Aviation Week & Space Technology

June 10, 1963

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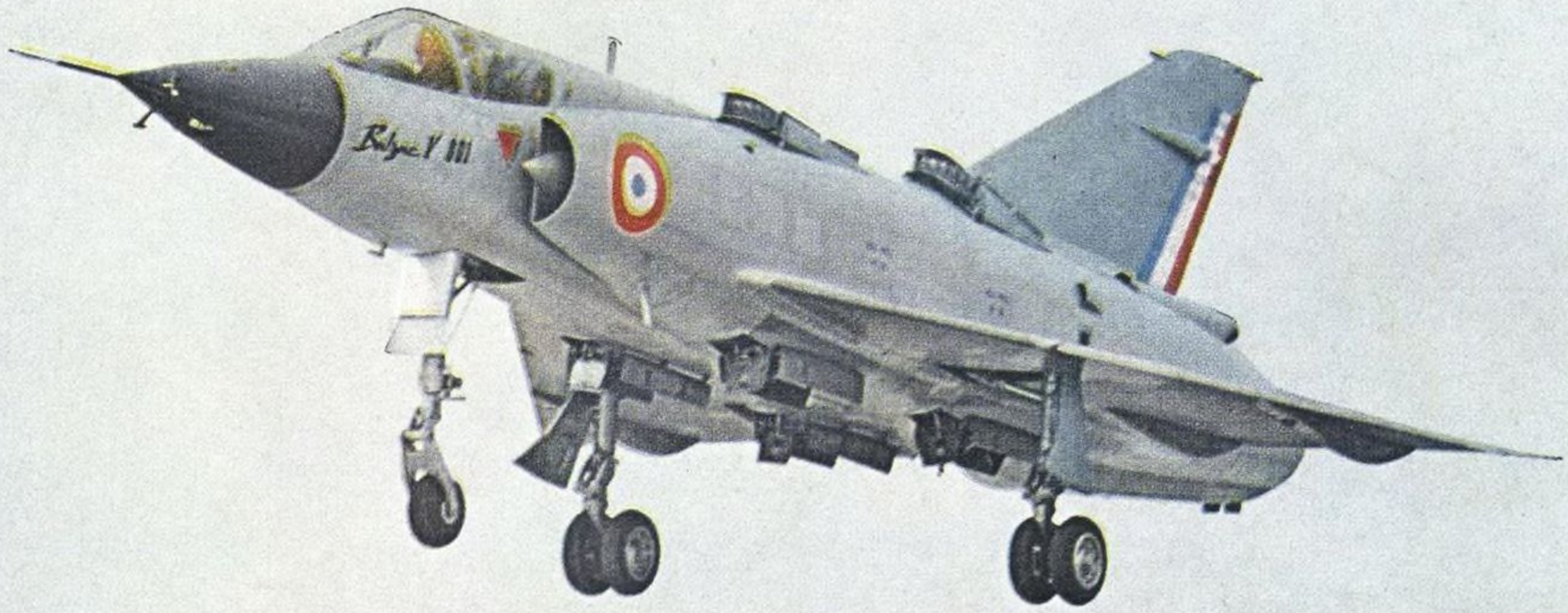
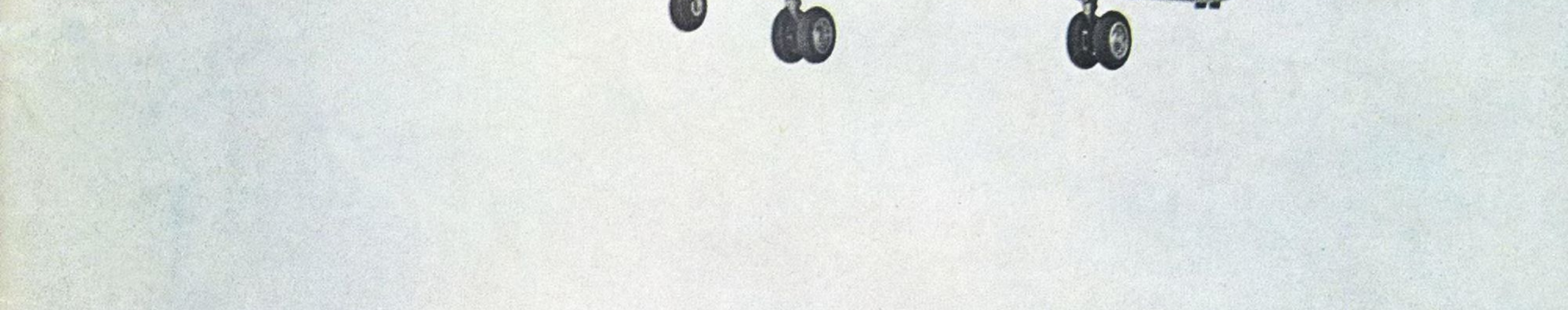
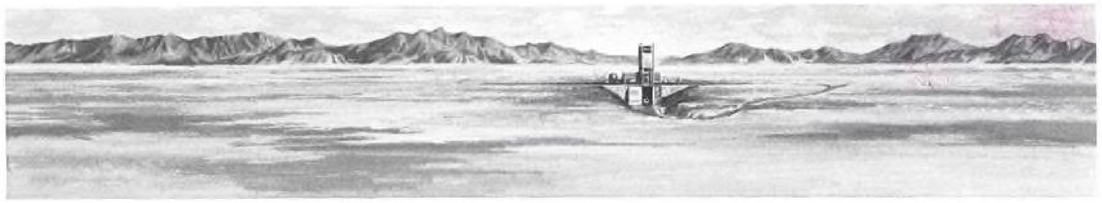




Special Report on French Industry



HARNESS FOR A NUCLEAR INFERNO The site: Jackass Flats, Nevada. The structure: the NERVA nuclear rocket test stand. Designed by AETRON for the Space Nuclear Propulsion Office—a joint office of the Atomic Energy Commission and the National Aeronautics and Space Administration.

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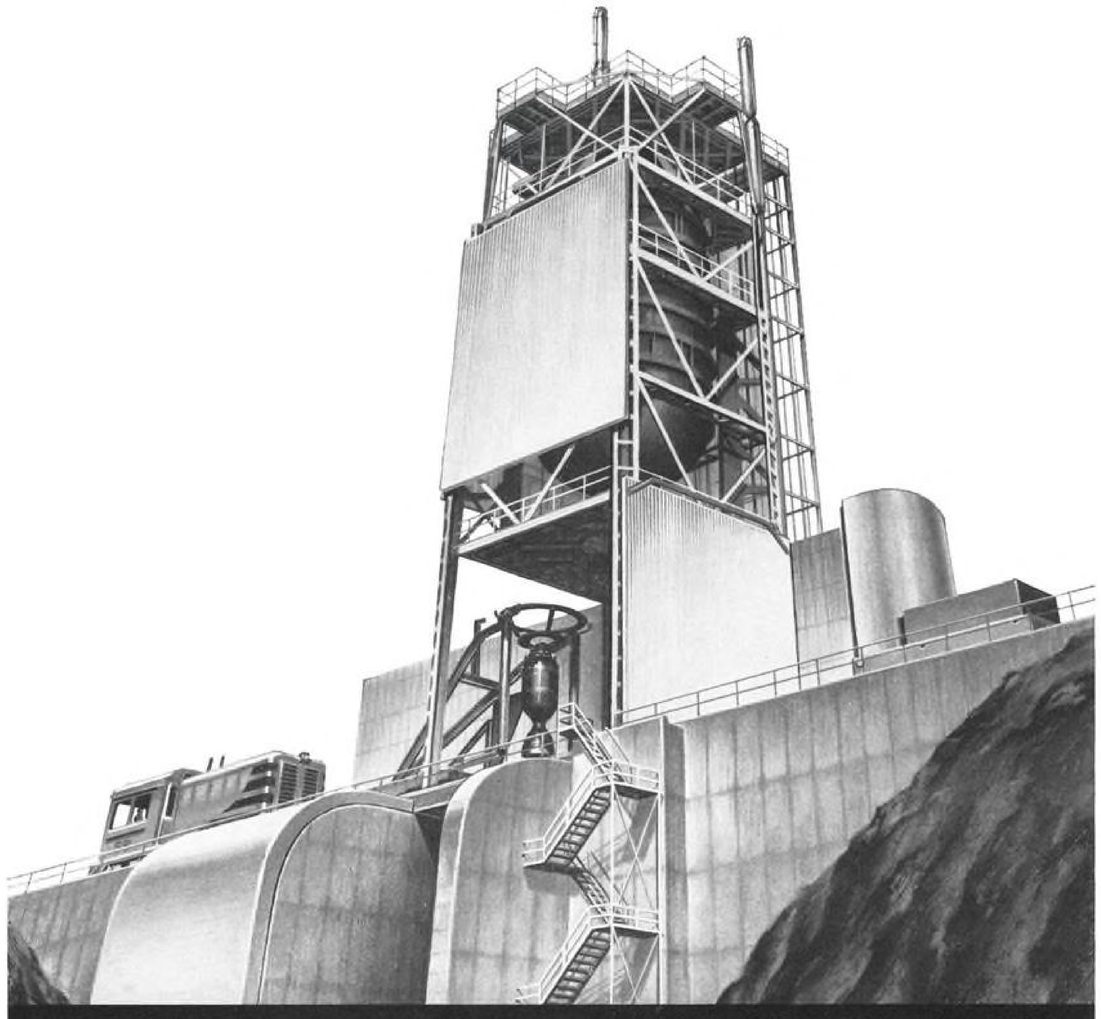

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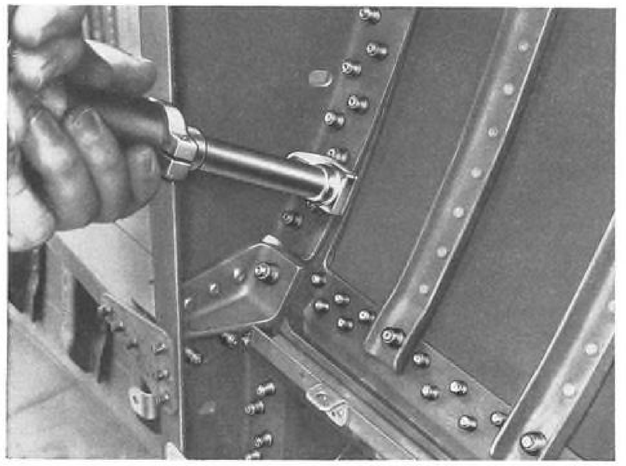
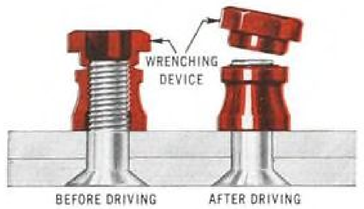
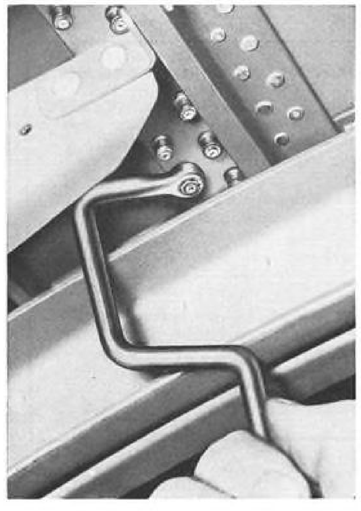




UPPER: Hi-Lok extended, 1" and 2" offset Adaptors, fitted to Ingersoll-Rand Air Motors, and 90° Adaptors, fitted to Keller Ratchet Wrench Motors, provide tooling access and minimum tool clearances for many tight spots.



CENTER: The self-locking Hi-Lok combines the best features of a rivet and bolt. Because of the collar's break-off at design preload, torque inspection of the installation is eliminated. Available in a variety of high strength, temperature resistant materials.

LOWER: The simplicity of the Hi-Lok installation, like a nut and bolt, permits use of improvised wrenches to reach into otherwise inaccessible areas in the A4D-5. From this extreme example to fully automatic assembly using Drivmatic Riveter production techniques, Hi-Loks offer a wide variety of installation methods.

Capable of near sonic speed, the newest Douglas Carrier Bomber, the A4D-5 Skyhawk has an unusual weight ratio of 9,300 pounds empty yet combat loaded, grosses 24,500 pounds. To achieve this outstanding weight ratio, one Douglas structures engineer expressed it as, "...designing five pounds into a one pound space."

As an example, around the engine main mount area, Hi-Lok Fasteners were selected for this highly compacted structure to overcome extremely tight clearances. Hi-Lok adaptor tooling, fitted to standard air drivers, meets these tough situations with a variety of unusual offset, extended and back-driving configurations. In some tight places on the A4D-5, only Hi-Lok hand tools can be used, and in several extremely isolated spots, Hi-Loks are installed with improvised wrenches.

For the A4D-5's skin panels, the small head of the Hi-Lok uses the minimum countersunk depth, permitting higher allowables to be designed into thinner gages. The smooth and quiet Hi-Lok assembly results in a controlled preload or clamp-up, consistent in each installed Hi-Lok in any grip condition.

From the Navy maintenance viewpoint, Hi-Loks can be easily removed with hand tools, and if the pin is not damaged, it can be reused.

If space is a problem, use Hi-Loks. If your structure is open and many fasteners are required, use Hi-Lok automatic driving techniques. Check your Engineering Standards Group for details.

U.S. PATENTS 2,882,773; 2,927,491 AND 2,940,495. OTHER U.S. AND FOREIGN PATENTS GRANTED AND PENDING.

