Aviation Week & Space Technology

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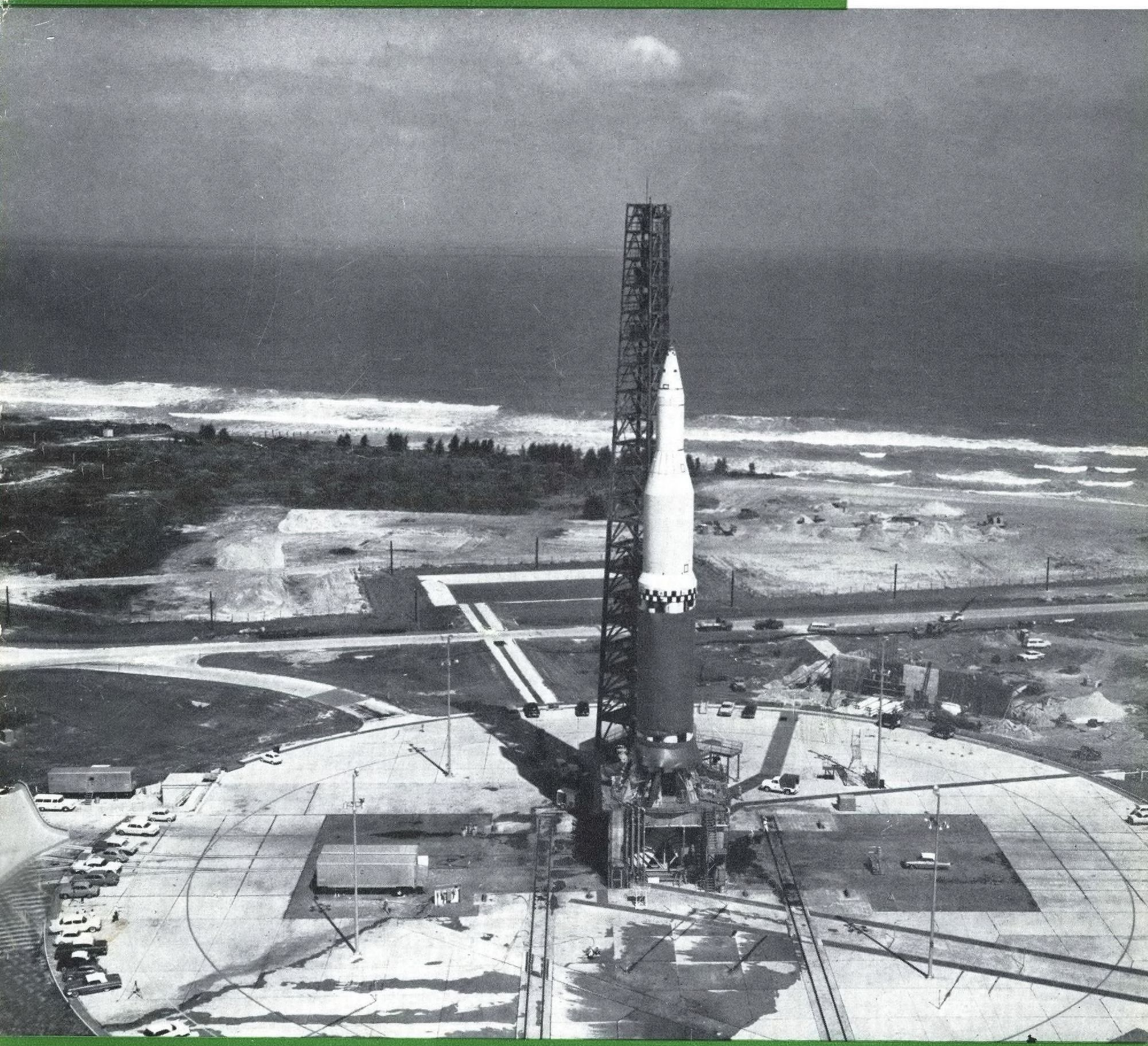
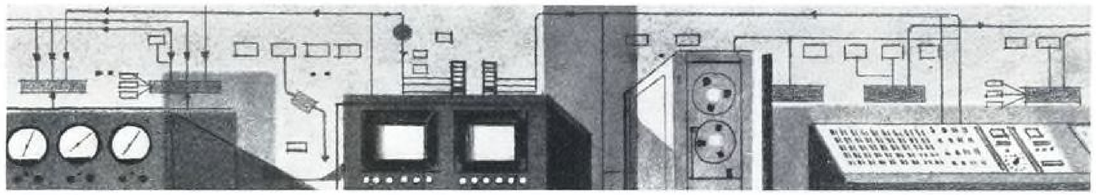
November 26, 1962

JPL Organizes Multiple Space Mission Center

Saturn SA-3



Navy Spasur Provides Vital Norad Coverage



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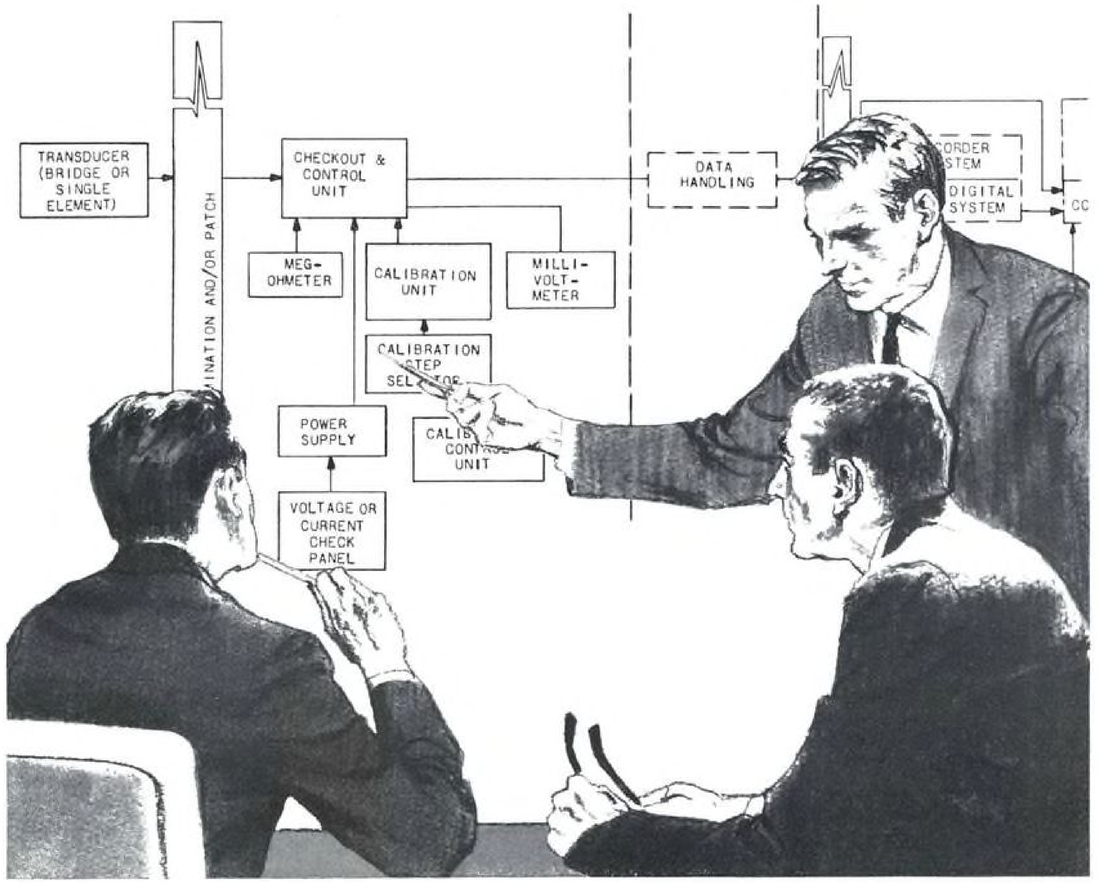

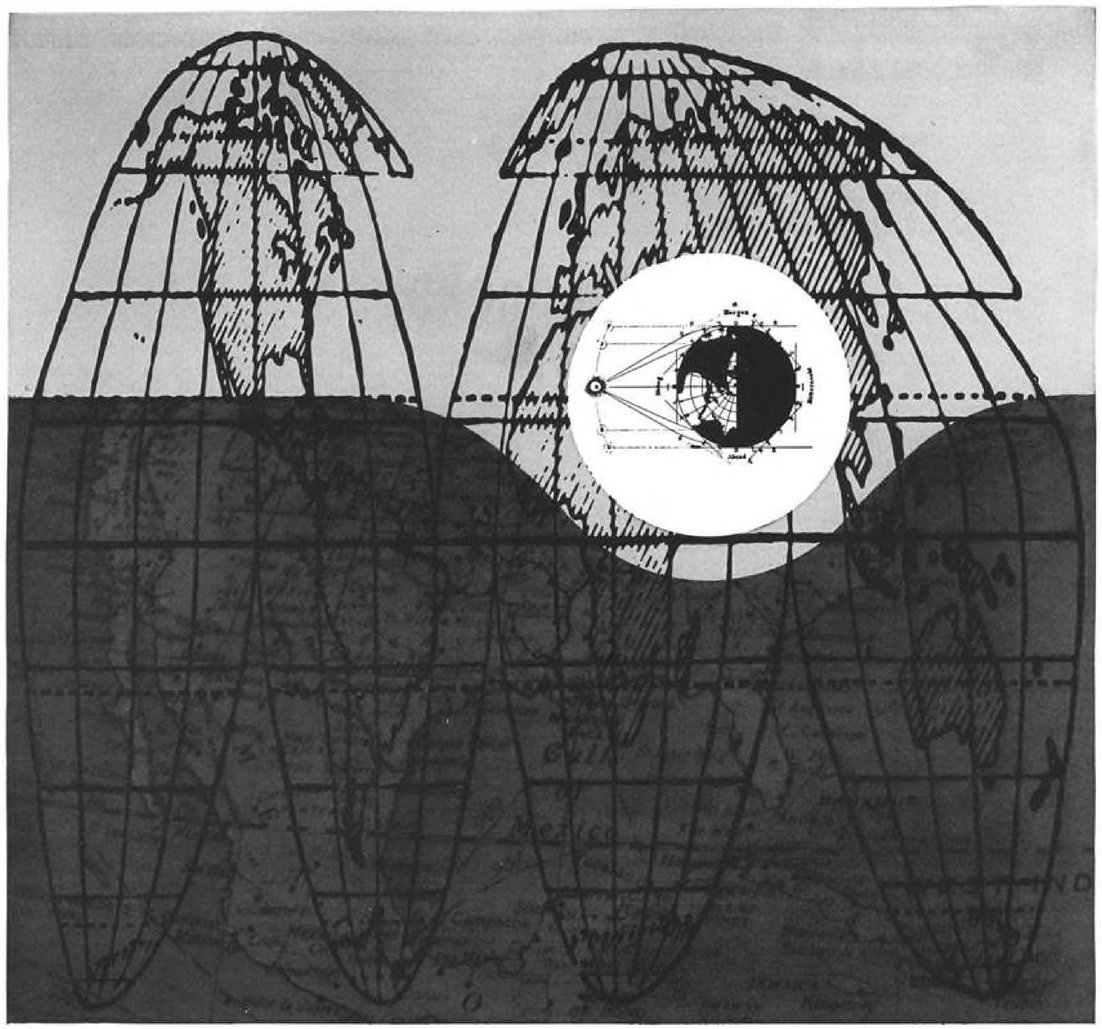

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AEROSPACE CALENDAR

Dec. 2-6—15th Annual International Air Safety Seminar, Flight Safety Foundation, Williamsburg, Va. (FSF members and by invitation.)
Dec. 4-6—Fall Joint Computer Conference, Sheraton Hotel, Philadelphia, Pa. Sponsors: American Federation of Information Processing Societies; IRE.
Dec. 4-6—1962 Convention, National Aviation Trades Assn., Flamingo Hotel, Las Vegas, Nev.
Dec. 5—12th Annual National Air Taxi Conference, Flamingo Hotel, Las Vegas.
Dec. 5—Annual Dinner Meeting, Strategic Industries Assn., Statler-Hilton Hotel, Los Angeles, Calif. Speaker: Gen. Mark E. Bradley, Jr.
Dec. 6-7—Vehicular Communications Conference, IRE, Disneyland Motel, Los Angeles.
Dec. 10-11—First Annual Symposium on Unconventional Inertial Sensors (classified), Republic's Paul Moore Research & Development Center, Farmingdale, N. Y. Co-sponsors: Bureau of Naval Weapons & Republic Aviation Corp., in cooperation with AFSC Scientific and Technical Liaison Office.
Dec. 10-12—Conference on VTOL Aircraft, New York Academy of Sciences, Henry Hudson Hotel, New York, N. Y.
Dec. 17-20—International Arms Control Symposium, University of Michigan, Ann Arbor, Mich. Co-sponsors: University of Michigan; Bendix Systems Division.
Dec. 26-31—Space Physics Meeting, Ameri-

(Continued on page 7)

AVIATION WEEK and Space Technology

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AEROSPACE CALENDAR

(Continued from page 5)

can Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.

Dec. 27—American Astronautical Society Symposium on Scientific Satellites-Mission and Design, Franklin Hall, Philadelphia.

Jan. 7-10—Millimeter and Submillimeter Conference, Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.

Jan. 13-16—15th Annual Convention, Helicopter Assn. of America, Cabana Motor Hotel, Palo Alto, Calif.

Jan. 14-18—Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

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

Jan. 21-24—43rd Annual Meeting, American Meteorological Society, New York, N. Y.

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

Jan. 28—Fifth Annual Army Aviation Contract Services Symposium, International Inn, Washington, D. C. Sponsor: National Aeronautical Services Assn.

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

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

Feb. 5-6—Symposium on Engineering for Major Scientific Programs, Georgia Institute of Technology, Atlanta, Ga.

Feb. 11-15—Third International Symposium on Quantum Electronics, UNESCO Building, Paris, France. Sponsors: International Scientific Radio Union; Office of Naval Research; La Federation Nationale Des Industries Electroniques.

Feb. 12-13—Space Vehicle Thermal and Atmosphere Control Symposium, conducted by the Aeronautical Systems Division, Engineers Club, Dayton, Ohio. Sponsor: ASD's Flight Accessories Laboratory.

Feb. 20-22—1963 International Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.

Mar. 7-8—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.

Mar. 11-13—Electric Propulsion Conference, American Rocket Society, Broadmoor Hotel, Colorado Springs, Colo.

Mar. 18-20—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.

Mar. 18-21—1963 Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.

Mar. 25-28—International Convention, Institute of Radio Engineers, Waldorf-Astoria and Coliseum, New York, N. Y.

(Continued on page 9)

AEROSPACE CALENDAR

(Continued from page 7)

Apr. 1-3—Fourth Annual Structures and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, El Mirado Hotel, Palm Springs.

Apr. 2-3—Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, Barbizon Plaza, New York, N. Y.

Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 10-11—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley.

Apr. 15-17—Hypersonic Ramjets Conference, American Rocket Society and American Society of Mechanical Engineers, Naval Ordnance Laboratory, White Oak, Md.

Apr. 17-19—International Nonlinear Magnetics Conference, Shoreham Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; IRE.

Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.

Apr. 17-19—Technical Meeting: Nuclear Materials for Space Applications, American Nuclear Society, Netherland Hilton Hotel, Cincinnati, Ohio.

Apr. 22-23—Annual Meeting, National Aeronautical Services Assn., Washington, D. C.

Apr. 22-24—Second Manned Space Flight Symposium, Institute of the Aerospace Sciences in cooperation with NASA and AFSC, Dallas, Tex.

Apr. 22-24—Third Annual San Diego Symposium for Biomedical Engineering, Del Webb's Oceanhouse, San Diego, Calif.

Apr. 24-26—Seventh Region Technical Conference, Institute of Radio Engineers, San Diego, Calif.

May 2—Bioastronautics Conference, American Rocket Society and Aerospace Medical Assn., Los Angeles, Calif.

May 2-3—Fourth National Symposium on Human Factors in Electronics, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington, D. C.

May 7-9—Electronic Components Conference, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington.

May 13-15—National Aerospace Electronics Conference, Institute of Radio Engineers, Dayton, Ohio.

May 15-17—Connecticut General Flight Forum's Second National Symposium on Air Transportation, Hartford, Conn.

May 20-22—National Symposium on Microwave Theory and Techniques, Institute of Radio Engineers, Miramar Hotel, Santa Monica, Calif.

May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.

May 21-23—Spring Joint Computer Conference, American Federation of Information Processing Societies, Cobo Hall, Detroit, Mich.

May 27-28—Seventh National Conference on Product Engineering & Production, Institute of Radio Engineers, Continental Hotel, Cambridge, Mass.

June 7-16—25th French International Air Show, Le Bourget, Paris, France.

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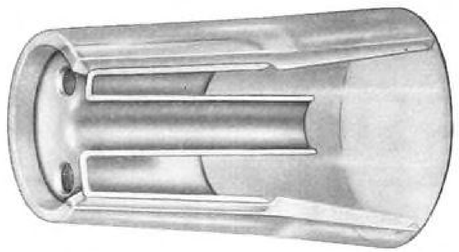

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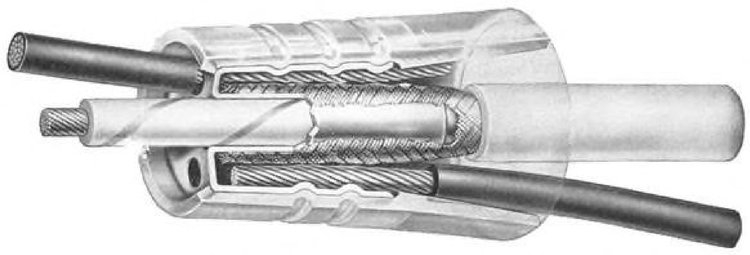

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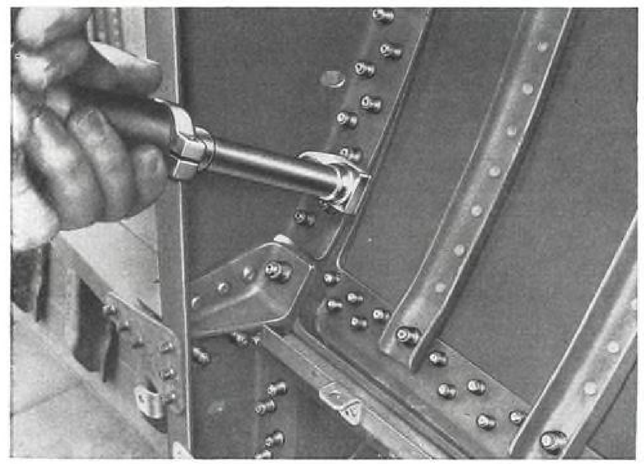

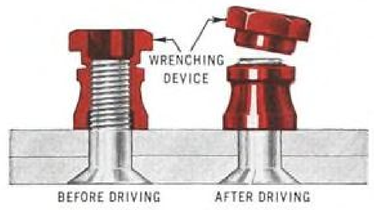

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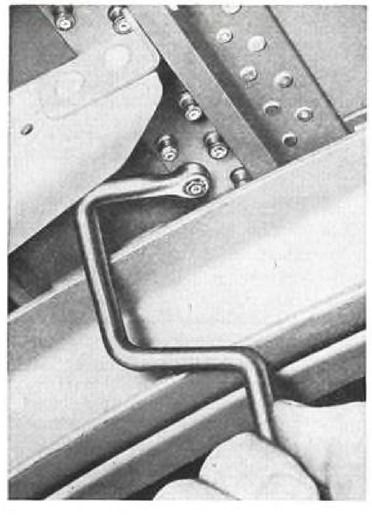

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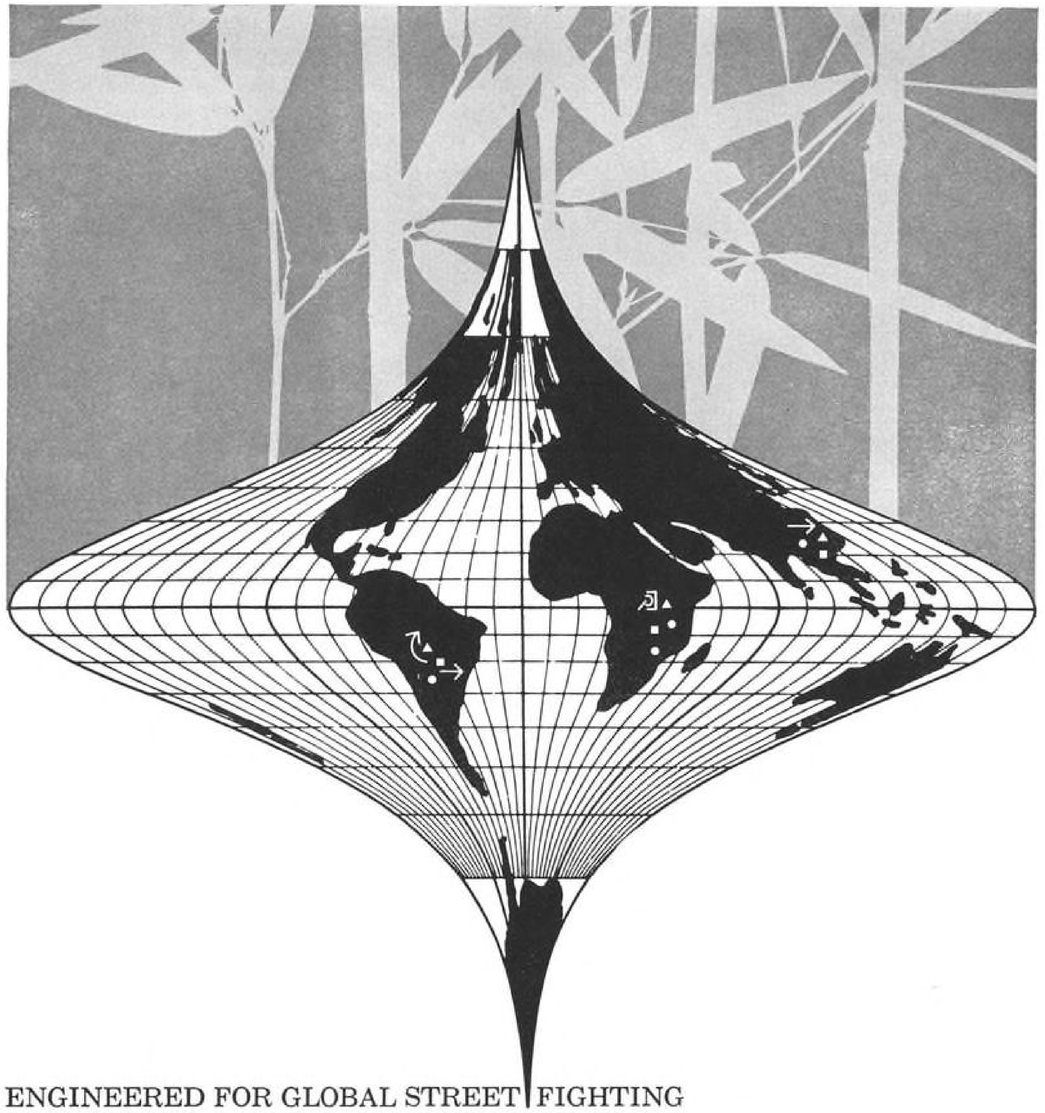

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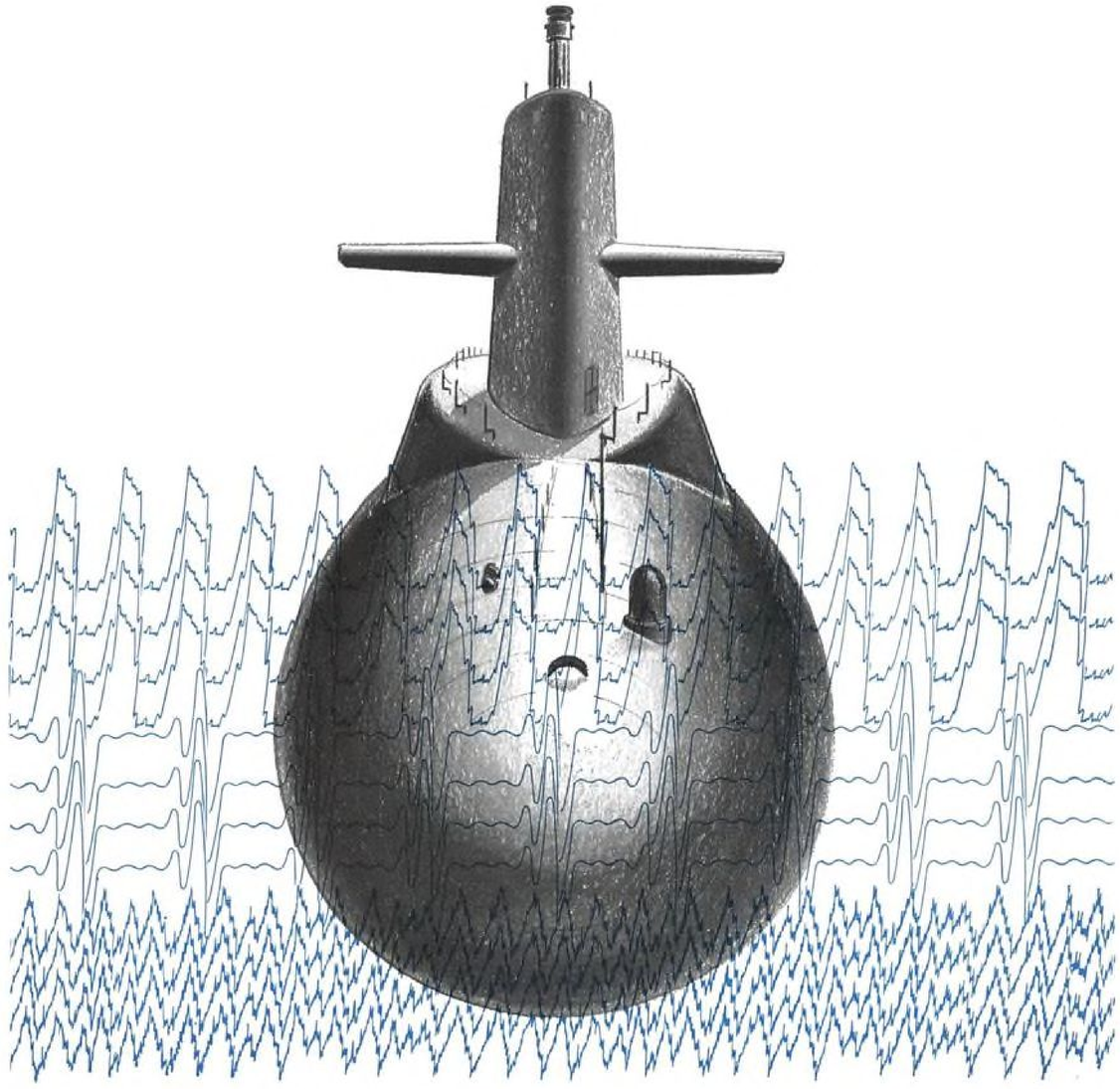

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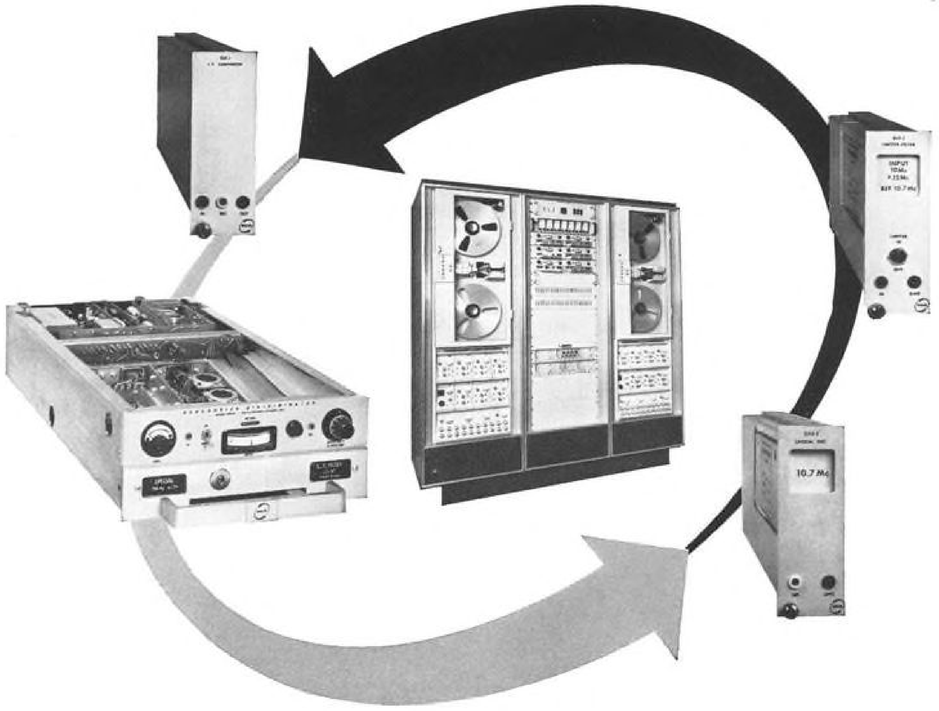

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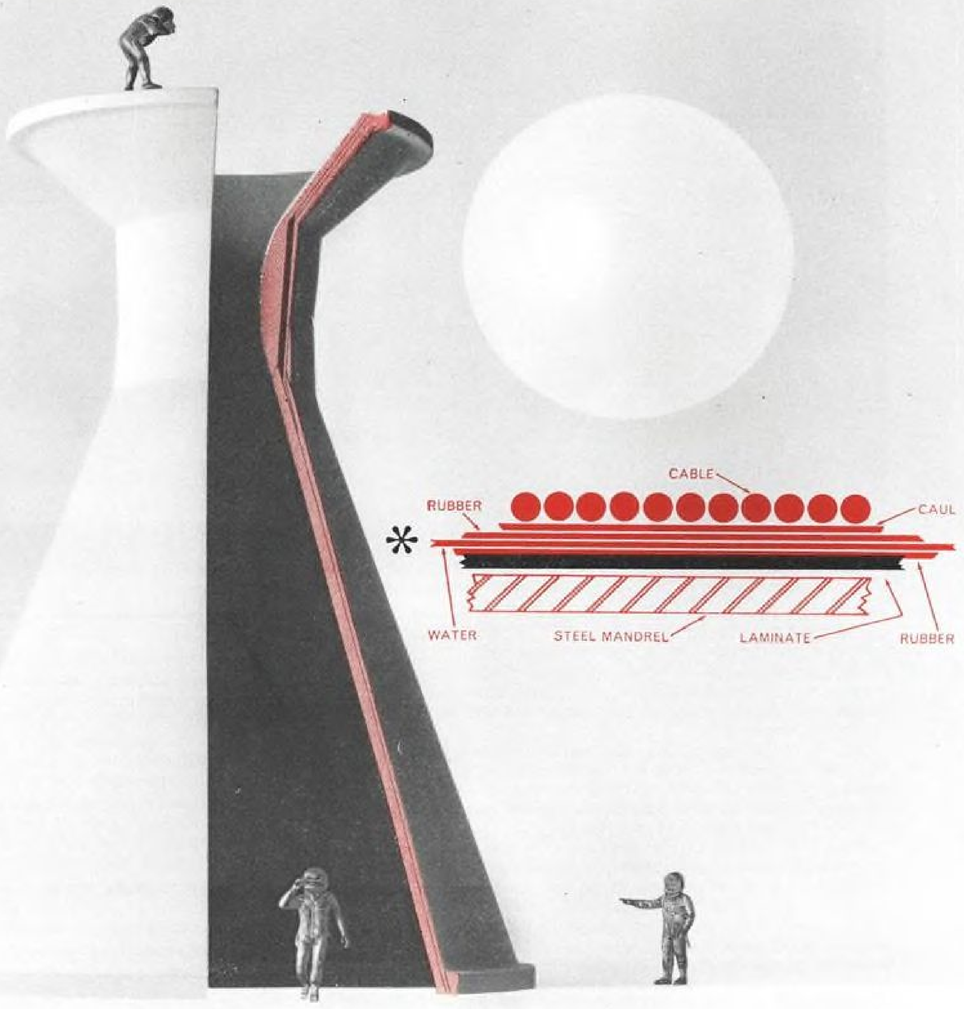

The Cable-Clave process involves a laminated structure, with the uncured nozzle section sandwiched between a liquid pressure enclosure and a steel form. This assembly is cable-wound for pressure containment, then encased in a heated shell. Controlled pressure is introduced to program the complete curing process. *Patent Applied For. Cable-Clave is a Trade Mark of Swedlow Inc.*

Aviation Week & Space Technology

Volume 77
Number 22

November 26, 1962

CONTENTS

COVER: Third Saturn test vehicle, SA-3, which was launched Nov. 16 from the Atlantic Missile Range, is shown during launch preparations at Complex 34. Dummy second and third stages contained 95 tons of water which was released into the ionosphere when the test vehicle reached peak altitude (AW Nov. 19, p. 34). One more vehicle of this configuration remains in test series (see p. 32). Early data indicates SA-3 was successful.

PICTURE CREDITS

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EDITORIAL

Progress on Cuba

Soviet agreement to remove all of their Il-28 twin-jet Beagle bombers from Cuba marks another milestone toward the eventual solution of the problem posed by the Russian attempt to establish a base for offensive nuclear weapons only 90 mi. from this country. All Americans will certainly applaud President Kennedy's firmness in refusing to dilute his original demand that all types of offensive weapons be removed from Cuba by the Soviets and in continuing to insist on some type of authentic on-site inspection of the Cuban weapon bases.

Apparently all of the Sandal MRBMs (a slightly longer-range version of the earlier Shyster) have departed from Cuba aboard Soviet freighters and the Ilyushin Beagles are scheduled to follow within 30 days. Both actions will help to de-fuse the potential explosiveness of the Cuban bomb, although the thorny issue of on-site inspection remains. The Mach 2 MiG-21 Fishbed fighters and the Guideline surface-to-air-missiles still remain in Cuba, although there has been no further Guideline firing since one brought down a U-2 on a photo-recon mission Oct. 27. The Fishbed-Guideline combination certainly strengthens the Cuban air defense system, but poses no real threat to a determined large-scale penetration of that island's air space.

Castro's Losing Struggle

It is interesting to note the sour grapes reaction by Fidel Castro to the forced departure of his Il-28 bomber-fleet as he cited their obsolescence, slow speed and limited ceiling.

As we noted earlier (AW Nov. 12, p. 21) the Il-28s posed a real threat in the Caribbean area, Central America and oil-rich Venezuela despite their lack of capability against the North American air defense system. Castro's reluctance to let them go is indicated by the weeks of haggling between himself and Soviet Deputy Premier Anastas Mikoyan before he bowed to the Russian's edict.

This haggling over the Il-28s probably was also another measure of the U.S. determination to see the Cuban crisis through to its conclusion. The Soviets were obviously surprised by the speed and determination with which President Kennedy reacted to their Cuban missile gambit, and there must still be considerable skepticism in the Kremlin as to whether the U.S. is really as tough as it sounds. The U.S. rejection of all compromise on the Il-28 removal must certainly have dissolved some of these lingering doubts both at home and abroad.

Progress on the Cuban crisis, however substantial it may in fact be, should not lull the American people and their allies into a feeling of false security on the over-all problem of Sino-Soviet imperialism. The sad plight of India today should be the only object lesson anyone needs on what befalls those who depend only on noble thoughts and minding their own business as a defense in this wicked world. Indian troops, when properly equipped and led, are among the world's finest fighting men. But the spectacle of them marching up the Assam Valley in thin tropical greens carrying World War I vintage bolt action Lee-Enfield rifles to do battle in the frigid Himalayan passes with Chinese hordes armed with automatic weapons, recoilless artillery and heavy mortars is a sad commentary on the wisdom of the leaders of this new nation. It has also taken great restraint on the part of both Britain and the U. S.—both of which have been roundly abused by leading Indian statesmen for their military might—to refrain from a sarcastic "it serves you right" as they rushed military aid to India.

Despite the skillful Chinese propaganda barrage of proffered cease-fires, withdrawals and truce offers, it appears that their offensive drive into India is no mere border dispute, but naked large-scale aggression aimed at major strategic gains that could outflank both their Russian allies in the northwest and the SEATO pact nations in the east. The Chinese are now extremely close to pouring into upper Assam and the broad Brahmaputra Valley. This was a strategic prize sought vigorously by the Japanese during World War 2 and thwarted only by the now almost-forgotten siege of Imphal. The Japanese were never able to swallow Imphal, the sole stumbling block on their open road to India, because the surrounded defenders were successfully supplied and reinforced by airlift. Nearly 20 years later, airlift to the Assam Valley is again a critical factor in deciding which army controls this key area, and maybe there are some lessons to be learned from that.

Airlift Foresight

One of the first military actions taken by the Kennedy Administration in 1961 was a program to strengthen military airlift by immediate acquisition of Boeing C-135 jet transports and initiating development of the Lockheed C-141 jet freighter. The Boeing C-135s have already been doing workhorse service, participating in three major emergency airlifts during the past month—to Guantanamo in the Cuban crisis; to typhoon-striken Guam, and in the quick arms delivery to India. The C-141 is still under development, but the events of the past year have proved that it will be sorely needed when it is ready for service. In the meantime, the Lockheed C-130 continues to play a brilliant airlift role, performing well beyond the scope of its original mission.

It is certain that the wisdom of this early decision to broaden military airlift capability will be reinforced with the passing of each international crisis. At the pace world events move today, only airlift can react in time to be truly effective. However, the organization of the current and future airlift capability of the military services into an effective instrument of national policy, which provides maximum response to top priority problems at reasonable cost and efficiency, is a problem as yet unsolved.

Cuba and India have certainly proved that it is hardly prudent for nations to stalk through the international jungles armed only with a high moral purpose.

—Robert Hotz

WHO'S WHERE

In the Front Office

George W. Leisz, vice president and general manager, Inertial Navigation Product Division of Autonetics, Downey, Calif., a division of North American Aviation, Inc., succeeding **S. Frederick Eyestone** (AW Oct. 22, p. 23).

K. Robert Hahn, a corporate vice president, Lear-Siegler, Inc. Mr. Hahn continues as president of the Power Equipment Division, Cleveland, Ohio.

Col. Langdon F. Ayres (USAF, ret.), assistant to the executive vice president, Aerojet-General Corp., Azusa, Calif. (AW Oct. 15, p. 25).

Honors and Elections

Robert R. Gilruth, director of NASA's Manned Spacecraft Center, has received the American Rocket Society's highest honor, the Robert H. Goddard Memorial Award, for "general eminence in the field of rocket engineering and space flight." Other 1962 award recipients: **Lt. Col. John H. Glenn**—the **ARS Astronautics Award** for outstanding contributions to the advancement of space flight for ". . . his feat as the first American to make an orbital flight of the earth."; **Vice Adm. William F. Raborn,** Deputy Chief of Naval Operations, Special Projects Office—the **James H. Wyld Memorial Award** "for outstanding application of rocket power" in recognition of his leadership in the Polaris missile program and his contributions to the Terrier-Talos-Tartar missile programs; **Samuel K. Hoffman,** president of Rocketdyne Division of North American Aviation—the **ARS Propulsion Award** for "outstanding achievement in the field of rocket propulsion systems."; **Dr. Howard S. Seifert**—the **G. Edward Pendray Award** (AW Nov. 5, p. 23); **Theodore Forrester,** head of the Ion Physics Department of Electro-Optical Systems, Inc.—the **ARS Research Award,** given to the person who conducts a significant program of individual research in rocketry or astronautics; **John R. Winckler** professor of physics at the University of Minnesota—the first **ARS Space Science Award,** to be presented annually to a scientist for achievements in investigation of the physics of the atmospheres of celestial bodies . . ." Elected fellows of the ARS: **H. Julian Allen, Abraham Hyatt, Eberhardt Rechtin, A. O. Tischler** and **Walter C. Williams,** of NASA; **Lt. Col. Paul G. Atkinson** and **Milton M. Slawsky** of the Air Force Office of Scientific Research; **Robert W. Bussard** and **Ruben F. Mettler** of Space Technology Laboratories; **James R. Dempsey** of General Dynamics/Astronautics; **Frank J. Malina** of the International Academy of Astronautics; **Ronald F. Probstein** of Massachusetts Institute of Technology; **Maj. Gen. Osmond J. Ritland** of USAF Systems Command's Space Systems Division; **William L. Rogers** of Aerojet-General Corp.; **L. Eugene Root** of Lockheed Missiles and Space Co.; **Leo Steg** of General Electric Co.; **Harrison A. Storms** of North American Aviation. **Harold Wexler** of the U.S. Weather Bureau, received a posthumous fellowship.

