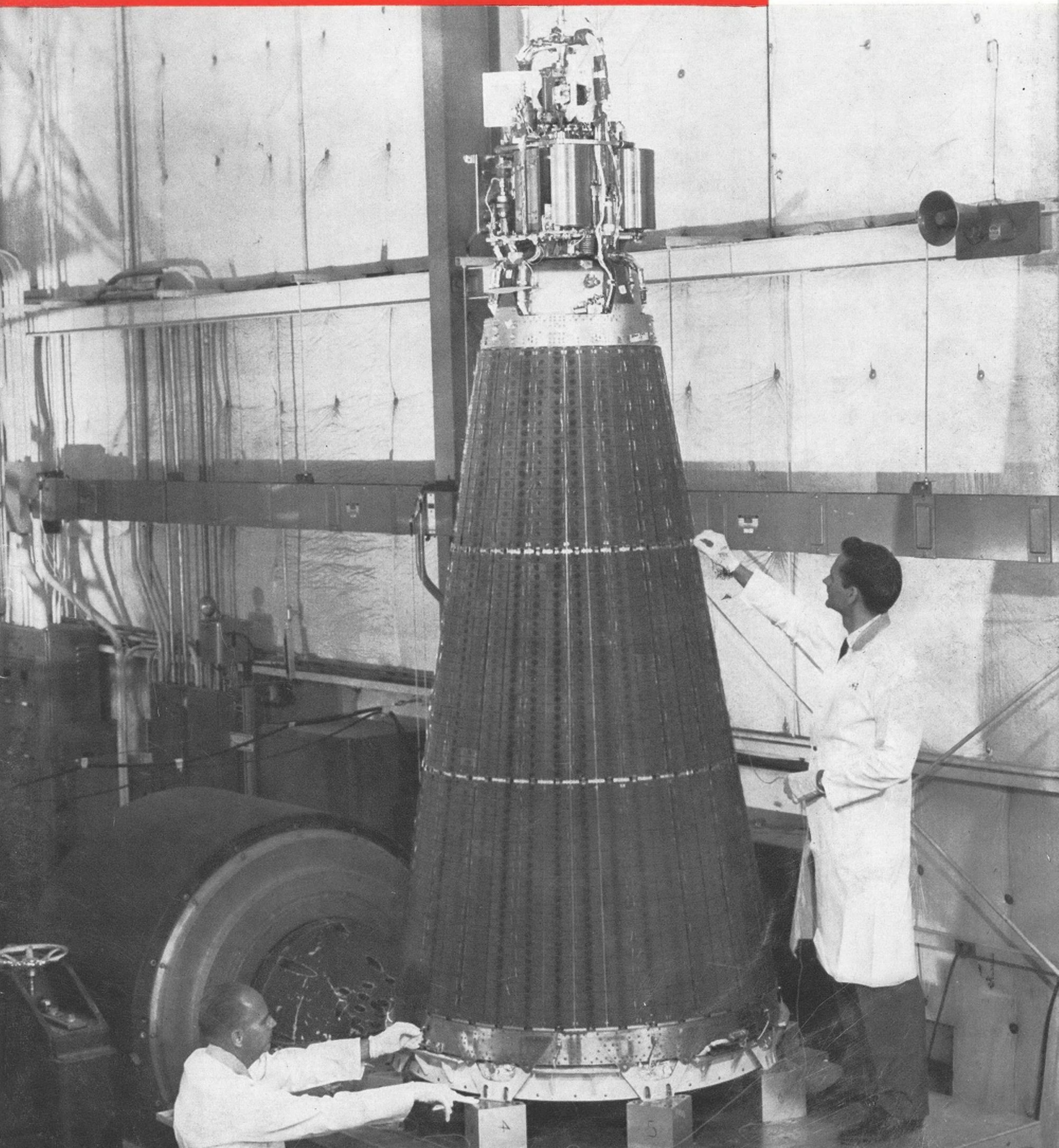
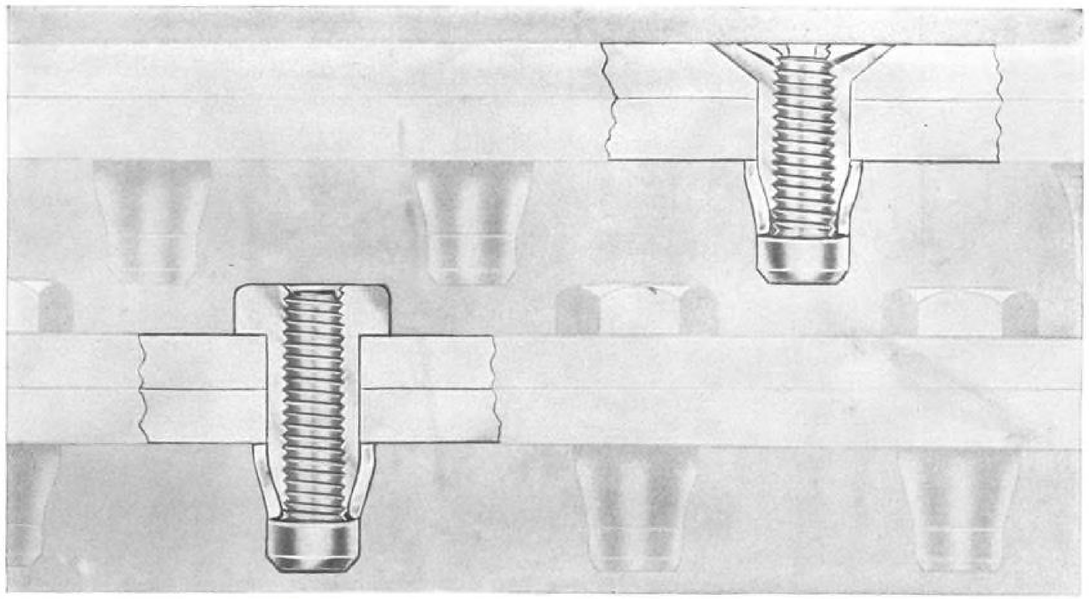
August 12, 1963

SPECIAL REPORT:

French Space Program Plans

Snap 10A Prototype





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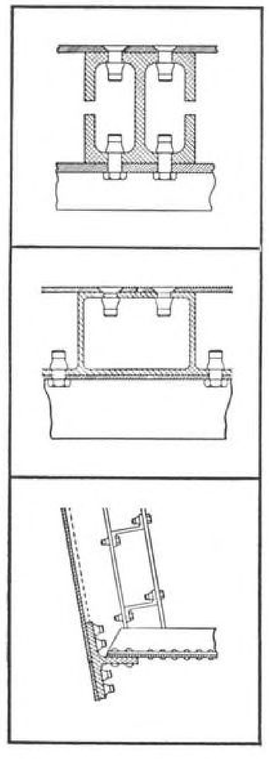

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GOODYEAR

AVIATION PRODUCTS

AEROSPACE CALENDAR

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

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

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

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

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

Aug. 26-28–Conference on Physics of Entry into Planetary Atmospheres, American Institute of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 27-30–National Conference and International Data Processing Exhibit, Assn. for Computing Machinery, Denver Hilton Hotel, Denver, Colo.

Sept. 4-6–Numerical Control Workshop Seminar, Cleveland, Ohio. Cosponsors: American Society of Tool and Manufacturing Engineers; Thompson Ramo Wooldridge.

(Continued on page 7)

AVIATION WEEK & Space Technology

August 12, 1963
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AEROSPACE CALENDAR

(Continued from page 5)

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

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

Sept. 8-20—14th Annual Statistical Quality Control Institute, University of Connecticut, Storrs, Conn.

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

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

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

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

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

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

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

(Continued on page 9)

PROBLEMATICAL RECREATIONS 183

Furbisher said to LaRouche, "I just bought four mujibs at $21.78 apiece, and I noted a curious thing. The total was $87.12, the price of a mujib in reverse order." "Isn't that a coincidence," said LaRouche, "the other day I bought some glinches (no, not one or four) and I remarked the same thing." How much does a glinch cost and how many did LaRouche buy? *—contributed*

Were you, perchance, at the recent Armed Forces Communications and Electronics Convention in Washington, D.C.? If so, you saw the new facsimile system from our RADCOM-Westrex division. If not, here's the picture: a high-speed, mobile, ruggedized system that sends a 300 line photo or other copy in 4½ minutes. Weight of each unit (transmitter and recorder) is about 100 lbs.; size is about 16x16x20. Further facts from: RADCOM-Westrex, 540 W. 58th St., New York 19, N.Y.

ANSWER TO LAST WEEK'S PROBLEM: 37081 and 37091 / 74162 / 74182

AEROSPACE CALENDAR

(*Continued from page 7*)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

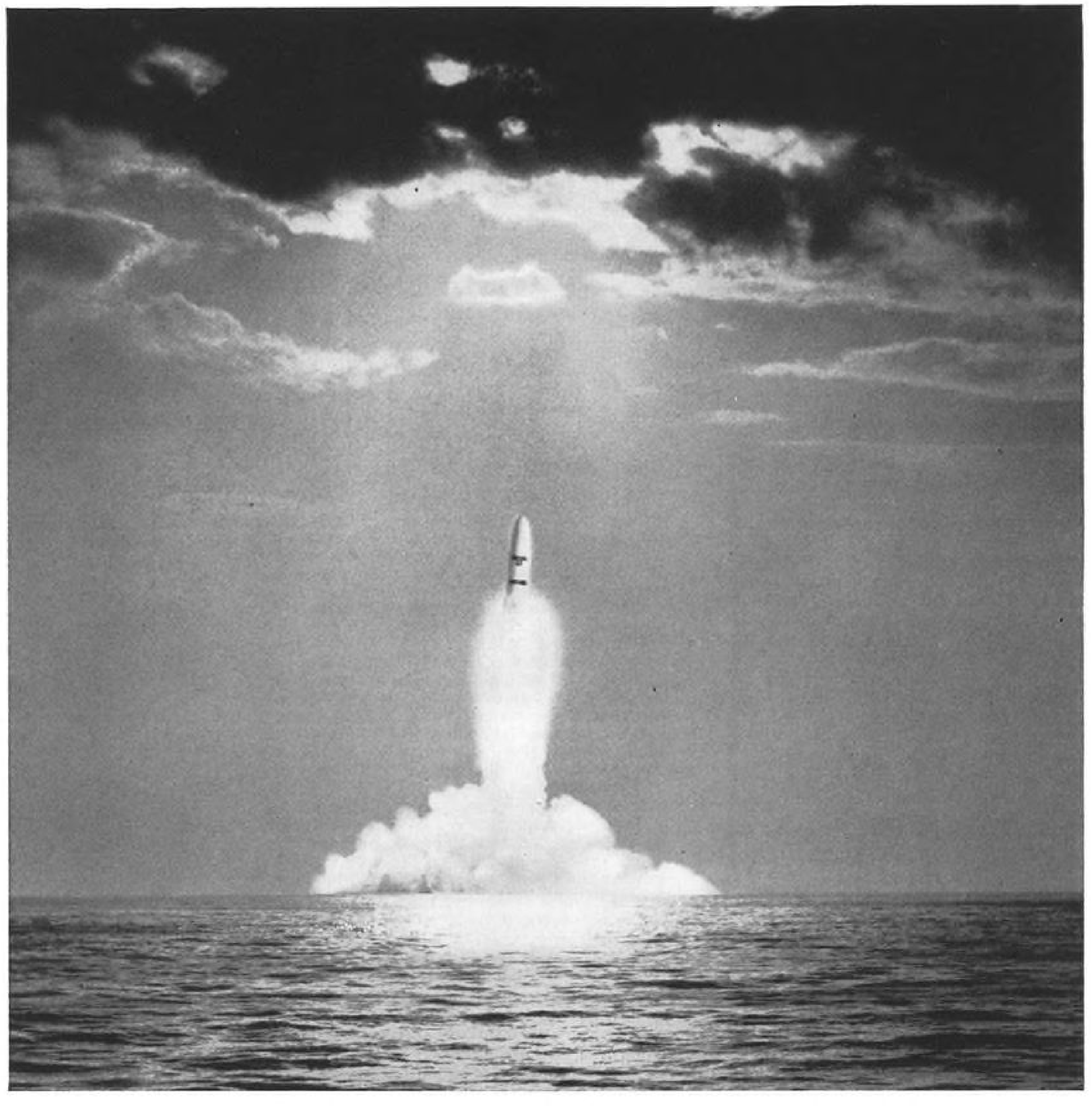
Raytheon electronics help guide Navy's new 2500-mile Polaris missile

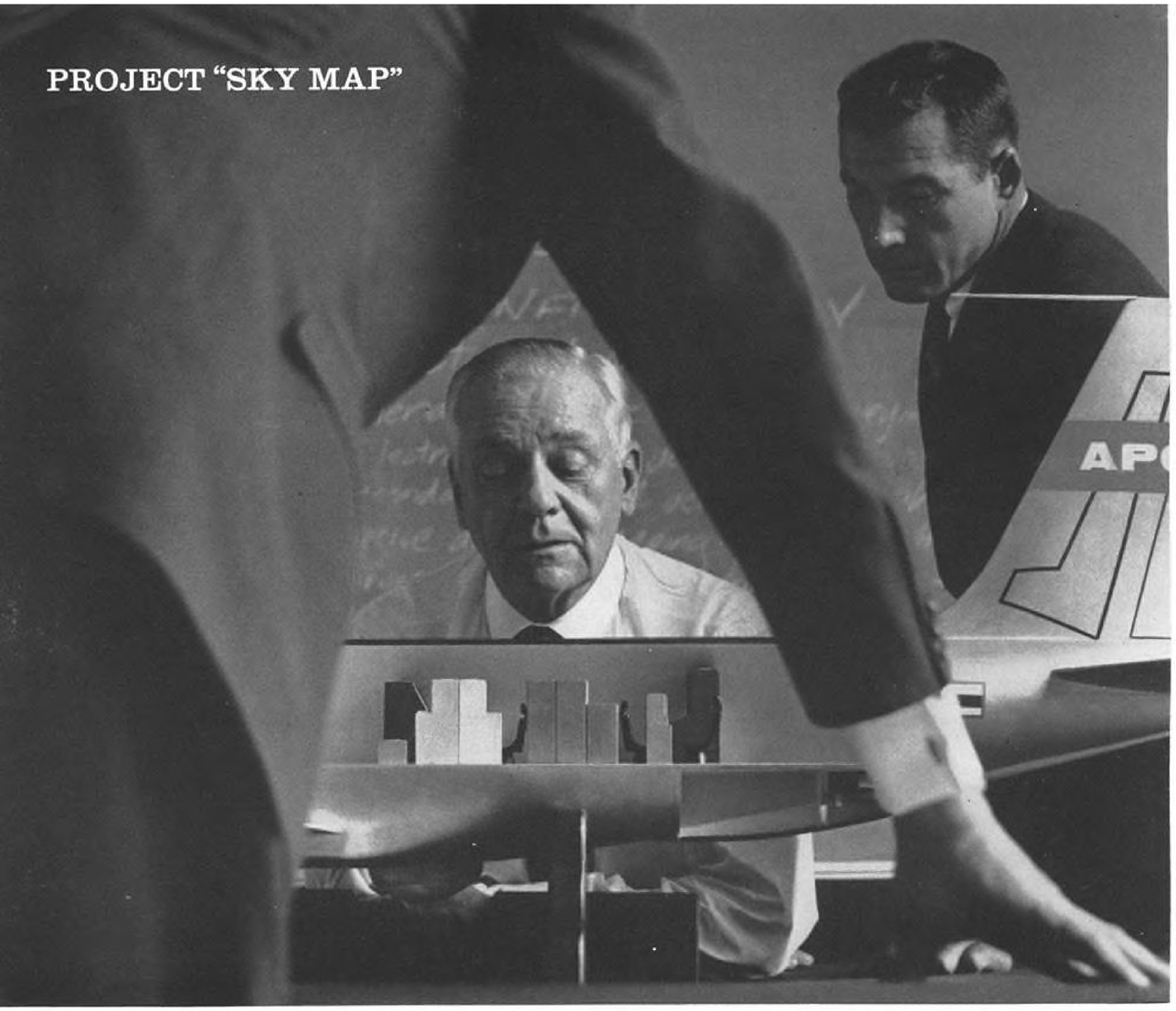
The ability to strike anywhere on earth in defense of the free world . . . this is the potential might of an improved Polaris, the submarine-launched ballistic missile. The new 2500-mile version—the A-3—gives the Navy a powerful counterpunch for its Polaris-armed underseas fleet, on patrol in strategic areas abroad. And within the missile is a Raytheon-produced computer "brain" that directs the Polaris to its target with pinpoint accuracy.

The Raytheon digital computer is part of a redesigned, highly compact inertial guidance system, Mark II. Less than half the size and weight of earlier versions, Mark II contributes importantly to the extended-range capability of the new Polaris. Its design, development and production have been a team effort of Raytheon and Massachusetts Institute of Technology.

Raytheon is proud to serve our fleet of nuclear submarines and the Polaris Men who man them . . . select, dedicated crews who stand watch at the outposts of freedom. Raytheon Company, Lexington, Massachusetts.

RAYTHEON





SYSTEMS MANAGEMENT From high in the sky will come accurate plotting of the earth's surface. This will be made possible by Project "Sky Map"—the U.S. Air Force's new AN/USQ-28 geodetic survey and photo mapping system for which the Kollsman Instrument Corporation is systems manager. Designed for use in RC-135A jet aircraft, the system will consist of mapping cameras of advanced design, an extremely precise inertial navigation system, provisions for data recording and supporting electronics. The fastest means ever available for obtaining and compiling geodetic information, "Sky Map" will also be the most accurate. The magnitude of the project is such that only a prime contractor with outstanding technical and systems management qualifications could have been considered. Kollsman has both.

Advanced Research
Aerospace Instruments
Celestial Navigation
Display Systems
Optical Electronics
Ordnance
Systems Management

SYSTEMS MANAGEMENT DIVISION

Kollsman Instrument Corporation

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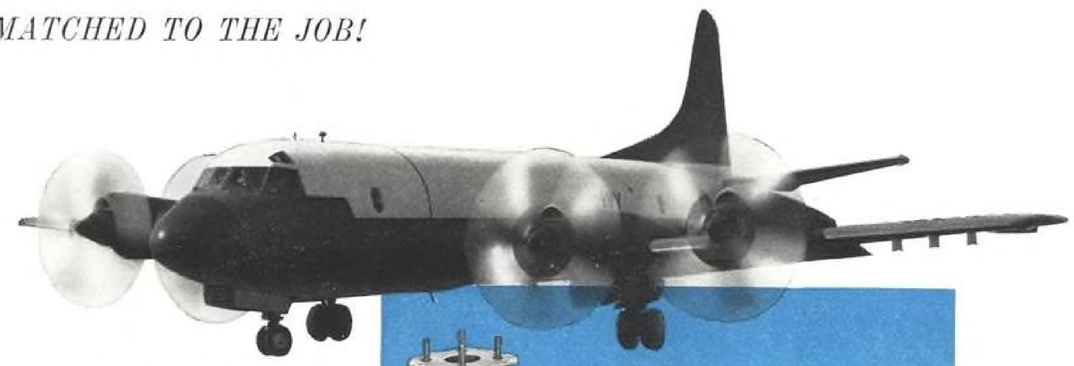

Long-range Lockheed P3V Orion—designed for anti-submarine patrol duties with U. S. Navy.

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VIBRATION NEWS

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How do you measure reliability in vibration test equipment?

The basic function of vibration test equipment is to determine the reliability of the component, product or system being tested. It is therefore imperative that the test equipment itself be reliable.

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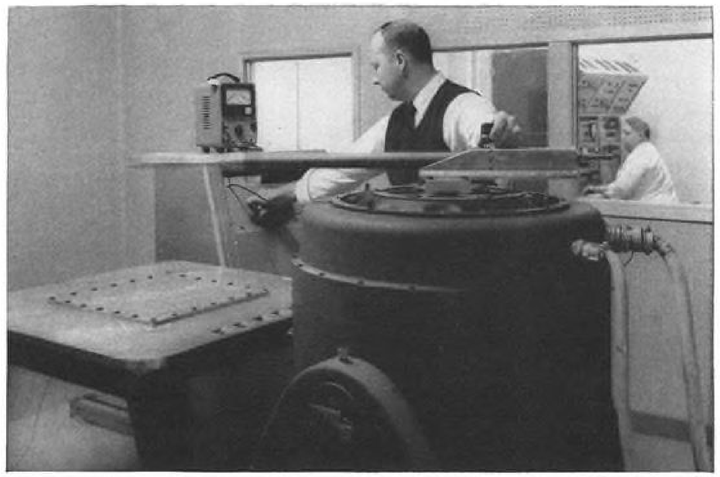
The best criterion is the acceptance and record of performance of the equipment in the field. How many test systems have logged how many hours of efficient service? It is the wide acceptance of MB test equipment among leading environmental test laboratories that is our most effective sales feature . . . and our best advertisement.

Today there are more than 4000 MB vibration test systems in use, some for as much as 18 years. This total includes 50 of our proven Automatic Equalization Systems which were introduced by MB in 1960. Accurate equalization of the test specimen is accomplished with 80 channel fully automatic equalization systems. Complete equalization takes place in less than 5 seconds which means exceptional savings in test time, labor and money for missile and aircraft manufacturers.

For information on the complete line of MB test equipment write for Bulletin 420 to MB Electronics, 781 Whalley Ave., New Haven 8, Conn.



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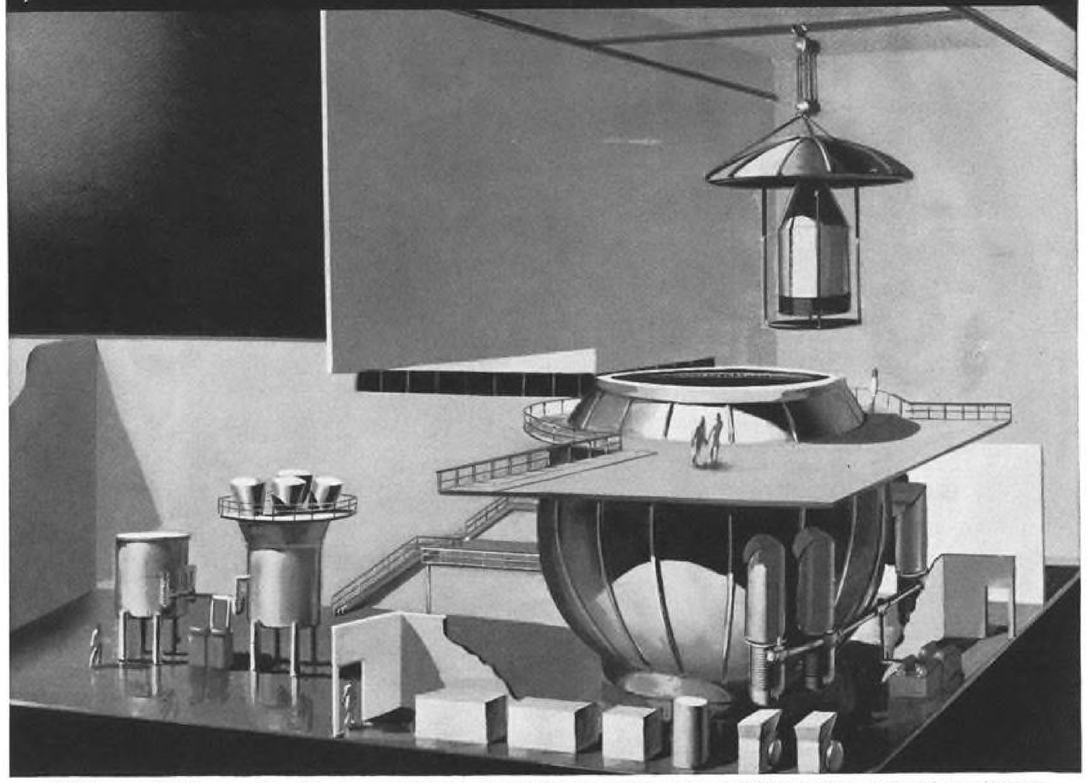
STOKES NAMED PRIME CONTRACTOR FOR NEW DOUGLAS SPACE FACILITIES



Artist's concept of Douglas Aircraft Environmental Test Center. Sketch shows test model of vehicle attached to lid and being lowered into 39' Stokes chamber. To the left are two Stokes "5 x 5s." One is shown with the solar simulator now being designed for it.

The Stokes Space System Department has been named prime contractor for the design and installation of three new space environment simulation chambers, key elements in Douglas Aircraft Corporation's privately financed Space Systems Center at Huntington Beach, California. The largest and most technically advanced space-test laboratory on the West Coast, the Center will be an integral part of Douglas' Missile and Space System Division.

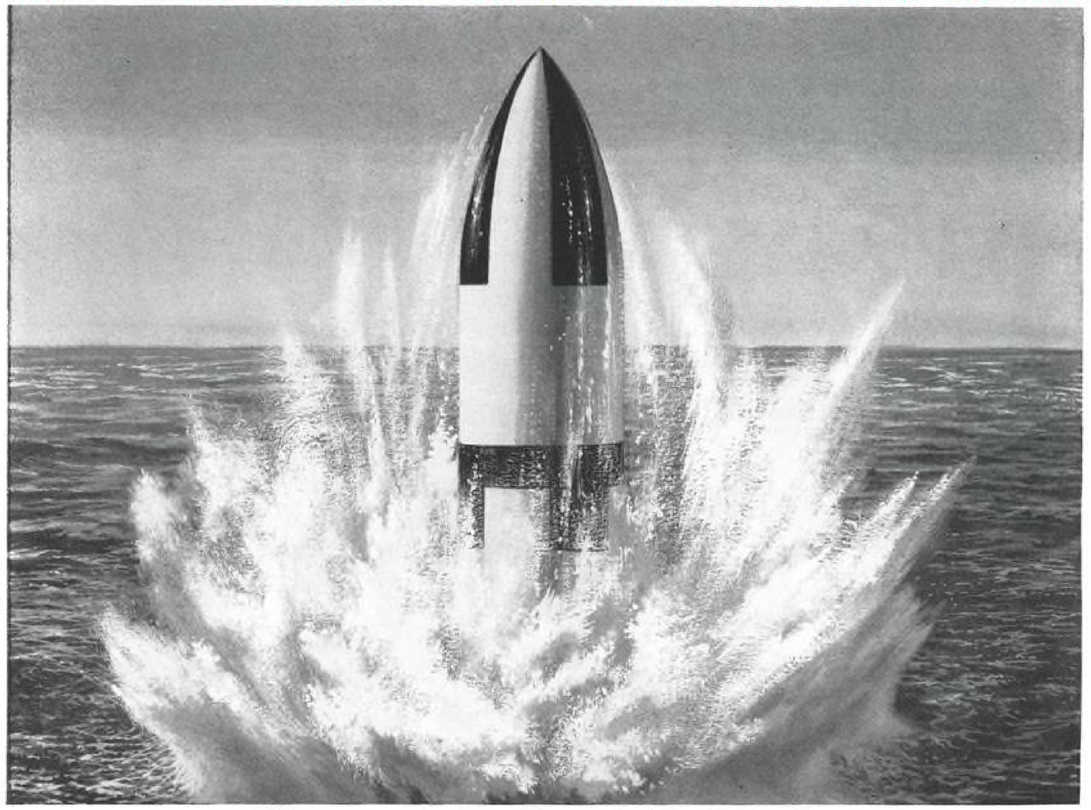
The largest chamber, 39 ft. in diameter, will be capable of testing fully assembled vehicles scheduled for manned flight. It will be used in the Saturn program, and in the development of lunar and planetary probe vehicles. The Stokes systems will represent the most advanced state-of-the-art on completion, and are designed for updating to even higher simulation parameters in the future. Stokes units similar to these are now achieving vacuums in the 10^{-10} Torr. range. High-speed cryopumping on all three chambers at 20°K will assure the attainment of true orbital vacuums, even under high gas loads. Stokes has assigned CryoVac, Inc. the design, fabrication and installation of cryogenic systems, and named Pittsburgh-Des Moines Steel Company to furnish and erect the large steel sphere.

A deciding factor in the selection of the prime contractor was Stokes' experience in designing and building large, first-of-a-kind space test facilities, such as those installed at G.E.'s Space Technology Center. Another was Stokes' related background in space vacuum and cryogenics, as represented by General Electric's and Goddard's SES and DTC systems. To this experience, Stokes adds its long and successful history in the development of large-scale industrial equipment utilizing ultra-high vacuum, thorough engineering design and coordination, fabrication facilities, and field erection service . . . an integrated, start-to-finish capability unique in the entire area of space environment simulation. **Space Systems Department, F. J. Stokes Corporation, 5500 Tabor Road, Philadelphia 20, Pa.**

F. J. STOKES CORPORATION: PHILADELPHIA / LONDON / TORONTO

STOKES

FLAME-PLATING: TOMORROW'S COATINGS . . . FOR TODAY'S WEAR PROBLEMS



More range for the mighty Polaris

with a lift from LINDE's complete custom coating service!

UP from the sea in a flash . . . to the target 2500 nautical miles away! That's the Navy A-3 Polaris, built by Lockheed . . . its greater range made possible by many design and material improvements, including a new, higher-performance solid propellant.

At first, the new propellant presented a design problem. Its fantastically hot exhaust gases (6000° F. range) caused erosion of the rocket nozzle entrance caps and exit cones in the 1st Stage power plant. LINDE's Plasma-Plating helped Aerojet-General solve the problem: to the graphite base material, LINDE applied an undercoat of pure tantalum —topped by a coating of pure tungsten—each only mils thick. Thin as they are, these coatings provide the heat- and erosion-resistant "skin" that helps the Polaris to utilize its more powerful propellant! Today, many critical wear problems are being solved for important aerospace parts by LINDE's Flame-Plating coating service—including rocket engine combustion chambers, jet engine compressor blades, aircraft valves, turbine engine seals, hydraulic pumps, and rocker arms.

With facilities ranging from metallurgical research to production and testing, LINDE is a "one-stop" source for all needs in prescription coatings.

Write for complete technical data—to Flame-Plating Dept., Linde Company, Division of Union Carbide Corporation, 1245 Main St., Indianapolis 24, Ind. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

UNION CARBIDE

LINDE COMPANY

Aviation Week & Space Technology

Volume 79
Number 7

August 12, 1963

CONTENTS

COVER: Technicians at Atomics International Div. of North American Aviation, Canoga Park, Calif., prepare a prototype of the Snap 10A (Systems for Nuclear Auxiliary Power) 500-lb. flight system for vibration and shock tests. Other prototypes are being fabricated for flight test next year. Atomics International is developing Snap 10A for AEC.

PICTURE CREDITS

Cover—John D. Frost, Atomics International; 31—Aerojet-General; 32—ONERA; 36—U. S. Navy; 47—Boeing; 63—General Dynamics/Astronautics; 64—NASA; 67, 69—British Aircraft Corp.; 72, 73 (bot.)—USAF; 73 (top)—C. M. Plattner; 85—Boeing Vertol; 86—Northrop-Norair; 88—General Precision, Inc.; 91—Raytheon; 95—Giannini Controls; 97—Korad Corp.; 101, 107—Boeing; 103—General Dynamics/Astronautics; 104, 105—Lockheed.

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EDITORIAL

Space Age Challenge to Physicists

(In a recent speech at the College of William and Mary, Dr. Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, pointed out the new opportunities provided by space flight for solving the most fundamental and intriguing questions concerning the universe. Because of the timeliness of Dr. Dryden's appeal to more physicists to join in the space program, Aviation Week & Space Technology is presenting excerpts from his speech—Ed.)

. . . Man's newly won ability to leave the confines of earth and explore the frontiers of space offers a challenging new opportunity for scientists of all disciplines. . . .

With the invention of the telescope and . . . other scientific instruments . . . advances in the science of physics began to come more and more rapidly. . . .

But impressive as this earth-bound data gathering has been, it is somewhat overshadowed by the events of only a few minutes last Dec. 14. On that day our Mariner 2 spacecraft flew past the planet Venus and resolved certain scientific questions . . . which conventional astronomy had not been able to do in the 350 years since the invention of the telescope. . . .

The data returned by Mariner 2 totaled about 65 million bits of information . . . (which) will eventually give us still more clues to the properties of our nearest planetary neighbor. . . .

The study of physics in space is a new kind of operation. It is almost diametrically the opposite of nuclear physics, in which larger and larger machines are being developed to examine the interaction of smaller and smaller particles over smaller and smaller distances. . . .

In the space science, on the other hand, we . . . employ extremely small devices to measure the physical phenomena . . . the entire scientific payload of the flight to Venus was less than 40 lb. and the payload to Mars will not be much, if any, larger. . . .

The need . . . is for our creative physicists to think of simple devices, or at least small ones, to make the critical physical measurements. . . .

Let me sketch for you briefly a few of the areas in which I strongly believe it will be possible to open up completely new vistas of understanding.

First, I might mention cosmic radiation. Only recently have we even begun to comprehend what happens to the energetic particles . . . emitted from the surface of the sun or from other distant points in space and radiated through the universe. . . .

The auroral glow has long excited the interest of physicists. Only since the advent of rockets capable of penetrating the blanket of the atmosphere have we begun to understand the nature of the extremely energetic radiation called cosmic rays. . . .

Of great interest to our national space program at the moment is the nature of the surface of the moon. Astronomers early noted that the moon's reflection of the visible light falling on it is remarkably uniform, approximately 10%. . . . Whereas the surface appears uniformly rough at optical wavelengths, it exhibits uniformly smooth characteristics at radio and radar wavelengths, even down to dimensions of a few millimeters.

When we examine the theories propounded by some of our most knowledgeable and reputable scientists, we begin to realize how little we actually do know about the lunar surface. One group . . . believes the surface to be made up largely of dust particles, and that this surface layer may be inches or even several feet in thickness. Another thinks the lunar surface is largely composed of porous rock . . .

Before we can undertake manned exploration of the moon, we need to know which, if either, of these theories is correct. . . .

Let us consider some other problems. . . . We now have two separate figures for the astronomical unit, that highly convenient measurement of the distance from the earth to the sun. This measurement is very important to us in the accurate navigation of spacecraft over the vast reaches of the universe. . . . astronomers, employing optical methods, have obtained one figure, while radar experts have. . . . shown a considerably different value. The difference is 60,000 kilometers . . . Here is another challenge to physicists—the development of a new experimental technique that will resolve the discrepancy. . . .

But these problems, important as they are, must take second place to some of the deeper ones that are closely entwined with the very origin and nature of the universe. A cornerstone of Newtonian physics has always been that we consider gravity as a constant. Now, for the first time, we are beginning to have some reason to believe that the "gravitational constant," so called, is perhaps not really a constant at all, but that it decays with time. . . .

There are yet other areas equally as challenging. In our radio astronomy studies of distant galaxies, sources of radio noise have been detected, so powerful that they could not have been achieved by any energy mechanism we know of at present . . . (and) cannot be explained with present theories of the generation of energy in galactic events and our knowledge of gravitation.

From what we do know about the energy involved, with our present state of knowledge, we believe that the entire mass of a galaxy might have to be destroyed in order to produce the effects we have detected. . . .

Finally . . . we have never really examined, in experimental fashion, one of the basic assumptions of Einstein's theory of relativity, namely, that the velocity of light is constant.

An experiment should be designed to determine whether the velocity of light is really constant or if it varies as a function of time. Certain phenomena, at present unexplained, such as the incredibly rapid rate at which the universe appears to be expanding, might be explained far more cogently if . . . the velocity of light is not really constant after all.

Such questions as these, I submit, should challenge the best efforts of creative physicists for many years to come.

WHO'S WHERE

In the Front Office

George L. Wilcox and **Ronald N. Campbell**, executive vice presidents, Westinghouse Electric Corp., Pittsburgh, Pa., and **A. C. Monteith**, senior vice president.

Ray W. Retterer, senior vice president-marketing, Univac Div. of Sperry Rand Corp., New York, N. Y.

Dr. Stanley F. Kaisel, president of Microwave Electronics Corp., elected a director of Systron-Donner Corp., Concord, Calif.

Eugene S. Culver, president, Washington Technological Associates, Rockville, Md., succeeding **Harold M. Briggs**, resigned. Also: **J. Roy Thompson**, secretary.

J. Dean Meyer, vice president, Menasco Manufacturing Co., Burbank, Calif., and general manager of the California Div.

Dr. Gustav H. Strohmeier, a vice president, IIT Research Institute (formerly Armour Research Foundation of Illinois Institute of Technology), Chicago, Ill.

Meyer Leifer, vice president-operations, Radiation at Stanford, Palo Alto, Calif., a subsidiary of Radiation, Inc.

Donald H. Bayles, vice president and general counsel, Nuclear Corp. of America, Phoenix, Ariz.

Dr. Launor F. Carter has returned to System Development Corp., Santa Monica, Calif., as vice president and director of research following a one-year term as U.S. Air Force Chief Scientist (AW May 20, p. 38). Recently, Gen. Curtis LeMay, USAF Chief of Staff, presented Dr. Carter with the Exceptional Civilian Service Award.

Raymond V. Ford, vice president-administration and finance, Maxson Electronics Div., Maxson Electronics Corp., Great River, N. Y.

John J. Douglas will become vice president-finance of General Telephone & Electronics Corp., New York, N. Y., succeeding **Thomas A. Boyd**, retiring Nov. 1. **Robert J. Gressens** will succeed Mr. Douglas as president of Kenkurt Electric Co., Inc., San Carlos, Calif., a subsidiary of GT&E.

Parkman Sayward, senior vice president-marketing and sales, Slick Airways Div. of The Slick Corp., with headquarters at San Francisco International Airport.

John H. Thomas, vice president-research and development, Owens-Corning Fiberglas Corp., Toledo, Ohio. **William H. Curtiss, Jr.**, succeeds Mr. Thomas as vice president and general manager of the company's Pacific Coast Div., Santa Clara, Calif.

Texas Instruments, Inc., Dallas, Tex., has announced the following appointments: **Vice President Fred Bucy**, in charge of the Apparatus Div., succeeding **Vice President H. J. Wissemann**, who will manage corporate research and engineering. Mr. Wissemann succeeds **Vice President R. W. Olson**, now head of a newly created Special Projects Office.

Maj. Gen. Paul A. Gavan (USA, ret.), director of Regional Activities for the Assn. of the United States Army.

Col. Albert J. Wetzel, USAF, formerly assistant for policy, deputy chief of staff—systems and logistics, now executive secretary for the Air Council.

(*Continued on page 109*)

INDUSTRY OBSERVER

►Space Technology Laboratories is performing a detailed study of problems associated with a lunar exploration mission involving the launch of a pair of vehicles—one manned and the other containing cargo—directly to the moon. The mission under study calls for the man to return directly to the earth. The study—a four-month effort being conducted for Marshall Space Flight Center—contemplates an operational period of 1969-73 for stage designs adaptable for multiple use in direct-flight pairs boosted by Saturn 5 vehicles.

►**McDonnell Aircraft Corp. is preparing for a new round of major subcontract awards in its F-4 Phantom production program. The company has been asked by the government to seek subcontracting sources in Canada, in line with the Administration's desire to bolster U. S.-Canadian relations.**

►Data from Tiros weather satellites, hitherto of little value in severe thunderstorm and tornado forecasting because of delays in relaying it to the Weather Bureau's severe storm forecast unit at Kansas City, will be available on direct readout through installation of new equipment being completed this week. Height of the tornado season is in the spring, but some severe storm activity can still be expected this year.

►**USAF's Electronic Systems Div. has launched a program to develop requirements for a space command and control system. Initial work will be conducted by The Mitre Corp., Bedford, Mass.**

►NASA's Manned Spacecraft Center will sponsor a six-month study of the characteristics of an advanced high-gain, deep-space antenna to be used on manned space vehicles. Apollo would probably be the first application. Industry bidders will submit proposals by Aug. 22 for the study, which contemplates a steerable antenna to operate in the 2.1 to 2.3 kmc. range with at least 35-db. gain. Erectable or inflatable types are being considered.

►**Naval Ordnance Test Station, China Lake, Calif., has demonstrated the feasibility of a magnetohydrodynamic generator, using a liquid-fueled rocket engine exhaust measured at Mach 2.3 as the working fluid. Seven successful test firings have indicated that the generator offers definite advantages over subsonic types. The small rocket burned gaseous oxygen and methyl alcohol. Cesium carbonate seed material was dissolved in alcohol before firing.**

►USAF Space Systems Div. is expected within the next month to request proposals for parallel competitive studies of a standardized space guidance system applicable to a wide range of possible future Air Force Space vehicles. The system—essentially an inertial guidance type capable of accepting updating inputs from radar, star tracking, horizon, earth center and planetary sensors—may first be applied in some of the more complex missions planned for the Titan 3 (AW June 17, p. 23). Companies which probably will compete for the studies include AC Spark Plug, IBM, Honeywell and Space Technology Laboratories.

►**Rome Air Development Center is seeking qualified sources to design and build a stacked array of semiconductor-type lasers. This is one of several programs which are attempting to overcome the limited output power levels of present lasers by combining the outputs of many devices.**

►Industry will submit bids to Jet Propulsion Laboratory by Aug. 23 for a study of the effects of preflight sterilization and long-term exposure to hard vacuum on parachute systems to be used in deceleration of soft-landing payloads at the end of a planetary flight lasting up to 300 days.

►**Manned Spacecraft Center is expected shortly to request proposals for the personal life support system to be worn by Gemini crewmen during extravehicular activity. The portable system envisioned by the NASA center would be strapped on the back or leg of the crew member just prior to leaving the spacecraft. The system would include its own backup provisions. The only connection between the astronaut and the capsule would be a tether line and possibly a communications line.**

Washington Roundup

Test Ban Tremors

Nuclear treaty tremors will be set off in the Senate this week when Dr. Edward Teller tells the Senate Preparedness Investigations Subcommittee in closed session his own fears about banning tests in the atmosphere, outer space and under water. Dr. Teller long has favored continued development of nuclear weapons and was the leading backer of the hydrogen bomb.

But Dr. Teller's reservations and Senatorial fears about Russia cheating under the ban are not considered enough to prevent approval of the treaty. Senate Democratic and Republican leaders have decided to press for a favorable vote after an intensive examination of the document.

Key witnesses in the view of such apprehensive Senators as Henry M. Jackson and Jacob K. Javits are members of the Joint Chiefs of Staff. If these leaders testify the treaty involves no real military risk, then the Senators feel they can go along with it in good conscience.

Official forum for the treaty is the Senate Foreign Relations Committee. Chairman J. W. Fulbright has invited Senators on the armed services and the joint atomic energy committees to participate in the hearings. Preparedness subcommittee considers its examination of the treaty as just part of continuing hearings on national security.

Lead-off witness before the Senate Foreign Relations Committee will be Secretary of State Dean Rusk. He will be followed by Defense Secretary Robert S. McNamara and the joint chiefs. Senators will questions these and other witnesses closely on U. S. capability for detecting nuclear explosions (AW Aug. 5, p. 27).