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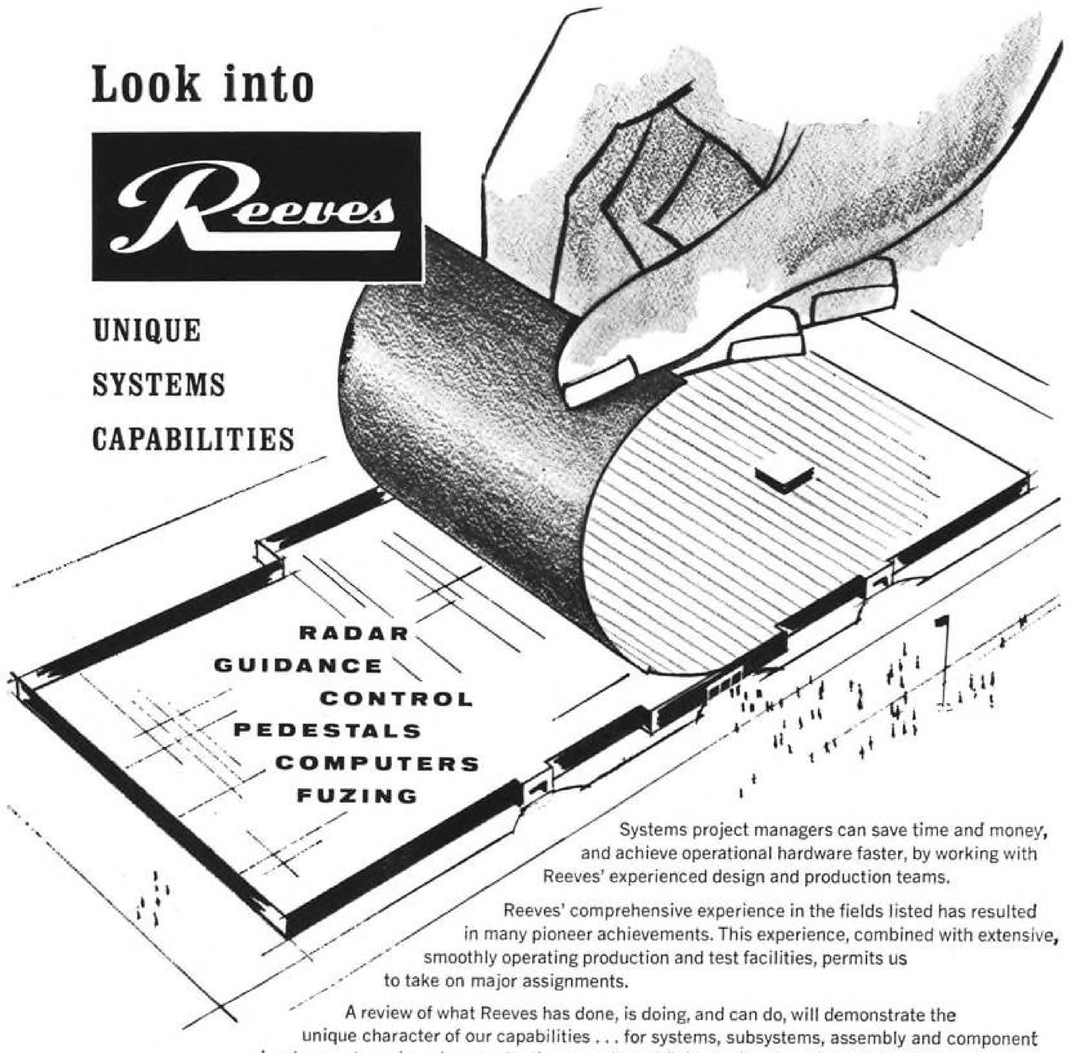

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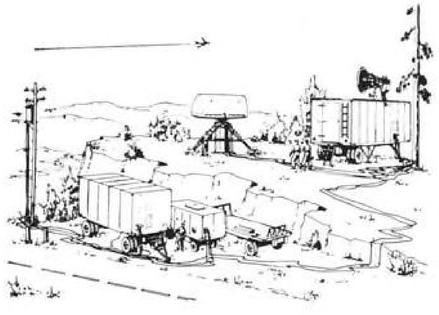
Reeves' comprehensive experience in the fields listed has resulted in many pioneer achievements. This experience, combined with extensive, smoothly operating production and test facilities, permits us to take on major assignments.

A review of what Reeves has done, is doing, and can do, will demonstrate the unique character of our capabilities . . . for systems, subsystems, assembly and component development, engineering, production, supply and field service. Data file 702 on request.



FOR EXAMPLE: TRACKING RADAR SYSTEMS

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Another unusual Reeves' development, the Radar Bomb Scoring Central (AN/MSQ-35), acquires, tracks, and records the flight of aircraft and release of bombs on practice missions. With provision for skin, beacon, and optical tracking, the Central produces continuous plots of aircraft position and bomb trajectory, in horizontal and vertical planes. Maximum range, 100 miles at altitudes up to 300,000 ft.

These complete systems have been designed for compact housing in air-transportable vans for field service. They typify Reeves' comprehensive capabilities for systems' production, from concept to delivery of operational hardware.

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AEROSPACE CALENDAR

June 17-20—Summer Meeting, American Institute of Aeronautics and Astronautics (AIAA), Hotel Ambassador, Los Angeles.
June 17-21—Summer General Meeting, Institute of Electrical and Electronics Engineers, Toronto, Canada.
June 17-21—71st Annual Meeting, American Society for Engineering Education, Philadelphia, Pa.
June 18-20—41st Meeting, Aviation Distributors and Manufacturers Assn., Chateau Frontenac, Quebec, Canada.
June 19-21—Fourth Joint Automatic Control Conference, University of Minnesota, Minneapolis, Minn. Sponsors: American Institute of Chemical Engineers; Institute of Electrical and Electronic Engineers; American Society of Mechanical Engineers; Instrument Society of America.
June 20-22—National Meeting, Institute of Navigation, University of Michigan, Ann Arbor, Mich.
June 23-28—66th Annual Meeting, American Society for Testing and Materials, Chalfonte-Haddon Hall, Atlantic City.
June 26-27—10th Annual Symposium on Computers and Data Processing, University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.
June 26-27—Symposium on Dynamic Load Problems – Helicopters and V/STOL, Statler Hilton Hotel, Buffalo, N. Y. Sponsors: Cornell Aeronautical Laboratory; Army Transportation Corp.
June 28-July 3—Second Annual Dorado Fly-

(Continued on page 7)

AVIATION WEEK & Space Technology

June 10, 1963
Vol. 78, No. 23

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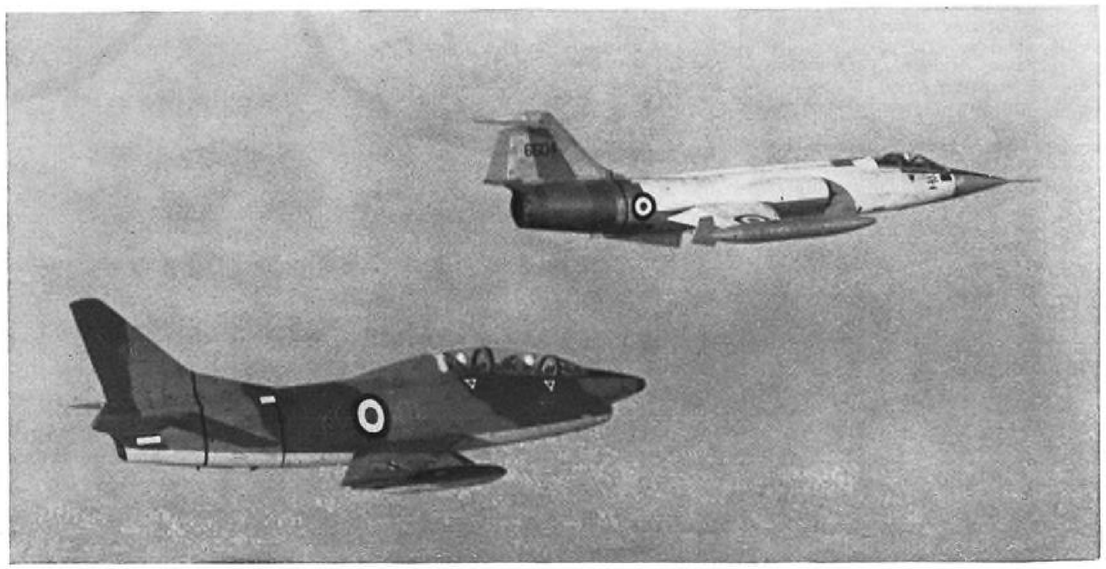

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AEROSPACE CALENDAR

(*Continued from page 5*)

In, Dorado Beach Hotel, Dorado, P. R.

July 7-11—Seventh National Conference on Aerospace Education, National Aerospace Education Council, Hotel Deauville, Miami Beach, Fla.

July 9-11—International Symposium on Space Telecommunications, Institute of Electrical and Electronic Engineers' Professional Group on Antennas and Propagation, Boulder Laboratories, Boulder, Colo.

July 10-12—Meteorological Support for Aerospace Testing and Operation, American Institute of Aeronautics and Astronautics and American Meteorological Society, Ft. Collins, Colo.

July 23-26—Torpedo Propulsion Conference (Confidential), American Institute of Aeronautics and Astronautics, U. S. Naval Underwater Ordnance Laboratory, Newport, R. I.

July 30-Aug. 4—11th Annual Fly-In Convention, Experimental Aircraft Assn., Rockford, Ill.

Aug. 4-9—International Conference and Exhibit on Aerospace Support, Institute of Electrical and Electronics Engineers/ American Society of Mechanical Engineers, Park Sheraton Hotel, Washington.

Aug. 4-16—Sixth Annual Institute on Missile and Space Technology, University of Connecticut, Storrs, Conn.

Aug. 5-9—Eighth Annual Technical Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles, Calif.

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

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

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

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

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

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

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

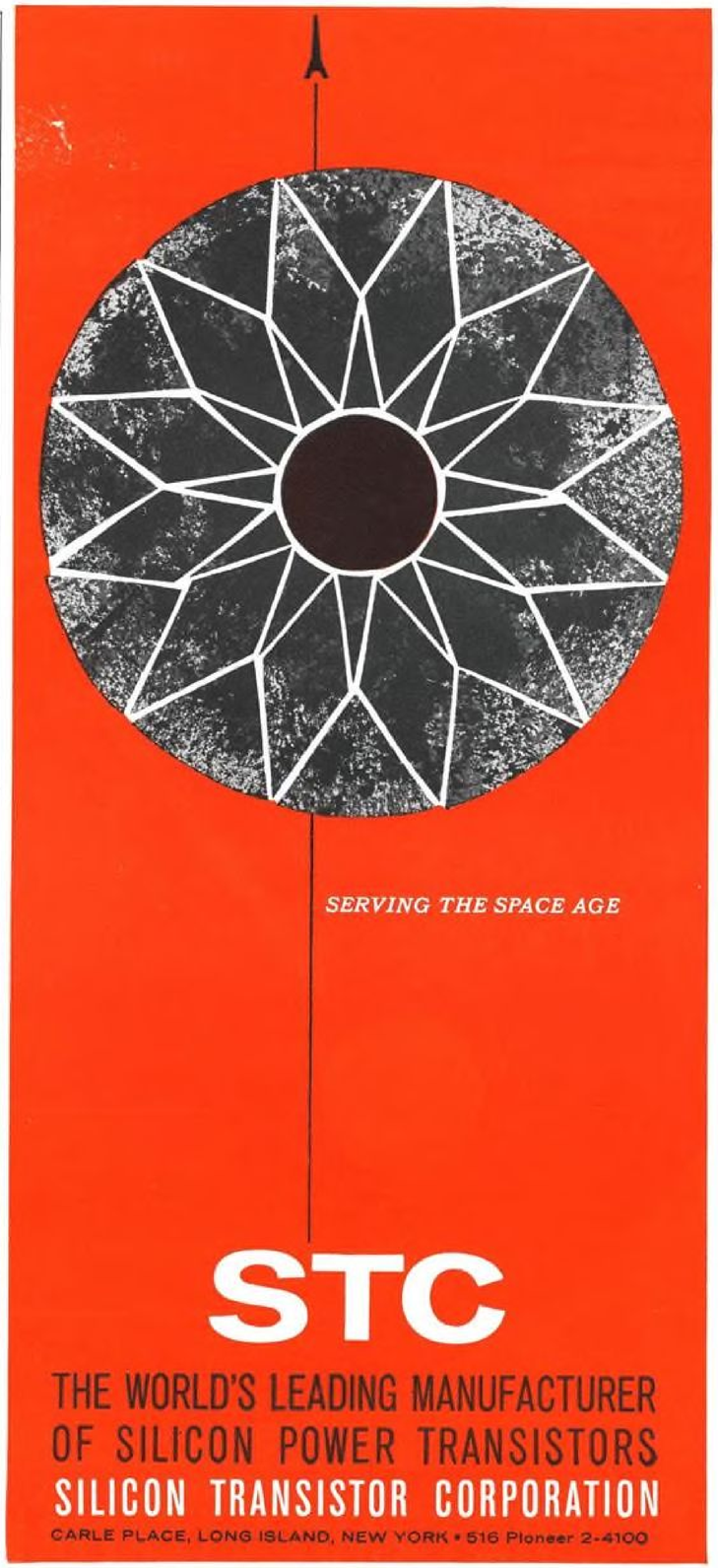
Sept. 8-11—International Symposium on High-Temperature Technology, Asilomar, Calif. Sponsor: Stanford Research Institute.

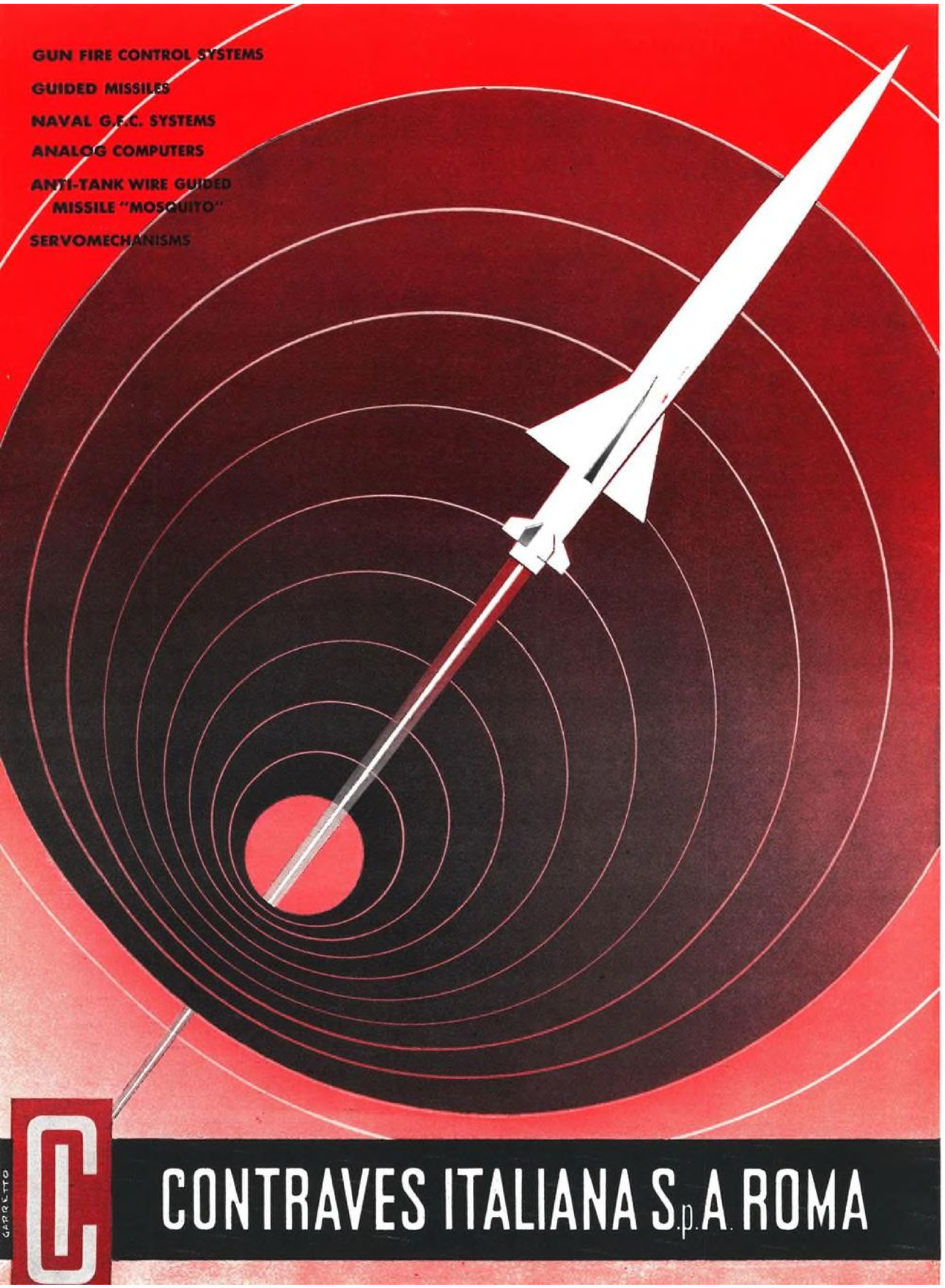
Sept. 8-11—Annual Meeting, Air Industries Assn. of Canada, Manoir Richelieu, Murray Bay, Quebec.