(*Continued on page 111*)

INDUSTRY OBSERVER

► Army has launched a development program at Raytheon to give the Hawk missile an anti-missile capability against short-range ballistic weapons similar to the Soviet Shyster MRBMs recently removed from Cuba. By adding long-range acquisition radar and a high-speed computer to the present Hawk system at moderate cost, Army believes, the Hawk can be made effective against such threats. Army has demonstrated Hawk intercepts of Corporal and Sergeant missiles under controlled conditions.

► **Boeing Co. has approached Bristol-Siddeley of Great Britain to obtain technical knowledge on intake and outlet variable geometry for supersonic transports in the Mach 2.2 range. Boeing has made similar approaches to other companies which have developed specialized knowledge in supersonic transport technology to avoid duplication of previously-done work.**

► Enthusiasm of Navy's Bureau of Weapons for microcircuitry has caused concern in some industry quarters that BuWeps might prematurely make that method of construction mandatory for all its avionics equipment within several years. But Navy officials say this is not likely, except perhaps in the field of airborne digital computers and the avionics system for the VAX fighter.

► **Italian government is asking Fiat, Augusta, Aerfer and Aeronautica Macchi to submit proposals for a three-ton V/STOL transport for the country's air force. The aircraft would use Rolls-Royce RB.162 lift engines for vertical flight and a General Electric CF700 aft-fan powerplant for horizontal thrust.**

► Navy's Transit navigation satellite program, still officially classified as in the development phase, is moving rapidly toward operational status. Transit navigation receivers are currently being installed in Polaris missile-carrying submarines.

► **Thrust-augmented Douglas Thor utilizing three strap-on Thiokol XM-33 Castor solid-propellant motors and topped by an Agena D stage probably will be test-fired early next year from Vandenberg AFB, Calif. The vehicle is being prepared for a dual function—initial practical evaluation of the Titan 3 launch concept and boosting of a variety of Discoverer payloads of more-than-standard weight or higher-altitude orbits.**

► RCA Relay communications satellite is scheduled for launch Dec. 11 from Cape Canaveral. Hughes Syncom (AW Aug. 20, p. 80) will be launched in February, and AT&T is undecided on whether it should schedule another Telstar or wait until Telstar 1, now in orbit, ceases to be useful before making firm the Telstar 2 schedule.

► **Schemes for arming Lockheed's Navy-Army XH-51A rigid-rotor helicopter with a variety of weapons are being prepared by General Electric's Armament Division, Burlington, Vt. One plan involves incorporation of the company's Vulcan small-caliber, Gatling gun-type weapon. GE also has proposed installation of a nose-mounted, 20-mm. M-61 Vulcan on Lockheed F-104 Starfighter.**

► Switch from a programed Blue Scout booster to the Douglas Thor probably will delay until July, 1963, the launch of the first hypervelocity, lifting re-entry test vehicle being built by McDonnell Corp. for USAF's Project Asset (AW Feb. 5, p. 50). Blue Scout will not develop the total thrust required to boost the Asset vehicle. Thors to be used for the seven Asset launches will be taken from those originally allotted for the Canadian space program development and later acquired by the U. S. Air Force. The Thors will have to be modified for the Asset mission, and there is a possibility that Space-General Corp.'s Ablestar upper stage will be used for the Asset program.

► **Interest is rising in nuclear warhead defeating techniques—methods for disarming hostile weapons before detonation. Besides government-funded studies, some companies also are beginning to invest their own funds in this area.**

Washington Roundup

Budget Complications

Budget ceilings are expected to be the central fact of life in defense and space programs in the next year. The Kennedy Administration already expects an $8-billion deficit for Fiscal 1963. Now new funding problems at National Aeronautics and Space Administration (see p. 26), and the extra cost of the Cuban and Indian crises threaten to push that even higher. The Administration faces an even tougher time with the Fiscal 1964 budget, which is being put together now.

Defense Dept. estimates, prepared by the services under rather explicit guidelines laid down by Secretary Robert McNamara, now total about $53 billion—$5 billion more than the total approved by Congress for Fiscal 1963. It will take drastic action to cut it appreciably below that. Austerity already is the word in the services, especially in such areas as plant maintenance and transportation. Most likely targets for cuts are weapon systems that don't stand up well in cost-effectiveness studies.

No funds had been released for work on the USAF-Martin Titan 3 space booster by late last week, even though Defense Dept. has announced Dec. 1 as the go-ahead date. A contract had been signed with United Technology for the solid boosters, a final agreement had been reached with Martin, and final negotiations were in progress with Aerojet for the liquid propellant engines.

New MRBM Position

State Dept. now agrees with the view held by most North Atlantic Treaty Organization countries that any medium-range ballistic missiles for Western Europe should be based on ships or submarines instead of on land. Several countries, notably France, fear that land-based MRBMs would be difficult to conceal and would subject each nation to nuclear retaliation. The U.S., in turn, fears that each nation might feel entitled to use the missiles independently, and might start a world nuclear war.

Under Secretary of State George W. Ball told the eighth annual NATO parliamentarians conference in Paris recently that "from a strictly military standpoint we do not feel that the alliance has an urgent need for a European nuclear contribution. But should other NATO nations so desire, we are ready to give serious consideration to the creation of a genuinely multilateral MRBM force fully coordinated with the other deterrent forces of the NATO organization."

State Dept. denied reports that this statement represents a policy shift, pointing out that nuclear warheads cannot be given to any nation without specific authorization from Congress. But department officials did say Ball's speech meant that, as West European integration increased, the U.S. intended to share more nuclear information with its allies.

Houston Space Post

NASA headquarters is sounding out James C. Elms, director of space and electronics for Aeronutronic Division of Ford Motor Co., on the possibility of becoming associate director of its Manned Spacecraft Center in Houston, Tex. Walter C. Williams has held the dual role of associate director and director of operations there. Williams would continue to hold the operations job. Some observers think the success in manned space flights so far is due largely to the fact that Williams held both jobs at once, welding top management and operations into a single element.

Elms has been at Aeronutronic since mid-1960. Before that he had been manager of Martin Co. avionics and an executive vice-president of Avco's Crosley Division.

Rear Adm. C. E. Weakley, assistant chief of naval operations for development and an anti-submarine warfare expert, said last week that Russian submarines in unprecedented numbers operated in the Cuban blockade area, where they have rarely appeared before. All were diesel powered subs which normally use snorkels to recharge batteries. Several surfaced after the Navy had tracked them for long periods. One, tracked for 35 hr. by a destroyer, stayed up for a day and a half, apparently because of mechanical trouble.

Soviet Laser Progress

Soviet Chairman Nikita Khrushchev recently demonstrated that interest in laser development reaches to the highest levels in the USSR. When W. E. Knox, president of Westinghouse Electric International Co., visited with Khrushchev for three hours recently, the Soviet leader showed him a 6-in. steel ruler riddled with tiny holes. Khrushchev said the holes had been drilled by laser beams. He said he knew the U.S. was working on lasers but was convinced his scientists had the lead. Dr. C. H. Townes did the early significant U.S. work on lasers in 1952. Russia claims to have been working on lasers since 1951 but the U.S. knows little about Soviet progress since then.

Skeptics still doubt that Soviet MRBMs (medium-range ballistic missiles) and IRBMs (intermediate-range ballistic missiles) could have flown as far from Cuba as the Administration claimed. This has led to a new category—PRBMs, or Political Range Ballistic Missiles.

—Washington Staff

NASA May Cut Agena From Gemini Plan

Rendezvous with scientific payload or piggy-back satellite considered as move to save money and time.

By Edward H. Kolcum

Washington—Elimination of the Agena D launch in Gemini rendezvous missions is under serious consideration by the National Aeronautics and Space Administration as one way to cut costs and time in the increasingly expensive manned space flight program. The agency is studying the feasibility of having the Gemini spacecraft rendezvous with orbiting scientific payloads, or with satellites attached to Gemini and then ejected, as alternatives to the Agena D target.

This is the most significant of a number of sizable re-programing moves under way in NASA which are designed to take up the slack in funding deficiencies the space agency is experiencing (AW Nov. 12, p. 27; Nov. 19, p. 26). More money is not anticipated because of Administrator James E. Webb's decision not to request supplemental or deficiency funds this fiscal year.

Several members of Congress are expected to urge Webb to re-consider his decision and ask for $500 million in supplemental appropriations in January. This money would cover a deficiency in manned space flight which now amounts to $340 million, and $110 million for Ranger, Centaur, nuclear propulsion and other unmanned programs which are running into funding deficiencies. The remaining $50 million would be a contingency fund.

The radical modification of the Gemini plan implies that NASA may depend on the Air Force to play an important role in developing rendezvous techniques. USAF wants to buy Gemini spacecraft (AW Nov. 5, p. 42) for Dyna-Soar (X-20) crew training and for perfecting rendezvous.

USAF would use the Agena D stage in rendezvous development with Gemini, in which both target and chaser would be maneuverable. If NASA shifts to a target such as a scientific satellite, only the Gemini spacecraft would be maneuverable. Combination of the two programs would provide data essential to both civilian and military requirements. NASA hopes to decide within a few weeks whether to embark on the new program.

Gemini program (AW July 2, p. 94) is designed basically to qualify rendezvous systems for later use in the Apollo lunar orbit rendezvous mission. Of the 12 flight programs on the schedule, eight involve rendezvous and docking, one is a ballistic mission and the other two are 14-day orbital missions.

The ballistic flight, which will be the first Gemini launch and the only unmanned mission in the program, is now scheduled for November, 1963, a four-month delay from the July schedule of earlier this year. Robert R. Gilruth, director of the Manned Spacecraft Center, told the American Rocket Society in Los Angeles of the slippage, but he attributed it to the complexities of the task and specifically said it was not due to a lack of funds. A few days earlier, Webb said the space program is on schedule.

It was later explained by a spokesman at the Manned Spacecraft Center that although the Gemini program alone is short $125 million for Fiscal 1963 and the program is unquestionably in funding trouble, its primary difficulty is a series of technical problems, none of them considered tough enough to endanger the program objectives.

Reprograming in NASA earlier this month resulted in subtraction of $10 million each from Gemini and Apollo projects. The Gemini spacecraft is budgeted at $131 million in Fiscal 1963, with another $72 million for Titan 2 and Atlas Agena B launch vehicles.

The ballistic Gemini capsule will weigh 6,800 lb., and the first manned spacecraft will weigh 7,200 lb. Final spacecraft weight for rendezvous missions is 7,800 lb. Present schedule calls for launch every two months.

If NASA decides to shift to a modified program by eliminating the maneuvering Agena D targets, the move could have these consequences:

- **Titan 2 Gemini** launch vehicle probably would be required to carry several hundred more pounds into orbit, because Gemini would do all the maneuvering. The capability of the launch vehicle is several hundred pounds more than the maximum 7,800 lb. now foreseen for Gemini.
- **Biological satellite** development may be accelerated, because there are some in NASA who believe rendezvous of a manned satellite with a biological payload is a logical step in manned space flight. A biological satellite plan has been developed by the agency, but has not been approved at the top level. When approval is obtained, program managers will decide on the capsule which will carry primates and biological specimens in orbit. Major contenders (AW Aug. 13, p. 26) are the Samos E-5 and modified Mercury capsules.

Air Force, which recently relinquished the biological satellite program to NASA (AW Aug. 13, p. 26), has recommended a Lockheed-developed life cell for the mission, but NASA refused.

- **Gemini piggy-back** satellite may be developed as the target. In this concept, the Gemini spacecraft would carry on board a light-weight payload which would be ejected out of the plane of the Gemini capsule after it was in orbit. Objective then would be for the Gemini pilots to practice various rendezvous maneuvers by approaching and docking with the satellite.
- **Spent Titan 2** second stage may be used as the target in the initial rendezvous missions.

The Gemini spacecraft is looked on not only as the testbed for Apollo components and techniques, but also as the first operational U.S. manned spacecraft because of its capability to maneuver and change orbital plane. It is anticipated that if NASA modifies the Gemini mission, the new target will incorporate a docking port, radar transponder and homing beacons. Agena D stage for the Gemini mission was to be modified by installation of a collar arrangement into which the Gemini pilots would guide their spacecraft.

Agena D funding for Gemini was $4.2 million in Fiscal 1962, and was to be $21.9 million in Fiscal 1963.

Radar Buster Missile

Competition for a small, maneuverable anti-radiation vehicle (Marv), or radar buster, which might be launched from a re-entering ballistic missile and could home on the radiation of a ground-based radar tied into an anti-ICBM system, may soon be held by USAF's Ballistic Systems Division.

Besides homing on, and jamming the hostile radar, Marv is intended to survive impact with the antenna of the radar system and continue radiating its jamming signals.

Work statement for Marv was being prepared recently by Aerospace Corp.

Texas Instruments has been at work on a Bureau of Naval Weapons air-to-ground anti-radar missile (Arm), which is unrelated to Marv. Space Technology Laboratories recently has proposed to the Air Force its own radar buster concept, known as Whipsaw.

Nord Rolls Out Transall C-160 Cargo Transport

Nord Aviation C-160 Transall cargo transport has been rolled out at the Nord factory near Paris. Aircraft is scheduled to begin engine run-ups shortly and to fly in late December. Second prototype of the joint Franco-German transport is being built at the Weserflug factory near Bremen and will fly next March. Third prototype is being built by Hamburger Flugzeugbau at Hamburg, will fly in late 1963.

More Minutemen Sought to Replace B-52s

By Larry Booda

Washington—Planned force of 800 Air Force/Boeing Minuteman intercontinental ballistic missiles will be more than doubled to 1,700 in Defense Dept.'s Fiscal 1964 budget requests. This proposed increase in ICBM strength would be made at the expense of a large portion of the USAF fleet of more than 700 Boeing B-52 bombers.

The fate of the USAF-Douglas Skybolt air-launched ballistic missile also hangs in the balance as final Fiscal 1964 budget decisions are being hammered out in the offices directly under Defense Secretary Robert S. McNamara.

When the Air Force submitted its first program package for Minuteman in June of 1961, it proposed a total of 2,500 missiles to be placed in silos and railroad cars over a five-year period from Fiscal 1962 to Fiscal 1967 (AW July 24, 1961, p. 34). This five-year plan was cut to 1,000 silo-based missiles in the Fiscal 1963 budget sent to Congress. Congress approved a figure of 800.

The present Defense Dept. plan would call for phaseout of all of the operational B-52A through B-52F aircraft over a three- to five-year period. A total of 449 of these models were produced. Some have been destroyed and others are in various test and special mission programs. There are now 14 B-52 wings. Each wing has 45 aircraft in the operating inventory and seven spares. This accounts for 728 aircraft. The remainder of the 744 B-52s produced are in the categories mentioned above.

But even the fate of B-52G and B-52H aircraft is being debated. The 193 B-52Gs are being modified to solve fatigue problems and to carry the North American Hound Dog air breathing missile, which could approach targets under the defensive radar umbrellas. The 102 B-52H aircraft are being modified because of fatigue and to carry Skybolt.

In many conferences with civilian and military chiefs of the services, McNamara has indicated that he stands by his contention—first offered, when the Fiscal 1963 defense budget was being prepared more than a year ago—that Russian anti-aircraft capabilities will make the air over the Soviet Union untenable for aircraft by 1965.

McNamara has also indicated that cost-effectiveness studies of the standoff missile programs show they are too expensive for the results they can be expected to achieve.

Of the two standoff missiles, Skybolt seems to be in the most trouble. The program cost goal has been increased steadily over the last three years. The first estimate for the entire program was less than $500 million. After major reviews and re-evaluations by both the Office of the Secretary of Defense and Air Force, program cost estimate has risen to $2.8 billion. This would buy enough missiles to equip the 102 B-52Hs with four missiles each, plus over 400 spares and development models.

This cost involves much more than the missile itself. The wings of the B-52Hs have to be extensively modified. A crash test program has been under way at the Aeronautical Systems Division at Wright-Patterson AFB for almost two years.

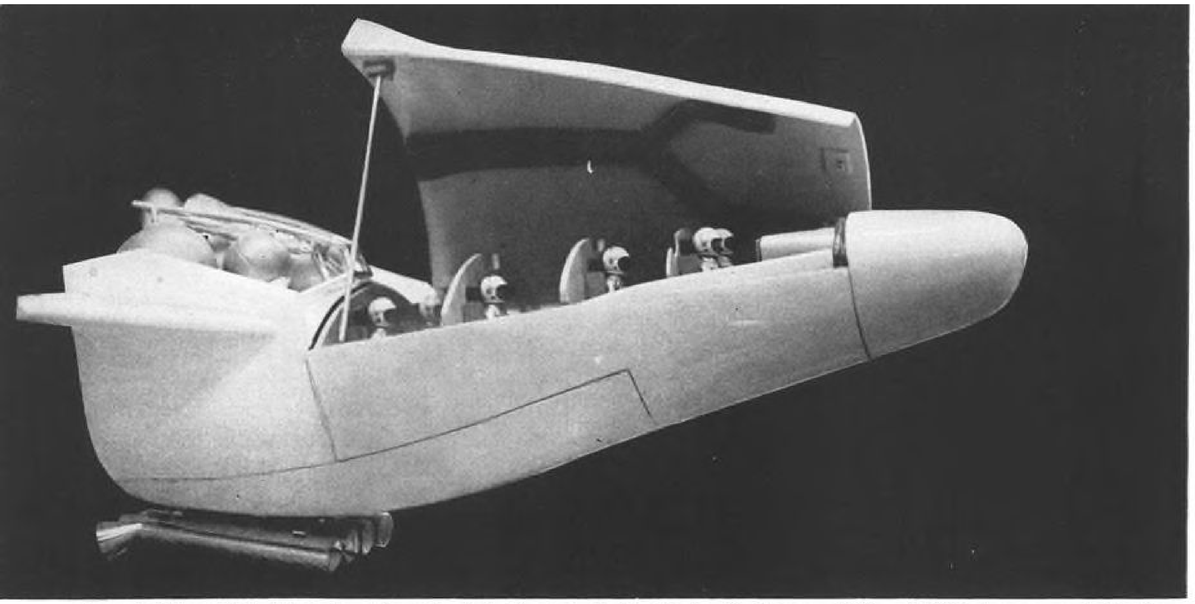
The B-52G modification program of the "wet wing," or wing that carries the fuel integrally in its sections rather than in separate internal cells, was delayed briefly at the Boeing Wichita plant because of the current world-wide alert of the military services in which the Strategic Air Command is participating.

In addition to the wing problems, the G and H models must be equipped with completely different guidance systems for their respective missiles. In one respect Hound Dog has an advantage over Skybolt. It can be guided from the moment of launch to impact. During its entire flight its radar can be monitored and corrections applied to its course. In the terminal portion of the flight it can use map matching radar to pinpoint its target. Thus the B-52G does not need the most sophisticated navigation equipment to determine its own position prior to launch.

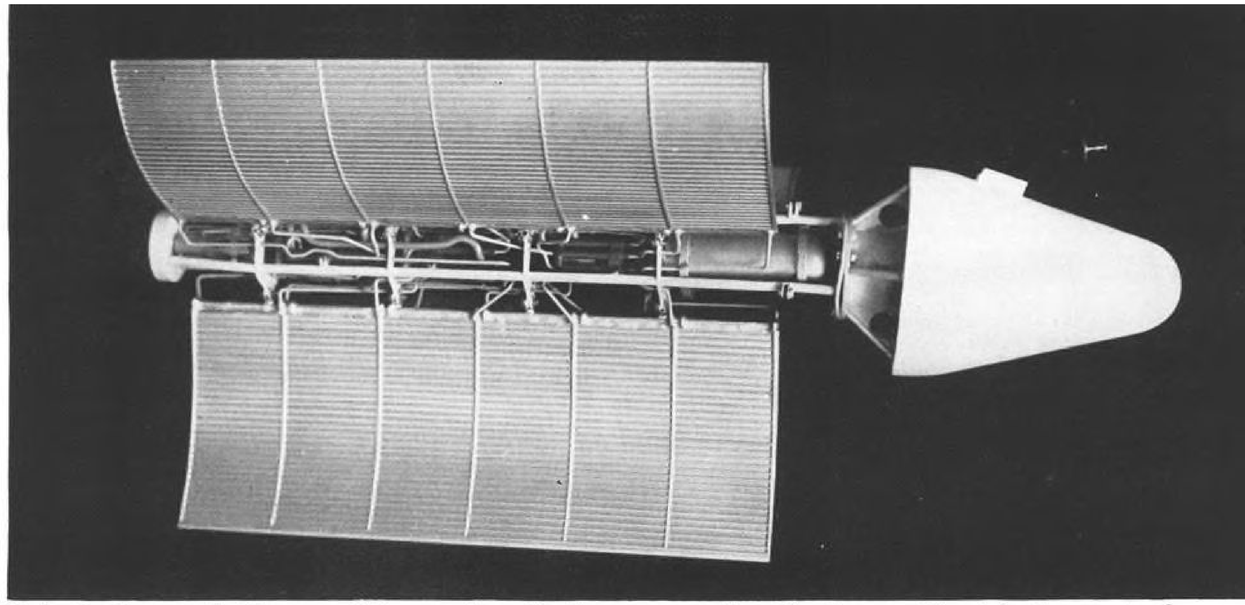
With Skybolt, however, the position of the launching aircraft must be determined with great precision. The most sophisticated and accurate method for navigating aircraft is by star tracking. At night the B-52 aircraft can track two stars continuously. It was announced recently that daytime star tracking which is as accurate as night tracking has been developed. Engineers of the defense secretary's office are skeptical on this point, however.

Skybolt can be guided only during its powered phase. Terminal guidance and control for ballistic missiles is still being developed. It will be applied to large missiles first, not a small one like Skybolt. Cost-effectiveness studies have posed the question: "Is it worth $2.8 billion to furnish the B-52H type of aircraft with the capability to deliver a maximum of 408 missiles with a yield of X megatons of destructive power rather than 408 Minuteman missiles costing $2 billion and delivering a much greater number of megatons?"

Accuracy of the missiles, their vulnerability and their reaction time are also considered in making a final decision. Minuteman missile is still in development. There is enough optimism among defense officials that they are convinced it will soon be operational in sufficient numbers, along with the Navy's submarine-launched Polaris missiles, that the bomber force can be cut drastically over the next five years.

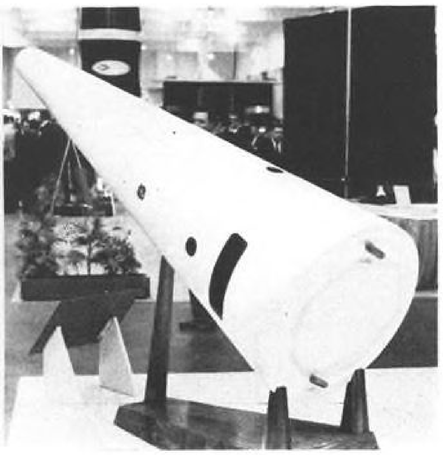


Space logistics vehicle, latest stage of a series of studies made by the Martin Co. between 1958 and 1962, shows current thinking on designs for re-supply and support of orbiting space stations. (See page 82 for other ARS details.)



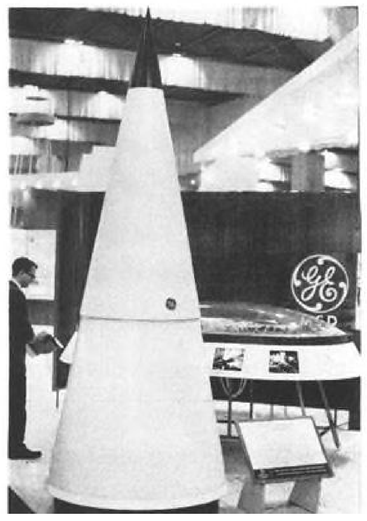
Nuclear Rankine powerplant for space vehicles, currently considered as one means of providing large quantities of electric power in space, is shown in this conceptual model by Pratt & Whitney Aircraft Division of United Aircraft Corp.

Aerospace Companies Display Advanced Designs



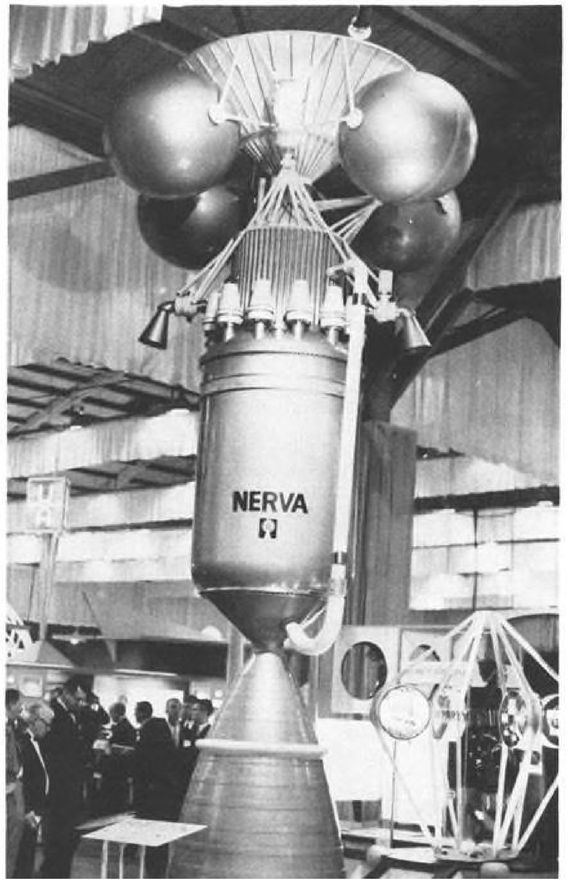
Hercules Powder Co. used a filament-wound casing (above, left) for a 156-in. dia. solid for its technical display at the 17th annual meeting of the American Rocket Society in Los Angeles (AW Nov. 19, p. 27). Subliming solid salt is the fuel for microrocket engine (above right) developed by Rocket Research Corp. Throat diameter is 0.01 in.; thrust is about one-ten thousandth lb.

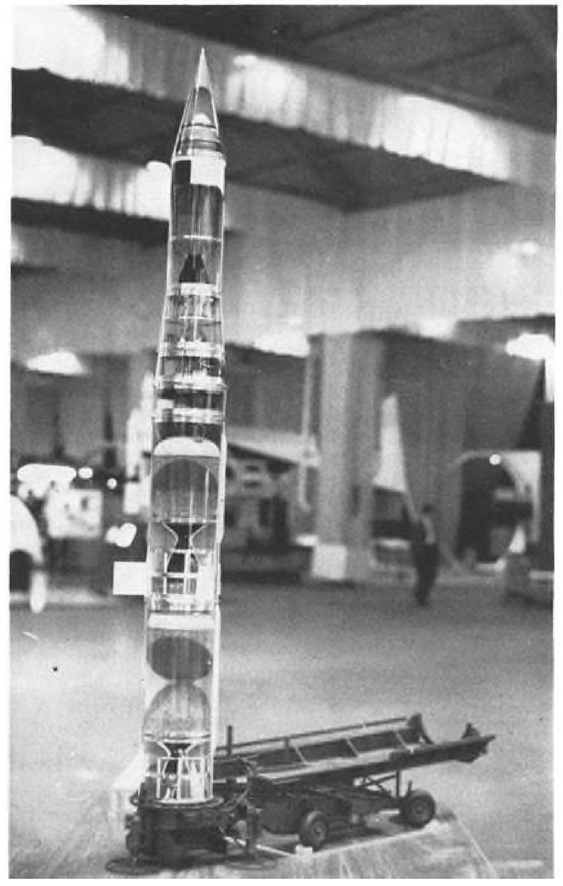
Douglas Skybolt re-entry body (left), developed by General Electric, is simple conical shape with hemispherical nose. Small rocket engines are attached to base of the body, presumably for spin-stabilization of the shape during re-entry to reduce dispersion. Target vehicle for Nike Zeus system tests (right), is one of several being developed by GE's Re-entry Systems Dept.



Of Powerplants, Probes, Logistics Vehicle

Quarter-scale Nerva mockup (below, left), exhibited by Aerojet-General Corp., indicates the size of the final unit planned for upper stage testing in the Rift vehicle. Martin Pegasus (below, right), a three- or two-stage high-altitude probe developed from the company's Pershing missile program, is detailed in this cutaway model. First details of the Pegasus were revealed in Aviation Week (AW Nov. 19, p. 27).





Arms, Supplies Airlift to India Accelerated

By Cecil Brownlow

New Delhi—Airlift of supplies and arms into India and to frontline positions is being accelerated in an effort to meet the threat imposed by new Chinese thrust deep into the mountainous northeast frontier area.

Immediate effects of last week's Chinese offensive after a two week lull in general fighting included virtual suspension of all scheduled domestic airline services as the Indian air force appropriated the entire fleet of DC-3s and Vickers Viscount turboprop transports operated by government-owned Indian Air Lines in a move to speed the flow of arms and equipment to forward positions.

Royal Air Force, in response to Indian requests, also began emergency airlift of arms and ammunition from Singapore and Britain.

USAF, which flew in urgently needed equipment in C-135s for seven days during initial stages of fighting in late October and early November (AW Nov. 19, p. 39), also was expected to renew its airlift activities to meet new Indian arms requests made as a result of the Chinese offensive and to augment American supplies now arriving by sealift.

In another move Air-India was put on the alert last week for possible diversion of at least portions of its Boeing 707 fleet to carry supplies to available prepared strips in threatened frontier areas and to fly in equipment from abroad.

Number of its piston aircraft and crews already are under air force command and Air-India flights from the United States are ferrying in defense supplies on regularly scheduled runs. As of late last week, however, there had been no interruption in the carrier's regular operations.

In an RAF airlift hurriedly implemented last week, Blackburn Beverleys and Handley Page Hastings were scheduled to ferry into Calcutta's Dum Dum Airport 5½ tons of small arms and ammunition from army stores in Singapore while Bristol Britannia turboprops were to bring in another 150 tons from the United Kingdom in 12 sorties.

United Kingdom officials also were considering using these aircraft to evacuate British citizens residing in threatened frontier areas. At a British request, Indian air force transports last week began ferrying British citizens out of Assam on return flights after airlifting in arms and supplies. In Assam alone, there are an estimated 1,500 British citizens.

Number of U. S. citizens in the area, mostly missionaries, also were being evacuated to Calcutta.

Meanwhile, it is becoming increasingly evident that Indian plans to build a strong defensive force, including air (AW Nov. 19, p. 38), will be put into effect whether the fighting continues on a prolonged basis or not. Officials here, however, generally believe that limited war—if it remains within its present scope—may continue intermittently over a number of years.

Indian officials are learning a hard fact of life already known to U. S. allies in Europe and elsewhere—that State and Defense departments can be frustratingly severe in considering requests for advanced equipment. Major case in point is refusal of an Indian request for the Sidewinder to provide India's air force with an air-to-air missile capability now totally lacking.

Indians had hoped to place Sidewinder aboard Hawker Hunter fighters and possibly Soviet-supplied MiG-21s in an odd cold war mix, as well as locally developed HF-24s now flying in the prototype stage.

Indian officials say they understand U. S. reluctance to supply some types of equipment in view of the danger of its falling into Chinese hands and potential internal security leaks. In the case of the Sidewinder, however, they point out that the Chinese communists have publicly released pictures of an intact missile which had aborted and fallen on the Chinese mainland after being fired from a Nationalist Chinese aircraft.

For some time, Indian air force planners also have been interested in obtaining Hughes' HM-55 air-to-air missile, and at the company's suggestion made three separate requests to State Dept. for permission to obtain detailed data on the system. All three requests were denied, and officials here say they do not plan to ask again.

However, the Indian crisis and the promise of U. S. monetary aid is bringing an increasing flow of representatives of American aerospace firms to New Delhi, especially companies in the avionics field—an area in which India is particularly interested and weak.

Firms now negotiating for potential sales include General Dynamics, Bendix, Douglas and Hewlett-Packard. While Indian defense industry as a whole has lagged, development of an indigenous electronics capability has scarcely begun and has received minimal attention before the present emergency. Government, for example, signed licensed production contract with Bendix approximately two years ago covering a wide range of avionics products. No portion of the contract has been implemented thus far. Now, however, India is determined to build a broad production base for defense primarily through licensed production and/or establishment of joint companies with foreign firms. In the meantime it is scanning the world market to obtain arms and equipment that can provide a strong defense posture at the earliest possible moment. Although combat aircraft have not yet been used by either side, fighting thus far has demonstrated to the Indians the need for effective close-support aircraft, and because of the financial strain the country is seeking one plane that can be used in multiple roles.

Indian officials, familiar with the problem, say flatly that the MiG-21 which Soviets may or may not provide can only be used as an interceptor and cannot be diverted to close-support.

To perform the job air force planners have been seeking data on a number of different aircraft although no formal request for specific hardware has yet been made to Western authorities. One plane defense ministry is now studying for the possible multi-mission role is the McDonnell F-104. Air force and planners have been asked to provide ministry with a full list of its capabilities, cost etc.

Whether the United States would accede to any formal request for such an aircraft, particularly one equipped with a full electronics package, is another question. Still another moot point is how and if India can manage to pay for defense equipment purchased outside the scope of foreign aid or long-term government to government loans that can be repaid in soft currency rupees. Most United States, British, Canadian and French firms are expected to insist upon hard currency transactions in any direct negotiations with the Indian government, either for hardware or licensed production rights.

Fleet Modification

India also has modified, or wants to modify, its existing fleet of transports. C-119s have been equipped with J34 jet powerpacks (AW Nov. 5, p. 28), and Air Force's DC-3s have been fitted with new, more powerful engines.

Remaining problem for C-119s and the Soviet-built Antonov An-12s is the high landing speed of the aircraft. At altitudes of approximately 15,000 ft., which is sometimes necessary in this mountain war a standard C-119 touches down at speeds of about 160 mph. An-12 landing speed under the same conditions is believed to be slightly higher.

To combat this, air force officials are undertaking extensive redesign of the 119's wing based upon data from Fairchild. It also has asked Soviets to provide similar fixes for the An-12. Russians, according to officials here, have agreed to supply some but not all of requested modifications.

Two de Havilland Caribous now on order also will be evaluated here for high-altitude operations with several turboprop powerplants including standard General Electric T64 and Rolls-Royce Dart engine.

If the aircraft proves successful in Himalayan tests, Indian government probably will try to negotiate licensed production contract with de Havilland for manufacture of Caribous here since licensed production of the Dart already is under way for India's Avro 748.

It probably would be used on an Indian-built Caribou, if at all possible.

All three types of the air force's present transport fleet are regularly carrying payloads to altitudes of 20,000 ft. and above to clear the Himalayan ranges between the front and established air bases in the delta regions.

In the present push to supply troops with modern arms and ammunition, aircraft are flying an average of three to four sorties, each per day, with major reliance on airdrop rather than landing. This is due to a scarcity of mountain fields and provision for greater safety for aircraft and crews in paradrops. Despite the fact that planes often are forced to fly below the crests of ranges with only 1 to 1½ mi. between them, less than 5% of the material is lost, according to air force spokesmen.

Mark 12 Development Plans Resolving

Differences between Dept. of Defense Research & Engineering and the Air Force over the nature of the Mark 12 Minuteman ICBM re-entry system appeared to be resolving last week in favor of an advanced system with a multiple-warhead capability.

Air Force is expected to prepare a plan for a new re-entry system, designated Mark 12L, incorporating multi-warhead capability. The absence of this in the original Mark 12 development plan had drawn DDR&E criticisms (AW Nov. 5, p. 29). Contractor will then be selected sole source or through a competition, to conduct a study of the re-entry system. Meanwhile, the Air Force, working with the $2 million initially allocated to it as the first installment of Mark 12 development funds, is understood to be anxious to move ahead with an original concept, known as Mark 12H, and may try to select a development contractor for it next month. Mark 12 is a heavy re-entry system, incorporating a low-radar cross section vehicle and penetration aids.

Selection of the H or L version for production probably will depend on how far and how fast the new L-version manages to progress. Should full Mark 12 development funds be poured into the version, the L model conceivably might receive continued funding for still later versions of Minuteman or other ballistic missiles.

Mark 12H is another in a series of continually updated and improved re-entry systems for Minuteman. The series includes Mark 5, the original Avco vehicle and Mark 11, which includes a false ablative nose cone to reduce radar observability, now in production at Avco's Lycoming Division. In addition, Avco currently is working with Raytheon Co. in preparation of a proposal to Air Force Ballistic Systems Division on a Mark 11A. It includes a false nose cone that does not burn off until lower descent than in Mark 11, and also carries both active and passive penetration aids.

U. S., U. K. Send Military Missions to India

Washington.—U. S. and Great Britain last week sent missions to India to determine what kind of military equipment and general economic assistance that nation needs to fight what might be a long war with Communist China.

The missions will help formulate the massive assistance program for India now that the military airlift of infantry and mountain-fighting equipment has been almost completed (see p. 30). India is interested in obtaining military air transports and helicopters that can operate at high altitudes from the West, but the quantities are still being negotiated on a government-to-government basis.

Indian Ambassador B. K. Nehru said last week India was not seeking additional military assistance from Russia, but expected Russia to fulfill its existing commitments, including delivery of 12 MiG-21s.

The U. S. last week sent 12 USAF Lockheed C-130 turboprop transports from West Europe to India to help airlift supplies and troops. The aircraft are unarmed, the State Dept. said, but would be operated by American crews. Earlier, the U. S. released two Army de Havilland transports to India (AW Nov. 5, p. 26).

The U. S. mission is headed by W. Averell Harriman, assistant secretary of state for Far Eastern affairs. The mission left Andrews AFB, Md. on Nov. 21 in a Boeing C-135 from McGuire AFB.

Other members of the party are: Army Gen. Paul D. Adams, chief of the U. S. strike command and USAF Maj. Gen. Clyde Box, of that command; James P. Grant, International Cooperation Administration program and planning deputy director; Roger Hilsman, Jr., State Dept. director of intelligence and research; Brig. Gen. Charles E. Johnson, assistant chief of staff for intelligence; Carl Kaysen, deputy special assistant to President Kennedy and Paul H. Nitze, assistant secretary of defense for international security affairs.

The British mission to India is headed by Gen. Richard Hull, chief of Imperial General Staff, and John Tilney, parliamentary under secretary of state in the Commonwealth relations office.

Brazil-Moscow Route

Rio de Janeiro—Panair do Brasil President Paulo Sampaio is now in Moscow to negotiate for the extension of Panair's Rio-Paris route to Moscow, via Prague, in exchange for Soviet rights to Brazil. Panair would serve the route with Douglas DC-8s.

Russia, failing to win traffic rights into the U. S. (see p. 38), has also been unsuccessful in gaining a Western Hemispheric foothold in South America (AW Oct. 29, p. 40). Until now, the Soviets had concentrated on a route to Havana via Conakry in Africa. Soviets could reach Havana via Belem in Brazil with Tu-114 or Il-18 turboprop equipment.

U. S. Airlift Is Tested In Cuba, India, Guam

Washington – U. S. military airlift forces last week were engaged in their third major overseas effort in a month, flying emergency supplies to typhoon-stricken Guam in the Western Pacific and evacuating dependents.

As of Nov. 20, 51 missions had been flown to Guam from Travis AFB, Calif. by Boeing C-135 aircraft, Douglas C-124s, C-133s and C-118s and Lockheed C-121 and C-130s.

VIS Award Delay

Selection of a contractor to develop the visual instrumentation subsystem (VIS), the television camera payload for NASA's planned lunar orbiter (AW July 23, p. 22), has been delayed, apparently because of the space agency's funding problems (AW Nov. 19, p. 26).

Recent addition of five spacecraft to the Ranger series (AW Oct. 22, p. 35) is understood to have cut deeply into funds appropriated for the lunar orbiter project.

SA-4 Engine Will Be Shut Down In Flight to Test Rocket's Stability

By George Alexander

Huntsville, Ala.—Marshall Space Flight Center plans to shut down one of the eight Saturn C-1 booster engines during the launch vehicle's next test flight—now tentatively scheduled for April, 1963—to test the engine-out performance of the propulsion and flight control systems and the effect of one dead engine on base heating.

Present thinking at this National Aeronautics and Space Administration center inclines to the shut-down of one of the C-1's four outboard engines about 20 sec. before burnout of the booster, which will be designated SA-4. By shutting down one engine and simulating an actual failure, Marshall engineers hope to test the stability of the complete propulsion system. Propellants that normally would be consumed by the dead engine should be transferred to the other seven powerplants to extend their burning time and so compensate for the loss of one engine's thrust.

Selection of an outboard engine also would test the ability of the flight control system to respond to guidance system demands, despite the loss of one engine. The four outboard engines of the C-1 can be gimballed ±7 deg. to provide pitch, roll and yaw corrections; the four inboard engines are canted slightly inward and are rigidly fixed.