Comsat Corp. vs. FCC

Communications Satellite Corp. eschewed the usual bureaucratic niceties and bluntly told the Federal Communications Commission to mind its own business instead of trying to hurry the corporation into offering stock to the public. It was the first public clash between the two groups.

Leo D. Welch, corporation chairman, wrote the FCC last week that the stock would not be issued until the corporation was good and ready—"not later than the early part of 1964." He argued that the corporation should not offer stock until after enough information was developed to inform the investing public about the risks involved.

"Studies relevant to such factors as booster reliability, satellite liftime, multiple launch capability, satellite power, satellite stabilization and ground station configuration are of major importance in projecting the economics of any such system, and we are engaging in such studies," Welch wrote the FCC. Results of these studies will be given to potential investors.

FCC fears that delaying the public stock sale will result in the temporary board of directors making fundamental decisions without approval of future stockholders. FCC Chairman E. William Henry expressed these fears in a letter to Welch July 24, and also directed how a $600,000 loan to the corporation should be spent. Welch replied that such instructions were "an invasion of the managerial functions of the corporation," adding that additional clashes might be avoided through discussion.

DDRE Shifts Continue

Big turnover of key personnel in the office of defense research and engineering is continuing. These are the latest changes: Lt. Gen. William J. Ely, formerly of Army Materiel Command, has replaced Rear Adm. Charles B. Martell as deputy director for administration and management. Adm. Martell now commands the Second Fleet at Norfolk. Ronald M. Murray, formerly manager of international programs for Hughes Aircraft's Aeronautical Systems Div., has replaced Arthur Robinson as assistant director for DDRE's international programs. Robinson has returned to General Electric's Missile and Space Div. James W. Roach, former marketing manager for Fairchild Stratos' Aircraft Missiles Div., has replaced Robert Tucker as assistant director for engineering management. Tucker has joined the Northrop Corp. Daniel J. Fink, former vice president of Allied Research Associates, has replaced B. P. Holmes as assistant director for defense systems.

Air Force is asking Congress for $2.8 million in construction funds for Fiscal 1964 to improve its facilities at Cape Canaveral. One of the four facilities sought is a 15,600-sq. ft. bioastronautics operational support unit to replace two blockhouses at the Cape which must be vacated soon because of their nearness to new launch sites.

½ TFX=VAX

Boeing has submitted a design for the VAX attack aircraft which Pentagon wags have dubbed the F-55.5 because it is a half-size version of the company's losing proposal for the F-111 (TFX) tactical fighter.

—Washington Staff

Navy Evaluates Light Attack Aircraft Bids

VAL is among several issues to be decided. COIN, Phantom 2, F-111 differences are to be arbitrated.

By Larry Booda

Washington—Evaluation of proposals submitted for the Navy's interim light attack aircraft (VAL), which begins Aug. 12, will mark the beginning of a period when high Defense Dept. officials must resolve long-standing questions concerning the light counter-insurgency (COIN) aircraft, low-altitude attack missions and a future interceptor aircraft.

Differences on tactical and fighter aircraft missions and configurations between the Air Force and Navy and between the defense secretary's office (OSD) and both services will be subjected to arbitration after more than two years of analyses by the services.

With the VAL question resolved, the Navy will proceed next with the COIN program, which has been stalled since late last year (AW Dec. 10, p. 26). One of the toughest OSD decisions will be to bring the two services together on low-altitude mission profiles for the McDonnell F-4B and C and General Dynamics F-111A and B (TFX) aircraft. The Air Force will be directed to use a version of the F-111 as its future interceptor.

VAX Delay

A victim of the actions will be the VAX (heavier than air, attack, experimental) aircraft, which was expected to be developed for use in the same time period as the F-111, and which would fill the close troop support requirements between the COIN and the F-111. Introduction of the VAL will delay the VAX indefinitely.

When the Navy saw that its desire for the VAX would not be fulfilled in the near future, it sought other ways to gain a light attack aircraft that would improve on the job now being done by the Douglas A-4 Skyhawk series.

The VAL was the result. The proposals called for using existing airframes in the Navy inventory and modifying them to take powerplants that would increase payload or endurance, unless a company could do it in some other way. These ideas met the cost-effectiveness criteria of OSD.

Proposals have been submitted by four companies: Chance Vought, North American, Douglas and Grumman. Douglas proposes to modify the A-4 by installing a turbofan powerplant. This would necessitate considerable alterations to the fuselage, because a turbofan is considerably larger than the Pratt & Whitney J52 and the Curtiss-Wright J65 axial flow turbojets now installed in the A-4. This modified A-4 would have significantly increased range and endurance.

Chance Vought has proposed modifying its F-8A Crusader fighter for delivery of conventional armament. North American would like to use the F-1 Fury series, which superficially resemble the F-86 Sabre series fighters and are powered by the Curtiss-Wright J65 axial flow turbojet. Fuselage changes also would be necessary to accommodate a turbofan engine.

Grumman has proposed using its existing A-6A Intruder airframe and J52 engines, but would eliminate the complex electronics equipment needed for the all-weather, low-level, long-distance attack mission.

The companies were encouraged to make use of the Pratt & Whitney TF-30 powerplant if a turbofan is used.

In requesting permission to go ahead with the VAL, the Navy based its cost-effectiveness argument on the contention that a larger number of lower-cost aircraft would be more effective in delivering conventional bombs, rockets, napalm and other armament. Surface-to-air missiles, the Navy reasoning goes, are limited in the number of aircraft they can knock down. Attrition percentage would be less with a larger number of aircraft. In addition, more aircraft could deliver a greater variety of armament to a greater number of targets.

COIN Proposals

Requests for proposals (RFPs) for the COIN aircraft are expected to be mailed to industry by the Navy's Bureau of Weapons (BuWeps) early next month. The program had been stalled because BuWeps wanted to follow a slower, more thorough procedure in developing the aircraft than had been suggested by OSD last year. BuWeps took action only after Dr. James H. Wakelin, Jr., assistant secretary of the Navy for research and development, became directly interested in the project when the delay was called to his attention. BuWeps will develop the aircraft for the Marine Corps, Army and foreign aid programs.

The COIN RFP will call for study proposals, rather than programs leading directly to prototype development. These proposals will be evaluated to determine what the development program will be. The original idea was that three prototypes would be built, one or more of them constructed of glass fiber.

Even before the program had been officially announced, BuWeps was flooded with queries and proposals from almost every segment of the airframe and propulsion industries. This is expected to result in a wide variety of proposals. Basically, the RFP is expected to call for an upper weight limit of 5,000 lb. and turbine power. The original power limit was a total of 1,100 hp., without the number of engines being specified. This is expected to remain unchanged.

Air Force and Navy have differed on how a low-level attack mission should be flown against relatively heavily defended targets ever since the original Air Force TFX was changed into the bi-service F-111. The Air Force would like to approach a target at supersonic speeds at about 500 ft. for 200 mi. or more. Flying at Mach 1.2 for 15 min. at low altitudes would require a tremendous amount of extra fuel. The F-111A Air Force version would be a bigger aircraft with an intercontinental ferrying range. The extra ferry fuel would provide the low-altitude supersonic capability.

The F-111B Navy version, however, is a smaller aircraft and could perform the low-altitude mission only by sacrificing considerable range or payload. The Navy believes that missions can be flown at high subsonic speeds at about 100 ft. safely.

Since both services will use the F-4B and C in the near future, the F-111 argument has spilled over into use of this aircraft, and if the VAX ever is developed, the same issue will influence its configuration.

Since the two services are diametrically opposed, OSD will have to dictate what it feels the mission profile should be.

At one time, USAF Air Defense Command had a requirement for a Mach 3 interceptor for continental air defense use. It was called the F-108, but was canceled. Now it has revived its requirement, preferring that a new aircraft be developed.

Defense Climate

But this requirement has run into a defense climate that has dictated fewer weapon systems because of their higher cost. OSD officials have indicated that the F-111B aircraft could fulfill this mission.

The F-111B is the smaller, lighter aircraft with small, hard tires. The F-111A is larger and will have large wheels and tires for operations from rough fields. By removing the tactical mission features from the F-111B, an interceptor configuration that could destroy any enemy bombers of the foreseeable future is possible, according to the OSD officials.

So far, the Air Force has shown no desire to obtain a smaller, cheaper aircraft to perform the close support role. Its doctrine maintains that the aircraft must operate from fields some distance back of the action area, reaching places where help is needed with jet speed and shifting to other areas when needed. It also maintains that interdiction and reconnaissance far behind enemy lines is important and cannot be performed by a smaller aircraft.

This doctrine could be changed by Project Forecast, which is now examining the entire spectrum of Air Force missions (AW Apr. 8, p. 25). As it now stands, there is a gap in close support which the Army is anxious to fill with its own aviation. Meanwhile, the Navy and Marine Corps are meeting their own needs in this area.

Contractor Evaluation Approved

Washington—Defense Dept.'s new contractor performance evaluation program, intended to provide a permanent report on past performance for all major development programs to help in selecting contractors for major new programs, has been approved by Deputy Secretary of Defense Roswell Gilpatric and will be made public shortly.

Operation of the contractor evaluation system will be essentially as described in Aviation Week & Space Technology (Apr. 15, p. 32). The approved procedure will, however, place increased emphasis on the use of factual data by the project officer to support his appraisal of contractor performance. Another change from the original plan is that the contracting officer can defer the first evaluation report for up to one year after the program begins rather than the report being required six months after initiation.

The new procedure is expected to be applied retroactively to existing large development programs, except those in which more than 50% of the authorized funding and allocated time already have been spent.

Fire Signal Cuts Short S-4 Static Test

Los Angeles—The first static firing of a Douglas S-4 flight vehicle configuration was cut short Aug. 5 when instrumentation indicated the presence of fire in engine plumbing. Originally scheduled for a full-duration run of 7 min., the test firing was terminated deliberately by the test conductor at 1:36 min. Firing was conducted at the Douglas Aircraft test facilities at Sacramento, Calif.

Inspection later revealed no damage to either the stand or the stage itself. Source of fire indication was being investigated, but early indications were that the problem may have been in the instrumentation rather than stage functional components. Preliminary evaluation of test results indicated successful performance of all systems during the firing, which was a manufacturer's test to qualify the stage for flight.

The S-4, second stage of the NASA Saturn 1 space vehicle, is powered by six Pratt & Whitney RL-10 engines. Expected thrust of 90,000 lb. was developed by the engines prior to firing termination.

The S-4 involved in the most recent firing is the fifth S-4 to be test-fired. The four previous stages were not flight configurations. Successful full-duration static tests of earlier configurations are reported to have established basic design integrity.

Plans for future tests of the flight vehicle will not be made until after test data of the curtailed firing has been fully evaluated.

Senate Is Expected to Approve $5.5-Billion NASA Authorization

By Alfred P. Alibrando

Washington—Senate was expected to vote approval late last week of the $5.5-billion U. S. space agency budget authorization for Fiscal 1964 recommended by the Senate Space Committee, which restored $307 million of the $508 million cut by the House from the agency's authorization request (AW July 15, p. 29; July 22, p. 323).

The Senate committee's restorations gave a lift to National Aeronautics and Space Administration officials who had complained that the reductions recommended by the House committee would either slow down the manned space flight program or practically eliminate all other programs if the agency sought to maintain the Gemini and Apollo development pace despite the cuts.

NASA's budget is still a long way from final congressional approval, which is not expected until late August or early September. Meanwhile, the agency is permitted under a congressional resolution to continue its programs at the Fiscal 1963 funding level of $3.67 billion.

These are the legislative steps through which the NASA budget must pass:

- **Resolution of the differences** in the House and Senate authorization bills by a joint conference committee.
- **Adoption of the conference** report by the House and Senate.
- **Consideration of the NASA budget** by the Senate and House Appropriations Committees.
- **Senate and House approval** of the appropriations legislation.

Most perilous step from NASA's standpoint is consideration by the House Appropriations Committee, whose chairman, Clarence Cannon (D.-Mo.), has indicated he feels the NASA budget can stand a sizable cut.

The NASA authorization bill was approved by a vote of 334-57 in the House on Aug. 1. One of the issues in the debate that preceded the vote was the authorization of funds for a new $50-million electronics center in the Boston area.

Rep. John Wydler (R.-N.Y.), a member of the House space committee, offered an amendment that would have prohibited the appropriation of any funds for the center until further justification by NASA to Congress next year.

House Committee Cut

The House committee earlier had cut the authorization for start of work on the center from the $5 million requested by NASA to $3.9 million and stipulated that the agency would have to provide a more complete justification for the project. The House rejected Rep. Wydler's amendment, 111 to 64, and the approved bill contained the $3.9-million item.

Senate Space Committee first voted July 25 to eliminate all funds for the Electronics Research Center. Then, on Aug. 1, the committee reversed its earlier decision and restored the entire $5-million item (AW Aug. 5, p. 25). Committee members rejected suggestions that the influence of the Kennedys changed their decision on the proposed Massachusetts facility.

The accompanying table shows what has happened to the funding in major

Status of Fiscal 1964 NASA Authorization

(in thousands of dollars)

	NASA Request	House Approved	Senate Committee Approved
Research and Development:			
Manned spacecraft system	1,556,600	1,436,600	1,556,600
Launch vehicle and propulsion system	1,168,500	1,138,500	1,153,500
Aerospace medicine	16,700	11,000	11,000
Integration and checkout	153,000	125,000	140,000
Systems engineering	37,000	37,000	37,000
Meteorological satellites	63,700	63,700	63,700
Communications satellites	51,100	42,175	44,175
Advanced applications satellites	1,000	0	0
Industrial applications	3,500	3,500	3,500
Geophysics and astronomy	194,400	190,400	194,400
Lunar and planetary exploration	322,600	254,400	282,600
Bioscience	35,200	21,200	21,200
Launch vehicle development	130,700	127,700	127,700
Facility, training and research grants	55,000	30,600	50,000
Space vehicle systems	61,962	53,462	53,462
Electronic systems	30,362	30,362	30,362
Human factor systems	18,200	13,200	13,200
Nuclear-electric systems	68,768	68,768	68,768
Nuclear rockets	96,687	91,687	96,687
Chemical propulsion	22,497	24,497	24,497
Space power	16,524	16,524	16,524
Aeronautics	16,200	16,200	16,200
Tracking and data acquisition	231,500	216,700	220,200
TOTAL	4,351,700	4,013,175	4,225,275
Administrative operations	560,300	508,185	539,185
Construction of facilities:			
Ames Research Center	13,076	11,044	11,044
Flight Research Center	4,081	0	1,157
Goddard Space Flight Center	20,932	17,032	20,332
Jet Propulsion Laboratory	7,000	2,998	2,998
Langley Research Center	9,768	8,204	8,204
Launch Operations Center	312,855	279,677	300,316
Lewis Research Center	25,835	18,634	18,634
Manned Spacecraft Center	37,736	35,102	35,102
Marshall Space Flight Center	38,496	28,980	28,980
Michoud Plant	10,003	8,688	8,688
Mississippi Test Facility	111,690	92,696	102,196
Nuclear Rocket Development Station	20,490	15,650	15,650
Various locations	176,038	148,653	168,253
Wallops Station	2,000	0	505
Facility planning and design	10,000	15,000	25,000
TOTAL, construction of facilities	800,000	682,359	747,060
GRAND TOTAL	5,712,000	5,203,719	5,511,520

program areas. Some important projects within the programs, for which funds were restored include:

- **Apollo spacecraft development**—Senate Space Committee restored all of the $120 million cut by the House from NASA's $1.2-billion request.
- **M-1 engine**—$15 million of the $30 million cut by the House was restored.
- **Surveyor Orbiter**—Senate committee restored the $28.2-million Surveyor Orbiter program which had been eliminated entirely by the House.
- **Mississippi Test Facility**—Senate committee restored all of the $3.5 million cut from funds requested for construction of an S-1C test stand, all of the $1.5 million cut from funding for an S-2 stage static test facility, and all of the $4.5-million House reduction in funding for work on an F-1 test stand.
- **Lunar excursion module test facility**—$3 million was restored by the Senate committee to funds requested for a test facility at White Sands Missile Range.
- **Launch Complex 39**—$15 million of the $25 million requested for work on Saturn 5 launch facilities was restored, along with $2.8 million for a central instrumentation facility and $855,000 for an optical and electronic component servicing facility at Canaveral.
- **Apollo tracking ships**—Senate committee recommended $89 million of the $90 million NASA asked for three tracking ships, as opposed to $80 million voted by the House.
- **Meteorological Systems Laboratory**—Restored the $2.5 million for this Goddard Space Flight Center facility, which had been eliminated entirely by the House.

Zuckert TFX 'Rough Judgment' Charged

By Donald E. Fink

Washington—Sen. John L. McClellan (D.-Ark.) last week accused Air Force Secretary Eugene M. Zuckert of using the same "absolutely rough judgments" the Defense Secretary Robert S. McNamara used in selecting General Dynamics over the Boeing Co. for the F-111 (TFX) tactical fighter contract award (AW May 6, p. 24).

Sen. McClellan made the charge during the continuing probe of the F-111 award by the Senate Permanent Investigations Subcommittee. Contending that Zuckert should have further investigated the difference in the two companies' cost proposals (AW Aug. 5, p. 38), McClellan said the only document Zuckert had to show was a cost comparison memorandum prepared Nov. 17, 1962, by James E. Williams, Jr., assistant to Deputy Assistant Secretary of the Air Force.

McClellan asked Zuckert if he had any other documents or calculations, that were made after that date, on the cost differential between the two proposals.

Zuckert said he had no other calculations, "but on the other hand, I did analyze the evidence with such people as Dr. Charyk . . . and the Secretary of Defense. . . ."

"That is the rough judgment I am talking about," McClellan said. He then asked Zuckert if he prepared any charts analyzing the effect the lower wage rate in the Boeing's Wichita, Kan., area would have on lowering their cost estimates.

"Have you any charts or anything where you made the calculations along those lines to satisfy yourself?" McClellan asked.

Zuckert replied that he "didn't have to have calculations to weigh it."

He added that he "had what in my opinion were adequate discussions with Secretary McNamara, Williams (and others) to confirm my own impression of the cost proposals."

Zuckert said it "was quite clear that Boeing had used bomber experience, B-47 and B-52, as the basis for its cost estimates."

In his report, Williams said Boeing cut their man-hour estimates by 30% for the manufacturing effort, because their man-hours-per-pound averages achieved on the B-52 were 12.4 as opposed to an industry average for 19.5.

"In their opinion, since they beat the bomber average (by about 30%), they can beat the industry average of 26 for fighters by about 30%, (so) they chose a factor of 20 (for the F-111)," Williams said. He added in the report that he "cannot agree with this rationale, (because) the Boeing experience on bombers is not directly translatable to production of fighters."

Zuckert said Boeing's manufacturing man-hours were less per pound than for any modern fighter, "and even the P-38 and the P-47 of World War 2 fame."

Zuckert added that the fourth evaluation briefing and the briefing summary also gave indications of the cost differential and concluded "I don't want to leave the slightest impression that the matter did not get my most serious attention and consideration."

Earlier, Zuckert had challenged information presented by Thomas A. Nunnally, a General Accounting Office accountant on loan to the subcommittee, which purported to show that Boeing's lower proposal costs—listed as $416,105 below General Dynamics—were due primarily to the lower wage rate in the Wichita, Kan., area.

Nunnally said a 72-cent difference between rates in Boeing's Wichita, Kan., area and General Dynamics' Ft. Worth, Tex., area permitted Boeing to quote labor costs $261,922,000 lower than General Dynamics.

Zuckert then pointed out that Boeing had estimated it would take 45,905,000 fewer man-hours in its proposal and that this would account for $161,579,000 of the labor difference. A low estimate of the labor required to produce the F-111 throughout its full production run was one of the elements Zuckert considered unrealistic in Boeing's proposal.

Zuckert further insisted that about $229 million of a $351,499,000 advantage credited to Boeing for lower overhead costs also was due to the lower number of man-hours in their proposal.

He also challenged the $274,036,000 figure which the subcommittee said represented Boeing's higher material and other costs. Zuckert said the material costs "are a very minor percentage of this material and other costs." Zuckert also said "a good part" of Boeing's $30.6 million lower profit was "attributable to the difference in the estimates of the difficulty of doing the job."

Zuckert said that most of the $416 million difference could be attributed to the different number of hours, "without taking into account the labor rate at all. In other words, if it actually turned out that the Boeing Co. used 94 million man-hours, or whatever the General Dynamics figure is, the price for the job would be about the same as General Dynamics proposed."

Nunnally said it was possible to "interpret it that way . . . but I prefer not to do it that way."

The Williams memorandum, which Chairman McClellan said was Zuckert's sole document comparing the difference

TFX Prototype Contest Idea Revived

Washington—Question of conducting an F-111 (TFX) prototype competition between Boeing and General Dynamics was raised again last week during Senate hearings on award of the contract to General Dynamics.

Sen. John L. McClellan (D.-Ark.) asked Air Force Secretary Eugene M. Zuckert if he had given any recent consideration to having "the two companies build prototypes and have them tested and then buy the plane that is best."

Zuckert avoided taking a firm stand on the issue, saying that he had only tentative views on the value of such a competition. He said he was not "opposed to the idea entirely," but cautioned that it could mean delays, since in the F-111 program, preparations for production are scheduled to begin while the research and development program is still under way.

Boeing earlier had said they could build two prototypes for $105 million (AW May 6, p. 24), but Defense Dept. officials rejected the idea, as did General Dynamics (AW May 13, p. 27). Sen. Karl E. Mundt (R.-S. D.) said last week, however, that some thought is being given in Congress to appropriating up to $400 million to permit the two companies to build four prototypes each for a competition.

McClellan cited an Air Force-sponsored Rand Corp. study, which concluded that "the expedited prototype approach should be more widely applied to aircraft development programs" (AW June 10, p. 135), and asked Zuckert if he agreed with it.

Zuckert said there are advantages to the prototype approach, but added that it still will not determine quickly which is the better airplane. "You don't learn about a weapons system until you have used it," he said.

He added that there was not time for a prototype competition, because General Dynamics was seven months into the research and development program and would have to "start gearing for production with Fiscal 1965 funds" to meet the tight delivery date.

between the two companies' cost proposals in the period shortly before the contract award, was inserted in the subcommittee hearing record.

In the report, Williams said "negotiations with both contractors would result in a lower contract price with Boeing," but he recommended against conducting such negotiations, because he couldn't agree with some of the reasoning used in the Boeing proposal. He listed these five reasons for Boeing's lower cost proposal:

- **Negotiations** would start at a lower level.
- **Boeing can spread** their overhead on a larger base.
- **The hourly rates** at Wichita are significantly lower.
- **Proposed Boeing tooling,** even in the RDT&E (research, development, testing and evaluation) phase is simply tooling designed for large quantity production.
- **Boeing's past performance,** even though it is not for fighter aircraft, shows they can best the industry man-hour averages. This fact plus the company's desire to support this reputation will contribute to a lower price.

Williams added that "although the contract price with Boeing would be lower, it would not be sufficiently low enough to warrant using price as the sole determinant in awarding the contract. The only way to prove that one contractor price would be lower than the other would be to negotiate with both companies, and this is not recommended."

Zuckert pointed out that Williams said the "prices proposed by the contractors are just that—proposals or a starting point for negotiating a contract price." He said Williams cited "his feeling that the Air Force's estimate represents a much more realistic estimate of what the proposed program will cost."

The reference to Air Force cost estimates prompted Jerome S. Adlerman, general counsel for the subcommittee, to ask Zuckert if "you and your office have used the Air Force estimates on which to base a judgment as to the validity of the cost estimates of both Boeing and General Dynamics."

Zuckert replied that in earlier testimony he had spelled out "the purposes for which I used the Air Force cost standards, and I did rely on them as a step in the judgment-making process, about the realism of the cost proposals made by the contractors."

Zuckert had been asked at that time if he agreed with McNamara's statement that the Air Force figures were so "unreliable" that he could not use them in making a final decision on award of the contract, and therefore had to make a "rough judgment."

Zuckert replied that he used the figures for "two of the three" major steps involved in the final decision, and therefore the figures were of some use to him.

Adlerman said this appeared contrary to him "to the position that Secretary McNamara took . . . when he stated these could not be used at the secretarial level, (because) they were considered too unreliable."

Zuckert said that during the earlier exchange he had attempted to interpret what the secretary meant—that the figures perhaps were unreliable for the final decision process, but nevertheless of some value in decisions leading up to this—(but) "I didn't disagree with Secretary McNamara."

Zuckert also was asked about the past performance records of the two contractors and whether General Dynamics' history of 4.8% over-runs, according to subcommittee figures, and Boeing's 2.6% under-runs on contract costs were considered significant.

The secretary replied that "this problem of over-run/under-run is one of the toughest in the business" and that "if you accept Mr. Nunnally's figures . . . I still say that qualitatively you don't know anything" because they are not significant.

The charts had no merit in showing which contractor did the better job, because General Dynamics' work on the B-58 was "many times more difficult" than Boeing's work on the B-52, Zuckert said. The B-58 was the first supersonic bomber and made tremendous advances in the state-of-the-art, he said.

Merritt Island Telephone Award To Be Reserved for Southern Bell

Cape Canaveral—National Aeronautics and Space Administration last week returned the unopened bids of 10 firms vying for the communications system on the agency's Merritt Island Launch Area (MILA) and announced that the rewritten bid request would reserve the business telephone portion of the contract for Southern Bell Telephone Co.

Southern Bell and its parent organization, American Telephone and Telegraph Co., objected to NASA's launch operations center here and NASA headquarters, Washington, D. C., respectively, that the local common carrier was qualified to handle the commercial telephone part of the contract under established rates. Through the successful system contractor, NASA had planned to purchase, install, operate and maintain its own phone system and to connect with the carrier's trunk-lines on the Florida mainland. This arrangement is common to all Defense Dept. bases and installations and has been agreed to by carriers in the interest of national defense.

Telephone companies argued that NASA, as a civilian agency, could not justify this defense-type of installation. At stake, in the opinion of some observers, was not so much an insistence on a technicality as it was a fear on the part of the carriers that NASA's MILA facility might set a precedent for other non-defense government agencies and, eventually, private concerns to develop their own systems. Installation charges and equipment lease fees—a significant share of carriers' income—would be denied to the telephone companies if users began buying phones from sources other than the manufacturing arms of the carriers, such as Western Electric, and installing the equipment themselves.

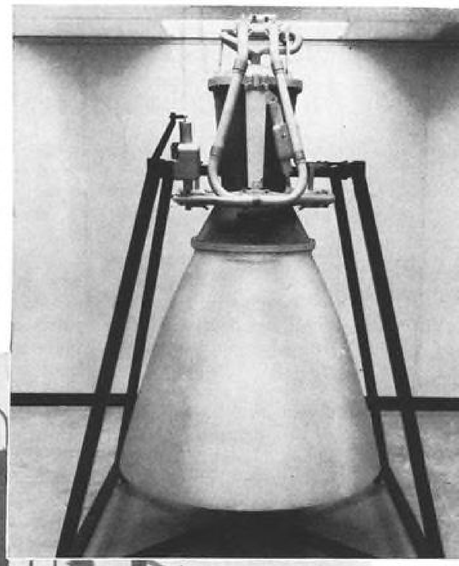
AT&T also was said to have made the point, in pleading Southern Bell's case, that clarity of long-distance calls necessitated compatible equipment at each end of the line, as well as in the circuits in between. One NASA official said that neither he nor other NASA personnel who participated in the two-month long discussions with the carriers construed this as advance notice that the space agency could expect little assistance from the Bell System if it went ahead with its original plan, installed its own equipment, and difficulties later developed. But another NASA official said the warning was implicit in the carriers' mere mention of the point.

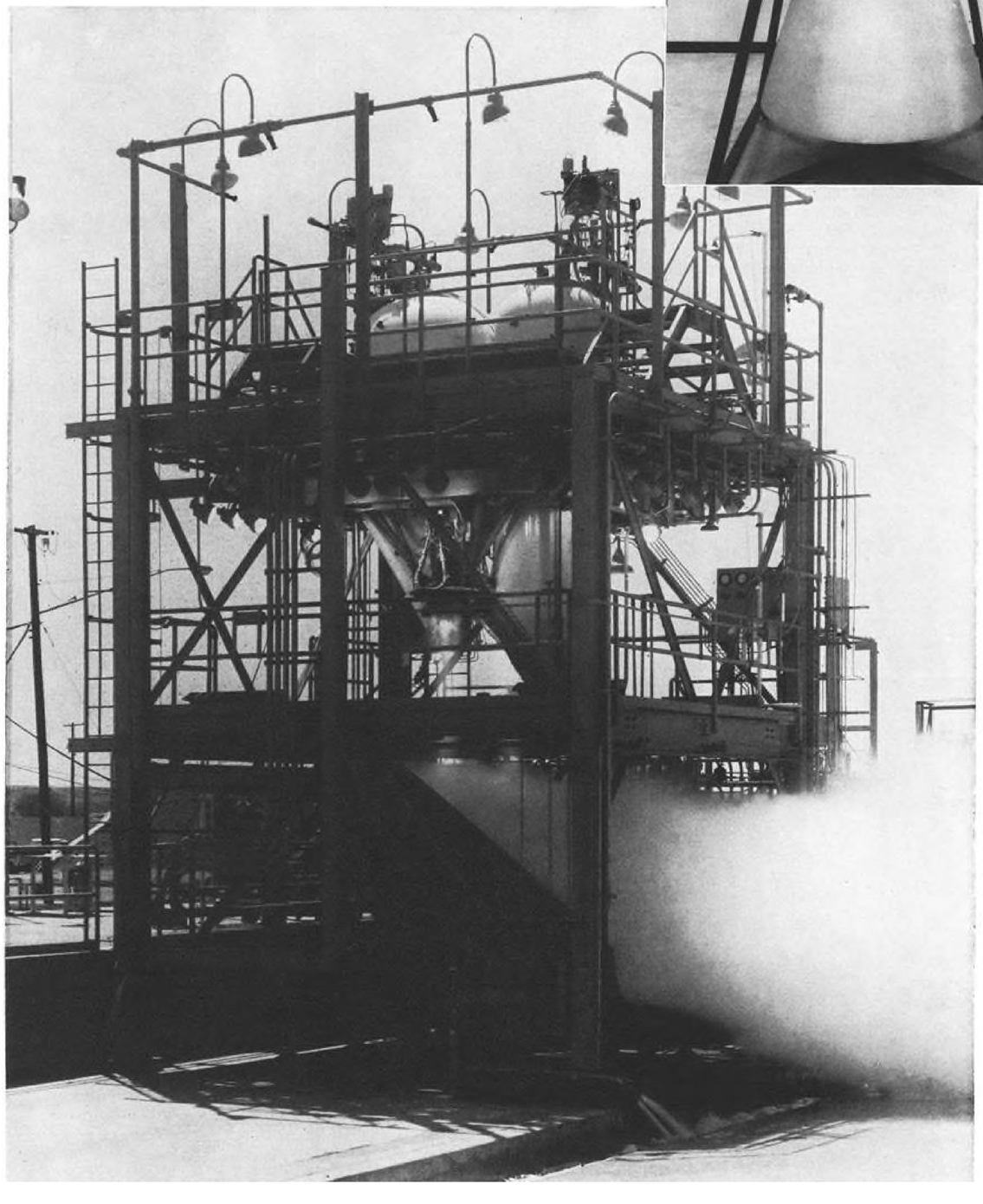
NASA agreed to let Southern Bell handle all conventional administrative telephones on MILA, including their installation, operation and maintenance. The agency did, however, insist on retaining the right to install and control all telephones in mission-sensitive or critical areas, such as the launch control center for Saturn 5-Apollo. The carriers yielded to NASA on this issue and so the successful communications contractor will be responsible for approximately 500 of the 3,000 telephones to be installed initially next year in the Merritt Island area.

Rewritten bid requests are expected to be reissued again this week. Firms receiving the new requests will have 21 days in which to resubmit their bids. Contract will cover all cable-plant and radio-frequency transmissions in the Merritt Island Launch Area. This will include all data, switching, microwave, video, voice, timing, intercom and countdown distribution systems. New request also includes a section on master planning support for future expansion of the MILA communications system.

Titan 3 Transtage Firing Shown

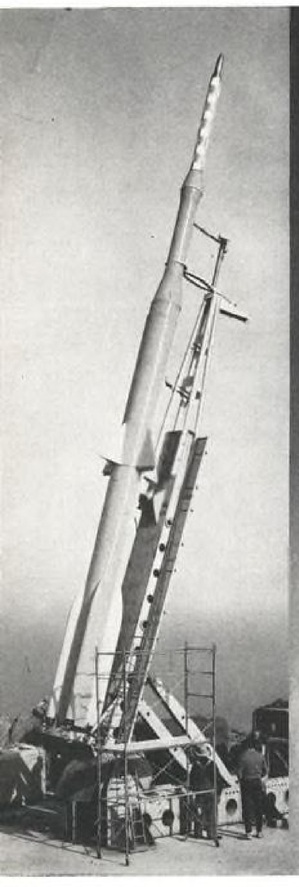
First long-duration firing of an integrated USAF Titan 3 transtage propulsion system involving multiple restarts took place recently in Sacramento, Calif. (AW July 29, p. 27). The engine was stopped three times and restarted twice during the 284-sec. run. Similar test firing is shown below with steam exiting from the test stand at right. Inset photo shows model of one of the twin engines that will power the transtage of the Titan 3. Engines, which develop 8,000 lb. thrust each, are built by Aerojet-General. Tankage is manufactured by Martin-Marietta Corp. Transtage is the third stage of the Titan 3A and the fourth stage of the Titan 3C. Long-duration test was halted short of the planned 6-min. duration when a hot spot developed at the juncture of the injector and thrust chamber.

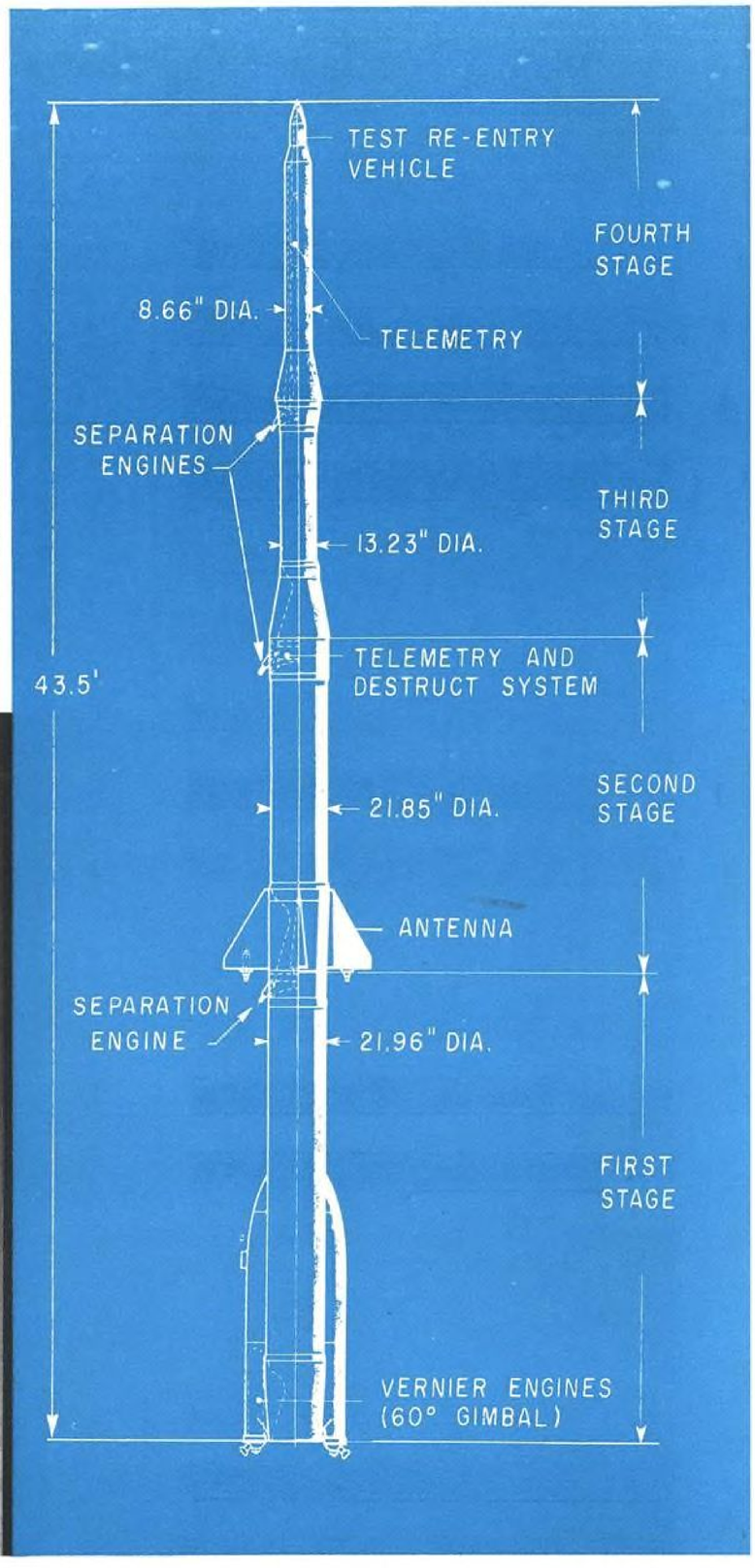




French Use Berenice In Nose Cone Tests

French Berenice, four-stage solid propellant rocket designed to evaluate proposed nose cone configurations, both ablative and heat sink, for an IRBM system (AW July 15, p. 34), is shown in diagram (right) of its over-all configuration. Note separation boost engines to aid stage separation following firing of explosive bolts, six for first-stage separation, and four each for third and fourth stages. Ground-controlled destruct system is located in second stage. Two telemetry systems are carried. Final two stages are ignited at about 34-mi. altitude during descent to propel the nose cone to a Mach 12 re-entry test speed. Maximum altitude of trajectory is about 170 mi. Nose cone designed by Sud Aviation is shown on 7,400-lb. Berenice vehicle (below, left) aboard its launcher on the Iles du Levant island chain near Toulon. With first stage ignited (below, right), Berenice begins 8.5-min. flight, traveling about 70 mi. down the Mediterranean range. Berenice was designed by Office National d'Etudes et de Recherches Aerospatiales in collaboration with the Societe d'Etude de la Propulsion par Reaction.





Cape Contracts Total More Than $60 Million

Cape Canaveral—More than $60 million in construction contracts for Saturn 5-Apollo and Titan 3 facilities have been awarded here by the Army Corps of Engineers for the National Aeronautics and Space Administration and USAF.

The joint firm of Paul Hardman, Inc., and Morrison-Knudsen Co., Inc., last week received a $22.4-million contract for construction of the USAF Titan 3 vertical integration building and solid motor assembly building (AW Apr. 8, p. 55), plus a connecting railroad track and smaller support buildings.

Also last week, the joint firm of B. B. McCormick & Sons, Inc., and Bailes-Sey Contractors was awarded $2.4 million to build 14 mi. of railroad track within NASA's Merritt Island Launch Area (MILA). Two spurs, one from the MILA industrial park and the other from the vertical assembly building at Saturn Launch Complex 39, will connect with a rail line being built across the Indian River onto Merritt Island by the Florida East Coast Railway.

American Bridge Div. of U. S. Steel has been selected to provide the steel framework of the 524-ft.-tall vertical assembly building in which the three-stage Saturn 5 and the three-module Apollo spacecraft will be assembled and checked out. The contract was valued at $24.5 million.

Blount Bros. has received a contract for $8 million to prepare the site of the vertical assembly building; Gahagan Dredging Corp. received $3.7 million for fill and R. E. Clarson Construction Co. received $1.8 million to construct foundations for Saturn 5 launcher-umbilical towers and to build a barge unloading area near the vertical assembly building.

Holmes to Raytheon

Washington—D. Brainerd Holmes, director of the U. S. space agency's multi-billion dollar Gemini and Apollo manned flight programs, will join the Raytheon Co., Lexington, Mass. on Oct. 1 as director and senior vice president when he leaves the agency Sept. 15.

Holmes' resignation was first announced by James E. Webb, administrator of the National Aeronautics and Space Administration, on June 12 (AW June 17, p. 37). Although Webb's announcement said Holmes' departure was part of a planned realignment following the conclusion of Project Mercury, it was known that the two had strong disagreements over policy.

Raytheon said Holmes' appointment was one of several changes intended to strengthen senior management.

West German Talks Point to Mutual R&D

Bonn—Mutual research and development programs leading to advanced hardware projected for use by the military units of the two countires during the nineteen seventies, including a supersonic VTOL aircraft, are expected to evolve from talks held here last week between U. S. Defense Secretary Robert McNamara and top German defense officials.

Specific agreement was reached on joint development of an advanced "main battle tank," while the VTOL program reportedly was the subject of serious discussion but without any accord being reached as to final details or a specific VTOL project.

German already has a test-bed version of a VTOL fighter in the air, the VJ-101C (AW May 27, p. 70), although transition from vertical to horizontal flight has not yet been made. There are no plans at present to place the aircraft into production, but, under a recent decision, two versions of the VJ-101D operational model may be manufactured and carried through the flight test stage in order to obtain further data.

West Germany already has an agreement with France, which has its own Dassault Mirage 3V program well under way, for the final joint development of a supersonic VTOL aircraft and a similar pact with Italy for a subsonic V/STOL strike fighter. Role, other than financial, that the U. S. could play in such a consortium appears to be one of the major issues under discussion.

One area might be within the avionics field, with Germany, the U. S. and possibly France joining together for final design and development of a common aircraft.

Potential range restrictions of the Mirage 3V in its present planned configuration reportedly have become a source of some concern to France military planners.

Joint development programs with European North Atlantic Treaty Organization members have become a source of priority as one method of assuring continued U. S. industry sales and participation in the military programs of West Europe (AW July 29, p. 64).

Scientific Cosmos Flights Resumed

Washington—Announcement by Soviet Union that it launched Cosmos 19 on Aug. 6 at an inclination of 49 deg. from the equator indicates the Russians have resumed their scientific satellite flight program.

Soviets said Cosmos 19 was launched into an orbit with an apogee of 322.29 mi., perigee of 167.67 mi. and period of 92.2 min. The spacecraft is transmitting on a frequency of 90.02 mc., the Russians said.

Cosmos 18 was launched on May 24 into a 65-deg. orbit (AW June 3, p. 23), and apparently was a Vostok-type spacecraft. The flight is believed by U. S. space officials to have been a check of radiation shielding and manned spacecraft systems preparatory to the twin flights of Vostok 5 and 6 between June 14 and June 19 (AW June 23, p. 33).

Soviet spacecraft placed in 65-deg. orbits are launched from Tyuratam, a rocket complex east of the Aral Sea for the launching of heavy rockets. Satellites placed in 49-deg. orbits apparently are smaller scientific satellites launched on one or more types of smaller rockets from Kasputin Yar, north of the Caspian Sea.

Soviet Union announced the Cosmos program in March, 1962, and said the purpose of the flights would be the study of charged particles in the ionosphere, detection and measurement of energetic particles, magnetic fields, micrometeorites and the earth's cloud cover distribution. The announced goals of the Cosmos flight program were related by the Russians to the evaluation of the effects of prolonged space flight on the human system.