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

Sept. 9-12—18th Annual Instrument-Automation Conference & Exhibit, Instrument

(*Continued on page 9*)





AEROSPACE CALENDAR

(*Continued from page 7*)

Society of America, McCormick Place, Chicago, Ill.

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

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

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

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

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

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

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

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

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

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

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

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

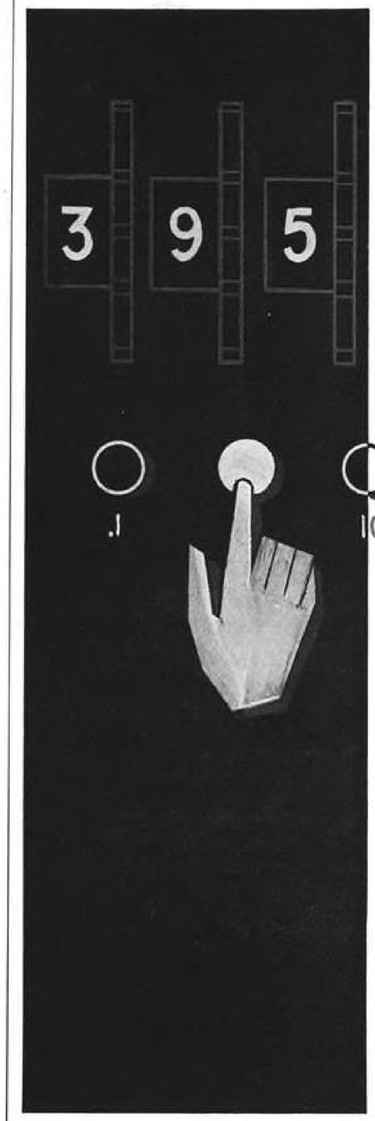
Oct. 9-11—21st Annual Aerospace Electrical/Electronics Conference, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

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

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

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

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



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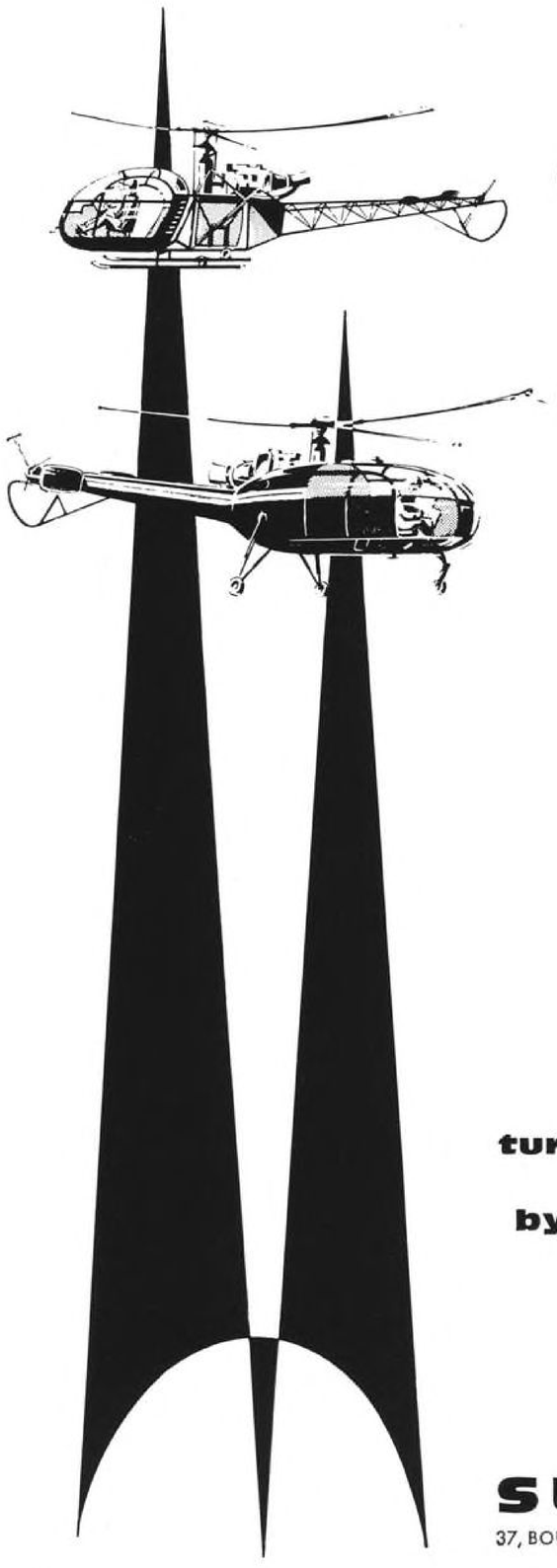

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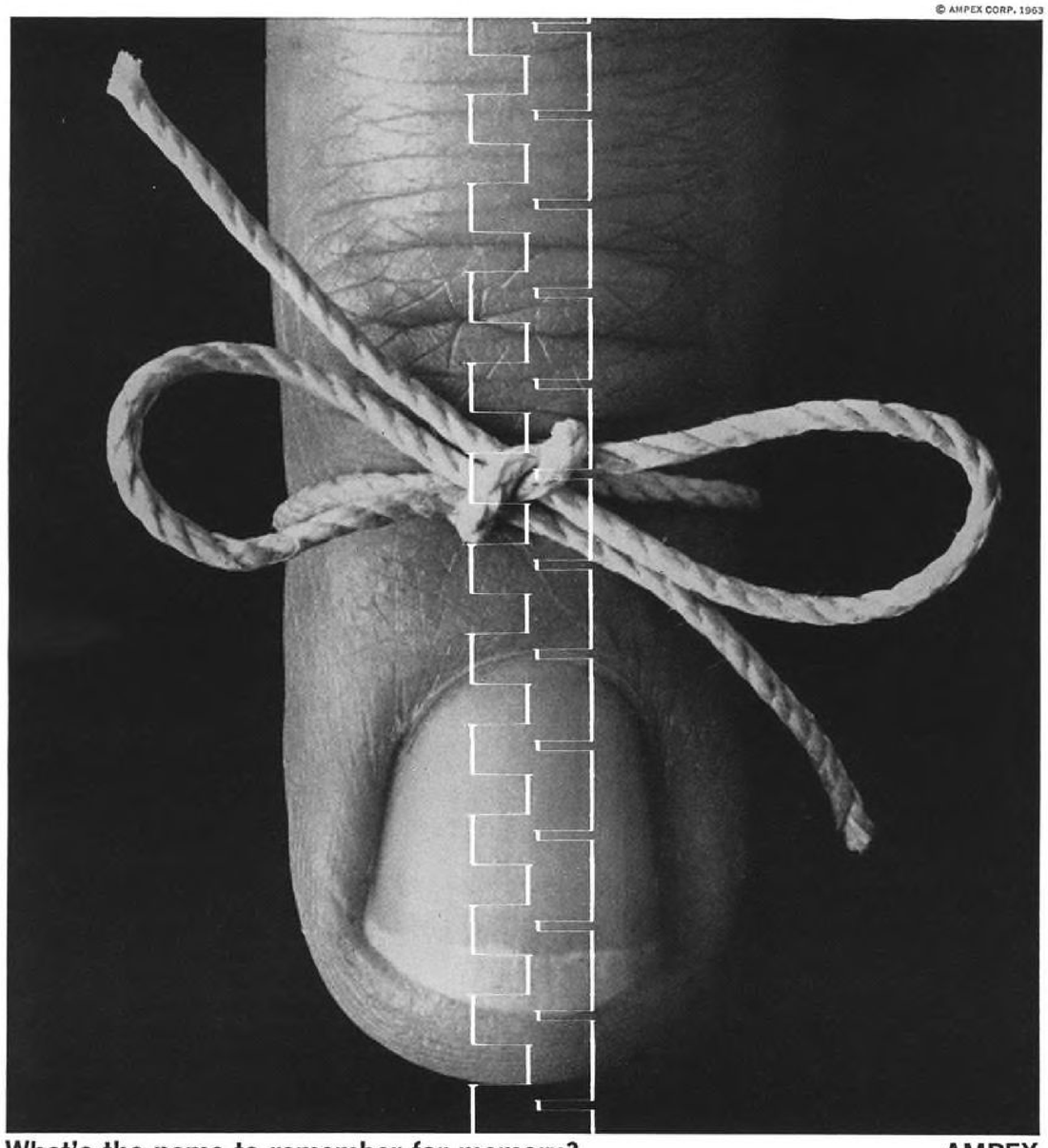

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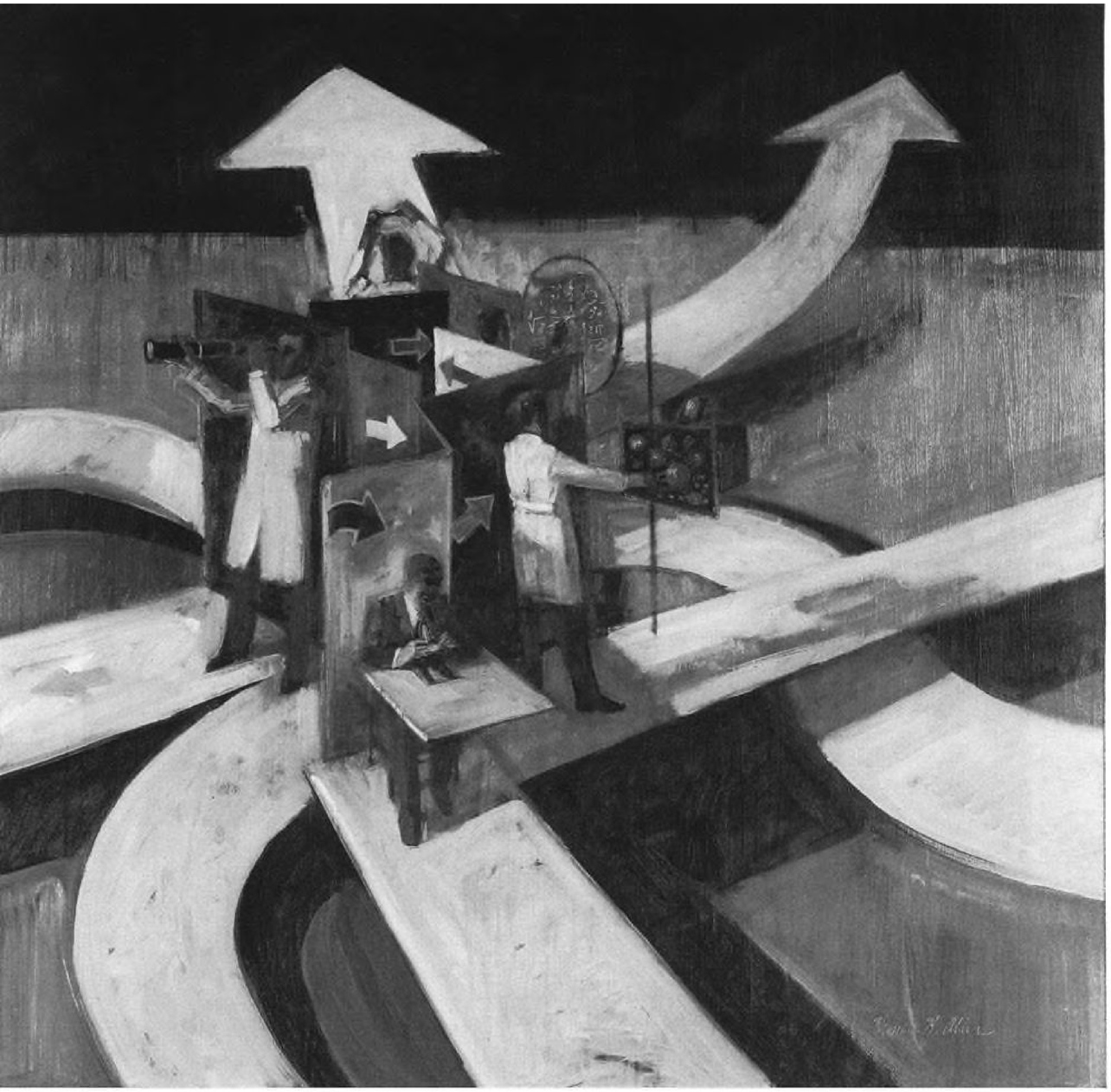

THE DISCONTENTED MEN "To be discontented with the divine discontent..." These words of Charles Kingsley describe a frame of mind most often found in the men of research.

For the phrase "divine discontent" could well define the creative impulse that motivates these men. It compels them to search again; to reject things not yet perfect... and to seek, over and over, their refinements.

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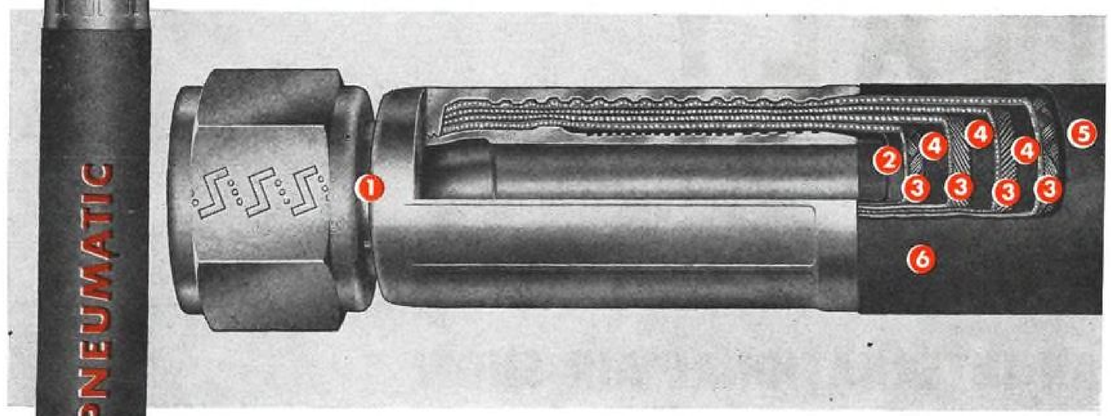

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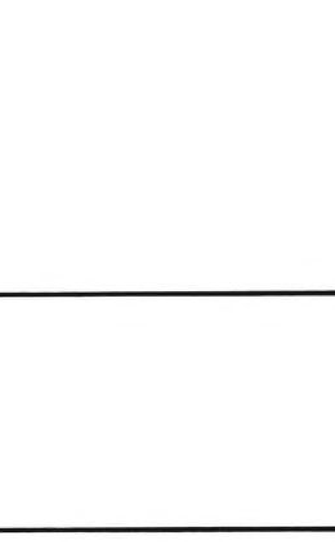

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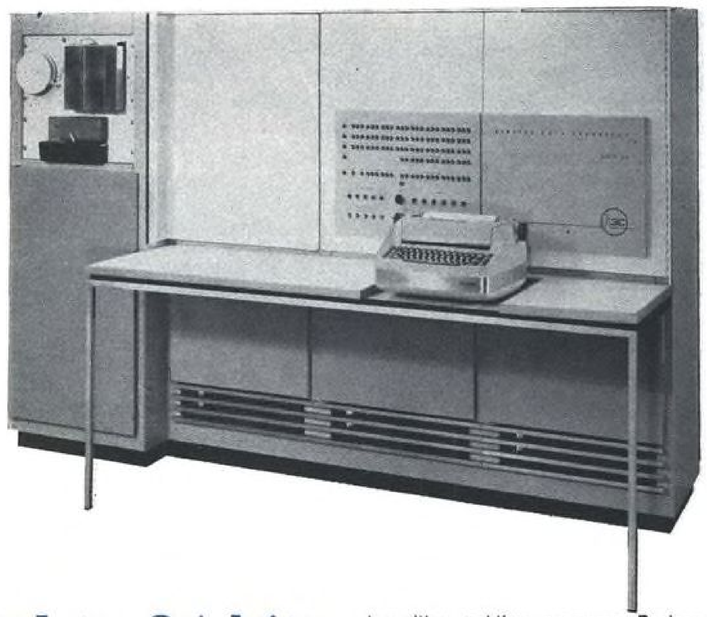

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DDP expanded to 24 bits Faster arithmetic unit Comprehensive software

DDP-24 is a parallel 24-bit word, core memory, sign-magnitude, binary, general purpose computer, with indexing and indirect addressing. Instruction repertoire includes multiply and divide, load and store, shifting, logical, jump, index, and input/output. Standard memory capacity is 4096 words (optionally expandable).