Also of major interest to Marshall engineers will be the effect of one dead engine on base heating. Exhaust gases of all eight engines tend to form an insulating sheath between the engines themselves and the glass fiber shield which protects the base of the tankage. Loss of one engine's exhaust will allow some back-flow of the other seven engine exhausts to the heat shield and may create a "hot spot" on the shield. Marshall engineers are curious to know if the shield can withstand this possibly severe localized heating.

Preliminary data analysis indicates that the third flight test of the eight-engine Saturn, SA-3 on Nov. 16, was as successful as its two predecessors, SA-1 on Oct. 27, 1961 and SA-2 on Apr. 25 of this year. Liftoff occurred after a 45-min. hold caused by a faulty ground generator.

Inboard engines of SA-3 burned for 141 sec. and the four outboard for 149 sec. Unlike SA-1 and SA-2, which were shut down—both inboard and outboard—by a sequencer after propellant levels had fallen below a level sensor in the tankage, SA-3 inboards were shut down by the sequencer but its outboards were allowed to run until automatic shut-down because of propellant depletion.

When the tankage level sensors detected SA-3's receding propellants they activated a sequencer which commanded shut-down of the four inboards about 350 millisec. after initial detection. On SA-1 and SA-2, the timer then commanded shut-down of the four outboards six seconds later. On SA-3, however, the timer—after shutting down the inboards—only commanded the tie-in to a single circuit of the thrust-okay switches on the four outboard engines. These thrust-okay switches are basically pressure sensors and all engine troubles—with the exceptions of rough combustion and fuel depletion—would be detected by these units as a pressure drop. Detection of a pressure drop of more than 10% of sea level thrust would initiate shut-down.

Under this new procedure, the four outboard engines continued to suck in propellants until cavitation in the liquid oxygen turbopumps occurred. This caused a pressure drop of approximately 10% of thrust which the thrust-okay switches detected. Outboard engine number 3 first detected this pressure drop and, with all thrust-okay switches then on one circuit, commanded shut-down of the other three outboards.

This shutdown procedure, which Marshall engineers said appeared satisfactory on SA-3, may be used again on SA-4. It will not be used for the flight of SA-5, the first of the C-1 Block-2 vehicles (AW July 2, p. 113), because the S-4 second stage will be flown live for the first time on that vehicle and there are special chill-down procedures which must be run on the S-4's RL-10A3 liquid hydrogen engines just prior to second stage ignition.

The timing of these chill-down procedures is important and so Marshall program officials will revert to a timer to coordinate shut down of the S-1 first stage and initiation of ignition sequence of the S-4. If SA-5 should prove successful, the propellant-depletion method of shutting down the S-1 probably will be re-introduced on SA-6.

Marshall telemetry and instrumentation engineers received two unexpected windfalls from SA-3. The first bonus was the result of an unexplainable roll of four deg./sec. which developed in the vehicle toward the end of powered flight. The roll, which was described as a "perfect slow roll" without any associated pitch or yaw motions, gave ground stations the opportunity to determine the propagation pattern of the vehicle's 27 antennas. Theoretical models were said to approximate closely observed patterns.

Second bonus was the discovery that five telemetry links continued to broadcast after the deliberate destruction of SA-3 for Project Highwater (AW Nov. 19, p. 34). The transmitters were housed in a canister mounted at the forward end of the S-1 stage. Analysis of the post-explosion transmissions is expected to provide information about the motion and direction of the fragmented airframe.

Two new telemetry links carried by SA-3—one a pulse-code-modulated (PCM) and the other an ultra-high-frequency (UHF) transmitter—were reported to have operated satisfactorily, although UHF transmissions were noisy. PCM system was one of the five links to continue operating after the Highwater explosion.

Retrorockets, another C-1 Block-2 experiment (AW Nov. 19, p. 34), were fired at about T+152 sec. and burned normally for about two seconds. During this short period, the regular frequency-modulated (FM-FM) telemetry antennas in the 230-260 mc. band experienced about a 30 db. attenuation. For SA-4, Marshall program officials plan to install a tape recorder both to store this attenuated data for later playback and to store data that normally would be transmitted when the Saturn vehicle is not in an optimum point in its trajectory for clear transmission to ground stations. Also aboard SA-4 will be a General Electric Co. Mistram transponder and radar altimeter.

Minuteman Troubles

Cape Canaveral—Air Force Minuteman solid propellant ballistic missile made a successful 3,500 mi. flight down the Atlantic Missile Range Nov. 19 after trouble with the Autonetics-built guidance system had postponed all test firings of the weapon system for more than a month. Ground path problems—short circuits—through the missile's airborne digital computer were the causes of the guidance system's difficulties.

After Minuteman 422 failed to receive steering signals from the inertial system after the launch from here Oct. 17 (AW Oct. 22, p. 35), it was destroyed by the range safety officer and USAF promptly suspended all further flights until the trouble was traced and corrected.

Autonetics, along with Boeing and Space Technology Laboratories, ran an extensive series of tests at its Anaheim, Calif., plant on both operational and research and development guidance units. Source of the random noise appeared to come from research and development instrument station. Autonetics re-worked one such guidance unit and shipped it to USAF here for last Monday's flight.

Kennedy to Review News Policy; Defends Cuban Crisis Crackdown

Washington—President Kennedy last week promised to review the information rules established during the Cuban crisis to determine if they "are being used in a way inimical to the free flow of news."

The President said he had "no apologies" for the tight lid clamped on information during the height of the Cuban controversy because "it would have been a great mistake and possibly a disaster" if details of the Administration's blockade plans "had been dribbled out when we were unsure of the extent of the Soviet buildup in Cuba, and when we were unsure of our response and when we had not consulted with any of our allies, who might themselves have been involved in great difficulties as a result of our action."

However, President Kennedy added, "if the procedures which have been set up, which are really to protect the interest and security of the United States, are being used in a way inimical to the free flow of news, then we would change these procedures." He said: "I don't think that as yet it has been demonstrated" that the Defense Dept. information policy "has restricted the flow of essential news of the Pentagon. If it does, we will change it. Now, I have not been convinced of that as yet."

The President said he "would be delighted" to talk with Arthur Sylvester, assistant secretary of defense for public affairs, and newsmen to see "if we can get this straightened out so that there is a free flow of news to which the press is entitled, and which I think ought to be in the press and on which any Administration really must depend as a check to its own actions." He said sensitive information has come out of the Pentagon in the past "which I can assure you in my own not-too-distant experience has been extremely inimical to the interests of the United States."

The information controversy centers on recent orders by Sylvester and Robert J. Manning, assistant secretary of state for the bureau of public affairs, requiring departmental employes to report their contacts with newsmen. On Oct. 27 Sylvester directed "all Department of Defense personnel in the Washington area" to report "the substance of each interview and telephone conversation with a media representative . . . to the appropriate public information office before the close of business that day" if there is no public information officer present during the conversation.

Sylvester's memorandum was widely interpreted as an effort to intimidate Defense Dept. personnel and has restricted the flow of information, according to reporters covering the Pentagon (AW Nov. 5, p. 21). Manning said his similar order was made verbally to State Dept. employes.

Both Sylvester and Manning have contended their orders have not restricted information. But President Kennedy said Manning will, "now that we passed at least a phase of this crisis, attempt to improve his order and improve the flow of information." The President implied Pentagon information policies will not be changed unless he is persuaded this is necessary.

USSR Agrees to Remove Il-28 From Cuba

Washington—U. S. last week lifted its arms blockade of Cuba after Soviet Chairman Nikita Khrushchev informed President Kennedy that all Russian-built Il-28 Beagle bombers will be off the island in 30 days.

The President indicated that aerial surveillance of Cuba will continue until agreement is reached over on-site verification that all offensive weapons have been removed and until the U. S. is assured that they will not be re-introduced.

Although the blockade task force of 63 ships and 25,000 men was dissolved, Navy was ordered to maintain surveillance of ships outbound from Cuba, primarily with Lockheed P2Vs, to photograph them and check the number of Il-28s aboard.

The President said the Soviet government "has stated that all nuclear weapons have been withdrawn from Cuba and no offensive weapons will be reintroduced." But he said "the importance of our continued vigilance is underlined by our identification in recent days of a number of Soviet ground combat units in Cuba, although we were informed that these and other Soviet units were associated with the protection of offensive weapons systems and will be withdrawn in due course."

These ground units may be the reason for reports from Cuban refugees recently that 25-mi. range tactical weapons, similar to U. S. Honest Johns, were hidden in caves on the island.

Several messages between Khrushchev and President Kennedy since their initial exchange of letters ending Oct. 28 have been aimed at explaining the U. S. definition of "offensive weapons" and at clarifying the Il-28 and verification questions, the President said.

Talks between U. S. and Russian officials at the United Nations also were credited with contributing to the Il-28 agreement, but the President did not mention Cuban Premier Fidel Castro's letter to Acting UN Secretary General U Thant. Castro last week wrote that Cuba would not stand in the way of removal of the Beagles, but that it "possesses a legitimate and indisputable right to defend its territory against [U. S. aircraft] and it repeats the warning that to the extent of the firepower of our anti-aircraft weapons, any war plane which invades Cuban airspace can do so only at the risk of being destroyed."

Castro said that "owing to their limited speed and low flying ceiling, [the Il-28s] are antiquated equipment in relation to modern means of anti-aircraft defense." He did not repeat his frequent demand that the U. S. withdraw from Guantanamo Naval Base.

President Kennedy made no pledge not to invade Cuba. He said negotiations have not been completed and that "serious problems" remain. "There will be peace in the Caribbean" if "all offensive weapons are removed from Cuba and kept out of the hemisphere in the future, under adequate verification and safeguards, and if Cuba is not used for the export of aggressive communist purposes," he said.

Inspection at sea has confirmed "that the number of missiles reported by the Soviet Union as having been brought into Cuba, which closely corresponded to our own information, has now been removed," the President said (AW Nov. 19, p. 29).

First Nimbus Launch Expected in Late 1963

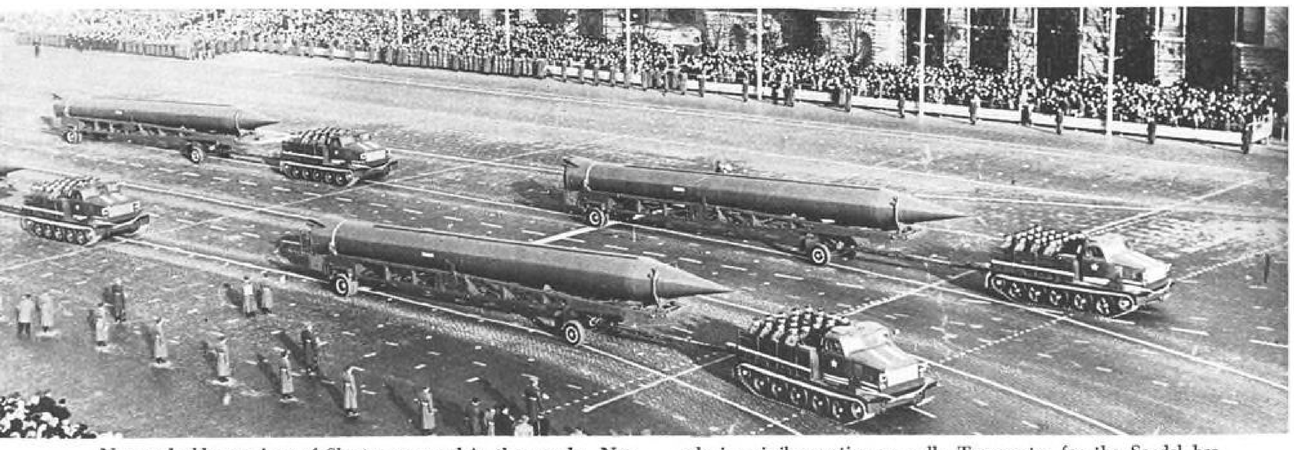
Washington—Nimbus weather satellite environmental testing should be completed by mid-1963 with the first launch of the 702-lb. payload scheduled for late next year, according to NASA.

Space agency officials told 250 government and industry managers attending a Nimbus review at General Electric Co.'s Valley Forge facility that NASA and GE are now starting environmental tests of spacecraft components in the GE pressure chamber. Vibration and antenna tests have been completed, and tests of the control system are under way.

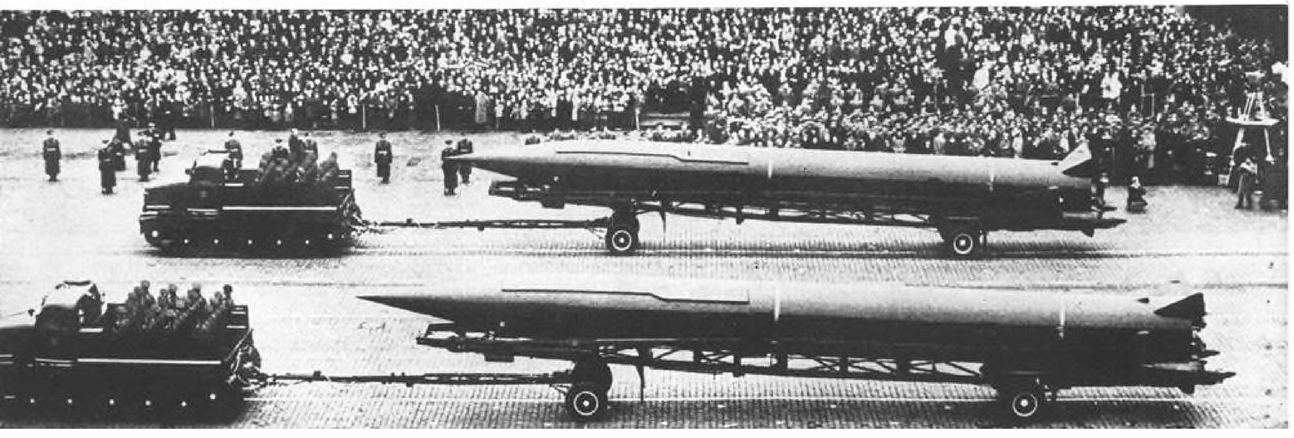
Nimbus is the second-generation U. S. weather satellite, and is being developed by GE under management of NASA's Goddard Space Flight Center. It will be launched into a 500-mi. polar orbit by a Thor Agena B vehicle from the Pacific Missile Range.

New Photos Show Russian Naval, Shyster Missiles

Russian naval insignia and uniforms are clearly seen (above) in new photos of the Russian ballistic missile unveiled by the Soviets at the Nov. 7 Bolshevik anniversary parade (AW Nov. 12, p. 28). The three-stage missile, described as capable of being launched from a submarine, has a blunt nose shape that may be a heat sink or ablative re-entry body or may be a radome covered with ablative material. Cluster of seven cylindrical extensions at the tail may be part of a solid fueled rocket cluster with fuel all the way down the cylinders. Another possibility is that the cylinders and aft section, which drops off at the point of the aft trailer mounting, may contain a propellant or black powder for firing the missile clear of the water like a mortar shell. Such a technique would require protection of the relatively fragile rocket engine nozzle afforded by the aft section here. Projections at the aft end and ahead of the central tiedown may be lifting points or act as guides in a launching tube. There are recesses behind them, indicating they may retract. Transporter has six pairs of wheels and is structurally stronger in appearance than the Shyster-Sandal transporter (left, below). Rings at demarcation of the two upper stages are toothed and may serve for rotating missile in its launcher. Length of missile is 45-50 ft. and diameter of the first stage at 6-7 ft.



New and older versions of Shyster appeared in the parade. New version (above) is designated Sandal, has flared skirt, modified fairings for plumbing and open jawed retainer at the nose on the transporter instead of a full tie-down. Note similarity of tow vehicle to the one used for the naval missile. Both are fitted with heavy wire cables for anchoring the forward end, indicating it may play some role in missile erection as well. Transporter for the Sandal has seven truss bays instead of six seen in most other photos of Shyster (AW Nov. 5, p. 34), and the Sandal is estimated to be approximately 80 ft. long, larger than the Shyster, and larger in diameter. Transporter below has center and aft tiedowns and none at the nose cone.



B-70 Flight Delay Due To Electrolytic Action

Washington—Electrolytic action between steels of dissimilar composition and between steel and other metals is the principal reason the first flight of the North American B-70 Mach 3 bomber testbed has been delayed from December until next March or April (AW Nov. 19, p. 25).

Air Force said the delay was due to leaking fuel tanks. Actually, this was the end product of the electrolysis problem.

As the B-70 was designed to make extensive use of steel, it has undergone a complete test program of component parts and their reactions to physical, electrical and chemical actions. But it was not until environmental testing of the entire airframe began that corrosion unexpectedly began to appear between surfaces of dissimilar metals.

This corrosion was due directly to electrolysis, or galvanic, action, which developed at the points where different metals touched. The dissimilar chemical compositions of the metals touching each other in the presence of water vapor or moisture and other catalytic substances resulted in chemical reactions which converted the metals to oxides and salts.

These reactions became severe enough to cause fuel tank leakage when the entire airframe was subjected to the elevated temperatures that will be encountered at Mach 3, while at the same time being twisted as if in flight. High temperatures accelerated the electrolytic action and the twisting parted the seams.

Manufacturers have solved similar problems involving steel-magnesium combinations in engines and magnesium and duralumin in airframes. Engineers are now concentrating on solving the same problem applied to various compositions of steel.

B-70 represents aerodynamic theory and testing dating from the early 1950s, while the metallurgy stems from the mid- and late 1950s. Defense engineers say that if such an aircraft were designed from the technology of 1960, the aerodynamic configuration would be about the same, the metallurgy would be considerably changed and the engines would be turbofans instead of turbojets.

Lunar Base Supply

NASA's Manned Spacecraft Center has completed an in-house analysis of requirements for supplying a base on the moon (see p. 82). Logistics vehicle envisioned by NASA will accommodate six astronauts, basic spacecraft equipment and sufficient cargo area for at least 2,000 lb. of supplies.

Apollo spacecraft conceivably could be used for this mission, but it would have to be modified extensively.

One booster scheme studied by NASA includes a 240- or 260-in.-dia. solid-propellant motor for the first stage, 156-in.-dia. solid for second stage, 128-in.-dia. spherical solid motor for third stage and a liquid-propellant fourth stage burning storable fuel.

Army Ends AN/USD-5 Surveillance Drone

Army last week terminated its AN/USD-5 surveillance drone program. System was being developed by Fairchild Stratos Corp., Hagerstown, Md.

Army re-evaluation study of the program, a Defense Dept. spokesman said, showed that the USD-5 was feasible, but that it would be too expensive for procurement in the quantities Army needed for an effective surveillance capability. Army will depend on the Mohawk observation aircraft and the USD-2 drone system for future all-weather combat reconnaissance needs.

Earlier this month, Fairchild announced receipt of a $9 million follow-on contract from Army for reliability and test flight development of the drone through June (AW Nov. 19, p. 123).

Termination of the program at this point is expected to save about $30 million for application to research and development of higher priority systems, Army officials said. Army will receive a cash refund of about $4 million from the reliability contract. Cost of the program, beyond the test flight development, apparently involves projections, however, since no production contract commitments had been made.

Impact of the program termination on Fairchild was not immediately determined, but 400 persons, mostly research and development, were involved in it. This represents about one-tenth of the company's total employment. About 20 test flights had been made this year with successful results.

Federal Mediators Hope to Avert Strike at Two Lockheed Divisions

By Katherine Johnsen

Washington—Final effort to avert a strike at two divisions of Lockheed Corp.—Lockheed-California Co. and Lockheed Missiles and Space Co.—was made late last week by Federal Mediation and Conciliation Service.

Immediately following an overwhelming vote by workers of International Assn. of Machinists to strike Wednesday, Nov. 28, the mediation service arranged a meeting of company and union representatives with two of its commissioners, Ralph Patterson and Grant Haglund.

The union shop—the most controversial issue in the aerospace labor field—deadlocked negotiations which had been in progress for several months and led to the strike action (AW Nov. 19, p. 40).

The company refused to permit a decision on union shop by a vote of union workers, as recommended by the special board appointed by the President to advise on aerospace disputes. The board, headed by Dr. George W. Taylor, proposed that a two-thirds vote of the membership be required to establish the union shop.

At three firms, the union has failed to win the necessary votes. These are: North American Aviation, Inc., and Ryan Aeronautical Co., both organized by United Auto Workers, and the Convair Division of General Dynamics Corp., organized by IAM. Boeing Co. has agreed to a vote by its IAM members early in December (AW Nov. 12, p. 39). Lockheed also turned down a union proposal to submit the union shop issue to arbitration.

Defense Dept., in a rare public intercession in a labor dispute, threatened on the eve of the strike vote to shift business from Lockheed, in the event of a work stoppage.

The missile-space company is producing the Polaris fleet ballistic missile, the Samos reconnaissance satellite, the Midas missile warning satellite, and the Agena launch vehicle stage. Company also has IAM workers at missile sites at Cape Canaveral, Vandenberg AFB, Santa Cruz, and Honolulu.

The major products of the California company are the F-104 Super Starfighter and P3A Orion ASW aircraft.

Defense Dept. noted that the two unions and all aerospace companies except Lockheed have accepted the Taylor Board recommendations. DOD said:

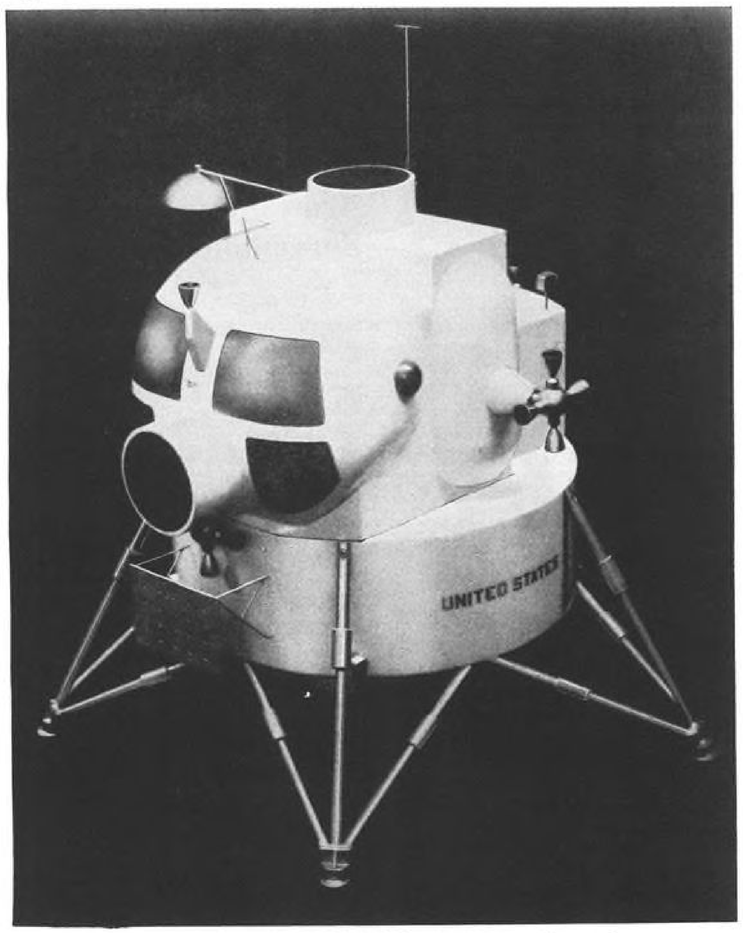
"Lockheed stands alone in refusing to follow the course that the other members of the industry considered reasonable. The President in his press conference on Sept. 13 pointed out, following acceptance of the Taylor Board proposals by the unions involved, that the responsibility for any strike that might take place in this industry would be clear to the American people.

"Should a strike take place at Lockheed, Defense Dept. programs of critical urgency to the national defense would be affected. It is imperative in the national interest that the Dept. of Defense make necessary preparations to minimize, to the greatest extent possible, any loss of production that might follow a work stoppage. Responsible officials of the Dept. of Defense are therefore considering whether alternate means of production can be utilized so that work on these vital programs can go forward in the event of a stoppage at Lockheed."

Lockheed management viewed the Defense Dept. statement as "an appeal to both the company and the union." The company called the strike action "an attempt to force compulsory membership and payment of union dues on some 14,000 employes who have refused to join the union."

Lockheed signed a contract with IAM at its Marietta, Ga., plant a month ago. Union shop was not an issue because of Georgia's right-to-work law.

Building trades unions, engaged in missile site construction, indicated last week that they would observe IAM picket lines.



Grumman's LEM Model Displayed

First photo of scale model of Grumman Aircraft Engineering's lunar excursion module for the Apollo spacecraft is shown above (AW Nov. 12, p. 29). Vehicle will stand 17-ft. high. Legs and afterbody will remain on the moon after LEM launches itself for docking with orbiting Apollo command module (AW Sept. 24, p. 32). Note reaction jet nozzle arrays on side and front. Plate on front is a radar reflector. Top and side orifices are access ports.

BAC Plans New Entry in STOL Competition

London—British Aircraft Corp. has designed a lighter, less-sophisticated military short takeoff and landing (STOL) airplane than its Bristol 208 as its prime candidate in the Royal Air Force OR-351 requirement to replace the Blackburn Beverley transport (AW Sept. 10, p. 38).

Proposed design calls for use of four Rolls-Royce Spey turbojets featuring deflected-thrust vanes in the exhaust section to provide the STOL characteristic (AW May 14, p. 56). A potential follow-on version for vertical takeoff and landing (VTOL) probably calls for packaged Rolls RB.162 pure-lift engines.

BAC previously had submitted the Bristol 208, using the more powerful Bristol-Siddeley Pegasus deflected-thrust engine. This airplane is competing with the Gloster Whitworth 681, also powered by the Pegasus, and the STOL version of the Short Belfast freighter. Dark horse is the Lockheed C-130 with boundary layer control, which would be built under license by British Aircraft Corp., if selected.

Decision on dropping the operational requirement, or going ahead with the replacement, is a year overdue, probably because of British Treasury resistance to spending $140 million in development costs.

However, Minister of Aviation Julian Amery will be asked today in Parliament for a progress report on OR-351. He also will be asked to report Ministry progress on the Anglo-French Concorde supersonic transport (AW Nov. 19, p. 41) and the possibility for an RAF-Royal Navy order for the Hawker P.1154 VTOL fighter.

Russia Claims Mark For Free Fall Jump

Moscow—Parachute jump from 83,502 ft. that included a free fall without a stabilizing chute for 79,560 ft. has set a new world's record, Soviet Russia claims. USAF Capt. Joseph W. Kittinger fell 84,000 ft. in August, 1960, but used a stabilizing chute.

The Soviet Defense Ministry newspaper Krasnaya Zvezda said Maj. Yvegeny N. Andreyev set the new record Nov. 1 in a jump from the gondola of the "Volga" balloon near a base on the east bank of the Volga River in the Saratov area.

Col. Peter I. Dolgov, a developer and tester of parachutes, ejection seats and Vostok spacecraft ejection devices, jumped from the same gondola when it reached 93,968 ft., apparently opened his chute when he stepped out, and was killed in the descent, the Soviets said (AW Nov. 12, p. 39). No cause of death was given. Maj. Andreyev said the temperature when he jumped was −78F.

This was Maj. Andreyev's 1,510th parachute jump. He holds six national records in single and group jumps and four of these are world records, Russia said.

The Volga took 2 hr. and 20 min. to ascend. Maj. Andreyev jumped at 10:13 a.m. landed at 10:21 a.m. He fell for 15,000 to 20,000 ft. with his back down to keep the faceplate of his heated helmet from frosting, Russia said. Both men carried batteries in their belts to provide power for the heat, and wore lifebelts in case of water landings.

Maj. Andreyev said he saw "dark purple sky with an orange fringe along the horizon" and unusually bright stars as he fell. After falling for about a minute face upward and reaching a speed of about 558 mph., Maj. Andreyev turned face downward. Later, in order to avoid landing in the river, he joined his legs and turned his right palm outward to form an angle of descent of about 40 deg., Russian reports said.

At an altitude of five to six miles, speed had slowed to about 145 mph. At about 4,921 ft., Maj. Andreyev received an automatic signal and at 3,152 ft. he opened his parachute.

The Andreyev jump exceeds the previous free-fall record by 32,400 ft., the report said. Federation Aeronautique Internationale records show that the altitude record for a jump with delayed opening of the chute was set Aug. 20, 1961 at Enguels Airport near Saratov by Nikolai Nikitin, who jumped from an altitude of 50,469 ft. and fell free for 46,965.8 ft.

Russians said Maj. Andreyev's jump disproved the theory that a stabilizing chute was essential to keep a jumper from spinning and blacking out during his fall.

Polaris A3 Failures

Cape Canaveral—Fifth failure in as many attempts to test fire the Lockheed Polaris A3 submarine-launched solid propellant missile occurred here Nov. 17 when the second stage malfunctioned after separation.

Navy sources said second-stage malfunctions also occurred in the first, second and third firings, and in each case the problem was different.

In the fourth test, the first stage malfunctioned.

Rocket motors for the A3 first stage are manufactured by Aerojet-General and for the second stage by Hercules Powder Co.

News Digest

British government last week approved funding for development of an advanced version of the Rolls-Royce Spey incorporating a zero stage and designated Spey RB.163-25 (AW Oct. 15, p. 23).

India has purchased eight de Havilland Vampire jet trainers from Indonesia to help offset India's lack of jet trainers.

United Technology Corp., a wholly owned subsidiary of United Aircraft Corp. will become United Technology Center, an operating division of UAC on Dec. 1. Meeting has been slated to appoint officers to the new center.

Acquisition of Trans International Airlines by the Studebaker Corp. has been completed following a recent CAB order disclaiming jurisdiction over interlocking relationships that have resulted from the purchase.

United Air Lines filed for federal court injunction in Chicago last week to block refusal by some of its pilots to proceed with training for jet landings with 200-ft. ceiling and ½-mi. visibility.

Grumman Aircraft Engineering Corp., winner of the lunar excursion module competition, has opened a liaison office in Houston near the NASA Manned Spacecraft Center. Jack Buxton is manager of the office, located at 7015 Gulf Freeway.

Four Navy officers in an altitude chamber were injured Nov. 17 when an electrical spark touched off a fire in the chamber near the end of a 14-day experiment at the Navy's Air Crew Equipment Laboratory in Philadelphia. Injured men were taking part in a NASA experiment to determine the effect on humans of breathing pure oxygen for 14 days at simulated high altitudes.

New NASA Position

Washington—Walter F. Boone, 64, a retired Naval admiral, has been appointed to the newly-created post of deputy associate administrator for defense affairs in the National Aeronautics and Space Administration. He will function as the contact point between NASA and the Defense Dept., starting Dec. 1.

NASA said his appointment will not affect the liaison function performed by Maj. Gen. O. J. Ritland, deputy director of USAF Systems Command for Manned Space Flight, who maintains an office in NASA.

Adm. Boone retired in 1960 and has been a member of the McDonnell Aircraft Corp. advisory council since then.

Foreign Flag Shifts Stall U.S. Air Policy

Changing composition of competition, particularly in Europe and South America, delay firm position.

By L. L. Doty

Washington—Chief obstacle to a firm U.S. policy on international air transportation is the changing composition of foreign air carrier competition, particularly in Europe and South America.

In the original White House study on international air transportation (AW Oct. 29, p. 49), little attention was paid to the effect on U.S. competition of such moves as the consolidation of four major European carriers into an Air Union. Meanwhile, two more European airlines—Scandinavian Airline System and KLM Royal Dutch Airlines—have run into serious financial difficulties and management problems which threaten to force major revisions in their competitive postures.

In Latin America, a proposed plan to pool international operations of flag carriers representing Argentina, Brazil, Colombia, Mexico and Venezuela is under study. Although the plan is meeting some resistance, particularly from Argentina and Colombia, there is a strong possibility that some form of co-ordinated airline operation will soon emerge.

Whether the full impact of these changes have been weighed carefully by the White House steering committee, which is responsible for formulating a final proposed policy, is not yet known. However, there is some apprehension that the pressures of time and widespread differences within the steering committee may result in a watered-down policy, or one that generalizes rather than takes a specific stand.

A group of three men have been working virtually around-the-clock in the White House in attempt to complete by Dec. 15 an acceptable draft based on the original study. Top White House officials reportedly want to present a policy to President Kennedy on or before that date in hopes that the policy can be included in the President's State of Union address early next year.

At present, it appears that any policy eventually formulated will consist of a series of compromises reached in moves to close dissenting ranks. This is how the various agencies and departments represented on the steering committee now stand with respect to the policy:

• **Budget Bureau** has taken a liberal position. It wants lower fares and a freer exchange of traffic rights between the United States and the foreign flag carriers.

• **State Dept.** also tends to be liberal but does not appear to take as extreme a stand as the Budget Bureau. State recognizes the need for controlling the grant of routes to foreign carriers.

• **Civil Aeronautics Board** stands about in the middle. CAB Chairman Alan S. Boyd staunchly supports the theory of reciprocity but acknowledges the importance of restraint in the exchange of routes. Charges that Boyd is basically a "protectionist" are without foundation.

• **Defense Dept.** leans toward the conservative side; would not weaken the position of U. S. carriers in international air transportation by granting additional rights to foreign flag carrier competition.

• **Commerce Dept.** takes the extreme conservative view, urging the strengthening of the economic character of U. S. airlines as a major goal.

Thus, it now appears unlikely that the U. S. will adopt a policy sufficiently strong to cope with stiffening competition overseas or one that is flexible enough with radical changes in the form of that competition.

General opinion in European airline circles is that Air Union, consisting of Alitalia, Air France, Lufthansa and Sabena, is all but an established fact. Merger of Britain's major carriers into a single civil air arm also now appears inevitable. The immediate future of KLM and SAS is unclear, but on a long-term basis, some major change in the competitive complexion of these two carriers can be expected.

An analysis of Air Union gives some clue as to the effect its formation will have on U. S. international carriers. To begin with, the concept of Air Union is contrary to the concept of the European Common Market.

Air Union will be formed in three stages: initially, it will be conducted as a pooling operation with each of the four carriers coordinating schedules and pro-rating revenues according to traffic volume. In the second stage, each of the four carriers will retain their national identity but they will operate as a single airline. In the third and final phase, identity of the four airlines will be dropped and Air Union will be, in fact and in name, a single airline or consortium representing four nations.

Thus, Air Union will emerge as a monopoly. The Common Market is not monopolistic in concept but is being built on the principle of free across-the-boarder trade. The German consumer, for example, will have a choice of purchasing a German-made Volkswagen automobile or an Italian-built, duty-free Fiat car.

Air travelers within the four countries represented by Air Union may have no such choice once Air Union is fully operative in its final phase. Carriers of other nations, including those of the U. S.—Pan American and TWA—could be denied the right to operate scheduled flights between points within the four nations because of cabotage.

Cabotage is the international law which prohibits a carrier of one nation from carrying traffic between two or more points within another nation. Since the monopolistic Air Union will be operating in what can be interpreted as a federation of states, it could feasibly apply the principle of cabotage within its European realm.

Such a move could deny U. S. carriers the Fifth Freedom rights now held on the European continent. For example, Fifth Freedom rights now held by TWA between Paris and Rome could be reclassified as cabotage, forcing TWA to terminate its transatlantic flights at Paris or to continue them to a point outside the province of Air Union.

This, of course, raises the question of how many points within the U. S. should the single Air Union airline be authorized to serve. The formation of Air Union will require the negotiation of a new bilateral, and undoubtedly the merged carrier will seek rights to serve all points within the U. S. now served by the four separate carriers.

Failing this, it is highly probable that Air Union will lean on the principle of reciprocity and insist that it be authorized to serve as many terminal points within the U. S. as U. S. carriers serve within Air Union's region.

Original White House study found that relations between the U. S. and foreign nations in the field of international air transportation should be based on purely economic considerations. Since political implications are bound to arise in negotiating with a monopoly carrier, it may be difficult to confine talks entirely to economic or commercial areas.

In fact, the U. S. has shown it is not reluctant to force political considerations into negotiations if such a move will serve U. S. foreign policy. In August, 1961, (AW Aug. 14, 1961, p. 25), the U. S. and Russia had agreed upon and initialed a bilateral agreement covering a route between Moscow and New York.

The agreement was solely economic in context and its annexes embraced only the technical aspects of airline operations. The document was completely free of any political elements. However, the construction of the wall between East and West Berlin by the Soviet Union caused the U. S. to drop the agreement on grounds that it could not grant Russia economic rights at a time when political relationships were so strained.

Meanwhile, several moves are under way toward developing an international agreement on standard Third and Fourth Freedom rights—the rights of one nation to carry traffic to and from a second nation. At present, there is no international conference covering such rights and they are granted only under the terms of bilateral agreements.

The internationally accepted "freedom of the seas" does not apply to the air. Attempts to reach an agreement calling for free rights at international airports failed at the Chicago Convention on Air Transportation in 1944 and no effort to develop such an agreement has been made since.

Early next year, L. H. Slotemaker of KLM, will propose to the Commission on Air Transportation of the International Chamber of Commerce, meeting in Paris, that the possibility of a worldwide system for the exchange of traffic rights in international civil aviation be explored.

KLM Air Union Talks

Paris—KLM Royal Dutch Airlines will seek to reopen talks with the Air Union group consisting of Air France, Sabena, Alitalia, and Lufthansa, from which it broke away in 1959.

KLM balked at the issue of revenue quotas at that time. The present quota formula, which in effect establishes potential growth rates among the carriers, will not be altered even if KLM entered the Air Union, according to Air Union spokesmen.

ATCA To Carry Traffic Control Arguments With FAA to Congress

By Robert H. Cook

Washington—Federal Aviation Agency's handling of air traffic control development may receive closer congressional scrutiny next year as a result of 87 specific points of criticism leveled at the agency by the Air Traffic Control Assn.

ATCA charged that air safety is being endangered and controllers overworked by FAA's continued reliance on "obsolete" radar equipment. The group called for an immediate "crash program" to provide enough new radar to permit nation-wide monitoring of all flights to altitudes of 14,500 feet within the next three years. In addition, the association asked for simplified air traffic control procedures and enough new controllers to reduce the present workload.

The group expressed concern that FAA may limit its Fiscal 1964 budget request by keeping personnel needs at a minimum, and pointed out that there now are too few controllers to handle the mounting volume of air traffic.

Budget Needs

Because of its mandate to protect and improve air safety, FAA can not formulate its budget needs in the same manner as an ordinary industry and should avoid leaving any impression that Congress has been "over-generous" in funding the agency, the association said.

ATCA pointed out that most of the terminal and en route control radar now in use was not designed for air traffic control. "Fifteen years of neglect must now be paid for by increased expenditures in the interest of air safety," the group said.

In its reply, FAA was generally in agreement on most of the minor issues raised, but failed to answer ATCA's plea for more controllers. FAA also took the position that its current program for the installation of new radar should be adequate to alleviate much of the present traffic control problems.

ATCA said it was not in "complete agreement" with the reply from FAA Administrator Najeeb E. Halaby. The association said it has no intention of compromising its views and will carry the battle before Congress during next year's appropriation hearings.

FAA's present rate of procurement and modification of radar equipment is inadequate to meet the demands of increasing air traffic, ATCA contends. A "proven tool" of air traffic control, it should form the core of a total system of control now, rather than wait for research and development programs to produce a substitute, the organization said.

Further delay in accepting expanded radar coverage as a keystone of traffic control would be "unwarranted," ATCA emphasized in urging immediate adoption of the following recommendations:

• **Technical analysis** of radar needed to provide radar monitoring of all flights down to 14,500-ft. altitude. Military radar sites that are not suitable should be removed from the program, which should be free of any "political pressures." FAA has requested three new long-range radar sites in Fiscal 1963, but at least 12 are needed, ATCA contended.

• **En route radar scopes** may be sacrificing safety to the interest of economy and should be replaced with new models, since current units lose targets at about 60 mi. and often experience fade-out within 20 mi. FAA has answered that its problem is delivery time, rather than money. By 1964 it plans to have these scopes converted to a bright display which will also provide a visual aircraft identity and altitude by means of letters and numbers on the scope face. Within the next year, the agency said, additional development on this type radar display will get under way. In the future it may be possible to indicate aircraft position, identity, altitude and approach or departure sequences. The agency said that it is also studying the utilization of joint radar sites with the military on a "site-by-site basis."

• **Terminal area approach** control radar should be analyzed with the aim of updating equipment and providing tower controllers with a video display of traffic. FAA agreed to this recommendation and said it would investigate ATCA complaints that controllers are being forced to handle too many flights during peak traffic hours with inadequate equipment. ATCA asked that controllers be permitted to handle no more than five flights at a time.

Controller workload took up a large portion of the recommendations. They called for less en route flights to be handled during bad weather, and a slowdown for all traffic in high density areas during peak hours, until better equipment is installed and more controllers hired. FAA rejected the slowdown idea as neither permissible nor desirable, but said it agreed more employes are needed and already is exploring the workload problem.