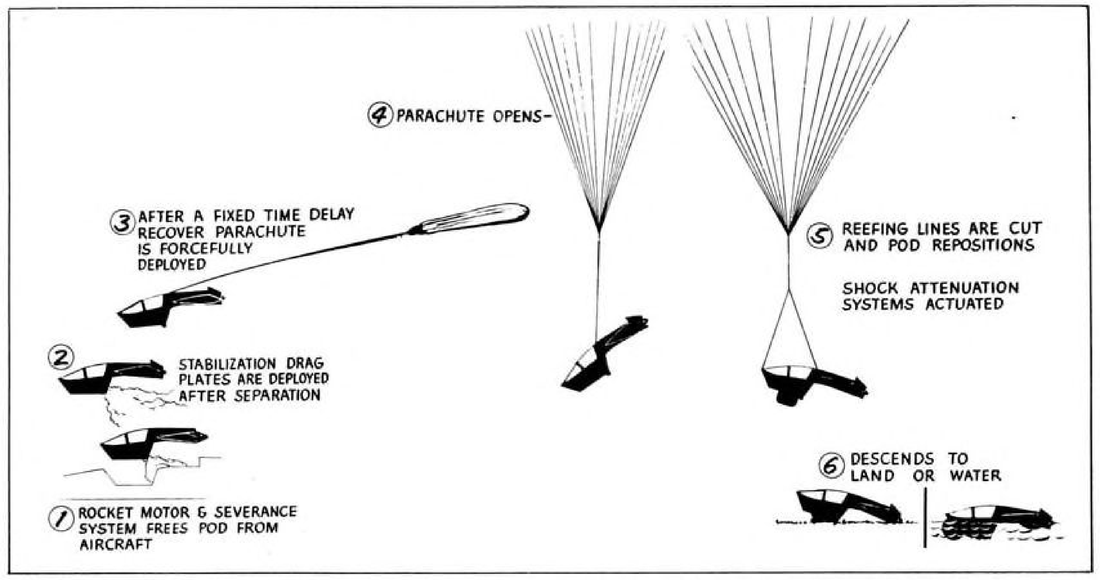
U. S., UK, Australia Plan Re-entry Study

U. S., Great Britain and Australia have announced they will conduct a joint basic research program aimed at identifying phenomena associated with re-entry of bodies into the atmosphere, leading to improved identification and tracking of flights by missiles and space vehicles.

The effort, called Project Dazzle, will utilize the Black Knight research missile of the British Royal Aeronautical Establishment. RAE will also design the re-entry bodies to be carried by the Black Knight missiles.

The re-entry bodies will be carried into space by one stage and given accelerated speeds for re-entry by a second stage.

Launchings will be made from the Woomera Range in Australia. U. S. Advanced Research Projects Agency will provide the instrumentation for observing re-entry.



DRAWING SHOWS F-111 (TFX) pilot capsule ejection sequence from separation of the pod from the fuselage through earth recovery.

Explosives Will Shear Pilot Pod From Fuselage in F-111 Escape

Pilot escape pod for the two-man General Dynamics/Grumman F-111 (TFX) fighter will be severed from the fuselage with explosives before being boosted away by a rocket, according to plans outlined last week by Air Force's Aeronautical Systems Div., which is directing the project.

A linear-shaped charge—"exploding wire"—will shear the crew compartment from the fuselage beginning forward of the instrument bulkhead, extending beneath the cabin deck and terminating behind the pilot's seat (see drawing). A portion of the wings adjacent to the crew compartment also will be cut out and left attached to the pod to provide stability during the escape.

Upon detonation of the shaped charge, a 50,000-lb.-thrust rocket motor will propel the pod away from the aircraft. Rocket Power, Inc., is developing the motor (AW July 29, p. 27). All survival equipment and provision for environmental protection, including emergency oxygen, will be contained in the capsule.

Simultaneously with the firing of the shaped charge and rocket motor, the ejection control which initiates the escape sequence will begin dispensing radar chaff and switch on an emergency transceiver and flashing beacon to assist recovery operations.

A small drogue parachute will be deployed first to decelerate and stabilize the pod. Then the main chute, similar to the one used in the McDonnell Mercury spacecraft, will be deployed (AW June 24, p. 23).

To reduce landing shock to the level experienced by a paratrooper during a routine jump, a shock-absorbing material will be attached to the pod.

The system is designed to allow the crew to abandon the aircraft at any altitude and speed and under water. In the event the aircraft is ditched in the sea and sinks, the escape mechanism will automatically sever the crew compartment at a predetermined depth and the pod will rise to the surface and float, ASD says.

Helicopter Tests

New York—Kaman Aircraft Corp., Bloomfield, Conn., will begin high-speed helicopter flight studies in early October with a UH-2A Seasprite equipped with a podded General Electric YJ85 gas turbine engine in a side mount.

The studies, funded by Army's Transportation Research Command (Trecom), Ft. Eustis, Va., will investigate the characteristics of a fully articulated, servo-flap controlled helicopter rotor system at speeds higher than current helicopters, the company says.

The initial phase of the program is funded for $100,000 and will involve one aircraft. Study is scheduled for completion by early 1964.

Two-Satellite Payload For Scout Planned

Washington—U. S. space agency will attempt its first launch of two satellites on a single Scout rocket late this year from the Pacific Missile Range.

National Aeronautics and Space Administration also said the launch would be the first attempt to place an air density drag satellite in a polar orbit.

Project is being managed by NASA's Langley Research Center, which has awarded a $478,922 contract to the State University of Iowa to provide one of the satellites, an Injun spacecraft containing instruments to detect and measure corpuscular radiation streaming into the earth's upper atmosphere from space.

Langley will build the second satellite, which will be a 12-ft. inflatable sphere.

Purpose of the experiment is to study the effect of space radiation on the atmosphere. A near polar orbit was chosen because the earth's magnetic field causes energetic particles to penetrate more deeply in the polar regions and thus exposes the spacecraft to maximum radiation flux.

Another YAT-28E

North American Aviation's Columbus Div. will modify a T-28 single-engine trainer under a contract presently in effect from Aeronautical Systems Div., Wright-Patterson AFB.

New modification is a continuation of the YAT-28E turboprop program (AW July 1, p. 57).

DOD Seeks Disarmament Impact Ideas

By Philip J. Klass

Washington—Defense Dept. has invited industry to suggest ideas for easing economic displacement that might result from arms control, if such an agreement is ever reached. The response to date has been slow, probably because few companies have yet made detailed studies of the problem.

The invitation was recently extended through the Defense Industry Advisory Council (DIAC) by Arthur W. Barber, deputy assistant secretary of Defense for arms control.

The program is part of a Kennedy Administration effort to explore the economic consequences of disarmament well in advance and to develop plans for coping with the situation if the need should ever arise. The Defense Dept. study was launched some months ago, prior to the start of negotiations for the recent limited nuclear test ban treaty. Similar studies are under way in other governmental departments with Dr. Walter W. Heller, Chairman of the President's Council of Economic Advisors, coordinating the multi-department effort.

In urging defense contractors to study the possible impact of arms control and recommend steps which could be taken in advance to ease the situation, Barber told DIAC that there was no cause for alarm nor any implication that an arms control agreement would be reached in the near future.

"Because we analyze and plan for the impact of a thermonuclear war on our military and economic posture does not mean that we expect the outbreak of general war soon. For similar reasons, we should plan now how to cope with an arms control situation," Barber told AVIATION WEEK & SPACE TECHNOLOGY.

Few Suggestions

Barber acknowledged that industry generally has not devoted much effort previously to study of the impact of arms control, and this explains why there have been relatively few suggestions advanced so far for easing any resultant strains. Discussions to date with industry representatives have tended to center on current defense business problems rather than on the problem which Barber is assigned to consider, he indicated.

However, one aircraft company has approached the Defense Dept. to determine if, in order to diversify into non-defense areas, it could use the government-owned plant which it now occupies. Since there is a surplus of government-owned aircraft plants unsuitable for missile or spacecraft production, some Defense Dept. officials believe it might be possible to sell such facilities to present occupants at a small fraction of their original cost to facilitate diversification into non-military lines.

Another possibility under consideration is to allow companies to use military test facilities for evaluating newly developed commercial items. For example, he cited the use of the USAF's Arnold Engineering Test Center to check the performance of a jet engine developed for commercial transports (AW July 15, p. 38).

A more lenient tax write-off policy on research and development aimed at new commercial products is another possibility, but goes beyond the authority of the Defense Dept.

Studies conducted several years ago by several large defense contractors indicated that the production of equipment needed to police adequately any arms control agreement might largely fill the gap resulting from decreased arms production. But other studies indicate that this may be wishful thinking.

The Defense Dept. and the Arms Control and Disarmament Agency (ACDA) recently launched a joint program, known as Project Cloud Gap, to learn first-hand more about the problems of inspection and enforcing an arms control agreement (AW May 6, p. 80). The objective is two-fold: to determine the effectiveness of existing reconnaissance-inspection techniques and pitfall areas where effective inspection and/or enforcement is impossible so that negotiators in any future arms control parley will be armed with such knowledge.

Recently, North American's Space and Information Systems Div. was selected from 16 bidders to be the system manager of Project Cloud Gap. Contract, covering the first six months effort, is for $294,000, with program funding expected to increase to several million dollars in Fiscal 1964. The Advanced Research Projects Agency (ARPA) is monitoring the project for the Defense Dept. and ACDA.

Although the detailed program for Cloud Gap has not yet been approved, it is expected that a number of realistic field trials will be conducted to determine the effectiveness and problem areas of available reconnaissance-inspection techniques. For example, one objective is to determine the effectiveness of a small group of ground observers, either mobile or fixed, living in a potentially unfriendly population, to detect an underground nuclear explosion, according to Vice Adm. Edward N. Parker, who heads the project at ACDA.

Field Trials

Field trials also are contemplated to determine the ability to detect the presence of hidden fissionable material production facilities, to monitor missile production and to perform effective aerial reconnaissance when there is a concerted effort to hide military objectives.

The first field trial is expected to be conducted by the Army this fall to determine effectiveness of qualified observers in identifying mobile military equipment by "eyeball inspection," both from the ground and low-flying helicopters.

Present plans call for gradual expansion of the field trials in order to substitute actual experience for what has previously been largely conjecture.

Soviet Chairman Khrushchev recently resurrected an old Soviet proposal for stationing observers at key points on opposite sides of the Iron Curtain, each manned by personnel from the opposite side, as a means of preventing surprise attack. How effective such observation posts would be and under what conditions, such as limitations on mobility and authority of the observers, is expected to be evaluated under Project Cloud Gap.

Barber says his office is anxious to receive any ideas responsive to the Defense Dept.'s request for specific suggestions to ease strains that might result from arms control, providing they are submitted in writing.

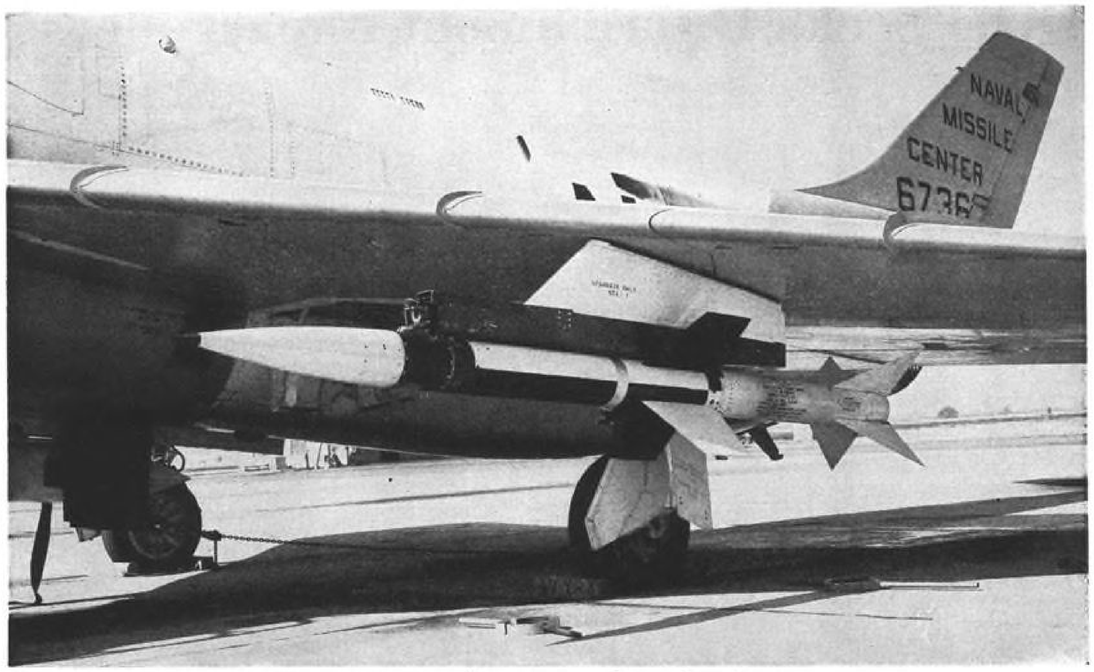
Fast-Spectrum Reactors

General Electric's Nuclear Materials and Propulsion Operation is studying fast-spectrum reactors for the Rocket Propulsion Laboratory at Edwards AFB under a $400,000 nine-month contract.

Fast-spectrum reactors are being considered for long-life multiple-restart nuclear rockets to be used for space propulsion because of their potential light weight and small size for a given power output.

Primary difference between the fast-spectrum and conventional thermal reactor is that in the former, neutrons from the fissioning process are used directly without requiring a moderator to retard them.

In addition, high-temperature refractory-metal fuel elements and structural materials can be used. High-temperature structural materials would poison the thermal neutrons in a conventional reactor.



Navy Probe Measures Star Radiation

Sparoair two-stage, solid-propellant space probe is shown mounted beneath the wing of a McDonnell F-3B. The piggyback instrument payload, developed by General Motors Defense Research Laboratories, consists of ultraviolet measuring devices, telemetering equipment and an attitude control system. The probe—first of five to be fired in the next few months—was launched in a nearly vertical attitude at 30,000 ft. and reached an altitude of 66 mi. during Operation Nite Owl, a recent experiment to measure ultraviolet radiation from the stars. At peak altitude, the probe was above 99% of the earth's atmosphere. At 100,000 ft., an ozone layer in the atmosphere stops ultraviolet radiation from the stars, making studies of this nature impossible from the earth's surface. The Sparoair probe vehicle was designed, built and launched by personnel at the Naval Missile Center, Pt. Mugu, Calif.

Atwood Calls 'Reputation' Best Incentive

New York—Incentive as a term in incentive contracting has been given more weight than it deserves, in the opinion of J. L. Atwood, president of North American Aviation, though increasing use of incentives in development contracts will unquestionably affect profits.

"I don't believe people are always just dogging alone at half speed and that the addition of a little monetary incentive will suddenly cause them to take off," he said. Reputation of a company and its contractual obligations will weigh much heavier in stimulating performance, Atwood told the New York Society of Security Analysts here last week.

Profit levels, he said, continue to be a major issue in contract negotiations. But, in the case of the definitive North American contract for the Apollo lunar program that still is unsigned, profit rate was heavily discussed but was not responsible for the delay in reaching final agreement, Atwood said.

All major issues are resolved in this contract, but fine points still are being negotiated. Date for the signing still is difficult to estimate, but Atwood said he was 95% sure personally that the document would be signed within a month.

Both sales and earnings of North American for the first nine months of its fiscal year ending Sept. 30—$1.3 billion and $28 million respectively—are increases over last year's figures of $1.1 billion and $24 million, Atwood reported. He estimated that total sales would reach $1.8 billion for the fiscal year and profits $4.60-$4.70 per common share, or about $39 million, compared to $34 million for Fiscal 1962.

Despite the increase in earnings, Atwood said, margins still are thin, so thin he does not have an absolute fix yet on what the profit margin for 1963 will be.

"Profit margins now are just over 2%," Atwood said, "and I think it would be possible to improve that somewhat. But it's hard when you're thinking of the over-all company. We could improve margins for one or two years by shutting off the valve on research and development, but that would certainly be bad for the future of the company."

North American spent $19 million on independent R & D in Fiscal 1962, Atwood said, 10 times what it spent 10 years ago, and the company will spend approximately $28 million this year. Some independent R & D costs are reimbursed by the government, however, under overhead charges in contracts.

Reflecting an industry trend, North American's capital spending continues to rise—from $34 million last year to an estimated $50 million for Fiscal 1963. This represents the peak of North American's building program, and capital spending in succeeding years should drop, Atwood added.

In this connection, United Aircraft Corp., preparing a $42 million debenture issue offering this month, gave increasing costs for fixed assets as one of the reasons for the financing program, and said that it expected to spend $75 million for fixed assets this year.

Atwood referred to the rapid pace and change in technology that has led to correspondingly significant changes in the way industry is organized and does business. But he made one qualification:

". . . Too much emphasis has been placed upon the impact of change on the industry, and too little on industry's response. In one sense, the way we have met change at North American is the same way that any organism meets change: by flexibility and adaptability. But in another sense we ourselves have been one of the factors bringing about change."

Other points covered by Atwood:

• **Supersonic transport** studies by North American and Boeing are under way in a Federal Aviation Agency-sponsored program, but the two companies have no agreement or understanding to bid jointly on any U. S. supersonic transport program. North American is taking part in helping to formulate a U. S. program, and Atwood declined to discuss the subject in much detail for this reason.

• **Little indication** exists of any addition to the XB-70 Mach 3 bomber program, but Atwood felt the technology gained would be useful to North American and the nation in future programs. Knowledge from this program makes North American "a most logical producer of the commercial supersonic transport," Atwood said.

• **North American's Autonetics Div.**, now its largest in terms of employment and sales, will show some shrinkage in the next year or two as the Minuteman program, for which it provides guidance and flight control systems, passes its peak. Employment has risen 10-15% at the Space and Information Systems Div., which has the apollo program. Its proportion of company sales can be expected to follow this trend.

F-1 Solution

Solution of the combustion instability problems of the Rocketdyne 1.5-million lb. thrust F-1 rocket engine for the Saturn 5 space booster is a matter of degree, according to J. L. Atwood, president of North American Aviation.

Goal of the man-rated F-1 program is to make the engine completely self recoverable (AW May 27, p. 48). The technical answers for all forms of instability, including those induced by small or large charges set off in various areas of the nozzle during firing, are pretty well in hand, Atwood said.

But there is a question of how much weight should be added and how much costs should be increased to nullify differing phases of the problem.

Rocketdyne reportedly has designed an injector that provides full recovery from instability, but at a sacrifice in specific impulse. This design probably will be adopted, but research will continue on an injector that can meet both stability and specific impulse targets.

French Navy Crusaders Will Have Boundary Layer Control on Flaps

Dallas—Ling-Temco-Vought F-8E-(FN) Crusader fighters to be used by the French Navy will incorporate boundary layer control on the flaps and ailerons and revised "droop snoot" wing leading edges to improve lift and reduce landing speed some 15 kt. from that of the standard U. S. Navy F-8Es. Shorter catapults and decks of the French carriers Clemenceau and Foch, on which the Crusaders will be based, require the modifications.

French Navy is getting two squadrons of Crusaders, purchase being made by the U. S. Navy, which has awarded L-T-V a $26,475,911 contract, with deliveries to begin next year.

Boundary layer control system will blow air bled from the J57-P-20As N2 (second spool) compressor over the flaps and ailerons at the rate of approximately three pounds/second. Bleed air valve for boundary layer control will be mechanically linked to the ailerons, to begin opening as the ailerons pass the 25-deg. drooped position, being fully opened by the time the surface is drooped 35 deg.

Ailerons and flaps on French Crusaders will have total deflection of 40 deg. in takeoff and landing configuration, twice that of the U. S. Navy F-8Es. Variable wing incidence will also be increased, from the 5-deg. takeoff and landing incidence on the U. S. airplane, to 7 deg. on the French one.

New wing leading edges will incorporate double section droop snoots, or flaps, having increased deflection from the U. S. Navy model. U. S. Navy F-8E Crusader's inboard leading edge flap has a 25-deg. deflection and the outboard panel 27 deg. On the inboard wing of the French Crusader, the forward section of the flap will deflect 35 deg. relative to the aft section and the aft section will have a droop of 8.9 deg. relative to the wing chord. The outboard wing leading edge flaps will be deflected 35 deg. and 20 deg., respectively.

BLC and flap tests will be performed on a prototype French F-8E-(FN). An additional F-8E-(FN) will be used to evaluate installation of the French Matra aircraft rocket.

News Digest

Piper Aircraft has begun production of its new 235-hp. Cherokee at the company's Vero Beach, Fla., plant. The plane received FAA certification last month.

Syncom 2 communication satellite successfully relayed teletype copy and photographs last week between Lagos, Nigeria and Lakehurst, N. J. The satellite's gas jets are to be fired early this week to lower it into a 22,300-mi. synchronous orbit that will trace a figure-eight pattern 33 deg. north and south of the equator along the 55-deg. meridian.

Tiros 6 weather satellite, launched Sept. 18, 1962, has exceeded the 320-day record of Tiros 5 for continuous operation. Tiros 6 has taken about 59,000 cloud cover pictures and last week helped spot Hurricane Arlene.

Defense Dept. has issued a new "PERT Guide for Management Use," the second document issued on the program evaluation and review technique (PERT). The first was "PERT Cost Systems Design."

MU-2 Agreement

Mooney Aircraft, Inc., has signed an agreement with Mitsubishi Heavy Industries, to assemble the Japanese-designed MU-2 seven-place twin-turboprop business plane (AW Apr. 1, p. 34) at Mooney's Kerrville, Tex., facility and market and service it in the U. S., Canada and Mexico.

First MU-2 is expected to be delivered in the U. S. in late 1964, and initial deliveries will be made by Mooney in 1965. Price of basic aircraft minus electronics will be about $300,000.

Mitsubishi started first flights of the MU-2 prototype recently. It is a high-wing configuration, with swept tail. The two 562-shp. Turbomeca Astazou engines are suspended under the wings by pylons.

The MU-2 has a gross weight of 7,940 lb. and weight empty of 4,570 lb. span is 33 ft. 9.5 in., length 32 ft. 2.6 in. and height 12 ft. 11.6 in. Wing area is 167.9 sq. ft.

Cruise speed at 20,000 ft. is 325 mph., rate of climb on two engines is 2,700 fpm., stall speed (flaps down) is 83 mph., service ceiling on two engines is 35,000 ft. Takeoff distance over a 50-ft. obstacle at sea level, no wind, is 1,030 ft. Landing distance under the same conditions is 1,290 ft.

Maximum range, with auxiliary tanks, at 20,000 ft., is 1,760 mi. with a 30-min. reserve.

New U.S. Moves Cloud Air Policy Role

Revival of capacity, sixth freedom issues viewed as conflicting with America's international goals.

By L. L. Doty

Washington—Recent moves by the U.S. to reach some agreement with European nations on the controversial issues of capacity and sixth freedom traffic have made some headway, but have also raised doubts abroad over the efficacy of the new U.S. policy on international air transportation (AW Apr. 29, p. 34).

A memorandum of understanding, prepared by the State Dept. and the Civil Aeronautics Board, provides a new interpretation of sixth freedom traffic, and calls for further negotiations on the exchange of traffic data for capacity purposes. It has been informally accepted by the British.

However, similar memoranda have been bluntly rejected by Italy and the Scandinavian consortium, and the British reportedly are now having second thoughts on the document's terms. The Dutch have accepted a substantially modified version of these papers.

Sixth freedom traffic is defined as that which moves from one nation to a second and beyond to a third. Fifth freedom traffic is considered to be that which stops at a third country on route between a first and second.

Sixth Freedoms

Generally, the feeling in European airline circles is that sixth freedom traffic is no longer the crucial problem it once was since most major destinations are on direct jet routes, making it pointless to fly, for example, to Frankfurt from the U. S. via Copenhagen.

The U. S. began its drive for some control of sixth freedom traffic as early as 1960 (AW Sept. 19, 1960, p. 40), but it has never been successful in reaching an agreement with European nations and the effort has strained relations with foreign flag carriers. Chief force behind the drive has been Pan American World Airways.

Principal cause of contention has been the U. S. insistence that traffic statistics, schedules and other information should be exchanged as a means of determining whether the volume of sixth freedom traffic flown by any airline is in violation of the Bermuda principles, the backbone of most all bilateral air transport agreements.

The memorandum of understanding between the U. S. and Britain states that "procedures encompassing traffic data and other information to be exchanged in any capacity consultations dealing with such traffic would be agreed bilaterally."

While the British accepted this provision, several European nations opposed it violently and interpreted it as an indirect move to draw them into agreeing that traffic statistics ultimately would be exchanged. It is possible that the Scandinavians will accept the watered-down version offered the Dutch, but the Italians are remaining steadfast in their opposition.

Thus, the U. S. has stirred up a new controversy on an issue which is presumed to be dead and one over which it is fruitless to argue, as demonstrated by past actions. Furthermore, feeling in Europe is that the latest U. S. approach to the issue scuttles the U. S. international air transport policy (AW Apr. 29, p. 34) which opposes "arbitrary capacity restrictions."

It should be noted, however, that the memorandum has been cautiously worded to avoid any contradiction of the policy which also calls for "consultation, arbitration, and, in the last analysis, denunciation and renegotiations" of bilateral air transport agreements if an acceptable capacity agreement is not reached.

But some government aviation officials in Europe felt that the memorandum implicitly went beyond the policy provisions and, as a result, mistrusted the intent of the U. S. in seeking a new interpretation of sixth freedom. On the other hand, the British Ministry of Aviation acknowledged last May that a State Dept. letter "puts on record the understanding we reached during our recent discussions . . . on certain aspects of the capacity article of the Bermuda agreement."

Impression is that air ministry officials were more conciliatory than usual in negotiating with the U. S. at that time because of the unfavorable light thrown on British air transportation by the hassle over North Atlantic fares (AW May 20, p. 39). In any event, indications are now strong that the British are less inclined to apply the memorandum in future negotiations.

The Bermuda capacity clauses specify, in part, that parties to the agreement "shall retain as their primary objective the provision of capacity adequate to the traffic demands between the country of which such air carrier is a national and the country of ultimate destination of the traffic."

Provision Interpreted

In effect, this provision is interpreted to mean that there will be restrictions placed on traffic flying between the two countries; that is, third and fourth freedom or primary objective traffic. The capacity clause adds that the right to carry traffic destined for, or coming from, third countries shall be applied in accordance with the general principle of "orderly development," which earmarks such traffic as secondary objective, sixth freedom traffic and which calls for control and points to the direction of protection.

The memorandum of understanding with Britain gives this interpretation to sixth freedom traffic: an air carrier can include in the primary objective classification "the provision of capacity for traffic stopping over in the country of which it is a national en route to other destinations." It adds:

"The right to carry international traffic which transits the country of which the carrier is a national, either by continuing on the same flight, or on flights operated by means of a connection in that country to give a through facility to other destinations, would be subject to the general principle that capacity is not provided primarily for this traffic."

In other words, stopover traffic may flow unrestricted, but direct connecting sixth freedom traffic should be subject to restriction or control. Direct connecting traffic is not defined in the British memorandum, but one draft of the memorandum of understanding offered the Italians states that "'the first reasonable connection' is deemed any connection involving a scheduled layover of less than four hours."

This memorandum had a slightly different wording than that developed with the British. It states that an air carrier, in addition to primary objective traffic "which has its initial origin or destination in that carrier's home country as shown on the pertinent ticket or waybill, include with its primary objective the provision of capacity for traffic stopping over in the country of which it is a national en route to other destinations."

On capacity, the memorandum prepared for the Italians said this: "Should capacity consultations be requested in the future by either party, sufficient traffic data shall be exchanged in advance to determine whether the capacity offered by respective carriers conforms to the interpretation of the bilateral" agreement.

The Italians turned down a route to Los Angeles for Alitalia rather than to agree to exchange traffic statistics.

The memorandum accepted by The Netherlands is vague on the definition of sixth freedom traffic and specifies that, if capacity consultations are deemed necessary, traffic data "sufficient" to resolve the problem will be exchanged. However, these statistics will include only total figures and not origin and destination information, which is essential to the determination of sixth freedom traffic volume.

New Malev Routes

Malev Hungarian Air Transport will begin its first service outside Europe on Sept. 17 with a once-a-week round-trip service between Budapest and Cairo via Athens. Route will be served with Russian-built Ilyushin Il-18 turboprop equipment.

A second beyond-Europe service probably will be introduced next spring between Budapest and Beirut via Athens on a once-a-week round-trip basis.

New Zealand Carrier Selects DC-8

London—New Zealand government last week approved the purchase of three Douglas DC-8 Series 52 jet transports for Tasman Empire Airways, Ltd. (TEAL), climaxing a long sales battle between Douglas, Boeing and Vickers-Armstrongs, builders of the VC.10 aft-mounted jet transport.

J. K. McAlpine, minister of civil aviation, said the DC-8s will be used to extend TEAL routes to the U. S. West Coast in 1965, citing this factor as a major reason in selection of the DC-8 over the Boeing 707 and VC.10.

McAlpine said: "In reaching this decision, the airline evaluated the Boeing 707 and VC.10. They concluded that the DC-8 was most suitable and that neither the Boeing 707 nor the VC.10 would have offered such good economic prospects for TEAL's particular route pattern."

The airline, noting that the DC-8 could be used on its Tasman and island routes, stressed that it also had the ability, unlike the standard version of the VC.10, to operate over the long haul between Tahiti and the U. S. West Coast with a full load of passengers and fuel reserves. Large freight capacity also was mentioned in the decision.

The new jets will be based at Mangere Airport, Auckland, now under construction.

The three aircraft have been under evaluation for more than two years. Vickers had planned to send one of its VC.10s to New Zealand for demonstration (AW July 15, p. 39) but this plan has now been canceled.

In Wellington, Sir Andrew McKee, TEAL chairman, said the airline would have preferred to buy a British plane, but the extensive evaluation changed this idea.

ATA Letters, Memos Made Public by CAB

Washington—Approximately 50 letters and memos from the files of the Air Transport Assn. have been made public by the Civil Aeronautics Board staff in a move apparently designed to strengthen staff's position in a dispute over attorney-client relationship.

The latest round in the 4½ year battle between the two groups also bore implications that the ATA had allegedly sought political support to put pressure on the Board as a means of achieving certain goals for the airlines.

ATA has agreed to nine of 10 conditions proposed for the settlement of the investigation. On the 10th point, the ATA has refused to release certain papers and documents to the Board staff on grounds that an attorney-client relationship is involved. If overruled on this point, ATA will take its case to the courts.

Merger Seen as Competitive Tool

Washington—Pan American World Airways last week told a Civil Aeronautics Board examiner that the most effective way of combating foreign flag carrier competition is to authorize the merger of Pan American and Trans World Airways.

Testifying at hearings on the CAB Transatlantic Route Renewal Case (AW Aug. 5, p. 41), Harold E. Gray, Pan American executive vice president, said the next best way of meeting such competition was to retain the present pattern of U. S. route structures on the North Atlantic. He opposed the division of markets between the two U. S. airlines serving Europe, as proposed by the Board staff.

A move by the Board's bureau of economic regulation to force Pan American to present detailed evidence on the order for six Concorde supersonic transports (AW June 10, p. 40) was rejected by Examiner James Keith, who stated he did not want hearings "bogged down" with "speculative data." The carrier did introduce an exhibit showing a tentative schedule for the Concorde, calling for eight daily round trips between the U. S. and Europe and the Middle East.

Gray also called for a permanent rather than a temporary status on transatlantic routes so that U. S. carriers could plan with assurances that their "efforts would be rewarded." He added, however, that any order splitting the European markets between the two carriers should be temporary.

In support of his argument for retaining the status quo, Gray said that the trend of U. S. flag operations on the Atlantic had reversed in recent months, and that both TWA and Pan American are now enjoying improved business. He said TWA has reported a 92% increase in traffic on the North Atlantic for the week ended July 13, the latest figure available.

He added that foreign competition has reached a plateau, since there are few countries left which do not operate a flag carrier.

Cole Joins Eastern

New York—Todd G. Cole, former executive vice president and director of Delta Air Lines, has been named executive vice president-finance and a director of Eastern Air Lines, effective Aug. 15 (AW Aug. 5, p. 41).

Spokesmen say that Cole, considered one of the airline industry's leading financial specialists, was sought by Eastern to aid the carrier with its fiscal problems. He was earning more than $50,000 a year at Delta and was considered a likely successor to that carrier's president, C. E. Woolman.

Cole will replace Thomas E. Creighton, who becomes vice president of budget for Eastern and continues as corporate secretary, reporting to Cole.

Another vice presidential change at Eastern involves Ralph H. Skinner, Jr., who will head the airline's industrial relations office. Skinner is presently director of labor relations for the Pennsylvania Railroad.

J. O. Jarrard, who preceded Skinner in the Eastern post, has resigned to become vice president-personnel for American Airlines.

PAA Sees Profit in Mystere 20 Service

By James R. Ashlock

New York—Pan American World Airways' entrance into the business aircraft distribution field, a move fostered largely by Juan T. Trippe's personal interest in the venture, is based on the prospect of profits realized from supporting the aircraft through existing facilities (AW Aug. 5, p. 40) as well as sales or lease of the aircraft.

Although it expects to realize a net gain from leasing the Dassault Mystere 20 executive jet, or from selling it outright from $900,000, Pan American sees a longer range potential in servicing the aircraft.

Its initial order for 40 Mysteres, with options for 120 more, has enabled Generale Aeronautique Marcel Dassault to program a production of 500 units. Pan American plans to equip its stations abroad for specialized service to Mystere users, assuming that the aircraft will become popular as an executive airplane abroad.

Parts will be stocked at the stations, and facilities such as ground support equipment, flight planning, dispatch, communications, maintenance and personnel for assistance with government formalities will be available. A credit arrangement to cover fees for such service will be established.

Trippe is himself a user of an executive aircraft, often flying in a modified twin-engine Douglas B-23 of World War 2 vintage. The aircraft was originally a bomber developed from the DC-3. Owned by Pan American, but carrying no airline identification, the B-23 is now equipped with an executive interior, flown by a Pan American pilot, and based at Butler Aviation's facility at La Guardia airport. Trippe uses it primarily between New York and Washington, as do other Pan American executives.

Jet Market

His own experience with an executive aircraft could have led Trippe to the conviction that other corporations are ready to exchange existing piston aircraft for jets, provided the airplane is priced right and is operationally economical. Pan American itself is expected to release the B-23 for one of the Mystere 20s.

In the U.S., Pacific Airmotive and Butler Aviation have been signed as co-distributors with Pan American for the Mystere. Both firms will stock parts for the aircraft and conduct all maintenance and overhaul, also drawing from a parts warehouse that Dassault will establish here. Safe Flight Instrument Corp. will train crews for those leasing or buying the Mystere, using a flight simulator provided by Pan American.

Carrier will pay approximately $800,000 per aircraft to Dassault, and will offer them for $900,000 in this country, cost including import duty and initial crew training. Pan American expects to receive its first 15 units in 1965 and the other 25 in 1966. Dassault's production schedule calls for three aircraft a month, a rate that can be increased as orders arrive.

Pan American will pay $73,550,000 for the airframes of the 140 Mysteres it expects to sell in the U. S. plus $35 million for the engines and U. S.-built communications and landing gear components specified for the aircraft. It expects to sell 20 Mysteres in Canada and an unestimated number in Latin America, sales that Pan American estimates will net $3 million.

Airframe Cost

Cost of individual airframes obtained from Dassault will be $525,000, while the U. S. components will cost another $283,330.

Pan American's policy with the Mystere is somewhat different from that envisioned several years ago when it established its Business Jet Div. The Lockheed JetStar was then considered as the airplane to buy. The plan then was to offer corporations a lease package, whereby Pan American would provide crews and service along with the aircraft.

Complaints arose among pilots already on corporation payrolls, many of whom were also connected with firms providing the maintenance on existing executive aircraft fleets. This program was eventually abandoned when the military cancelled orders for the JetStar, leaving prospective buyers faced with having to cover the research and development costs.

No Consideration

Pan American officials say that since that time, there has been no serious consideration of entering the business jet field on anything other than a sale or dry lease basis. Provision of pilots would be impractical, they say, because of the complications involved in drawing contracts specifically tailored to cover the individual characteristics of executive pilot duty.

Alvin P. Adams, vice president of Pan American, said that the Mystere 20 was selected principally because of its range and performance in light of its purchase price. The airline looked at all the executive class jets now available or under development, with the de Havilland DH-125 ranking as the second choice.

Mystere 20 has a 1,600-mi. range capability, and provides a 1,600-lb. payload out of its 22,700-lb. gross weight. It can cruise at 540 mph., and Adams said its average runway requirement for both takeoff and landing is 4,500 ft.

Hughes Tool Co. Drops Northeast Support

New York—Expected withdrawal of Hughes Tool Co. from its agreement to cover Northeast Airlines' operating cash deficits (AW July 8, p. 30) came last week following the Civil Aeronautics Board's vote canceling Northeast's Florida route.

Notice of the withdrawal was in a letter to James W. Austin, Northeast's president, from Raymond M. Holliday, executive vice president of Hughes Tool.

The agreement to cover the operating deficit was made by Hughes Tool in June, 1962. Among the reasons listed by Holliday for canceling the agreement was the $22 million already invested by Hughes Tool through direct loans and guarantees, and "the inherent uncertainty of predicting the outcome" of efforts to obtain a CAB reconsideration.

Holliday said, however, that Hughes Tool would implement a $1-million loan through the Chase Manhattan Bank of New York to aid Northeast. The amount is what remains of a $5-million loan fund established in 1962 when Hughes Tool obtained CAB approval to back Northeast's financial needs.

The tool company would also consider further financial support of Northeast, should some merger prospect arise that would be approved by the CAB, Holliday added.

Hughes Tool officials said that efforts would continue toward a merger of Northeast, hoping that the CAB might reverse its decision should a merger be attained.

Negotiations have been conducted with two other carriers besides Trans World Airlines. Northwest Airlines was one of the two. Continental Air Lines is known to be interested in discussing merger with some carrier, but any consideration it would give Northeast would probably be conditional on the CAB granting the merged company not only a permanent Florida route, but also New York-Chicago rights.

Adams said that several of the jets that were considered had ranges that looked good on the surface, but that the capability waned when compared with Pan American's fuel reserve requirements. Carrier insisted on 10% above normal reserve, the same that exists for its larger jets. With minimum sacrifice on payload, Adams said, this would allow a non-stop flight from New York to Houston, a missed approach at the destination, a 150-mile flight to an alternate field and 30 minutes of holding time at 1,500-ft. altitude.

Aft-Fan Performance

Mystere's performance rests primarily in the General Electric CF-700 aft-fan engine, which produces 4,200 lb. of thrust as compared with the 3,300 lb. of the Pratt & Whitney JT12A-8 currently installed on the Mystere 20 prototype. Aircraft's improved range comes from the CF-700's better fuel economy, and the engine was probably a factor in Pan American's choosing the Mystere over the DH-125.

With the CF-700, the Mystere can attain a design range of 1,600 mi. with eight persons aboard, whereas only four passengers could be carried this distance with the Pratt & Whitney powerplant. CF-700 will probably power the majority of Mysteres sold.

Production of the aircraft is actually a joint venture between Dassault and Sud Aviation, with Dassault to build the fuselages and Sud the wing and tail assemblies at its Toulouse facility.

General Electric engine also gave Pan American some relief from potential criticism over its upsetting the nation's balance of exchange with foreign countries through the Mystere order.

Pan American is stressing that through its specifying U.S.-built engines and aircraft system components for the Mystere, the balance of payments under the program should appear very favorable.

American manufacturers, according to Pan American, will produce and export $125 million worth of equipment under the program. Pan American will pay $35 million for the engines installed on the airframes, leaving $90 million in exports to offset $73,500,000 paid for airframes imported into the U.S.

Pan American estimates that net U.S. foreign exchange earnings under the program, including $3 million it expects through its role as exclusive distributor in Canada and co-distributor in Latin America, should total $19,500,000.

French officials view the Pan American order as a valued stamp of approval which should help sales of the Mystere elsewhere. Special significance is attached to President Charles de Gaulle's endorsement of the government's financing, on a loan basis, the cost of production tooling for the aircraft.

Third-Level Carrier Plans Service Between Cape Canaveral, Orlando

Cape Canaveral—Southeast Airlines, Inc., a third-level carrier, will begin scheduled commercial passenger service between this space center and Orlando's Herndon Airport Aug. 15 at a price—$6.50 one-way—directly competitive with the cheapest form of land transportation presently available between the two points.

Using two nine-passenger Beechcraft D-18s, Southeast will operate four flights daily in each direction, two in the morning and two in the afternoon. Arrival and departure times at Herndon are expected to be convenient for most major trunk flights into and out of both Herndon and nearby McCoy AFB, according to Don Sittman, Southeast vice-president and co-owner. Ramp-to-ramp time normally will be 25 min., he said. By car, driving the approximately 50-mi. distance between Cocoa Beach and Orlando normally takes 75 to 90 min., depending on traffic conditions.

Cocoa Beach terminal will be the Central Brevard (county) Airport on Merritt Island. This terminal, presently a 4,000-ft. sod strip which the airport manager hopes will be paved in the near future, is 7 mi. from the string of motels in the center of Cocoa Beach. Rental cars are available at the Merritt Island hangar.

Flights will depart Merritt Island at 8:00 a.m. (all times are local), 9:40 a.m., 2:10 p.m. and 4:50 p.m. Flights from Orlando to the Cape will depart the former at 9:05 a.m., 1:05 p.m., 3:05 p.m. and 7:25 p.m. Flight time is expected to be 25 min., ramp to ramp, so that arrivals would be 25 min. after scheduled departures.

Southeast says that passengers desiring its service can make reservations through their regular ticket agent as a regular purchase. Or, they may call the airline after arriving at Orlando or at Cape Canaveral.

Sittman said that Southeast had attempted to bring its service into McCoy AFB, a Strategic Air Command base used by Eastern and Delta Air Lines as a jetport, but that USAF had denied the firm landing rights. McCoy is about 15 mi. from Herndon. The Southeast officials said that the airline, however, will continue to seek authorization to service the jetport.

Sometime in October, Sittman said, Southeast will extend this Cape-Orlando route to Tampa and from there connect with the airline's Ft. Myers-Miami route. Southeast, which owns four D-18s and three amphibious Grumman Goose aircraft, also has a route between Miami and Key West. Its headquarters are at Miami International Airport.

Sittman said that the $6.50 fare, which compares with an airport limousine charge of $5.50 and an approximate minimum of $14 for a rental car, is based on a seat mile cost of 15 cents and an estimated break-even load factor of 40%.

Swissair Reports Gain

Geneva—Swissair reports a 10% gain in its over-all operations for the first six months of 1963 as compared with the corresponding period of last year. Prime reason cited for the increase is an increased demand for service over its West African, Middle Eastern and North Atlantic routes.