Simplicity, maintainability, user convenience are factors of design. Regulated power supplies and power failure protection preserve integrity of computation. Ready and interrupt modes give DDP-24 master or slave relationship with external equipment. Optional independent memory banks and fully buffered channels give true input, output, and compute overlap.

SPEED

Computation rate is 100,000 additions per second. Multiplication takes 31 microseconds, division 33 microseconds. Times include instruction and operand access. Other arithmetic speeds:

Add floating point	125μ/secs. max.
Multiply floating point	99μ/secs.
Add double precision fixed	55μ/secs.
Add double precision floating	181μ/secs.
Multiply double precision fixed	263μ/secs.
Multiply double precision floating	371μ/secs.

Core memory cycle time is five microseconds with three microsecond access. Input and output can occur asynchronously and be interleaved with processing at transfer rates up to 166,000 24-bit words per second.

INPUT-OUTPUT

Strong input-output capabilities enhance communication with surrounding equipment; offer unique freedom of system implementation. Standard DDP-24 incorporates an eight-bit I/O character buffer register and channels, a 24-bit parallel input channel, a 24-bit parallel output channel, sixteen lines for external sense inputs, eight output control pulse lines, and four interrupt lines capable of asynchronous operation with the associated four basic input-output channels. Standard I/O equipment: typewriter, paper tape reader, punch.

SOFTWARE

Programming software provided with the DDP-24 is comprehensive; satisfying professional programmers writing complex routines, mathematical analysts, and the occasional user. Fortran II, DAP, and DIP are modular, patterned after SHARE, easily adapted to specific hardware configurations. Diagnostics for rapid isolation of programming and system faults are included. Also provided: mathematical subroutines, number conversion, memory dump, library routines, master executive program, load program, and computer exercise routines.

Fortran II compiler permits investigation and development of math models prior to writing real-time programs. Boolean augmentation and macro calls are provided.

DAP — DDP-24 Assembler Program — with one-to-one and one-to-many assembly, facilitates tight real-time programs in convenient language.

DIP — DDP-24 Interpretive Program — permits users with minimum programming experience to generate scientific computation routines after only half a day's study.

OPTIONS

To offer still greater system adaptability and functional capabilities, extensive standard options and peripheral equipment are available for the DDP-24:

- ☐ core memory expansion to 16,384 words, with special expansion 32,768 words. (directly addressable)
- ☐ additional index register ☐ word forming buffers ☐ character I/O buffer registers ☐ interrupt lines ☐ eight level hardware interrupt priority system ☐ additional sense lines ☐ output control pulses ☐ parallel I/O channels.

I/O control units for maximized interlace and truly simultaneous operation:

- ☐ direct memory access control unit with unlimited channels ☐ fully buffered I/O control unit with unlimited channels.

Peripheral equipment optionally available: Magnetic tape control and transport units, A/D, D/A converters, card adapter, high speed line printer and adapter, digital plotter and adapter. Digital Resolver, satellite computer, increases DDP speed up to 10 times for algebraic and trigonometric functions. Other peripheral requirements can be fulfilled. Write for the full story.

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EDITORIAL

Spearhead Technology

The 25th international air show, which will soar to its climax at Le Bourget this week, provides a major opportunity to sense just how the major nations are faring in the spearhead technologies that constitute the aerospace industry. Of all the nations that are seriously working in the aerospace field, only the Soviet Union, with its introverted, mole-like attitude, will not be represented by products truly indicative of its current state-of-the-art developments. For the many thousands of Frenchmen who will jam Le Bourget on the flying weekends, the Paris air show is an exhilarating exhibition of flying, from the solo performances of the aerobatic aces to the precision formation maneuvers of the various national military teams. But for the thousands of aerospace technicians from all over the world, who thread their way slowly through the static technical exhibits and talk business in the company chalets, it is a rare opportunity to determine which way the technical winds are blowing and how the fortunes of individual companies and nations are changing as a result.

In the 20th Century, the aerospace industry has not only been a major measure of national military power, but has also served as a significant gage of national positions in the highly competitive technologies that pace modern industrial development across the entire spectrum of the economy. In the postwar era, the development of national aerospace power, with supersonic aircraft and intercontinental ballistic missiles, has largely overshadowed the economic importance of a vigorous, technically alert aerospace industry to each national economy involved. In the modern world the fortunes of a nation's economy inexorably depend on the progress of its technology. The aerospace industry has made a habit of pushing hardest on most of the new technologies that are the true measure of technical progress, such as electronics, nucleonics, advanced metallurgy and materials development and the ever-expanding speed range of aerodynamics into the hypervelocities of missiles and re-entry from outer space.

Early British Lead

It is the nations that make the basic investment to push their national representatives hardest in these spearhead technologies that are bound to play the major roles in international affairs, as they are the keys to modern power as well as a significant economic force. The British got off to a strong start in this postwar competition, largely as a result of their wartime work on the gas turbine engine. The technological foundations they laid during the first postwar decade reached a period of maximum return in the late 1950s, when British aeronautical exports ran at a level of over $400 million annually for four years from 1958 to 1961, before beginning a decline in 1962 that is expected to continue for the foreseeable future. Over half of the British 10-year export total of $3.3 billion in the 1952-62 decade resulted from their initial dominance of the gas turbine engine technology. During this period British aviation exports passed up such traditional leaders as scotch whisky, automobiles and textiles as the prime source of foreign exchange. The current decline is the direct result of a period of false economy, brought about by government leaders who refused to make the investments in research and development required to keep up the hot pace of the supersonic and space era. Ironically, the significance of these crippling economies were lost on the treasury types who inflicted them, because they failed to understand that the peak levels of exports that then prevailed could be supported for the future only through adequate investment in research and development.

In contrast, the French aviation industry rose like a phoenix from its wartime ashes to a point where at the 1957 Paris air show we were able to write, "there is little doubt that the French are becoming the dominant force in European aviation" (June 10, 1957, p. 21). In the last four years the French economy has reaped a good harvest —almost a billion dollars in export business—from those technical developments that were just sprouting in 1957. French aviation exports have grown to the point where they are now just a shade behind the British total, have taken several of the key British markets away and will challenge the British severely for European leadership in the future.

French Drive Continues

The French are still pursuing these spearhead technologies wherever they lead, regardless of how high the initial cost must appear at times. They are continuing their own development of nuclear weapons and their supersonic delivery systems, they are pushing technically sophisticated electronics and propulsion developments and they are determined to develop their own space technology. The current French government is sufficiently realistic to recognize that whether the weapons these technologies develop are ever used or not, the industrial techniques that fall out into the general economy from this weapons research and development are absolutely essential to the maintenance of a first-class modern nation.

It is interesting to note that the U.S. has exported $10.6 billion in aeronautical products during the last decade with the largest annual volumes—averaging about $1.3 billion annually—during the 1960-62 period when U.S.-manufactured jet transports were swelling the international airline fleets of the world.

The Anglo-French Concorde supersonic transport project (see p. 40) has the capability of challenging the U.S. lead in the lucrative jet transport market of the future, although this race is far from run. But the figures cited above are a reminder to short-sighted politicians that the real question in maintaining a superior aerospace industry is not whether a nation can afford it but whether a nation can truly afford not to have it.

—Robert Hotz

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In the Front Office

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John A. Huston, vice president-legal, Sperry Divisions of Sperry Rand Corp., Great Neck, N.Y., and **Carlyle H. Jones,** vice president-public relations.

Glenn R. Lord, corporate vice president-marketing, Northrop Corp., Beverly Hills, Calif.

Capt. Otis C. Ferrell (USN, ret.), vice president-planning, LFE Electronics, a division of Laboratory For Electronics, Inc., Boston, Mass.

Harold A. Olsen, vice president-traffic and sales, elected a director of Pacific Northern Airlines.

Mrs. O. A. Beech, president of Beech Aircraft Corp., named president and board chairman of Beechcraft A. G., Zurich, Switzerland, a newly formed Beech subsidiary. Other directors include: **Michael G. Neuburger,** vice president-export sales for Beech; **Dr. Eric Homburger,** Zurich attorney; **Dr. Hans R. Frey,** an officer of the Swiss Credit Corp.; **Robert C. Gerber.** Mr. Gerber is resident manager of the new company.

Marlin G. Kroger, assistant to the president of Autonetics Div. of North American Aviation, Inc., Anaheim, Calif., responsible for evaluation, planning and policy director-command and control activities.

Robert E. Eaton, group controller, Hughes Aircraft Co.'s Ground Systems Group, Fullerton, Calif.

Francis P. Cotter, a vice president, Westinghouse Electric Corp.; as the representative of the company's Atomic, Defense and Space Group, Mr. Cotter will be located in Washington, D.C.

Honors and Elections

Maj. Robert G. Sowers, Capt. Robert MacDonald and **Capt. John T. Walton,** crew of a Strategic Air Command/General Dynamics B-58 Hustler, have been selected to receive the 1962 MacKay Trophy "for the most meritorious flight of the year" for establishing three new transcontinental speed records on Mar. 5, 1962.

Prof. A. R. Collar, Professor of Aeronautical Engineering at the University of Bristol, has taken office as President of the Royal Aeronautical Society for 1963-64, succeeding **B. S. Shenstone** of British European Airways.

George A. Van Epps, supervisory investigator of the CAB's New York Office, has received the first Frederick J. Fleming Award for Air Safety, 1963, "in recognition of his outstanding service as a CAB Air Safety Investigator."

William Littlewood, vice president-equipment research for American Airlines, has received the 1962 Monsanto Aviation Safety Award from the Aviation/Space Writers Assn. for having made the year's "most significant and lasting contribution to aircraft operating safety."

(Continued on page 199)

INDUSTRY OBSERVER

► Concept for a "Super Minuteman" ICBM, under study at Aerospace Corp. for USAF, would use a solid-propellant first stage exceeding 100 in. in diameter. This would allow much larger payloads than possible on the current Minuteman, which has a 65-in.-dia. first stage. Super Minuteman would use existing Minuteman launch silos.

► **Bureau of Naval Weapons this month will request industry proposals toward prime contractor selection for an integrated avionics system in the VAX attack aircraft. This will be followed by a series of proposal requests from Naval Air Development Center for development of seven major subsystems for the integrated avionics system. Subsystems, which are to make maximum use of microcircuit construction, include Tacan navigation system, UHF transceiver, emergency radio receiver, UHF direction finder, data link, data link converter and an IFF identification beacon.**

► Balsa wood bonded between two sheets of aluminum will be used for the skin of the Vought-Hiller-Ryan XC-142A tilt-wing V/STOL transport. Material is expected to provide a high-strength, low-weight structure that will absorb sound and vibration. Chance Vought has begun fabricating some panels and is building assembly jigs for the aircraft.

► **De Havilland CV-2 Caribous have played a major role in transferring Vietnam villagers from their homes to strategic hamlets organized to repel Viet Cong attacks. Caribous, which carry 32 troops, usually carry 60 villagers.**

► Extension of the hybrid rocket motor technique is being considered by United Technology Center to create a "tribrid" motor. It would include in the core space of the solid fuel-liquid oxidizer motor an additional solid-fuel charge which cannot be mixed with the basic fuel because of chemical incompatability. Use of the two solids would give a higher specific impulse than obtainable with either used separately.

► **Philco, one of two companies selected to conduct a program definition phase study for the military communication satellite, has proposed an incentive-type contract for the construction phase in which the company's profit would be keyed directly to the satellite's operational lifetime in orbit.**

► Army helicopter experience in Vietnam has shown a definite need for an accurate low-level navigation system that will permit aircraft to make zigzag and multiple approaches to troop and cargo drop zones and target areas. This would increase tactical capability by reducing traffic control problems and confusing the enemy's warning systems.

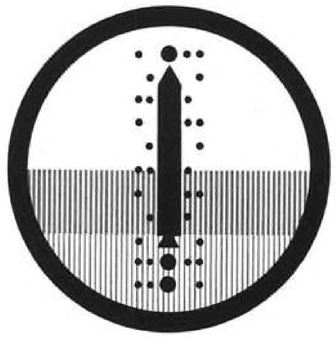
► **Atlas F ICBM using a relatively small percentage of oxygen difluoride as an additive to the liquid oxygen in the missile's propellant is scheduled to be launched soon at Cape Canaveral. Propellant formula for the test is expected to indicate the magnitude of specific impulse and payload increases that may be obtained by using a new propellant of this type.**

► Eight companies have submitted proposals for Navy's HHX integrated helicopter avionics system competition. Bureau of Naval Weapons expects to select the winning contractor this month.

► **NASA will select a contractor to conduct an independent mathematical reliability study of the Advanced Syncom satellite (see p. 108) in an apparent effort to increase confidence in the prospective lifetime of the satellite.**

► Use of lasers for semi-active (beam-riding) missile guidance will be studied by Radio Corp. of America's Aerospace Communications and Controls Div. and North American Aviation's Autonetics Div. under contracts to be awarded by Army Missile Command. Autonetics' approach will utilize adaptation of monopulse radar techniques.

► **First components of Aerospace Plane will be sent to the structures laboratory at Wright-Patterson AFB around the first of the year. Parts of several designs may be tested.**



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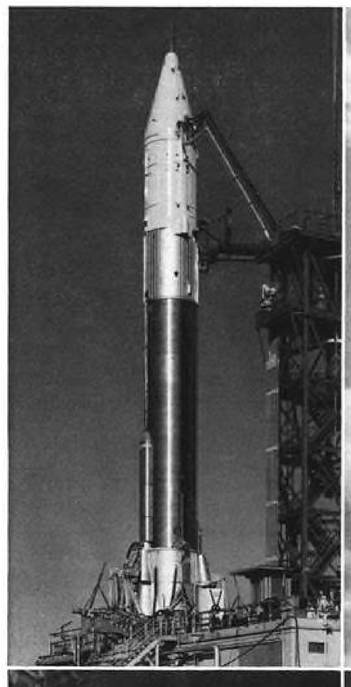

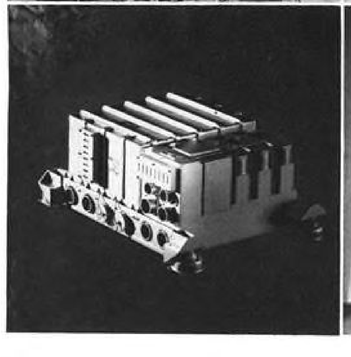

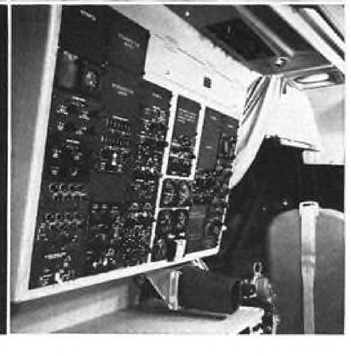

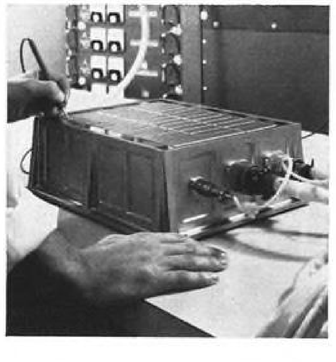

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Washington Roundup

Space Budget Cuts

House space committee this week will decide on subcommittee recommendations for cutting National Aeronautics and Space Administration's $5.7-billion Fiscal 1964 budget by about $500 million.