TAG AIRLINES nine-passenger de Havilland Dove aircraft get heavy utilization on scheduled flights between Detroit and Cleveland.

TAG Airlines Gets High Dove Utilization

By Ward Wright

Detroit—TAG Airlines, an air taxi now flying 30 week-day scheduled flights between Detroit and Cleveland with nine-passenger de Havilland Dove aircraft, sees its operations as a needed "third level of service" between major points for business passengers.

William C. Brookmyer, TAG's general manager, makes a careful distinction between what he calls TAG's "third level of service" and the traditional concept of third level air service as a separate category designed to serve marginal traffic points unprofitable for local service carriers.

Business Passengers

TAG's role, Brookmyer said, is to complement trunkline and local service operations between such major traffic hubs as Detroit and Cleveland with service tailored to the needs of business passengers. "Trunklines can't be putting a jet up and down all day long between points like Detroit and Cleveland," Brookmyer said, "but we can operate when business operates."

TAG's present philosophy has paid off with an increase in scheduling that began with three round-trip Detroit-Cleveland flights in 1957 and now stands at flights every-hour-on-the-hour between 7 a.m. and 9 p.m. in both directions.

TAG does little advertising, "we rely on word-of-mouth," Brookmyer said. In spite of this conservative policy, TAG's passenger traffic has increased from 15,660 passengers in Calendar 1958 to 24,313 for the first nine months of 1962.

Prime reason for passenger response to TAG's services is its ability to use downtown airports in Detroit and Cleveland which offer passengers a significant time saving in ground transportation.

TAG operates from Detroit City Airport, about six miles or about 10-15 min. from the city center—compared with about 35 min. and 50 min. ground time needed to reach Detroit's Metropolitan and Willow Run airports.

In Cleveland, TAG serves Lakefront Airport, about 5-10 min. ground time from the city center as opposed to about 1 hr. needed to reach the city's Hopkins Airport. TAG advertises that it can save a round-trip passenger as much as 3 hr. 10 min. between the two cities compared with other scheduled services. Total round-trip time, including ground transportation for the 95 naut. mi. between Detroit-Cleveland, is about 2 hr. for TAG flights compared with about 5 hr. and 35 min. for other scheduled services.

Brookmyer was unable to assess the impact of TAG's operation on its trunkline and local service competitors between the two cities, but he noted that since TAG began full-scale night operations early this year, a trunkline competitor inquired about TAG's operations and mentioned that Detroit-Cleveland local traffic on its night-through flight had dropped sharply.

TAG operates a fleet of three Dove aircraft under the CAB's 12,500 lb. maximum gross weight limit for air taxi operators. By observing this restriction, TAG does not have to submit fares or scheduling to the Board for approval. Its fares run about one-third to one-fourth higher than the competition.

Outlook for 1962

In spite of this, TAG, which does not carry mail or receive subsidy, has experienced losses every year since it began operations. However, Brookmyer said, 1962 may be the turning point and TAG may show a small profit.

Brookmyer conceded that it might be more profitable to operate larger aircraft for certain peak hours, but TAG's policy will be to continue to "give passengers more frequency by using smaller aircraft."

TAG has had an application before CAB since February, 1960, to operate a similar high-frequency service between Detroit, Chicago, Pittsburgh and Cincinnati where downtown local airports favor such an operation with smaller aircraft. Brookmyer indicated TAG might be interested in the four-engine Potez 840 turboprop for such an operation, should CAB approve. Such a move would require a change in TAG's air taxi status under present regulations.

TAG maintains its operations with a total of 31 employes—12 pilots and copilots, six mechanics, eight sales people and five persons in its general offices. The airline has no fixed-base operation. TAG uses two-man crews.

Brookmyer estimated that 85 to 90% of TAG's customers are charge customers. TAG uses all major oil, hotel and airline credit cards as credit references and does its own billing.

While TAG's customers are traditionally male business people, Brookmyer said, more women are beginning to use the airline. TAG also has a significant weekend student traffic. Freight and express comprise about 8-10% of the airline's income, Brookmyer added.

TAG—an acronym for Taxi Air Group—has been operated since 1957 as a division of Miller Oil Co., which controls a chain of filling stations and other petroleum facilities in the lower Great Lakes region.

Ross E. Miller, owner of Miller Oil and TAG's president, foresaw a possible need for direct Detroit-Cleveland service when he bought the air taxi operation in July, 1957. Earlier, TAG had scheduled service between the two cities with seaplanes (Otters and Beavers) for about a year except during freezes.

Miller began operations with two purchased Doves and one de Havilland Heron leased from TAG's former owners. In the fall of 1957 Miller bought Illini Airlines, an air taxi service operating between Rockford, Ill., Detroit and Chicago—services TAG kept until it dropped Rockford in July, 1958, and Chicago in February, 1960.

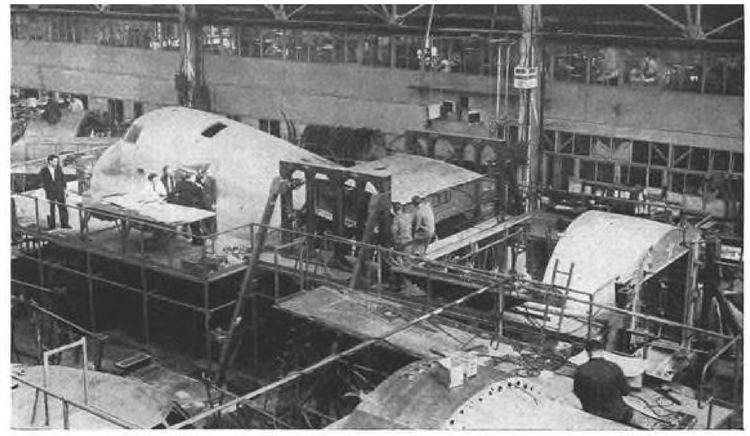
Illini acquisition brought TAG's fleet to three Doves. The airline acquired a fourth Dove in the summer of 1958 and gave up its leased Heron in the fall. In 1960, TAG sold one Dove.

By the end of 1958, TAG had increased its schedules to eight round-trip flights daily between Detroit and Cleveland. Flights remained fixed at eight partly due to the lack of permanent landing lights at Lakefront Airport prior to 1961. In these years, TAG provided its own lights at Lakefront during winter for late evening flights.

In 1961, Federal Aviation Agency and the City of Cleveland installed permanent landing lights at Lakefront, paving the way for increased night operations. Last February, TAG increased its schedule to 10 round trips daily, followed by 12 round trips in April, 14 in September and 15 round trips in October.

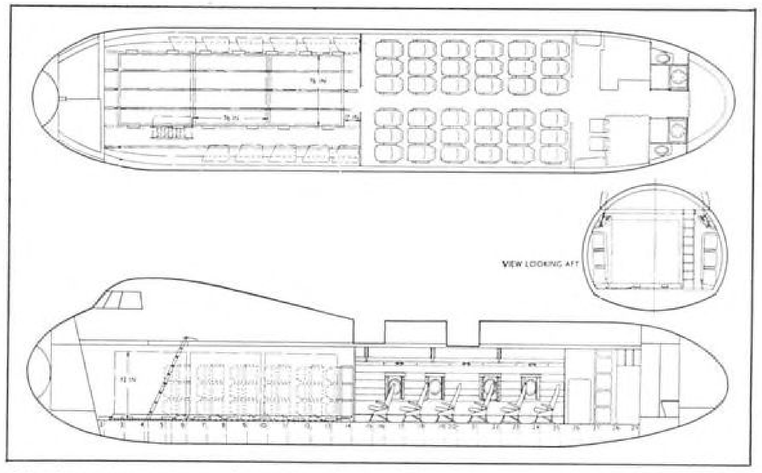
TAG 1958-1962 Detroit-Cleveland Service

		Daily Round-Trip Flights	Passenger Traffic	Passenger Load Factor (%)
1958	.....	8	15,660	59.5
1959	.....	8	20,767	68.4
1960	.....	8	22,340	67.6
1961	.....	8	23,683	71.0
1962	(first nine months)	15	24,313	70.8



Center section of box spar wing is lowered into place on a Series 200 Argosy in production at Gloster Whitworth's production line at Coventry. Wing design gives Argosy full fail-safe characteristics throughout the fuselage.

Argosy 650 Mixed Cargo-Passenger Version



Mixed cargo-passenger version of the Gloster Whitworth Argosy 650 turboprop transport, now being offered to several North American airlines (AW Nov. 19, p. 49), carries up to 14,000 lb. of cargo in forward cabin section and up to 46 passengers. Layout pictured above is for 36 passengers and three cargo pallets forward. For increased flexibility in loading, passenger seats can be folded into the rounded section of the side fuselage (see center section cutaway). Powerplants are four Rolls-Royce Dart engines. Demonstration mockup of the Argosy seating plan (below), shows how a section of three seats can be folded against the bulkhead to provide additional space.

Boeing to Roll Out 727 Tomorrow; First Aircraft Will Go to United

By David A. Anderton

Renton, Wash.—Rollout of the Boeing 727 short-range jetliner is scheduled tomorrow, with intensive systems testing planned before it makes its first flight early next year.

First airplane, painted temporarily in the brown and yellow color scheme that characterized the Boeing 707 prototype, eventually will be delivered late in 1963 as the first of 40 to United Air Lines. This is the first Boeing transport not to be built in prototype form first.

Total of 131 aircraft are currently on order. In addition to United's 40 airplanes, Eastern Air Lines bought 40, announcing its order simultaneously with United in December, 1960, and starting the program off on a firm foundation.

Latest addition to the order book was made last week, when the Australian minister of civil aviation announced approval of orders of two 727s each for Ansett-ANA and Trans-Australia Airlines.

Since then, Lufthansa German Airlines has ordered 12, American Airlines 25 and Trans World Airlines 10.

Major goal of the 727 program was to produce a short-range jet transport that would have low operating costs and be able to work in and out of fields with short runways.

Extensive market surveys defined the capacity and seating arrangement of the airplane. They showed that the 727 should be aimed primarily at short-haul route segments that could generate high traffic. The design also had to be versatile enough to handle the longer routes where there might be less traffic.

Boeing's studies showed that the world market for an aircraft of this type might exceed 1,000 airplanes by 1970. The 727 was designed with the expectation of a large production run to match this conclusion of the studies.

Built around the fuselage cross-section of the 707 and 720 designs, the 727 will feature six-abreast seating for a maximum of 114 tourist-class passengers. The interior can also be planned around 70 first-class passengers.

With interior volume and fuselage cross-section defined, the Boeing designers developed a wing with a small area—or high wing loading—to minimize drag and to get the desired high-speed performance. High-lift devices were developed to give the airplane the short-field performance that was necessary.

Triple-slotted flaps extend aft and down at a 40-deg. angle and increase the effective wing area by about 100 sq. ft. Normal wing area is 1,650 sq. ft.

Wing also has outboard slats in four segments, and inboard Krueger flaps in three segments. This combination of leading-edge, high-lift devices extends over almost the entire wing span.

Boeing says that a standard 727 at maximum takeoff gross weight of 142,000 lb. will lift off from a 5,500-ft. field length on a standard day, using 20-deg. flap deflection. For the overload gross weight of 152,000 lb. under the same condition, field length is 6,200 ft.

Another way of looking at this is to consider the total weight that can be flown out of a given field. If a 5,000-ft. limit is set on the field length, then the takeoff gross weight becomes about 136,000 lb. Fuel is traded for payload, and the 727 can then fly a 1,200-mi. stage length with full payload.

All-weather operating conditions received detailed attention during the development program. In addition to the high-lift devices, which would reduce the airplane's approach speeds, Boeing went through extensive selection and development of the autopilot and control system. Some components of the system were adapted from Boeing missile designs and de-rated. Other components were chosen from existing and proven units.

The 727 is controlled about all three axes by irreversible hydraulic controls. The over-all control and autopilot system has provisions for multiple channels and manual operation of the primary system.

New chemical system, working like the windshield washer in a car, was developed by Boeing for rain removal. It can be used while the high-speed windshield wipers are operating, and one treatment will last for a single approach.

Powerplants for the Boeing 727 are a trio of Pratt & Whitney JT9D-1 turbofan engines, rated at 14,000 lb. takeoff thrust each. Two engines are pod-mounted, one on each side of the aft fuselage, and the third is slung at base of vertical fin in the tail cone.

Thrust reversers, developed along the same lines as those on the 707 series, are used on the three engines and are interchangeable between center and side powerplants. Sound suppressors are not needed, Boeing says, because the tailpipe exit velocities are low, but tuned panels are installed in the inlets to reduce the noise of the compressors.

Preliminary design of the 727 started with a scaled-down 707 configuration using four engines. It was discarded and twin-engine versions were developed. Later the three-engine layout was chosen and carried through preliminary design and test.

When the airplane went into production, it had more than 4,500 hr. of wind-tunnel time behind it. The Boeing 707 prototype was modified to test the leading-edge and trailing-edge flaps and to check the characteristics of a rear-mounted engine. That airplane accumulated another 250 flight hours testing the flaps and engine.

Two structurally complete airplanes will be built and static-tested to destruction. The first of these already is being installed in the test stand and testing is scheduled to begin in February, 1963. Fatigue tests will start on the second airframe later in 1963, and will cover a span of 12 months of accelerated testing, simulating more than 15 years of airline operations.

Crew for the first flight will be S. L. Wallick, who is senior experimental test pilot and 727 project pilot; R. L. Loesch, who is Boeing chief of flight test and co-pilot; and M. K. Shulenberger, Boeing's chief flight engineer. He will be 727 flight engineer.

Boeing 727 has a 108 ft., 7 in. wingspan, is 134 ft., 1 in. long over-all, and stands 33 ft., 9 in. high. Wing sweep is 32 deg. at the quarter-chord point. Landing weight is 131,000 lb.

Cruise speed can be varied from 550 to 600 mph., and cruise altitudes from 15,000 to 35,000 ft. Operational ceiling is 42,000 ft.

Aeroflot Tu-124 Service

Soviet airline Aeroflot has started the first regular scheduled service of its twin-turbofan Tu-124 transports on Moscow-Ulynavosk and Moscow-Gorky routes.

Flight time for the 500-mi. Moscow-Ulynavosk segment is 1 hr. 15 min. for the Tu-124, as compared with 3 hr. for the Il-14 piston engine aircraft being replaced. The medium-range turbofan makes the Moscow-Gorky flight in 40 min. For the past two years the airline had promised that regular Tu-124 service would begin "in the near future."

India, Aeroflot Agree To Extend Air Service

New Delhi—Russia and India have agreed to the extension of Aeroflot's Moscow-Tashkent-New Delhi route to Rangoon and Djakarta, Indonesia, and to the extension of Air-India's service to points beyond Moscow.

Air-India, which operates one flight a week between New Delhi and Moscow, may eventually extend the service to London. Aeroflot has two flights weekly from Moscow to New Delhi. Aeroflot and Air-India services between the two countries operate on pool basis.

Early Selection of Heliport Sites Urged

James R. Ashlock

Hartford—Continued rise of property values and urban development make it advisable for cities to act promptly in establishing heliport sites to meet the helicopter's growing importance to public transportation, delegates to a one-day conference here were told.

Civic representatives, most of them from Connecticut, were advised on how to open their communities to scheduled helicopter service. The conference was sponsored by the American Helicopter Society and the Greater Hartford Chamber of Commerce.

Reservation of sites, changes in zoning laws to facilitate heliports and public education were listed as three vital considerations in civic planning toward attracting helicopter service.

"This is not a complex and costly thing we are talking about, nor is it like an airport facility," said Harry Bernard, chief of the steep gradient aircraft section of Federal Aviation Agency.

"The aviation people you have been exposed to have probably made it sound mysterious and exotic," Bernard said. "But keep it simple and straightforward."

Bernard suggested that heliport platforms be planned on rooftops, above highways and freeways and on structures over reservoirs.

Lack of Uniformity

Lack of uniformity in cities' evaluations of proposed heliport sites was blamed by Bernard for creating misunderstanding and confusion, particularly over operational safety factors.

Citing the safety record of helicopters, Bernard said the three U. S. scheduled carriers have operated for years with only one accident, a crash at Chicago (AW Aug. 1, 1960, p. 34), which caused death or injury of passengers.

"Bear in mind that the three carriers today are carrying perhaps 50-60,000 passengers per month, and this accident is the first and only one involving injury or death," he said.

He said that of 122 accidents involving both private and commercial helicopters in 1961, only three, or 2.4%, occurred in urban areas.

"To my knowledge, no person on the ground has ever been injured by a helicopter in these accidents listed," Bernard said.

Safety of rooftop operations is evidenced, he added, by two Chicago operators having logged over 115,000 rooftop takeoffs and landings without incident. Los Angeles Airways, an air taxi service (AW Aug. 27, p. 40), performs over 300 rooftop flights every month, he said.

Flight tests from the roof of the 800-ft. Pan Am building in New York City, a proposed heliport for New York Airways, are scheduled to begin shortly after the first of the year, Bernard said. He said the site may be approved for scheduled operations by the time the building is opened in September, 1963.

FAA will also construct a heliport atop its new 10-story building in Washington, which Bernard said will be a model facility for anyone planning a rooftop heliport. Although it will not be used for scheduled operations, the FAA heliport will be equipped with night lighting, radio communications and fire fighting equipment, including a foam supply.

Noise, rather than anxiety over safety, appears to be of more concern to parties within a municipality where heliports are under consideration. Horace B. Wetherell, director of the Connecticut Dept. of Aeronautics, said the noise problem arises frequently in talks about downtown heliports in his state.

"We've been told, for example, that a heliport would discourage hotels and other downtown construction," Wetherell said.

Bernard said the FAA had conducted special tests which revealed that a helicopter's noise adds little if anything to the normal background sounds of a metropolitan area.

"Still, people will be attracted to helicopter noise because it is not a familiar sound and comes from an unusual direction," he said. "We believe that noise should indeed be a factor in planning and locating airports."

He said that in Los Angeles there are 22 heliports, about half of them on rooftops. In addition, over 100 permits have been issued for "infrequent landing" points.

"Objections about noise, safety and nuisance were heard before the permits were issued," Bernard said. "But the record fails to show a single case of objection on any grounds after helicopter operations began."

L. Welch Pogue, general counsel for the Aerospace Industries Assn.'s Vertical Lift Aircraft Council, outlined the growth of helicopter service. He said that in 1958 there were 120 commercial helicopter operators in the U. S. using 520 aircraft. In January, 1962, the number had risen to 322 operators using 994 aircraft. In addition, several hundred machines are used by corporations and government agencies.

"In 1961, the gross revenues of Los Angeles Airways, Chicago Helicopter Airways and New York Airways was $8,602,000," according to Pogue.

In view of this growth, he urged communities to encourage interest in the potential of helicopter service, examine their regulatory framework and make changes where needed to facilitate establishment of heliports.

Recent survey by the Vertical Lift Aircraft Council revealed that of 39 cities, only four permit heliports in all of their zoned areas, and without lengthy hearings and complex licensing. These are Denver, Los Angeles, Phoenix and Seattle, he said.

"Six provide that a heliport cannot be established even in an industrial district without a public hearing," he said, citing Chicago, Boston, Kansas City, Kan., New York, Pittsburgh and Portland, Ore.

Pogue said that Rochester, N. Y., under a 1959 ordinance, specifically restricts helicopters to fixed-wing airports.

"If heliports are to take their place as one of the essential facets of the urban community in the 1960s, as they have in some communities already," Pogue said, "the long-range community interest requires that heliport zoning be considered not simply as a problem of controlling a nuisance, but as making it possible for the various types of helicopter operations to serve the community and its citizens."

Heliport Guide

Vertical Lift Aircraft Council and the AIA have distributed a pamphlet as a guide to communities on heliport dimensions. It shows that a 75-ft.-sq. pad will handle small single-engine aircraft, while 100-ft.-sq. areas are necessary for large twin-engine transport helicopters. Approach and takeoff clearance should be based on 1 ft. of vertical clearance for each 8 ft. of horizontal distance along at least two flight lanes, which would be determined by prevailing winds.

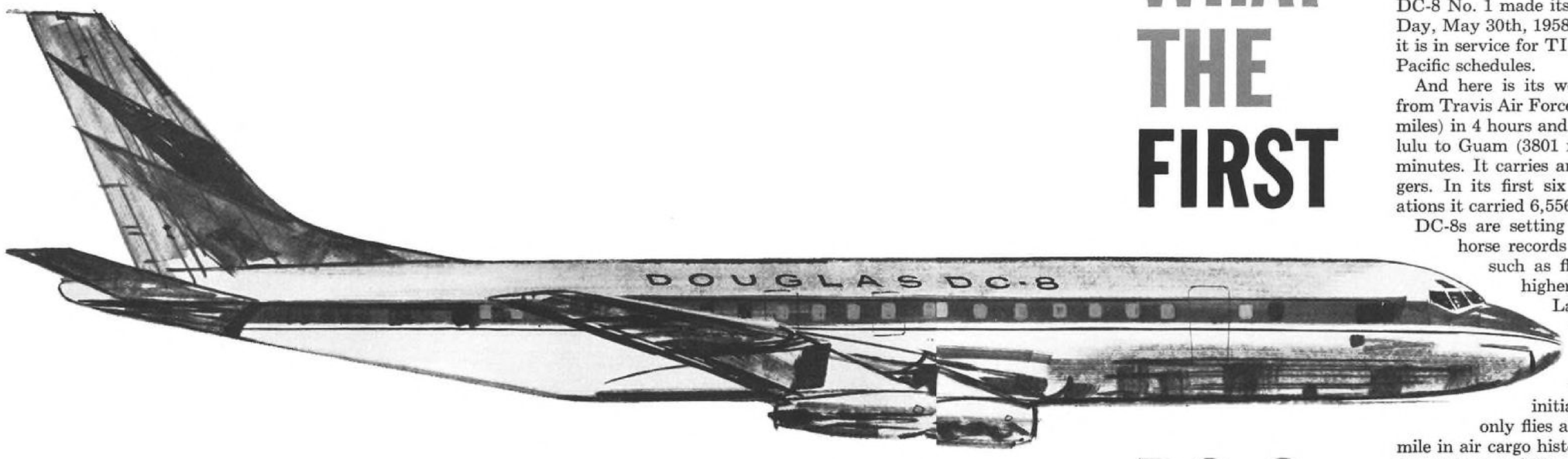
David G. Davis, deputy director of commerce for aviation at Philadelphia, said that city has concluded that it is proper for a local government to provide, operate and maintain heliport facilities as a public convenience. Philadelphia would thus treat heliports in much the same way it would a municipal airport.

He said that a report done for Philadelphia by a transportation consulting firm recommended that a public heliport be included in a proposed downtown project.

"It recommended also that adequate helicopter facilities be installed at our two existing airports, and that land be reserved for the future installation of five or six public heliports . . ."

DOUGLAS BUILDS GREAT TRANSPORTS

LOOK WHAT THE FIRST



DC-8 IS DOING NOW!

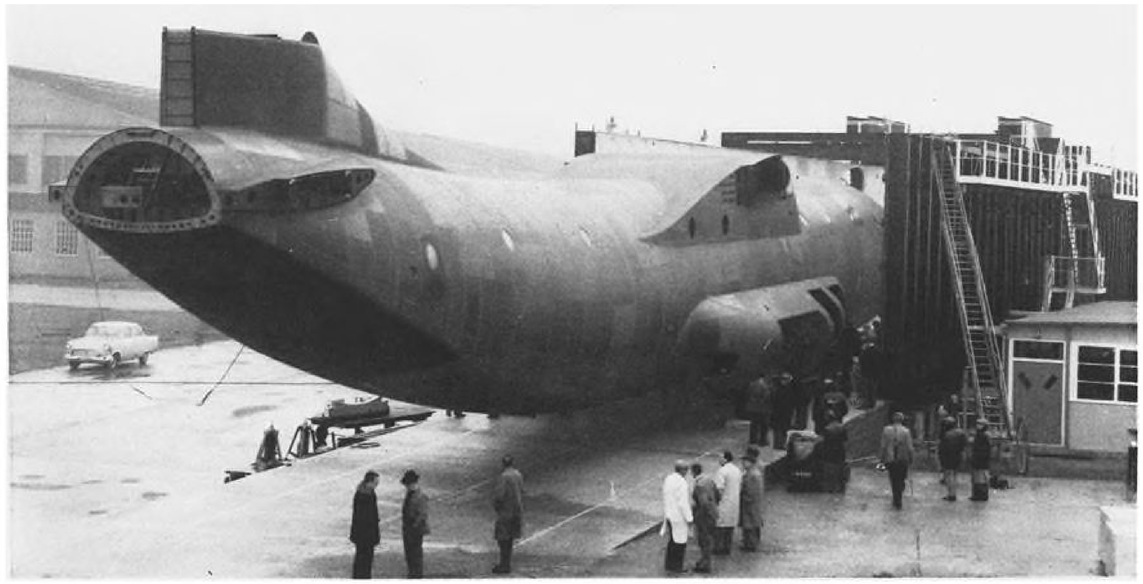
DC-8 No. 1 made its first flight on Memorial Day, May 30th, 1958. Today, 4½ years later, it is in service for TIA, flying regular MATS Pacific schedules.

And here is its workhorse record: It flies from Travis Air Force Base to Honolulu (2437 miles) in 4 hours and 30 minutes; from Honolulu to Guam (3801 miles) in 7 hours and 50 minutes. It carries an average of 149 passengers. In its first six weeks of MATS operations it carried 6,556 passengers.

DC-8s are setting performance and workhorse records all around the world... such as flying faster, farther and higher than any other jetliner. Latest in the series is the world's first all-jet air freighter, the great new DC-8F "Jet Trader," which recently made its initial flight. This aircraft not only flies at the lowest cost per ton mile in air cargo history, but also can be converted to any of 12 cargo-passenger configurations in less than 2 hours.

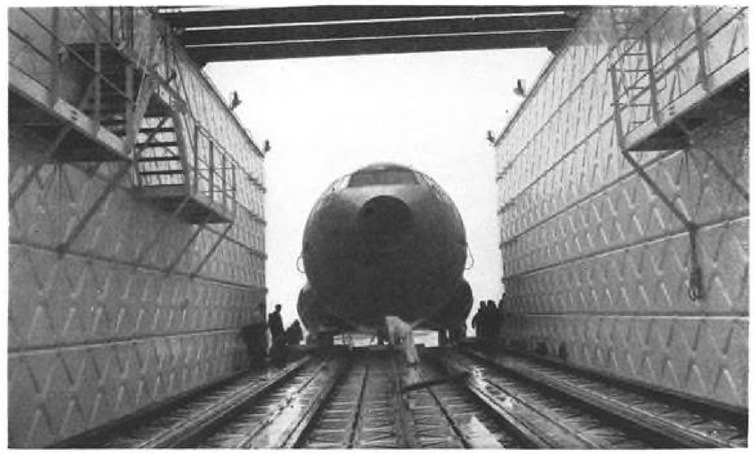
DC-8 No. 1 is another example of the reliability of Douglas aircraft, demonstrated during 3 decades of service. Thirteen thousand Douglas transports... DC-3s, 4s, 6s, 7s and 8s—C-47s, 54s, 118s, 124s and 133s...have been the workhorses of military and commercial air transportation... and you can expect even greater things from future Douglas transports.

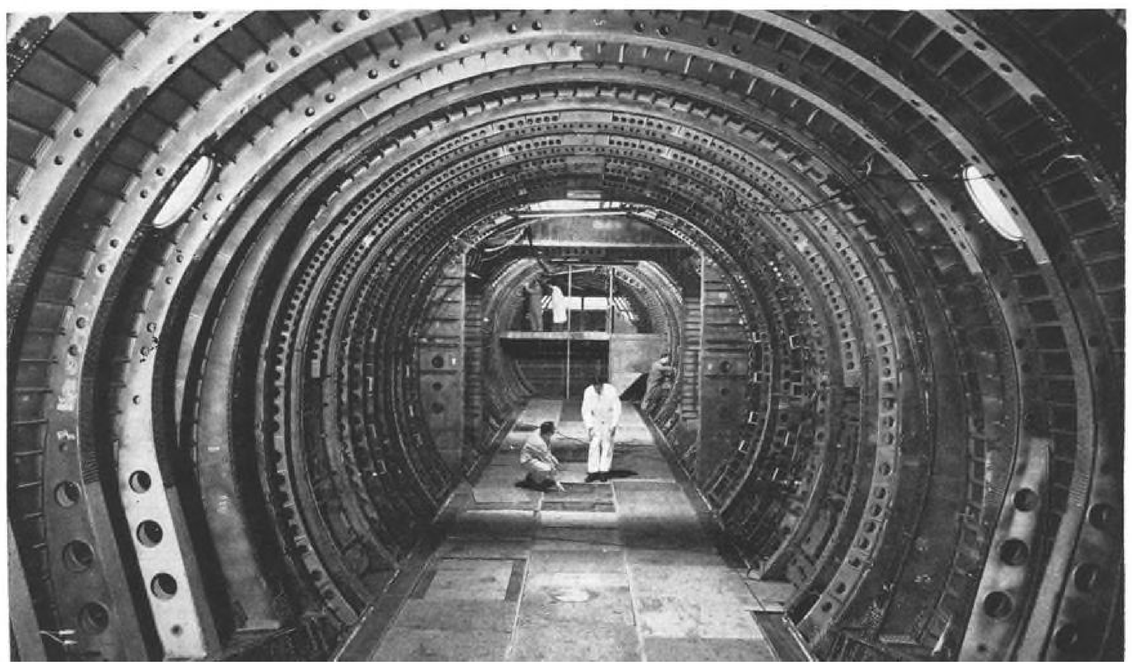
DOUGLAS AIRCRAFT DIVISION



First Belfast Freighter Fuselage Undergoes Water Tank Testing

First complete fuselage of the Short Belfast turboprop freighter for Royal Air Force started recent series of tests in water tank at Short Bros. & Harland plant in Northern Ireland. Tests will simulate ground and flight loads with water pumped through the fuselage in various cycles. Tank is more than 150 yd. long and holds 600,000 gal. of water. Interior view of Belfast freight hold is shown in bottom photo. Hold has a volume of 11,000 cu. ft., flooring is honeycomb sandwich enclosed between two layers of aluminum. At right, fuselage is winched into water tank.





BRITISH AIRCRAFT CORPORATION

ONE HUNDRED PALL MALL LONDON SW1 ENGLAND

USA: BRITISH AIRCRAFT CORPORATION (USA) INC., 399 JEFFERSON DAVIS HIGHWAY, ARLINGTON 2, VIRGINIA

AIRLINE OBSERVER

► British Overseas Airways Corp. is studying a Rolls-Royce proposal to retrofit the airline's Boeing 707s with Conway RCO.42 engines now being used on the Vickers VC.10. Firm decision will probably be made early next year. The manufacturer claims that the Conway powerplants will give BOAC a 10% saving in engine operating costs.

► **Trans World Airlines will retain a high volume of schedules across the Atlantic this winter, on the strength of its 17-day excursion fares. Eastbound advance bookings for this month are 29% over November, 1961, and westbound, 52.1%. December eastbound bookings are up 26.1% and westbound show a 227% gain, partially due to TWA's special Christmas holiday jet economy group fares for U. S. military personnel and their families stationed overseas. Through Mar. 31, the airline will provide 84 passenger flights a week across the Atlantic.**

► Turbojet equipment now provides 80% of domestic trunkline service, compared with only 5% four years ago. Turbofan aircraft continue to gain in popularity and now account for one-fourth of the jet equipment total.

► **British Aircraft Corp.'s sale of three BAC 111 turbojets to Central African Airways (AW Oct. 1, p. 27) is expected to lead to orders from at least two other African carriers soon. Sales pattern generally indicates that purchasers have been satisfied operators of either the Vickers Viscount or de Havilland Comet. Seven African airlines currently operate these aircraft.**

► Civil Aeronautics Board has expanded its new Handbook of Airline Statistics, due for release by the end of November. Contents are updated and will include new topics such as bilateral agreements, state and federal fuel taxes, traffic volume by city pairs and jet penetration of major markets.

► **International Civil Aviation Organization is urging airlines to reduce rates for freight carried on passenger flights to a figure below system average operating costs, as one means of offsetting excess cargo capacity. For each pound carried by air, surface freight services carry one ton, ICAO contends, and airlines may have to consider more cooperative arrangements, such as interchanges, sale of space to one another and pooling in order to meet the surface competition.**

► Soviet Airline Aeroflot plans to start regular commercial service from Moscow's new Domodedovo Airport by next spring. Construction crews are completing the 1,300-ft. long glass, aluminum and concrete building, which has separate covered passageways extending from each end toward the field. Passengers will board via horizontal ramps from these two passageways. Domodedovo has a completed, five-story, 500-bed hotel. It has been designed to handle Aeroflot's largest transports, including the four-turboprop Tupolev Tu-114 and the new, four-turbojet Ilyushin Il-62.

► **American Airlines is confident that experience with such new jet freighters as the Boeing 320C and Douglas DC-8F will encourage CAB approval of lower cargo fares. Company spokesmen estimate that two years of cost analysis will be needed before rate reductions may be requested.**

►Nigerian Airways management is being investigated by the Nigerian government after a series of sharp clashes between its chairman, Chief Fadahunsi and his deputy, Chief Dafi, over the handling of employes. The Lagos Daily Times reports that the investigation not only involves charges of "tribalism, but also deep political intrigue" within the company.

► **Swissair has signed a firm order for one Series 53 Douglas DC-8 turbofan transport for delivery next October in time for service over the North Atlantic later in 1963. Powered by four Pratt & Whitney JT3D-3 engines, the aircraft design incorporates a new wing leading edge and fuselage extension capable of accommodating 162 passengers in economy configuration, or a standard 142-seat configuration with 16 first-class seats plus lounge and 126 economy-class seats.**

SHORTLINES

► **Allegheny Airlines** has asked Civil Aeronautics Board approval of two new group travel plans designed to attract new passengers. One plan would permit group travelers holding round-trip tickets to return independently and the other offers one-way group travel rates at 20% off the normal one-way fare.

► **Continental Air Lines** flew 82 million revenue passenger miles last month for a 12% gain over October, 1961. A 14% gain was recorded over the airline's Chicago-Kansas City-Denver-Los Angeles route, while traffic over other segments rose 10%.

► **Local service airlines** recorded a 19.7% gain in revenue passenger miles for the first 10 months of 1962 as compared with the same period a year ago. The industry's average system load factor increased to 42.6%, compared with 41.7% for the first 10 months of last year.

► **Mohawk Airlines** has reported a third-quarter profit of $233,574 for a nine-month profit of $421,288. Last year the airline showed a third-quarter profit of $42,233 and a nine-month profit of $299,552.

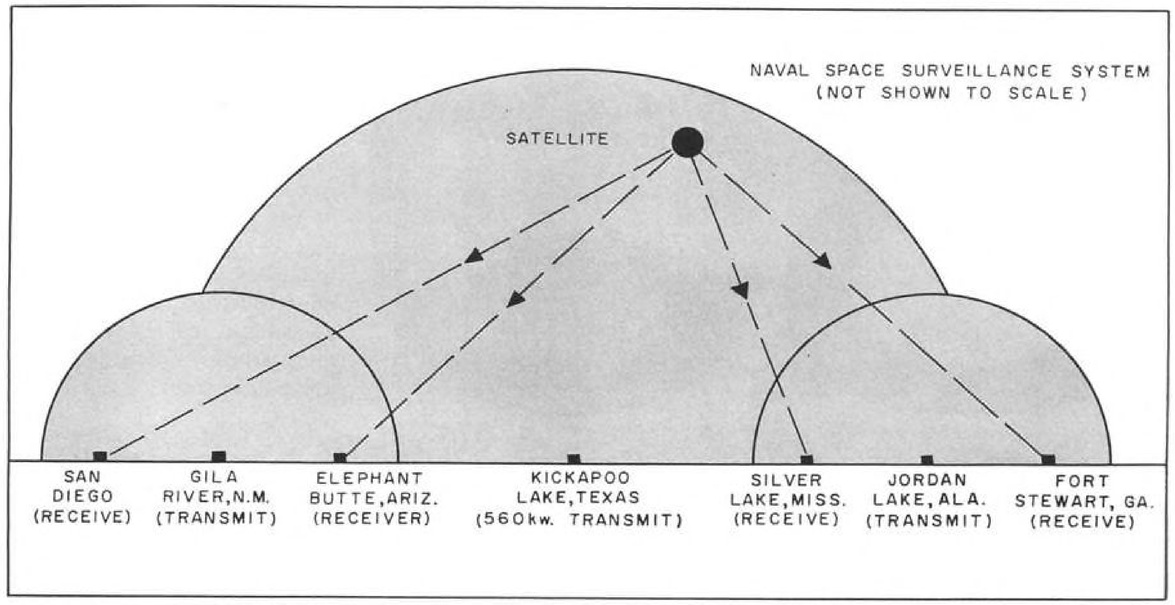
► **Northwest Airlines** will operate nine extra all-cargo round trips across the Pacific in December. The service will be in addition to the cargo space on Northwest's regular passenger flights and a weekly DC-7F cargo flight between New York and Tokyo.

► **Pan American World Airways** will begin a weekly flight to the island of Pago Pago on Dec. 2. It will also provide twice-weekly service to Nandi, Fiji Islands.

► **Sabena Belgian World Airlines** will include four daily Sikorsky S-58 flights in its fall and winter helicopter schedule between Brussels and Eindhoven, Holland and two daily flights between Brussels and Rotterdam.

► **Seaboard World Airlines** has earned a third-quarter profit of $803,000 on the basis of $6.5 million in revenues. For the first nine months of this year, the airline has experienced a loss of $3.1 million.

► **Sudan Airways** has taken delivery on its first de Havilland Comet 4C and will receive a second before the end of this year. The airline plans to extend its present route system to Cyprus and is considering adding service to India in the near future.



NAVAL SPACE SURVEILLANCE SYSTEM, which detects and catalogues Soviet satellites, uses three transmitters to produce thin curtain of electromagnetic energy stretching from Atlantic to Pacific oceans, plus four receiving stations to determine satellite position.

Spasur Net Giving Vital Norad Coverage

By Philip J. Klass

Dahlgren, Va.—Naval Space Surveillance System (Navspasur) has developed from a jerry-built experiment into a vital operational element in the North American Air Defense Command's Space Detection and Tracking System, (Spadats) in less than four years.

As a satellite passes over a great circle which stretches from San Diego to Savannah, Ga., it penetrates a thin curtain of electromagnetic energy erected by Spasur. Instantly the pens in Sanborn recorders here at Navspasur headquarters begin to trace out heavy black "alert" markers while other pens stop their random oscillations and begin to trace out sloping lines.

Direction of the slope shows the satellite's heading. From a few other simple measurements, operators here quickly determine the time of initial penetration and the satellite's east-west location. This is compared with similar data on when and where previously catalogued satellites are expected to pass through the Spasur fence.

Unless the two sets of data match within close limits, the visitor is a new satellite in orbit or debris from the breakup of an existing spacecraft. Data on the unknown is immediately transmitted to Norad headquarters in Colorado Springs. Meanwhile, Norad may be receiving data from other sources, such as the Ballistic Missile Early Warning System in Greenland and Alaska or from other radars and sensors, within and outside the U. S., to assist in object identification.

Unusually modest cost of installing and operating Navspasur belittles the important contribution it is making to the Norad Spadats capability. Capital cost of the present Spasur network, with three transmitting and four receiving stations, is only $20 million, including research and development expense. Annual operating cost, to provide continuous 24 hr. per day surveillance, runs about $4.5 million. Figure will rise to about $5 million with programed improvements.

Single Pass

Single pass of an object through the Spasur fence permits it to be identified as an unknown or a known object and provides data on its equatorial inclination angle. A second pass gives moderately accurate data on an unknown satellite's period and its semi-major axis dimensions (one-half an apogee plus perigee). To obtain specific values for apogee and perigee it is necessary to wait roughly 12 hr. until the earth has rotated 180 deg. to permit the network a look at the opposite side of the orbit.

Satellite launched at an equatorial inclination less than approximately 33 deg. does not pass far enough north to penetrate the fence, except at its extremities which dip as low as about 28 deg. latitude over the oceans. However, such satellites could not pose an offensive threat to the continental U. S. except for extreme southern portions of the nation.

Another limitation of the present network applies to Soviet satellites launched at higher inclination angles. A Soviet satellite at a 50-deg. inclination may not pass through the Spasur fence until it has been aloft for about three orbits, while one at a 65-deg. inclination requires about five orbits to be detected by Spasur.

These are limitations of the geographic location of the present network and not an inherent shortcoming of the Spasur technique. If a similar network were installed in the Western Pacific both of these limitations would be overcome.