Total number of point-to-point passengers carried during the period was 853,985 or 8% above the 785,685 figure for the first half of 1962, while freight increased by 25% and mail by 3%.

Over-all revenue ton/mi. rose from 62,545,980 to 69,086,280. However, with 138,500,835 ton/mi. capacity available —11% more than the 124,783,710 ton/mi. offered during the same period of last year—the total load factor dropped to 49.9% from 50.2%.

FAA's International Division Reorganized

Washington—Federal Aviation Agency has reorganized its international division by assigning field activities to its new overseas offices and by confining activities of the international headquarters offices here to policy guidance and evaluation functions.

The former International Aviation Service has been redesignated the Office of International Affairs and will be headed by Raymond B. Maloy, whose title will be raised from director to assistant administrator. The office will handle policy matters and will advise the administrator in activities pertaining to FAA relations with the Committee on International Aviation Policy, established by the State Dept., and with the Interagency Group on International Aviation.

Field functions will be handled by an overseas office with headquarters in London. George C. Prill, former director of FAA's Flight Standards Service, has been placed in charge of the organization with the title of assistant administrator.

Jurisdiction of the office covers Europe, Africa and the Middle East.

Italians Protest Indian Accident Report

New York—Italian Ministry of Transportation and Civil Aviation has protested the opinion of an Indian investigation team that pilot error was the cause of an Alitalia DC-8 crash near Bombay on July 6, 1962. Eighty-five passengers and nine crew members died in the accident.

The Italian ministry refused to sign the Indian report and says it will submit its own findings on the accident to the International Civil Aviation Organization.

Air traffic controllers at Bombay's Santa Cruz airport were cleared of any blame in the investigators' report. However, Italian officials insist that the pilot, Captain Luigi Quattrin, was given erroneous instructions which caused a premature descent into a mountain top.

The aircraft was on a flight from Sydney to Rome, with stops at Bangkok and Bombay. It was approaching Bombay at night through heavy clouds and rain, characteristic of the monsoon season.

The inquest report said that the pilot's error in navigation caused him to believe he was nearer his destination than he actually was. He therefore descended the aircraft prematurely, it said, in instrument conditions for a straight-in approach and consequently crashed into high terrain.

"The contributory causes and the circumstances connected with the accident have been found to be the pilot's failure to use the navigational facilities available to ascertain the correct position of the aircraft, infringement of the prescribed minimum safe altitude of 9,000 ft., and unfamiliarity of the pilot with the terrain on the route," the report said.

The Italian protest of this opinion came after the Indian government had accepted the investigation report. All four members of the investigation team endorsed the findings.

The Italians claim that Capt. Quattrin descended to 4,000 ft. on instructions from tower personnel, and that voice recordings prove he did so only after the tower affirmed his question as to whether radar contact had been made.

"The Alitalia captain, in fact, received instructions from the control tower to descend to an altitude of 4,000 ft. while on the route there existed an obstacle of 5,000 ft., and while the air route flight rules for the area described the minimum safe altitude as 6,400 ft.," the Italian protest read.

The Italians insist that the man in charge of approach control was not even at his station when the Alitalia jet was approaching Bombay, and that the instructions were being given by a controller responsible only for traffic within the airport pattern.

"Modifications recently introduced by the Indian air authorities for the approach to the Bombay airport confirm the validity of what is being affirmed by the Italian airline," the protest read.

The modifications referred to prohibit an aircraft's descent, during instrument conditions, below prescribed levels until approach controllers confirm by radar that it is within a 25-mi. radius of the airport.

"It is impossible to accept the argument that the clearance given to the aircraft would justify the pilot to descend to 4,000 ft. at any stage outside the limit of a 25-mi. radius of Bombay airport," the investigation report said.

"It must, therefore, be held that the clearance was in order," the report continued, "was not ambiguous and was intended to apply only to the vicinity of Bombay airport within a radius of 25 mi., and that is was understood as such by the pilot himself.

"The pilot was sufficiently experienced to ask for clarification if he had not understood the clearance or to reject it if he had found it unsuitable in any way."

The report indicated that Bombay controllers expect pilots to be familiar with the surrounding terrain, and that the responsibility for assuring terrain clearance rests with the pilot.

"However, it does appear that there is an impression among some pilots, possibly used to radar and other specialized procedures, that the clearances issued by air traffic control all over the world would take terrain into consideration," the report said. "Such an impression is a dangerous one and can lead to serious consequences."

The Indians rebuffed Alitalia's charges of improper procedures by the traffic controllers, saying that "the aspersions made against their veracity are unfair and deserve to be rejected."

CAB Reaffirms Credit Plan Decision

Washington—Civil Aeronautics Board last week reaffirmed its decision that airlines must pay interest on deposits made under the Universal Air Travel Plan (AW Jan. 28, p. 39), but agreed to re-open the case to determine whether a varying interest rate should be substituted for the uniform 5% prescribed by the Board.

In petitions for reconsideration, trunklines held that high-volume users of transportation have used more transportation than they have paid for in advance through the deposit, and hence, have no deposit with the carriers at any time. These travelers, the airlines argued, receive the same 5% interest rate as low-volume users who, in effect, do have a deposit if transportation used is less than the amount of the standard $425 deposit required for each account.

Trunklines thus concluded that a uniform interest rate applied to deposits without regard for transportation used and the length of time the deposit has been on hand would create the discrimination between high and low-volume users which the Board attempted to eliminate.

In last week's order, the Board stated it would not reverse its decision that, if the deposit is not eliminated, interest for the 12 months beginning Jan. 1, 1963, must be paid. It added, however, that the case should be re-opened on the issue of whether the uniform interest rate should be substituted by "a requirement that would take account of possible differences in the positions of various depositors."

Pakistan Carrier Sees Profit in Fiscal 1964

New York – Pakistan International Airlines is predicting that it can absorb the losses of its planned helicopter operation in East Pakistan (AW June 4, 1962, p. 44) and still make a $2,730,000 profit in Fiscal 1964.

Expense of the helicopter service is expected to take only half of the anticipated difference between revenues and costs. The carrier's officials are forecasting revenues of $40,441,000 for the year against expenditures of $36,987,000 for fixed-wing operations.

The airline, which operates without government subsidy, has quadrupled its revenues during its five years of operation, having recorded total revenues of only $12,180,000 in Fiscal 1959.

Increased revenues are anticipated during the coming year from expanded service, which will include the carrier's first service to Japan and an increase from four to five in weekly flights to Europe. In the fiscal year just ended, the Pakistan airline earned a net profit of $1,428,000.

Boeing Rolls Out First 727 for Eastern

First Boeing 727 three-jet, short-to-medium range transport for Eastern Air Lines has been rolled out at Boeing's Renton, Wash., facility. Eastern has ordered 40 of the aircraft, which will be placed into service to about 30 cities on the carrier's routes beginning next year. Deliveries will start later this year. Total of 727 orders now stands at 131 aircraft for seven airlines.

First Reports Indicate Substantial Six-Month Profit for Trunklines

Washington—First reports from domestic airlines for the first half of 1963 indicate that the industry will show substantial earning gains for the period compared with the first six months of 1962. Both National Airlines and Delta Air Lines have reported record profits for the fiscal year ending June 30.

Delta reported a net income of $13.8 million for the fiscal year, equal to $5.42 a share, compared with $6.9 million, or $2.74 a share last year. The 1963 net income included no profits from equipment sales. That source accounted for profits of $1.3 million in the previous year's report.

National's net profit for the fiscal year was $6.2 million, compared with net earnings of $4.2 million in Fiscal 1962.

Operating Revenues

National's operating revenues for the year rose to $109.4 million, contrasted with $89.8 million in the previous year. Delta's operating revenues climbed 24%, from $169.7 million in Fiscal 1962 to $210 million this year.

For the first six months of calendar year 1963, Northwest Airlines reported a net profit of $3.4 million on total operating revenues of $78 million. This compares with a $1.9 million net profit in the like period of 1962 on total operating revenues of $71 million.

Western Air Lines' profits for the first six months of the year increased 52% for an all-time company high for any six-month period. Net profit was $3.8 million, or $2.71 per share, compared with $2.5 million, or $1.79 per share last year. Operating revenues for the six-month period were $45.8 million, compared with $41.4 million in the same period last year.

Western attributed the favorable results in part to traffic generated by the economy Thriftair service between Los Angeles and San Francisco. The service is averaging some 1,100 passengers per day, according to the airline.

Western also reported that the breakeven load factor for the six month period was 43.1%, compared with 47.8% last year. The carrier said that the slight drop in system load factor to 53.5% from 54.6% was offset by the reduced breakeven load factor, which increased the profit margin from 6.8 to 10.4%.

Trans World Airlines showed significant improvement for the first six months by cutting last year's six-month loss of $12.5 million to $4.8 million in the 1963 period. Total revenues for the period rose from $185.1 million in 1962 to $216.4 million this year. The airline's second quarter net earnings reached $5.7 million, due to record June revenues that resulted in net earnings of $7.3 million for the month.

Continental Air Lines earned $1.4 million, or 51 cents a share, in the first half of 1963, compared with $376,000, or 13 cents a share, in the same 1962 period. Operating revenues for the period were $36.9 million compared with $31.8 million in the first half of 1962.

Braniff Airways reported a $31,041 net profit, a drop from the $1.6 million gain reported for the first six months of last year.

Net earnings of $363,958 in the second quarter of the year offset losses reported in the first quarter to produce the six-month profit.

Among the international carriers, Pan American World Airways reported a net profit of $4.7 million, or 71 cents per share, for the first six months of the year. This compares with a net loss of $756,000 reported for last year's six-month period. Second quarter earnings were $6.9 million.

Pan Am Improvement

Pan Am said the improvement in earnings "reflects a 10% reduction in ton-mile costs. . . ." Operating revenue during the first half of 1963 was $258 million, an increase of 12.1% over the corresponding period of 1962, but the rise in operating expenses was held to 7.7%.

Seaboard World Airlines reported a $82,015 net loss for the first six months, compared with last year's $734,841 loss. Revenues rose from $8.6 million in the first six months of 1962 to $12.8 million for the 1963 first half.

For the first six months of the year, Flying Tiger Line reported a loss of $833,942, after provision for a federal income tax credit of $937,000. Revenues for the period were $19.2 million, compared to last year's gross revenues of $25 million which brought a net income of $1 million. The airline reported a net profit of $442,000 for the second quarter of 1963.

Cape Cod Taxi Offers Trunk-Type Service

Provincetown — Operating within Civil Aeronautics Board limitations governing air taxi services, Provincetown-Boston Airline has developed into a carrier grossing $350,000 a year and offering practically every amenity afforded by a major trunk line.

Carrier's multi-engine fleet consists of two 1936-vintage Lockheed Electras, two Cessna AT-50s and a Piper Apache, supported by several single-engine aircraft which are also used in scheduled service when needed.

"To my knowledge, we're the only air taxi operation in the country that offers the full program including scheduled passenger service, reserved seats, mail and express," said John Van Arsdale, president of the airline.

One exception is food and beverage service, but it is hardly significant considering that the longest scheduled route segment—in fact, the only scheduled route segment—is 45 mi. long, or about 20 min. flying time.

However, this compares with 120 land miles that require three hours of driving between Boston and this holiday retreat and artist colony at the tip of Cape Cod. In 1962, the air service attracted 10,204 passengers at $9 a head, with about 70% of this volume being interline connections from New York-Boston flights.

Cash Exchange

There is a big cash exchange between Van Arsdale's airline and the big interstate operators, mainly because they sell tickets on one another and Provincetown-Boston Airline is authorized to honor Air Travel Plan credit cards. In 1962, Van Arsdale paid the airlines he feeds $75,000, and received $90,000 in return payments.

"We're primarily a seasonal operation," Van Arsdale said, "and things really drop off around here during the winter."

Seasonal aspect is the reason why Provincetown-Boston Airline is actually the northern division of a two-season operation, which in the winter becomes Naples Airlines. When the tourists leave Provincetown, Van Arsdale takes his airplanes and 18 employes to Naples, Fla., where they join 12 other employes in providing scheduled service between that city and Miami.

Provincetown-Boston route relies almost entirely on the period from late May to Sept. 30, in which 90% of its yearly volume is realized. Weekly figures show the impact. Between July 1-7 this year, 839 persons were carried. From Jan. 7-13, eight were recorded.

"We always leave one single-engine airplane and a pilot in each city during the respective winters, just to take care of whatever business comes along and to maintain our identity," he said.

"The Naples-Miami business isn't as great as that of Provincetown-Boston," he added, "but it is satisfactory, providing 4,000-5,000 passengers in 1962."

Van Arsdale's philosophy toward airline operations involves close attention to the vital factors—cost control, optimum personnel and equipment utilization, and an awareness of the dangers of becoming too big.

His six multi-engine and instrument rated pilots not only fly, but also help out with the varied ground duties. Van Arsdale's 18-year-old son has his commercial rating and is breaking in on single-engine flights. Mrs. Betty Van Arsdale, the president's wife, keeps the books and even runs the ticket office in Provincetown one day a week.

Van Arsdale also capitalizes on diverse services such as charters, nonscheduled air taxi, sightseeing and fixed-base operations at Provincetown and Naples, with the airport leases.

At Naples, the airline has a contract with the Gulf American Land Corp. to fly prospective buyers over developed land sites. Van Arsdale has eight Cessna 172s committed to this operation, and eight pilots. Last year he flew 64,300 persons under this contract, operating as many as 123 flights in a single day.

Leased 880s

New York—Six Convair 880 aircraft on lease to Northeast Airlines from the General Dynamics Corp. are being purchased by Trans World Airlines.

Although financial arrangements for purchase of the airframes and engines are still being completed, two of the 800s have already been delivered to TWA's maintenance base at Kansas City. Northeast is expected to release the other four by mid-September.

General Dynamics demanded earlier that the 880s be returned because Northeast was $4.8 million behind in lease payments (AW June 24, p. 40). General Electric was also due $2.35 million on lease of the aircraft's CJ-805-3 engines.

General Electric is selling the repossessed engines to General Dynamics, and TWA will purchase both airframes and engines as a single package. No spare engines are involved. TWA already has spares for its present 20 Convair jets.

Northeast will continue jet operations with four 880s owned by its controlling stockholder, Hughes Tool Co.

His sightseeing airplane at Provincetown is a Stinson SM8A built in 1931, able to carry four persons besides the pilot. Each year approximately 8,000 persons pay $2.50 for a 15-minute look at Cape Cod's tip.

In 1961, Van Arsdale's charter business topped scheduled service revenues by $3,000. However, a major charter contract was discontinued in 1962, and charter revenues totaled 80% of those realized from scheduled service. President Kennedy's family at Hyannis Port are frequent users of the charter service.

Operating without a CAB certificate of public convenience and necessity, Provincetown-Boston Airline is limited by Part 298 of the Civil Aeronautics Act, which prohibits use of aircraft exceeding 12,500 lb. gross weight. The airline's Lockheeds gross at 10,500 lb.

"Under this condition, these Lockheed Electras are the best aircraft for our operation," said Van Arsdale. "The empty weight is only 7,500 lb., and there's space for 12 passengers plus 350 lb. of baggage in the nose and 250 lb. in each wing compartment."

Full Payload

There's no problem in putting a full payload on the Lockheeds, since fuel is a minor weight consideration. They need only 65 gal. for the round trip to Boston. The Lockheeds operate at about 33 cents a mile, providing a cost-per-seat-mile approximating 3 cents.

One of Van Arsdale's Lockheeds is a 10A, with Pratt & Whitney 985 powerplants producing 450 hp. The other is a 10E, with P&W 1340s of 550 hp. Cruising speed is 150 mph. on the 10A and 170 on the 10E.

"We fly visual flight rules almost exclusively, being certified to go down to 500 ft. enroute," Van Arsdale said. "Consequently, we need only one pilot, and can even sell the copilot's seat to a passenger if necessary."

Four schedules a day are offered between Provincetown and Boston, with increased service on Friday and Sunday evenings when peaks are highest. On Fridays, a shuttle service is initiated to handle the heavy volume of summer weekend traffic to Provincetown. At Naples, three flights a day are operated year round, fare being $15.24 to Miami. Bringing in the multi-engine aircraft takes care of the summer increase without boosting schedule frequency.

Van Arsdale recently initiated an air taxi service available to 37 New England communities for flights into Boston's Logan Airport.

Using a Cessna 182 and a Piper Apache, the taxi is available upon phone request.

AIRLINE OBSERVER

► National Aeronautics and Space Administration's Manned Spacecraft Center at Houston is already a major airline customer, having spent $2.7 million during Fiscal 1963 to send employes to space contractors and test and development sites throughout the country. MSC currently has about 3,000 employes, and expects the total to level off at about 5,000 under current programs. In addition to NASA personnel travel, the center estimates that 300 industry personnel visit MSC monthly from various parts of the country.

► Standardization of equipment is reason given by Northwest Airlines for the sale of its five Douglas DC-8 aircraft. Move will leave Northwest with an all-Boeing jet fleet. Carrier currently has 12 Boeing 720Bs and three 707-320Bs, with two more 320Bs on order. Officials said more Boeings would be ordered to replace the DC-8s. Four of the sold aircraft are going to National Airlines, and one to the independent French carrier Union Aeromaritime de Transport. L. B. Maytag, Jr., president of National said the DC-8 purchase would be handled without additional financing. Northwest has had its DC-8s up for sale for two years (AW May 8, 1961, p. 38).

► Seaboard World Airlines has reached an agreement with Canadair, Ltd. extending terms of payment of $10.6 million it owes the manufacturer. Refinancing did not involve the issuance of any equity securities, and the airline states it can meet repayment schedules out of charges for depreciation and amortization. Under the plan, Seaboard will pay Canadair $3.1 million in 1963, $3.8 million in 1964, $2.9 million in 1965 and $800,000 in 1966 to meet the debt.

► United Air Lines will convert 14 more Boeing 720 transports to one-class service configuration this fall as single-fare schedules are expanded to 15 more cities. Move will place 21 of United's 28 Boeings in one-class service. Also planned is conversion of some Douglas DC-8 transports to one-class service next spring. Schedule expansion includes inauguration of one-class service between Chicago and Los Angeles, where the concept will receive a big test against the multiplicity of fares already in effect on that route. With the expansion, United will be offering 71 daily one-class flights, compared with 30 now.

► Russia's Aeroflot for the first time has released break-even load factors on several transports. TU-104B, 100-passenger twin jet, breaks even with 64 passengers on the Moscow-Tashkent route and, between Novosibirsk and Moscow, the plane's break-even point is 66 passengers. Il-18 turboprop requires 72 passengers to break even on the Leningrad-Sverdlovsk route and the An-10 turboprop needs 70 passengers flying from Kharkov to Leningrad. It is presumed that the planes are the high-density versions carrying 100 passengers.

► Air Line Pilots Assn. last week signed an agreement with United Air Lines that combines the seniority lists of the merged United-Capital company, provides for a jet crew complement of a minimum three pilots and hikes wages to give captains on jets as much as $31,860 annually, copilots as high as $20,244 per year and second officers as high as $17,196. Contract also brought improvements in rules, working conditions and pensions.

► Alitalia has ordered two additional Caravelle transports for delivery next spring. Order brings the Italian carrier's Caravelle fleet to 18 aircraft and Sud Aviation's Caravelle backlog orders to 171.

► Domestic trunkline common stocks are becoming favored issues on Wall Street. Declines which set in during the opening months of the year have been reversed by the recent surge of popularity, and most airline listings are being quoted at prices at least 30% above 1963 lows. Last week, some airline stocks dipped slightly as a result of profit-taking, but continued reports of profits, traffic growth and equipment expansion programs are expected to bolster the upward trend. Last week, Pan American's stock rose 1¾ when its purchase of 40 Mystere 20 jet transport aircraft was announced (AW Aug. 5, p. 40).

SHORTLINES

► **British European Airways** has purchased two Sikorsky S-61N helicopters for operation between Land's End and the Scilly Isles, the shortest routes on the carrier's system. Helicopters, which cost $2.1 million with spares, will replace the seven-passenger de Havilland Rapide biplanes currently shuttling daily between the two points.

► **Civil Aeronautics Board** has ruled that its investigation into rate practices on the North Atlantic should be closed to the public and proceedings kept confidential.

► **Federal Aviation Agency** will conduct a series of meetings during the next two months with aviation mechanics to discuss ways of modernizing certification requirements of mechanics. Total of 31 meetings are scheduled at points throughout the U. S.

► **Iberia Air Lines** of Spain has inaugurated Douglas DC-8 turbofan transport service on its route from Madrid to Caracas via the Canary Islands. Flights initially are scheduled once a week, and bring the total of transatlantic flights operated by Iberia to 24 each week.

► **Irish International Airlines** reported a load factor of 58.8% for the second quarter of 1963. The airline said this was the highest load factor of all 15 IATA carriers flying between the U. S. and Europe.

► **Pacific Southwest Airlines** earned $950,000, or $1.67 a share, in the six months ended June 30, 1963, up 95% over the $485,000, or 86 cents a share, reported for the first half of 1962. The California intrastate carrier also said that revenues and passenger boardings in July were the largest of any month in the company's history.

► **Sabena Belgian World Airlines** has reported a 50% increase in cargo traffic on its North Atlantic route for the first six months of 1963 compared with the same period last year.

► **Trans World Airlines** President Charles D. Tillinghast, Jr. has warned that unless U. S. airlines see a "pretty tangible" domestic supersonic transport program, they'll have no choice but to order the Concorde transport under development by a French-British combine.

► **United Air Lines** has added Red Carpet Rooms for use by members of the airline's 100,000 Mile Club to the Chicago and Honolulu airport terminals.

French Plan Space Research in New Areas

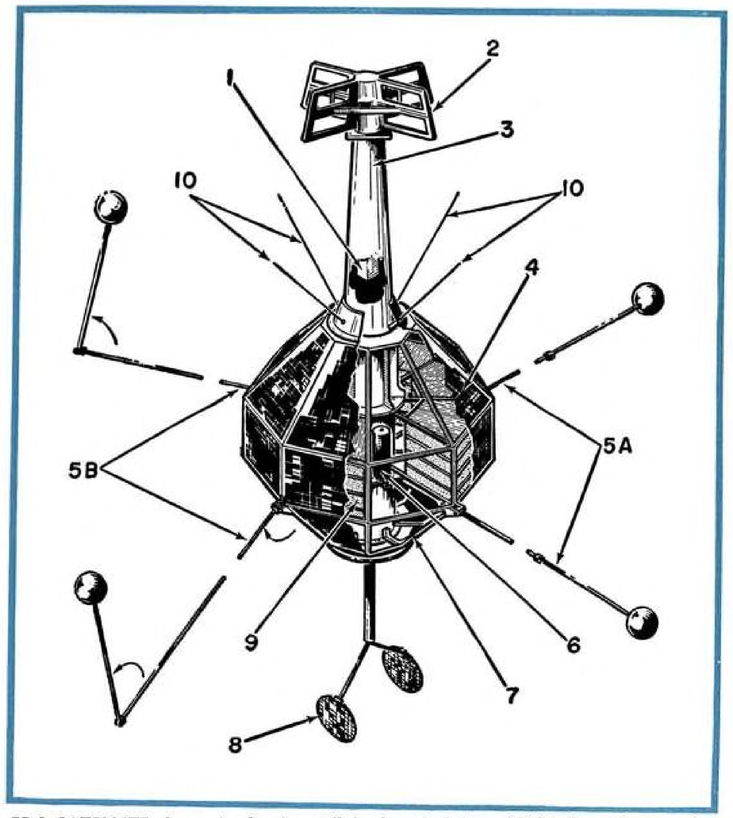
By Cecil Brownlow

Paris—France plans to establish itself as a world leader in the exploration of the lower and middle fringes of space within the next few years under a wide, government-sponsored research program now evolving at a rapid pace with active industry participation.

Following the successful precedent established by its postwar aviation industry, the government plans to channel France's purely national efforts into areas of space largely ignored thus far by the U.S. and the Soviet Union rather than directly challenging the two present giants in this field.

First step—and one already well under way—calls for an intensive study of the lower spectrums of space between the altitudes of 25 and 350 mi. using a variety of French-designed, developed and produced sounding rockets as well as high-altitude polyethylene balloons.

Second step, beginning in early 1965 is well beyond the present scope of any other European national program (AW June 17, p. 26). It calls for French boosters to place French satellites and payload packages into orbits ranging in altitude from a low of 250 mi. to a possible high of 6,250 mi., although the latter figure may never be attempted since French planners for the moment are more interested in the relatively unexplored areas of the lower altitudes.



FR.1 SATELLITE shown in drawing will be launched by a NASA Scout booster from Pacific Missile Range into a 500-mi., semi-polar orbit. Satellite systems include: magnetometer to measure earth's magnetic field (1); antennas to measure magnetic field (2); isolation pylon (3); 3,840 solar cells (4); antennas to measure electronic field, shown in deployed and unfolding positions (5A and 5B); accumulator (6); magnesium anti-vibration structure (7); paddles to measure electronic density (8); electronic equipment (9), and four antennas for transmission of telemetry data and command receiver (10). FR.1 is designed to study very low frequency (VLF) waves in the atmosphere.

The price of any comprehensive steps into deep space is beyond the capability of the budget now envisioned for the French space effort, at least for the next decade. France wants to conduct original research, both in the experiments used and the areas probed, whenever possible, rather than simply follow along trails already covered by the U.S. and the Soviet Union.

The former approach assures a share of international scientific prestige for France and also may help alleviate any internal criticism of the nation's growing outlay of funds for development of an independent nuclear-striking force, including an intermediate-range ballistic missile.

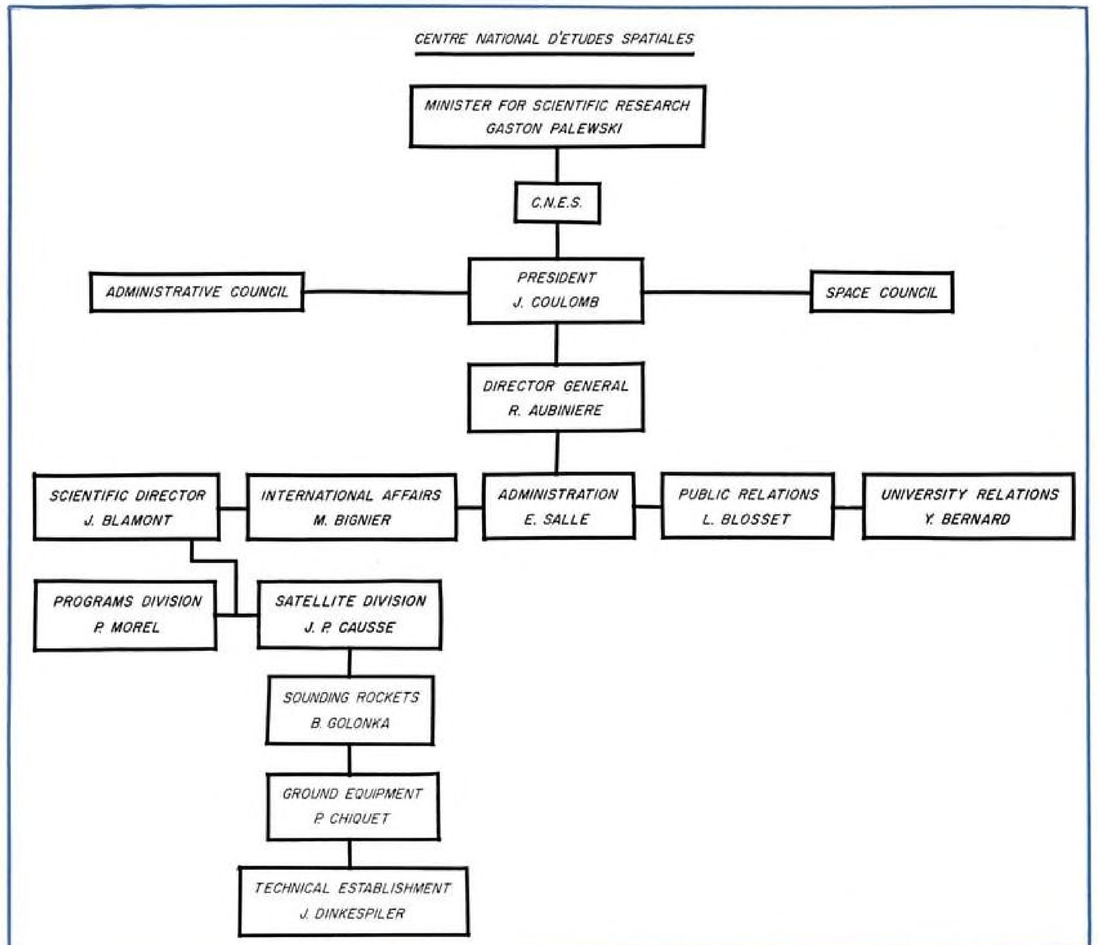
Technical spinoff from the IRBM program has been of major benefit in development of the country's three-stage Diamant 1 space boost vehicle scheduled to place France's early satellite payload packages into orbit. The military program also is providing most of the answers required for fabrication of the second generation Diamant 2 scheduled to become available in the 1967-68 period.

Once the program as such has become firmly established, the Centre National d'Etudes Spatiales (CNES), the government agency formed to coordinate and define France's national space effort, hopes to place between three and four satellites into orbit each year (AW June 17, p. 26).

Six satellite projects proposed by CNES already have received French government approval, although only the first three have been funded thus far. There appears to be little doubt, however, that money will be made available for the others in subsequent government budgets.

But, funding will become a problem as relatively inexpensive plans begin to demand more and more money as they approach the hardware stage despite full support for the program on the part of the de Gaulle government. The government recognizes the benefits of a broad-based space effort and its potential technological fallouts for the nation's industry as a whole.

The total 1963 budget for French



ORGANIZATIONAL CHART shows the makeup of CNES, the French agency which coordinates and defines the nation's space efforts.

space activities, including its commitments to the preliminary agencies established as a prelude to the anticipated multination European Space Research Organization (ESRO) and the largely collateral European Launcher Development Organization (ELDO), is approximately $32.65 million.

With the national program moving into the satellite era at approximately the same time that ESRO and ELDO projects will begin to make sharp financial demands, French space officials say the over-all budget should be at least doubled each year for the next several years in succession. No one believes that this actually can be attained. The 1964 budget request for $60 million-plus already is threatened by cuts in view of the large outlays required to support France's development of an independent nuclear military force.

One possible means of partially offsetting this would be for France to enforce a tight rein on the scope of planned ESRO projects, especially those that might overlap programs already under way or accomplished within the sphere of France's national program.

Number of top officials here say the country's primary interest in ESRO and similar multinational efforts on the European level is in the realm of far space, including lunar and solar probes, with which France's budget cannot yet cope without hampering the program.

In any such advanced multilateral efforts, France also plans to play a major role and already is drafting projects designed to make this inevitable.

The wide range of government scientific and development agencies, universities and industry talent being pulled together by CNES for the major push into lower space also are studying such advanced techniques as nuclear and ionic propulsion, plasma jets, lasers and improved electronic systems with ultra high reliability factors that may play only minor roles in France's national space program as such.

The number and diversity of agencies being called upon to contribute to the national space program also provide some indication of the importance the government is attaching to the effort.

Aside from the major roles being assumed by individual companies, universities and astronomical observatories, other organizations are working actively in the program with CNES:

- **Centre National d'Etude** des Telecommunications (CNET), the electronic research and development arm of the Postal Ministry, which is responsible for the experiments designed for France's first satellite, the FR.1, scheduled to be launched with a U.S.-built Scout rocket in late 1964 or early 1965. The other five French satellites already formally approved will be launched by Diamant 1 rockets, with the first orbital firing scheduled for early 1965.
- **Office National d'Etudes** et de Recherches Aeronautiques (ONERA), which is working on experimental rocket programs for the military that can be used as sounding probes in the space

program. ONERA also is active in the field of space simulators.

• **Commissariat a L'Energie** Atomique, France's rough equivalent of the Atomic Energy Commission in the U. S., which is working in the area of nuclear propulsion techniques with space applications.

• **Societe pour L'Etude** et la Realisation d'Engins Balistiques (SEREB), an industry consortium developing France's IRBM as well as the Diamant space booster series. Member firms are Nord-Aviation, Sud Aviation, SNECMA, ONERA, Dassault, MATRA and SEPR (Societe d'Etude de la Propulsion par Reaction).

• **Central National de la Reserche** Scientifique, which is active in high atmosphere research, using both balloons and research rockets, primarily for the collection of meteorological data.

• **Direction de la Meterologie Nationale,** also active in high atmosphere research, using in-house developed and inexpensive meteorological rockets that can reach an altitude of approximately 50 mi. The government agency also is developing electronic packages for inclusion in the rockets' nose cones plus a new steel thread parachute for recovery use. The parachute is designed to be effective in very rare atmospheric conditions. The research rocket developed by the agency is slightly less than 11 ft. in length and can carry a 4.4-lb. payload. Total weight of the package is 132 lb.

• **Office National d'Etudes** et de Recherches Aerospatials, which is currently planning an experiment to measure with precision the intensity of infrared radiation on several wavelengths along the horizon. Experiment is scheduled to be conducted from the monitored payloads of sounding rockets sent to altitudes of between 60 and 120 mi.

• **Centre d'Enseignement** et de Recherches de Medecine Aeronautique, charged with studying the bioscience aspect of space, plans to launch a monkey along a ballistic trajectory sometime next year in the nose cone of a Vesta research rocket developed for the Direction des Etudes et Fabrications d'Armement by the Laboratoire de Recherches Balistiques et Aerodynamique. A second and longer ballistic trajectory launch of a monkey may be made with Diamant 1 in 1965 if the first test proves successful.

Animal Launches

A cat will be launched into a suborbital trajectory later this year in the nose cone of a Veronique research rocket.

Veronique, developed by Sud Aviation, was used last October to fire two rats of the Wistar species in separate ballistic launchings. First rat was recovered after a 70-mi. flight, but the second landed in an inaccessible area and could not be retrieved.

Each was fitted with a series of electrodes attached to the brain and other muscle areas, and the resultant data was telemetered to the ground.

Despite these experiments, CNES president Jean Coulomb says France's national program has no room for a man-in-space program as such. Other officials say the country eventually might be interested in participating in a European-wide manned space program, should one come about, although others contend that, even on a multilateral basis, budget considerations probably would preclude any attempts that could begin to approach in scientific terms the accomplishments already attained by the U. S. and the Soviet Union in this field.

Advanced Programs

In other areas, however, France is pushing ahead toward developments well beyond the current needs of its national space projects in order to assure itself a leading role in potential, advanced intra-European programs of the future.

In the nuclear area, the CNES proposals to the government urge that studies of both nuclear propulsion for use aboard advanced booster systems and of nuclear satellite power sources be undertaken on a top priority basis under the direction of the Commissariat a L'Energie Atomique.

Actual hardware, if any, probably would require multinational financing, and CNES admits that development of a nuclear reactor for propulsion "would possibly exceed the national capabilities." An agency report adds, however, that "first priority" should be given to a study of "the difficulties which must be overcome, to calculate the cost and duration of a development program and to estimate the performances that can be achieved. . . . It appears a matter of urgency to assemble the determining factors concerning nuclear propulsion in order to clarify ideas on an international basis . . ."

The agency says France should consider thermal nuclear propulsion for potential use in a first stage booster and for applications as an auxiliary source that could push a vehicle toward a far space voyage after it already has been placed in a low earth orbit.

In the field of auxiliary nuclear power for satellites, CNES says that to date "it is impossible . . . to decide between the fundamental technical options that exist," including a choice between uranium and plutonium as a power source, and warns that to do so could result "in copying the American program without the hope of avoiding certain disadvantages which already have become apparent in the choices made for Snap (Systems for Nuclear Auxiliary Power)."

CNES says a 2-3 year study should produce recommendations as to the basic approach that should be taken, particularly if it incorporates work France already has undertaken on the use of plutonium and on direct conversion of nuclear energy to power. After this step, CNES says, a firm program should be established during which:

"The first years will be concerned with the production of sub-units" [heat circuits, critical assemblies]. The preparation of a preliminary plan for the construction of an earth prototype . . . will take place in the third year of studies.

"The construction and test phase of the earth prototype will last 4-5 years so that the prototype will be ready 7-8 years after the start of the program.

"The construction of the reactor core assembly appears necessary during the exploratory period, possibly during the second or third year of the program. This assembly will use a fairly large quantity of fissionable material, either plutonium or enriched uranium."

In a separate report, the Commissariat a L'Energie Atomique estimates that design of a ground prototype system can begin by early 1966. It estimates that work on an airborne reactor will require approximately $61.2 million by 1970.

Commission Studies

Over-all, the commission's studies with space applications include:

• **Design studies** for an auxiliary power source for satellites and of methods of direct energy conversion.

• **Investigation and design** of cosmic radiation detectors for satellites.

• **Studies of the effects** of radiation on various materials.

• **"Documentary" study** of nuclear propulsion.

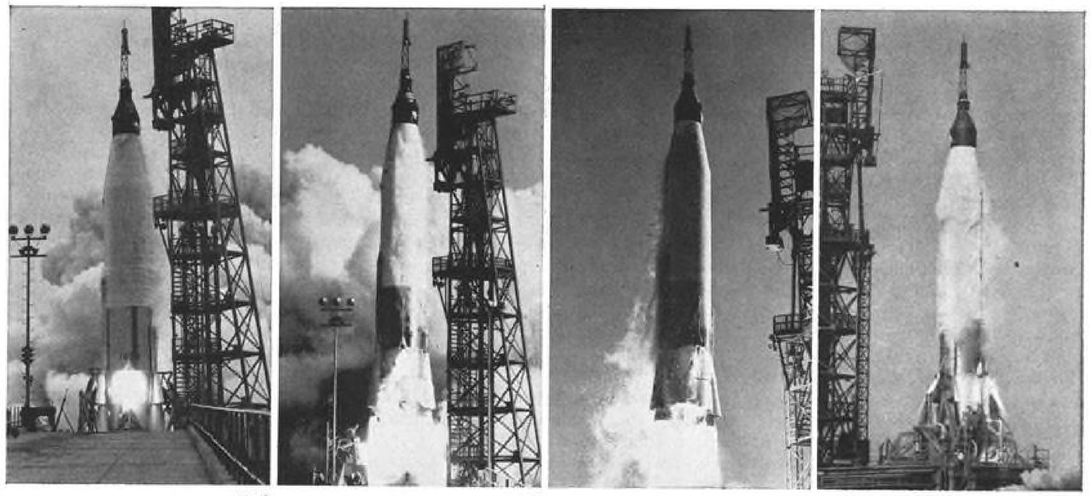
• **Investigation of isotopic** power sources and methods of converting this power.

• **Investigation and design** of electrical propulsion systems. In this regard, CEA, French industry and universities have conducted joint studies on ionic propulsion techniques over the past several years, and the commission estimates that an operational system could be made available within the next 10 years.

The Office National d'Etudes et de Recherches Aerospatiales (ONERA) in a related effort is constructing a series of chambers for space propulsion simulation, with more than one-half of the units now in operation. Designation, mission and size of these respective simulators are:

• **A611—Tests of thermal plasmas,**

Perfect Atlas Record in Launching Manned Mercury Orbital Flights...



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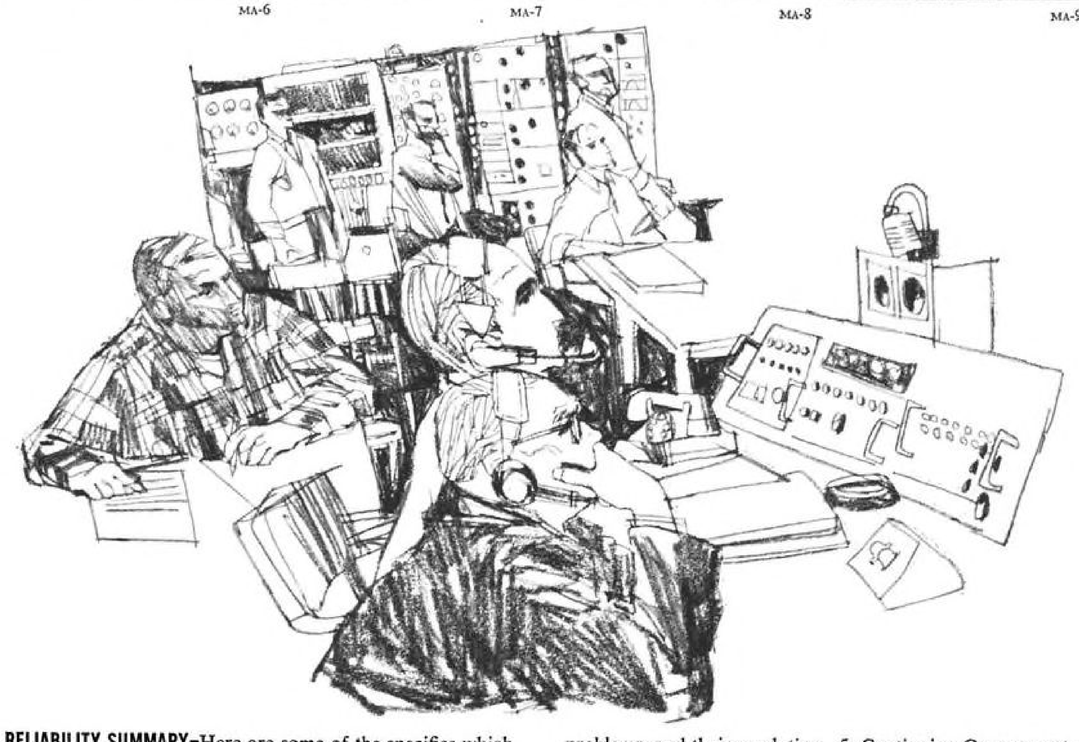


RELIABILITY SUMMARY–Here are some of the specifics which contributed to the Atlas-Mercury 100% success:

1. A base-line of dependability derived from Atlas ICBM development, test, and production, dating from 1955. 2. A thorough program of motivation for Astronautics people at all levels, and for key Atlas subcontractors and suppliers, geared to man-rated flight. 3. Continuous and cooperative review of all proposed changes by system-oriented Government and contractor technical management, so as to keep abreast of technology, yet not adversely affect reliability. 4. Continuous cross-feed of data between Government and contractor personnel, permitting rapid isolation of critical problems, and their resolution. 5. Continuing Government-contractor management consultation and agreement to maintain the proper balance among reliability, cost, and schedule. 6. Specific man-rated parts-acceptance criteria. 7. Heightened level of managerial approval for use of any parts requiring rework to meet standards. 8. Detailed, finite, analysis of any part falling below Mercury standards. 9. Special technical liaison between Astronautics and its principal Mercury-Atlas suppliers. 10. Increased precision of test equipment and procedures, and cross-feed of test data, between suppliers, Astronautics' home plant, and the launch site. 11. Extraordinary cleanliness controls.