Manned space flight subcommittee is recommending a slash of $300 million, while the space sciences and data acquisition subcommittees are proposing reductions of $100 million each. But the full committee probably will restore about half of the proposed $500-million cut before sending the bill to the floor next week.

Many of the cuts will be made with the understanding NASA can obtain restoration early next year if the agency can prove the cuts are hurting its program. Space committee leaders decry the vagueness of NASA officials in trying to justify many of their money requests this year.

One likely victim of the budget cutters is the new electronics center for the Boston area. NASA wants $5 million to start the facility in Fiscal 1964, but there are growing doubts among House and Senate space committee members that the facility, which eventually will cost $50 million, is really needed. Cutting the money request for the center would be especially embarrassing to the President's brother, Sen. Teddy Kennedy, who was elected under the banner of "He can do more for Massachusetts."

Sizable cuts are proposed in NASA's money requests for the M-1 liquid hydrogen engine, supersonic transport, surveyor orbiter, Mariner, Ranger, nuclear rocket and advanced re-entry research programs.

NASA Field Maneuver

Announcement that NASA will enlarge its pool of astronauts (see p. 38) was timed to strengthen the hands of space agency officials who oppose letting the first 16 pilots sell Field Enterprises the rights to their personal stories for $3.2 million. Adding 10 or 15 astronauts will dilute the relative importance of any one pilot as a public figure. This is expected to complicate negotiations over the Field contract, which has not yet been signed, and to force a re-evaluation of the whole idea.

Although the White House approves of the contract, most officials in NASA headquarters and at the Manned Spacecraft Center oppose both the Field contract and a similar contract which the first seven astronauts signed with Life Magazine. They feel that NASA's approval of the Life contract in 1959 helped create a public relations problem that has been a continuous source of embarrassment to the agency.

Tighter R&D Control

Congress is tightening its grip on military research and development funding by giving the House and Senate armed services committees the power to approve all such budget requests before the money can be appropriated.

Right now the approval authority of these committees over research funds applies only to aircraft, missiles and ships. The additional authority is provided in language quietly added to the $1.6-billion military construction bill passed by the House last week. Senate passage is virtually certain.

New authority becomes effective Jan. 1, and will cover about $7 billion in research money requests, compared with about $3 billion under current law.

Dr. Eugene Fubini will succeed John H. Rubel as deputy director of Defense Dept. research and engineering this week (AW Apr. 29, p. 21). Rubel plans to return to private industry. Fubini moves up from the post of DDRE's deputy director for research and information systems. He came to the Pentagon two years ago from Airborne Instruments Laboratory and helped perfect radar during World War 2 as a member of a pioneering group at Massachusetts Institute of Technology Radiation Laboratory. The group included Dr. Jerome B. Wiesner, the President's science adviser.

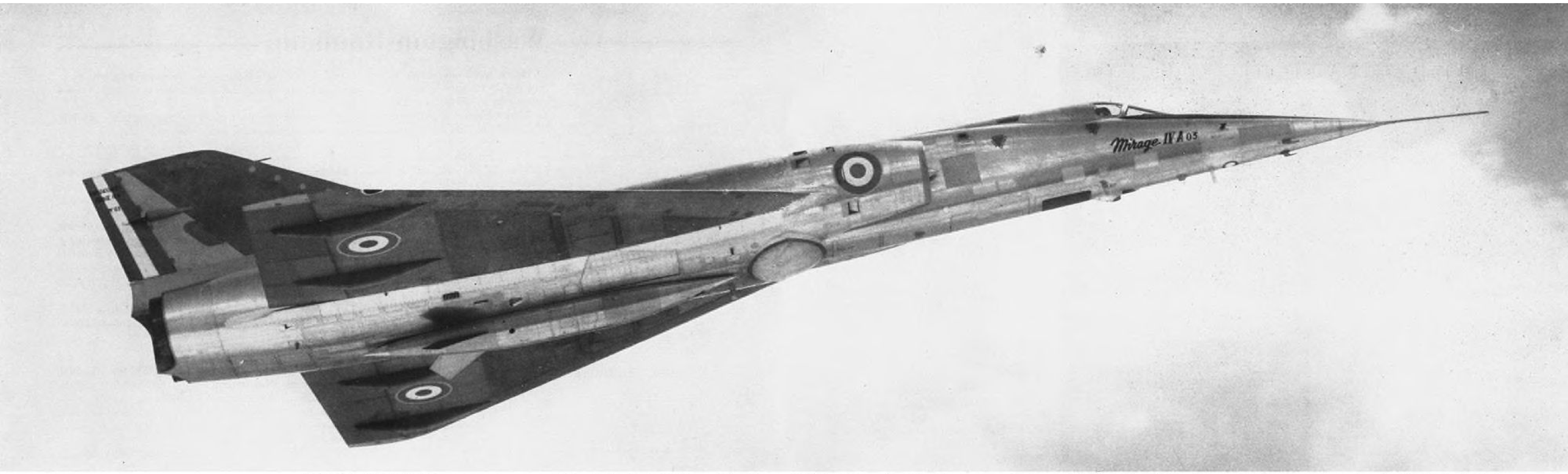
Soviet U-2='Mandrake'

Mandrake is North Atlantic Treaty Organization code name for the Soviet high-altitude reconnaissance aircraft nicknamed "Uski-Twoski" (AW June 3, p. 26). Mandrake is suspected to be the aircraft India reported flying over its territory recently. Russian aerial reconnaissance is heavy in that area.

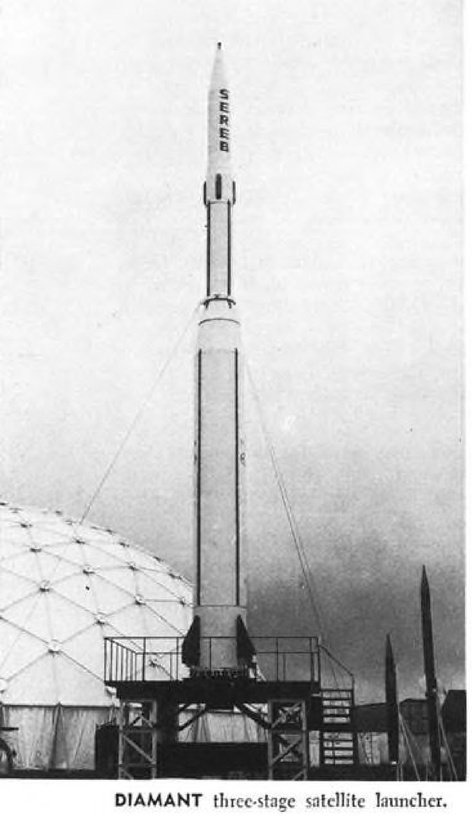
Another type of reconnaissance is suspected of some of the Russian Cosmos satellites. Theory is the satellites are equipped with aerial reconnaissance equipment to help determine the effectiveness of U. S. Samos satellites passing over Russia. U. S. officials contend it is unlikely all the Cosmos satellites would be placed in extremely low-altitude orbits, far below the inner Van Allen radiation belt, if the objectives were purely scientific.

Navy study on what type of strike forces it should build for the future has run aground somewhere within the Navy secretary's office. The study, performed under a group headed by Vice Adm. William A. Schoech, deputy chief of naval operations for air, was finished May 15 and is overdue at Defense Secretary Robert S. McNamara's office.

—Washington Staff



SYMBOLIC OF FRANCE'S growing aerospace capability is the Mach 2 Mirage 4 bomber. Third prototype shown here has an array of antennas, including a large belly radome, and a finned weapons pod partly faired into the belly.



DIAMANT three-stage satellite launcher.

Paris Air Show Stresses Surge by French Aerospace Industry

By Cecil Brownlow

Paris—New evidence of the French aviation industry's successful drive for pre-eminence in Europe, its expansion into the space field and its determination to capture additional markets and national prestige is embodied in the 25th Paris Air Show which opened last week at Le Bourget Airport.

Aside from the exhibits themselves, including for the first time a special display of French research efforts in the space field, reports on the industry's progress included revelation of French plans to place a research satellite into orbit by late next year instead of 1965 using the French-developed Diamant three-stage launch vehicle, and of the Pan American World Airways order for six long-range versions of the Concorde Mach 2.2 supersonic transport, under joint development by France's Sud Aviation and British Aircraft Corp.

Name of the show itself has been altered to reflect France's expansion into the space arena. Formerly known simply as the International Air Show, the exhibition this year is called the International Air and Space Show.

Thirty-seven exhibitors are represented in the French space display, which includes mockups of the SEPR Phaton satellite vehicle being designed with the capability of changing angle and inclination of orbit upon command from the ground; the Diamant launch vehicle, being developed also to carry a nuclear warhead over an IRBM trajectory, and the Veronique booster system that will form the second stage of a multination three-stage launch vehicle under development by the European Launcher Development Organization.

Snecma on its company stand also is displaying a mockup of a proposed television relay satellite.

In the scheduled 1964 satellite launch, Diamant is to place a 175-lb. payload into a relatively shallow orbit. The three-stage booster system weighs approximately 18 metric tons and its height is 53.4 ft.

The U. S. is the only other nation of 17 represented at the show with a single exhibit devoted largely to space. In the U. S. exhibit, which includes a number of satellite designs, is the McDonnell Mercury capsule used by Astronaut Walter M. Schirra during his six-orbit flight in October, 1962.

On the aircraft side, France is exhibiting 33 airplanes, some of them for the first time. These range from Dassault's Balzac VTOL testbed for the Mirage 3V supersonic fighter to a group of light aircraft. Aside from the Balzac, new models include:

- **Breguet 1150 Atlantic** long-range turboprop maritime patrol aircraft, a French-designed and managed program being developed with other nations under sponsorship of the North Atlantic Treaty Organization.
- **Transall C.160** turboprop transport designed for both military and civil use, under development as a Franco-German project.
- **Sud SA. 3210 Super Frelon** heavy military turbine-powered helicopter. First two prototypes are now flying and both are to be at the air show, one configured for Army use, the second as a Navy ASW search vehicle.
- **Prototype of the Dassault Mystere 20** executive jet transport. This privately financed aircraft first flew early last month and is making its initial public appearance at Le Bourget. (Details on all the projects are covered in articles beginning on p. 72.)

First opportunity for a concurrent look at two differing approaches to VTOL flight is provided at the show. The Balzac, which uses eight Rolls-Royce RB.108 lift engines during its vertical flight regimes, is being joined by Britain's Hawker P.1127, which relies upon a single Bristol Siddeley BS.53

RAYTHEON HAWK low-altitude anti-aircraft missile unit is being exhibited at the Paris Air Show. The unit on display was produced in Europe under license by a North Atlantic Treaty Organization consortium. The missiles carry NATO markings. Hawk is 16.5 ft. long, with 4-ft. span and has a body diameter of 3 ft. The weapon system uses a semi-active homing radar for guidance, has a maximum range of 22 naut. mi.

MODEL OF FINAL DESIGN of Fokker F.28 short-range turbojet transport shows straight wing, T-tail and podded rear engine configuration. Interior view shows both four- and five-abreast seating arrangements. Fokker says seat mile cost of the 40-60 passenger aircraft would be 1.44 cents at ranges of 600 mi. Aircraft's maximum takeoff weight is 54,000 lb. and planned cruise speed is 500 mph.

PROPOSED JET VERSION of the double-decked Short Belfast transport, shown in model form, would carry 150 passengers on upper deck and 100,000 lb. cargo below.

deflectable-thrust powerplant for both VTOL and horizontal flight.

De Havilland's DH-125 executive jet transport, regarded by Dassault as the major competitor to the Mystere 20, also is on display.

Over-all, the show has expanded to a point 30% larger than its 1961 predecessor, with a total of 407 exhibitors and approximately 150 aircraft on hand, including scheduled displays by four East European countries—the Soviet Union, Czechoslovakia, Yugoslavia and Poland.

U. S. Aircraft

In sheer number of aircraft, the U. S. leads with a total of 55. Totals from other nations include 27 from the United Kingdom, 10 from Italy, 7 from West Germany, 3 from Poland, 2 from Canada, 2 from Switzerland, 2 from Czechoslovakia, and 1 each from Austria, Belgium, Sweden and Yugoslavia.

Russia has delayed dispatching any aircraft to the show and had not informed French authorities prior to the opening as to just what it intended to display, a stratagem it has followed in the past. At previous shows, it exhibited only established commercial transport models, shying away from any display of military aircraft.

Poland's entries include two gliders—the S.Z.D. 19-2A Zefir 2 and S.Z.D. 24C—and one helicopter, the SM 1, a Polish-built version of Soviet-designed Mi-1 four-place general purpose helicopter.

The Czech display also is conventional featuring the much-exposed and aging two-place Z. 326 Trener-Master basic trainer and the L200M Morava twin-engine executive aircraft. Absent is the new Czech L-29 jet trainer.

Yugoslavia, however, is exhibiting its twin-jet Galeb trainer built by the Soko Co. and powered by French Turbomeca Marbore powerplants.

U. S. Military Exhibit

U. S. military exhibit includes the Northrop T-38 jet trainer; North American T-39 Sabreliner and the Lockheed C-140 utility jets; McDonnell's F-101 close-support and reconnaissance aircraft and F4B Navy all-weather fighter; Republic F-105 fighter-bomber; Convair F-102 and 106 interceptors; Lockheed C-130 turboprop transport and P3A turboprop maritime patrol aircraft; Boeing KC-135 jet tanker; North American Aviation A5A Vigilante Navy attack plane; Douglas A4D attack aircraft; Grumman E1B tracker-early warning aircraft, S-2D tracker-anti-submarine aircraft, G159 Gulfstream turboprop transport and OV-1A Mohawk two-seat Army observation plane.

American helicopters on display include Kaman's H-43 Huskie, Bell's UH-1D Iroquois and Sikorsky's CH-3B, which made the second transatlantic helicopter flight in history last week on its trip to the show.

New German vehicles include Dornier's Do.32 one-man helicopter and the Weserflug-Sikorsky WS.64 turbine powered flying crane helicopter. Crane on display in Paris was built by Sikorsky, but units also are scheduled to be produced under license by the German firm.

Static Display

Static display includes models of two new projects under consideration by Bolkow-Entwicklungen—one a 24-place feeder-liner rotorcraft built around the company's high speed lead lag rotor system, and the other a 14-place STOL short-range transport.