But Navy spokesmen emphasize that they are not pushing hard to get funds for a Spasur extension, although such a move is believed under consideration for the Fiscal 1964 budget. They emphasize that any such Spasur extension must be weighed against the operational need for added capability as well as against other pressing defense needs. The Spasur technique is one which requires relatively short lead time to procure hardware and install it should the need arise, Navy spokesmen point out.

Navspasur network is an adaptation of the radio interferometer techniques first developed by the Naval Research Laboratory (NRL) for tracking Project Vanguard satellites, known as Minitrack.

First Spasur feasibility demonstration in February, 1958, using the Soviet Sputnik 2, employed the Minitrack station at Blossom Point, Md., and a Minitrack calibration transmitter at the Army Signal Corps Laboratories in Ft. Monmouth, N. J.

Network Location

Present location of the Spasur network results from the fact that Minitrack stations near San Diego and at Ft. Stewart, Ga., could be quickly converted to the Spasur function.

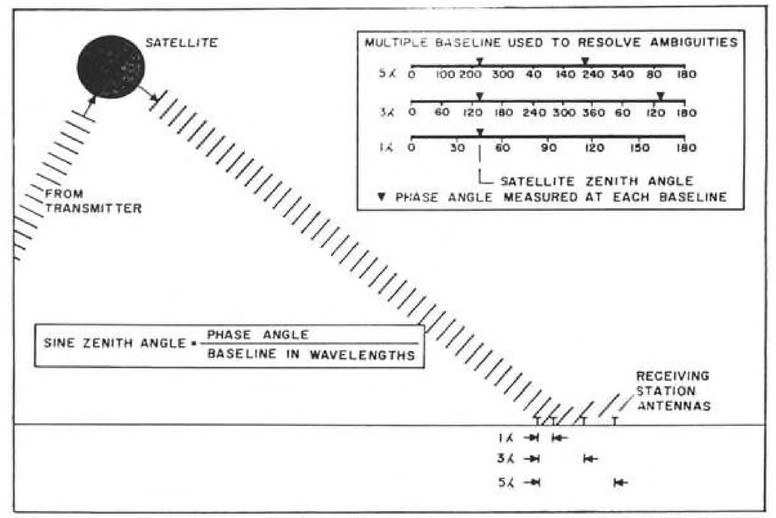
On June 20, 1958, the Advanced Research Projects Agency authorized the Naval Research Laboratory to develop, install and operate a surveillance system to detect and obtain orbital parameters on non-radiating satellites. Only six weeks later NRL had a two-station facility in operation with a transmitter located at Jordan Lake, Ala., and the modified Minitrack station at Ft. Stewart, 250 mi. to the east.

On Dec. 22, 1958, the first signal to be received simultaneously by two stations at Ft. Stewart and at Silver Lake, Miss., 250 mi. west of the transmitter, occurred when an Atlas booster containing the Score communication satellite experiment was placed in orbit. But the data was almost incomprehensible at first because of improper calibration and there was a brief period of discouragement, according to Capt. W. E. Berg, head of the Astronautics Branch, Office of Chief of Naval Operations.

Six-Station Network

But by February, 1959, a six-station network was in operation on a 24-hr./day basis. In addition to the eastern complex already cited, the network included a western complex with transmitter at Gila River, Ariz., and receiving stations 250 mi. either side at San Diego and Elephant Butte, N. M.

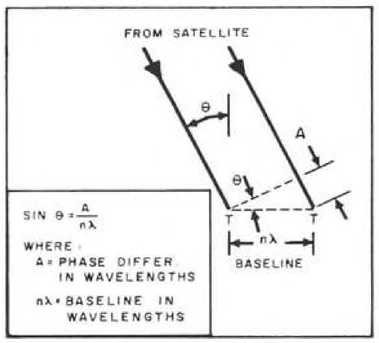
Since then there has been a steady effort to devise and introduce improvements, and this process is continuing. In June, 1961, a 560-kw. transmitter, the most powerful VHF unit ever built, was installed and placed in operation at Kickapoo Lake, Tex., to increase greatly the range and coverage of Spasur. The other two transmitters have powers of 50 kw.



NAVSPASUR DETERMINES satellite zenith angle by comparing received energy phase at several antenna arrays displaced in east-west direction. Closely-spaced antennas give approximate angle; wider-spaced units allow more precise angle measurement.

Concept behind Spasur is ingeniously simple. The Minitrack tracking system design was based on using receiving stations equipped with several suitably spaced antennas at each site and having a low-power transmitter (beacon) operating at 108 mc. in the satellite. By comparing the phase of the 108-mc. signal received at the several antennas at each receiving station, the angle (with respect to the zenith) can be determined. With data from the two or more stations, triangulation provides data on satellite position in space and its altitude at any given instant in time.

Studies by Naval Research Laboratory scientists indicated that the technique could be adapted to silent satellites by use of the one or more ground transmitters, providing their power was sufficient to reflect back to earth a signal whose strength approached that of the 108-mc. beacon signal from cooperating U. S. satellites. Calculations indicated that a 50-kw. transmitter would provide such power levels.



INCREASED separation between receiving antenna pairs provides corresponding increase in angle measurement.

Three transmitters now installed, using a 5,200-ft.-long antenna at Kickapoo Lake and 1,600-ft.-long antennas at the other two sites, produce a curtain of continuous-wave electromagnetic energy with a thickness of about 0.3 deg. in a north-south direction, extending out into the Atlantic and Pacific oceans.

Narrow beam width in the north-south direction enables the system to get a fix on satellite position in this plane. The original operating frequency of 108.00 mc. was changed in December, 1961, to 108.015 mc. to exclude signals from U. S. satellites carrying tracking beacons radiating at the Minitrack frequency.

Receiving Stations

Energy reflected by the satellite is received by one or more stations, the number depending upon the satellite position along the fence in an east-west direction and its altitude. Each receiving station has a series of antenna arrays, running north-south, which are displaced from one another in an east-west direction by distances ranging from a few feet to distances of as much as a mile.

Closely-spaced elements in the array determine the approximate location of the satellite while those having longer baselengths determine its position within any one sector with great precision.

Maximum baseline (displacement between elements in an array) in operational use today is 520 ft., corresponding to 57 wavelengths at 108 mc., which makes it possible to determine the angular position of a satellite to within 0.1 deg. Currently installed and under evaluation at three of the sites

is a 5,200-ft. baseline antenna which is expected to improve angular resolution to 0.01-0.02 deg.

Even more important than the improved angular resolution will be the ability to measure the rate-of-change of reflected signal phase to obtain a measure of satellite velocity. This, it is hoped, will make it possible to obtain more information on satellite ellipticity during the first pass, according to Roger Easton, head of NRL's Space Surveillance Branch.

Raw signals received at all four stations are instantly transmitted by telephone-type landlines to Navspasur headquarters here at Dahlgren and recorded in visible analog form. Signals also are transmitted to NRL and recorded to enable its scientists to evaluate new techniques and system performance.

Satellite Catalogue

Running catalogue is maintained here on every satellite and object in orbit which had been previously detected. The Naval Ordnance Research Computer (Nore) is used to calculate orbital parameters for all such objects and to print out a daily prediction of what satellites can be expected to pass through the fence at what times, their headings and approximate east-west positions.

Thus the human operators here are alerted to the expected arrival of known satellites.

As soon as a known satellite penetrates the Spasur fence, the recordings here show its presence.

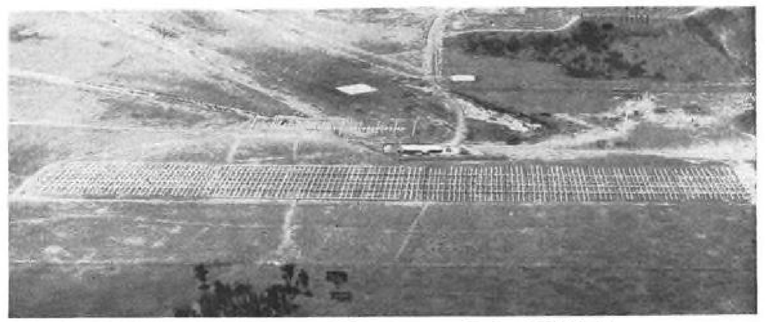
Unanticipated arrival does not necessarily mean a new Soviet satellite is in orbit. It could, for example, be a known satellite which is beginning to re-enter the atmosphere. During the period of orbital decay it becomes increasingly difficult to predict accurately the orbital parameters.

Booster Break-up

Or the stranger may be the result of a break-up of a known booster or spacecraft. For example, in June, 1961, the rocket body of Transit 4 exploded and produced more than 100 individual pieces of debris which greatly increased the number of objects in orbit, according to Cdr. Edward van Ribbink, commanding officer of Navspasur. Cdr. van Ribbink came here from Norad where he directed the space surveillance plans office.

For this reason a considerable amount of human judgment must be applied before an unexpected arrival can be firmly identified as a new Soviet satellite. This explains why the Navy has moved cautiously in attempting to automate the present system and data analysis.

However, within the next several months Navy hopes to take a major step toward reducing the amount of human analysis required. Signals from all stations, now transmitted up in analog format, will be converted at each station to digital form before transmission to Dahlgren.



SPASUR RECEIVING STATION, one of four in network, has 1,600-ft.-long antenna array to detect presence of silent satellites, plus 400-ft.-long arrays, displaced in east-west direction, to measure relative phase angle of energy reflected from satellite to determine its zenith angle, position and altitude. One of displaced arrays is visible just beyond main array. Currently under evaluation are arrays displaced 5,200 ft., which would provide angular resolution to nearly 0.01 deg.

NAVY SPASUR OPERATIONS CENTER at Dahlgren, Va., which now requires human analysis of all satellites passing through space surveillance fence, soon will have semi-automatic facility in which computer will analyze each entry, determine which are previously-catalogued satellites and alert human operators to new unidentified objects in orbit.

Within one second of the time the satellite enters the Spasur fence, data will be recorded on magnetic tape and entered into an IBM 7090 computer here which will contain the latest calculated orbital parameters for all catalogued satellites and objects in space. The computer will instantly compute the position and altitude of the new entry and compare these and its time of arrival with stored information on known satellites. If the new arrival fails to coincide within reasonable limits, the computer will flash an alarm and human operators will then reconstitute the original analog signals from the magnetic tape and analyze them from the Sanborn recordings as they do at present.

New semi-automatic system will largely eliminate the need for human intervention in the identification of satellites which are already catalogued, enabling them to devote their efforts to analyzing new unknowns, according to Cdr. Robert Carr, executive officer of Spasur.

Space Objects Inventory

Need for reducing the routine work load of the human operators is pointed up by the fast-growing inventory of objects in space. In January, 1959, just before the system went into 24-hr. operation, there were only 10 objects in orbit and a year later the total was only 14. By January, 1961, the number of objects in orbit was 35 and by January, 1962, it had mushroomed to 200. While much of this number was debris from Transit 4, there were about 40 satellite payloads in the total.

In February, 1961, Navspasur was reporting about 2,600 routine observations per month to Norad, but by this fall the number had increased nearly 1,000% to about 25,000 per month, according to Lt. T. E. Oliverio, USN, who is in charge of the Navspasur command control center here.

At present orbital data on all known

satellites is updated once a week and transmitted to Norad, except for satellites on the verge of orbital decay whose parameters change rapidly. These are updated every day for Norad and Spasur headquarters.

With the new IBM 7090 computer rented for system automation, and another 7090 which will be used for back-up and off-line computation, Cdr. van Ribbink expects to keep an up-to-the-minute catalogue of orbital parameters for all objects in the space inventory.

Headquarters Move

Navspasur headquarters soon will move out of its old frame building, which reverberates sharply every time a naval gun is tested here at the Naval Weapons Laboratory 60 mi. southeast of Washington. The modest facilities here reflect Spasur's humble beginnings as an NRL experiment and belie its important role in the Norad Spadats network.

Despite the fact that stations in the Spasur network do not have dual (standby) equipment installed to permit instant changeover in event of failure, the network consistently exhibits reliability of better than 99% according to van Ribbink. The network stations are operated and maintained by Bendix Radio under contract. Bendix employs about 100 persons at the seven stations for round-the-clock operation. Here at Navspasur headquarters there are about 90 persons, including 12 military personnel, required to provide continuous 24-hr. surveillance by the Navspasur.

Prospect of unfriendly reconnaissance satellites has important military implications for naval operations, which explains Navy's keen interest in Spasur. The vast reaches of the oceans no longer provide the implicit security they once did.

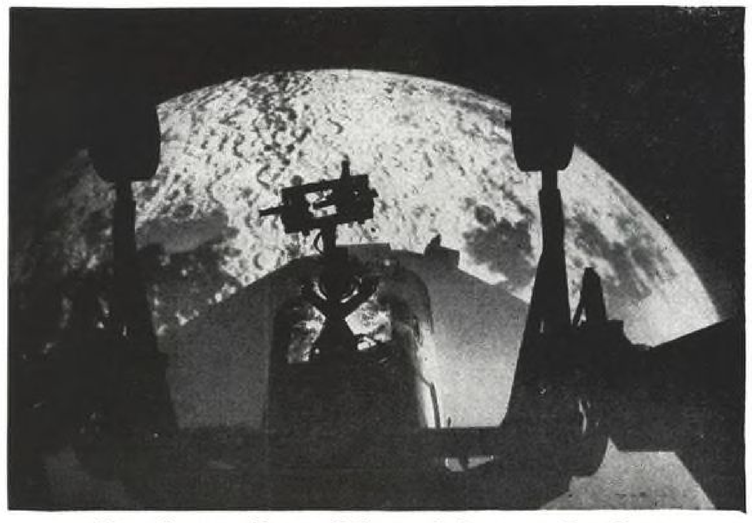
If the fleet can be kept posted on the time and position of non-U.S. satellites which might be reconnaissance types, it can take steps to reduce vulnerability. For example it can shut down radio and radar transmissions during satellite passage.

If there is suitable cloud cover in the vicinity, a ship can take shelter there. If there is no cloud cover, a ship can at least reduce speed to minimize its wake and reduce its visibility to a satellite.

Once a week the orbital parameters of all satellites in the inventory are transmitted to fleet navigators. They also serve as spotters for Spasur, reporting back by radio any object seen re-entering the atmosphere, which enables headquarters to record the demise of satellites on the verge of decay.

System Improvement

Since the system first became operational early in 1959, the Naval Research Laboratory has had a continuing program of research and development aimed at improving system performance to meet more demanding operational requirements. An important advantage of the Spasur technique is that the system performance can be upgraded on



Simulator Uses Film of Lunar Surface

Filmed image of the moon's surface is used in space flight simulator built by Ling-Temco-Vought's Astronautics Division (AW Jan. 15, p. 77). Film is projected on inside of large sphere surrounding simulator. Simulator and projected moonscape move in relation to each other, and additional projectors provide patterns permitting simulator pilot to practice rendezvous-in-lunar-orbit procedures. Cylindrical objects atop elongated arms are counterbalances for moving-base simulator.

a piecemeal basis as required without major expense.

Receiving station at Ft. Stewart serves as an R&D facility for evaluating new techniques and therefore differs somewhat in configuration from the other three stations.

But even among the other three receiving stations there are some minor differences that do exist.

Antenna arrays at all stations, both transmitting and receiving, run in a north-south direction. This gives a narrow beam in the north-south direction and broad coverage along an east-west direction. At the receiving sites the parallel north-south elements of the array used to measure relative phase of the received signal are displaced from one another in an east-west direction. Each of these elements is 400 ft. long in a north-south direction, except at Ft. Stewart where some of the elements are 1,600 ft. long. The array at Kickapoo Lake was built by Antenna Systems, Inc., the rest were supplied by Technical Appliance Corp.

In addition to these phase-comparison antenna elements, each receiving site has a special "alert antenna" which is 1,600 ft. long at San Diego, Silver Lake and Elephant Butte and 5,600 ft. long at Ft. Stewart. The alert antenna's increased sensitivity enables it to detect a satellite a few moments before a signal is detectable on the phase-measuring antennas. The signal from the alert antenna is transmitted to Spasur headquarters and NRL in Washington and appears as a heavy horizontal line to alert human operators to an impending satellite signal on the phase-comparison channels.

But the basic reason for the alert antenna is to measure the Doppler shift in the original transmitted frequency which results from the relative east-west velocity of a satellite with respect to the transmitter and receiver so that narrow-band receivers can be used with resultant enhancement of signal strength.

Comb Filter

To measure the precise frequency of the received signal, NRL developed a 160-tooth comb filter in which each element has a 100-cps. passband. This information then is used to tune the station receivers automatically to the exact signal frequency.

Equipment providing this narrow-band preselector function, built by Itek and introduced into the network in the summer of 1961, resulted in a "major improvement in system performance," according to Naval Research Laboratory's Roger Easton.

The 1,600-ft.-long alert antennas actually consist of four 400-ft.-long segments whose amplified signals are combined so that the four segments function as a single antenna. But the four signals also can be used separately for phase comparison to determine a satellite's position more accurately within the narrow Spasur beam in a north-south direction.

Another signal transmitted from each of the receiving stations to Dahlgren and NRL and recorded is the setting of the automatic gain control which indicates received signal strength. This enables operators to estimate the size of the satellite, taking into account the satellites altitude and distance from the station.

Wave Bending

Amount of bending of radio waves as they pass through the ionosphere (refraction) sets a practical upper limit on the ultimate resolution that can be obtained by going to longer baselines, Easton points out. Tests currently under way or planned are aimed at determining if the 5,200-ft. baseline is near the point of diminishing returns or whether a longer baseline should be attempted.

To check the accuracy obtained with the new 5,200-ft. array, NRL is photographing the Echo satellite against a star background to determine its position precisely and then comparing this

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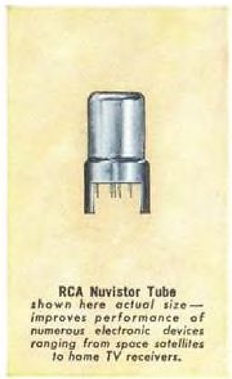
NUVISTORS . . . Display Storage Tubes . . . Magnetrons . . . are just three of the many electron tube categories produced by RCA in its unceasing effort to produce new tubes for new uses—in home entertainment, science, industry, medicine, and national defense.

RCA ELECTRON TUBE DIVISION

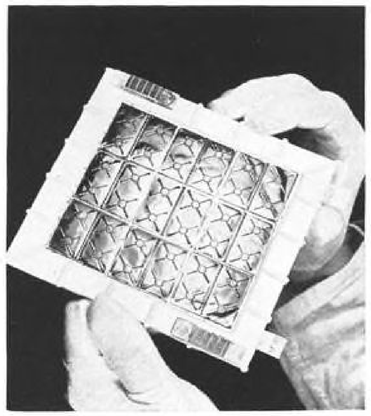


RCA Nuvistor Tube *shown here actual size—improves performance of numerous electronic devices ranging from space satellites to home TV receivers.*

RCA Display Storage Tube *—similar in principle to your home TV picture tube—paints a picture of electronic signals in radar systems and industrial test instruments.*

RCA Magnetron Tube *develops tremendous amounts of electronic power for the exacting and important national defense mission of radar surveillance.*

The Most Trusted Name in Electronics



New Solar Panel

Solar thermoelectric panel, one of three 4 x 4 in. panels to be launched this fall from Vandenberg AFB for orbital tests of new type power source built by General Atomic for Lockheed and USAF. Panel consists of small thermoelectric elements sandwiched between two thin metallic sheets, one of which collects solar energy and converts it to heat while the other serves as radiator to cool space. Each panel produces ¼-watt.

with the position which has been determined by the Spasur system.

Another experiment planned for next spring will use a satellite equipped with a 400-mc. transmitter. Because ionospheric refraction decreases as the square of operating frequency, the difference in apparent satellite position, as measured at the 108.015 mc. Spasur frequency and the satellite's own 400 mc., will give a measure of the refraction error.

Spasur's maximum detection range and minimum detectable object size depend upon a number of factors such as target size, shape, aspect angle and whether it has protruding antennas. Spasur has spotted the small despin weight and its 15-ft.-long wire released by Explorer 8 and it regularly receives reflected signals from the moon.

If additional range should be required it could be obtained by moving to higher power transmitters, narrower passband comb filters or higher gain antennas. Despite the great size of Spasur antennas, they are relatively inexpensive because they consist only of large numbers of simple fixed dipoles. (In appearance they resemble a farm growing TV antennas.)

For the same reason it is relatively easy to change or modify the Spasur antenna arrays.

Navy spokesmen believe that Spasur is inherently countermeasures-proof. If the Soviets were to try to jam it by putting a 108-mc. transmitter aboard their satellites, it would merely provide a greatly enhanced signal and assure satellite detection by the Spasur system.

Since Spasur went into operation nearly four years ago, it has been able to catalog every satellite or space object sighted except for an unknown in April of this year which has not been sighted again.

The one-time visitor might have been a large meteorite which swung through the fence before entering the atmosphere.

Another possibility is that the object was the Lunik 3 satellite launched by the Soviet Union on Oct. 4, 1959, which circled the moon in a highly elliptical orbit and swung back around the earth.

If Lunik 3 did not re-enter the atmosphere on its return from the moon, it would shoot back out into space on a highly elliptical orbit whose position would be difficult to predict without knowledge of the initial trajectory. Infrequently it would then swing back around the earth, spending only a very brief period in the vicinity before swinging back out into space. Unless the earth position and satellite return happened to to be such that it passed through the Spasur fence it might not be sighted again for many months, if ever.

From the meager data obtained during the single pass of the unknown in April, scientists estimate that it had a velocity which would give it an apogee of about 100,000 mi., which fits the Lunik 3 hypothesis.

Microcircuit Fabricator

Lear-Siegler Multicoater, mechanized thin-film microcircuit fabrication facility, can produce complete circuits without cracking vacuum by means of lazy-susan arrangements for changing deposition masks and materials. Machine can produce 720 thin-film microcircuits during 8-hr. shift, LSI says. Machine, developed by LSI's Solid State Physics Laboratory in Santa Monica, has recently been installed at company's Instrument Div., Grand Rapids, Mich.

JPL Centralizing Space Mission Facilities

By Barry Miller

Pasadena, Calif.—Centralized facility for simultaneously conducting more than one spacecraft mission will go into operation here early in 1964 as Jet Propulsion Laboratory prepares for the complex task of handling a heavier, overlapping schedule of planetary and lunar space shots.

New $12 to $15 million facility, to be known as the Space Flight Operations Facility (SFOF) will be an expanded, updated and consolidated version of the operations center and supporting installations located here which currently direct and control the nation's unmanned lunar and planetary probes after launch from Cape Canaveral. Management of these space launches is Jet Propulsion Laboratory's principal assignment, under contract from the National Aeronautics and Space Administration.

Expected Tasks

SFOF will be expected to provide initial spacecraft acquisition information, perform all necessary spacecraft maneuver calculations and compute terminal maneuvers for all projected flights in the several sequences of lunar and planetary projects (Ranger, Mariner, Surveyor and Voyager). Among its unusual features, SFOF eventually will contain a scientific laboratory to enable scientists at the facility whose experiments are aboard the Surveyor landers to control in real time and read out information from their devices operating on the lunar surface.

JPL's international tracking and command network, the Deep Space Instrumentation Facility (DSIF), geographically distributed to ensure 24-hr. line-of-sight contact with its space probes (AW July 2, p. 175), will be linked to SFOF by commercial teletype and telephone lines and ultimately by wideband radio communications.

Wideband microwave communications link, which will relay television image signals received from Surveyor lunar spacecraft from the Goldstone, Calif., DSIF sites to JPL, presently is being constructed by Western Union. The DSIF sites will ensure that telemetry and tracking data are received from the spacecraft, and commands calculated in SFOF are forwarded to the spacecraft. These sites will be controlled from SFOF.

Need for a centralized facility like SFOF increases as the number and density of JPL's spacecraft schedules climb. In SFOF's first anticipated year of operation, for example, NASA plans call for four planetary and five lunar shots. This compares with three lunar and two planetary attempts this year. And as more complicated lunar spacecraft with longer operational lifetimes (such as Surveyor) phase in, the likelihood of overlapping mission times rises.

In 1964, JPL may have the task of controlling and commanding a pair of planetary and a single lunar spacecraft at the same time. The 1966 launch timetable dwarfs earlier ones, making the control problem even more complicated.

Present Operation

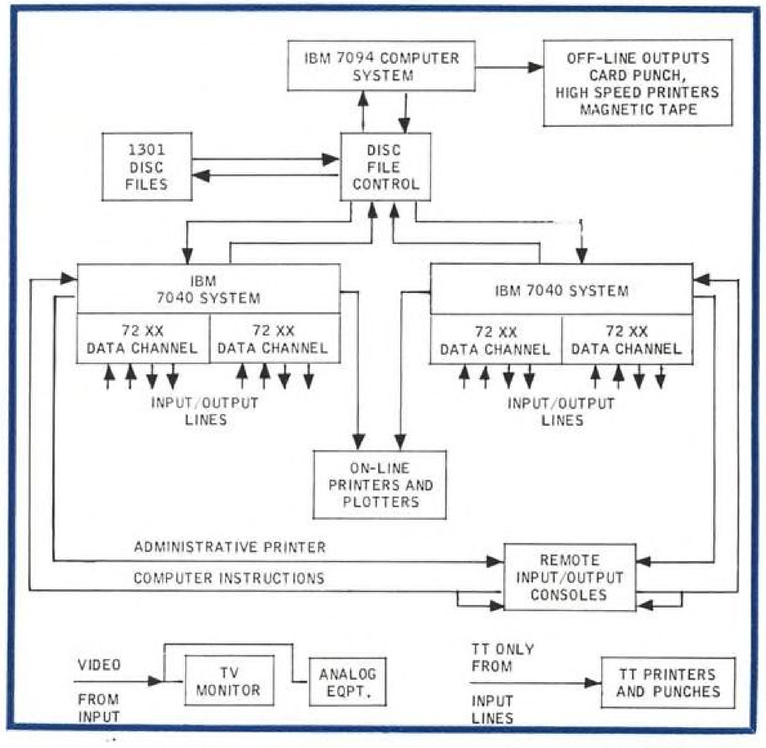
At present, JPL conducts its flight operation from a severely limited Space Flight Operations Center here. When overlapping shots occur, as they did recently when Ranger 5 was launched in an unsuccessful lunar mission while Mariner 2 was cruising toward Venus, facilities have to be shared, (Mariner data had to accumulate while critical control of Ranger was maintained). Essential ground checkout of spacecraft before flights imposes similar demands on the center.

New SFOF will provide these advantages:

- **Ability to carry out** multiple operations.
- **Increased capability** for performing operational checkout of spacecraft before launch, for supporting final system checkout and support of system.
- **Bring together** into a single center the former space flight operations facility, its communications center and all relevant data-processing equipment.
- **Ability to display** real time television data.
- **Growth potential** with a physical plant built along modular lines.

SFOF will be implemented in steps, thereby increasing the probability of realizing an operational system sooner and permitting JPL to gain experience before SFOF grows into its final configuration. The growth steps are:

- **Stage 1**—In January, 1964, the facility is scheduled to be able to service two missions simultaneously, using equipment sequentially. In addition, it will be capable of preparing for a third mission with closed loop operational test



BLOCK DIAGRAM indicates major data processing gear to be employed in Jet Propulsion Laboratory's new Space Flight Operations Facility in Pasadena, Calif. Video data from spacecraft are fed experimentally to data processing as well as to television monitor. All 12 teletype lines are fed to data processing and, as a backup, to remotely located teletype printers and punch machines.

MERCURY JOURNAL

..Days of achievement follow months and years of creative engineering and planning.

NASA's First Administrator T. Keith Glennan, and Pres. J. S. McDonnell Disclose Mercury Configuration 12 January 1959

McDonnell Project Engineers Establish Production Plans

Astronauts Visit McDonnell 12 May 1959

Big Joe R & D Capsule 9 September 1959

Little Joe Tests 1959-61

Hypervelocity Impulse Tunnel Tests

Paradrop Tests

#1 Spacecraft Delivery 2 April 1960

First Mercury-Redstone Flight 21 November 1960

Manufacturing and Assembly

Final Manufacturing and Testing in White Room

McDonnell Engineers Perform on Site Checkout

Abort Rocket Test 9 May 1960

Ham—the Astro-Chimp

Procedures Practice in Simulator

Launch—Checkout Trailer

Freedom 7 Spacecraft Hoisted Aboard Redstone

A-OK for Astronaut Shepard 5 May 1961

Launch Preparation for Astronaut Grissom

Mercury Orbits with "Mechanical Man" 13 September 1961

Friendship 7 and John Glenn

Liftoff for Astronaut Carpenter 24 May 1962

They Safely Return

29 July 1958 . . . . . President Eisenhower signed bill creating the National Aeronautics & Space Administration (NASA).

1 October 1958 . . . . NASA began official operation.

21 October 1958 . . . NASA announced a competition for a manned spacecraft, to be launched by an Atlas, placed in orbit around the earth and returned safely. A McDonnell study team, which had been working on manned orbital spacecraft for 11 months under company research budget, was assigned to prepare the proposal.

12 January 1959 . . . NASA announced selection of McDonnell to build Mercury Spacecraft.

13 February 1959 . . . Contract was signed with McDonnell for the design and construction of 12 manned orbital Mercury spacecraft. As the program expanded, subsequent orders were received for eight additional spacecraft, two procedural trainers, an environmental trainer, seven check-out trailers and much of the prelaunch operation at Cape Canaveral, including the mating of the spacecraft to the launch vehicle, check-out and countdown.

9 April 1959 . . . . . NASA announced names of the seven Mercury Astronauts.

9 September 1959 . . NASA-produced "Big Joe" R & D spacecraft launched to test basic Mercury design concept. Spacecraft survived high heat and airload and was recovered.

4 October 1959 . . . . Little Joe 1 fired at NASA's Wallops Station, Va., checked matching of launch vehicle and NASA-produced spacecraft. The Little Joe test series enabled early evaluation to the spacecraft in the high aerodynamic pressures encountered at low altitudes.

4 November 1959 . . . Little Joe 2 fired from Wallops. Evaluated low-altitude abort conditions.

4 December 1959 . . . Little Joe 3 fired at Wallops Station to check high altitude performance of the escape system under high airloads. Rhesus monkey "Sam" used in successful flight.

21 January 1960 . . . Little Joe 4 fired at Wallops to evaluate escape system under high airloads. "Miss Sam", another Rhesus monkey, served as test subject.

25 January 1960 . . . Less than a year after signing of contract, McDonnell delivered first production spacecraft (#4).

2 April 1960 . . . . . First instrumented spacecraft (#1), with escape tower, delivered to NASA by McDonnell.

9 May 1960 . . . . . Spacecraft #1 fired in an off-the-pad abort escape rocket test.

29 July 1960 . . . . . Mercury-Atlas 1. The first Atlas-launched flight was aimed at qualifying the production spacecraft under maximum airloads and afterbody heating rate during re-entry conditions. Spacecraft (#4) carried no escape system or test subject. Test objectives were not achieved due to launch system malfunction.

8 November 1960 . . . Little Joe 5 fired from Wallops to check production spacecraft (#3) in an abort simulating the most severe Little Joe launch vehicle airload. Premature spacecraft separation signals resulted in early firing of the escape tower and loss of test objectives.

21 November 1960 . . Mercury-Redstone 1 was the first scheduled unmanned Redstone-launched flight. Premature engine cutoff at launch terminated the test. The emergency escape system was jettisoned. Spacecraft (#2) was not damaged and test was rescheduled.

19 December 1960 . . Mercury-Redstone 1A was a repeat of November attempt. Successful flight reached a peak altitude of 135 statute miles and covered a horizontal distance of 236 statute miles. Spacecraft (#2) was recovered.

31 January 1961 . . . "Ham", the 37-pound Astro-Chimp, was rocketed into space history aboard Mercury-Redstone 2. "Ham" and spacecraft (#5) were recovered after reaching an altitude of 155 miles and landing 420 miles downrange. Flight demonstrated ability of primate to react normally in prolonged weightless flight. "Ham" was recovered safe and well.

21 February 1961 . . . Mercury-Atlas 2 reached an altitude of 108 miles and speed of 13,000 mph. Flight checked maximum heating during worst possible re-entry conditions. Spacecraft (#6) was recovered 1,425 miles downrange.

18 March 1961 . . . . . Little Joe 5A at Wallops Station repeated Little Joe 5 test. Spacecraft (#14) was recovered but all test objectives were not met and shot was rescheduled.

25 April 1961 . . . . . Mercury-Atlas 3 was an attempt to orbit spacecraft (#8) with a "mechanical man" aboard. Forty seconds after launching, the launch vehicle was destroyed by radio command. Spacecraft escape system functioned perfectly and spacecraft was recovered for reuse.

28 April 1961 . . . . . Little Joe 5B completed the spacecraft escape system flight qualification tests. Spacecraft (#14) was reconditioned by McDonnell after previous flight and reused in this successful maximum dynamic pressure escape test.

5 May 1961 . . . . . Astronaut Alan B. Shepard, Jr. rode Mercury-Redstone 3 into history with his ballistic flight seen by the world. The flight reached a peak altitude of 116 statute miles and was recovered 302 miles downrange. Spacecraft (#7) is now on public display in the Smithsonian Institute.

21 July 1961 . . . . . Mercury-Redstone 4 was a successful downrange flight by Astronaut Virgil I. "Gus" Grissom. This was the first flight with the large window, greatly improving astronaut observation capability. Premature loss of the escape hatch caused spacecraft (#11) to take on water and sink despite determined helicopter recovery efforts. Astronaut Grissom was recovered from the water by helicopter.

13 September 1961 . . Mercury-Atlas 4 placed the McDonnell Mercury Spacecraft in orbit for the first time. The spacecraft (#8) carried a McDonnell-developed "mechanical man" designed to use oxygen and add moisture to the cabin at the same rate as a man. The spacecraft was recovered after one orbit 160 miles east of Bermuda.

29 November 1961 . . Space-Chimp "Enos" twice orbited the earth in Mercury-Atlas 5. Spacecraft (#9) was recovered about 260 miles south of Bermuda.

20 February 1962 . . . Three years and 39 days after Mercury contract was awarded, Mercury Spacecraft (#13) and Astronaut John Glenn aboard an Atlas launch vehicle lifted-off from Cape Canaveral. After three orbits, spacecraft and astronaut returned safely to the earth and were recovered. It is significant to note that the initial assignment of Project Mercury was completed with this flight. The spacecraft had been proven. Man's ability to adapt to the space environment had been demonstrated.

24 May 1962 . . . . . Astronaut M. Scott Carpenter aboard Mercury-Atlas 7 completed a three orbit mission, adding knowledge about man's visual perception with balloon experiments, photographing the launch vehicle and the sun from his atmosphere-free vantage point, drifting for long periods in free flight and solving the phenomena of the "Space Fireflies" first observed by Glenn. A yaw condition at the time of retro-fire contributed substantially to a 250 mile overshoot on re-entry. Astronaut Carpenter left the spacecraft (#18) and awaited recovery in a rubber raft alongside.

12 September 1962 . . President Kennedy visited the McDonnell plant in St. Louis and told employees, ". . . I can imagine no action . . . which is more essential and more exciting than to be involved in the most important and significant adventure that any man has been able to participate in, in the history of the world . . ."

3 October 1962 . . . Astronaut Walter M. Schirra, Jr., in his Sigma 7 Mercury Spacecraft (#16), completed a near-perfect six-orbit flight by landing on target in the Pacific Ocean off Midway Island. Much of the mission was accomplished in drifting flight by the United States' fifth man to go into space. The mission contributed additional knowledge about spacecraft control, space vision, and man's ability to work effectively in a prolonged weightless condition. The successful performance of Astronaut Schirra and Sigma 7 prepared the way for the planned one-day Mercury flight, and later 2-man McDonnell Gemini Spacecraft rendezvous flights. The flight was part of continuing U. S. space exploration programs.

Astronaut Schirra

FIRST FREE MAN IN SPACE

or open loop spacecraft and complex check.

• **Stage 2**—Starting in January, 1965, SFOF is expected to be able to handle three missions simultaneously using equipment in sequential fashion. It will also be capable of supporting tests for another two missions.

Entire SFOF will be located in a new building, construction of which was to get under way recently, according to Marshall Johnson, who heads space flight operations here. About $2.5 million of NASA's current fiscal budget is earmarked for SFOF. It will be located here to make optimum use on a full or part-time basis of the large pool of scientific and engineering talent at the laboratory.

SFOF Functions

SFOF operations will divide into three functions for which there is an executive type of programing of the facility's data processing gear. These are:

• **Spacecraft Performance Analysis**—This revolves about the review of spacecraft power, temperature, attitude control, communications and other parameters, and the calculation of any necessary changes.

• **Flight Path Analysis**—Determination of orbits and computation of maneuvers on the basis of Doppler and angular-tracking data.

• **Space Sciences Analysis**—Reduction and comparison of scientific data returned from the spacecraft.

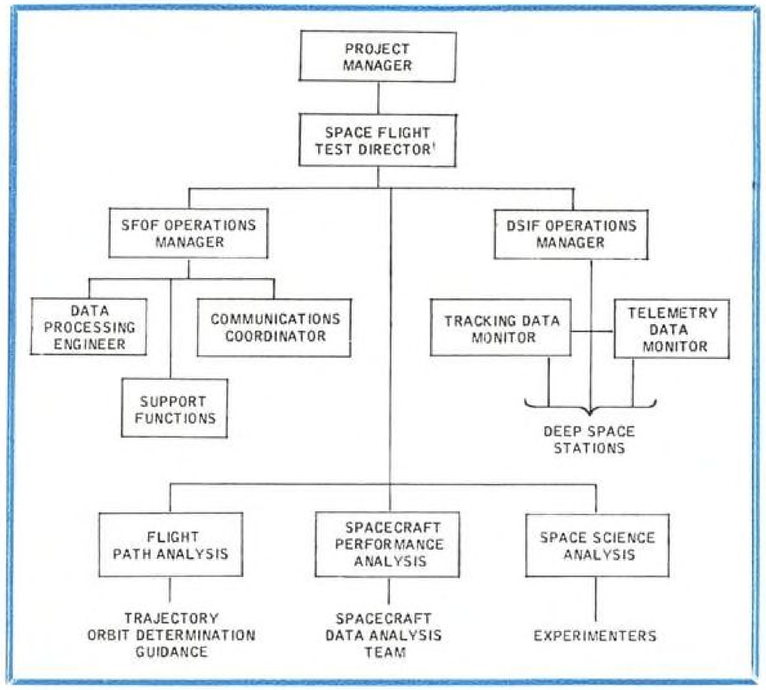
There are a number of separate programs for each function, all controlled by the executive program. This arrangement will permit the substitution or addition of individual programs without redoing the entire program.

Groups handling these three functions will be separated into specific areas on the main floor of SFOF—each with its own input and output devices.

Heart of the data processing gear in SFOF will be the laboratory's two IBM 7090 computer systems, which will be updated into 7094 systems so that they can compute faster. In stage one, only one 7094 will be employed, the other serving as a backup. Ultimately both will operate as parallel systems in SFOF.

As indicated in the accompanying block diagram (see p. 65) of the stage one setup, data processing will accept information over 12 teletype lines, a 100-kc. microwave link from Goldstone and two data lines. The teletype lines link SFOF with the DSIF stations and with the Cape, through which it secures tracking data from downrange stations.

Raw telemetry and tracking data are fed into 72XX data channels which put data into a form usable by a pair of IBM 7040 computer systems. The latter machines, announced late last year by IBM, probably will be the first of their type delivered to any customer, will serve as input/output processors, or data sorters. Compared with the 7094 system, the 7040 has greater sorting and storage capability, but is slower and has less arithmetic capability.



ORGANIZATIONAL CHART of principal components of new Space Flight Operations Facility being built at Jet Propulsion Laboratory indicates relations of Deep Space Instrumentation Facility and principal technical analysis teams to space flight project managers.

Raw data can be transmitted from the 7040s through a disk file control to 1301 disk files for storage and to the 7094 (eventually to two 7094s) for processing. The 7040s will accept instructions from seven remotely-located input/output consoles which permit some control to be exercised from remote spots in SFOF. All of the instructions originating in the remote consoles are fed back into the consoles for a check.

Information routed through the 7040 into the 7094 can be returned to the 7040 input output processor for redistribution to the communications lines or delivered as processed data for storage in the 1301 disk files.

The 7094 can directly emit finished information (off-line) through several output devices, including high speed printer, card punch and magnetic tape.

On-line information will be read out remotely by medium-speed printers and automatic plotters located remotely in SFOF.

Remote input/output consoles can request information from the disk files, and administrative printers at the consoles will print, on request, limited amounts of data secured from the 7040 to give fast estimates of answers to specific problems.