...Case Study in Demonstrated Reliability in a Major Space System

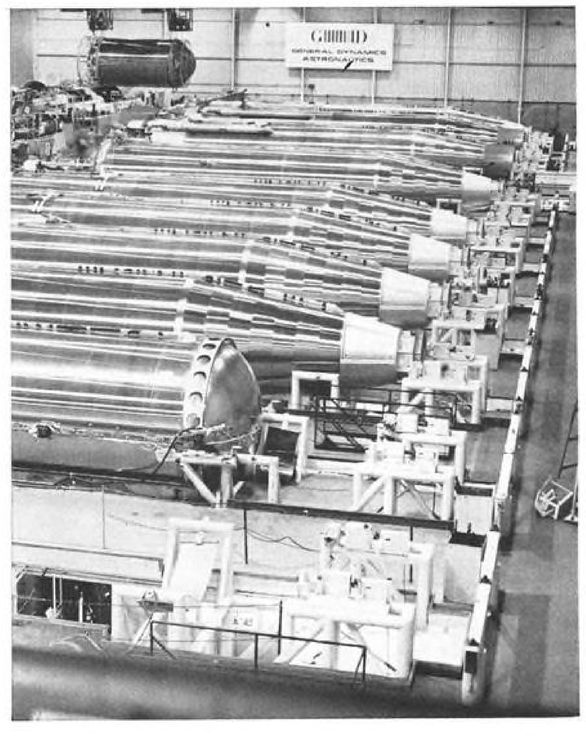
4 for 4...100%

The 100% Atlas success in launching all U.S. Manned Orbital Flights springs from combined management action by the Air Force, NASA, and industry – including General Dynamics | Astronautics as Atlas integrating contractor. And the knowledge gained can benefit many other aspects of the national space program, as well as future Atlas-launched space systems and Atlas weapon systems.

Demonstrated Atlas Reliability Now Applied to Atlas SLV-3

The latest outgrowth of the continuing Atlas program is the United States' first *Standardized* Space Launch Vehicle, Atlas SLV-3. Atlas SLV-3 is already specified, and in production, for several USAF and NASA space programs, involving over 30 launches.

Each SLV-3 is tailored to specific payloads and flight profiles with "plug-in" guidance, programing, telemetry, tracking and other components . . . yet without affecting the integrity of basic Atlas reliability, accumulated by Mercury-Atlas and more than 160 other flights.



GENERAL DYNAMICS

ASTRONAUTICS DIVISION

SAN DIEGO, CALIFORNIA

rockets and super-aerodynamics at simulated altitudes of between 10 and 50 mi. Volume is 5,300 cu. ft., and the simulator is operational.

• **A612—Experiments with thermal** plasmas and ionized gases at altitudes of between 50 and 120 mi. Volume is 175 cu. ft., and the unit is operational.

• **B61—Tests of ionized gases** and particles at altitudes of between 100 and 300 mi. Volume is 125 cu. ft., and the simulator is operational.

• **A63—Tests on optical** and electrical signals at altitudes of between 200 and 600 mi. Volume of the unit, which is still in the design stage, will be 125 ft.

• **B63—Experiments with models** and other components, including wind tunnel tests, at altitudes of between 100 and 200 mi. Volume of the simulator when completed will be 1,950 cu. ft.

CNES also plans to build a test facility at its Bretigny research headquarters near Paris that will contain a number of space environment simulators including several small and one large vacuum chamber, a climatic chamber for thermal cycling, a vibration machine and a centrifuge.

24-hr. Orbit

Beyond the presently planned six satellites which already have the stamp of government approval, CNES also is investigating the problems related to placing a satellite into a 24-hr. orbit along the principles of the National Aeronautics and Space Administration's Syncom series. Studies include potential launching methods, either from the ground or from a preliminary low orbit; orbital transfer and correction; tracking and an advanced guidance system plus disturbances that might be caused by gravity, electromagnetic effects and meteorites.

Within the field of stabilization, CNES is following a number of approaches, making its first advanced step in this area with the launching of FR.6, last of the currently authorized series, which will be solar stabilized. As further steps, the agency also is considering earth-oriented and star-oriented satellites.

The first satellite with which France will attempt to break new scientific ground will be the FR.4, designed primarily to measure the hydrogen distribution in the upper atmosphere with a payload developed by Prof. J. E. Blamont, scientific director of CNES (AW June 17, p. 26). A similar Blamont experiment will be carried aboard NASA's Pogo satellite.

FR.5, which will include a laboratory for laser research, has a primary mission of studying the magnetic impulses in space, while the final payload for FR.6 will not be determined until results of the earlier launches have been evaluated.

FR.2 and 3 will serve as essentially flying laboratories for the French equipment involved, particularly the marriage of the satellite vehicle to the Diamant 1 launcher.

FR.1, which will be quickly followed by the launch of the all-French FR.2 from Hammaguir, Algeria, will be placed into a 500-mi. semi-polar orbit by a NASA Scout booster from the U.S. Pacific Missile Range in California. Prior to the orbital flight, two FR.1 payloads will be fired this September to altitudes of between 125 and 137 mi. by Aerobee rockets from NASA's Wallops Island, Va., facility in order to check out the over-all package. Payload is approximately 200 lb.

FR.1 Objectives

FR.1 is designed to study the very low frequency (VLF) waves in the atmosphere and will carry a payload designed by L. R. O. Storey, chief of research at the Centre National de la Recherche Scientifique. Attempts will be made to measure the intensity, polarization and propagation direction of electromagnetic waves within the 16-20 kc. range. During the period of its orbit, the satellite will monitor the VLF transmission from three major submarine communication stations.

French space officials also say that a study of the irregularities in the ionization distribution should help determine the local electronic density.

Over-all responsibility for the FR.1 experiments has been assigned to the Centre National d'Etudes des Telecommunications, headed by Pierre Marzin with headquarters in Paris.

CNES has the responsibility for installing the payload into the satellite shell which is being built by Nord-Aviation.

Aside from the Nord contract, CNES thus far has been reluctant to name the private firms engaged in the actual fabrication of the satellite shells and payloads for the other projects already approved. Contracts, however, have been awarded for work on the FR.2 and 3 satellites and their payloads.

All five now scheduled to be launched by Diamant 1 from Hammaguir will be restricted in weight and size by the capabilities of the three-stage booster system.

The best payload performance, according to CNES, can be attained in an eastward launch at a latitude of 30 deg. which can place a 176-lb. satellite into an orbital plane with an apogee of 812 mi. and a perigee of 250 mi. A westerly launch, where the vehicle is moving against the earth's rotation, would cut the effective payload weight to 55 lb.

Fired toward the east, Diamant 1 also could be used to place a 176-lb. satellite into a circular orbit at an altitude of 312 mi., a 92-lb. payload into a plane with an apogee of 3,125 mi. and a perigee of 250 mi., a 77-lb. package into a 500-mi. circular orbit, or a 44-lb. unit into a path with an apogee of 6,250 mi. and a perigee of 250 mi.

Use of the more-powerful Diamant 2 in the 1967-68 period will permit launchings of satellite vehicles weighing up to 660 lb. Normal payload weight for the booster probably will be about 440 lb.

A need to retain the capability for firing satellites into an easterly orbit may force France to construct a second launch site on its own soil. One now under consideration by the French army would be located on the South Atlantic coast and would permit firings only to the northwest because of the populated areas in all other directions.

The South Atlantic site is being considered as a military substitute for the Hammaguir center, which the army must vacate by July, 1967, under terms of the Evian peace agreement with Algeria. CNES President Coulomb hopes that the Algerian government will continue to permit "peaceful" satellite launchings from Hammaguir. If not, a second site that would permit launchings to the east may be built along the Mediterranean in the region of Roussilon.

Diamant 1 Weight

Diamant 1 will have a total launch weight of 39,600 lb. and an over-all height of 53.4 ft. Thrust of the first-stage Emeraude, using a nitric acid and turpentine base propellant, will be 62,700 lb. as opposed to the 88,200 lb. planned for the first stage of the completely solid-propellant Diamant 2. Scheduled combustion time for the Emeraude is 88 sec., and total fuel weight is 27,000 lb.

SEREB-designed first stage of Diamant 2 will incorporate four swiveling nozzles for directional control, whereas Emeraude houses only one such control unit.

Solid-propellant second stage for Diamant 1, designated Topaze and built by Nord, has a total thrust of approximately 32,550 lb. with a normal burning time of 39 sec. Four internally guided gimballing nozzles are provided for attitude control, and the same vehicle with some modifications and state-of-the-art improvements will be adapted for use on the Diamant 2 booster.

The Saphir third stage for Diamant 1, built to SEREB specifications by Sud Aviation, also incorporates a solid propellant and has a thrust of between 5,610 lb. and 11,890 lb., depending upon the mission requirement, plus a single fixed nozzle. Total propellant

Objectivity

If you're tired of hearing about the "perfect" printed circuit connector, you're just the man we want to talk to.

We're here to offer you freedom of choice, because that's where objectivity begins. The boy blowing his last penny on candy wants to be able to choose between the 30-second delicacies and the stuff that lasts all afternoon. It's licorice versus jawbreakers, root-beer-barrels versus bubble-gum. They're all good, but none are perfect.

That's why we make such a variety of printed circuit connectors. Each type and style has its own special bailiwick. They're all "perfect" when they're applied properly.

OUR NEW BELLOWS-TYPE

Take the new Amphenol 225-series. This bellows-type connector has the smoothest, gentlest, most efficient mating action you'll find anyplace. Even after thousands of insertions, the delicate conductive surfaces of the printed board are unscathed by the 225.

The 225-series has remarkably low contact resistance, too. For the solder terminated style, it's under 25 millivolts at 5 amperes.

The bellows-type contact on the 225-series is split down the middle. You get two contact points for every interconnection. This helps keep the contact resistance low, of course, but it also conforms readily to irregular mating surfaces.

The 225 is convex. It meets and mates the printed circuit board with a wiping action that assures contact.

AND, FURTHERMORE

The 225-series contact is self anchored in the connector body. Contact faces will not distort at the slightest pull on the terminals.

The 225-series has twice the flexing range that you'll find on other bellows-type contacts. This means you can rock the board twice as far with no danger of contact distortion.

The 225-series does not waste valuable contact space with a polarizing key. The key is sandwiched in between contacts.

The 225-series can be terminated with solder lugs, taper pins, removable crimps, or Wire-Wrap* terminals.

Contact styles? Contact positions? Mounting provisions? Well, let's just say that there are over 100,000 combinations available in the Amphenol 225-series bellows-type connector.

WHO NEEDS IT?

And now for the facts of life. Some people simply don't need the 225-series. Some printed circuit boards are inserted once and never disturbed again. Some printed circuits are never subjected to pull on the terminations. Some printed circuits are not really so delicate that they must be protected from contact wear. Some printed circuit boards never get rocked. And in some applications, the space taken up by a conventional polarizing key is of no consequence. And so forth.

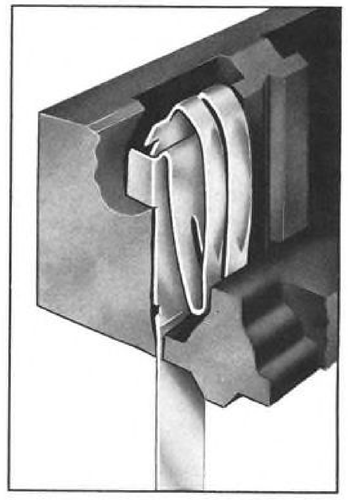
And that is why Amphenol makes Prin-Cir® connectors, Micro-Edge® connectors, Micro-Min® connectors, and specials that haven't been named yet. They are all printed circuit connectors. They are all "right" where the need dictates their use.

The hero of this story is the Amphenol Sales Engineer. He's the only man who has access to a complete line. Thus he's the only man who can look you in the eye and tell you exactly which printed circuit connector you need. Objectivity.

You won't hear Amphenol Sales Engineers telling you about perfect connectors. They don't have to. They know better.

DETAILS, DETAILS

If you're *really* interested in seeing what a complete line of printed circuit connectors looks like, we invite you to write for our new 20-page catalog PC-1. Just contact your local Amphenol Sales Engineer, or write to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 South 54th Avenue, Chicago 50, Illinois.



Problem: To make contacts that give an extremely low millivolt drop, yet do not mar printed circuit conductors, even after thousands of insertions.

Solution: Bifurcated, convex faces for sure contact. Double spring action with wide flexing range. Then double-plate and polish so smooth they caress the mating surface.

*T.M. Gardner-Denver Co.

AMPHENOL ***Connector Division*** / Amphenol-Borg Electronics Corporation

weight is 1,430 lb. with a normal combustion time of 44.5 sec.

Second and third stages already have been fired, and the first stage is scheduled to undergo a live launch test early next year.

Meanwhile, France for the past several years has become progressively involved in the development launch of a series of rocket probes. Initial development, as in the case of Diamant, often has been financed by the military, with the civilian space program later adopting the probes at relatively little cost.

As an example of the current pace in this area, a French government survey reports that 47 research rocket probes were launched between May 9, 1962, and Feb. 28, 1963. These included 11 Veroniques built by Sud for the Laboratoire de Recherches Ballistiques et Aerodynamique, 7 Beliers, 22 Centaures, 1 Dragon—all also built by Sud—2 Meteo MD-1s and 4 Matra-built Emmas, which have a maximum design altitude capability of 44 mi. and can be produced at relatively low cost.

Under present planning by CNES and other French research institutions, similar launchings will be continued on an accelerated basis over the next several years.

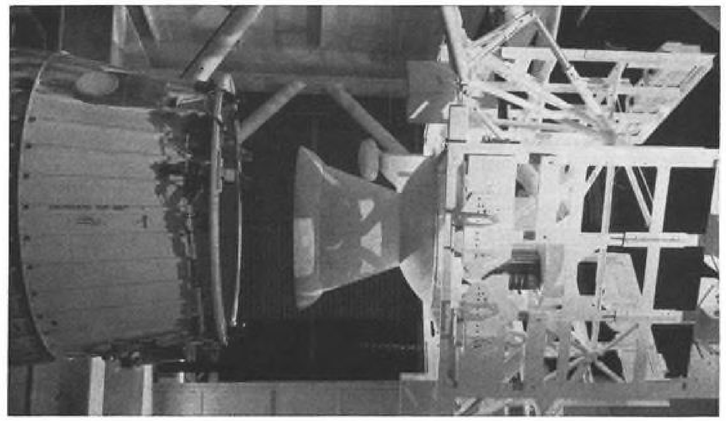
Standard Veronique, which has become a mainstay in French rocketry and will form the basis of France's second-stage contribution to the initial multilateral European Launcher Development Organization's three-stage booster system, can send a 176-lb. payload to a maximum altitude of 125 mi. or 264 lb. to 87 mi.

Advanced follow-ons within the national program include the Super Veronique, which can loft 176 lb. to a 212-mi. altitude or 330 lb. to 175 mi., and the Vesta rocket, scheduled to be made available to CNES by the army sometime next year. Vesta can hurl a 440-lb. payload to an altitude of 216 mi. or 2,200 lb. to 125 mi.

All three units—Veronique, Super Veronique and Vesta—are liquid-propelled and have no guidance system aboard.

Solid-propellant Belier, first launched in the spring of 1961, can carry a 70-lb. payload to a maximum altitude of 50 mi. Centaure, a Belier plus a first-stage tandem booster, 66 lb. to 112 mi., and Dragon, a two-stage Belier with rocket boost, 198 lb. to 250 mi. No guidance or control systems are employed in any of the three.

Special research incorporating payloads carried to altitudes of 23 mi. and beyond by polyethylene balloons manufactured by Potez is also gaining impetus with completion of a special launch center at Aire-Sur-Adour. Tetrahedral-shaped balloons, ranging in size from 3,000 to 5,000 cubic meters and capable of carrying payloads of 11 to 440 lb., were designed and developed primarily by Prof. Blamont and are fabricated by the continuous welding of polyethylene strips.



Centaur-Surveyor Separation Simulated

Weightless condition in space flight has been simulated at General Dynamics/Astronautics in a test of separation of models of a Centaur booster and a Surveyor unmanned spacecraft. Full-scale Surveyor mockup floats on nitrogen gas cushion to provide data on spacecraft separation velocities and tumbling rates and directions.

Balloon experiments already conducted or planned include studies of the solar corona, the molecular structure of the atmosphere and planets, space radiation and observations of the solar and lunar surfaces.

The French industry is moving deeper into space and spending substantial sums of its own in doing so. Individual firms realize that they must keep abreast of this new technology or inevitably fall behind in all aspects of their business. As a result, the industry is making strides commensurate with the ambitious CNES program.

When the FR.1 satellite program began, as an example, no French firm could fabricate the necessary solar cells required to supply power to the space systems with the precision and quality desired. Consequently, they were purchased directly from a U. S. outlet. Now, according to CNES, the French industry has the know-how and capability to produce on its own the solar cell units for later satellites.

FR.1 itself was all French except for the solar cells, and the industry is beginning to take a lead in proposing complete satellite packages. SEPR, for instance, has completed a study on the Phaeton, which could be used for solar and nuclear power research, while SNECMA is pushing the Genevieve, a 24-hr. synchronous orbit television relay satellite. Neither has yet received formal CNES blessing.

In the metallurgical field, Air Liquide, Pechiney, Ugine and Carbone Lorraine are working on cryogenics, advanced nozzle materials and propulsion techniques. Compagnie Generale de Telegraphie sans Fil (CSF) and Thomson-Houston, among others, are becoming actively involved in the field of space electronics, both airborne and ground support systems, including simulators.

CNES itself came into being on Mar. 1, 1962, with an already established set of responsibilities laid down by its predecessor working group, including:

- **Collection of all information** on national and international space activities.
- **Preparation of proposals** for a national space program plus the follow-up assurance that the adopted programs are properly executed. This particular sphere includes design studies and final responsibility for the end product, although, for actual fabrication, CNES plans to contract directly with industry whenever possible.
- **Over-all coordination** of the national space program, including France's participation in multilateral projects.

Now, shortly more than a year after its formal incorporation, it is well on its way, and France obviously plans to continue and perpetuate its drive into space.

CNES is supervising and encouraging the probing rocket research efforts among the country's youngsters, offering scholarships to those who show the most promise and working to ensure that there will be projects that will hold their interest in order to dispel any temptation to migrate from France to the U. S. or elsewhere. In commenting upon the latter point and the numbers of technically trained youngsters who will be available in France within the near future, CNES technical director Robert Aubiniere has said: "It is up to us to ensure that, instead of emigrating abroad, in particular to the United States, this new blood flows into French laboratories, design offices and factories."

U.S., Soviets Plan Joint Space Projects

By Edward H. Kolcum

Washington—Most ambitious series of projects in the rapidly expanding U. S. international space program will be the three-part cooperative launch and data exchange effort being planned by the U. S. and Soviet Russia.

Terms of the bilateral agreement (AW Aug. 5, p. 37) provide for a timetable in which the two countries will establish a communications link by early next year, using the Echo 2 sphere as a passive relay point. Even before this link is established, joint conferences will be held to implement the key project in the effort—coordinated weather satellite launchings.

Planning also will begin for the third project—coordinated launch of satellite-borne sensors to map the geomagnetic field.

Agreement with Russia will bring to nine the number of international cooperative satellite programs in which the National Aeronautics and Space Administration is participating, which involve five countries. In addition to the three USSR programs, they are:

• **Canada**—The S-27 Alouette ionosphere topside sounder, launched last September from Pacific Missile Range.

• **France**—The FR-1 ionosphere-magnetosphere satellite to be launched in early 1965 from PMR by a Scout vehicle.

• **Britain**—Three separate satellites: the S-51 Arial payload, launched Apr. 26, 1962; the S-52 atmospheric satellite to be launched by Scout from Wallops Island, Va., late this year, and S-53, an enlarged version of S-52, also to be launched from Wallops Island after assessment of the earlier satellite results are completed.

• **Italy**—Project San Marco atmospheric density satellite to be launched from a platform in the Indian Ocean near the equator with a Scout in 1965. San Marco payload instrumentation is now being tested in sounding rocket launches from Wallops Island. Same procedure will proceed the FR-1 satellite launch.

As it now stands, the agreement with USSR calls for the satellite communications link to be established between U. S. and Russia as soon as possible after Echo 2 is launched. The launching is scheduled during the last quarter of this year from PMR using a Thor Agena vehicle.

Co-ordinated meteorological satellite project will begin about the same time with the exchange of weather data obtained by satellites. The schedule calls for co-ordinated satellite launches starting late next year.

Arnold Frutkin, director of NASA international programs, pointed out that the U. S. task in the agreement will be met by the Nimbus polar orbiting satellite, and the Soviets also will launch polar weather satellites. Paths of the two payloads will be phased so that they are 90 deg. apart, so that one of the two satellites will cross each spot on the earth every six hours.

SAN MARCO PAYLOAD is prepared for a sounding rocket test from Wallops Island, Va., by U. S. and Italian technicians. The payload is shown both with the fairing removed and in place. San Marco, which is scheduled to be launched from a platform in the Indian Ocean near the equator, is one of a number of bilateral space projects in which the U. S. is involved. The sounding rocket, called Shotput, consists of a Thiokol Pollux E6 first stage with two Thiokol Recruit assist rockets. At launch, the combination provides 120,000 lb. thrust. The second stage is an X248 Altair, manufactured by Hercules Powder Co.-Allegany Ballistics laboratory. The vehicle has a launch weight of 11,000 lb., and is 32 ft. long with a 33-in. dia.

The geomagnetic field program calls for each country to launch a satellite equipped with magnetometers in 1965.

One of the unexpected space program by-products, Frutkin said, is its potential to bring dollars into the country and thereby help offset the unfavorable gold flow. He estimated that since the international program started, about $13 million in foreign money has come to this country as payment for payloads and instrumentation.

Frutkin feels the foreign market could be increased significantly through the sale of the Douglas Delta launch vehicle. The European Launch Development Organization (ELDO) is developing a relatively heavy launch vehicle based on the Blue Streak booster, and France is developing the light Diamant launch vehicle (AW June 10, p. 26).

This, Frutkin said, leaves a big hole in the medium launch vehicle class that could be filled by Delta, which is the most successful and reliable U. S. vehicle. The Syncom communications payload launched July 26 (see p. 75) was the 19th successive successful Delta mission.

European Space Research Organization (ESRO) already has made what Frutkin called "serious inquiries" regarding purchase of Delta, for launch both here and elsewhere. Woomera, Australia range will be used for the Blue Streak launcher, and Delta could be launched from that complex.

As the U. S. international space program has matured, Frutkin said it has become clear that in Europe the space program is being justified on the basis of its economic and technical potential. The Europeans, he said, "believe space technology represents the forefront of the art."

At this time, in addition to the five countries with which U. S. has bilateral agreements for co-operative satellite projects, there are agreements with France and Britain to fly their experiments on U. S. satellites, agreements with 12 countries for joint sounding rocket programs, with 40 countries for weather satellite observations, with 10 countries for communications satellite observations, with 18 countries for ionosphere beacon observations, and with 14 countries for ionosphere sounding satellite observations.

U. S. also has established 54 separate agreements for foreign tracking and data acquisition stations. Seven cover the Minitrack net, seven the manned space flight net, two the deep space net, nine optical stations, 25 moonwatch stations and four data acquisition stations.

Personnel Exchange

The international program also has grown in terms of personnel exchange. At present, there are 44 foreign nationals from 19 countries participating in research at NASA centers. Another 21 students from nine countries are attending U. S. universities under NASA sponsorship, and 109 foreign nationals from 16 countries are undergoing technical training at NASA centers.

The foreign instrumentation on NASA satellites includes a photometer to be built by the University of Paris, which will be carried on the polar orbiting geophysical observatory (Pogo); an ion mass spectrometer built by University College, London, on the ionosphere topside sounder; helium absorption sensor built by University College and the University of Leicester, to be flown on the third orbiting astronomical observatory; and three solar emission measurement devices built by University College and University of Leicester, on the fourth orbiting solar observatory.

Sounding rocket projects are the oldest of the international space flight programs, and probably will continue to be the mainstay of the over-all international program because the rockets are relatively inexpensive and can obtain a wide variety of measurements from a number of geographical launch sites. Ft. Churchill, Canada, for example, is an excellent site from which to sound the auroral zone. Between 1958 and 1961, 34 U. S. rockets were launched from this site, and the plan is to launch 30 a year from there.

The sounding rocket agreement with Canada also included launch of six Canadian Black Brant rockets from Wallops Island last year, because of fire damage that took Ft. Churchill out of operation all last year.

Rocket Agreements

Sounding rocket agreements also are in effect with these countries:

• **Argentina**, to launch an unspecified number of Nike Cajuns from Chamical, Argentina, next year to measure electron densities in the D and E regions.

• **Australia**—Launch of four Skylark rockets from the Woomera range to measure ultra-violet radiation, done in late 1962, and launch of two Aerobee 150A rockets from Wallops last April and May to measure VLF radio noise above the ionosphere.

• **France**—Launch of optical equipment on Nike Cajuns from Wallops in 1961, and the launch of an Aerobee 150 next September to study ionospheric irregularities, also from Wallops. In addition, the FR-1 instrumentation will be tested at Wallops Island in Shotput launches.

• **India**—Launch of an unspecified number of Nike Cajuns and Nike Apaches from the Thumba, India range later this year carrying sodium vapor payloads for wind studies.

• **Italy**—Series of Nike Cajun and Nike Asp sodium vapor flights from the Sardinia range during the past two years. The San Marco satellite payload instrumentation was to have been tested earlier this month from Wallops in a Shotput launch. This vehicle also will launch a similar payload from the Italian launch platform in the Indian Ocean near the equator.

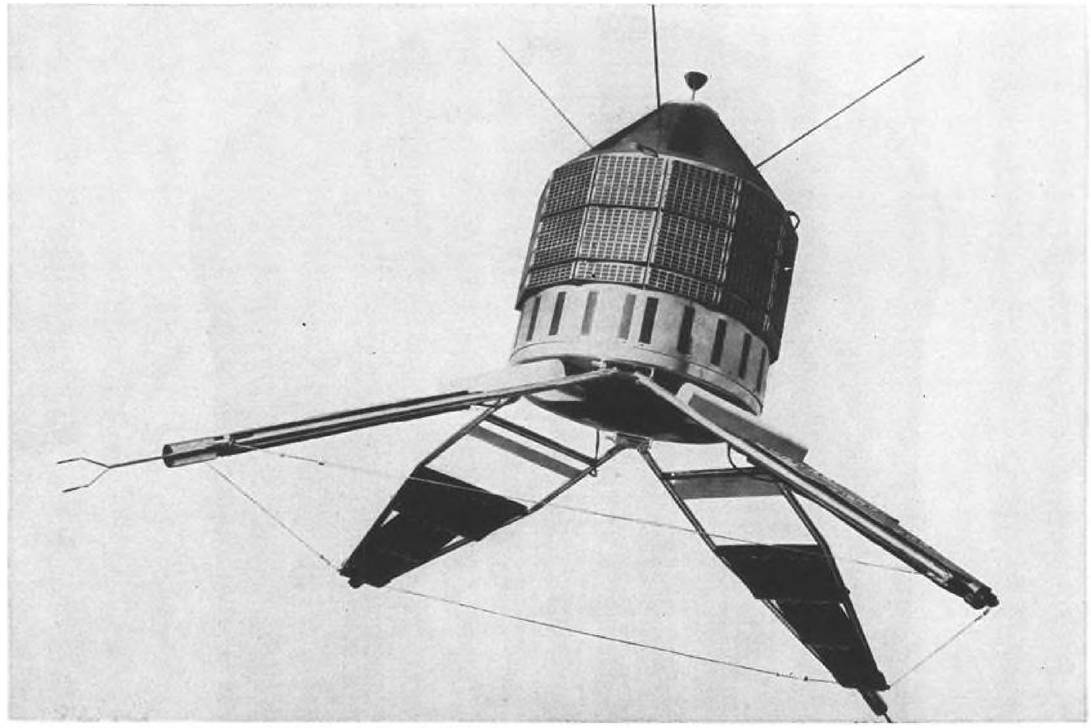
• **Japan**—Launch of three Nike Cajuns last year, and Aerobee 150A in September and several Javelin rockets next year, all to test a Japanese swept frequency resonance probe in combination with a NASA Langmuir probe.

• **New Zealand**—Launch of an Arcas last May from Birdling's Flat, N. Z., carrying an aerosol payload for wind diffusion and turbulence studies.

• **Norway and Denmark**—Series of seven Nike Cajun and Nike Apache launches from Wallops and Andoya, Norway, during the past two years to measure characteristics of the D and E regions.

• **Pakistan**—Continuing series of Nike Cajun and Nike Apache launches, which began in June, 1962, from Sormiani Beach, Pakistan, with sodium vapor payloads for wind studies.

• **Sweden**—Continuing series of Arcas and Nike Cajun firings from Jokkmokk and Kronogard, Sweden, with payloads to study noctilucent clouds.



FIRST SATELLITE DESIGNED and built by the British, UK3, is shown in model form, 5 ft. high and with a 7-ft. span across the booms.

UK3 Satellite to Carry Five Experiments

By Herbert J. Coleman

London—British Aircraft Corp. has begun cutting metal for the first all-British research satellite, the UK3, after long series of discussions between the Royal Society, British universities and the Royal Aircraft Establishment succeeded in freezing a five-experiment payload package.

The UK3 will be launched in about three years from Wallops Island, Va., with a four-stage Scout booster (AW June 17, p. 36). Main structure is being built by BAC Stevenage in collaboration with Marconi's Wireless and Telegraph Co. (AW July 22, p. 326).

First details on the UK3 payload package were outlined recently by Sir Harrie Massey, professor of physics at University College of London and chairman of the British National Committee on Space Research. Major details disclosed include:

• **Meteorological office experiment,** headed by Dr. R. Frith, to measure the vertical distribution of oxygen in earth's atmosphere at levels where molecular oxygen is being destroyed by solar radiation. Measurements will be made of the intensity of direct solar ultraviolet radiation as seen through the oxygen absorption region of the upper atmosphere at times when the UK3 is entering or leaving the earth's shadow.

• **Mullard Radio Astronomy** Observatory, Cambridge, measurement of the emission of radio noise from sources in the galaxy at frequencies too low to be observed from the ground, with sufficient angular resolving power to distinguish components from the galactic plane and the galactic halo against

British Payloads for U.S. Satellites

London—Under a plan formulated by National Aeronautics and Space Administration, British scientists now are allowed to compete on equal terms with their U.S. counterparts for payload space in U.S. scientific satellites.

Successful proposals so far in the large observatory family of satellites include:

• Study of solar helium resonance emission, an experiment by Prof. R. L. F. Boyd and Dr. A. P. Willmore, of University College of London, for inclusion in OSO-4 (fourth NASA Orbiting Solar Observatory, scheduled for launch in 1965).

• Distribution of total solar X-ray emission, a backup mission for OSO-4 in collaboration with Prof. E. A. Stewardson of the University of Leicester.

• Study of discrete sources of solar X-ray emission, selected for definite inclusion in OSO-4, to measure emission of X-rays from particular places in the sun and using scanning instruments.

• Study of X-ray emission from stars, an experiment developed by Prof. Boyd, Prof. Stewardson and Dr. Willmore and selected as a piggy-back experiment for OAO-3 (third NASA Orbiting Astronomical Observatory, scheduled for launch in 1966).

NASA also has asked Prof. Boyd and Dr. Willmore to provide, for installation in the S-48 Topside ionosphere sounding satellite, the mass spectrometer probe designed by them and carried in UKI, the Ariel satellite. The probe measures mass and temperature of atomic and molecular ions throughout the satellite's orbit.

isotropic flux. Dr. F. G. Smith is in charge.

• **University of Sheffield,** in an experiment headed by Dr. T. R. Kaiser, will measure very low frequency (VLF) radiation, its spatial and temporal variation and its spectrum. VLF noise intensity will be monitored at three fixed frequencies at a number of points around each orbit; frequencies are 3.2, 9.6 and 16 kc., harmonically related to facilitate calibration in flight. Wideband (about 1 kc.) and narrow bandwidth (100 cps.) will be centered on radio station GBR at Rugby to study field patterns.

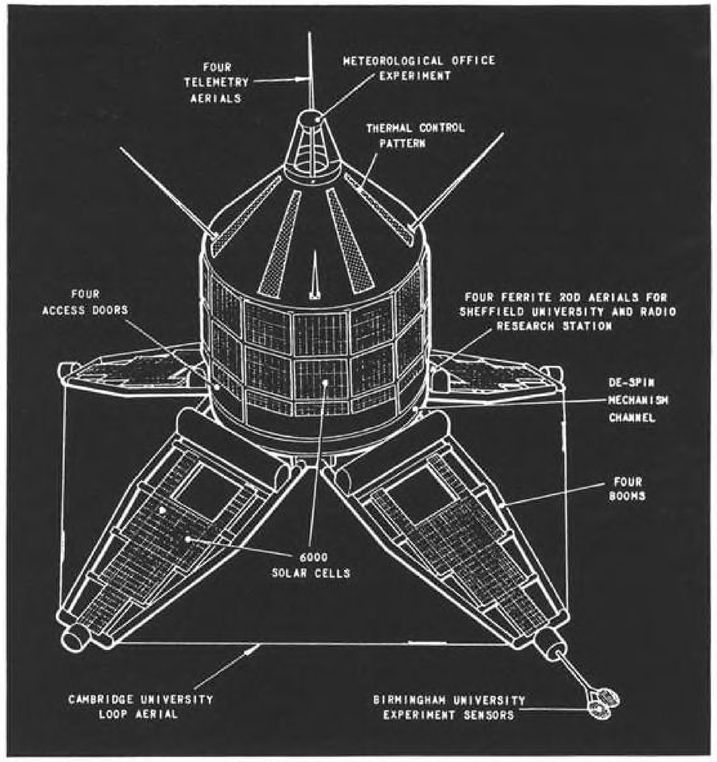
• **University of Birmingham** experiment devised by a team led by Prof. J. Sayers, will survey the ionosphere above the F_2 maximum by measuring the ionization density and temperature at frequent points along path of the satellite. The measurements will be made by a plasma probe developed by the Birmingham group for the British Ariel satellite but refined to take a higher frequency of 40 mc. and modified to enable measurement of electron temperatures.

• **Radio Research Station** team headed by J. A. Ratcliffe, plans to determine the flux of radio wave energy at the altitude of the satellite, at selected radio frequencies, from natural terrestrial sources (mainly thunderstorms) and the geographical distribution of the sources at different times of the day and different seasons. Ratcliffe said data will be used in the design of highly directional aerials and will help show to what extent radio noise is a potential source of interference to satellite radio receivers.

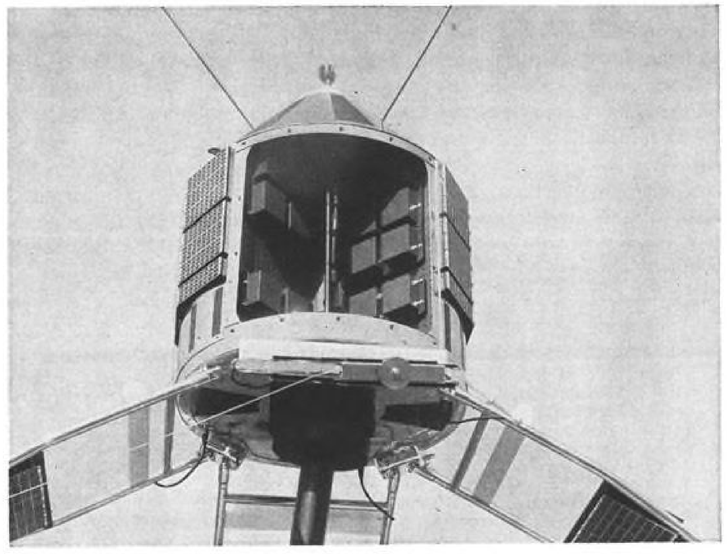
British Aircraft Corp. will build five UK3 satellites—the initial prototype, two fully equipped prototypes for testing, the flight model and a backup spare. The company now is building up to a 35-man engineering team at BAC's Guided Weapons Div. at Stevenage. Instrumentation will be provided by the division's Bristol works, which already has gained considerable experience in instrumenting the United States-built UK1 (Ariel) and UK2 satellites.

UK3 will enter a circular orbit. Present calculations based on the expected atmospheric density at the planned time of launch in 1966 indicate that a 400-mi. altitude will be satisfactory to carry out the five experiments.

Chosen angle of inclination will be 57 deg., which meets the requirements of the Radio Research Station experiment and the Meteorological Office program. The orbit will be attained by firing in a southeasterly direction from Wallops Island. After burnout of the third stage, the Scout nose cone will be jettisoned, leaving the satellite exposed atop the fourth-stage motor. The motor will then be ignited and spun by tangential rockets to maintain directional stability.



DRAWING OF UK3 (above) shows positioning of power system and five experiments devised by British scientists. Cruciform cross-sectioning (below) holds equipment and experiments. Semi-circular rods across booms near attachment points are aerials mounted in glass fiber. Total satellite weight is 150 lb.



BAC said the shape of the satellite represents a compromise between the conflicting requirements of power supplies, thermal control, aerials, the five experiments, structural strength and access. Over-all diameter, length and boom lengths were dictated by the Scout rocket.

Boom design was determined by the Birmingham experiment, which demanded that mesh paddles be mounted beyond a minimum distance from the

satellite body, with no solid material located outside a cone generated at the center of the boom. The erection mechanism consists of four hinges connected by a universal joint so that all four booms erect simultaneously and symmetrically to prevent wobble of the satellite.

Originally, all solar cells were mounted on the satellite body, but subsequent, experiment requirements necessitated removing some from the body and relocating them on the booms. By stretching cables between the boom tips, four loop aerials could be provided for the Cambridge experiment.

Solar Cells

About 6,000 solar cells will be built onto the satellite. Layout on body and booms gives a minimum change in projected area as the satellite rotates and tilts in relation to the sun line.

Trays holding the cell are designed so that additional cells can be installed at a later date without structural redesign, in the event the power requirement increases. Five experiments need a minimum of 5 w., but the solar cells will provide 15 w.

Upper cone and the bottom face of UK3 have been left uncovered to provide a sufficient ion-collecting area for the Birmingham experiment.

Basic structure of UK3 has been simplified so that the body consists of a central torque tube off which four honeycomb vanes are mounted in a cruciform layout. The tops of the vanes carry a fixed cone, insulated from the remainder of the structure, and the bottom ends are closed by a flat diaphragm. Vanes provide necessary mounting area for equipment and experiments; the outer edge of the bottom diaphragm carries a turned ring which mounts the de-spin mechanism, and the under surface carries the four trunnions for mounting the booms.

Ferrite Rod Aerials

UK3 includes four ferrite rod aerials —three for the Radio Research Station experiment and one for Sheffield University—which are mounted across the booms near the attachment to the body. Each is encased in a foam-filled glass-fiber cylinder bolted to the booms.

De-spin mechanism consists of a pair of weights, attached to steel ribbons, which are wound around the base of the satellite and locked by explosive bolts. On a time command, after fourth-stage separation, the bolts are fired and release the weights, which are thrown out centrifugally. Two mechanisms, consisting of oil-filled tubes containing sliding weights, are fitted in the satellite to damp nutation and to maintain a mass balance about the spin axis.

Batteries are of the sealed nickel-cadmium type, using ten 3-amp./hr. cells per battery. One battery is on standby while the other is in use. The control system connects one battery to the power distribution system while switching a trickle charge to the other.

A solid-state counter puts one battery on full charge for eight orbits, a total of about 12 hr., and then the other battery for the next eight orbits. At the end of the period, the first battery is put back on load.

Tape recorder is mounted at the bottom of the central torque tube in the satellite. The package includes a record and playback amplifier, playback timer, speed controller and a phase-shift oscillator to provide a three-phase supply to the capstan motor.

Two programmers are provided. No. 1 gives outputs to the recorder and telemetry transmitter, putting an identification tone on the transmitter at the receipt of a command and a tone marker on the tape. No. 2 provides two operation modes for the low-speed encoder at sunrise and sunset; mode 2 accepts only the Meteorological Office experiment output and mode 1 switches to all other experiments except the Meteorological Office 8 min. after sunrise.

PRODUCTION BRIEFING

Bell Aerosystems Co., Buffalo, N. Y. has received its $11.2 million subcontract from Grumman Aircraft Engineering Corp. to develop the ascent engine for the Lunar Excursion Module (LEM) of Project Apollo (AW Dec. 10, p. 35; July 22, p. 141).

Dynalectron Corp., Washington, D. C., has a $900,000 contract extension from Air Force for continued maintenance of aircraft and aircraft base facilities for the USAF Space Systems Div., at Los Angeles International Airport. Work will continue through June 30, 1964.

Beech Aircraft Corp., Wichita, Kan., has a $2.4 million Army contract for additional target missile work. Contract provides $1.6 million for production of Model 1025 Cardinal target missiles, $692,000 for flight service support at Ft. Bliss, Tex., and $51,000 worth of target system spares.

Avco Corp.'s Aerospace Structures Div., Nashville, Tenn., has received a $7.5 million follow-on contract from Lockheed-Georgia Co. for continued production of C-130 empennages.

Ryan Aeronautical Co., San Diego, Calif., has received a $1.5 million Army contract for follow-on flight testing of the Ryan-Army XV-5A V/STOL research aircraft. Additional funding provides for Army pilots to phase into the XV-5A flight test program scheduled for early 1964 at Edwards AFB after company test pilots have completed initial flight research.

Temco Electronics Div. of Ling-Temco-Vought, Inc. will continue to develop and produce fluid injection valves for the Titan 3 solid propellant first-stage rocket engines under terms of a new $2 million contract with United Technology Center, Sunnyvale, Calif.

Texas Instruments, Inc., Dallas, will lease an 18,000 sq. ft. manufacturing facility now under construction at Richmond Hill, Ontario, near Toronto, Canada. The facility will be used to manufacture thermostatic and electrical controls. Plant is expected to be in operation before the end of the year.

Kaman Aircraft Corp., Bloomfield, Conn., has a $418,362 subcontract from Grumman Aircraft Engineering Corp. to manufacture empennage sections for Army's Mohawk observation aircraft. The sections include three rudder surfaces, stabilizers and elevators. Deliveries will start in January.