The Bolkow rotorcraft is apparently the most serious of the two projects, incorporates two lead-lag rotor blade units fitted on pylons at the ends of stub wing projections plus two forward-thrust propellers attached at each wing tip. Power for both rotor and propeller units is to be supplied by two jet powerplants attached directly to pulling propellers.

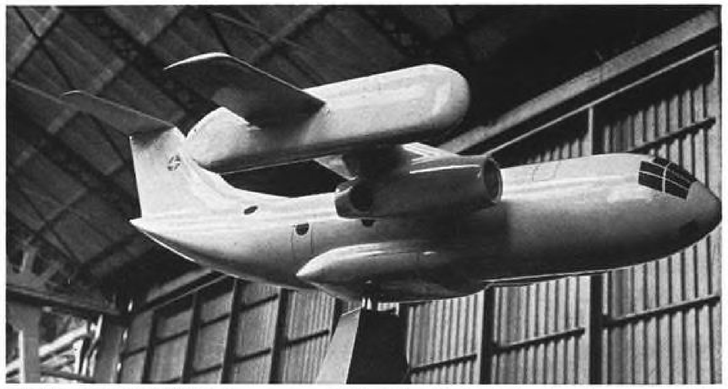
Engines currently under consideration are the Lycoming T-55 and the General Electric T-64, each of which is rated at between 3,200 and 3,400 shp. takeoff power. Cruising speed at 10,000 ft. is quoted at 270 kt. and range with 20 min. reserves is reported as 430 mi.

High-wing STOL transport, BS-210, was designed in cooperation with Siebelwerke ATG GmbH to carry a maximum load of 12 passengers and two crew members over 300-mi. stage lengths. With decreased payload—six passengers and two crewmen—range could be extended to 880 mi. Maximum speed for the aircraft, powered by two Turbomeca Astazou 2 turboprop engines of 530 shp. each, is quoted at 155 kt. Cruising speed would be 150 kt.

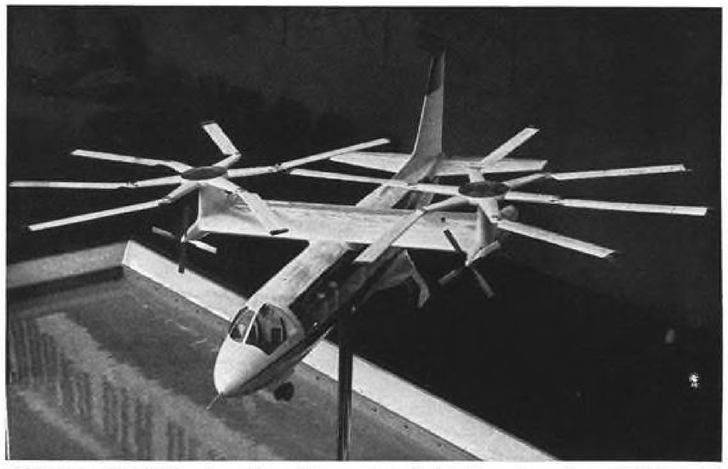
Flying Teams

Total of eight precision flying teams are scheduled to participate in the final two-day flight exhibition which begins on Saturday. They are:

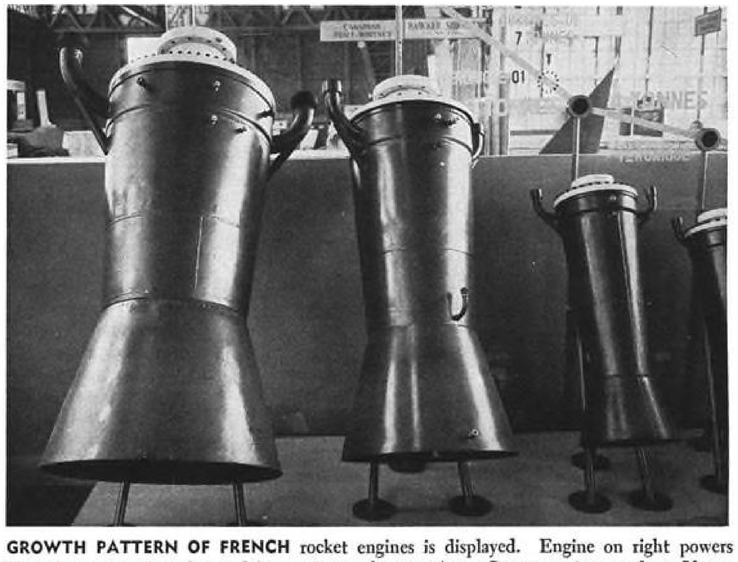
- **USAF Thunderbirds,** flying North American F-100s.
- **France's Patrouille de France** with Dassault Mystere 4s.
- **Greek team with Republic** F-84Fs.
- **Swedish group,** a new entry, flying Saab J-35 jet fighters.
- **Italian unit** with North American F-86s.
- **France's Patrouille** de l'Ecole de l'Air using Potez Fouga CM 170 jet trainers.
- **Royal Air Force "firebirds"** flying English Electric P.1 Lightning all-weather interceptors.



DORNIER DO.31 V/STOL transport model is being displayed for the first time. Under development for the German Air Force, Do.31 will have Rolls-Royce RB.162 lift engines and Bristol Siddeley BS.53s.



PROPOSED BOLKOW rotorcraft employs company's lead-lag rotor system (AW Jan. 28, p. 29) plus conventional propellers.



GROWTH PATTERN OF FRENCH rocket engines is displayed. Engine on right powers Veronique research rocket and has a six-ton thrust rating. Center engine, used on Vesta, is rated at 16 tons and engine at left, rated at 30 tons, powers Diamant.

Soviets Planning New Deep Space Probes

By Warren C. Wetmore

Warsaw—Soviet space program for 1963 will entail investigations of deep space and the planets of the solar system, according to Soviet Academician A. A. Blagonravov—pointing to possible renewed efforts this year to accomplish flybys of Mars or Venus in the wake of two successive failures.

Blagonravov, who presented the USSR national report to the opening session of the sixth meeting of the Committee on Space Research (COSPAR) held here last week, further stated that biological and medical studies also are planned. The program of investigations of the upper atmosphere and circumterrestrial space will be continued by means of meteorological and geophysical sounding rockets (see box) and Cosmos-series satellites. The latter, he said, will be continued as long as necessary, indicating that the Soviets are seeking a broader base for their space activities rather than concentrating so heavily on manned space flight.

Concerning the unsuccessful Mars 1 probe, Blagonravov confirmed earlier reports (AW May 27, p. 24) that contact with the spacecraft was lost on Mar. 21 after a malfunction in its orientation system prevented the vehicle's two antennas from being pointed at the earth.

"The main objectives of the Mars 1 space probe," he said, "were the realization of long-term investigations of interplanetary space during the flight to the planet Mars and the testing of long-range radio communications." Possibility of close range observations of the planet was not mentioned.

During the flight, radio contact with the spacecraft was maintained at regular five-day intervals, using three onboard radio systems operating in the metric, decimetric and centimetric wave bands. Data from the instrumentation and information on systems status were stored in memory devices, and could be read out either by ground interrogation or under control of the spacecraft's programmer. Duration of the contacts was 1.5 to 2 hr., during which time trajectory measurements were also made.

Environmental control system maintained temperatures between 20C and 30C in the sealed section which contained the instruments. Power was furnished by a system of solar batteries in conjunction with chemical storage cells.

Long-range space communications center employed large antenna systems and amplifying equipment cooled by liquid helium—possibly maser amplifiers—to receive the signals from the distant probe. Mean power of the center's transmitters was 100 kw.

Shortly before contact was broken the distance to the probe was so great that 12 min. were required between transmission of a command and the receipt of the response. Soviets claim that the final contact with the spacecraft, at a distance of 66 million mi., established the record for long-distance communications.

Preliminary analysis of data obtained from the scientific instrumentation carried by the probe are consistent with the U. S. Mariner 2 probe findings.

Particle radiation was measured by conventional gas discharge and scintillation counters. Devices located inside the shell of the spacecraft counted particles with sufficient energy to penetrate the shell, while those located outside the shell recorded lower-energy particles. Launch trajectory of Mars 1 differed from those of the Soviet Venus probe and the Luniks in that it traversed the Van Allen radiation belts at high geomagnetic latitudes—suggesting a higher inclination of the parking orbit—while the others passed outside the inner belt and crossed the maximum of the outer belt at low latitudes. Radiation measurements indicated that the boundaries of the inner belt had changed considerably since 1959. Region of maximum intensity of the inner belt appeared to have receded from the earth since the Sputnik 3 measurements in 1958.

Interplanetary experiments on Mars 1 revealed that cosmic ray intensity had increased two-fold over the level recorded in 1959, an occurrence which was said to be related to the sunspot cycle. During passage through the magnetosphere, the probe's three-electrode charged-particle traps determined that the electron flux at the maximum of the outer belt was 2 to 4 times 10^8 electrons per sec. for particles with energies greater than 80 ev. Also confirmed was the fact that an ionized gas envelope extends to an altitude of approximately 12,400 mi. and that only low electron fluxes occur beyond the magnetosphere.

Multi-electrode modulation trap was used for determining the positive ion energy of the solar wind for ions with energies greater than 3.2 kev. Solar wind was continuously sampled in the region outside the earth's orbit and was found to fluctuate between a minimum of 3 times 10^7 and 10^8 ions per sq. cm./sec. Unicomponent magnetometer onboard Mars 1 had a sensitivity threshold of two gammas, or lower than that of Mariner 2. Sensor was installed at 45 deg. to the spacecraft's rotational axis, which revolved at one-quarter rpm., thus causing the sensor to describe a cone and permitting readings in opposite directions. Data obtained indicates that the value of the measured field component averaged 3 to 4 gammas and on several occasions registered as high as 6 to 9 gammas.

During these measurements the rotational axis of the vehicle was constrained to within 30 deg. of the normal to the plane of its trajectory and to within 12 deg. of the sunline. Meteoroids with masses greater than 10^{-7} grams were detected by 16 sq. ft. of piezoelectric sensors.

On launch day—Nov. 1—the probe intercepted the Taurid swarm. Mean rate of meteoroid impacts at distances between 4,100 and 26,000 mi. from the earth was 7 times 10^{-8} per sq. m. per sec. Spatial density was extremely nonuniform. Spacecraft encountered another meteor swarm between 14 and 28 million miles from the earth, the existence of which was said previously to be unknown. This swarm resembled the Taurids in spatial density and distribution of matter.

Impact rate for sporadic meteoroids not associated with any swarm was approximately 10^{-6} per sq. m. per sec. Launching of 12 Cosmos-series satellites during 1962 demonstrates a renewed Soviet interest in the scientific exploration of space. This had been in abeyance since the end of the Sputnik launchings several years ago with the exception of experiments carried in the Vostok capsules.

Blagonravov outlined the program of investigations for the Cosmos satellites:

- **Charged particle density** in the ionosphere for the purpose of studying the mechanism of radio wave propagation.
- **Energy composition** of the Van Allen belts to estimate the danger of radiation during prolonged orbital flight.
- **Composition and variations** in intensity of cosmic rays.
- **Geomagnetic field.**
- **Ultra short electromagnetic radiation** from the sun and other heavenly bodies.
- **Upper atmosphere.**
- **Effect of meteoroids** on spacecraft materials.
- **Distribution and formation** of cloud systems in the earth's atmosphere.

Ionospheric studies were carried out by means of satellite-borne ion traps and by using radio waves. The latter technique is similar to that employed in the Canadian Alouette swept-frequency topside ionosphere sounding satellite, except that two fixed frequencies of 20.005 and 90.0225 mc. were used. Ground stations were described as multichannel coherent radio-receivers with phase and amplitude registrators. Sensitivity of these receivers was said to be high enough to permit reception of signals from the satellite with a phase difference of one-hundredth (0.01) cycle per sec.

Preliminary analysis of the data from these instruments revealed large-scale inhomogenieties in the ionosphere probably analogous to the ionization sheets observed by Alouette. Dimensions of these inhomogenieties were of the order of 60 to 290 mi.

Analysis of the Faraday effect—which gives rise to rapid changes in the amplitude of the received signals—gave local electron densities comparable to the results of ground-based measurements with coherent radio waves. Spherical and other unspecified types of ion traps showed that charged particle density variation with altitude had changed considerably with respect to the measurements made by Sputnik 3 in 1958. The decrease with altitude of electron density above the primary ionization maximum was observed to be more rapid last year.

Chemical composition of the upper atmosphere also was found to be changed. Atomic oxygen atoms predominated at altitudes above 370 mi. in 1958, but Cosmos measurements in 1962 revealed a substantial increase in the number of helium ions.

Cosmos satellites also carried fluorescent indicators, Geiger counters and charged particle traps for the investigation of geoactive particle radiation. Separation of particles was accomplished through the use of absorbing screens, permanent magnets and special modulators.

Fast ion fluxes observed were in some cases accompanied by electron fluxes of comparable size but flowing in the opposite direction, with energies not in excess of several kev. This points to the possible existence of ionospheric electromotive forces, Blagonravov said, which influence the location and motion of the particles, particularly those of lower energies. Sporadic electron fluxes were found to exist in two energy groupings—with tens of kev. and with several kev. of energy.

Electron fluxes over the South Atlantic anomaly also were investigated. Energies were observed to range up into the hundreds of kev., and the intensity increase with altitude peaked at a value of 10^8 electrons per sq. cm. per sec. at a height of 930 mi. Geiger counters shielded with 3 mm. of lead indicated that counting rates were less than 0.4 per sq. cm. per sec. 125 to 185 mi. above the geomagnetic equator.

Aluminum foil with area densities of 0.4 mg. per sq. cm. and higher was used for shielding the fluorescent indicators. No perceptible increase in their transparency due to micrometeorite erosion was noted during their exposure, which means that the number of micrometeorites is low in the region of the satellites' flights. Spatial distribution of the geomagnetically trapped particles in the outer Van Allen belt was investigated up to 250 mi. and data on the belt's stability in time and intensity were obtained. Latitude drift of the outer belt was observed to accompany the alteration of the sun-earth physical situation.

Mean density of the upper atmosphere in the region of the satellite's perigee was determined by observation of drag retardation of the satellite's motions. Daytime density increase in comparison with nocturnal minimum was noted—the same phenomenon found by U. S. observations of the Discoverer satellites. Energy spectrum of solar ultraviolet radiation was studied by use of langmuir probes and photoemitters, but no results were given.

Intergalactic and solar cosmic ray investigations using circular triple-incidence telescopes and ionization chambers were begun in 1962 and will be continued over the next few years, Blagonravov said. Extensive ground-based experiments also are being conducted, particularly radar-bounce and radio astronomical studies.

Radar contact with the planet Mercury—said to be the first—was made in 1962 at a distance of 54 million mi. Reflectivity of the surface of the planet was found to be similar to that of the lunar surface. Frequency used by Soviet interplanetary radars is approximately 700 mc.

Venus radar bounce was accomplished at inferior conjunction of that planet with the earth in 1962, and permitted refinement of the value of the astronomical unit obtained in 1961. This experiment also permitted an estimate of the rotational period of Venus. If it is assumed that the axis of the planet is perpendicular to the ecliptic plane, then retrograde rotation with a period of 300 days is possible—a figure which agrees closely with the period determined by Mariner 2. In November, 1962, Venus was used as a passive reflector for radio communication between two Soviet stations.