Eventually, JPL expects to bring its second 7094 machine into SFOF and have a redundant pair of data-processing systems, each 7094 operating in conjunction with a 7040 and two 72XX data channels.

To ensure the mission against failures in the data processing, JPL expects to route data coming off the communications lines to teletype printers and punches throughout SFOF so that a backup hand mode of control would be possible. The printers are expected to have adequate capacity for any foreseeable operations.

Video Data

Video data will be directed to the data-processing gear on an experimental basis in Stage 1. However, it will also be printed on television monitors in a video processing area in real time.

Several subcontractors assisting JPL in its SFOF preparations are:

• **Data Processing Hardware Integration**—International Business Machines.

• **Programing** — Computer Sciences Corp., El Segundo, Calif.

• **Communications**—Hughes Aircraft, Fullerton, Calif. This contract is concerned with communications internal to SFOF (closed circuit TV, intercoms,

paging and voice communications) as well as communications external to the facility.

• **Status displays**—General Electric's Heavy Military Electronics Department.

Selection of an over-all systems contractor, on the basis of a competition earlier this year, was postponed because JPL says it believes initial needs are well defined and the future course of SFOF development will hinge on initial experiences with it.

GE's and Hughes' roles call for studies of requirements, developing functional designs, monitoring and integration of hardware needed to realize the design and then monitoring, installing and checking out hardware.

Three forms of information display in SFOF will be:

• **Mission Display Board**—Suspended from the ceiling in the center of SFOF will be a 7-ft.-high, 56-ft.-long, five-section mission display board capable of displaying for technical and operational personnel working at SFOF all information relating to two flights (first stage). The center section of the mission status board, shared by the two missions, will present relatively invariant information, such as the status of DSIF, communications and data processing. It will also have some type of earth track display.

Two sections on either side of the center of the mission board will display mission information, including tabulation and explanation of the trajectory of the spacecraft (flight path analyses), space science analyses and spacecraft performance. A portion of the mission status board will be reserved for special mission events data supplementary to other data.

• **Technical Displays**—Three technical areas (flight path analysis, spacecraft performance and space sciences), which are grouped about the mission control area and are the primary source of information about the operations displayed on the mission status board, will require their own, more technically oriented displays to keep them posted on what they are doing and where they are in the sequence of space mission.

• **Operational Consoles**—Eighteen special operational consoles, each adapted to specific functions, such as those of the test director, directors of individual remote areas, data processing, or communications, provide the third type of information display. These consoles will contain closed-circuit TV monitors, paging systems, leased and dial telephone lines and individual displays, which provide information on aspects of operations pertinent to the function.

During Stage One of SFOF evaluation, the quality of displays and consoles will be largely experimental because of the uncertainties about exact needs. Consequently, during this year of operations there will be no computer-driven displays.

Other features of SFOF will include the following:

• **Spacecraft Model**—General Electric is planning a spacecraft centered hemisphere to enable scientists and other SFOF personnel to visualize more easily how the spacecraft is oriented.

• **Trajectory Model**—Three-dimensional model, capable of displaying trajectory of the spacecraft to understand better where it is going with respect to heavenly bodies, also is being investigated by GE.

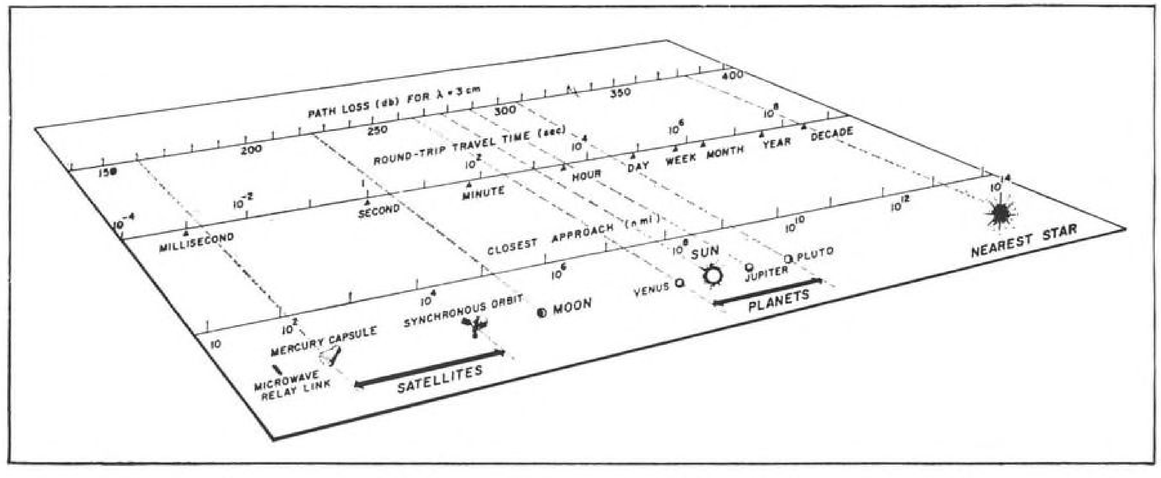
• **Physical Layout**—Basically a two-story building with the possibility of adding an additional floor or laterally expanding it, the SFOF facility will provide 53,800 sq. ft. of working space and house a permanent cadre of 150 persons. The first floor will be devoted to mission operations. The top floor will have offices, a conference room, dormitories, standby rooms, etc. The basement will contain the communications center, maintenance and repair laboratories and mechanical facilities. The building will be windowless, as daylight may degrade the clarity of displays and the presence of windows would be too consuming of wall space.

Integrated Center

Since the DSIF stations will be used in Apollo flights, and because of DSIF's close connection with SFOF, the SFOF may eventually tie into the Integrated Mission Control Center for manned space flight, being contemplated for Houston (AW Nov. 12, p. 38). At present, however, there are no plans for linking the two, according to Harris M. Schurmeier, head of JPL systems division.

When SFOF is fully operational, some type of wideband communications will link it to outlying DSIF sites in Australia and South Africa to ease the anticipated communications bandwidth overload.

While spacecraft operations will be controlled from SFOF, the DSIF sites will have, at least in the Surveyor project, a limited ability to generate remedial commands in the event communications are broken or overtaxed. Special command and data-handling consoles (CDC), being built by Hughes Aircraft in connection with the Surveyor project, will be located at each DSIF station, can generate these commands and serve as a backup mode of operations.



Solar, Near-Solar System Distances, Communication Times

Solar and near-solar system distances are shown in terms of nautical miles, time required for two-way communications at speed of light, and path loss at X-band. Chart was prepared by Lincoln Laboratory and presented by W. H. Radford at Nerem Conference in Boston.

FILTER CENTER

► **Plasma Range Effects Study**—Investigation to determine effects of rocket engine-produced plasma on missile range instrumentation and data link system is planned by Rome Air Development Center. Program is to include investigation of various ionization control techniques, such as flame seeding, electron entrapment and flame skirt cooling. Qualified contractors should contact Code RAKS.

► **Nimbus Photo Archive Planned**—Weather Bureau is calling for proposals for design and fabrication of an archives system for storing and rapid retrieval of weather photos obtained from Nimbus meteorological satellite, under RFP-1-63. Proposals are due Dec. 7.

► **Apollo Guidance Computer**—Guidance computer for the Apollo spacecraft will incorporate several technological advances including the use of semiconductor microcircuits and a core rope memory. The microcircuits will be employed as scalor circuits because of their ultimate reliability, small size and low power consumption. Both a core memory, the most dense type of non-volatile fixed memory presently available, and a ferrite core matrix will be employed. The latter will serve as a convenient way of storing volatile information. The computer, being developed by Massachusetts Institute of Technology as part of its Apollo guidance and navigation system responsibility, will be fabricated by Raytheon Co.

► **New Interplanetary Probe Gets Go-Ahead**—Probe for International Quiet Solar Year, previously called PIQSY (AW Aug. 13, p. 28), will be developed by National Aeronautics and Space Administration for making interplanetary measurements during the year of the quiet sun. The 120-lb. probe to be launched by a Thor Delta booster combination will be redesignated as a Pioneer satellite.

► **Superpower Laser**—An unusually high-power laser theoretically capable of providing 1,000 megawatts peak power for a brief interval of less than a nonosecond (one nanosecond at the ½ power points) is being developed at General Motors Defense Research Laboratories in Santa Barbara, Calif. A ruby optical maser with a new mirror shuttering arrangement is employed. Total energy output is expected to be about one joule. The concept will be described at a forthcoming meeting of the American Physical Society.

► **More Superpower Klystron Details**—Ultimate objective of the superpower klystron tube research and development contract being conducted by Eitel-McCullough for Rome Air Development Center (AW Aug. 13, p. 81; Feb. 12, p. 73) is to yield a high-power tube well in advance of current tube technology at this frequency. Specifications include peak power minimum of 1 mw. and maximum of 100 mw., a minimum of 100 kw. and perhaps as high as 1 mw. average power at a center frequency of 8 kmc., a bandwidth of at least ½% and efficiency of 30% minimum and 50% as the final goal. Pulse length capability is to be a minimum of 20 microsec. and gain is to be a minimum of 15 db., with 35 db. as final goal. Fabrication of three engineering models of the tube is to be completed in mid-1964.

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

• **Hamilton Standard Division of United Aircraft Corp.** will develop automation techniques for interconnecting and packaging individual semiconductor and thin film microcircuits into functional modules, using electron beam welding, machining and metal film deposition techniques under a $240,000 study contract awarded by USAF's Aeronautical Systems Division.

• **Melpar, Inc.**, Falls Church, Va., $1.9 million feasibility study contract from Army for a forward-area electronic intelligence subsystem to be used for electromagnetic reconnaissance.

• **Microdot, Inc.**, South Pasadena, Calif., $148,750 contract from National Aeronautics and Space Administration for 90-channel temperature measuring systems to be used in development of Apollo spacecraft.

• **Fairchild Camera and Instrument Corp.**, Defense Products Div., Clifton, N. J., $634,749 award from Navy Bureau of Ships for submarine surface search radar systems to detect and locate surface targets.

• **Collins Radio Co.**, three USAF contracts totaling more than $1.1 million for mobile radio transceivers, airborne communication and navigation gear and for instrument landing receivers.

• **Astra, Inc.**, Raleigh, N. C., $34,908 contract from NASA to conduct preliminary parametric study of space powerplants in the 3-30 kw. range using low-temperature working fluid.

• **Electro-Optical Systems, Inc.**, Pasadena, Calif., $67,675 award from Jet Propulsion Laboratory to develop and produce four production models of an ionization chamber to be used to measure Van Allen radiation aboard Ranger spacecraft.

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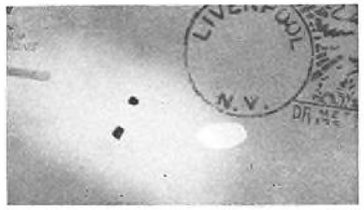
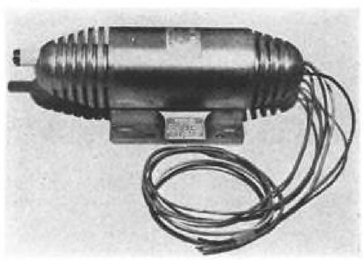
NEW AVIONIC PRODUCTS

• **Stable crystal frequency standard,** Model 104AR, has long-term stability of five parts in 10 billion per day, with short-term stability of five parts in 100 billion based on a one-second average and reasonably constant environment, according to manufacturer. The oscillator provides a 5-mc. output of extreme spectral purity as well as outputs of 100 kc. and 1 mc. Unit is designed for rack mounting and is priced at $3,250 with delivery in seven weeks. Similar unit, designated the 103AR, without the 5-mc. output, is priced at $2,500. Manufacturer: Hewlett-Packard Co., Palo Alto, Calif.

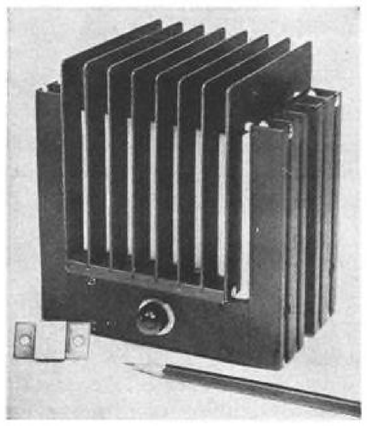


• **Passivated micro-transistors,** silicon planar and planar epitaxial versions of 15 conventional military and industrial types, are priced at $6 to $13 in quantity. Transistor pellet is mounted on a Kovar tab measuring 0.05 in. wide and up to 0.10 in. long, then encapsulated with an epoxy resin. Semiconductor crystal is surface-passivated with silicon dioxide to provide for hermetic seal of the surface. Manufacturer: General Electric Co., Semiconductor Products Dept.



• **S-band backward wave oscillator,** Type SYB-4400, with integral permanent focusing magnet, has output power of 100 mw. minimum from 2.0–4.0 gc. (kmc.) Frequency can be swept over the full band by varying delay line voltage from 150 to 1,450 v. Tube weighs 7½ lb., is designed for use in aircraft and missiles. Manufacturer: Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

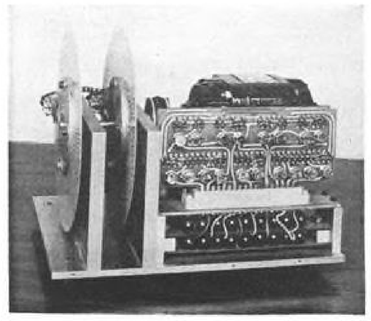
• **Miniature displacement gyroscope,** two-degree of freedom, weighing less than 1 lb., available either in spring-driven or hot-gas actuated models, has demonstrated drift of 0.7 deg during 15-sec. sled run under 350g acceleration and 0.5 deg. drift in 15 sec. run on a 3-axis tilt-table test, according to manufacturer. Gyro, which measures 2 in. dia. x 3 in. long, has 30-deg. of gimbal freedom, uses potentiometer pick-off. Angular momentum of 350,000 gm. cm. squared per second is developed in 70 milliseconds spin-up time. Manufacturer: Clary Dynamics Corp., San Gabriel, Calif.



• **Thermoelectric controller,** Model 1700, maintains temperature in 2½ cu. in. chamber within one degree of any desired temperature between 0-25C, for use with solid state components and frequency standards. Thermostat control is included. Power requirements are 6.3 v. center-tap, 3½ amp., 50-400 cps. Standard connector provides up to 12 electrical leads into temperature controlled chamber. Manufacturer: Energy Conversion, Inc., 336 Main St., Cambridge 42, Mass.

• **Cryogenic timer,** solid-state device for use at temperatures as low as —196C, provides time intervals from 0.05 to 1 sec., adjustable by changing an external timing resistor, and operates from 20-31 v.d.c. Timer, encapsulated in rigid polyurethane foam, measures 1 × 1 × 1⅛ in. and weighs 0.13 lb. Manufacturer: Tempo Instruments, Inc., Plainview, L. I., N. Y.

NEW AVIONIC PRODUCTS

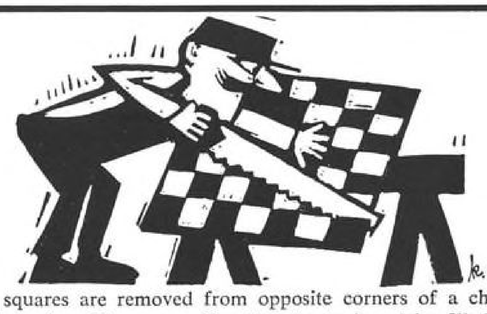


• **Photoelectric digital code converter,** Model 190, can convert 20 characters per second in any 5-8 bit code into any other 5-8 bit code by installing appropriate coded disks. Code disks contain up to 128 characters with parallel bit, serial character conversion. Device measures 7½ × 7½ × 9 in., weighs 9 lb., and operates from 117 v.a.c. Manufacturer: Invac Corp., 26 Fox Road, Waltham 54, Mass.

• **Micro shift register,** single-bit magnetic type packaged in TO-5 can, operates on 50 mw. peak power per shifted one for a pulse duration of two microseconds and requires no power on standby. Operating frequency of the micro shift register device is 0-200 kc., and operating temperature range is −55C to 100C. Manufacturer: C&K Components, 105 Morse St., Newton 58, Mass.

• **Digital pressure transducer,** Model P606, converts pressure measurement into a seven-bit unambiguous binary code providing resolution to 128 discrete parts. Transducer is available to measure pressures from 0-1 psi. through 0-1,000 psi., absolute, gage and differential. Transducer, with dimensions of 1¾ in. dia. × 3⅜ in. long, operates over temperature range of −65F to 250F. Combined non-linearity and hysteresis is less than 1% full scale, according to manufacturer: Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.

PROBLEMATICAL RECREATIONS 146



Two squares are removed from opposite corners of a checkerboard leaving 62 squares. Can the checkerboard be filled with 31 dominoes, each domino covering two adjacent squares?

—Contributed

A good move for digital computer men would be to contact our Guidance and Control Systems Division. Specifically Mr. J. T. Lacy. Write to him about positions now open in connection with our airborne digital computers including general and special purpose machines, digital differential analyzers, and digital data processing equipment. Simply mail your resume and let Mr. Lacy call you. He handles all-digit numbers rather neatly.

ANSWER TO LAST WEEK'S PROBLEM: 153846

ALLOY NOMENCLATURE

1. Table I—Nomenclature of Aluminum Powder Metallurgy Alloys

Alloy	Old Designation	$\%Al_2O_3$
XAP001	M257	6
XAP002	M583 & M658	8
XAP003	M470	11
XAP004	M430	14
XAP005	—	6

APM PRODUCTS

2. Table II—APM Product Chart

X—Products have been fabricated on a production or experimental basis.

Alloy	Sheet	Plate	Forgings	Impact Extrusions	Extruded Shapes	Drawn Tube	Fasteners
XAP001	X	X	X	X	X	X	X
XAP002	X	X	X	X	X		
XAP003	X	X	X		X		
XAP004			X		X		
XAP005	X	X	X	X	X	X	X

Alcoa capability at work...

guaranteed properties up to 900°F for an aluminum alloy

Alcoa research has developed a series of new high-temperature (600°F to 1,000°F) alloys *made from aluminum powder*. These remarkable Aluminum Powder Metallurgy (APM) Alloys have higher mechanical properties at these temperatures than any other aluminum alloy.

Alcoa's Aluminum Powder Metallurgy Alloys also exhibit several other attractive characteristics including:

1. Stable properties at temperature regardless of the length of exposure time at temperature.
2. Retention of original room temperature properties and dimensions after repeated elevated temperature exposures.
3. High modulus of elasticity at both room and elevated temperatures.
4. Strength without heat treatment. All APM alloys are used in the as-fabricated condition.
5. Low neutron capture cross section and rapid decay of induced radioactivity.

Take Alloy XAP001 for example: Check its minimum mechanical properties in Table 3 reprinted from Alcoa's Development Division Report. (This is the first time minimum guaranteed properties have ever been published for any aluminum alloy at temperatures up to and including 900°F.) In addition, XAP001 has corrosion resistance comparable to 6061-T6 and is immune to stress-corrosion cracking. It has been ultrasonically spot welded, flash-butt welded and eutectic bonded to itself and other aluminum alloys. Alcoa® Aluminum Alloy XAP001 can be spun, machined with a minimum of tool wear, and anodized, hardcoated or plated.

XAP001 is available in rods, forgings, extrusions, tubes, impacts and sheets—write us for procurement specifications on any of these items. Consider APM alloys for such applications as reactor core components, valves, pistons, piston rings, hydraulic and heating equipment, and jet engine accessories.

XAP005 exhibits mechanical properties similar to XAP001 but was developed for nuclear reactor applications.

Though extensive design information on XAP001, as well as on APM alloys XAP002, XAP003, XAP004, and XAP005, is already available, Alcoa will continue, as always, to investigate new APM alloys, new processes and improvements. Please keep in touch with us for current information.

NOTE: Graphs and data shown here were not compiled from special samples but are the results of many production runs.

3. Table III—XAP001 Extrusions, Minimum Mechanical Properties

ROOM TEMPERATURE

	Longitudinal	Transverse
Ultimate Strength PSI	32,000	30,000
Yield Strength PSI	20,000	17,000
Elongation % in 4D	10	7

600°F

	Longitudinal	Transverse
Ultimate Strength PSI	13,000	12,000
Yield Strength PSI	11,000	9,000
Elongation % in 4D	5	3

900°F

	Longitudinal	Transverse
Ultimate Strength PSI	8,000	Not established
Yield Strength PSI	6,500	Not established
Elongation % in 4D	3	Not established

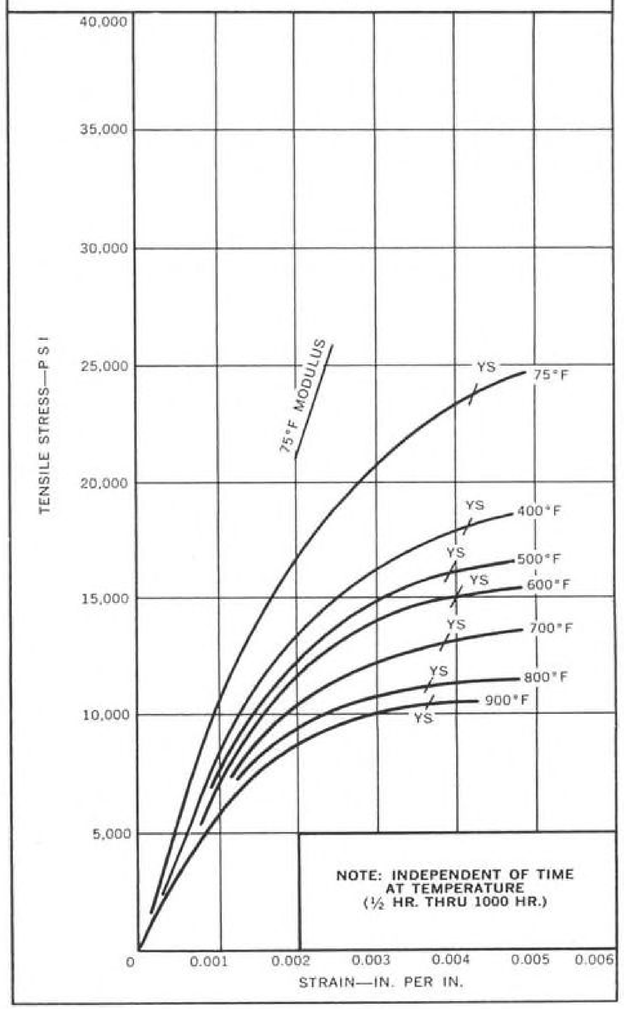
4. Table IV—Physical Properties of Alcoa's APM Alloys

		XAP001 XAP005	XAP002	XAP003	XAP004
Specific Gravity		2.74	2.74	2.75	2.77
Density, lb/cu. in.		0.099	0.099	0.099	0.100
Electrical Conductivity at 25°C (77°F) % IACS		47	44	39	34
Thermal Conductivity CGS Units (Calculated on Basis of Electrical Conductivity)	75°F	0.43	0.40	0.36	0.32
	400°F	0.44	0.43	0.39	0.36
	500°F	0.45	0.43	0.40	0.37
	600°F	0.45	0.43	0.41	0.38
	700°F	0.45	0.44	0.41	0.38
	800°F	0.45	0.44	0.42	0.39
	900°F	0.45	0.44	0.42	0.40
	1000°F	0.45	0.44	0.42	0.40
Average Coefficient of Thermal Expansion per °F x 10^{-6} Temp. Range, °F	68-212	12.0	11.8	11.5	11.1
	68-392	12.6	12.4	12.0	11.7
	68-572	13.1	12.9	12.5	12.1
	68-752	13.6	13.3	12.8	12.3
	68-842	13.9	13.8	13.0	12.5
Melting Range of Aluminum Phase (°F)		Solidus for All Alloys = 1180-1200 Liquidus for All Alloys = 1215 Oxide Phase Melts at 3700 (approx.)			
Specific Heat (cal/g) (Calculated) 68°F		0.213	0.212	0.211	0.210
212°F		0.225	0.224	0.223	0.223

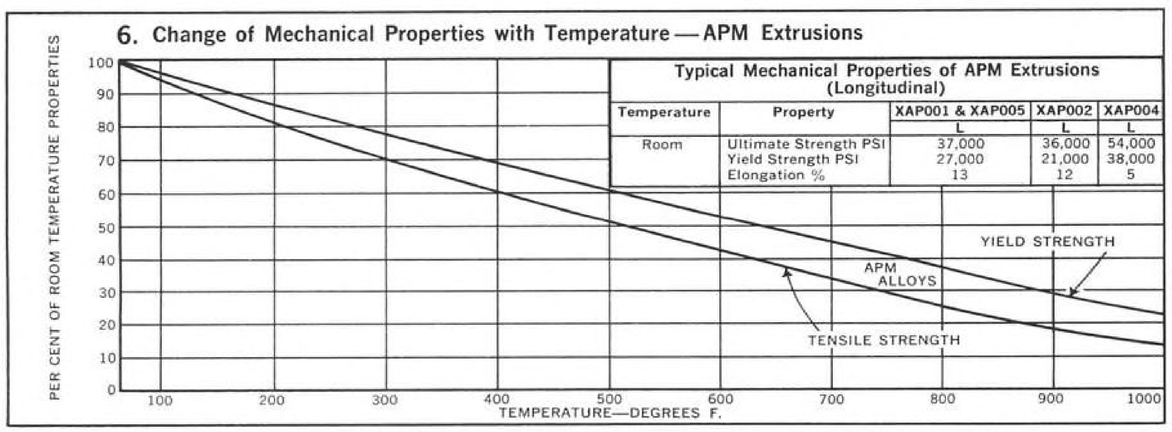
Damping

Tests made at Alcoa Research Laboratories on 0.250" thick XAP001 and XAP004 plate showed that these alloys have 1½-2½ times as much damping capacity as other bare wrought aluminum alloys. Alclad products also exhibit unusually high damping capacity.

5. Tensile Stress—Strain Curves for Alloy XAP001 at Elevated Temperatures



6. Change of Mechanical Properties with Temperature — APM Extrusions



Typical Mechanical Properties of APM Extrusions (Longitudinal)

Temperature	Property	XAP001 & XAP005 L	XAP002 L	XAP004 L
Room	Ultimate Strength PSI	37,000	36,000	54,000
	Yield Strength PSI	27,000	21,000	38,000
	Elongation %	13	12	5

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- ☐ Send me the Alcoa Development Division Report on APM Alloys.
- ☐ Have an Alcoa Salesman contact me concerning APM samples.

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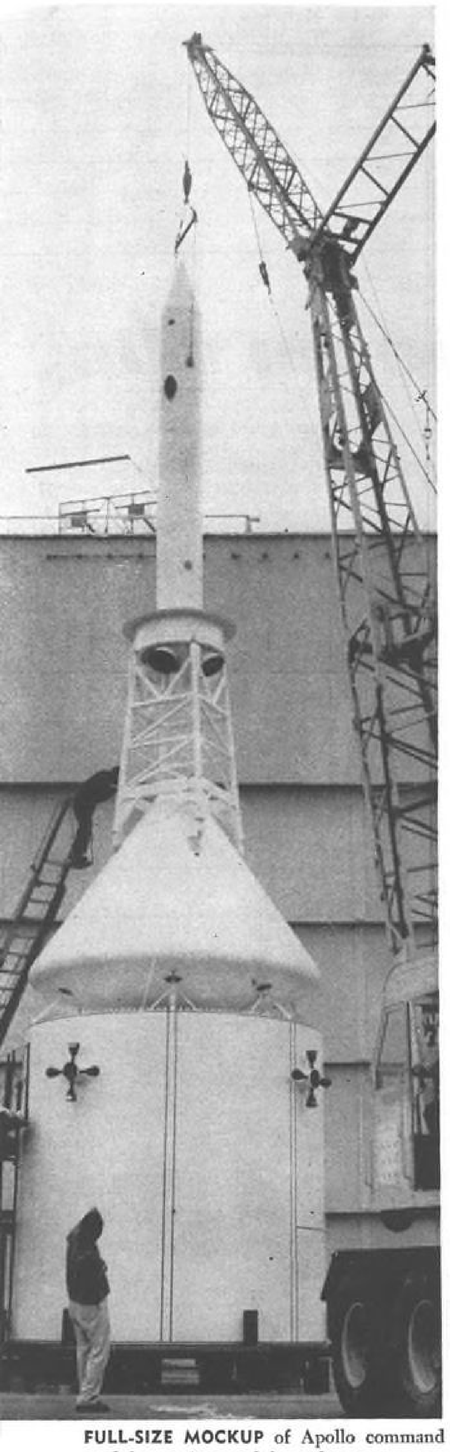
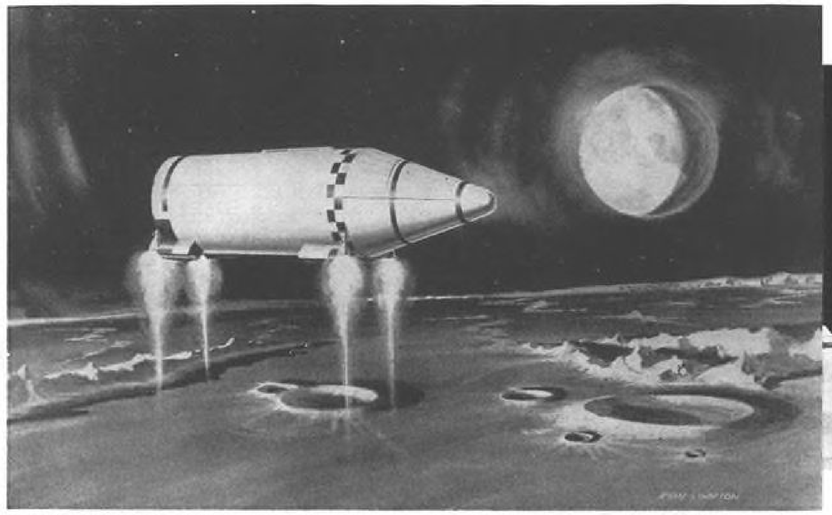


FULL-SIZE MOCKUP of Apollo command module, service module and escape tower were featured at American Rocket Society meeting in Los Angeles. Mockup was built by North American Aviation Space and Information Systems Division.



LUNAR HOUSING UNIT, part of Douglas-proposed system for lunar survival shelters, is shown in this artist's concept just before landing on the moon's surface.

Assembly, Placement of Lunar

By David A. Anderton

Los Angeles—Problems of lunar operations, logistics and support received detailed attention at the recent 17th annual meeting of the American Rocket Society here (AW Nov. 19, p. 27).

There is general agreement among space scientists that lunar exploration, after the first approaches by Apollo crews, will depend on some form of shelter on the lunar surface. Not only does this shelter furnish protection against the hostile environment, but it also provides the volume for equipment and supplies necessary to sustain an exploration effort. Further, if the possibility of earth return were lost due to system failures somewhere, the shelter should be able to serve as a survival means until explorers could be rescued.

Current approaches focus on three ways of accomplishing this task—unmanned emplacement of a shelter by robot vehicles—manned assembly and emplacement on the moon—manned manufacture and emplacement.

These three approaches, detailed during one of the more than 30 technical sessions at this meeting, were described in detail by C. William Henderson, a registered architect working at Douglas Aircraft Co., Inc.'s Missile & Space Systems Division.

Henderson emphasized the problem of manned construction on the moon, and stated that for the immediate future, designs should be guided by the largest available components that can be launched from earth. The more man engages in structural assembly on the moon, the more difficult quality control will be, he said.

One of the specific examples Henderson used to prove the difficulty of manned operations occurred during a space maintenance program sponsored jointly by Rocketdyne and NASA earlier this year. One of the goals was to evaluate as many different pressure suits as possible during the two days available for the program—in fact, almost all the time was spent evaluating just one suit.

One problem to be performed by a subject in a full-pressure suit involved the removal and replacement of a small duct fastened with 12 nuts and washers. It took 90 min. in one case, and 91 min. in another, to complete the task, which was estimated to require 10 min. for an unhindered subject. Gross movements in the suits were clumsy, even to the point of the subject falling. Sense of touch was non-existent. Perspiration dripped from one subject's forehead into the lower lip of his helmet faceplate, causing microphone failure.

Second maintenance task, to remove and replace a gas generator spark plug harness, never was accomplished by the pressure-suited subjects. Limitation was that the subject had to reach forward with his arms to get at the harness—this required continuous and strong effort in the suit. After seven minutes of working to reach and remove Allenhead bolts, one subject was hyperventilating and had to be removed from the suit.

Henderson's presentation also detailed a robot vehicle, stored and carried to the moon in the landing stage of a typical spacecraft, which could be operated from earth by a combination of television and telemetry to emplace the landing stage. The robot would dig into the lunar surface and stack the soil around the landing stage for shelter.

Water and oxygen, believed available on the moon in the rock structure, can be extracted by processing means that will be difficult but which will pay for themselves over a relatively short time, said Bruce B. Carr, Callery Chemical.

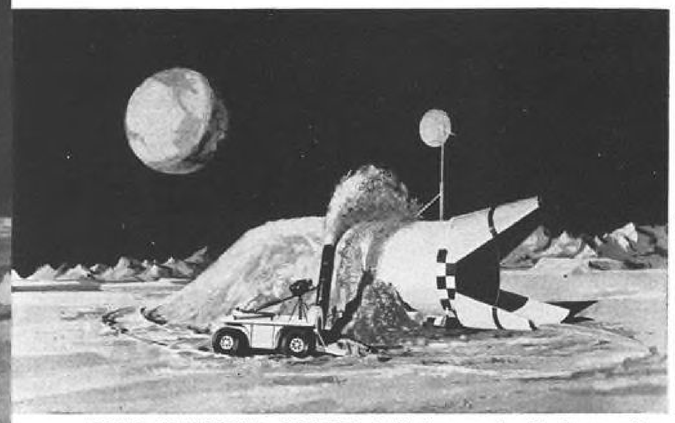
Plant to produce 5 lb./hr. of oxygen would weigh 5-7 tons, including its nuclear power unit.

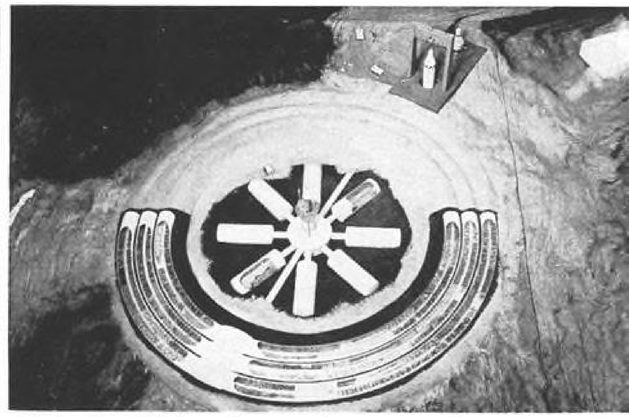
Tetrahedron Satellites

Tetrahedron-shaped satellite, weighing 1¼ lb. and riding piggyback aboard an Air Force Thor Agena-boosted Midas satellite was placed in orbit recently to measure damage to solar cells from the Van Allen radiation belt. Launch took place from Vandenberg AFB, Calif.

Air Force announcement of the successful orbit and its purchase of six of these active satellites from Space Technology Laboratories for the purpose of measuring radiation in space confirms an Aviation Week report on the program (June 18, p. 23).

Pyramid-shaped satellites, measuring 6.5 in. on an edge, carry their own small transmitters which send data from five experiments. The satellites cost $25,000 each (not including development and launch), have a maximum lifetime of 90 days and are powered by solar cells.





DOUGLAS-PROPOSED SHELTER (left) is covered with lunar soil moved by robot vehicle to give protection against environmental extremes. Operations would be controlled from earth by television and telemetry; TV camera is mounted on vehicle. North American lunar housing concept (right) has underground life center made of clustered booster tanks. Outer rings are closed ecological farm system and for food production, also contain carbon dioxide-to-oxygen converters and depository for biological byproducts.

Surface Shelter Outlined in ARS Reports

WATER-CONVERSION PLANT is modeled in North American Aviation concept. Cupola covers a fissure from which volcanic rock has been removed and processed to furnish water by crushing the rock and then heating it. Rock residue can be used for construction purposes after water has been removed.

how this tube got a good name

Less than three years ago, Microwave Electronics Corporation delivered its first metal ceramic traveling wave tube. Today MEC has a broader line of metal ceramic TWT's in field operation than anyone else, including some of the biggest companies in the electronics industry. Why has MEC been so rapidly accepted by military systems designers, the military itself, and industrial instrument and system builders? ***1*** Because MEC tubes work when the customer gets them. MEC has one of the highest acceptance rates in the industry. ***2*** Because MEC tubes operate longer. Users report 4,000 to 5,000 hours field life; our own life tests exceed 10,000 hours. ***3*** Because MEC will tackle the tough jobs and do them in a hurry. Any socket where there is a problem in life, reliability, or controlled characteristics. ***4*** Because MEC offers production tubes with truly reproducible characteristics—the result of engineering skill plus careful fabrication. ***5*** Because MEC tubes can satisfy critical military environments, such as MIL-E-5400 Class II. ■ Each year MEC has substantially broadened its product line in terms of frequency, power and noise figure. From R & D this year, for example, came a 200-watt pulsed power TWT, matched gain tubes in S, C, X, and K_u bands, and a high power, low noise TWT operating in X band. **And, of particular note, a field operational traveling wave maser using closed cycle refrigeration.** Of these, and other developments, more later on these pages.

Excellent opportunities exist for qualified microwave device engineers and scientists at MEC. Call or write Dr. Stanley F. Kaisel, president, for an appointment. An equal opportunity employer.

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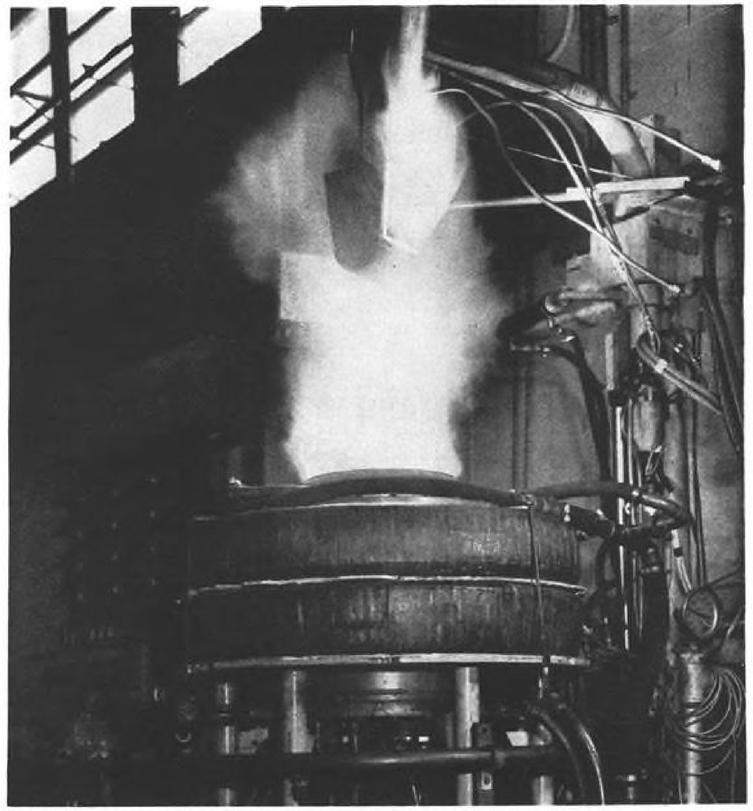


Arc Heater Simulates Spacecraft Re-entry Heat

Electric arc heater, generating 2,500-kw. of power, is being used to produce air streams with temperatures of 7,000F to test samples of heat protective materials for future spacecraft. Heater is located at NASA's Langley Research Center, Hampton, Va.

PRODUCTION BRIEFING

Hughes Aircraft Co. will develop and test a multi-engine electric propulsion ion engine positioning system for adjusting the attitudes and orbits of advanced long-lifetime satellites under a $494,000 contract from NASA's Lewis Research Center.

Lockheed California Co. is working under a 13-month contract from Air Force's Aeronautical Systems Division to study potential of expandable structures for earth-orbit and interplanetary missions. Study includes investigation of materials such as metals, fabrics and plastics and methods of fabrication.