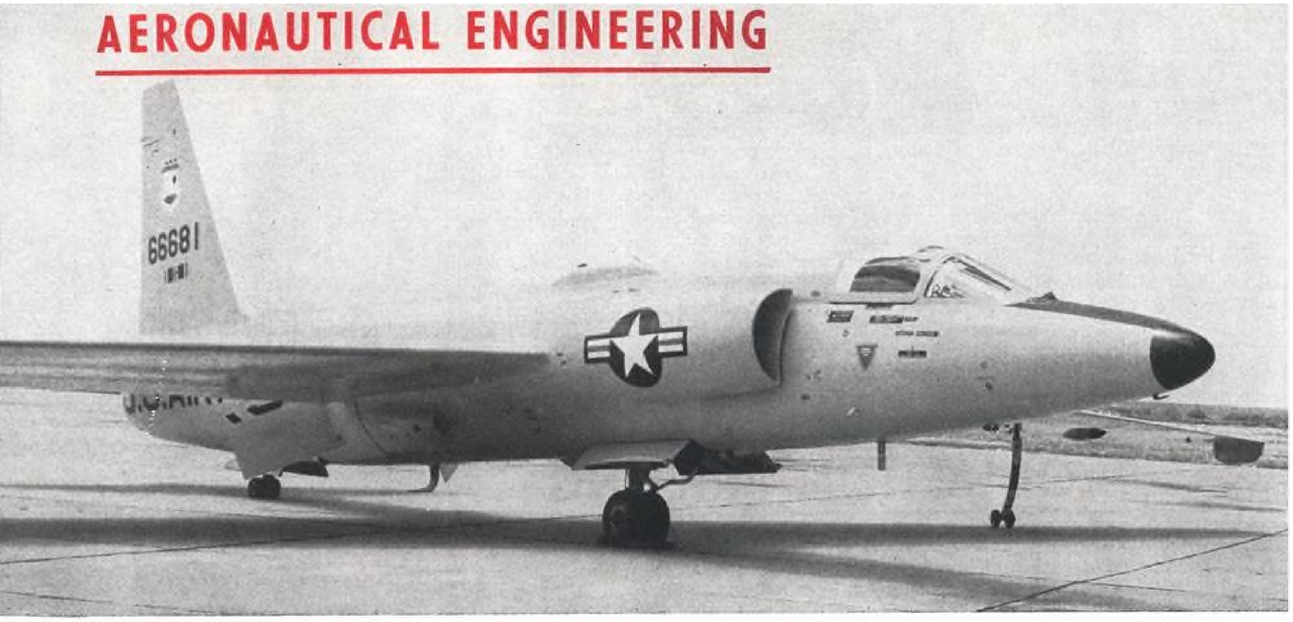
Kellett Aircraft Corp., Willow Grove, Pa., has created a new products department for promoting the firm's existing proprietary products, and for developing new ones as well as unique methods of materials handling.

International Aircraft Services, Inc., Oakland, Calif., has a $6.7 million Air Force contract for maintenance and modification of F-100 series aircraft. Work will be done in Oakland.

FMC Corp., New York City, has a $4 million Air Force contract for production of unsymmetrical dimethyl hydrazine (UDMH). Work will be done in Baltimore, Md.

Pratt & Whitney Div., United Aircraft Corp., East Hartford, Conn., has received a $5 million Bureau of Naval Weapons contract for continued general development and testing of the TF-30 engine for the F-111 (TFX) fighter. Previous obligations under this contract have totaled $32.7 million.

General Dynamics/Pomona, Pomona, Calif., has been awarded a $15 million contract for continued research and development work on the Mauler missile system.



WU-2 IN BASIC CONFIGURATION has canopy painted white at top and rear to reflect sun's rays. Semi-cylindrical hatch on lower fuselage just forward of front landing gear provides access to equipment carried on air sampling flights.

SAC U-2s Modified for Fallout Sampling

By C. M. Plattner

Tucson, Ariz.—Strategic Air Command's Lockheed WU-2 wing at Davis-Monthan AFB here is flying missions up to 8 hr. in length at altitudes as high as 70,000 ft. to gather high-altitude nuclear fallout samples. Typical mission covers a distance of about 3,000 naut. mi.

Weather designation, W, was recently added to the specially-equipped U-2 aircraft of the 4080th Strategic Wing. ("Reconnaissance" was deleted from the title of the wing in June by the Defense Dept.) New designation emphasizes the air-sampling mission of the wing, which moved here recently from Laughlin AFB, Tex.

WU-2s equipped for upper air sampling have special nose and side intakes. The nose intake is used to collect gaseous samples in three containers located in the forward nose section. On the lower left-hand side of the aircraft, an air particle intake brings air samples to a filtering system which extracts microscopic particles for analysis of particle density in the sampling area.

An engine-driven alternator provides the sampling equipment with primary a. c. power at frequencies varying from 370 to 415 cps., depending on engine speed.

Other Air Force U-2s of the Systems Command are based at Edwards AFB (AW Sept. 25, 1961, p. 243) and used in various weather reconnaissance missions, including photographing cloud patterns. However, since they are not engaged in upper air sampling, the Edwards aircraft are still designated JU-2s.

In support of its high-altitude sampling mission, the 4080th wing assigns small units, called operating locations (OLs) to foreign and other U. S. bases. Combat crews assigned to an OL are rotated approximately every three months. When flights over other countries are necessary, permission from that country is required.

Overflight Approvals

Currently, Canada, Argentina, Puerto Rico and Australia have granted overflight privileges in support of the research program. These countries also support the missions with rescue and ground communications services. OLs now are located at Eielson AFB, Alaska; Albrook AFB, Panama Canal Zone; Royal Australian Air Force Station, Laverton, Australia, and Barksdale AFB, La.

Other fields from which WU-2s have flown in the past, include Azezi International Airport, Buenos Aires, Argentina; Plattsburg AFB, N. Y.; Ramey AFB, Puerto Rico; Royal Air Force Station, Upper Heyford, United Kingdom; Royal Air Force Station, East Sale, Australia; Anderson AFB, Guam; Kadena AFB, Okinawa; Hickam AFB, Hawaii; Howard AFB, Panama Canal Zone; Laughlin AFB, Tex., and Minot AFB, N. D.

Technical direction for the High Altitude Sampling Program (HASP) is provided by the Defense Atomic Support Agency (DASA). HASP WU-2s now fly at constant altitudes between 50,000 and 70,000 ft. at 5,000-ft. intervals.

The Defense Atomic Support Agency would like to add higher-altitude sampling flights to its HASP program to gain more information about the nuclear debris in the upper atmosphere, but this would require different aircraft. A gain in information about long-range fallout of between 5 and 15% could be realized by flying missions at 75,000-ft. levels, according to DASA spokesmen.

Altitudes up to 90,000 ft. have been reported for U-2s powered by J-75-P-13 engines (AW May 23, 1960, p. 32). WU-2s of the 4080th are powered by Pratt & Whitney J-57-P-13A turbojet engines rated at 11,200 lb. of thrust at sea level.

On sampling flights, pilots wear dosimeters to guard against over-exposure to radiation. Only two pilots have been grounded temporarily for two weeks in the HASP program.

The pilots ordinarily spend between nine and 10 hr. in their partial pressure suits, including time spent pre-breathing oxygen. These partial pressure suits, when pressurized in an emergency, will maintain an equivalent altitude of about 29,000 ft. Before flights during which they can descend in the event of depressurization, pilots pre-breath oxygen for 30 min. When fuel considerations require that they maintain altitude in the event of depressurization, such as during flights over water, pilots pre-breathe oxygen 1 hr.

The pre-breathing procedure removes nitrogen from the body and prevents bends in the event cockpit pressurization is lost suddenly.

Aboard the WU-2, a standard 1,750-psi. oxygen system is used. The three-bottle system (of 500 cu. in. each) provides sufficient oxygen for over 8 hr.

All mission checkpoints and times are pre-computed on the ground prior to flight by a special navigation section. About 15 navigators are included in this section. Missions must be pre-planned because the cockpit of the WU-2 is too small to permit the use of tables and charts required for celestial navigation, although a remotely-controlled sextant is housed in a small glass bubble protruding from the upper nose section just forward of the cockpit.

Sextant Fixes

Fixes using this sextant are taken only to check pre-planned checkpoints, requiring close adherence to planned takeoff times. When using the remote sextant, the pilot observes the remote image on a screen in front of him and centers the celestial body inside a projected illuminated bubble to properly align the sextant. Rotation and elevation of the instrument is accomplished by means of manually-operated controls connected to the sextant through flexible cables.

Modifications have been kept to a minimum in the WU-2 and have only been implemented in the navigation and communications systems. No changes have been made to the basic airframe since the Air Force accepted the first three U-2s in mid-1956.

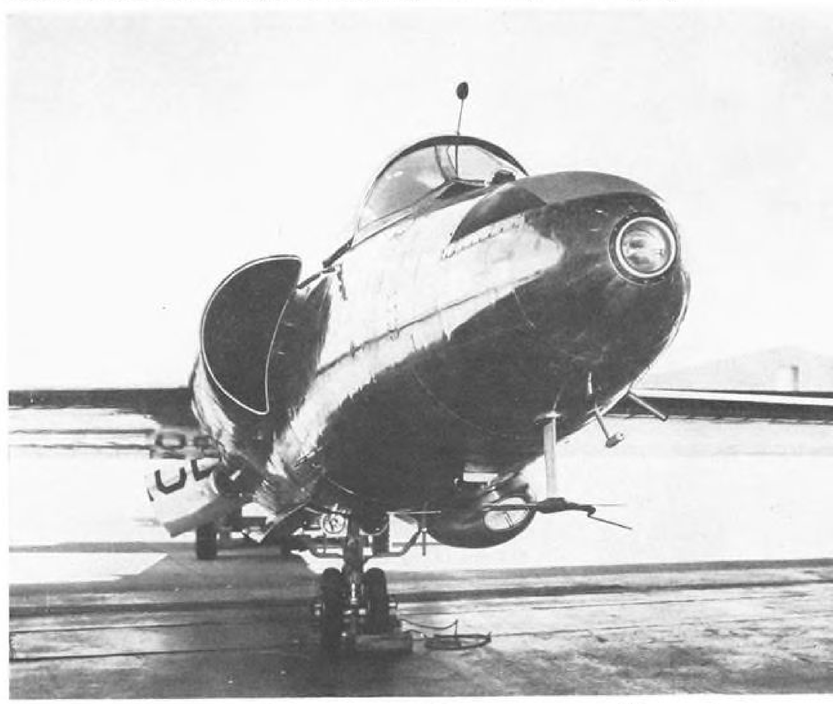
Avionics Equipment

Avionics equipment includes small, lightweight VOR and ADF units, with voice communication provided by multi-channel ARC 34 UHF and Collins 618T. High frequency radio is installed in an exterior fairing on the top of the center fuselage, added since the aircraft was manufactured.

A minimum of extra equipment is installed in the WU-2 and basic systems have been kept simple, using only standard, well-proved components.

Low-volatility fuel, MIL-F-25524A, is used in the WU-2 to prevent losses due to evaporation at high operational altitudes (AW May 23, 1960, p. 33). JP-4 can be burned in the WU-2's J-57, but tends to build up carbon deposits on the fuel injection nozzles, which shortens engine life due to irregular burning patterns. Use of JP-4, which also has a lower density, results in about a 2% loss in range.

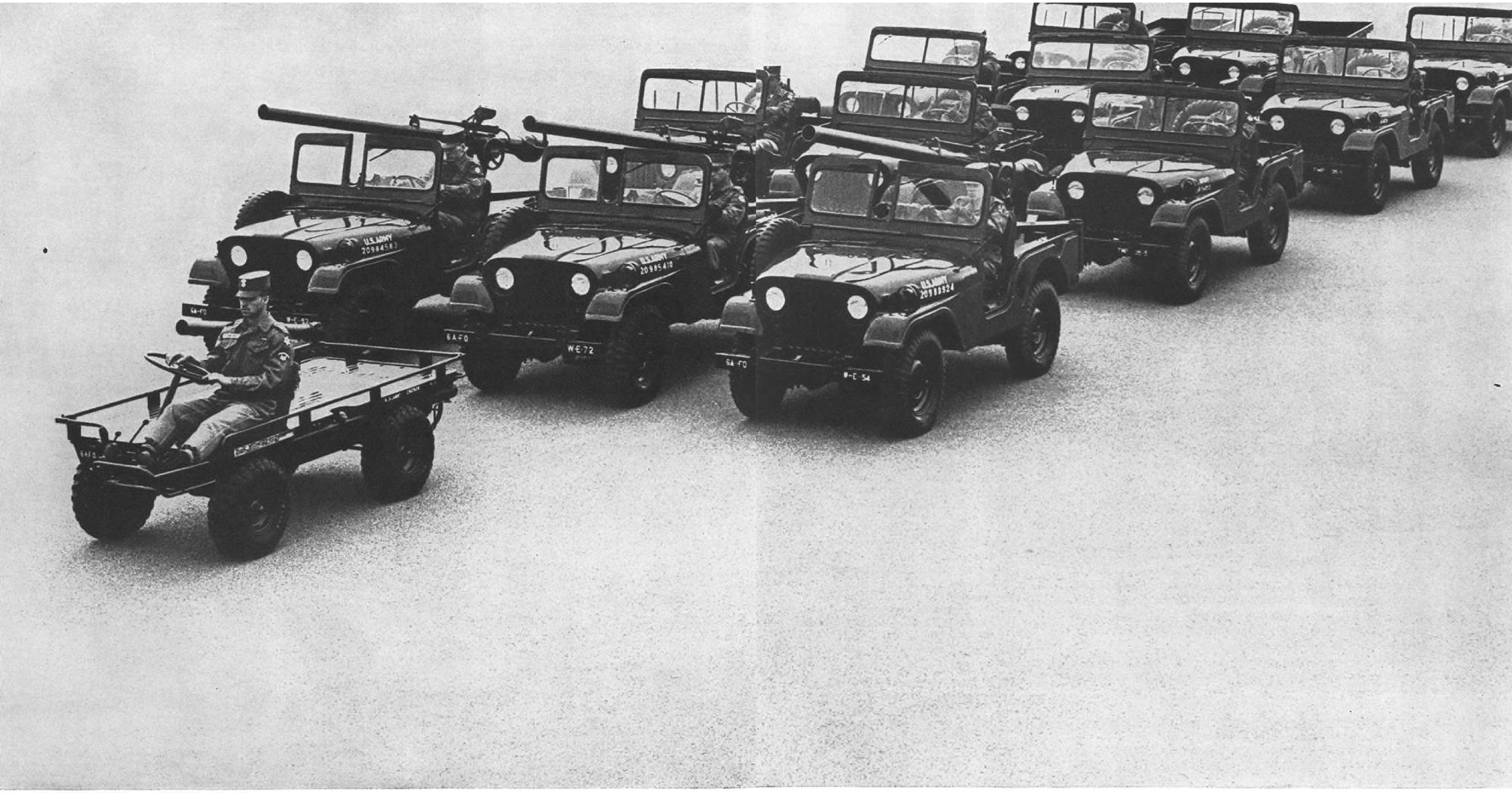
Take-off and landing speeds of the WU-2 vary between 90 and 100 kt., depending on fuel load and runway temperature. Initial rate of climb is about 6,000 fpm. with a climb angle of almost 45 deg. Although full power is usually used for takeoff and climb, maximum EGT of slightly over 600C restricts rpm. to 96 or 97% for takeoff on a hot day. Landings may be made with a cross-wind component of up to 15 kt. at 90 deg.



WU-2'S REMOTE SEXTANT (above) is located in front of cockpit. Pilot uses the sextant to check pre-planned navigation points. Remote indicator in the cockpit allows pilot to align sextant visually with remote hand controls. WU-2 (below) is shown fitted with nose and side intakes for upper air sampling. Nose intake is used to collect gaseous samples in three containers located in forward nose section. Filtering system extracts microscopic particles from the air and filters are analyzed to determine particle density in the sampling area.

Other components and key systems of the WU-2 configuration include:

• **Wet wing fuel system.** All fuel (1,335 gal. maximum) is carried in the wings, which require support on the ground when fully fueled. Removable outrigger gear, called Pogos, support



How much will one USAF StarLifter lift?

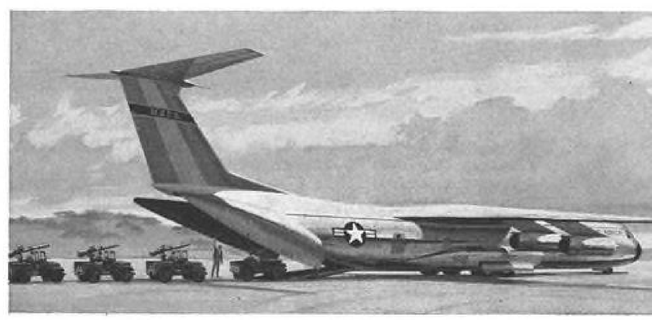
Twelve M151 ¼-ton utility trucks, three 106mm recoiless rifles, three ¼-ton trailers, one mechanical mule with rocket launcher. Total payload: 48,761 pounds. Distance transportable: 4,500 nautical miles.

This is a typical example of how the new C-141 StarLifter will give MATS the airlift power to increase the Army's air mobility.

The StarLifter will also transport 154 troops, 127 paratroops. And it can carry many combinations of men and machines, including outsize vehicles that never could be airlifted by jet before.

The C-141's truck-bed height or drive-on ramp rear-loading design permits immediate access to the 7,000 cubic foot clear cube cargo area. For palletized cargo, the C-141 will use the new 463L mechanized loading system. In a matter of minutes, the big turbofan airlifter can be loaded and be on its way.

Progress report: The first C-141 StarLifter is scheduled to fly this December, starting military and commercial certification testing.



Lockheed C-141 StarLifter

LOCKHEED-GEORGIA COMPANY: Marietta, Georgia – a division of Lockheed Aircraft Corporation

the wing during ground operations. Fuel flows by gravity to a fuselage sump tank where a hydraulically-driven fuel pump pumps the fuel to the engine. Electric pumps in each wing level the fuel load in flight. Each wing has two filler ports to expedite refueling. The aft filler port, which is lower than the forward filler port, also acts as a mark for limited fuel loads.

• **Tandem gear.** Forward gear has dual wheels and standard hydraulic disc brakes. The rear gear, which is steerable, has dual solid rubber wheels. Tow attachment points are located on the rear gear. Aircraft ideally is landed on both main gear at the same time. During landing another WU-2 pilot, stationed near the landing end of the runway, talks the pilot down through the last 10 ft. of his landing, due to poor visibility from the cockpit. Pogos, which drop off under their own weight after takeoff, are installed quickly after landing to prevent fuel from transferring from the up-wing to the down-wing. Pilot keeps the aircraft balanced on the tandem gear as long as possible and the plane then drops off on one wing and skids along the runway on the special wing-tip skid until it comes to a stop.

• **Hydraulic system.** The high-pressure system operates at approximately 3,000 psi. An engine-driven pump supplies system pressure to actuate and drive the landing gear, speed brakes, flaps and fuel pump.

• **Electrical system.** An engine-driven generator supplies 28 v.d.c. current, part of which is converted to ac. by a three-phase, 400 cps. inverter to power flight instruments, radios and autopilot. As described earlier, a separate alternator supplies the sampling gear.

• **Control surfaces.** Standard rudder, elevator and aileron control surfaces are actuated through direct mechanical linkage. A yoke, rather than a stick, is used for aileron and rudder control. Rudder pedals are used for steering the aft main gear while taxiing, as well as for rudder control.

TECHNICIAN from Strategic Air Command's 4080th Strategic Wing is shown loading the nose filter on a Lockheed WU-2 with filter papers. Isotopes, Inc., Westwood, N. J., analyzes the filters brought back from high-altitude atmospheric sampling flights.

Other mission capabilities of the squadron include photographic reconnaissance, radar calibration and acting as targets for intercept aircraft. The unit was credited with obtaining the first conclusive photographic evidence of the build-up of Russian missiles in Cuba last year. The unit was presented an outstanding unit award for high-altitude photo missions over Cuba. Maj. Rudolf Anderson, Jr., who was killed on a photo mission when hit by an SA-2 missile, was a member of the 4080th. His U-2 was hit after descending to an altitude of approximately 30,000 ft. to get under a high cirrus cloud cover.

Designed by Clarence L. (Kelly) Johnson of Lockheed, the WU-2 is a conventional straight-wing design which has a low wing loading of about 25 psf. Only standard, well-proved components have been used which, coupled with the simple design of the aircraft's systems, provides an exceptionally high availability rate (AW Sept. 25, 1961, p. 244), due to ease of maintenance.

WU-2 Role in Fallout Detection

USAF Lockheed WU-2 aircraft, flying at altitudes up to 70,000 ft., in Defense Atomic Support Agency's high altitude sampling program (HASP) have played a key role in detecting and tracing radioactive materials deposited in the upper atmosphere by nuclear tests.

According to predictions released in June by the Federal Radiation Council, based largely on information supplied by DASA, the total of all radiation due to fallout of radioactive materials such as Cesium-137, Strontium-90 and Carbon-14 will peak in 1963 and recede by 1965 to approximately 1961 levels. These predictions show that the level is below that which would justify purification of foods such as milk, however.

The Russians contributed heavily to a high level of radioactive fallout expected in 1963 by injecting 60 megatons of fission yield (equivalent energy released as the result of nuclear fission) in 1962. The U. S., in the same year, injected 11 megatons of fission yield.

Samplings of upper air show that the Strontium-90 concentration in Jan., 1963 below 55,000 ft. in the northern hemisphere was about 2 megacuries compared to 1 megacurie of Strontium-90 in Jan., 1962. Almost all debris present up to 55,000 ft. in January falls out within the same year. Roughly 80% of the Strontium-90 in the stratosphere observed in Jan., 1963 was due to tests conducted in 1962.

Strontium-90 is chemically similar to calcium and when introducted through food such as milk or vegetables makes its way into the bone structure of the body. The Strontium-90 level is of considerable concern because the radioactivity associated with it may lead to leukemia or bone cancer.

Information from high-altitude sampling flights flown since 1957 has also been used to verify the amount of above-ground testing performed by other countries, although it is not primarily used as a detection source. Long-range fallout in the upper atmosphere moves eastward around the globe, roughly paralleling the latitude lines, and sampling aircraft intercept the debris by flying north and south legs which collectively span the area from the North Pole to the Antarctic Ocean.

Other SAC aircraft used in the high-altitude sampling program are: RB-57s, RB-52s, WB-50s and C-130s. These aircraft are used to sample at altitudes of 45,000 ft. and below.

The long-range fallout material in which DASA is interested is composed of 0.5 to 1.5 micron nuclides too light to be affected by gravity. These particles behave much in the same manner as air molecules. Typical nuclides are formed when metallic Strontium-90 or Cessium-137 attach themselves to ammonium sulphate or ammonium persulphate particles.

Approximately 30% of the long-range fallout from U. S. tests comes down in the southern hemisphere, while practically all of the debris due to Russian tests falls in the northern hemisphere. Ths primarily is because U. S. tests are conducted at lower latitudes.

For a given year, approximately 70% of the long-range fallout deposited in the northern hemisphere will come down through the tropopause between March 1 and May 30. The majority of this fallout will come down in a band from 30 to 50 deg. north latitude. It is theorized that the material is sucked through the discontinuity in the tropopause at mid-latitudes by large, low pressure cells moving in a generally easterly direction. The material then is scrubbed from the air by snow or rain.

The half-residence life length of time required for 50% of the long-range fallout to reach the earth of USSR yields from 500 kilotons to 10 megatons is 5 to 6 months. For USSR yields above 10 megatons, the half-residence life is 1 year. In U. S. tests, half-residence life of yields between 500 kilotons and 2 megatons is 1 year, while for yields above 2 megatons it is 3 years. Long-range fallout of USSR tests has a shorter half-residence life because tests are conducted at higher latitudes.

Firms Report Officers' Salaries

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:

Aerojet-General Corp.—A. H. Rude, chairman of the board, $100,000 salary, 2,503 shares of common stock in The General Tire & Rubber Co.; D. A. Kimball, president, $98,000 salary, 220 shares of common stock in Aerojet-General, 38,335 shares of common stock in The General Tire & Rubber Co.; W E. Zisch, executive vice president and general manager, $95,000 salary, 3,295 shares of common stock in The General Tire & Rubber Co.; R. I. McKenzie, vice president, treasurer, $70,750 salary, 204 shares of common stock in Aerojet-General, 4,992 shares of common stock in The General Tire & Rubber Co.; T. E. Beehan, secretary and assistant treasurer, $42,500 salary, 4,849 shares of common stock in The General Tire & Rubber Co.; M. G. O'Neil, director 266,976 shares of common stock in The General Tire & Rubber Co.; J. O'Neil, director (elected 3/28/62), 347,438 shares of common stock in The General Tire & Rubber Co.; L. A. McQueen, director, 35,-921 shares of common stock in The General Tire Rubber Co.; F. W. Knowlton, director, 6,011 shares of common stock in The General Tire & Rubber Co. All salaries are for the fiscal year ending Nov. 30, 1962. All stock beneficially owned as of Jan. 1, 1963.

Aeronca Manufacturing Corp.—John A. Lawler, president and director, $60,000 salary, 40,275 shares of common stock (including 400 shares held by associates); S. J. Kuderer, vice president-finance, secretary-treasurer, and director, $37,500 salary, 395 shares of 5½% prior preferred stock, 1,175 shares of common stock; D. B. Cowie, director (elected Nov. 9, 1962), 100 shares of 5½% prior preferred stock; F. D. Danford, director, 8,022 shares of common stock; J. Slezak, director, 105 shares of common stock; R. A. Dadisman, director, 130 shares of 5½% prior preferred stock, 2,000 shares of common stock; R. E. Harrison, director, 625 shares of 5½% prior preferred stock, 1,800 shares of common stock; G. C. Hill, director, 525 shares of common stock; T. W. Jones, director (elected Nov. 9, 1962), 525 shares of common stock; J. M. Lockhart, director, 1,560 shares of common stock (including 360 shares held by associates); A. Verity, director; T. D. White, director, 100 shares of 5½% prior preferred stock, 100 shares of common stock. Stock owned Mar. 1, 1963.

American Bosch Arma Corp.—C. W. Perelle, president and director, $140,000 salary, 10,100 shares of common stock; C. A. Sharpe, senior vice president, $65,000 salary; V. C. Schorlemmer, vice president, $46,000 salary; C Allen, Jr., director, 40,457 shares of common stock (owned by Allen & Co., of which Mr. Allen is a general partner); F. W. Harder, director, 8,600 shares of common stock; J. L. Holtzmann, director, 1,172 shares of common stock (in addition, 1,689 shares are owned by Howard M. Holtzmann, a member of the firm of

U.S. Business & Utility Plane Shipments

May 1963

Make & Model	No. of Units	Net Billings
Aero Commander 500A, B	6	
560F	2	$852,000
680F	2	
Beech Super 18	1	
23 Musketeer	40	
33 Debonair	12	
35 Bonanza	22	$3,617,000
50 Twin-Bonanza	1	
55 Baron	22	
65 Queen Air	2	
80 Queen Air	5	
Cessna 150	40	
172, Skyhawk	93	
P172	3	
175 Skylark	7	
180	19	
182 Skylane	44	$4,011,000
185 Skywagon	5	
205	28	
210	8	
310	11	
320 Skyknight	3	
336 Skymaster	9	
Champion 7GCBA Agricultural	3	$133,000
402 Lancer	7	
Mooney Mark 20D Master	8	$630,000
Mark 21	37	
Piper PA-18-150 Super Cub	17	
PA-22-108 Colt	23	
PA-23-235 Apache	10	
PA-23-250 Aztec	18	
PA-24-180 Comanche	4	$3,191,000
PA-24-250 Comanche	18	
PA-25-235 Pawnee	58	
PA-28-150 Cherokee	3	
PA-28-160 Cherokee	3	
PA-28-180 Cherokee	58	
Totals	652	$12,434,000

Note: This brings total for January through May to 3,167 aircraft delivered having a net billing value of $61,260,000 exceeding the same period last year by nearly 200 aircraft and nearly $1 million in net billings. Above shipments table marks initial deliveries of twin-engine center-line-thrust Cessna Skymaster by the factory.

Holtzmann, Wise, & Shepard); J. E. Parker, director (elected Mar. 21, 1962), 1,000 shares of common stock; R. F. Peo, director, 500 shares of common stock; M. L. Sindeband, director, 132 shares of common stock; G. C. Textor, director, 135 shares of common stock; W. S. Wasserman, 202 shares of common stock. All stock beneficially owned as of **Mar. 1, 1963.**

The Bendix Corp.—M. P. Ferguson, president and director, $156,749.96 salary, 11,307 shares of stock; A. P. Fontaine, executive vice president and director, $86,499.96 salary, 1,185 shares of stock; E. K. Foster, vice president and director, $83,749.92 salary, 3,538 shares of stock; W. H. Houghton, vice president, treasurer, and director, $84,375 salary, 7,523 shares of stock; R. P. Lansing, vice president and director, $88,175 salary, 6,979 shares of stock; L. F. Polk, vice president and director, $38,900.04 salary, 4,230 shares of stock as of the same date, Mr. Polk had a reversionary interest in 9,855 shares of stock of the corporation with a right to receive such shares upon termination of certain trusts on or subsequent to Feb. 2, 1964); G. E. Stoll, executive vice president and director, $107,750.04 salary, 6,348 shares of stock; H. B. Baker, director, 2,360 shares of stock (as of the same date, Baker, Weeks & Co., of which Mr. Baker is a general partner, was the record holder of 3,152 shares of stock of the corporation, in none of which it had a beneficial interest); J. D. Biggers, director, 210 shares of stock; L. I. Doan, director, 200 shares of stock; E. Kanzler, director, 1,180 shares of stock; H. J. Loynd, director, 200 shares of stock; C. S. H. Mott, director, no stock holdings (as of the same date, the Charles Stewart Mott Foundation was the record holder of 23,594 shares of stock of the corporation, and members of the Mott family group owned 33,821 shares); E. R. Palmer, director, 942 shares of stock. All stock beneficially owned as of Jan. 1, 1963.

The Boeing Co.—W. M. Allen, president and director, $99,600 salary (this amount does not include $25,000 of Mr. Allen's salary for the year 1962 or an award under the incentive compensation plan for the year 1961 made to Mr. Allen in Mar. of 1962 of $7,220 in cash and $7,155 in capital stock of the company, which amounts were credited to a deferred compensation account under an employment agreement entered into as of Sept. 1, 1960), 10,811 shares of stock; W. E. Beall, senior vice president and director, $87,800 salary, 5,676 shares of stock; J. E. Prince, vice president-administration, secretary, and director, $53,900 salary, 1,809 shares of stock; E. C. Wells, vice president, general manager-military aircraft system div., and director, $81,700 salary, 4,870 shares of stock; J. O. Yeasting, vice president, general manager-transport div., and director, $64,900 salary, 4,111 shares of stock; W. L. Campbell, director, 200 shares of stock; C. L. Egtvedt, director, 18,421 shares of stock; D. A. Forward, director, 530 shares of stock, $2,200 principal amount of debentures (convertible until maturity unless previously redeemed into capital stock at the conversion rate of two shares of stock for each $100 principal amount of debentures—equivalent to a conversion price of $50 a share, subject to adjustment in certain events as provided in the indenture); A. L. Gates, director, 648 shares of stock; L. P. Mickelwait, vice president-industrial and public relations (entered office May 24, 1962) and director (elected Oct. 12, 1962), no salary paid in 1962 (annual benefits to be paid to Mr. Mickelwait upon his retirement from active employment with the company, pursuant to terms of an employment agreement entered into as of May 29, 1962), 100 shares of stock; W. G. Reed, director, 1,446 shares of

stock; D. E. Skinner, director, 300 shares of stock; G. H. Weyerhaeuser, director, 500 shares of stock. All stock beneficially owned as of Feb. 1, 1963.

Borg Warner Corp.—R. C. Ingersoll, honorary chairman of the board, $43,101 salary, 5,500 shares of common stock (4,000 additional shares of common stock are held in a trust, for which Mr. Ingersoll is not a trustee and in which he holds no beneficial interest, established by Mr. Ingersoll for members of his family); R. S. Ingersoll, chairman and chief executive officer, $185,000 salary, 2,740 shares of common stock (1,000 additional shares of common stock are held in a trust, of which Mr. Ingersoll is trustee, established by him for his children); L. G. Porter, president, $165,000 salary, 2,664 shares of common stock; R. W. Murphy, vice president, general counsel, and chairman of the executive committee, $120,000 salary, 686 shares of common stock; A. Steg, vice president and treasurer, $120,000 salary, 3,000 shares of common stock; E. S. Russey, president and general manager-Warner Gear Div., $162,500 salary, 5,131 shares of common stock; E. F. Ball, director, 18,240 shares of common stock (2,925 additional shares of common stock are held in trusts established by Mr. Ball for his children; he is neither trustee nor has he any beneficial interest in such trusts); C. S. Davis, Jr., director, 7,872 shares of common stock; P. H. Davis, director, 18 shares of common stock (3,258 additional shares of common stock are held by a trust under which Mr. Davis is entitled to the net income and has certain powers of administration, but of which he is neither trustee nor trustor and of which shares he does not have beneficial ownership); A. E. Duncan, director, 12,700 shares of common stock; J. R. Forgan, director, 300 shares of common stock; G. A. Freeman, Jr., director, 100 shares of common stock; H. G. Ingersoll, director, 5,000 shares of common stock; Ray P. Johnson, director, 28,800 shares of common stock; W. G. Karnes, director, 100 shares of common stock; J. Madden, director, 100 shares of common stock; G. S. Moore, director, 100 shares of common stock. All salary figures include fees and incentive compensation awards. All stock beneficially owned as of Mar. 1, 1963.

Test Time for ASW Aircraft Is Reduced

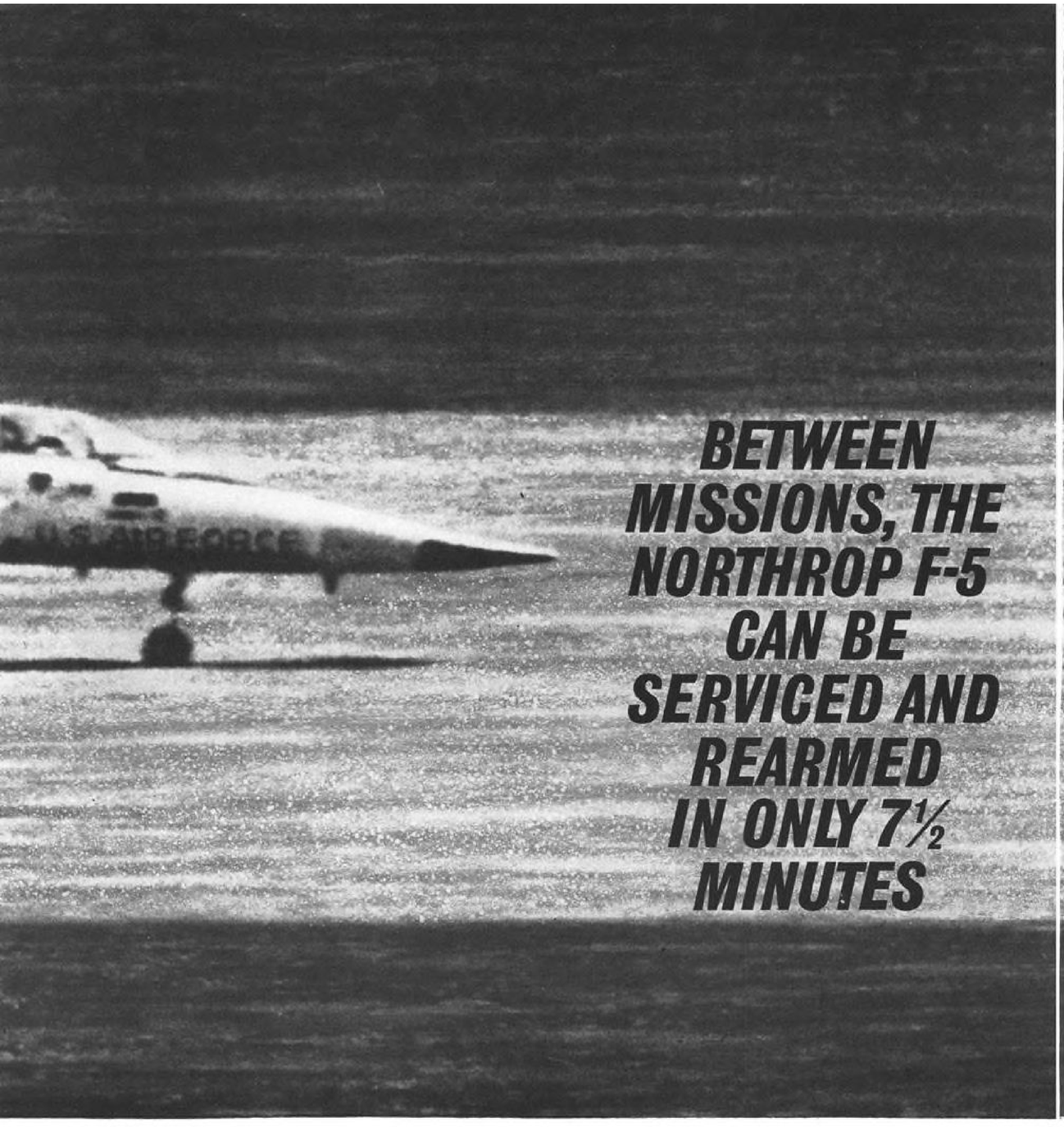
Washington—Pre-flight test time for the complex electronic gear in the Navy's Lockheed P-3A Orion anti-submarine warfare (ASW) aircraft has been cut from 8 hr. to 43 min. through use of the Martin Co. Test and Training Central (TTC).

While still in development, a TTC unit helped in readying ASW aircraft during the Cuban blockade last fall.

The production TTC will be a self-contained mobile unit housed in a delivery-type truck. Formerly, manual checkout procedures using a variety of equipment took 6 to 8 hr. to complete. TTC has more automatic features and is more thorough.

TTC is also being built for use with Lockheed P-2H Neptune and Martin P-5A and B Marlin aircraft. Its use with the Grumman S-2D ASW aircraft and the Sikorsky SH-3A is being studied.

Operators in the TTC van listen to tapes containing pre-recorded monitoring instructions while the tape-controlled automatic checkout sequence is proceeding. The TTC can be used as a training device by switching tapes.



BETWEEN MISSIONS, THE NORTHROP F-5 CAN BE SERVICED AND REARMED IN ONLY 7½ MINUTES

After returning from an intercept mission, the F-5 can be serviced and rearmed, ready for another mission, in an amazingly short time. Just 7½ minutes.

The reason for this fast turnaround time is that the F-5 is extremely easy to service. Approximately one-fourth of the fuselage area is composed of doors and panels which permit rapid access to all internal components. All systems are easily accessible from ground level without special workstands or ladders. Refueling can be accomplished quickly at a single point.

The F-5 is a highly practical supersonic fighter in many ways. It can operate from the sod fields and unimproved runways of forward-area bases. It consumes half the fuel of other contemporary supersonic fighters. In operational squadrons, the F-5 will require considerably less man-hours of maintenance per flight hour than other supersonic fighters.

With all this practicality, the F-5 also delivers high performance. In ferry configuration, it has a range of 1,650 nautical miles. It can carry 6,200 pounds of ordnance payloads and extra fuel. It can perform air superiority, reconnaissance, attack, or close support missions. It can climb 30,000 feet per minute from sea level, and fly supersonic to altitudes above 50,000 feet.

NORTHROP F-5

Assembly of XB-70 Prototype Completed

Dayton, Ohio—Last major problem in assembly of the first of three USAF-North American XB-70 prototypes—sealing of a fuel tank before welding the wings to the fuselage—has been completed, according to Aeronautical Systems Div. at Wright-Patterson AFB here.

First flight test is still scheduled for the end of this summer, even though final wing tank sealing was about two weeks late. Brig. Gen. Fred J. Ascani, USAF B-70 project chief, qualified this, however, by saying that first flight test could come as late as the end of the year, even though no other major problems remain.

Remaining to be accomplished is welding of the wings to the fuselage, followed by sealing and pressure checking of three body fuel tanks. The wing tanks will be rechecked after welding. Wing alignment to within 2 in. of the stubs and installation of shear ties, now in progress, precede welding of the wings to the fuselage. Alignment tolerances are ±0.002 in. The welding schedule is 24 days and consists of four individual 82-ft. welds. Status of wing welds and estimates of slippage in the assembly schedule will be made Aug. 20, according to Wright-Patterson officials.

Hydraulic lines have been tested to 6,000 psi., which is 2,000 psi. over design requirements, with a jury rig used to check wing hydraulics. All subsystems are already in place in the aircraft, engines are installed and the cockpits are completely finished and tested.

First flight will include ferrying the XB-70 from North American's Palmdale plant to Edwards AFB, where the flight test program is to be conducted. First flight probably will not be supersonic, although this is still being considered.

No further techniques or hardware need to be developed at this time, in contrast to last fall when slippage of the first flight dates began due to sealant problems. At that time, the basic problem of low-quality honeycomb was compounded by honeycomb damage caused by workers inexperienced in its handling. The difficult problem that then resulted was sealing the repaired portions of the 0.006-in. to 0.011-in. honeycomb face surfaces.

The repair technique was to cut a plug to replace the section enclosing the damaged area and spot-braze the plug into place.

In some repairs, a flat piece of material, called a doubler, was laid over the plug and spot-brazed to the skin.

Initially, metal-to-metal sealing of the plugs resulted in excessive leakage rates from the fuel tanks. Leakage rates were determined by filling the dry fuel tanks with helium and using a helium leak detector—a mass spectrometer—to determine helium outflow. Normal operation of the XB-70 calls for tanks filled with JP-4 and pressurized with nitrogen. Both JP-4 and nitrogen have much lower leakage rates than the small helium atoms used in ground testing.

North American was unsuccessful at first in using metal-to-metal seals, so together with Wright-Patterson's Field Control Laboratory, it developed a high-temperature elastomer sealant called Viton B which they applied to the brazed plug areas to seal them. They are now returning to metal-to-metal seals as a result of improved capability in sealing techniques attained during this phase of the B-70 program.

Along with handling techniques, the quality of the honeycomb has improved to the extent that its use is no longer considered a problem.

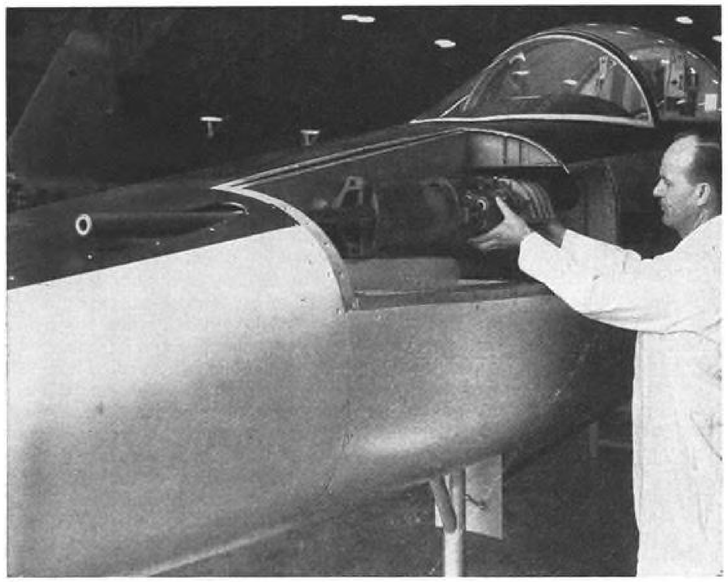
The second XB-70 is now 60% completed with most of the forward fuselage assembled. It has a June-July, 1964 flight date. Panel work on the third prototype is under way. It is about 30 to 40% completed and will be slightly different from the first two models. The third prototype will be equipped with an integrated bombing and navigation system which made necessary a bigger cooling system to accommodate the additional environmental control requirements of the bombing-navigation system and a bomb-bay door. It is scheduled for a December-January, 1964-65 flight date.