Radar bounce was accomplished during the opposition of Mars last February. Analysis of the spectrum of the reflected signal revealed a narrow band component less than four cycles wide, indicating that Mars has surface features with dimensions of a few miles. Part of the Martian surface had reflectivity higher than that of the moon. Brightness temperature variations of Venus were recorded by radio astronomy in wave lengths of 0.8, 1.6 and 3.3 cm.

Observations at the latter wavelength from the facility at Pulkovo failed to reveal any evidence of limb brightening that would be expected if the ionospheric model of the Venusian atmosphere (which permits lower surface temperatures) were valid—thus seconding the Mariner 2 findings that the surface of Venus must be extremely hot.

Soviet Launches

Warsaw—Total of 71 geophysical and meteorological sounding rockets were launched by the Soviet Union during 1962. Of these, 51 were fired from the high latitude observatory situated in the Franz Josef Land area of the Soviet Union, 19 from ships in the Pacific Ocean, and one from a medium-latitude location in the USSR. Month of highest activity was January, when 13 probes were launched from the Pacific Ocean ships.

Prime goal of these soundings—which were conducted up to altitudes of 310 mi.—was to obtain temperature, density and wind profiles of the upper atmosphere. Instrumentation carried by the rockets consisted of resistance electrothermometers, thermal and membrane manometers and parachutes for wind studies.

Soundings also determined that the value of the electrical field in the ionosphere ranges between 10^{-4} and 10^{-3} volts per cm. Electrostatic fluxmeter was used for this measurement.

Soviets Scout Carrier

Washington—Six Soviet twin-jet Tu-16 Badger bombers flew near the aircraft carrier U. S. S. Ranger June 4 in bad weather 330 mi. east of Japan as the carrier was on a great circle route from Yokosuka, Japan, to the U. S. West Coast.

Only one of the Soviet medium bombers made sight contact with the ship. The others seemed to have difficulty in locating it. The aircraft had been detected by the ship's radar and fighter interceptions were made between 65 and 100 mi. away.

Badgers had previously flown over the U. S. S. Kitty Hawk east of the Kurile Islands Jan. 27 and Feb. 3 (AW May 27, p. 28) and the U. S. S. Princeton Feb. 5. Russian M-4 Bison four-jet bombers had also flown close to these carriers. Tu-95 Bear four-turboprop aircraft flew over the U. S. S. Enterprise in the Atlantic Feb. 12 and 13 and the U. S. S. Constellation in the Pacific Mar. 16.

Navy Structure Survives Reorganization

By Larry Booda

Washington—Long-heralded reorganization of the Navy retains that service's traditional bi-lineal structure, and places the procurement bureaus under the chief of naval material.

The secretary of the Navy will retain direct control of basic research, development, production and part of the logistics activities. The chief of naval operations will generate material requirements as before, and will have to transmit them through the secretary. He will gain control of fleet support activities ashore, but will have only a monitoring function in relation to development.

What had been expected to be a shakeup resembling the abolishment of the Army's technical bureaus and consolidation of their functions under one command last year (AW Jan. 22, 1962, p. 34) has turned into a voluminous set of recommendations designed to fit the Navy's management processes into the over-all defense picture. This would be accomplished by shifting functions piecemeal and emphasizing coordination and consolidation in both of the lines of authority.

Navy Structure

Thus the Navy will remain radically different in structure from the Air Force and Army, representing a victory by these groups:

• **The relatively large management** group working in the executive office of the secretary (EXOS), and mainly controlled by career civilian employes. John H. Dillon, administrative assistant to the secretary, heads this group. It was he who was charged with the review of the management of the Dept. of the Navy as chairman of the advisory committee. The EXOS group has been described by senior naval officers as a "ministry of supply," run in hidebound fashion. In contrast, the immediate staffs of the secretaries of the Air Force and Army are relatively small and streamlined.

• **Congressional committees** with direct interest in defense structures, particularly the Senate and House armed services committees. Navy Secretary Fred Korth first approached Chairman Carl Vinson (D.-Ga.) of the House committee with the Dillon report last January and was told to hold the plan in abeyance until May 1 because of the press of other congressional business. As proposed by Dillon, considerable changes in laws pertaining to the structure of the Navy would have been necessary.

After the May 1 date passed and it was evident to Korth that he would have no immediate support from Congress in changing the laws, he changed the provisions of the Dillon report enough to make the necessary actions fit into the provisions of the Defense Act of 1958.

Dillon had proposed creation of the post of chief of naval support (AW June 3, p. 21), which would be a military command with direct control of the weapons, ships, yards and docks and supplies and accounts bureaus, plus widespread logistic support of the shore and sea activities.

The proposed title was changed to chief of naval material in a last-minute attempt to make the changes within current law. This office already exists, but in the plan its power would be expanded to provide a focal point for the fiscal and procurement bureaus.

Vinson and Chairman Richard B. Russell (D.-Ga.) of the Senate Armed Services Committee have little desire to see the Navy conform to the Air Force and Army pattern because if it did, further unification of the services could be accomplished easily by combining the procurement functions of the three services. This is said to be the reason the committee chairmen have stalled in changing the laws regarding the Navy.

It is the "two-hatted" nature of these positions that has created the most opposition within the Navy to the reorganization:

• **Material.** The chief of naval material will report directly to the secretary, but must be responsive to requirements generated by CNO and to continuous monitoring of development by the deputy chief for development (DCNO-development). A ranking officer of another service describes the task of the chief of naval material as "impossible" because in effect, he will have two groups of bosses—the military officers under CNO and the appointive and career civilians under the secretary.

• **Development.** DCNO-development last year was made a two-hatted billet. He actually has two bosses—the CNO and the secretary. This would remain unchanged.

• **Personnel.** The chief of naval personnel reports to the secretary of the Navy and DCNO-personnel to the CNO. Both personnel posts are held by the same person with the rank of vice admiral. This would remain unchanged, but the qualitative and quantitative aspects of naval manpower would be given to the CNO completely.

The dual nature of these jobs was one of the bones of contention between Secretary Korth and Adm. George W. Anderson, the outgoing CNO, which led the Administration to not appoint Adm. Anderson to a second term as CNO (AW May 13, p. 26). Adm. Anderson maintained that the reorganization further eroded the role of the military in administering the service.

Dissenting View

The published account of the management review group contains a dissent by the ranking military member, Adm. Claude V. Ricketts, Vice CNO. He maintains that the chief of naval support—now chief of naval material—organization would add an administrative layer between the bureaus and the secretary and CNO; that the office would become either a clerical one processing papers or would grow large with a staff of technical experts in every field of endeavor; and that if it does grow the bureaus will cease to function in everything but name. He does admit that, to be effective, the chief of naval material needs authority in all areas affecting the activities of the bureaus.

The one technical bureau which remains untouched is the Bureau of Medicine and Surgery. The activities of this bureau are described as unique and do not fit into the weapons and other material procurement structure.

The report recommended that a Fleet Activities Command be established under the CNO. It would abolish the Naval Operating Base and Naval District and River Commands. The naval districts now operating would come under this command, and their titles would be changed to naval operating base commands and district commandants. Thus all shore bases, airstations and other facilities will come under the Fleet Activities Command.

This command will be charged with direct support of the fleet. Many of these functions have been performed by the bureaus. They have been directly involved with the fleet units, bases and stations in providing logistic support. For instance, naval air stations have been dependent on the Bureau of Naval Weapons for fiscal and technical support, and other bases dependent on either the Bureau of Yards and Docks or the Bureau of Ships.

Maintenance of buildings, grounds and structures, and operation of utilities now under each of the bureaus at installations under its cognizance, will now be the responsibility of the Bureau of Yards and Docks. The Marine Corps would continue to maintain and operate its own facilities with the technical guidance of the Bureau of Yards and Docks.

The reorganization affects the Bureau of Supplies and Accounts more than any other. It will lose control of the naval working fund, which will shift to EXOS. Most of the bureau's pay and related functions will be transferred to the comptroller of the Navy, who is directly under the secretary.

The report recommends greater concentration on project management in the acquisition of weapons. At present, project managers have no central executive source but the secretary. The one special project manager is for the Polaris ballistic missile effort. He reports directly to the secretary. Other than that the project and program managers are in the separate bureaus.

The plan now is to place more systems on the project, rather than program, level and put them all under the chief of naval material. Like the Army, the Navy identifies about 30 projects which can be subject to special management techniques. Of these, about 10 are said to be of such importance that the chief of naval material should have direct control of them.

These projects will be placed under him because they have numerous interfaces among the bureaus. Most weapons, for instance, are developed by the Bureau of Weapons, but since they have to be placed aboard ship somehow, the Bureau of Ships must be involved closely in the designs and concepts.

The lack of coordination between the bureaus was the subject of the sharpest criticism in the report. Coordination will be the principal task of the chief of naval material.

The projects which the report says should be managed at the chief of naval material level are the fleet ballistic missile (Polaris), surface-to-air missiles, Seahawk, Artemis-Trident-Sosus, Autec and command and control systems. Others suggested are the VAX attack aircraft, Subroc, NTDS (Navy Tactical Data System) and anti-ballistic missile projects.

Seahawk is an integrated, surface vessel-based anti-submarine system. Artemis-Trident-Sosus are underwater sound systems. The term Sosus was formerly classified. Autec is the advanced underwater test and evaluation center in the Bahama Islands area.

Project management is defined as requiring a manager of high rank who has ready contact with top officials and can hold together a competent staff. He must be able to control his budget and allocate resources with flexibility, and he must have the authority and ability to obtain quick support from other service elements.

Some programs, the report says, can remain at bureau level. Such aircraft programs as the F-4B, TFX, P-3A and VTOL and airborne weapons and torpedo programs can remain with the Bureau of Weapons, while hydrofoils and ship nuclear propulsion can remain with the Bureau of Ships.

The 30 projects would account for about one half of the Navy's research, development, test and evaluation funds and about 65% of the major procurement appropriations.

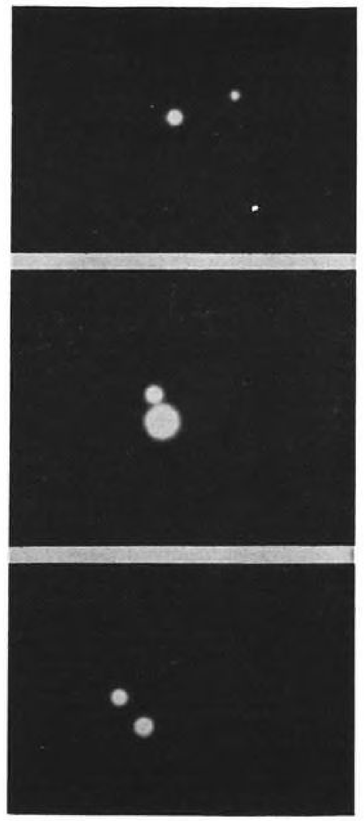
Within the office of CNO, one major change has been ordered in which another DCNO—plans and programs—would be created under a senior vice admiral. This officer would have the authority to direct and coordinate the over-all planning and programing effort. The Navy has suffered recently by having its planning and programing splintered among various DCNOs. Air Force has already implemented consolidation of its programing and planning functions at the headquarters staff level (AW Feb. 11, p. 34).

Establishment of three planning documents is recommended. One would be a long-range plan with a time span of 10 to 20 years, setting broad goals as a basis for research and development efforts. The second, a 10-year plan, would set the force structure of the Navy and mobilization plans to support the over-all defense plans. The third document would be a 10-year programing paper to fit the Defense Dept.'s continuous programing system, which is aimed at keeping all programs up to date for use in budgeting, eliminating a once-a-year effort on each program.

A program co-ordination office will be formed at the secretarial level. It will absorb the current office of analysis and review. The office will provide the secretary with an independent program and appraisal and analysis capability.

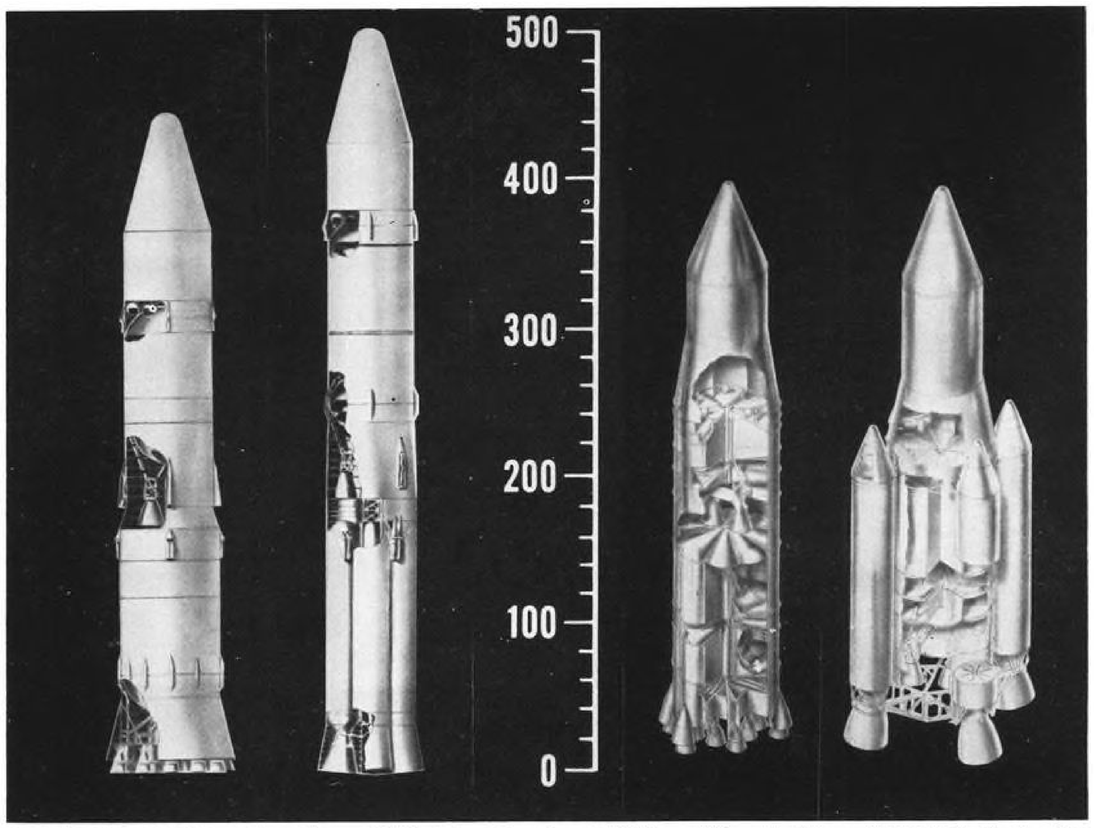
The report's rationale for not having the chief of naval material report to the CNO is that the CNO "would become deeply involved in actively directing and controlling the producer side of the organization. His attention to the important Joint Chiefs of Staff responsibilities, including active assumption of special operations, would be lessened. . . . The secretary and the secretariat would tend to become isolated in their influence and knowledge."

No mention was made of Defense Project 39A, which envisions reduction of headquarters staffs. The Air Force has already taken steps to move project management and other active management to field commands. Unless there is radical reorganization in the office of the CNO, the addition of a DCNO-plans and programs, assignment of a wider role for DCNO-development and the necessity of supervising the fleet activities command will make attainment of the Project 39A goals difficult.