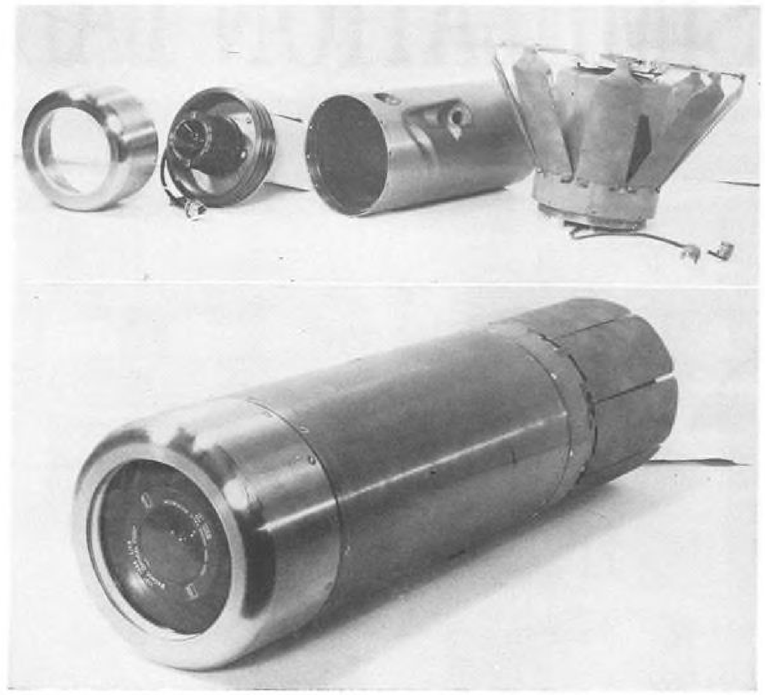
Westinghouse Electric Aerospace Electrical Division has been selected to build the static inverter unit to convert fuel cell and battery power from d.c. to a.c. for the Apollo spacecraft.

Corning Glass Works reportedly will purchase a controlling or substantial interest in Signetics Corp., Sunnyvale, Calif., manufacturer of semiconductor microcircuits for the avionics industry. The move will strengthen Corning's interests in the avionics business and presumably finance Signetics' continued activities in microcircuitry.

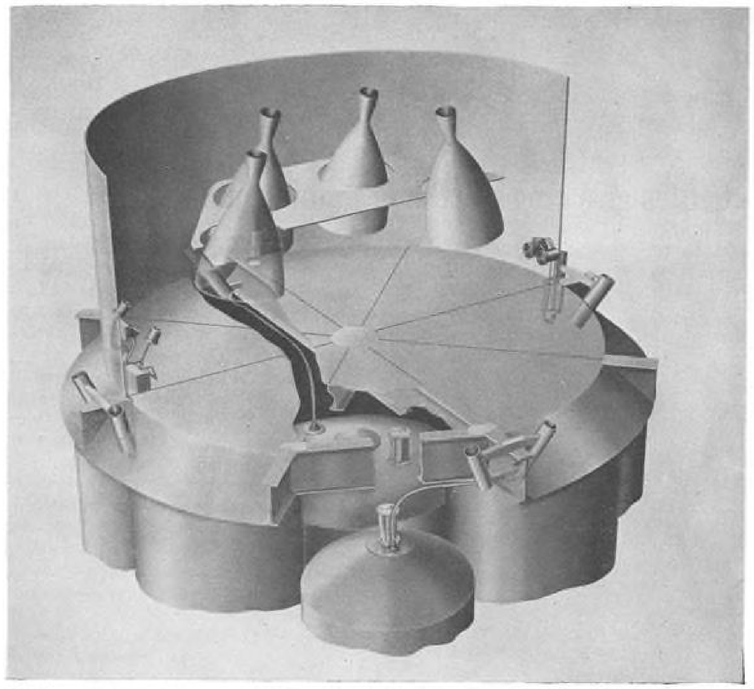
Beckman Instruments, Inc., has delivered a spaceborne gas chromatograph to National Aeronautics and Space Administration's Manned Space Center under terms of a $240,000 contract. Instrument, designed for use in future NASA vehicles, will monitor the closed atmosphere of the spacecraft. Total package, consisting of analyzer unit, panel readout and helium tanks, weighs 12 lb. and operates on a few watts of power.

Quantic Industries' Pelmec Division, San Carlos, Calif., has received contracts totaling $350,000 from Avco Corp.'s Lycoming Division for production of re-entry vehicle separation systems for the Minuteman missile. Production award follows earlier completion of a systems development program by Pelmec.

Recoverable Camera Films ICBM Firings



RECOVERABLE CAMERA components (top) from left are quartz window housing, Milliken DBM-3A camera with 110-deg. field of view lens, power package housing and recovery package with drag flaps deployed. Flight configuration of the capsule is shown at bottom.



CUTAWAY VIEW shows use of fiber optics (light traveling like water through a tube) in positioning camera capsules to monitor Saturn fuel tanks during flight.

Washington—Cook Research Laboratories' recoverable camera capsule, used for the first time in the SA-3 test to monitor Saturn propellant action, has photographed in-flight behavior of 28 Titan and Minuteman development launches.

In the SA-3 flight, eight Cook capsules were installed above the propellant tanks in which the fiber optic technique was employed in order to provide a light source.

Fiber optics system (AW Nov. 12, p. 94) permits light to flow around corners like water in a tube.

In later Saturn flights, the recoverable camera system may be used to photograph the ejection of blowoff panels from the interstage connection, ullage rocket firing, retrorocket firing, stage separation and engine ignition, and booster motion.

Capsule Sections

Complete capsule consists of three sections—instrumentation, control and recovery.

The camera is in the instrumentation system, and in Titan and Minuteman tests was replaced by a magnetic tape recorder.

The camera was used for the first time in test launch of an Atlas vehicle to photograph booster separation (AW Oct. 29, p. 72).

Capsule is a 28.5 in. cylinder, 7.75-in. dia. Flight weight, including 100 ft. of film, is 57.5 lb. Other specifications are:

• **Performance**—Designed for Mach 10 re-entry at an altitude of 300,000 ft. Maximum dynamic pressure is 600 psf. at a 14,000-ft. altitude. Capsule impacts at 90 fps. In the Atlas vehicle test launch, the capsule reached an apogee of 420,000 ft.

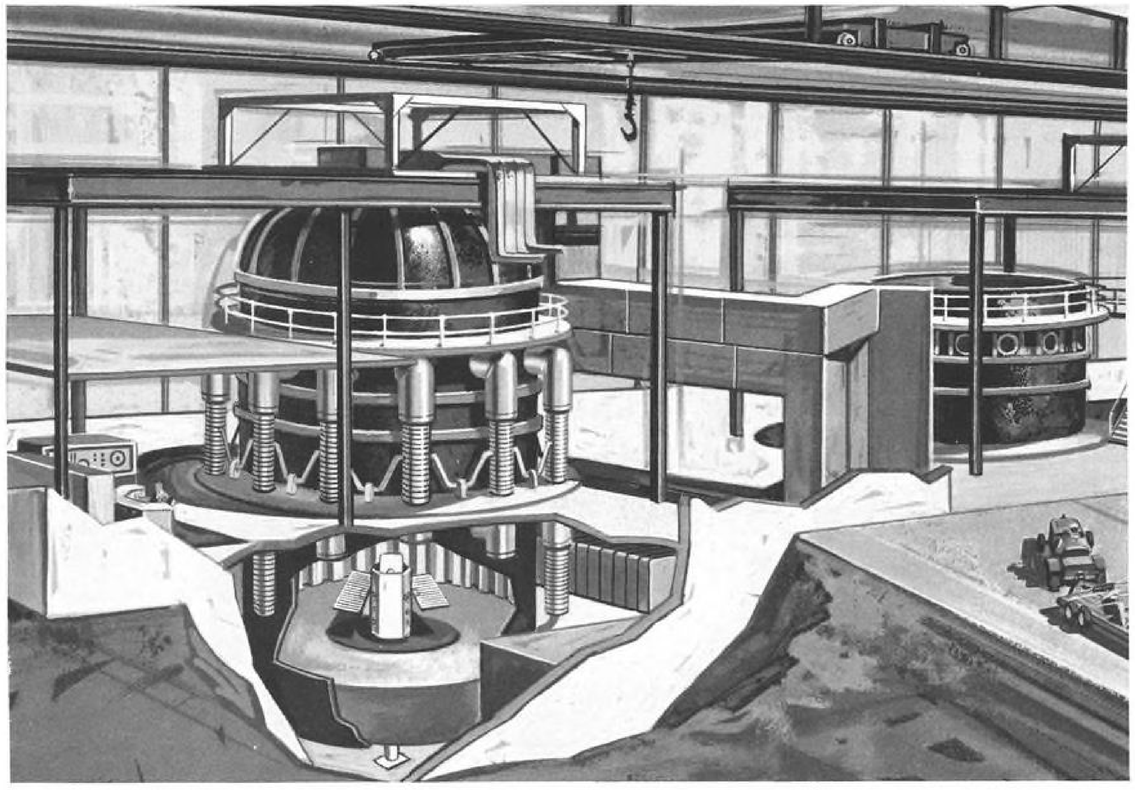
• **Photographic system**—In the Saturn application, a Milliken 16-mm. camera was used with a wide-angle (110 deg.) telephoto lens and a quartz viewing window, 5.5-in. dia., 3-in. thick and optically flat. Film is exposed at the rate of 400 frames/sec.

• **Post-ejection components**—Capsule has a two-stage deceleration system. First stage consists of eight drag flaps which are deployed when the capsule leaves its launching tube. Second stage is a flotation balloon, 18-in. dia., with an equator skirt parachute, called a paraloon, 37-in. dia.

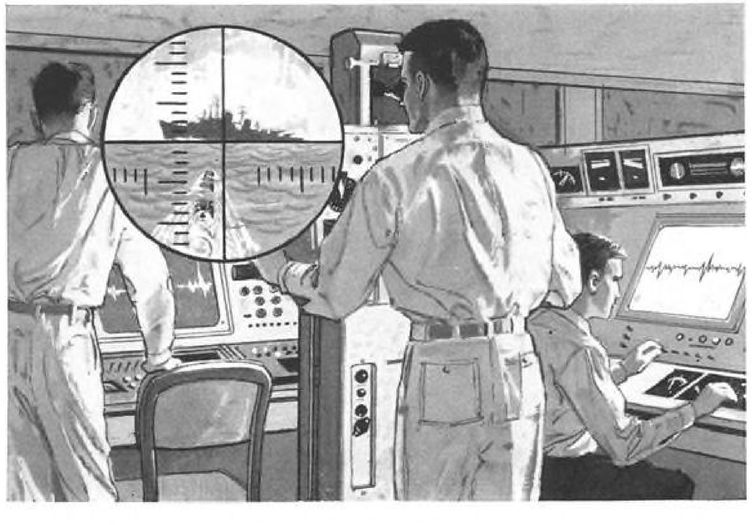
• **Recovery aids**—S-band radar chaff is ejected when the capsule is ejected. System also contains a 15-watt radio beacon, high-intensity flashing light and dye marker.

Cook said it is now developing stereo cameras and taped television cassettes for installation in the capsule.

NEW SIMULATION LAB



Nuclear submarine battles give crews realistic training on land



To supply the trained manpower necessary to operate America's fast-growing fleet of nuclear ballistic missile submarines, Honeywell is installing the Submarine Attack Trainer facility at New London, Connecticut.

Designed and built for the Navy by Honeywell, the trainer incorporates replicas of the attack centers of three operational nuclear submarines. Through realistic simulation of sonar, radar and periscope contacts with the "enemy", officers and crewmen are given valuable experience in making combat decisions.

The first floor simulates the three attack centers, while on the second floor a Honeywell H-800 solid state digital computer works out tactical situations to be solved by the officers and crewmen. A command center on the third floor is directed by master instructors and officers who create strategic and tactical problems and evaluate the trainees' responses.

DUPLICATES CONDITIONS OF OUTER SPACE

Honeywell chambers speed spacecraft testing with exact simulation of vacuum, temperature, solar radiation

Scheduled to go into operation next year at NASA's Goddard Space Flight Center is one of the world's most advanced space test and simulation facilities.

The new laboratory will house two giant chambers: the Space Environment Simulator (far left) and the Dynamic Test Chamber. These will provide the flexible test and evaluation capability required for flight acceptance tests of the Orbiting Astronomical Observatory. The Space Environment Simulator will reproduce the high vacuum, temperature and solar radiation conditions encountered in a flight through outer space. The Dynamic Test Chamber will test spacecraft performance under varying air pressures.

Honeywell, as prime contractor, is responsible for design and installation of the two chambers which will permit testing and evaluation without lost time due to weather, and at a greatly reduced cost.

This advertisement is paid for by Honeywell, not from Government funds. While it is a report concerned largely with our nation's defense programs, it is particularly addressed to companies seeking help in areas where Honeywell experience can be most useful. Your inquiries are invited. This material has been cleared for publication by the Government agencies and companies concerned. Minneapolis-Honeywell Military Products Group, Minneapolis 8, Minnesota. Sales and service offices in all principal cities of the world.

Entomology chamber creates controlled world for insect study

Breeding insects friendly to man and learning more about the life habits of harmful insects are but two of many uses of a unique environmental chamber recently completed by Honeywell at its Duarte, California facility for Purdue University.

The comparative behavior chamber measures 8 x 10 x 12 feet and will be housed in the Purdue Entomological Combined Environment Laboratory.

Equipped with an overhead bank of fluorescent and incandescent lights, the chamber is able to simulate a typical day in which the sun goes through a complete cycle—from sunrise to sunset.

A Honeywell programming unit provides for automatic or manual control of temperature, humidity, rainfall and illumination conditions—similar to actual field conditions found throughout the world.

Honeywell

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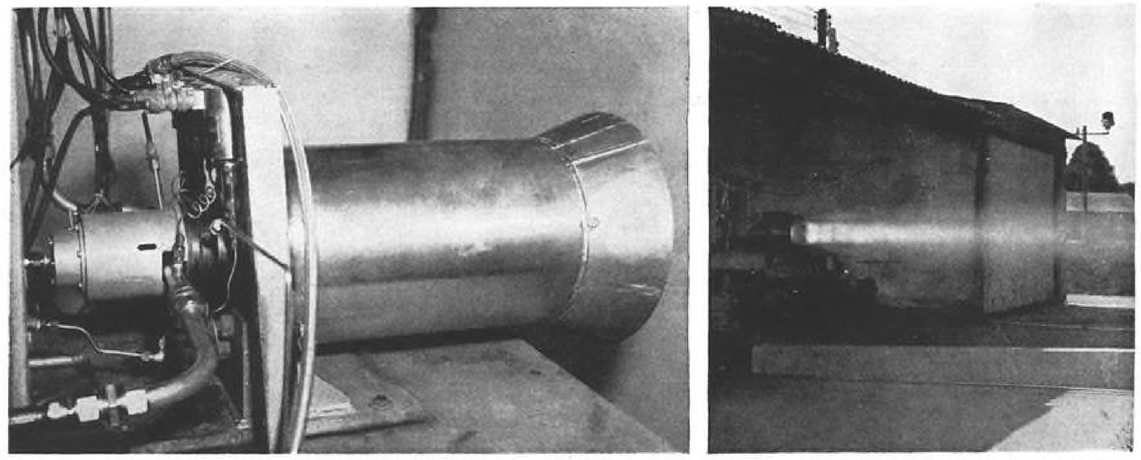
ENGINEERS AND SCIENTISTS: Explore new professional opportunities—write Mr. Fred Laing, Honeywell, Minneapolis 8, Minnesota.



TD-321 COMBUSTION CHAMBER and nozzle assembly is shown (left) mounted on test stand at Thiokol's Reaction Motors Division. Uncooled engine, with a throttleable vortex injector, has been test fired for 264 sec. TD-321 is designed for 10,000 lb. thrust in space. Unthrottled TD-239 developmental engine is shown firing at right.

Thiokol Fires Throttleable, Ablative Motor

Denville, N. J.—Uncooled, all-ablative rocket combustion chamber and nozzle assembly, with a throttleable vortex injector which achieves homogeneous combustion by swirl-mixing the liquid propellants, has been test-fired by Thiokol's Reaction Motors Division here.

Ablative liner of the one-piece assembly, designed for deep space use, is fabricated from preferentially wrapped phenolic-impregnated silica cloth. Insulation layer is a company-developed plastic material called Ablatalite. It is pour-molded between the liner and the outer aluminum shell.

Two test firings, totaling 264 sec., have been run on the engine, which Thiokol has designated TD-321. First firing was a short 8-sec. run. Second firing lasted 256 sec. Combustion efficiency slightly under 100% was achieved with an oxidizer-fuel flow ratio of two to one, according to Joseph Lovingham, project engineer. Fuel was a 1:1 mixture of UDMH and hydrazine. Oxidizer was nitrogen tetroxide. Chamber temperature reached about 5,000F, but heat transfer rate of the insulation layer was low enough to allow engineers to touch the casing shortly after the 256-sec. firing, he said. Chamber pressure reached a peak of 150 psia.

Throttling capability of the 73.6-lb. engine was tested through several cycles, Lovingham said, from low thrust to maximum, down to minimum and back up to intermediate. Minimum thrust produced was 130 lb., and maximum was 5,300 lb. Space rated thrust is 10,000 lb., with a 40:1 nozzle area ratio and a chamber pressure of 167 psia.

Combustion was constant at all ranges. Preliminary post-firing examination indicated little erosion in the chamber throat, Lovingham said.

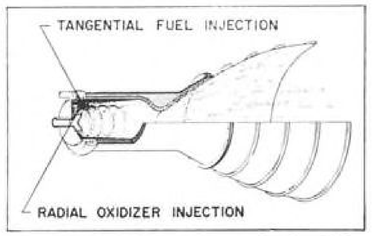
Major reason for the low erosion rate was elimination of thermal and chemical hot streaks by the injector, which swirls the fuel in tangentially from an outer ring and sprays the oxidizer in radially from an inner ring. The elements are mixed in a vortex, which spins back through the combustion chamber.

"The swirling fuel prevents chemical and thermal hot streaks by creating a cool boundary layer along the wall," Lovingham said. "Unmixed elements are circulated back up the center of the vortex until they are thoroughly mixed and burned."

Injector consists of two principal components, a deep metal dish with an inverted smaller dish at its center. The inner dish has a convex bottom. Fuel is forced into the hollow walls of the outer dish, circulated around its circumference and sprayed out into the chamber through holes in the inside surface.

Oxidizer is driven into the inverted inner dish, where it strikes the convex bottom and sprays out radially into the swirling fuel stream. The injector can

ABLATIVE LINER (left) of the TD-321 engine is fabricated from preferentially wrapped, phenolic-impregnated silica cloth. Plastic insulation layer, called Ablatalite, is pour-molded between it and the aluminum shell. Engine developed 5,300 lb. thrust in recent test firings.



VORTEX ACTION of injector developed by Thiokol's Reaction Motors Division is shown in drawing above. Tangential fuel injection creates vortex into which oxidizer is sprayed radially.

be built in a fixed-area, constant-thrust configuration or in a throttleable configuration in which area inside the injector is variable, thereby affecting vortex.

Two other throttleable configurations can be developed around the fixed-area injector by using upstream valves or a pulse feed technique, Lovingham said. The TD-321 has a variable-area injector.

Test firings totaling 880 sec. were run on an earlier engine, the TD-294, which used the same liner, but which had a fixed-area injector, a thicker insulation layer, a glass fiber-wound case and weighed 98 lb.

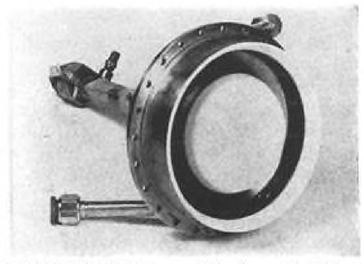
Maximum combustion pressure achieved in the TD-294 firings was 108 psia. at an oxidizer flow rate of 11.85 lb./sec. and a fuel flow rate of 6.25 lb./sec. Maximum combustion temperature was slightly under 5,000F.

"The TD-294 was designed primarily to prove the capabilities of the liner material and the basic injector design," Lovingham said. "After more than 14 min. of firing, . . . diameter of the chamber throat had not changed."

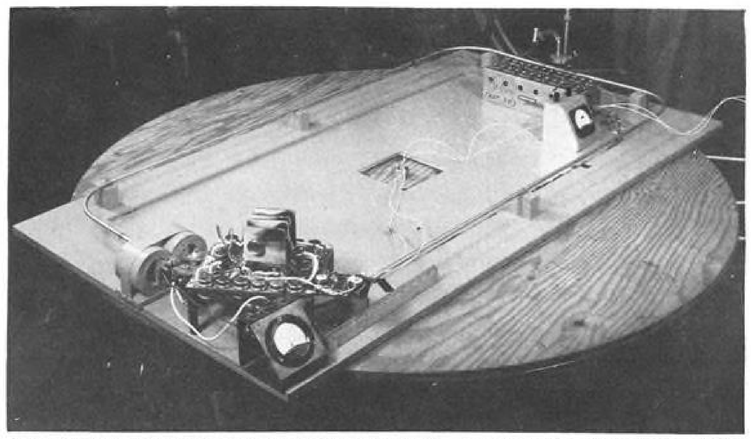
To reduce weight and eliminate quality control problems of filament winding, a second generation engine utilizing the new insulation material and an aluminum shell was developed.

New insulation is one-third as dense as the asbestos phenolic and has one-tenth the thermal conductivity. It cures at room temperature after being poured between the liner and the outer shell.

Aluminum shell is lighter than the glass case, eliminates need for metal connecting flanges at each end and can be polished for thermal reflectivity.



BASIC INJECTOR assembly shows fuel lines at bottom left and upper right leading into outer swirl ring. Line in background feeds oxidizer into inner ring.



TEST BENCH LAYOUT of General Electric's liquid metal inertial system shows electromagnetic pump (left foreground) and single axis loop. Three-axis system has been built.

GE Develops Liquid Metal System To Stabilize, Control Spacecraft

By Donald E. Fink

New York—Liquid metal inertial system, which exerts torque for stabilization and attitude control of space vehicles by circulating mercury through closed loops, has been developed by General Electric Co.

System consists of circuits of stainless steel tubing around the pitch, yaw and roll axes, three electro-magnetic pumps to move the mercury and accumulators on each axis loop to maintain constant pressure on the circulating fluid.

According to R. E. Tompkins, project engineer at GE's General Engineering Laboratory in Schenectady, N. Y., an attitude control system depending on gas expulsion alone would be impractical for extended space trips because of the large fuel supply required. A mechanical system is more practical for prolonged stabilization and precise attitude control, he said.

Secondary gas jet system will have to be included with the mechanical system, however, to produce large displacement impulses when needed or to give added torque when the mechanical system is accelerated to its maximum capacity.

Tompkins said mechanical control devices using gyroscopes or reaction wheels also have been developed, but the liquid metal system has four advantages:

• **Liquid metal system has higher** inherent reliability because it has no moving parts. The mercury flow is the resultant of crossed electrical and magnetic fields in the electro-magnetic pump.

• **Liquid metal system can be** accelerated about 60 times faster than a reaction wheel, thereby correcting erratic movements at their inception. It also is more easily regulated.

• **System can take advantage** of otherwise wasted space, since the tubing loops can follow irregular paths. The loop system also could be integrated into structural members.

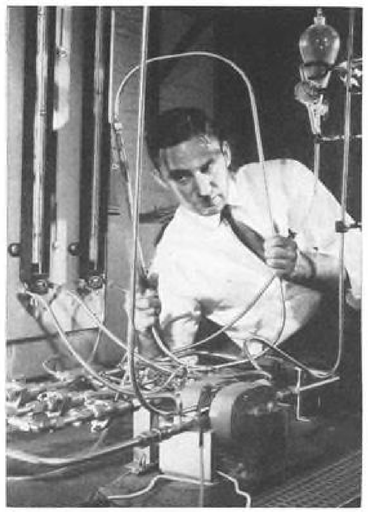
• **Circulating mercury** can be used as a heat sink to carry concentrated heat away from one area.

Work on the liquid metal system was started two years ago, first as a company-funded project and later as part of GE's work on the attitude-control system for Army's Advent communications satellite. Experiments also were carried out using reaction wheel devices, with the liquid metal system representing a second generation development. Even though the Advent program, later transferred to Air Force control, has been terminated, development work has continued on the liquid metal system.

"Our primary aim is to develop an attitude control system for unmanned communications satellites, but the principles are applicable to much larger space vehicles," Tompkins said.

"In its present state of development, the liquid metal system has a better weight to torque ratio than other forms of mechanical stabilization systems on satellites in the 1,000-lb. class," he said. "Vehicles in this class are large enough to allow an efficient lever-arm length. The weight advantage does not hold true for smaller satellites, but it could be achieved with refinements in the circulating system."

Heart of the circulating system is the electro-magnetic pump, which is reversible. In it, a magnetic field is passed vertically through the mercury-filled tube. Direct current, in the 25 to 100 amp. and 25 to 100 millivolts range, is passed through the mercury at right angles to the magnetic field. The resultant force pushes the mercury along the tube. Direction and rate of the mercury flow are governed by the direction and rate of the current flow.



MERCURY IS CIRCULATED through loop held by GE engineer to exert torque for stabilizing and controlling space vehicles. Constant pressure is maintained on the circulating fluid.

Refined Device

"The electro-magnetic pump is not a new device, but until recently it was too inefficient for space applications," Tompkins said. "Drawing on technical developments achieved in liquid metal systems designed for nuclear powerplants, we refined the pump and increased its efficiency from about 3% to 30%."

Tompkins said reliability of the whole system is further enhanced by having the mercury sealed inside the loop system. It would not have to be replenished for the duration of any of the presently contemplated space missions.

"The adaptability of the system to almost any shape or size satellite is another important feature," he said. "We found it possible to make sharp changes of direction with the loop system and counterbalance them with switchbacks, without unbalancing the whole system."

Feasibility of the concept has been proven ,he said, with more than 13,000 hr. of testing on components and an integrated three-axis system which matched the geometry requirements of the Advent satellite.

Early Use of Scientist-Astronauts Urged

By Warren C. Wetmore

Cambridge, Mass.—Inclusion of scientist-astronauts and scientist-observers in lunar and interplanetary spacecraft crews, with geologists to be given top priority for initial missions, is being urged by participants in the National Academy of Science's Summer Study on Space Research, according to Dr. James A. Van Allen.

Van Allen, physics professor at the State University of Iowa and discoverer of the earth's radiation belts, addressed the New England Regional Conference on Science, Technology and Space held here recently (AW Nov. 19, p. 26) under the aegis of the National Aeronautics and Space Administration and Massachusetts Institute of Technology.

He summarized the results of the eight-week study, conducted last summer at the State University of Iowa under a grant from NASA. Participants included 75 of the nation's leading scientists and engineers, drawn principally from universities and industry.

Purpose of the study was to analyze the U.S. space program and make recommendations on new directions and areas in which greater effort is necessary. Scientists were divided into study groups by individual specialty.

Conferees took a strong stand in favor of manned space flight, Van Allen said, but recommended that James Webb, NASA administrator, create an institute near NASA's Manned Spacecraft Center in Houston for training a cadre of qualified scientists as astronauts for future lunar and planetary missions.

These scientist-astronauts would act as copilots for the pilot-astronauts, but their primary function would be on-the-spot scientific examinations and measurements of phenomena that might go unnoticed by a non-scientifically trained pilot-astronaut.

Cadre would have 50 members, including biologists, physicists and meteorologists, as well as geologists. Van Allen said that he knew of several competent scientists who have expressed willingness to begin training at any time.

Other groups and their recommendations included:

• **Biology.** Group members agreed that exobiology, the search for extraterrestrial life, is one of the prime objectives of space exploration. However, biologists are greatly concerned about the possible contamination of other planets, particularly Mars, by spacecraft-borne terrestrial organisms, and are urging strongly that Mars be kept an "ecological preserve" until a thorough investigation has been made.

"The contamination of the surface of Mars," Van Allen said, "could spoil native life-forms and would be counted as one of the greatest crimes in scientific history."

Best scientific evidence on hand indicates that the elevated surface temperature of Venus probably would preclude the existence of life, but the cooler upper atmosphere might contain some form of life, and care should be exercised there as well as on Mars.

Environmental biologists stressed the unparalleled opportunity for study of the influence of weightlessness and other space flight phenomena on the physiological rhythms and processes of animals. They recommended that more research be undertaken on biomedical instrumentation, which they consider to be comparatively crude at present.

• **Lunar and Planetary Studies.** Principal considerations for selenologists (lunar geologists) will be the determination of the lunar surface structure, chemical and radioactive properties of the crust, seismology, temperature of the crust as a function of depth, dielectric properties of the crust and topology. Participants in this study group took a strong stand on a thorough unmanned exploration of the moon before any attempt is made to land a man.

• **Astronomy.** Members of this study group developed the concept of bi-static radar astronomy. Technique involves a powerful earth-based radar transmitter, which would be beamed at a planet at the time a probe was passing. Information on the surface and atmosphere of the planet would be obtained by comparing the signal, which the probe received directly from the earth-based radar, with the echo from the planet.

• **NASA-University Relationships.** Scientists at the study criticized the "unnatural environment" in which they were forced to perform their work if they wished to have payload space on a NASA satellite, including the requirement for submittal of plans two years in advance of the launch date. They feel that this is unduly restrictive, Van Allen said, since their project could become obsolete during that period of time or they might develop new ideas that should be included in the experiment.

As a solution to this problem, conferees recommended that a policy of block allocation of payload space be instituted, in which qualified scientists would be allotted a certain instrument weight and power, with no restrictions on the nature of the experiment. This would substantially shorten the period from conception of the experiment to the execution, Van Allen said, and lessen the chance of obsolescence. Group also endorsed a Navy plan to give an academic institution a whole satellite to use as it saw fit. Such academic satellites would probably be orbited by means of a composite launch, where several satellites share a booster.

• **Meteorology.** Participants in this study group recommended increasing the number of sounding rockets fired from locations distributed around the earth. They stressed the impossibility of obtaining a meaningful vertical profile of the earth's atmospheric properties unless this is done.

• **Atmospheric Physics.** Group members emphasized the need for more research on the chemical, molecular and ionic properties of the earth's atmosphere above 50 km., with specific attention to be paid to such phenomena as airglow and aurorae. They cautioned against the error of including experiments in satellites which could be performed as well or better by ground-based installations, such as the Peruvian observatory (essentially a huge dipole field radar), that is mapping the earth's atmosphere and magnetosphere out to three earth radii.

In another session, the conferees voiced approval of international scientific cooperation with the scientists of other Western nations and with Soviet scientists whenever feasible.

Proceedings of the summer study, which was closed to the public, will be published by the National Academy of Science later this year. Many of the recommendations have been studied by NASA and incorporated into its programs, Van Allen said.

Space Recorder

Leach Corp. is developing tape recorders, including the MTR-2100 shown above, with high resistance to radiation, for use in space satellite program of Lockheed Missiles and Space Co. Life cycle of more than 1,000 hr. continuous duty is sought. Cost of the various programs is approximately $1 million. MTR-2100 records up to 120 min. at 1.8 ips. It is a self-contained, hermetically sealed unit with quarter inch Mylar-base magnetic tape.

SEC Lifts Stock Trading Ban After Atlantic Research Amends Reports

Trading in the stock of the Atlantic Research Corp. has resumed on the American Stock Exchange after a five-week suspension ordered by the Securities and Exchange Commission that stemmed from a registration statement filed by the company for a secondary offering of 179,000 shares of Atlantic stock.

Company has entered into a stipulation with the SEC consenting to issuance of a stop order against the registration statement and agreeing to the correctness of the SEC's information on which the adequacy of the registration statement was challenged.

Company Solvency

Atlantic's board of directors reported to stockholders that the solvency of the company was not questioned. The SEC action was based principally on lack of disclosure of $1,161,722 in loans authorized by Dr. Arch Scurlock, Atlantic's president, to Texas Capital Investments, Inc., and used to purchase Atlantic's stock in the open market and $556,937 to Pine Ridge Corp., used for the same purposes.

Texas Capital, owned by W. O. Bowers III, of Austin, Tex., a personal friend of Dr. Scurlock, was organized in 1958 to take title to land and facilities owned by Pine Ridge at Gainesville, Va., used for testing by Atlantic, the SEC said. Pine Ridge was organized in 1955 to acquire this land, and its stock originally was held by Dr. Scurlock, Dr. Arthur W. Sloan, Atlantic chairman, and other Atlantic employes. Pine Ridge later built facilities for Atlantic at the site.

Besides the stock purchases, the SEC said, both companies served as conduits for other loans from Atlantic to subsidiaries or in connection with Atlantic's purchase of interests in other companies.

SEC also said that Atlantic's annual reports for 1960 and 1961, reporting net income of $811,689 and $1,473,192 respectively, did not reflect losses of subsidiaries. Consolidated results of both years show deficits.

Atlantic's board, following an investigation that confirmed the loans—which it said were made without authority from the board—has voted to add two new, outside directors to the board and appointed an executive committee having broad powers with Dr. Sloan as its chairman.

Board, in line with SEC suggestions, ordered changes in the company's accounting methods, and it also ordered adjustments including:

- **Establishment of a reserve** of $1.5 million—$690,000 net after taxes—against possible loss on notes receivable by Atlantic, including those of Pine Ridge and Texas Capital. Less reserve, these were reported by Atlantic as totaling $3,533,510 as of June 30.

Additional personal guarantees were provided by Dr. Sloan and Dr. Scurlock, who own approximately 40% of Atlantic's stock, and also by a deed of trust on the 580 acres leased by Atlantic from Texas Capital at Gainesville, adding margin estimated at $700,000.

Stock Value

Guarantees of Dr. Sloan and Dr. Scurlock are dependent to some extent on Atlantic's stock value. At the date of suspension, Oct. 10, the stock was selling for $23.50 a share, though Pine Ridge had paid as high as $35 a share in late 1961. On reopening, on a block of 5,800 shares, the price was $13.12 a share. Dr. Scurlock, as of July 31, had pledged his 421,000 shares of stock and other securities as collateral with banks and brokers for loans of about $4.5 million.

- **Provision of $850,000** in its inventory valuation against the estimated losses two of its subsidiaries are expected to incur on completion of government contracts.
- **Write-off of $519,792,** the excess of the cost to Atlantic of acquiring the General Communication Co. over its present net asset value.

Effect of these and other accounting changes and adjustments:

- **For 1960,** Atlantic showed a loss of $174,747 instead of $811,689 profit.
- **For 1961,** Atlantic showed a $1,066,015 loss instead of a $1,473,192 profit.
- **For the first half of 1962,** a loss of $473,079 instead of a profit of $1,289,838.

Dr. Scurlock issued a personal statement in which he said that the loans cited were made within his authority as chief executive officer of Atlantic Research, and that he had no personal interest in either Pine Ridge or Texas Capital Investments. Both are independent of Atlantic Research, he said, and the purchases of Atlantic stock by them were made because these companies believed the stock of Atlantic to be an asset of great potential.

He said he concurred in the steps taken by the board, and added he did not believe the loan program would result in damage to Atlantic stockholders.

Air Force Accepts Texas Tower CH-3Bs

Air Force has taken delivery of three additional Sikorsky CH-3B helicopters for use as support aircraft for Texas Tower radar stations located off the New England coast. Three CH-3Bs shown above will be stationed at Otis AFB, Mass. Three additional 28-passenger CH-3Bs (S-61) have been used on the tower mission since last spring (AW May 7, p. 68).

Skybolt Hydraulics Function Successfully

Detroit—Hydraulic control system for the Douglas Skybolt air-to-surface ballistic missile has functioned successfully in the four test flights completed to date, according to a company official.

Details of the Skybolt's hot gas-powered hydraulic control system and the Centaur control system were reported recently at the Vickers Aerospace Fluid Power Conference here.

Skybolt uses solid-propellant, hot-gas generators, designed by Douglas, to drive hydraulic motorpump packages supplying control power for both stages.

Motorpump packages, designed by Vickers' Aero Hydraulics Division, are standard axial-piston, fixed-angle pump and motor units mounted back-to-back and driven by a common shaft. Hot gas at 2,000F from the burning solid propellant is piped to the motorpump package and to other subsystems, including the control nozzles. Gas pressure is maintained at 2,000 psig. by a relief valve which vents excess pressure overboard, thereby providing a constant torque input to the motorpump which varies speed to meet hydraulic system demand.

Hot-Gas Accumulator

Hot-gas accumulator, eliminating the need for a pre-charged unit, energizes the hydraulic side of the system during peak flow demand periods.

Will Klock, Skybolt system manager at Vickers' Torrance, Calif., facility, described the first stage motorpump package as a standard 30-deg. bent axis pump driven by a 30-deg. motor through a common shaft. Package is rated at 22 hydraulic horsepower at 7,800 rpm., with a maximum flow of 12 gpm. Unit weighs 8 lb.

Second stage unit is also a standard 30-deg. pump driven by a 30-deg. motor through a common shaft. Package is rated at 5.6 hydraulic horsepower at 7,500 rpm. System pressure is a nominal 3,200 psig., with a maximum flow of 3 gpm. Unit weighs 3.8 lb.

To combat effects of heat and friction, alloys were extensively used throughout motorpump construction. Copper-impregnated carbon is used for motor inlet and exhaust valves which are retained by a pure molybdenum ring which provides the required resistance to internal gas pressure. Temperature at the inlet valve exceeds 1,900F.

Motor cylinder block is nitrided, corrosion-resistant steel. The nine motor pistons are of free-floating design as opposed to the retained pistons in a conventional hydraulic motor.

Pistons and piston rods are through-hardened M-2 tool steel. Motor cylinder block is connected to the common shaft through a set of bevel gears. Motor is sealed from the pump assembly by a carbon-faced, bellows-type shaft seal to minimize use of elastomeric seals.

Standard universal link drives the conventional pump rotating assembly. Thrust loads are balanced between pump and motor except for efficiency losses. Residual thrust is absorbed by the bearing stack on the shaft.

During operation, a slight flow of lubricating and cooling oil is introduced into the motor case, which is vented through the gas exhaust system. Combined oil consumption for both Skybolt stages is 3.1 lb./min.

Vickers says tests have indicated a substantially lower amount of oil could be used.

Motorpump testing is accomplished with pressurized, ambient temperature nitrogen gas or by actual firing of a propellant charge. Vickers has developed a propane, liquid oxygen and liquid nitrogen combuster for checkout use which simulates the characteristics of the ammonium nitrate solid propellant gas. The combuster, which is not yet in use, is expected to cut the cost of testing motorpumps with solid propellants sharply.

Present Vickers work on the Skybolt motorpump centers around experiments with various alloys and other heat-resistant materials to achieve better processing and material control and a longer duty cycle.

Centaur System

Design of Centaur hydraulic control system was outlined at the conference by H. D. Davis, General Dynamics/Astronautics fluids design specialist. Davis said design of the Centaur hydraulic control system was dictated by proximity of the pump-motor combination to an extreme low-temperature environment resulting from use of two cryogenic fluids as propellants.

Problem was compounded by the need to keep the system within accepted state-of-the-art temperature limits between —30F and 400F during periods of coast and still remain operational for refiring.

Aside from allowance for temperature problems, the remaining hydraulic system design was conventional. Both engines had to be positioned on two planes requiring less than one hydraulic horsepower per engine, Davis said.

All hydraulic pump and fluid regulation components were packaged into one compact unit, with the pump drive attached to a 12,000-rpm. power take-off from the engine accessory pad.

Power unit body is machined from solid aluminum and is electroless nickel-plated inside and out to provide a low emissivity for reduced heat radiation loss and a good wearing surface for moving parts. Aluminum power unit body encloses part or all of the power unit components.

One power unit is provided for each engine, so that with its two associated actuator assemblies it will make a closely knit system with a minimum surface exposure to low ambient temperatures. Engine positioning actuators are conventional linear type attached to engine and airframe clevises.

System components include a miniaturized, cartridge-type, fixed-displacement hydraulic pump capable of 1.5 gpm. output at 12,000 rpm. The pump is connected to the engine by a flexible nylon coupling to limit heat transfer between pump and engine. The pump is embedded in the power package to keep it warm.

A 1.35-in. (air volume) accumulator was provided to dampen surges in output pressure accompanying variations in flow rate. This unit was buried transversely in the power package, because in this position it tends to prevent cooling of the gas charge which would degrade functioning of the accumulator.

Bootstrap activated fluid reservoir, to prevent cavitation in the main pump, is the largest component in the power package and forms the main body of the unit. A high-pressure relief valve limits outlet pressure to a nominal 1,100 psig., providing a constant torque load for the power take-off.

Low-pressure reservoir thermal relief valve prevents thermal overpressurization on the low-pressure side of the totally enclosed system.

Studies indicated that the power package formed a natural thermal reservoir during periods when the Centaur's accessory system was shut down, Davis said. Heat from this source was found to be sufficient to keep the system operative during coast phases of the flight if the warm hydraulic fluid could be circulated to the system's coldest points.

Accordingly, a recirculating cartridge-type pump, driven by a 28 v., 6,000 rpm. d. c., thermostatically activated electric motor, was provided to circulate fluid when the coldest points of the system reached a pre-set temperature.