The B-70 program will terminate in January, 1966, unless it is extended. By that date, all necessary test data and flight time will have been logged, according to the present schedule. The total over-all allocation for the program is $1.3 billion.

Mass production of the aircraft is

CH-46A Sea Knight Completes Blade-Folding Tests

Boeing Vertol-Marine Corps CH-46A Sea Knight helicopter has completed powered blade-folding tests at Vertol's Flight Center, Philadelphia International Airport, prior to delivery to the Navy. Blade-folding is designed to facilitate storage aboard carriers. Auxiliary power plant is used in folding and unfolding for electrical and hydraulic power. Blades have a 25-ft. radius.



M39 Cannon Installed on F-5A Mockup

One of two M39 20-mm. revolving-chamber cannon is shown being installed in full-scale mockup of the nose of a Northrop F-5A jet fighter-bomber. M39s, built by Springfield Armory and General Motors' Pontiac Motors Div., can fire at a rate of 3,000 rounds/min. Cannon will be fitted on F-5A beginning with fifth production plane.

expected to present no real problems should the program be continued.

The Senate and House appropriated $363.7 million more than the Kennedy Administration requested for the RS-70 program last February (AW Mar. 4, p. 26). The $363.7 million would be part of $1,070,000,000 needed to build two additional prototypes beyond the three already being assembled. The RS-70 exists primarily as a reconnaissance design concept and has not progressed any farther, due to the intense controversy linked to the program since its inception. The XB-70 designation refers to the first three prototypes.

Production emphasis would be on quality control rather than on highly skilled labor which is not required for assembly operations. Each honeycomb is X-rayed before assembly, which consists primarily of welding panels together. Most honeycomb repairs that might be necessary would be made using the plug system without any degradation of the airframe's structure.

FINANCIAL BRIEFS

Cohu Electronics, Inc., had first six months of 1963 sales of $4 million with a net income of $202,190 or 14 cents per share. Same period last year showed sales of $3.3 million and a net profit of $18,152, equal to 1 cent per share. Backlog stood at $7.8 million on June 30 compared with $3.7 million in 1962.

Pacific Airmotive Corp. and subsidiaries had sales totaling $13.7 million with a loss of $120,000 equal to 14 cents a share for the six-month period ending May 31. Comparable figures for last year showed sales of $15.8 million with a profit of $190,000, equal to 26.5 cents per share.

Breeze Corp., Inc., report first half 1963 earnings of $109,995, or 20 cents per share, on sales of $5.6 million. Earnings for a comparable period last year were $76,114 or 14 cents per share on sales of $5.3 million. The firm attributes the increases to aerospace sales and riot control products.

Texas Instruments, Inc., Dallas, reports sales of $68.5 million with earnings of $2.8 million—70 cents per share—for the second quarter ended June 30. Comparable period last year showed sales of $62.3 million and earnings of $2.4 million—59 cents per share.

Electronic Communications, Inc., St. Petersburg, Fla., had a net income of $323,683, 41 cents per share, on sales of $17.7 million for the nine-month period ended June 30. Same period last year showed $450,263—60 cents per share—earned on sales of $25.9 million.

Republic Aviation Corp. reports consolidated sales of $178.6 million with earnings of $3 million, equal to $1.09 a share, for the first six months of 1963. First six months of 1962 showed sales of $134.6 million with earnings of $2.7 million, equal to 95 cents per share. June 30 backlog was $411 million.

North American Aviation, Inc., had a net income of $27.9 million—$3.33 per share—on sales of $1.3 billion for the nine-month period ended June 30. Comparable period last year showed North American with a net income of $24.5 million—$2.94 per share—on sales of $1.1 billion. Backlog on June 30 totaled slightly over $1 billion compared with $1.1 billion on June 30, 1962.

Motorola, Inc., had sales of $172.2 million and profits of nearly $5 million —equal to $1.22 a share—for the first six months of 1963. Sales last year were $159.6 million with earnings of $5.7 million, equal to $1.41 per share.

Baldwin-Lima-Hamilton Corp. earned $22,114 on sales of $67.6 million for the first six months of 1963. Comparable figures last year showed $1.4 million earned on sales of $70.9 million.

General Dynamics Corp. had a consolidated net income of $26 million, equal to $2.60 per share, on sales of $706.2 million for the first half of 1963. First half of 1962 showed $22.8 million, or $2.29 a share, earned on sales of slightly over $1 billion. Decline in sales was attributed to completion of the B-58 bomber and Atlas missile base construction programs. Company's backlog stands at approximately $2 billion.

Aeronca Mfg. Corp. had sales of $13 million and profits of $57,443 for the first six months of 1963. Same period last year showed sales of $14.3 million with a net loss of $610,932.

United States Steel Corp. had sales of $1.9 billion and earnings of $103.1 million, or $1.67 per share, for the first half of 1963. First half of 1962 showed sales of $1.9 billion and earnings of $96 million, equal to $1.54 per share.

Lockheed Aircraft Corp. reports net earnings of $21.5 million, equal to $2.03 per share adjusted for the 4-for-3 stock split made June 28. Sales totaled $902 million for the first six months of 1963. Comparable figures for last year showed earnings of $16.5 million, equal to $1.59 a share, on sales of $848 million. Missile and space activity accounted for $422 million in sales during 1963; aircraft and related activities, $442 million; and shipbuilding, electronics, propulsion, and other activities for $38 million.

3M Co. reports sales of $362.3 million with a net income of $22.4 million, or 38 cents a share, for the first half of 1963. Comparable period last year showed 3M with sales of $334.5 million and earnings of $19.8 million, equal to 38 cents per share.

Borg-Warner Corp. had sales of $345.9 million and earnings of $17.2 million, equal to $1.87 per share, for the first six months of 1963. First half of 1962 showed sales of $335.5 million and earnings of $15.3 million, equal to $1.67 per share.

Cubic Corp., electronic systems and instrument manufacturer, reports earnings of $259,161, or 16 cents per share, on sales of $6.3 million for the first half of 1963. Comparable figures for last year showed earnings of $353,386, or 21 cents a share, on sales of $7.6 million.

Sanders Assoc., Inc., estimates that sales for its fiscal year ended July 31 will be in the $54-55 million range, compared with $41.8 million sales for the preceding year. The firm predicts Fiscal 1964 sales will be in the $65-$75 million range. Net earnings for Fiscal 1963 equal between $1.55 to $1.60 per share, compared with last year's earnings equal to $1.40 per share.

New Gyro Uses Mercury Isotope Mixture

By Philip J. Klass

Washington—First details on an atomic gyro, which uses the angular momentum of spinning nuclei instead of a spinning rotor to measure angular displacement, were disclosed here last week during the International Conference on Aerospace Support.

The atomic gyro, developed by the GPL Div. of General Precision, Inc. under sponsorship of USAF's Aeronautical Systems Div., operates at room temperature and requires only modest magnetic shielding—a problem which had plagued earlier feasibility models.

First successful gyro operation was achieved last fall. The accuracy achieved to date and potential future accuracy are classified. But because the gyro inherently is not sensitive to external accelerations and does not require any bearings or other moving parts susceptible to unbalancing torques, its potential accuracy would appear to be high.

The new gyro uses a mixture of two isotopes of mercury (199 and 201) in the form of a low-pressure vapor in a fused quartz container as the basic working medium. In earlier GPL efforts on a nuclear gyro, which began in 1958 under ASD funding, water was used as the working fluid to demonstrate basic feasibility. Approximately two years ago, GPL switched to the mercury isotopes to get around magnetic shielding and other problems, according to Dr. James H. Simpson, principal investigator on GPL's atomic gyro program.

At the present stage of development, GPL is reluctant to give firm predictions on the ultimate size and weight of a production model gyro. However, Simpson says the nuclear gyro element might occupy a volume comparable to a baseball, while external power and control circuits would be several times this size. GPL officials say that the new type gyro should be "competitive in size and weight with equivalent performance gyros."

The nuclear gyroscope makes use of the fact that atomic nuclei with odd numbers of protons and/or neutrons exhibit magnetic moment properties which result from their charge and spin. In effect, such nuclei behave as if they were tiny bar magnets mounted on a spinning disc.

When such nuclei are exposed to an external magnetic field, there is a gyroscopic interaction due to the torque applied to a spinning mass which causes the tiny bar magnet to precess so that its north-south magnetic axis spins around the axis of the external magnetic field. (See sketch A, p. 89.)

Roughly, only one out of every million nuclei normally respond in this way to the magnetic field while the remainder retain a random orientation of their bar magnets. Because there are approximately 10 billion-trillion nuclei in one cubic centimeter of water, there are sufficient numbers of responsive nuclei for gyro use. In mercury vapor under high vacuum, there are only about a trillion nuclei, but GPL uses external means to align a higher percentage of those available than would occur naturally.

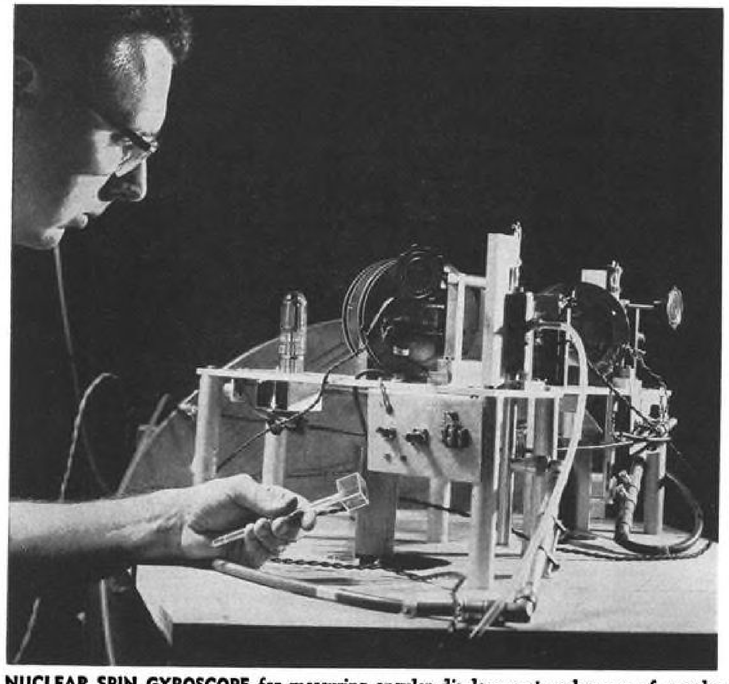
The nuclei which are precessing about the external magnetic field have a tendency to lose their precession energy to randomly aligned nuclei, causing them to slowly align their bar magnets with the axis of the magnetic field, unless this energy is replenished by external means. (See sketch B, p. 89.) The time required for 67% of the barmagnets to align themselves, unless external energy is supplied, is called "relaxation time." The material selected for use in a nuclear gyro should have a relatively long relaxation time.

To prevent the nuclei from relaxing and to keep them precessing about the steady state (d.c.) field axis, an oscillating (a.c.) magnetic field is used.

When this oscillating field is applied along an axis perpendicular to the plane containing both the dc. field and bar magnet spin axis, it transfers energy to the nuclei, providing the ac. field is oscillating at the same frequency at which the nuclei are spinning—known as the Larmor frequency. (See sketch C, p. 89.)

The Larmor frequency, or spin rate, is directly proportional to the d.c. field strength and inversely proportional to the mass of the particle. For example, in the presence of a 1.3-gauss field used in the GPL gyro, the spin frequency of Mercury 201 is about 367 cps. while that of Mercury 199 is 1,000 cps.

The precessing nuclei can be used to perform the function of an angular displacement gyro whose sensitive axis corresponds to the direction of the nuclei precession/d.c. field axis. This contrasts with a conventional gyro which is insensitive to rotation about its roller spin axis.



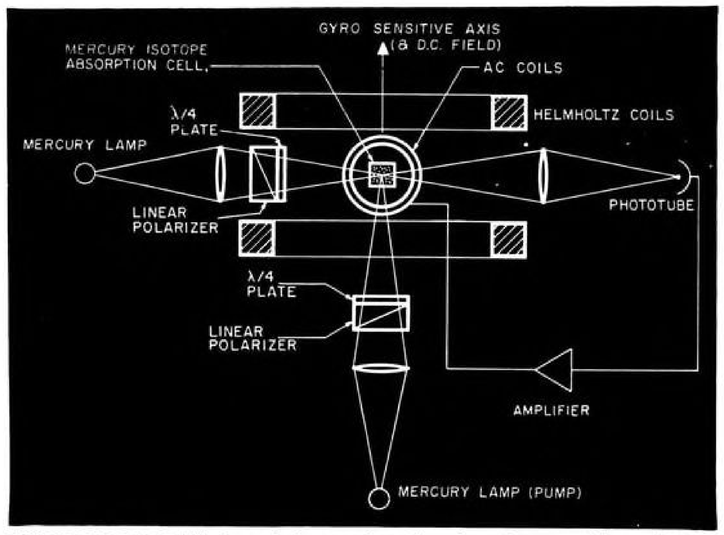
NUCLEAR SPIN GYROSCOPE for measuring angular displacement makes use of angular momentum of mercury vapor nuclei instead of conventional spinning rotor. Developed by GPL Div. of General Precision, Inc., under Air Force sponsorship, ultimate size is expected to be far smaller than the experimental unit shown above. Accuracy is classified.

To visualize the operation of the nuclear gyro as an angular displacement sensor it is convenient to imagine that it is possible to actually see the tiny spinning bar magnet in the mercury vapor cell and that directly underneath the device there is a 360-deg. compass rose to provide a convenient azimuth reference. Under these conditions it would be possible to observe the azimuth location of the spinning bar magnet at any specified instant in time using an extremely accurate crystal or atomic frequency standard as a timing reference.

Using Mercury 199 with a precession rate of 1,000 cps., one might observe that the bar magnet position corresponded to an angle of zero degrees each 0.001 sec., at time 0.001 sec., 0.002 sec., 0.003 sec., etc. If suddenly the container housing the mercury vapor were rotated, say 20 degrees, an observer would now find that at 0.004 sec., 0.005 sec. and succeeding 0.001-sec. increments the bar magnet would be opposite the 20-deg. scribe on the compass rose (or the 340-deg. scribe, depending upon the direction the mercury vapor container was rotated.

Stated in more familiar technical terms, using an extremely accurate frequency standard as a reference, the relative phase of the bar magnet shifts through an angle equal to the angle through which the mercury vapor container is rotated.

The phase of the nuclei bar magnets can be determined by passing a circularly polarized light through the plane of the spinning nuclei, in a direction parallel to the d.c. magnetic field. As the nuclei bar magnets spin, they modulate the light beam causing it to vary in intensity. This variation is detected by a photocell which provides a signal indicating the relative phase, i.e. position, of the bar magnet at any instant.

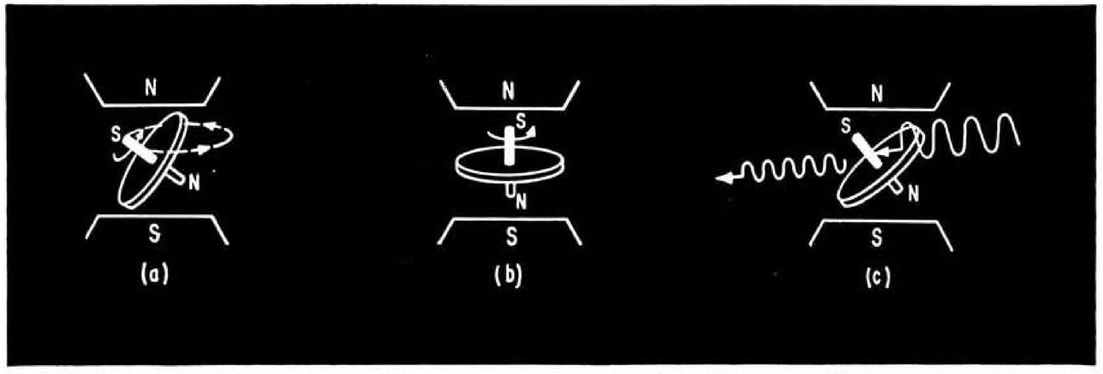


SCHEMATIC DIAGRAM shows basic operation of nuclear-spin gyro with sensitive axis coinciding with that of d.c. field (H_o) to measure angular displacement with respect to the printed page. The mercury isotope mixture in center absorption cell is illuminated by mercury discharge lamp (left) whose beam is modulated by spinning nuclei before reaching phototube (right). This provides means for measuring relative phase of nuclei, which indicates angular displacement of gyro. It also provides feedback signal, through amplifier, for controlling frequency of a.c. current which generates oscillating field to keep nuclei spinning. The lower mercury lamp, aligned with d.c. field, increases number of nuclei available for gyro action.

The modulation imposed on the polarized light beam by the spinning nuclei also provides a convenient means for controlling the frequency of the d.c. power supplied to the oscillating pumping field to maintain it at the proper Larmor frequency. The signal obtained from the photocell is used to generate the excitation applied to the coils producing this a.c. field, providing a closed-loop oscillator.

The foregoing description assumed that the d.c. field which induces nuclei precession remained roughly constant. Any variation in the magnitude of this d.c. field would cause a change in Larmor frequency which would result in an apparent change in bar magnet phase angle indistinguishable from that caused by an angular displacement of the device. This would make the device extremely vulnerable to errors from stray magnetic fields or changes in the strength of the earth's magnetic field at different geographic locations, requiring a great deal of shielding.

To get around this problem, GPL uses the mixture of two mercury isotopes in a single container: Mercury 199 with a Larmor frequency of 1,000 cps. and Mercury 201 with a precession frequency of approximately 367 cps. When there is an angular displacement of the gyro cell containing a mixture



CERTAIN ATOMIC NUCLEI which behave as if they were tiny bar magnets are basis of nuclear gyro. When exposed to steady magnetic field (a), bar magnet precesses (spins) about the axis of the field. If no external energy is supplied, relaxation occurs and precession stops (b). For use in nuclear gyro, an oscillating magnetic field is applied which supplies energy to keep nuclei spinning (c).

of these two isotopes, both nuclei will experience an identical change in phase angle. But if there should be a change in the steady state magnetic field, each isotope nuclei will undergo a different change in phase angle because the Larmor frequency is directly proportional to magnetic field strength. For example, a 1% decrease in field strength would result in a reduction of 10 cps. in the Mercury 199 nuclei compared to a reduction of approximately 3.67 cps. in the Mercury 201, corresponding to nearly a 3:1 ratio in relative phase shift.

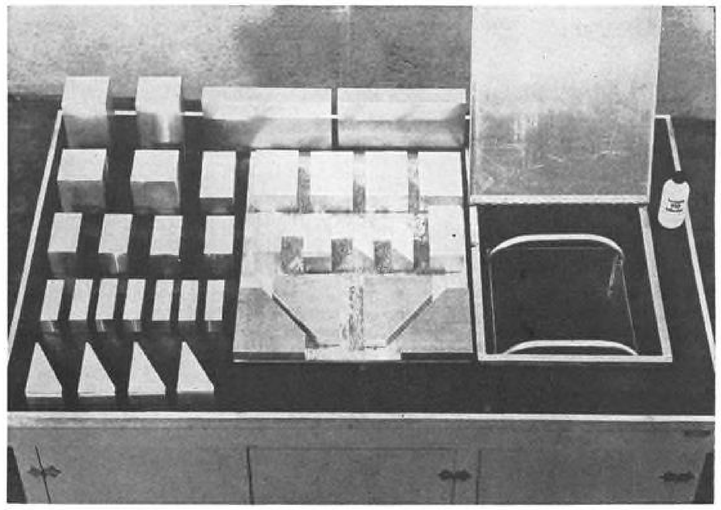
This not only provides a means for discriminating between phase shift caused by angular displacement of the gyro and changes in the d.c. field, but it also provides a signal which can be used to detect any change in the field strength and automatically adjust the current in the magnetic coils to keep it roughly constant.

While the foregoing description of operating principles assumed the use of a separate crystal or atomic frequency standard as the reference for measuring the phase of the mercury nuclei, GPL employs a more ingenious approach. Instead of using a single cell containing a mixture of Mercury 199 and 201 vapors, two cells are used which are identical except that the direction of the d.c. magnetic field is reversed for the second cell. This means that any rotation of the device about its sensitive gyro axis will produce a phase shift in one cell which is equal and opposite in direction to that produced in the other.

By combining the output from two photocells, each of which measures the phase angle of its respective mercury vapor cell, GPL obtains a phase reference which is unaffected by rotation of the device. This reference signal then is compared with the phase of one of the mercury vapor cells to measure phase shift due to gyro rotation.

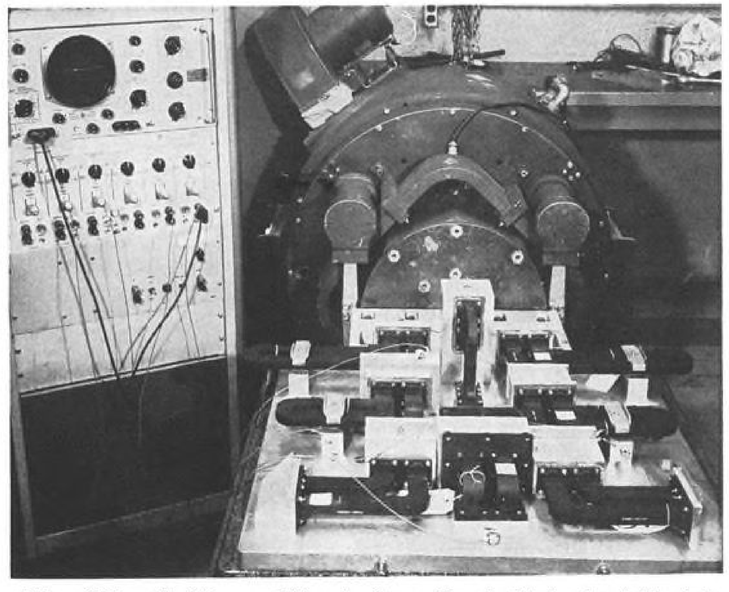
There will be two modulation frequencies imposed on the beam passing through each cell: one at approximately 1,000 cps. and one at approximately 367 cps. These signals from one cell are separated by conventional filtering techniques and compared in phase with the combined reference signal phase from the two cells.

As previously mentioned, GPL uses external means to increase the population of useful mercury vapor nuclei so that nearly one out of every five has its spin axis aligned with the steady-state magnetic field instead of only one out of a million that would occur naturally. This external means is a circularly polarized high-intensity electrode-less discharge lamp containing Mercury isotope 204 which functions as an optical pump. This isotope radiates photons



Test Fixtures Bonded to Fit Requirements

Raytheon's Sudbury Environmental Laboratory uses aluminum building blocks, displayed on counter top of circulating bath (above), to fabricate on-the-spot test fixtures for dynamic shock and vibration testing of products such as waveguide components (below) on vibration tester. Test fixtures are made by bonding blocks into the required configuration in a matter of hours instead of weeks by using Eastman 910 cyanoacrylate monomer-based adhesive. A dimethyl formamide solution removes adhesives, permitting re-use of blocks.



which collide with Mercury 199 and 201 nuclei in the gyro cells and transfer angular momentum to the latter causing many of the nuclei to orient their spin axis in the direction of the high-intensity light beam. By orienting the light beam axis so it coincides with the direction of the steady state magnetic field, the population of oriented spinning nuclei suitable for gyroscopic action is greatly increased.

Originally, GPL employed two light sources: the high intensity Mercury 204 lamp aligned with the d.c. field axis to increase the number of oriented nuclei; and a low-intensity lamp at right angles to the other beam used to detect the phase of the spinning nuclei. More recently, GPL scientists have combined the two functions into a single mercury lamp which is placed at a 45-deg. angle with respect to the d.c. field axis.

While the nuclear spin gyro avoids many of the problems encountered in the design, fabrication and operation of conventional gyros, it is not without

challenging problem areas peculiar to its own design, GPL spokesmen concede. This is evidenced by the fact that approximately five years effort and nearly $500,000 of Air Force funds have been required to advance the technique to its present state, which is described as "experimental." GPL is hopeful, however, that added government funding will be obtained to extend the gyro technique into a flyable prototype design.

One problem area, for example, is the design of an extremely phase-stable amplifier for the feedback loop in which nuclei modulation of the light beam is used to control the frequency of the a.c. field which must maintain synchronism with the nuclei Larmor frequency. An extremely small or momentary phase shift in this amplifier and feedback circuit results in the equivalent of random drift in a conventional gyro, Simpson points out.

Similarly, any instability in the output intensity of the lamp used to detect nuclei position will result in a spurious amplitude modulation which resembles that due to nuclei spin. Extremely precise angular relationships are required between different elements of the atomic gyro.

These are what Simpson calls practical instrumentation problem—difficult and demanding but not overwhelming."

PERT Computer

PERT calculation slide rule enables operator to manually compute PERT expected time, earliest and latest event times, slack, critical path and probability of meeting schedule, both on an elapsed-time and calendar-date basis. New PERT-O-GRAPH II critical path computer was developed by James Halcomb as successor to earlier expected-time slide rule (AW May 7, 1962, p. 103). Slide rule is available from $5.00 from James Halcomb Associates, 495 California Ave., Palo Alto, Calif.

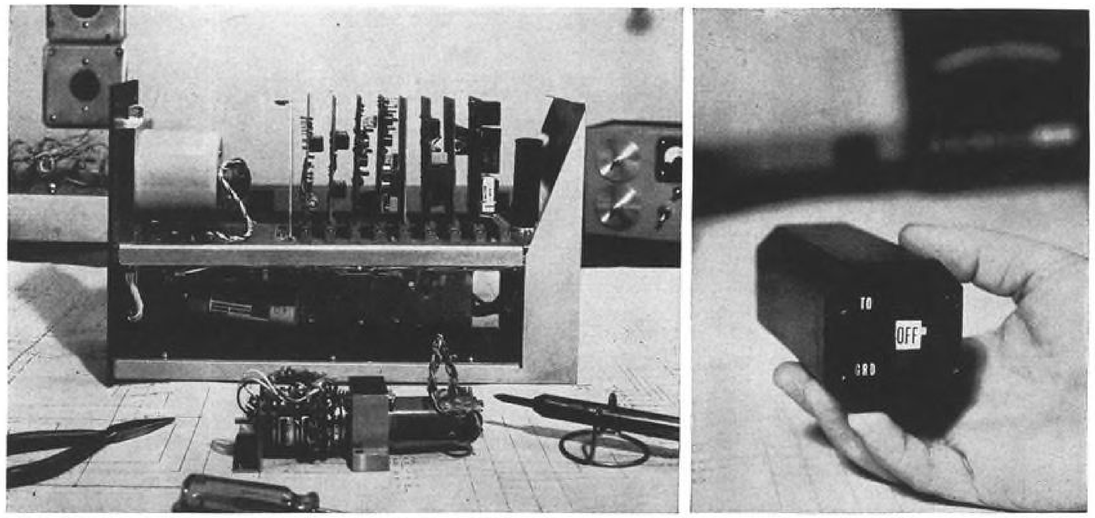
The ultimate limit on the accuracy of a nuclear spin gyro is established by the statistical nature of the device. In the GPL mercury isotope unit with optical pumping used to increase the population of nuclei spinning in unison, there still are about 80% of the nuclei which are spinning in completely random fashion. This generates a random fluctuation in the modulation of the light beam used to determine phase of the aligned nuclei, sometimes referred to as "magnetization noise."

Current theory suggests, however, that this will not be a serious limitation for any practical gyro requirements, according to Simpson.

General Precision is not the only company active in the nuclear gyro field. Others known to be working in the field include American Bosch Arma, General Electric, Republic Aviation and Sperry Microwave Electronics Co. The idea of using the electrons or nuclei which nature conveniently sets in spinning motion is an old one.

In 1951, Varian Associates devoted some effort to the concept.

General Precision expects to receive four patents next month covering some of its basic techniques for a nuclear gyro. The paper delivered at last week's Aerospace Support Conference was jointly authored by Simpson, J. T. Fraser and Ivan A. Greenwood, Jr., all of the GPL Div., Pleasantville, N. Y.



OPTIMIZER COMPUTER FUNCTIONS are mounted separately on plug-in printed circuit boards to simplify maintenance. Entire computer (left) is housed in short ¾ ATR case. Note servo unit, removed from computer, in foreground. Pilot's flight indicator (right) presents simple meter display of difference between actual and programmed angles of attack. Pilot flies to indicator (behind the OFF flag warning), which appears much like a sensitive pitch indicator. System is intended to permit aircraft flight at optimum conditions regardless of gross weight, center of gravity and other variable conditions throughout slow-speed phases of flight, such as rotation for take-off, climbout and landing.

Optimizer Programs Best Angle of Attack

By Barry Miller

Duarte, Calif.—A flight optimizer, or speed command system, designed for possible use in the Boeing 727 jet transport, has been developed here by Giannini Controls Co.

The flight optimizer is intended to enable a pilot during critical slow-speed phases of flight to fly at an optimum condition regardless of aircraft gross weight or other variables by maintaining specific programmed angle of attack.

The system is based on the belief that for every flap position of the aircraft there is an optimum angle of attack. And by controlling to this angle of attack it may be possible to achieve an optimum flight condition.

Prototype Delivered

A prototype of the quipment recently was delivered to Boeing where it currently is undergoing laboratory tests. Flight tests are expected in the fall. Other companies, including Safe Flight Instrument Corp., which developed a functionally similar speed command system for other aircraft (AW Oct. 17, 1960, p. 92), are working on related devices.

A system of this type may be made available as optional equipment to carriers using the new Boeing jet transport. At least one carrier is understood to be interested in a sensor of this type for its 727 aircraft.

In the Giannini flight optimizer system, the pilot flies to an indicator needle. The display is a measure of the difference between the aircraft's actual angle of attack and a programmed value, with the needle centered when these values coincide. Initially, the indicator is centered during take-off roll. After liftoff, the system will command a smooth change in pitch angle to the point where the aircraft is climbing at an optimum angle, according to the company.

Once other factors, such a optimum Mach number climb, take over, the indicator moves off scale. Unexpected transients created by wind gusts or an engine failure will not cause the aircraft to deviate from its optimum pattern during climb.

The pointer returns to scale as the aircraft slows during its approach. It again is kept centered to maintain a desired approach angle of attack. An "approach mode" reference is switched automatically into the computer about 5 min. after liftoff and its operation confirmed by the appearance of an approach indicator flag on the pilot's indicator.

Should the pilot make a mistake, the optimizer would tell him the optimum angle of attack to follow for the aircraft's prevailing configuration. He would hold the needle centered and his airspeed would come out to a proper value for that configuration.

Giannini has flight tested the system in a light aircraft in tests totaling about 40 hr. in duration. These indicate that the system works effectively, according to a company engineer.

The system is comprised principally of a small computer, housed in a short ¾ ATR case, and a bar-type flight indicator. Angle-of-attack signals are secured from synchros placed in vanes available for the 727 stall warning system. In addition, a cam and synchro are associated with the flap position transmitter in the stall warning system to compensate for changes in aircraft geometry.

Modular Construction

The computer is fabricated along modular lines, with individual potted modules mounted on a number of removable printed circuit boards, each containing separate functions. This is aimed at simplifying the task of isolating malfunctions and replacing faulty parts. Giannini says it does not expect any customer to have to replace more than 10% of the modules over the 15-year lifetime of the aircraft.

Calibration is not required as circuit parameters are maintained by feedback techniques and the use of precision valued components.

An "off" flag covers the indicator when power is not applied, either because power is turned off or in the event of a failure. Two other flags indicate modes—take off or approach. A single press-to-test switch on the panel indicator tests the computer's amplifier

and indicator circuits and makes possible simple visual inspection of the indicator flags.

The optimizer signal is derived as a sum of two angles from the two angle of attack vanes to the flap position transmitter. This signal is compared with a reference, transmitted to the computer, demodulated, filtered and passed to a summing resistor network at the input to an operational amplifier which drives the indicator. The angle of attack display has high gain and fast response, the company says.

To assure a continuously varying angle of attack during the periods from liftoff to steady-state climb, a bias signal is applied to the operational amplifier through these intervals. The bias is secured from a function potentiometer and goes to zero volts in periods other than take off and approach.

During the transition from liftoff to steady-state climb, the speed of a transition servo in the computer is varied to take into account changes in aircraft thrust-to-weight ratio by commanding servo rate with acceleration signals.

The latter are obtained from an accelerometer so located in the computer that its sensitive axis is parallel to the aircraft's longitudinal axis.

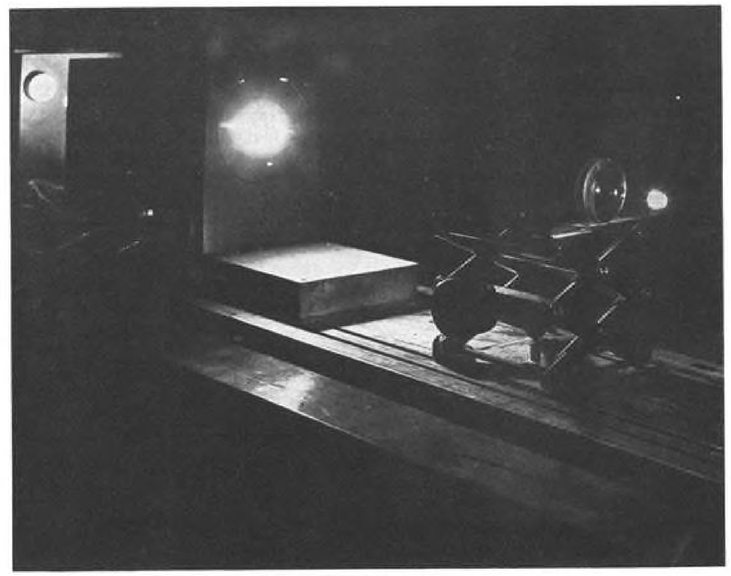
The flight optimizer will stabilize both short period and phugoid oscillations. Short period response, Giannini points out, corresponds with the response of an expanded scale attitude gyro so that no changes in piloting techniques are necessary. For phugoid stabilization, an indicated air speed signal is filtered and differentiated, applied as an input to the operational amplifier in such a manner that increasing airspeed alerts the pilot to increase the angle of attack.

To prevent discomfort from high body altitude, the maximum positive pitch attitude commanded by the system is limited, typically to about 15 deg. This is done by picking off a signal from a vertical reference gyro elsewhere in the aircraft (in the instrument system) and using it as an override.

The gyro signal is demodulated in the computer, limited and applied to the operational amplifier to override the angle-of-attack signal when pitch exceeds the desired limit.

Outputs are available from the computer to drive special of multiple indicators should they be added. An output for command signals to the aircraft's autopilot also is available, although driving the autopilot with optimum angle-of-attack signals is not now contemplated.

Giannini has, however, conducted studies of the possibility of controlling throttle with angle-of-attack information.



Ruby Laser Beam Ionizes Air

High-power light beam from a ruby laser (left) ionizes air—visible as a flash of light to the right of the small lens. Lens focuses the light to a point creating an extremely high electric field. The laser is Korad Corp.'s experimental K 1001 unit, with a peak power output of 500 megawatts.

FILTER CENTER

► **British Develop Miniature Altimeter**—Lightweight radar altimeter which uses solid-state construction and weighs only 21 lb. has been developed by Standard Telephone & Cables Ltd., as successor to its older 51 lb. tube model which demonstrated high accuracy in recent Federal Aviation Agency blind landing tests (AW June 10, p. 127). The new STR 52 altimeter, which uses CW/FM techniques, is expected to offer competition to the Minneapolis-Honeywell unit for use in new jet aircraft automatic landing systems.

► **TWA Buys New 3-D Indicator**—Trans World Airlines has become first airline to order new three-dimensional flight director indicator developed by Collins Radio, which uses combination of depth and color to give pictorial type vertical situation display. (AW Aug. 6, 1962, p. 93.) TWA has placed $400,000 contract with Collins for integrated flight director systems with new 3-D display for use on new fleet of short-range jets.

► **Computer Market Tightens**—The shake-out of digital computer manufacturers, particularly in the highly competitive commercial market, a trend first reported by AVIATION WEEK & SPACE TECHNOLOGY (April 15, p. 112), is continuing. Philco, which recently consolidated its computer division into its communications and electronics division, has announced that in the future it "will not actively seek industrial data processing business" but instead will place primary emphasis on military command and control and industrial-scientific applications. El-Tronics, Inc., Warren, Pa., has announced that its Alwac computer manufacturing facility is up for sale.

► **On The Corporate Checkerboard**—Recent acquisitions and corporate changes in the avionics industry include the following:

• **General Precision, Inc.**, has sold its financial interest in Kearfott Semiconductor Corp., Newton, Mass., to Stephen Cudlitz, president of the latter company. GPI will, however, continue its work in microcircuitry at research facilities on the East and West coasts, company says.

• **Electronic Communications, Inc.**, St. Petersburg, Fla., has purchased substantially all the assets of Electronic Instruments for Research, Inc., Baltimore.

• **The Singer Metrics Div.** of The Singer Co., has reached tentative agreement to acquire assets of Empire Devices, Inc., Amsterdam, N. Y., in stock exchange deal, marking division's third

acquisition in the past 10 months.

• **Hoffman Electronics Corp.** will enlarge its El Monte, Calif. facilities by 165,000 sq. ft. and consolidate all operations at the 38-acre site.

▶ **Signed On The Dotted Line**—Major avionic contract awards recently announced include the following:

• **Dalmo Victor Co.,** division of Textron, Inc., Belmont, Calif., $3.3 million contract from General Dynamics/Ft. Worth to develop and manufacture radar homing and warning systems for the F-111 (TFX).

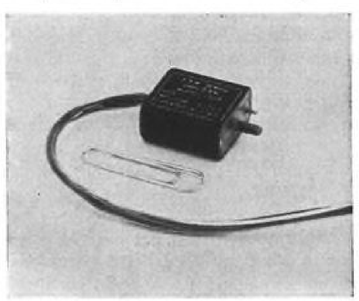
• **Data Display Inc.,** St. Paul, Minn., will develop system to display dynamic trajectory and impact prediction information for range safety officer at Atlantic Missile Range under $196,700 contract awarded by AF Missile Test Center. Company also will build two digital display systems for pre-launch data on manned spacecraft under $596,183 contract from NASA's Manned Spacecraft Center.

• **Massachusetts Institute of Technology** will conduct research program on advanced computer systems which can be independently accessible simultaneously to large number of users. Program, known by the acronym of MAC (multiple-access computer), is sponsored by Advanced Research Projects Agency, under $2.2 million contract awarded by Office of Naval Research.

NEW AVIONIC PRODUCTS

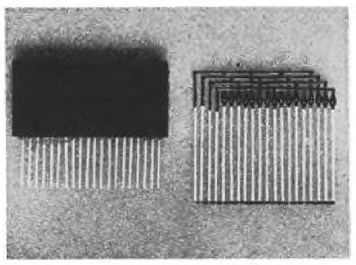
• **Fast-response laser detector,** Model K-D1, has a rise time of 0.3 nanoseconds and is available with S-1, S-4 or S-20 photo-surface, providing spectral response range from 0.3 to 1.15 microns. Device can be used to measure laser output power ranging from one watt to 10 billion watts and energy measurements from 0.001 to 1,000 joules. Manufacturer: Korad Corp., 2520 Colorado Ave., Santa Monica, Calif.

• **Miniature solid-state servo amplifier,** Model 1359, weighs only ¼ oz., is designed to provide 3½ watts output to



drive 40 v., 400 cps. two-phase servomotor. Voltage gain from 1-5,000 can be externally varied by gain-setting resistor in series with input and a 3 db. gain stability is provided over temperature range from –55C to 100 C. Amplifier is housed in quartz crystal case. Manufacturer: Melcor Electronics Corp., 110 Central Ave., Farmingdale, L.I., N.Y.

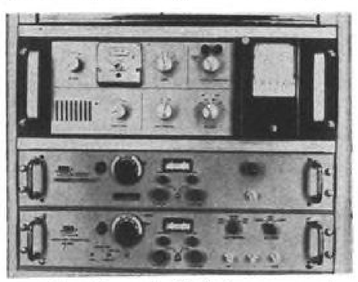
• **Micro-diode core-driver assemblies,** offering pulse currents a high as 1.5 amps, recovery times as short as 0.002 microseconds and junction capacity as low as 2 picofarads, are available either in open or encapsulated form. Size of



a 10-diode common cathode or common anode array is only 0.5 x 0.15 x 0.06 in. thick. The four quadruple common cathode assembly illustrated measures 1 x 0.45 x 0.1 in. Manufacturer: MicroSemiconductor Corp., 11250 Playa Court, Culver City, Calif.

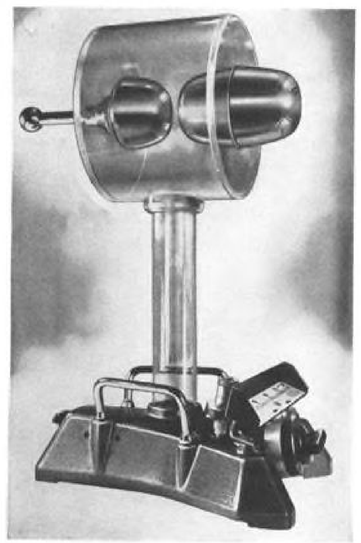
• **Laser second-harmonic generator,** consisting of plates of potassium dihydrogen phosphate (KDP) or ammonium dihydrogen phosphate (ADP) for use with ruby or neodymium-doped lasers, are cut from crystalographic orientations which closely match refractive indices for both fundamental and harmonic. Manufacturer reports the index matching has provided a 300-fold increase in intensity of second harmonic generated in KDP by ruby laser. Manufacturer: Isomet Corp, 433 Commercial Ave., Palisades Park, N. J.

• **Ultra-stable crystal reference,** reportedly accurate to within 5 parts in 10 billion per year with a time error of less than 8 milliseconds per year, includes a VLF radio receiver for periodically checking and correcting for



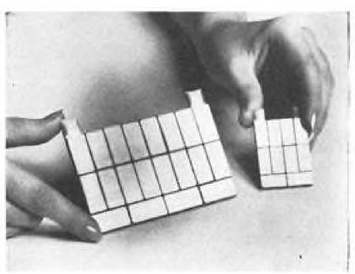
crystal aging. A built-in comparator system automatically compensates for rate of crystal aging as experience is accumulated, eventually making the reference independent of VLF recalibration, according to manufacturer. Reference is called Bravo, an acronym derived from Best Rate of Aging Verified Oscillator. Manufacturer: Manson Laboratories, Inc., Box 1214, Stamford, Conn.

• **Electrostatic voltmeter,** for measuring ac. or dc. voltages from zero to 100,000 v. where only small power levels are present or where voltage is



too high to use conventional instruments. Device can be used to measure ac. of any frequency. Electrostatic voltmeter, made by Trub, Tauber and Co. of Switzerland, is marketed by Hardco Scientific Corp., 5710 Wooster Pike, Cincinnati 27, Ohio.

• **Thermoelectric modules,** with heat-pumping capacities ranging from 8 to 33 watts, designed for a 40 C hot-side temperature and a 0 C cold side, are



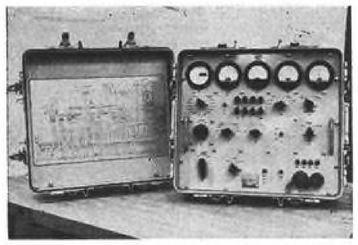
available from stock in four module types. These include 10 and 20 couples in either high-current (40-50 amp.) or medium current (20-30 amp.) range. Manufacturer: Westinghouse Semicon-

ductor Div., Special Products Dept., Youngwood, Pa.

• **High power laser,** with output of more than 1,500 joules per pulse and input of 120,000 joules per pulse, is now available from Maser Optics, Inc., 89 Brighton Ave., Boston 34, Mass. Company claims it is the highest power laser on the market.

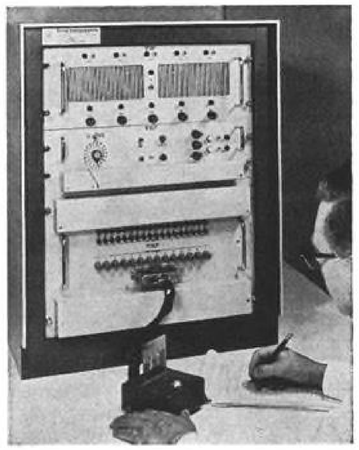
• **Integrated reference amplifier,** new silicon semiconductor device which performs circuit functions of a transistor plus a zener diode in a regulated voltage or current power supply. Device has integrated structure which reduces effects of long and short-term drift of reference voltage, reportedly providing temperature coefficient as low as 0.001%/degC. Integrated reference amplifier, housed in a transistor case, currently is available in 10 different models. Manufacturer: General Electric, Semiconductor Products Dept., Syracuse, N. Y.

• **Aircraft electrical system analyzer,** for use with 400 cps. a.c. systems, enables operator to locate malfunction and check system performance in 20 min. Analyzer is contained in portable



case measuring 21 x 18 x 13 in. and weighing 55 lb. Manufacturer: Westinghouse Aerospace Electrical Div., Box 989, Lima, Ohio.

• **Microcircuit automatic tester,** Model 659A, performs 36 tests on devices with up to 14 terminals, with programming accomplished by means of precision resistors on a plug-in board.



Two leads are connected to each terminal, one to supply power and one to make measurements to prevent contact resistance errors. Bias conditions are selectable.

When used with a companion device, tester can be used to automatically sort microcircuits according to their characteristics.

Manufacturer: Texas Instruments Inc., Industrial Products Group, 3609 Buffalo Speedway, Houston, Texas.

• **Low-frequency magnetic recorder,** Model 6037, utilizes Hall-effect recording heads to achieve low-frequency response and constant output amplitude for recording analog type signals. Recorder drum has frequency range of 5-2,000 cps. and has a servo drive on the drum which permits system synchronization or signal follow-up.

Manufacturer: Instrument Systems Corp., 111 Cantiague Road, Westbury, L. I., N. Y.

CAB Accident Investigation Report

Faulty Latch Blamed in Decompression

Allegheny Airlines Flight 928, a Convair 340/440, while descending to land at Bradley Field, Conn. experienced an explosive decompression when the rear service door became disengaged at its lower latch points. The ensuing outward rush of air ejected a hostess who was near the door opening.

Following departure from Philadelphia, a high-frequency whistling noise was heard and inspection revealed an escape of air at the lower aft corner of the rear service door. Pillow cases were placed in this area to reduce the air noise but no further action was taken until the door blowout occurred after descending through 4,000 ft. At no time was the pressurization system intentionally deactivated.

The Board determines that the probable cause of this accident was an undetected insecure latching of the rear service door, resulting in an inflight explosive decompression which ejected a hostess from the aircraft.

Contributing factors were Allegheny Airlines' inadequate emergency pressurization instructions, and the continuation of pressurized flight after discovery of the pressurization leak.

Investigation

Allegheny Airlines Flight 928, a Convair 340/440, N 8415H, was a scheduled passenger flight from Washington D. C., to Providence, R. I., with enroute stops at Philadelphia International Airport, Philadelphia, Penn., and Bradley, Windsor Locks, Conn. The flight departed Washington National Airport on schedule at 1845,[1] Oct. 19, 1962. The aircraft was released with the gross weight and center of gravity within prescribed limits. The crew consisted of the captain, first officer, first and second hostesses. The flight to Philadelphia International Airport was routine and conducted under Visual Flight Rules (VFR). The captain subsequently stated that the air was smooth at the cruising altitude of 5,500 ft.

Flight 928 was released at Philadelphia with the gross weight and center of gravity within prescribed limits. Forty-eight passengers and the crew of four were aboard. After the right engine was started, and prior to starting the left engine, the crew noted that both the passenger and the rear service door warning lights were on, indicating that these doors were open.

Hand signals were exchanged between the flight crew and the ramp agent indicating that the rear service door was insecure. The ramp agent stated that he then climbed on a ground power unit, which was driven beneath the aircraft, and closed the rear service door. While the ramp agent was closing the rear service door, the second hostess informed the captain that she was having trouble closing the passenger door and the first officer left the cockpit to assist her. The captain stated that upon the return of the first officer, all door warning lights indicated that the doors were closed and locked.

When the ramp agent returned to his normal position by the nose of the aircraft, the captain gave him the all clear signal indicating that the doors were properly closed. The agent stated, "I could see this myself as all red lights were out." These warning lights are located on the first officer's overhead console and were visible from the ramp agent's position.

The flight departed Philadelphia International Airport during the hours of darkness at 1955 on a VFR flight plan. The cabin pressurization system was activated. Approximately five minutes after takeoff, during the climb to cruising altitude, the first hostess informed the captain of a noise emanating from the rear service door. The first officer said that the door warning lights were still out. He then accompanied the hostess to the rear of the cabin where a high-pitched sound was audible.

The first officer explained "I immediately checked the door handle; it was in the locked position. I then moved over to the door and checked the overhead door latches; they were in the locked position. I knelt down by the door, placing my left arm around a stanchion in the galley compartment and pushed forward on the door handle with my right hand. It was in the full forward or locked position. The bottom latches not being visible, I put my hand down at the bottom of the door and felt at the bottom latches; they felt to be locked . . . I took some paper from the beverage glass box and dropped it around the door to see if I could find a leak around the door. I could not find any . . . I then went to the cockpit and advised Capt. Could that I could not find anything wrong with the door but there was noise coming from around the rubber seal."

Noise Stopped

The first officer was then instructed by the captain to attempt to stop the noise. The first hostess removed the covers from several pillows and these covers were dampened and placed on the rear side of the door in the area where the rubber seal was visible. This stopped the high-pitched noise and the first officer returned to the cockpit.

The flight was continued at the cruising altitude of 5,500 ft. with sea level cabin

[1] All times herein are Eastern Daylight based on the 24-hr. clock.

Sea Knight Lands Aboard USS Guadalcanal

Boeing-Vertol/Marine CH-46A Sea Knight assault helicopter lands aboard the USS Guadalcanal (LPH-7) (AW Aug. 5, p. 114) to take part in recent commissioning ceremonies of the new troop-carrying assault carrier. Carrier can accommodate 29 CH-46As, eight on the flight deck and 21 in the hangar deck, and has space for 2,000 Marines.

pressure maintained. Although pressurization was not required at this altitude, the captain stated that pressurization was maintained for passenger comfort. In the vicinity of the Trinity Very High Frequency Omnidirectional Range (VOR), approximately 57 naut. mi. from Bradley Field, light turbulence was encountered and the captain turned on the "fasten seat belt" sign. A few minutes later, the turbulence subsided but the sign was left on in anticipation of the descent to Bradley Field. Shortly thereafter, a gradual descent was commenced.

Bradley Approach Control was contacted and Allegheny Flight 928 reported being about 10 mi. southwest of the WTIC radio tower which is located near Bradley Field. This transmission was acknowledged and the flight was instructed to make a straight-in approach to runway 6. The Bradley Field weather was: clear skies and visibility more than 15 mi.

Explosive Decompression

Just after passing through the 4,000-ft. level, at approximately 2052, there was an explosive decompression; simultaneously, this was felt in the cockpit and the service door warning light illuminated. The decompression tore off the cockpit-cabin door which was blown approximately eight feet down the cabin aisle. At the moment of decompression, the second hostess was in the lavatory. The decompression ripped the lavatory door from its hinges and forced its occupant to the floor. The first hostess, who was in the buffet area, was ejected through the rear service door which had blown open, and fell to her death.

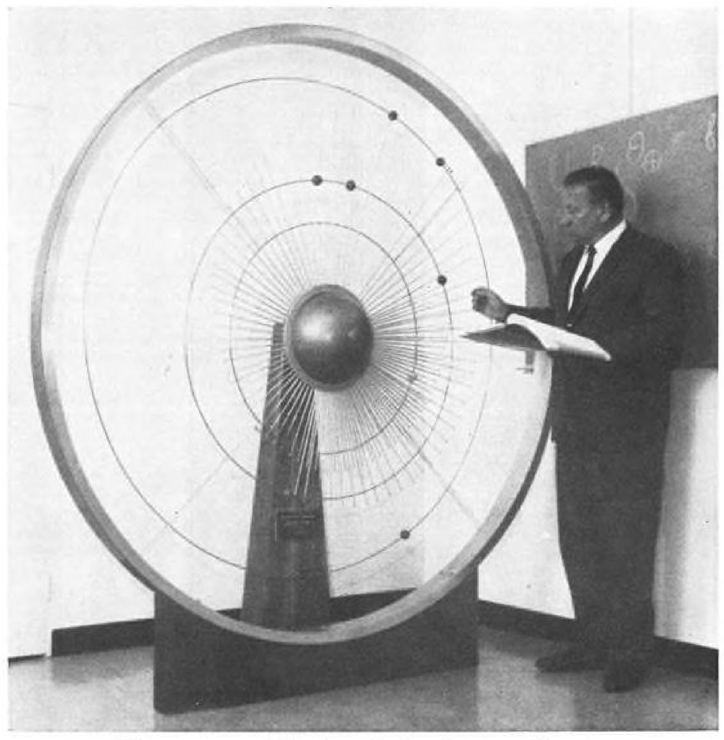
Bradley Tower was advised of the accident and subsequently a priority landing was requested. The aircraft landed at 2058.

Aircraft Damage

Investigation by the Civil Aeronautics Board at Bradley Field disclosed that the lower edge of the rear service door was one foot away from the lower lock pins and twisted rearward. The upper latching hooks were over the upper lock pins; however, the hooks were twisted and bent outward. The door handle was in the open position, aligned with the "open" reference arrow painted on the door fabric.

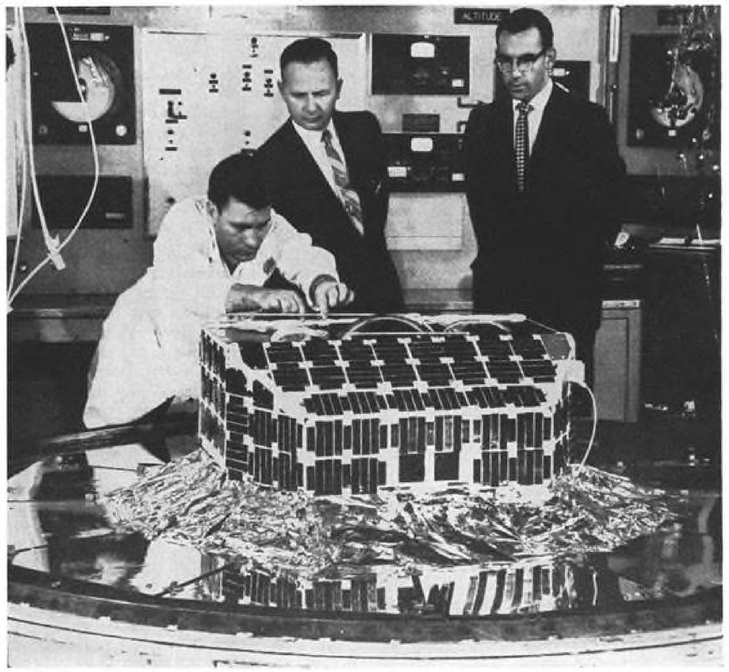
The parallelogram door hinge had separated at the horizontal and diagonal tubular cross members. The vertical portion remained attached to the fuselage and the horizontal portion separated at the attachment to the interior of the door. The upper idler bar and the assist arm were separated. The attachment of the assist arm to the interior surface of the door was intact, allowing the arm to become wedged between the door and jamb at the aft side.

The rear service door was removed from the aircraft, under CAB supervision, and the warning system was checked. Two plunger



Planetary Flight Calculator Shown

Interplanetary navigation analog system is designed for rapid calculation of flight paths to Mars and Venus. System can calculate flight paths to either planet during any time period. Rods extending from the hub are adjustable in three dimensions. Computations are made from readings that appear on the hub and rods. Krafft Ehricke, right, director of advanced studies at General Dynamics/Astronautics, developed system.



Hitchhiker Satellite Readied for Launch

Lockheed Missiles and Space Co.'s Hitchhiker satellite will be launched with an Agena D space vehicle, then fire its own motor to achieve the desired orbit. Hitchhiker is 3 ft. in diameter and can carry a variety of payloads, company says. It is spin-stabilized.

type switches are utilized in the warning light circuit; their operation is dependent upon the engagement or disengagement of the upper and lower forward latching hooks. There are no indications of the position of the two rear latching hooks in the warning system. The door warning light, located over the first officer's station, went off when the plunger-type switches at the upper and lower forward lock pins were depressed simultaneously. The light was on with both switches released and stayed on when either switch was depressed independently.

Door Reinstalled

The aircraft was ferried to the Allegheny Airlines main base at Washington National Airport, with the rear service door stowed aboard. This door was reinstalled with the replacement of damaged parts. Inspection holes were cut in the outer skin of the door to observe the operation of the lower latching hooks. The two upper latching hooks that were distorted were replaced.

The door was reinstalled and efforts made, on the ground, to duplicate the unsafe door condition that caused this accident. When closing the door all four hooks went into place and the door warning light went off. The door was reopened and when slammed shut the two upper hooks and the lower forward hook went into place over the lock pins, and again the door warning light went off, even though the lower aft hook was not fully engaged.

The door was partially closed, sufficient to trigger the lower latching hooks actuating plunger, quickly opened, then slammed and locked; the lower aft hook was again insecurely positioned over the lock pin, the door warning light was off and the door appeared to be properly secured. With the door in this semi-latched configuration, the cabin was pressurized to 2.1 pounds psi. differential, the equivalent of 4,200 ft. altitude, based on standard day conditions. The pressurization was obtained from the aircraft system by operating the No. 2 engine. As a result of pressurization and engine vibration, the door handle progressed slowly one and one-half inches toward the "open" position. The door handle could not then be moved manually toward the "locked" position. The cabin was then depressurized normally. During the depressurization, the door handle progressed further toward the "open" position. Upon reaching a 0.5 psi. differential pressure, the rear service door popped outward at the bottom, hinging about the two upper hooks that remained engaged.

Pressure Ratio

At the time of the accident, the cabin-to-ambient pressure differential was computed to be approximately 1.7 psi. based on standard day conditions.

Allegheny Airlines Convair aircraft were placed into operation in April, 1960, and since that date Allegheny had recorded seven inadvertent inflight rear service door openings. Three of these occurrences, including the subject accident, involved Convair N 8415H.

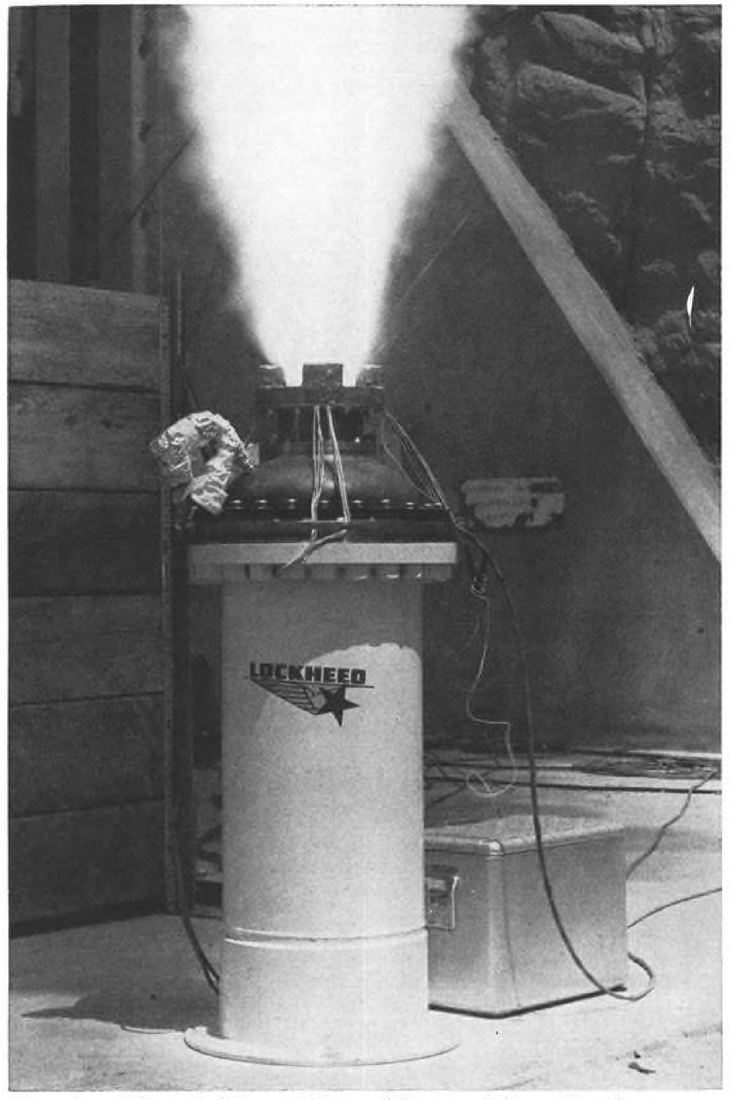
As early as 1954, Convair recognized the deficiencies existing in the rear service door and issued the first of several Convair 340/440 Service Bulletins recommending appropriate modifications. These Service Bulletins were available to Allegheny Airlines in their Maintenance Manuals; however, the majority of the modifications were not incorporated in N 8415H.

The Allegheny Airlines Operations Manual containing emergency instructions to the flight crew was very brief in reference to inflight emergency procedure pertaining to rear service door or window pressurization leaks. The manual required the flight crew upon "Evidence of window, door or hatch failure; dump immediately."[2] However, there were no specific instructions requiring any action on the part of the flight crew in the event of an impending pressurization failure. Currently effective operations instructions now provide comprehensive pressurization instructions and emergency procedures.

It was determined that the flight was properly dispatched and the flight crew and aircraft were currently certificated in accordance with existing Civil Air Regulations and company procedures.

Investigation at Bradley Field, and later at Washington National Airport, established that electro-mechanical continuity existed in

[2] Referring to actuation of depressurization by the use of dump valves, which provides for rapid cabin depressurization.



Lockheed Fires Char Motor Test Rocket

Char motor, containing approximately 300 lb. of uncured propellant in viscous liquid form, is fired to test material under consideration for nozzle insulation and jet-tab thrust vector control devices. Materials are for use in a 156-in.-dia. solid propellant rocket motor.

the rear service door warning light system. However, this system does not indicate the position of the two aft latching hooks.

The closing procedure of the rear service door at Philadelphia resulted in an insecure engagement of the aft lower latching hook over its lock pin. The improper latching of the service door was not indicated by the warning light and would be difficult to detect by reference to the position of the door handle. The slight displacement from the locked position could easily have been overlooked in a visual inspection. The ease with which a potentially dangerous condition could exist was demonstrated in the ground tests previously described.

It is concluded that the partially engaged lower aft latching hook remained in this configuration during the climbout from Philadelphia and subsequent cruising flight. The descent to Bradley Field, with the resulting decrease in pressure differential, lessened the tension on the partially engaged latching hook against the lock pin. The insecurely positioned lower aft latching hook allowed the lower portion of the door to be distorted by pressure which, when assisted by aircraft vibrations, caused the door handle to move toward the open position. When this hook became disengaged, further distortion of the door occurred and the door handle traveled to the fully open position thereby disengaging the forward lower hook, resulting in explosive decompression. Immediately prior to the decompression, assuming a pressure differential of 1.7 psi., the total force exerted on this door would have been in excess of 3,000 lb. Therefore, it can be concluded that anyone adjacent to this door during explosive decompression would be ejected from the aircraft.

Although the flight crew took reasonable precautions to determine that the service door was secure, it is evident that their analysis of the leak to be the result of a door seal was in error. In view of the history of many inadvertent openings of the service door experienced by Allegheny in operating the Convair 340/440 aircraft, the Board believes that the crew should have exercised the precaution of depressurizing the aircraft, and warned the flight attendants and passengers to avoid the rear service door area.

Probable Cause

The Board determines that the probable cause of this accident was an undetected insecure latching of the rear service door resulting in an inflight explosive decompression which ejected a hostess from the aircraft.

Contributing factors were Allegheny Airlines' inadequate emergency pressurization instructions, and the continuation of pressurized flight after discovery of the pressurization leak.

Recommendation

Convair Service Bulletin 126A, dated June 1, 1954, recommended improvements in the door latch and warning system. The Civil Aeronautics Board, on Mar. 15, 1955, recommended to the Administrator of the Civil Aeronautics Administration that an Airworthiness Directive be issued that would have made mandatory the changes noted in this Convair Service Bulletin. The Civil Aeronautics Administration issued Air Carrier Maintenance Alert Bulletin No. 203, which called attention to the difficulties experienced with this door and encouraged compliance with the Convair Service Bulletin. Additional Convair Service Bulletins dated May, 1955; October, 1956; February, 1957; September, 1957; and January, 1958; were issued recommending improvements in the rear service door.

N 8415H was purchased by Allegheny Airlines and subsequently placed into operation on Apr. 12, 1960. The provisions of Convair Service Bulletin 126A were incorporated in N 8415H; however, the majority of the Convair Service Bulletins pertaining to rear service door improvements were not incorporated in N 8415H prior to purchase nor subsequently by Allegheny.

On Nov. 5, 1962, the Board recommended to the Federal Aviation Agency that methods for improving the Convair 340/440 rear service door system be considered, and that the adoption of these improvements be of a mandatory nature. Consequently, the Federal Aviation Agency issued an Airworthiness Directive, effective Dec. 18, 1962, making mandatory the modification of Convair 340/440 rear service doors incorporating improvements contained in Convair Service Bulletins.

This Airworthiness Directive requires, among other pertinent items, that:

- **The Airplane Flight Manual** be revised to require inspection of the latching before takeoff and each time the rear service door is operated;
- **The aircraft be depressurized** if there is evidence of a latch disengagement or leakage around the door;
- **Inspection holes and lights** be installed for inspection of the lower door latches; and
- **Door latching electrical** warning switches be installed in the upper and lower forward latches.

By The Civil Aeronautics Board:
Alan S. Boyd, Chairman; Robert T. Murphy, Vice Chairman; Chan Gurney, Member; G. Joseph Minetti, Member; Whitney Gilliland, Member

Investigation

The Civil Aeronautics Board was notified of this accident at 2130 on Oct. 19, 1962. Civil Aeronautics Board Investigators were immediately dispatched to the scene and an investigation was conducted in accordance with the provisions of Title 7 of the Federal Aviation Act of 1958, as amended.

Air Carrier

Allegheny Airlines, Inc., holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property, and mail. It also possesses a valid air carrier operating certificate issued by the Federal Aviation Agency.

Capt. Harold E. Gould, age 39, holds a valid Federal Aviation Agency airline transport pilot certificate with ratings for the Martin 202, 404, Convair 340/440, Convair 540. Capt. Gould has a total of 14,450 flying hours of which 1,800 were in the Convair 340/440.

First Officer Harold T. Hawkins, age 34, holds a valid Federal Aviation Agency commercial pilot certificate and instrument rating. He has approximately 9,000 flying hours of which an estimated 1,700 hr. are in Convair aircraft.

First Hostess Francoise De Moriere, age 29, had an estimated flying time of 1,680 hr. approximately 440 hr. of which were in Convair-type aircraft.

Second Hostess Katherine Lacy, age 20, has 135.5 hr. of flying time of which 79.3 hr. were in Convair-type aircraft.

The Aircraft

The aircraft is a Convair 340/440, U. S. Registry N 8415H, owned and operated by Allegheny Airlines, Inc. It was manufactured on Oct. 14, 1953, serial No. 125. The total time on the airframe was 20,960:11 hr. at the time of the accident. The engines are Pratt & Whitney, model R-2800 CB-16, with Hamilton Standard propellers, model 43E60.

USAF Builds Jet Weather Fleet

Boeing WB-47 flying weather laboratory being flown by USAF's Air Weather Service, has airscoop amidships, left, fitted to collect material which is analyzed, recorded and then transmitted to ground weather stations for use in preparing forecast maps. Lockheed-Georgia Co. is converting 34 B-47s for weather missions. The fleet will fly approximately 23,000 mi. daily on regular routes.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Astronaut John H. Glenn, Jr., has received the 1962 Gold Medal of the French Association Pour l'Etude et la Recherche Astronautique. Col. Glenn accepted the award, "on behalf of myself and the thousands of persons here and abroad who have made these space flights possible."

Changes

Roy A. MacKenzie, assistant to the president of Lockheed-Georgia Co., Marietta, Ga. **H. Lee Poore** succeeds Mr. MacKenzie as director of manufacturing operations.

Maurice A. Sulkin, assistant to the vice president of research and development, North American Aviation's Los Angeles (Calif.) Div.

Robert J. Gladwell, assistant to the executive vice president of British Aircraft Corp. (U.S.A.), Inc., Arlington, Va.

F. L. Passmore, general manager, London Airports, succeeding **R. S. F. Edwards**, retiring.

Harold I. Baynton, former chief counsel of the Senate Commerce Committee, will become assistant to the president of World Airways, Inc.

William E. Stoney, Jr., chief, Spacecraft Technology Div., Office of Engineering and Development, Manned Spacecraft Center, National Aeronautics and Space Administration, Houston, Tex.

Ned E. Garlock, director-science and engineering applications, Northrop Corp.'s Ventura Div., Newbury Park, Calif.

James R. Lewis, corporate director of public relations and advertising, Litton Industries, Inc., Beverly Hills, Calif.

Milton B. Korelitz, general manager, Eastern Operations, CTS Missile/Space Technology Div., Studebaker Corp., Cincinnati.

Marche Rothlisberger, security administrator, Center for Naval Analyses, Washington, D. C.

Carl B. Burnett, assistant chief engineer, Consolidated Diesel Electric Corp., Stamford, Conn.

Alexander Alexandrovich, assistant to the vice president for engineering technology, Grumman Aircraft Engineering Corp., Bethpage, N. Y.

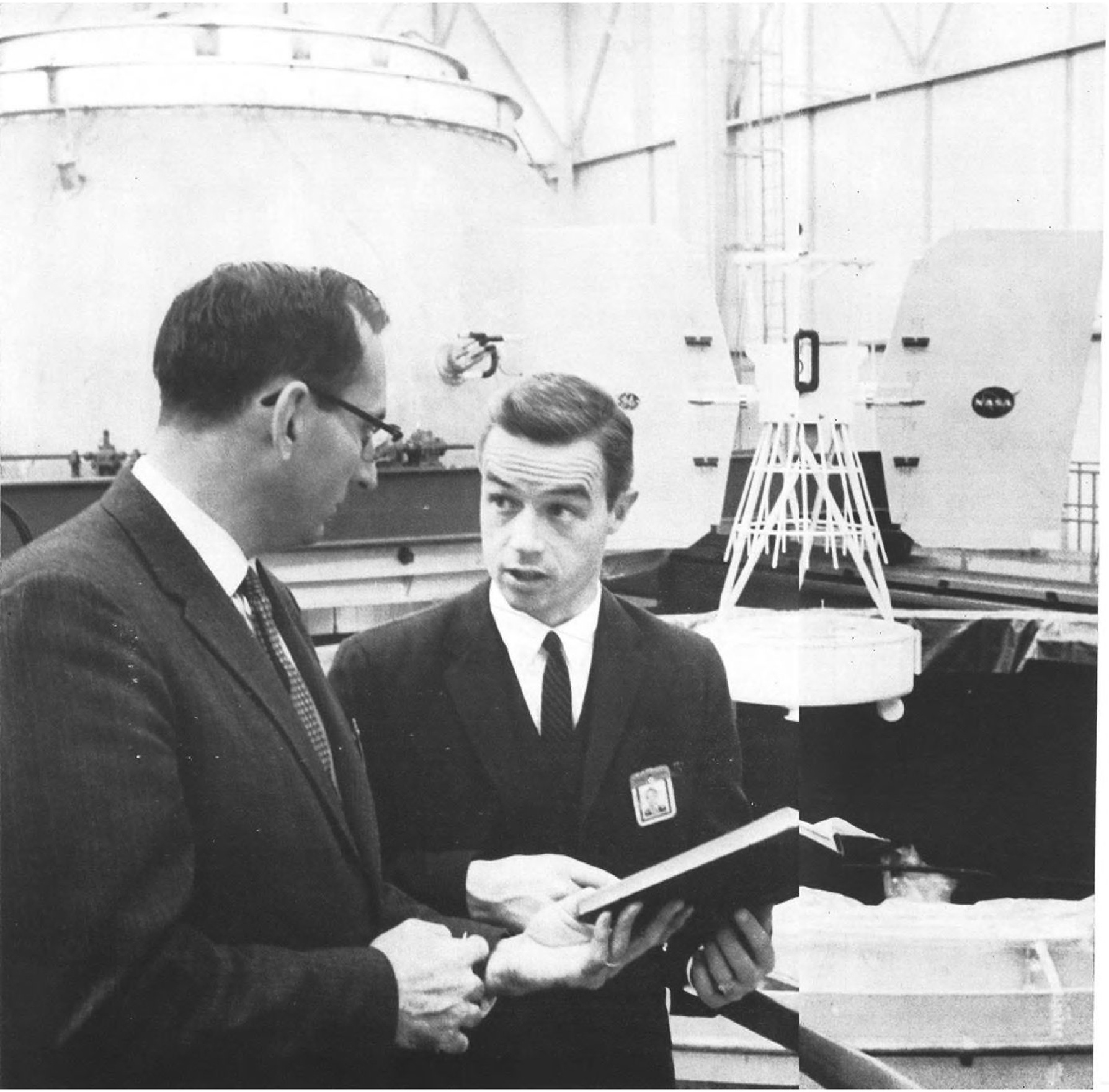
P. C. C. Brown, manager of the newly opened Washington (D. C.) office of Graviner Manufacturing Co. Ltd., London, England.

William J. Hammond, assistant general manager and marketing manager, Claud S. Gordon Co., Richmond, Ill., a subsidiary of PneumoDynamics Corp.

Frederick V. Martin, Jr., director, Business Development, Space Systems Div., Fairchild Stratos Corp., Washington, D. C.

Pierre Stoeckel, cargo services manager for the North Central American and Caribbean Div. of Air France, succeeding **Roland Hawkins**, now passenger services manager for the division.

Raymond R. Taylor, assistant manager, Garrett Manufacturing Ltd., Etobicoke, Ontario, Canada, a subsidiary of The Garrett Corp. **Eric Peckham** succeeds Mr. Taylor as support service manager.



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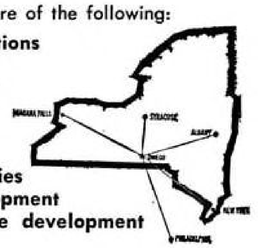

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National Aeronautics and Space Administration
at the Aeronautics and Space Committee Hearings,
U.S. House of Representatives, 1963.

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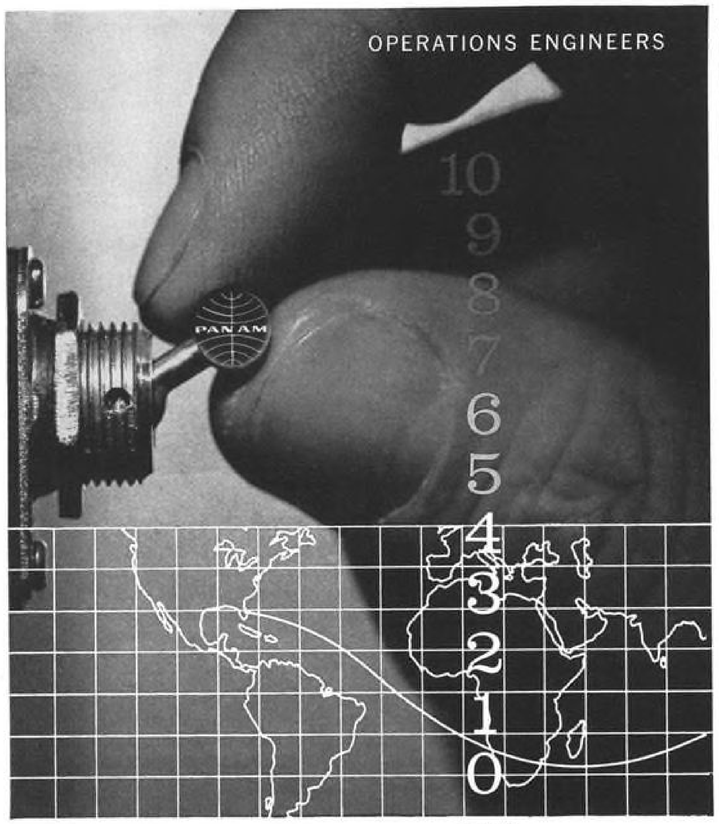

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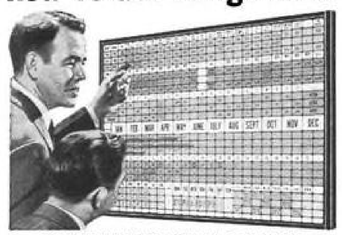

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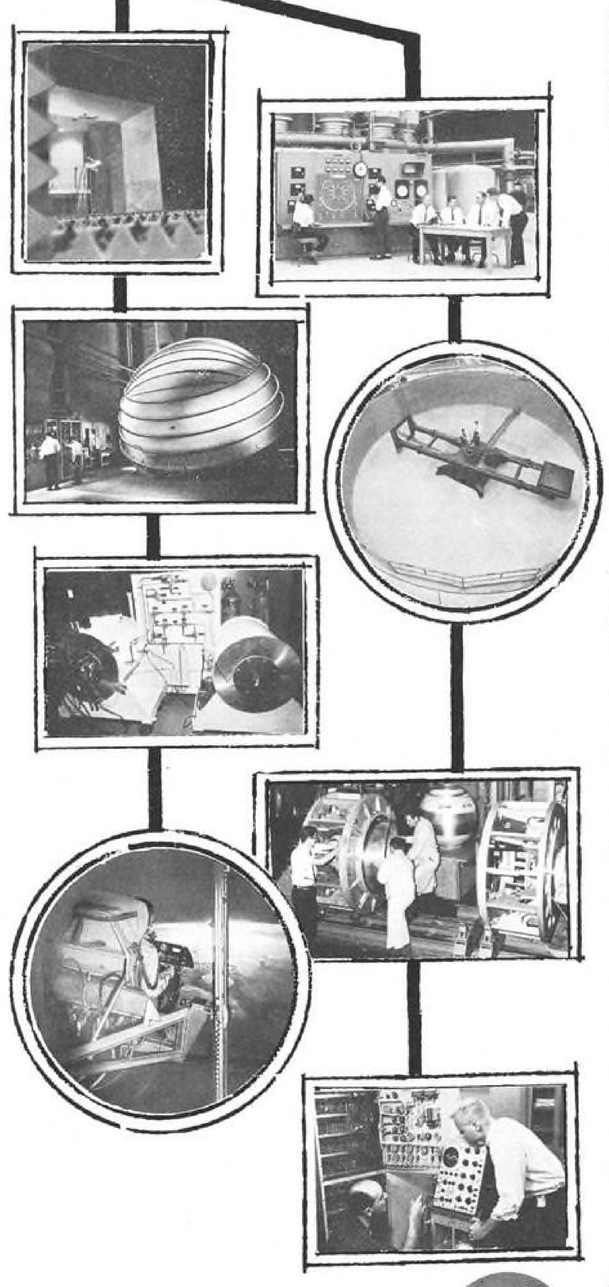

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, AUGUST 12, 1963

LETTERS

X-21A Coverage

Aviation Week's June 24 article (pp. 52-62) on the X-21A laminar flow control demonstration airplane has created much comment here. This article undoubtedly will do much to extend the understanding of details about this airplane and its testing program. In the interest of amplification and clarification, I am writing to add several comments regarding possible future applications of LFC.

With regard to cargo aircraft applications, the reduction in powerplant requirements will be more than one-fifth. It will, in fact, be one-third. The thrust of the smaller and more economical engines will be adequate for takeoff because the LFC wing is larger and provides additional lift. In all of our LFC application studies, the matter of critical field length is an essential parameter for comparison of performance of turbulent and laminar aircraft. In none of these studies has there been a finding that laminar aircraft would need additional propulsion for takeoff.

LFC is most applicable to the multipurpose aircraft concept. LFC's optimum use is for long ranges or long endurance at higher altitudes as required for logistics and surveillance missions and for the airborne command and communications center concepts, to name but a few applications of the multipurpose airplane.

Concerning supersonic applications, Northrop supersonic wind tunnel tests to date have indicated that laminar flow control can be maintained on wings swept in front of or behind the Mach cone. Further and more exhaustive tests are planned.

W. E. Gasich
Vice President and Assistant General Manager-Technical
Norair Div.
Northrop Corp.
Hawthorne, Calif.

MA-9 Sightings

Those who would categorically discount Maj. Cooper's sighting of small ground objects while in orbit had better review a bit of recent history. The exact details escape me, but at the time the VOR navigation system was proposed, it was ridiculed for a somewhat similar argument. How could an antenna system, whose dimensions were so small that the beam width could not resolve to better than 30 deg., ever give directional information to within three degrees? This is a "black box" approach to the problem, where an appropriate physical law is stamped on the outside without regard to the contents.

The problem of ultra-high optical resolution might be attacked, for instance, from a point of view of "jitter." This is the way in which our proprioceptive sense determines such things as control stick forces. A jitter which scans or oscillates the image on the retina with an amplitude of the order of the spacing of the receptor elements, could conceivably operate to resolve a distance smaller than the dimension of the receptor element. Intensity comparisons would probably be involved, since it seems unlikely that the motions would allow for phase comparisons of visible light.

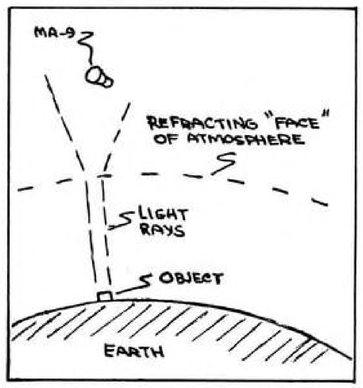
Leo Mackta
Belle Harbor, N. Y.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Regarding the skepticism expressed over Maj. Cooper's report of distinguishing small objects from MA-9 during his flight, Maj. Cooper saw what he said he saw. It is quite easy to explain what would normally be considered the unusual visual acuity involved in these sightings. Maj. Cooper had the help of what amounts to a gigantic diverging lens, the earth's atmosphere, to magnify objects so he saw things he rightly should not have seen (see sketch below).

Seen from a vantage point in space outside the sensible atmosphere, rays from an object on earth will be refracted so they will spread out as they pass from the denser medium of our atmosphere into the emptiness of space. This will magnify objects on earth seen from space. Because of the magnitude of the radius of curvature and the rather poor definition of the refracting "face" of the atmosphere which forms the diverging lens, the magnification would not be great—only enough to nearly get the poor major certified.

William Strumbos
Northport, N. Y.



Regarding the comments of Dr. W. R. Adey (AW June 17, p. 34) and reader Dunkerley (AW July 15, p. 98) and any others who have disparaged or dismissed as hallucinations Maj. Cooper's sightings, they are just as scientific as the sages who "proved" that man could not fly. While I do not have the visual acuity of either Maj. Cooper or reader Schoenky (AW July 15, p. 98), a simple experiment that your disbelievers can perform proved to me that Cooper's sightings are completely plausible.

It is necessary only to pick out while driving a distant single electric or telephone wire (not cable) of approximately ¼ in. diameter and note the mileage to target. I consistently picked out such targets at 0.3 to 0.4 mi. which indicates a minimum ratio of 75,000 to 1. We have permitted to graduate from college too many who accept printed "facts" as gospel against the testimony of completely competent men such as Maj. Cooper and who wave the printed "truths" instead of setting up an objective experiment and analysis. Perhaps the earth's atmosphere also acted as a slight lens to Maj. Cooper's eyes?

Earle C. Smith
New York, N. Y.

ATC Equipment

Your article "Technicians Score FAA on Traffic Control" (AW July 15, p. 36) commenting on the ATCA and RTCA reports criticizing the FAA's accomplishments on keeping pace with Air Traffic Control is true, but not entirely fair. We have produced the major share of ILS, VOR, and Video Mapping equipment for many years. In certain areas it is true that the equipment prices are unnecessarily high in regard to performance because the performance requirements are too high in relationship to the design capability. In some cases they may be too high in an absolute sense but that is very minor. We need better equipments, not just less expensive equipments. Why haven't the designs changed? Because of annual, straight-fixed price competitive bidding which doesn't have enough quantity procured to amortize a potentially cost reducing and/or performance improving change. The pressure Congress put on procuring agencies to buy in this manner is detrimental. No responsible industrial purchasing agent would buy in that fashion. The pressure is severe from Congress, but it can be avoided and it should be avoided.

The unfair part is that no recognition is given to the accomplishments. Remember, for many years, a bunch of fuddy duddy railroad men in the Commerce Department held the purse strings and they knew airplanes would never amount to anything. That the country got equipped as well as it did is something of a miracle. The equipment engineering and procurement people couldn't afford to up-grade—they needed a lot of hardware and only so much money was forthcoming each year. Some of the broken and badly bent contractors will also point out that this "miracle" was accomplished by some equipment delivered at way less than cost, even free in some cases, because of a harsh and harshly administered liquidated damage clause.

Sure, there is a long way to go, but a favorable climate has just arrived and present plans and action attest that it is not being ignored.

Robert Bilhorn
Marketing Manager
Televiso Electronics
Wheeling, Ill.

"Go straight for 54,331,129 miles, then turn left."

In the control station, a new course is computed. A command flashes from the earth to a space vehicle half a universe away. In seconds the spacecraft obeys—because its communications system got the message. Making contact with an object traveling through space calls for sensitive devices that can detect even the weakest signal, need only a minimum of power to operate. Meeting such requirements is a Fairchild specialty—one reason Fairchild transistors have been selected to go to Mars aboard the United States' next major space probe.

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