Actuators are insulated from the colder engine and airframe attachment clevises through use of plastic blocks at each end of the units to minimize heat transfer. Unusual feature is the use of a separate sleeve around the cylinder in which fluid flow is directed during main and recirculating system operation to warm the whole assembly.

A 10-micron rated stainless steel wire mesh element filters all fluid entering the actuator prior to delivery to the servo valve. This arrangement places the filter as close as possible to the valve to prevent introduction of contamination from intermediate sources.

Norstad Reviews NATO's Military Posture

New York—European medium-range ballistic missile force to replace North Atlantic Treaty Organization's obsolete aircraft strike force still is being discussed, but no recommendations for its establishment have been made, Gen. Lauris Norstad, NATO commander, said recently.

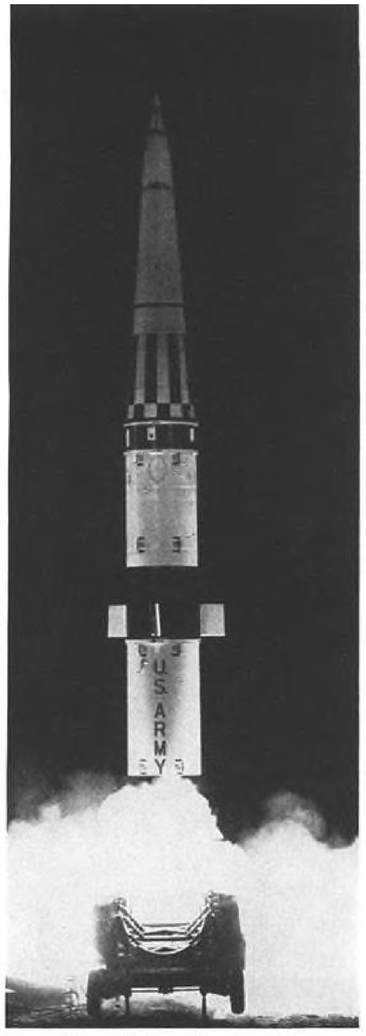
Norstad said NATO has reduced its aircraft force to half that of five years ago, because the manned aircraft is losing its effectiveness against certain targets in the face of improved defenses.

The modernization means the implementation of missiles which, because of Europe's position, automatically become MRBMs, he said. Control of the nuclear weapons delivery systems is one problem, but it should not be limited strictly to the missiles.

Norstad made the comments in an interview broadcast Nov. 11 on "The Twentieth Century," a Columbia Broadcasting System documentary series. Asked why his 1957 recommendations to develop a second generation NATO missile to replace the obsolete Thor have bogged down, Norstad said they have not, because NATO now has the Polaris submarine and the still effective Jupiter missile.

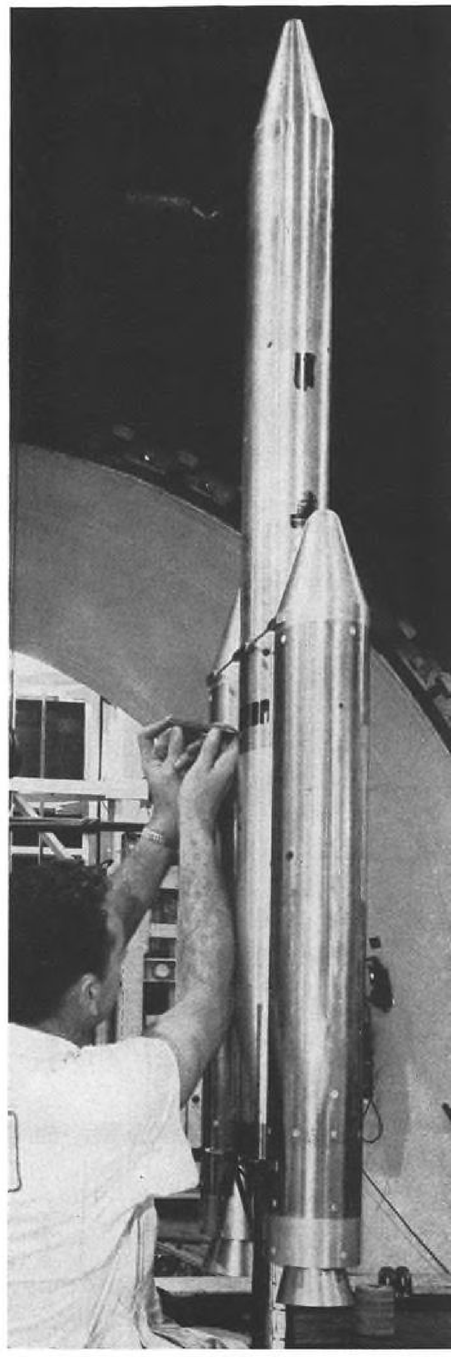
Norstad also made these points on NATO's status in Europe:

- Logistics plans have been developed by the airlines to cover their participation in rapid troop movements from the U. S. to Europe. Because there are only 25 of the required 30 ground divisions in Europe, a program was worked out within the last year to deploy reserve forces rapidly. Equipment is stored in Europe and the men are flown over "just like airline passengers" with about 40 lb. of baggage. This capability, using Military Air Transport aircraft, was demonstrated last spring with operation Long Thrust (AW Mar. 19, p. 87).
- NATO troops are now committed to meeting an enemy attack at the Iron Curtain and holding that line for a limited time. This new concept, under which the main forces will now be brought forward from a secondary line to join the covering forces in case of attack, was implemented this summer.
- Conventional actions in Europe will not automatically prompt nuclear war. Use of nuclear weapons will depend not only on what is happening, but the context in which it is happening. NATO's conventional forces have raised the "threshold," the level of encounter at which nuclear weapons will be used, to a high point.



Pershing Launch

Martin/Army Pershing (AW Apr. 9, p. 80) recently became first ballistic missile to be launched from a battlefield-type unprepared site at Cape Canaveral. Erector-launcher was placed on sloping, sandy ground adjacent to regular concrete pad. Army said nose cone impacted at preselected area.



Titan 3 Model Tested

Scale model of the Titan 3 space booster undergoes final checking by a technician prior to tests in the transonic wind tunnel at Cornell Aeronautical Laboratory, Buffalo, N. Y. The experiments were conducted by Cornell for the Martin Co., Titan prime contractor. Pressures and aerodynamic forces and moments were studied at high Reynolds numbers and low speeds simulating ground-level conditions.

Peruvian Navy Receives Bell 47G-2As

Peruvian Navy has received two Bell 47G-2A helicopters for use as trainers, rescue and utility vehicles. The aircraft were delivered to Lima, Peru, late in October from the Bell factory near Fort Worth, Tex. One of the helicopters had flotation gear; the other, shown above, was equipped with standard skid landing gear.

F-101 Target Prices Excessive, GAO Says

Washington—General Accounting Office has charged in a report to Congress that Temco Aircraft Corp., now a part of Ling-Temco-Vought, Inc., will receive $1.2 million in "unearned profits" unless excessive target prices on F-101 subcontracts are reduced.

GAO said that the "unearned profits" to McDonnell Aircraft Corp., the prime contractor, stemming from the alleged over-charges on the subcontracts, would amount to $370,900.

The contracts were incentive types under which the contractor is rewarded for reductions in target prices during performance. GAO noted that Temco certified the accuracy of its costs.

"The report shows that costs to the government for aft fuselage assemblies for F-101 airplanes will be increased by about $1.5 million because estimated costs included in the target prices for the subcontracts and prime contracts were excessive at the time the targets were negotiated," Comptroller General Joseph Campbell said in a letter of submittal.

The case is being reviewed by Justice Dept.'s civil division.

"In negotiating firm target prices on subcontracts for F-101 aft fuselage assemblies," the GAO report said, "Temco proposed and McDonnell accepted prices which were based on cost estimates that were excessive by approximately $4.9 million in relation to cost information available to Temco at the time the subcontract target prices were established. Subsequent to the subcontract negotiations, Temco certified that it had used current, complete, and correct cost and pricing information in its target cost proposals and that such information as was available to Temco had been furnished to the McDonnell buyers prior to the conclusion of target negotiations."

Sud Aviation of France is flying an H-34 conversion powered by paired Turbomeca Bastan turbine engines developing 950 hp. each. Turbomeca is offering the twin Bastan power installation as a retrofit program for the H-34.

Sud Installs Turbomeca Bastan Engines on H-34

Empty weight of the helicopter is 8,000 lb. and gross weight is 13,266 lb. Sud's twin Bastan H-34 first flew in early October. Company assembled 92 S-58s purchased by the French government, then built 185 under license, including five for Belgium.

USAF Project Seeks Inventory Control

By Ward Wright

Wright-Patterson AFB, Ohio—Project MINT, an intensive Air Force Logistics Command effort to reduce a 2-million-item inventory growing by 300-400 items daily, has entered its initial phase with a comprehensive screening of federal stock and manufacturers' parts numbers to weed out duplicate items.

Logistics Command created MINT (Materiel Identification and New Item Control Techniques) last May after a three-year period of concern over growth rate of the USAF inventory—until recently highest of any service.

Air Force inventory increased by 421,000 items, or 26.4% between January, 1959, and July, 1961. During the same period, Army's inventory gained 116,000 items and the Navy's only 1,000. At the USAF rate, Logistics Command estimates it would have to manage 2.7 million items by 1965 and 3.3 million by 1970.

Program Background

Warnings that Logistics Command must modernize its inventory management have been evident for some time in USAF Inspector General reports, General Accounting Office reviews, participation in Defense Dept.'s Project Shakedown to cut all military inventories, and Logistics Command's own inventory reduction test programs.

These warnings led Logistics Command to begin inventory reduction programs in late November, 1961, and again last January while the MINT concept was being developed.

First program was an order to Air Materiel Area commanders that hardware and electronic systems components—two of Logistics Command's most troublesome inventory areas—would not be procured until the items' characteristics had been screened against those already in the inventory. This policy, expanded with additional goals and applied to all federal supply categories, is essentially the foundation of MINT.

Second program was an order to Air Materiel Area commanders to begin eliminating items no longer needed—with a Calendar 1962 goal of a 300,000-item reduction.

Another reason for MINT's urgency is the demand made on the inventory management system by the rapid transition of a missile weapon system from research and development to production stage. The Boeing B-52 jet bomber, a Logistics Command spokesman said, had a five-year design stability phase. During this period there was time to develop a parts list, assign federal stock numbers and build an inventory.

With missiles, R&D is followed quickly by production, making a streamlining of Logistics Command's inventory management practices imperative if these weapons are to get proper support and at the same time the inventory is to remain manageable.

Under the MINT timetable—which began last May with a letter from Logistics Command Vice Commander Lt. Gen. Kenneth B. Hobson—1,306 headquarters and other personnel in the nine regional Air Materiel Areas were detached from their duties for one year beginning last Sept. 1 to implement MINT in two phases.

Phase one is an exhaustive comparison of manufacturers' part numbers against federal stock numbers to disclose any duplication, either by a manufacturer's part number being assigned two or more federal stock numbers or by printing errors. Duplicate items will be consolidated or eliminated.

During this phase, MINT personnel are collecting manufacturers' engineering data, blueprints, drawings and specification sheets for all items in the inventory for use in phase two.

Key to the MINT program will be the use of manufacturers' engineering data to form what Logistics Command calls a "characteristic data base." The data base will consist of a uniform, orderly description of all significant physical and performance characteristics of a given item. These data bases will form the nucleus of Logistics Command's new item control technique, as a means of comparison in screening new items.

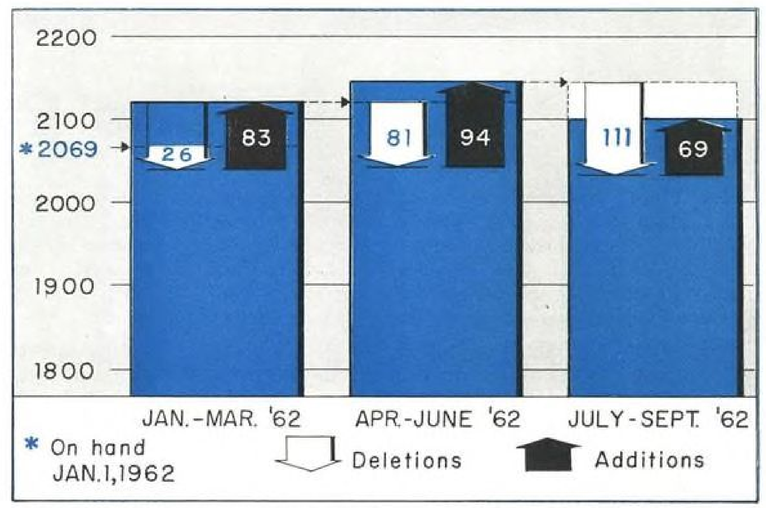
For screening items in Logistics Command's high-volume procurement areas, data bases will be coded for machine processing. Items in these areas, according to MINT Project Manager Phillip C. Hannaford, "are largely basic to the commercial economy and have the greatest potential for standardization and consolidation."

In Fiscal 1962, two of these high-volume groups accounted for 56.5% of the total inventory increase, with seven more federal supply groups totaling 90% of the increase.

For items whose annual volume of procurement does not warrant machine processing, data bases will be laid out on a visual format and screened manually by personnel already familiar with the item's general characteristics.

Once these data bases have been developed, items already screened for stock number duplications and printing errors will be grouped by physical and performance characteristics to determine whether any further duplication or any interchangeability relationships exist.

Duplicate items will again be con-



TOTAL FEDERAL stock numbers in USAF inventory (blue) dropped for the first time during the third quarter due to inventory reduction programs. Historically, deletions (downward arrows) were always offset by inventory additions (upward arrows).

solidated or eliminated at this stage. Interchangeability and substitution relationships will be published by Logistics Command.

While Logistics Command has been responsible for development and publication of interchangeability relationships in the past, demands on personnel have kept the command from fully exploiting this function.

Once the inventory has been reduced through an orderly screening of physical and performance characteristics, several new interchangeability and substitution relationships are expected to result.

After the MINT program, data bases will be used as bases of comparison to screen all new procurement items to determine whether the inventory already has an article that will do the job or whether an interchangeability possibility exists that would make procurement unnecessary.

If a new item must be purchased, it will be described on a data base and be used as a standard of comparison for future purchases. Data base for an individual item will be kept at the Air Materiel Areas responsible for supply of that item.

Procurement Guide

Another facet of MINT will be development of criteria to guide Air Force and industry in procurement. Main factor to be stressed here is the need for standard items rather than cut-to-size products.

Hannaford envisions a series of illustrated handbooks, devoted to product areas, which would instruct procurement personnel seeking to purchase specific items on the market. Handbooks would describe what selections of standard items are available, their characteristics, and suitability or adaptability to Air Force needs. Similar handbooks would be prepared for industry use to emphasize Air Force's need for standard items.

For instance, a handbook on electrical wire would stress the possibility of buying plain wire by the roll or in standard color codes as opposed to cut-to-length sections with non-standard coding, each requiring a separate federal stock number.

Air Force would cut the wire to length as needed and code it if necessary.

During phase two, the actual tasks of reducing manufacturers' data to data bases would be undertaken, followed by screening to eliminate further inventory duplications.

Also, any interchangeability or substitution relationships discovered in the process will be published.

During this phase, the groundwork will be laid for publication of criteria handbooks.

By the end of the project, scheduled

Aug. 30, 1963, Hannaford hopes, MINT will have accomplished five objectives: validation of stock identities, consolidation of like items, development and publication of interchangeability and substitution relationships, establishment of data bases for new item control, and publication of Air Force-industry procurement criteria handbooks.

After a one-month phase-out period, the inventory control machinery developed by MINT will be turned over to a 217-man permanent staff within the Air Materiel Areas and Logistics Command headquarters. The staff will keep data bases current, screen new items against data bases, continue to publish interchangeability relationships as they become apparent and keep criteria handbooks current.

Much of the machinery MINT is using to attain its goals has always been available to Logistics Command. Regular inventory procedures have provided for parts number screening and elimination of duplicate items.

However, the volume of new items flowing into the inventory, coupled with a decline in Logistics Command personnel, has led to practices where it became easier and quicker to assign an item a new federal stock number than to perform a thorough inventory check to determine if the item was already in stock.

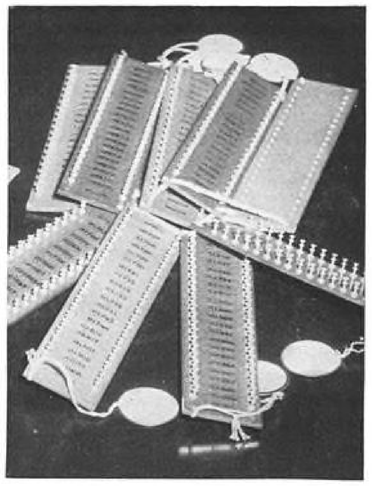
So far, results for Air Force's inventory reduction programs have been encouraging. During the third quarter of 1962, the combination of previous inventory reduction programs and some help from MINT procedures has trimmed the Air Force inventory from a high of 2.14 million items at the end of the second quarter of 1962 to 2.09 million items at the end of the third quarter.

Procurement Savings

Savings expected from MINT are not known, but a hoped-for 30% reduction in federal stock numbers would lead to a substantial saving in procurement and inventory management costs, Gen. Mark E. Bradley, Jr., commander of Logistics Command, said.

Examples of inventory problems MINT is trying to eliminate were furnished in a tri-service preliminary study of aircraft fuel system components in September, 1961, in connection with Defense Dept.'s Project Shakedown.

For example, the tri-service inventory listed 946 "different" types of aircraft carburetors, each with its own stock number. When these were screened, 784 stock numbers were found to be assigned to duplicate items. Of the remaining 162 types of carburetors, 60 are being identified as "standard," against which any prospective procurement must be compared before a new type is bought.



EXAMPLE of an area where MINT can reduce federal stock numbers. Contact boards are identical except for numbering stenciled between terminals. Under present inventory practice, each board has its own federal stock number and is procured as separate item. After MINT program, plain contact board with one federal stock number would be procured. Terminal marking would be done by USAF. Board would be described on data base for machine comparison with similar proposed procurement item to determine whether new procurement is needed.

Fairchild Seeks Larger Space Business Role

By Edward H. Kolcum

Hagerstown, Md.—Fairchild Stratos Corp., which had a net loss of $17.4 million in 1958 and almost $6 million in 1960, is coming into its own as a third-level aerospace contractor with ambitions for prime satellite and space probe contracts.

The corporation showed a profit of $3 million last year on the basis of its decision to accept a role as a medium-sized organization to which prime contractors and their principal second-tier contractors come for components and subsystems. Fairchild Stratos continues to produce and sell one F-27 each month, but it looks to the aerospace field as the main source of potential new business.

Lee Farnham, corporate director of advanced engineering, who joined Fairchild a year ago from General Electric, typifies the new corporate approach aimed at establishing within the company a complete systems awareness in the space market.

To generate this awareness and at the same time provide proof of Fairchild's increasing capability, the corporation last year formed Farnham's group and gave it a charter to maintain a broad knowledge of space developments so that corporate management can forecast most likely future business, and also to provide direct engineering assistance to the company's four divisions.

Expected Growth

Farnham's group, housed in Bayshore, L. I., presently totals 14. He anticipates that the staff will grow to 200. During this initial period, scientists and engineers on the staff are developing unsolicited proposals which they submit to National Aeronautics and Space Administration and the Defense Dept.

As it expands, the group will fulfill proposal requests for complete spacecraft systems.

Corporation in-house effort for such systems is keyed to two fairly advanced proposals which have been offered to NASA. They are:

- **Steam sounding rocket** which differs in fundamental concept from early unsuccessful attempts to propel launch vehicles with steam. Robert E. Hughes, marketing manager for the space systems group, said steam rockets able to loft 12-lb. payloads to a 208,000-ft. apogee could be sold for less than $600 if they are bought in quantity.
- **Unmanned lunar crawler**, weighing only 43-lb. and conceived as part of the Surveyor soft lunar landing payload. Fairchild plans to build a crude model of this battery-powered vehicle, which features a rocket-charged penetrometer system able to obtain as many as 12 samples of the lunar crust. Over-all project envisioned by the company includes a vehicle on which pilots will learn to move on the lunar surface, and Farnham's engineering group is now developing fundamental equations for the dynamics of the lunar surface.

The firm also recently entered the re-entry vehicle field when it was awarded the program definition study of the mobile medium-range ballistic missile (MMRBM) for the nose cone. This is the first Air Force re-entry vehicle contract which was not won by Aveo Corp. or General Electric.

Walter J. Schafer, engineering director the Aircraft-Missiles Division, explained Fairchild's steam rocket concept as one which uses a solid propellant charge which exhausts into the water-steam chamber. Exhaust heat is transferred to the water, producing steam, which provides a thrust level of about 700 lb., and a specific impulse of about 100 sec.

Nozzle exit area and propellant burning rate are matched so that a constant boiling rate and chamber pressure are maintained. This results in a constant level of thrust. In tests conducted in the company's stand here, burning times have averaged 6.5 sec.

Two other concepts have not resulted in adequate performance in past development attempts by other companies. One is a straight steam rocket, which is loaded with superheated steam and, when a nozzle restriction is removed, simply takes off. Because of the low density of steam, mass ratios achieved in this concept have been too low.

The other concept is a hot water rocket. Part of the hot water converts to steam as chamber pressure is reduced. Specific impulse drops to about 60 sec., which is not acceptable, because much of the water is unused.

Fairchild proposes a 100-in. long, 10-in. dia. rocket to launch small weather and ionospheric sounding payloads.

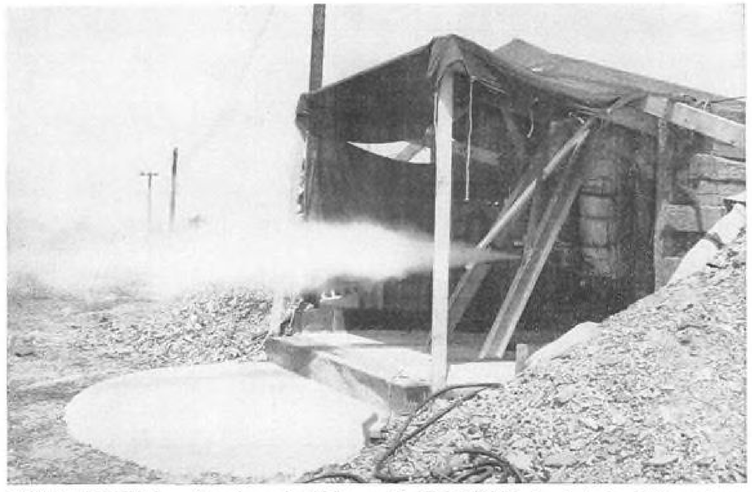
System has been demonstrated to the Weather Bureau, Air Force and Army, and has been proposed to NASA for development.

Willard Everett of Fairchild has a patent pending on the rocket, which weighs 315.5 lb. in its launch configuration. Water weight is 200 lb.; inert parts, 80 lb.; propellant, 23.5 lb., and payload, 12 lb.

Analytical Studies

Fairchild also is conducting a number of analytical studies for NASA and in-house as part of its own development program. Among them are an operations analysis to optimize payloads carried on unmanned space vehicles; test plan for the Italian San Marcos satellite, and a reliability analysis on the over-all Ranger program (AW Oct. 29, p. 38).

Among hardware component contracts now held by the company are the heat protection fairing for NASA's solar internal power attitude control system test vehicle, equipment housings for the orbiting geophysical observatory, structural panels for Nimbus and Advent satellites, and valves for Saturn, Centaur and Titan 2 launch vehicles.



STEAM ROCKET is undergoing a hot firing on the Fairchild Stratos test rig at Hagerstown, Md. Company said a steam rocket able to carry 12-lb. payloads to 50 mi. can be marketed for less than $600 if the steam rockets are bought in quantity.

WHO'S WHERE

(*Continued from page 23*)

Changes

John H. Monahan, head, Air Defense System Design and Test Department of The Mitre Corp., Bedford, Mass., and **Alan J. Roberts,** head, Norad Command System Department.

Frank N. Carlson, manager of the newly established Custom Instrumentation Laboratory, Los Angeles, Calif., a West Coast extension of Baldwin-Lima-Hamilton Corp.'s Electronics Division, Waltham, Mass.

Joseph C. Ross, Jr., manager of operations, Pacific Semiconductors, Inc., Lawndale, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc. Also: **Roy A. Juusola,** manager, PSI Diode and Rectifier Division; **George E. Deaderick,** manager, PSI Transistor Division.

Donald F. Malcolm, Boeing Co.'s Washington, D. C., representative responsible for ballistic missile and space activities.

Dr. David A. Kahn, chief engineer, Melpar, Inc., Falls Church, Va., a subsidiary of Westinghouse Air Brake Co.

Delwin B. Avery, general manager, Houston Fearless Corp.'s Nuclear Research Instruments Division, Berkeley, Calif.

Ivar L. Shogran, assistant to the chief engineer-commercial transports, Douglas Aircraft Co., Inc., Long Beach, Calif. **Gordon L. Farquhar** succeeds Mr. Shogran as chief project engineer for the DC-8.

Harris D. Gilbert, director of contracts and planning, Martin Co.'s Nuclear Division, Baltimore, Md.

Dr. Eric Durand, director of systems analysis, Aerospace Corp.'s San Bernardino (Calif.) Technical Division.

Albert F. Wild, manager, Southern region operation for General Electric Co.'s Defense Programs Operation, with headquarters in Huntsville, Ala.

R. L. Halpern, director of electronic systems, Ventura Division, Northrop Corp., Van Nuys, Calif.

Dr. Robert S. Carlson, director of engineering, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., and **Edward L. Montgomery,** assistant director. Also: **James C. Elms,** director of Space and Electronics; **Charles H. Sword,** manager, Contract Administration Office.

Simon W. Barnhart, chief engineer, Tamar Electronics, Gardena, Calif., a division of Tamar Electronics Industries, Inc.

Zelmar Barson, engineering program manager-missiles and space, Cleveland Pneumatic Division of PneumoDynamics Corp., Cleveland, Ohio.

Col. M. R. Collins, Jr. (USA, ret.), manager of the newly created product assurance program office, Space Systems Division, Lockheed Missiles & Space Co., Sunnyvale, Calif.

William H. Gable, director of engineering, Aircraft Armaments, Inc., Cockeysville, Md.

Earl C. Vicars, technical director, Hexcel Products, Inc., Berkeley, Calif.

Morris M. Arnold, head of marketing, Planning and Marketing Staff, United Technology Corp., Sunnyvale, Calif., a subsidiary of United Aircraft Corp.

Edward J. Bresnen, manager of material, Trimpot Division of Bourns, Inc., Riverside, Calif.

M. L. Jofeh, managing director, Sperry Gyroscope Co. Ltd., Brentford, England.

Harry A. Schmidt, director of special projects, Dynamic Science Corp., South Pasadena, Calif.

William K. Mickelsen, manager for American Airlines, Inc., at Dulles International Airport.

Dr. Francis H. Webb has joined the staff of MHD Research, Inc., Newport Beach, Calif.

Robert W. Dugan, marketing director, Amelco, Inc., Mountain View, Calif.

Kenneth J. Luplow, director-international sales, The Boeing Co.'s Transport Division, Renton, Wash. **Hans W. Ott** succeeds Mr. Luplow as director of the Division's European office, Geneva, Switzerland.

Jerome Rothstein, senior staff scientist, LFE Electronics, Laboratory for Electronics, Inc., Boston, Mass.

Gen. Charles D. Palmer (USA, ret.), consultant to the Research Analysis Corp., Bethesda, Md.

W. W. Benbow, assistant general manager-Skybolt, Douglas Aircraft Co.'s Tulsa (Okla.) Division.

Col. Jack L. Bentley (USAF, ret.), manager-business acquisition planning, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

Albert C. Lazure, administrative assistant, Explosives Department, Hercules Powder Co., Wilmington, Del.

Lt. Col. Edward D. Landis (USAF, ret.), production supervisor of the newly established Government Division, Schavitz Engineering, Pennsauken, N. J.

Robert W. Smith, marketing manager, Magnetics Division, Microdot, Inc., South Pasadena, Calif.

John E. Woodward, corporate director of material, Texas Instruments, Inc., Dallas, Tex.

Dr. Michael J. Plizga has joined the research division of Astropower, Inc., Newport Beach, Calif., a subsidiary of Douglas Aircraft Co.

Hugh B. Martin, III, senior project engineer, Kinetics Corp., Solana Beach, Calif.

George I. Lyman, small business representative, The Bendix Corp., with headquarters at South Bend, Ind.

Claude C. Kirk, assistant division manager, AiResearch Manufacturing Co., Phoenix (Ariz.) Division of The Garrett Corp.

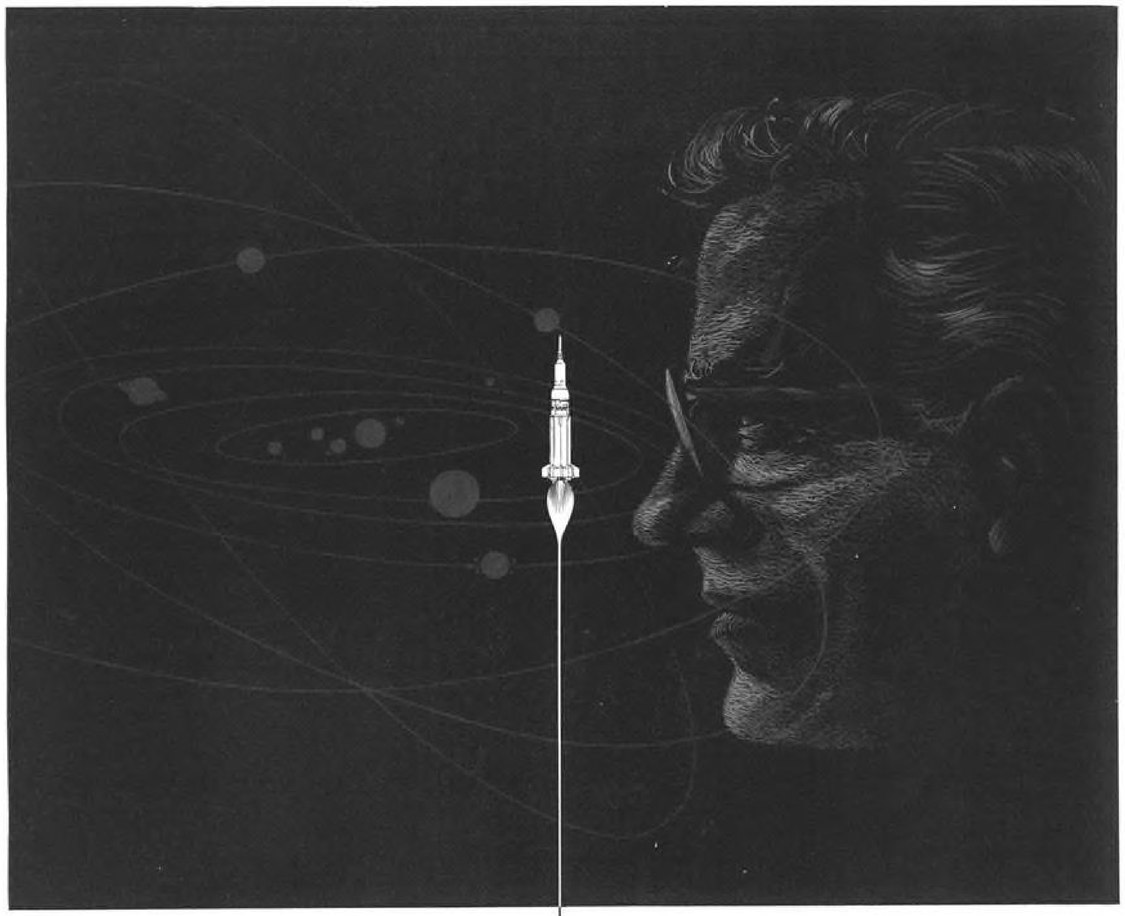
Dr. Richard K. Orthuber, director, Electro-Optical Laboratory, ITT Federal Laboratories, San Fernando, Calif., a division of International Telephone and Telegraph.

Carl E. Hill, contract representative for the BAC 111 program, Mohawk Airlines, Inc., to coordinate production and act as liaison man for the British jet, with headquarters in London, England.

Brion Foulke, head of marketing research, Leach Corp., Compton, Calif.

John Vergeichik, director of engineering, Defense Products Division, Fairchild Camera and Instrument Corp., Clifton, N. J.

Rear Adm. William A. Dolan, Jr. (USN, ret.), manager of Westinghouse Electric Corp.'s newly established corporate Security Department, with offices in Washington, D. C. Staff members are: **Lt. Col. L. E. Kindred** (USMC, ret.); **Col. John C. McCawley** (USAF, ret.); **Col Edward L. White** (USA, Ret.).



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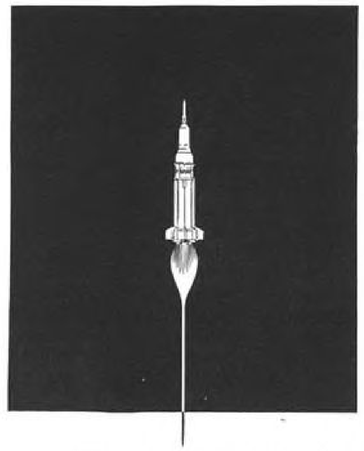

Two major task areas are of special interest:

ADVANCE ENGINEERING

This branch analyzes existing or proposed space system designs and operational characteristics to establish system requirements and feasibility for developing design concepts. It includes these sections:

Aeroballistics—concerned with dynamics and trajectory analyses, aerodynamic heating, staging studies, aerodynamics, and flight evaluation.

Preliminary Design—establishes configuration feasibility to meet mission changes and future missions as dictated by program requirements.

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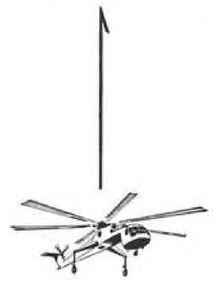

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by RICHARD STRIPLING (BSME 1951), Program Manager, UNDERSEA WARFARE DEPARTMENT, APPARATUS DIVISION

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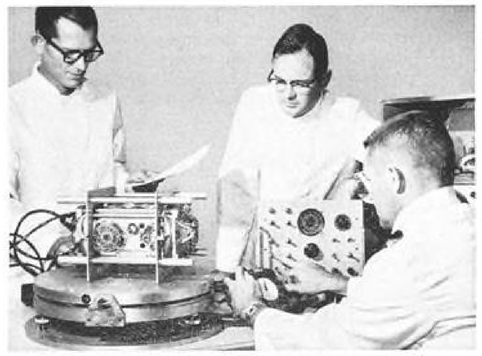

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AVIATION WEEK, NOVEMBER 26, 1962

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ADVERTISERS INDEX

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LETTERS

Airline Questions

Curt Olsen's corollary (AW Sept. 17, p. 138) to John Brancker's article raises, if I understand it correctly, a further series of questions:

• **The U.S. has, beginning at Chicago,** traditionally championed the multi-lateral approach to international air agreements and only reluctantly later bowed to Britain's apprehensions at Bermuda. If we have never viewed the bilateral with enthusiasm why would we now, when Britain herself is leaning the other way, embrace its inherent fallacies to perpetuate its existence?

• **What will issue for PAA pilots** from the proving that the U.S., which generates less than half of U.S.-South America traffic, operates more than half the flights and carries more than half the traffic? Is LAD (Pan Am's Latin American Division) reconciled to the consequences of this discovery?

• **Suppose EEC (the Common Market) launches "Air-Union"** and edicts only one or two gateways to the entire community for PAA and TWA. Is this expansion for them or for the merged "chosen instrument?"

• **Aren't user's fees simply the quotient** determined by dividing airport operating expenses by the transits? And if there is an inequity here, isn't the answer, if any, retaliation in kind? It seems to me that to talk up subsidy on this account is using an elephant gun to kill a mouse.

• **We have all known and respected** Pan American's pilots as the first of our pioneers in international air operations. They have been bold leaders in the advancement of the profession and the industry. It would seem a pity to see them later adventure into the muddy waters of cartellizing, a business in which they are not the world's most experienced airline and a business that even its originators are struggling, with the blessing of the U.S.A., to abandon in their search for economic communion and development. Wouldn't the better answer be to expand —not restrict—the entire industry, U.S. and foreign alike?

FLOYD S. BENJAMIN, CHAIRMAN
Committee on Legislation*
Seaboard World Pilots

*Financed and directed solely by Seaboard pilots for the purpose of developing and expanding the airline industry.

Photo Intelligence

After reading and viewing your articles and photographs of the Cuban situation in your magazine (AW Oct. 29 and Nov. 5), I wonder if the Russians haven't deliberately used our intelligence capability to their own advantage. Obviously they know we take photos. Obviously they take photos, such as missile bases in Italy. There apparently was no attempt to really hide the rockets. Now it appears as though the Russians have dutifully packed up and gone home. For what? To place "40" more rockets pointed at the countries that base our planes and missiles and say to those countries, "Look how those Americans behave when it appears their own homeland might be obliterated by our rockets instead of yours. Are you going to allow people like that to have bases on your land? And we do have rockets; just look at the hundreds of pictures the Americans have taken of them."

No better time could be picked for the missiles to be found in Cuba. News was "leaked" to the conservative politicians that they were there. I don't doubt that the Russians would have supplied photos themselves to put more pressure on the President to act during election time. It would be hard to make any other choice, even if it weren't election time.

When some future chess move is made and the gates to Berlin are shut, who among the people that live in the countries where we have our bases are going to say, "Let us and our children die for them."?

DON E. LLEWELLYN
Burbank, Calif.

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.

Revised Airline Policies

I read your recent editorial "Retrospect" (AW Oct. 1, p. 11) with a great deal of interest and that warming feeling one gets when you find your own "crying in the wilderness" views are, in fact, shared by others.

For several years now in my own column in ASTA Travel News, I have, from time to time, dwelled upon this characteristic "living in a dream world" attitude of the air transport industry. My comments have, of necessity, been written from a somewhat different viewpoint to yours, but in essence their burden has been the same; the total absolute and all encompassing disregard the airlines have for any suggestion that all is not completely well with their world. This was never more true than in the aspect of "sales" which you mention in your editorial. I was privileged to talk with Sir Frank Whittle during the early development days of the Comet, and I well recall him remarking that it would take the airlines about 10 years to learn how to operate jets and another 10 to find out how to fill the seats.

Two other very pertinent comments were made more recently—my memory fails me on the exact people involved, but it was on the occasion of the Airline Presidents Conference in Washington, D. C. The points raised were that the airlines are not actually in the "bus business," and not a glamour function, and that probably the basic trouble with the lines is that they believe their own advertising! This last I find especially pertinent.

In essence, it seems to me, the airlines have three primary tasks to accomplish: they must make their product more attractive (safety, convenience, price are the main factors here); they must find ways to sell more effectively and at lower cost; they must increase their operating efficiency to permit the highest return for the invested dollar.

Above all they must overcome the pernicious inhibiting fear of each other's competition and learn to concentrate more on the much greater problem of increasing their total market.

In any event, you have one firm supporter of your editorial snoot cocking, and I hope that you will continue to express the type of guideline you have given the carriers over the past years.

Who knows but that one day they may come out of the clouds and recognize those facts of life which seem so apparent to most of their customers.

JOHN BALDWIN SEALES
15446 Saltair Ave.
Los Angeles 25, Calif

Cockpit Camera

With reference to your airline violations article (AW Oct. 8, p. 42), I suggest that a timed camera be installed in the cockpit to take a flick every minute or so. This would take the place of inspectors, but would require an employe at each airport to develop the film. The developing process would take about five minutes.

I'm sure that all the crews are not as described in the article, but to make sure the captains of the aircraft would be responsible for the care of the camera.

Or does the FAA lack the funds to provide such an idea, also? Or is the idea too stupid? I'm tired of reading about such irresponsible attitudes!

BOB WORINGEN
RCA
Patrick AFB, Fla.

F-102 Defense

I am writing with regard to an item that appeared in the Airline Observer column of your magazine dated Oct. 15 (p. 52). The item in question states that Boeing engineers are nearing agreement on a variable sweep configuration for their supersonic transport because of "marginal handling qualities inherent in a tailless delta or canard-delta configuration." The news item goes on to quote a Boeing engineer in a statement implying poor landing characteristics for the F-102.

The engineer in question should have used a different illustration. Our pilots consider the F-102 flight handling characteristics equal to, or better than, those of the 707, DC-8, or 880/990 class airplanes. The approach speed of the F-102 is slightly higher than that of the typical four-engine jet transport, but this is a characteristic that can be overcome in a final supersonic transport design.

The general comment on the F-102 and F-106 is that pilots tend to become complacent because of their excellent flight characteristics.

B. J. SIMONS
Chief Engineer
General Dynamics/Convair
San Diego, Calif.

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