Zeus Intercepts Titan

U. S. Army's Nike Zeus anti-missile missile system successfully intercepted a Titan 1 ICBM re-entry vehicle recently over Kwajalein Island in the Pacific Missile Range. Three-photo sequence, enlarged from a black and white 16-mm. TV film clip, shows the Zeus missile (upper right of top photo) moving from right to left through the camera frame. Camera tracked the target vehicle, thus relative motion in the frame is caused by movement of the Nike Zeus. Re-entry heat illuminated the Titan 1 target vehicle (middle of top photo). Exhaust from the third-stage motor, which provides final guidance and control, illuminated the Zeus. Second photo, which was enlarged several more times for detail, shows actual intercept by the Nike warhead, which appears to pass above the target vehicle. Dots merge as small spotting charge in Nike warhead is detonated to give visual indication of receipt of warhead burst command. Neither the Nike nor Titan carried nuclear warheads. Bottom photo shows Nike missile (upper left) passing beyond the Titan vehicle as Nike's third stage continues to burn. The target vehicle was boosted to ICBM velocity on a 5,000-mi. trajectory from Vandenberg AFB, Calif., using a Titan 1 booster fired as a training exercise by a Strategic Air Command crew. Camera speed during filming of the sequence was approximately 400 frames per second.



CLASS 1 NOVA DESIGNS are shown above, with Martin's configurations at left, General Dynamics/Astronautics' at right. Martin vehicle at far left uses 18 advanced F-1 engines, with three M-1 engines in second stage. Vehicle second from left has cluster of four 300-in. solid engines topped by five M-1s. GD/A design second from right incorporates 16 F-1s, with M-1s in the second stage. GD/A configuration at far right includes cluster of four 325-in. solids used in parallel arrangement with four M-1s as second stage. Scale is in feet.

Three Nova Classes for 1970-80 Unveiled

Denver—Designs of a variety of Nova vehicle configurations being studied for NASA's Marshall Space Flight Center to meet projected 1970-80 mission requirements were revealed here last week at the American Astronautical Society's symposium on Mars exploration.

Highlights of parallel studies by General Dynamics/Astronautics and Martin-Marietta were outlined in a single report presented by Andrew Kalitinsky, Nova program director for GD/A.

Three Classes

Nova vehicles considered in the parallel studies have been grouped broadly in three classes:

• **Class 1**, a state-of-the-art Nova. Propulsion systems for this category would stem from current development or demonstration programs. Vehicles anticipated in this category could become operational in early- to mid-1970.

• **Class 2**—advanced Nova. These are designs based on technological advances which could be practically achieved in the near future. Propulsion systems would incorporate high chamber-pressure and altitude-compensating devices. Operational date is projected for the middle or later portion of the 1970 decade.

• **Class 3**—unconventional Nova. Concepts for this category are based on far-reaching advances which may not materialize. Propulsion schemes would include advanced rocket and air-augmentation systems. Vehicle operational availability might come in the late 1970s or early 1980s.

Within Class 1, the Nova vehicles include Rocketdyne F-1 first-stage engines and Aerojet M-1 second-stage engines, or large solid rockets for the first stage and M-1 engines in the second stage.

Liquid-propellant version of the Martin Class 1 Nova vehicle incorporates a first-stage system of 18 advanced F-1 engines, each developing 1.8 million lb. thrust. Second stage is powered by three M-1 engines. Each of the engines delivers 1.5 million lb. thrust.

The number of engines in the first stage increases the chance of an inadvertent shutdown, and sufficient propellant reserve would have to be provided to deliver the design payload in the event one of the engines were shut down in flight.

Transtage Used

A small transtage is located between second stage and the payload. Maximum diameter of the transtage and the payload is 60 ft.

Payload to be launched with this configuration and injected into a 121-naut.-mi. orbit is 980,000 lb. Liftoff weight of the vehicle is 25.2 million lb. Vehicle height, without payload, is 326 ft., and maximum base diameter is 89 ft.

Martin's solid-propellant Class 1 Nova vehicle has a tandem design and incorporates relatively simple staging sequence. The tandem arrangement introduces increased height, however. First stage uses a cluster of four 300-in.-dia. solid motors. Second stage incorporates five M-1 engines, and this stage has a requirement for an engine-out capability.

Payload capability to a 121-naut.-mi. orbit is 1.06 million lb. Liftoff thrust is 47.2 million lb.; liftoff weight is 33.7 million lb. Height of the vehicle, less payload, is 380 ft., and maximum base diameter is 75 ft.

GD/A's Class 1 Nova liquid-propellant vehicle uses a cluster of 16 advanced F-1 engines for the first stage, and two M-1 engines in the second stage. Multi-cell tanks also are incorporated in the design.

The smaller number of engines, compared with the Martin version, was selected to ensure high reliability and improved cost effectiveness, but payload is decreased to 810,000 lb. for a 121-naut.-mi. orbit.

Maximum payload diameter is 67.5 ft.; liftoff thrust is 28.8 million lb., and liftoff weight is 23 million lb. Height, minus payload, is 237 ft., and maximum base diameter of the vehicle is 85 ft.

GD/A's Class 1 Nova vehicle, with a solid-propellant first stage, uses a parallel staging scheme, which permits a shorter vehicle than the tandem-staging arrangement and allows more flexibility in payload shape. A disadvantage, however, results from the more complex staging sequence and related development problems.

The first stage includes four 325-in.-dia. solids with gimballed nozzles. Four M-1 engines comprise the second stage. The second-stage tank structure for the liquid oxygen-hydrogen propellant forms the vehicle core as a multi-cell makeup 67.5 ft. in diameter.

Payload for this vehicle to a 121-naut. mi. orbit is 1.14 million lb. Liftoff thrust is 56.2 million lb.; liftoff weight is 39.7 million lb. Height, minus payload, is 224 ft., and maximum base diameter is 128 ft.

One Martin vehicle in the Class 2 Nova category is a two-stage system using 1 million-lb.-thrust liquid oxygen-hydrogen in both stages. This would provide a lighter vehicle and permit use of the same basic engine modules in both stages.

First stage includes 18 advanced, high chamber-pressure engines arranged around the lower circumference of the stage in a zero-length plug cluster arrangement. This yields a saving in vehicle length, a simplified thrust-transfer structure, and a promise of improved performance based on altitude-compensating characteristics.

In the basic plug concept, an annular jet formed by a ring of rocket nozzles is directed inward along the centrally located plug. With a decrease in ambient pressure, the outward boundary of the jet is deflected farther outward, and the plug acts as a variable nozzle, adjusting the effective expansion ratio to the prevailing altitude condition.

Thus, the plug arrangement offers a means of obtaining very high expansion ratios in a vacuum by using the entire base area of the vehicle as the effective nozzle exit area. This eliminates the need for unwieldy nozzles, Martin says.

The extent of altitude compensation is still uncertain, however. Also, behavior of the plug at higher vehicle speeds, in supersonic flow with base-flow separation, is still unknown.

Additionally, the large number of engine modules in the cluster requires an engine-out capability. Loss of an engine would affect the flow pattern of adjacent engines and adversely affect the performance of entire cluster and the direction of the composite thrust vector.

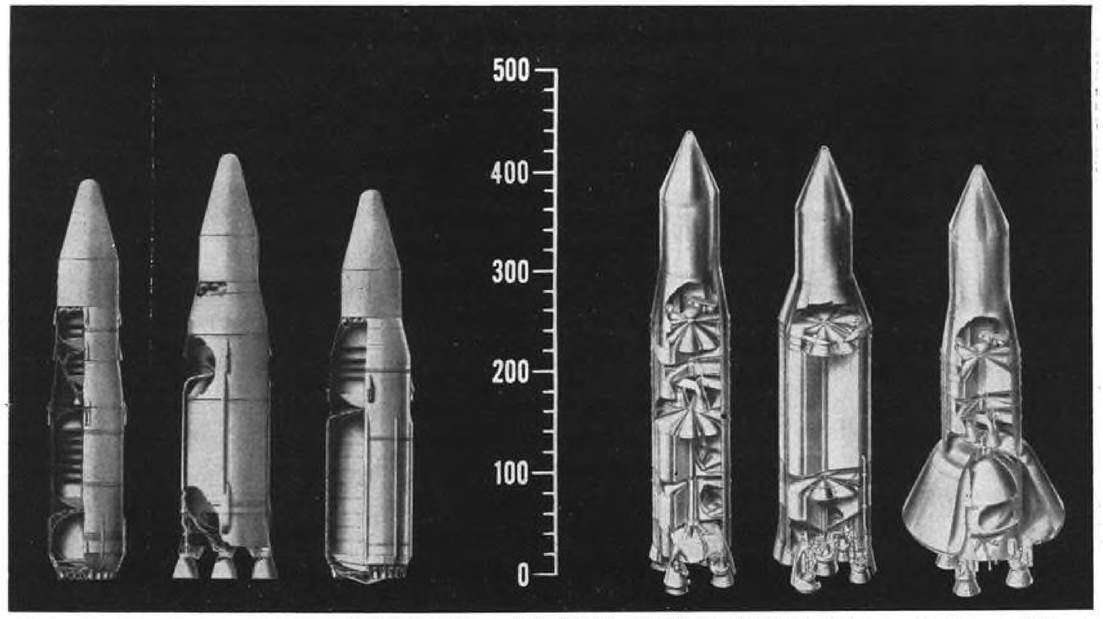
Therefore, it may be necessary to shut down an engine opposite the one which has malfunctioned.

Thrust vector control may require the use of differential throttling or secondary fluid injection, or both.

Two of the same engine modules, with a higher-expansion-ratio bell nozzle, are used in the second stage. Thus, only one advanced engine development effort would be required.

Liftoff weight of this Martin Class 2 Nova vehicle is 14.4 million lb. Payload capability for a 121-naut.-mi. orbit is 990,000 lb. Height of the vehicle, minus payload, is 258 ft., and maximum diameter is 76 ft.

GD/A's approach to the design of a two-stage Class 2 Nova vehicle incorpo-



CLASS 2 NOVA CONFIGURATIONS include Martin designs at left, GD/A's at right. Far left Martin design uses liquid oxygen-hydrogen in both stages. First stage has plug cluster of engines, with plug acting as variable nozzle. Second Martin vehicle has 1½ stages incorporating altitude-compensating, expansion-deflection engines. Vehicle third from left is single-stage-to-orbit design with 24 engines in plug arrangement. Left-hand GD/A design has four high-pressure bell-nozzle engines in first stage, two M-1s in second. Center vehicle has 1½ stages with four boosters around sustainer. Two-stage configuration at far right has recoverable first stage. Scale again is in feet.

RCA Awarded Major LEM Role

Washington—Radio Corp. of America has been selected by the National Aeronautics and Space Administration and Grumman Aircraft Engineering Corp. to provide over-all systems engineering services to Grumman on the Lunar Excursion Module (LEM).

RCA also has been assigned total subsystem responsibility for the LEM sensor package subsystem, with NASA and Grumman approval required for all the company's recommended make-or-buy decisions on each of the three major elements of the subsystem—the radar altimeter, rendezvous radar and Doppler velocity radar.

Under terms of an agreement reached late last week, RCA also will be responsible for the communication subsystem, ground support equipment and in-flight check-out equipment, with similar approval required of the company's make-or-buy recommendations. Under Grumman's direction, RCA also will be responsible for the design and fabrication of various elements of the stabilization and control system used in the LEM.

The program will be carried out by RCA's Aerospace Communications and Controls Dept., Burlington, Mass., which had teamed with Grumman last summer in anticipation of submitting a joint bid before it was known that team bids would not be allowed by NASA. Under terms of the agreement, RCA is required to give highest priority to selecting elements and subsystems which will be used in the main Apollo capsule to minimize the number of spares which must be carried.

rates a first stage consisting of four large high-pressure bell-nozzle engines using liquid oxygen/RP-1 as a propellant. Two M-1 engines using liquid oxygen-hydrogen comprise the second stage. Propellant tanks incorporate multi-cell construction.

Use of RP-1 in the first stage results in a heavier vehicle, but higher propellant density in the smaller tanks, lower propellant costs, and less expensive launch facilities indicate a better cost-effectiveness factor than a similar vehicle using liquid hydrogen in the first stage. The small number of engines enhances vehicle reliability, and the bell-nozzle engines are a direct extension of the present state-of-the-art.

Payload capability to a 121-naut.-mi. orbit is 1.13 million lb.; maximum payload diameter is 67.5 ft. Liftoff thrust is 32 million lb., and liftoff weight is 26.4 million lb. Vehicle height, minus payload, is 276 ft., and maximum diameter is 86 ft.

Nova studies indicate that recovery of first-stage engines would be economically feasible within a reasonable program span. A more advanced step would call for recovery of the complete stage. A vehicle design by GD/A to meet the recovery requirement consists of a recoverable first stage and an expendable second stage.

First-stage shape is tailored to meet atmospheric re-entry, water impact and flotation requirements. The 140-ft.-dia. configuration would be hypersonically stable and provide low weight-to-drag ratio to minimize re-entry heating.

At second-stage separation, the first stage follows a ballistic trajectory and re-enters at about the same speed which existed at the staging point. Additional heating protection probably will not be required for the aluminum structure.

Large chutes are deployed when the stage slows to subsonic speeds. Just before water impact, the solid-fuel retrorockets in the forward dome reduce impact velocity.

The stage floats with the engine up, far above the water, and can be towed in this position. The vehicle must be designed more like an airplane than a booster for extended fatigue life, weather-protection and maintenance considerations. Extensive work is required in the areas of recovery and refurbishment to obtain the full benefits of a reusable system.

Both Martin and GD/A have Class 2 Nova 1½-stage vehicle designs. The GD/A configuration consists of four jettisonable booster engines and a centrally located sustainer engine. These use a liquid oxygen-hydrogen propellant and ignite simultaneously. A single set of multi-cell tanks simplifies the design.

The vehicle tends to be larger than the two-stage design because of reduced gains due to staging, and is more sensitive to variations in engine performance and vehicle mass fraction. However, increased simplicity provides cost-effectiveness comparable to the two-stage design. Liftoff thrust is 26 million lb., and payload capability to a 121-naut.-mi. orbit is 1.14 million lb.

One of Martin's designs for Class 2 Nova 1½-stage configuration is similar to the GD/A design, but uses altitude-compensating, expansion-deflection engines. These are, in effect, plug clusters turned inside-out with an annular jet initially directed radially outward and deflected along the inner face of a modified bell contour. Liftoff thrust is 30 million lb., and payload capability to a 121-naut.-mi. orbit is 1.17 million lb.

The Class 2 Nova probably will be a two-stage vehicle rather than the 1½-stage configuration. The cost effectiveness may approach $50 per pound.

Characteristics of the "unconventional" Class 3 Nova vehicle are difficult to define specifically at present. Additional, thorough analysis is being conducted. Almost certainly, however, the Class 3 Nova will be a fully recoverable, single or partially staged vehicle, Kalitinsky said.

One approach is the GD/A extension of the recoverable first-stage design concept to the 1½- and single-stage configurations. If the full potential of altitude compensation can be realized, then a fully recoverable 1½-stage design is economically competitive.

Booster engines would be recovered separately, and the entire tankage would be placed in orbit. The operational advantage in this case would be that the stage may re-enter after one orbit, very close to the launch site. However, re-entry would have to occur at orbital velocity.

The GD/A single-stage configuration, called Nexus, is more promising, Kalitinsky said, since only one object must be recovered. To be competitive, the single-stage vehicle would require substantial improvement in mass fraction and propulsion efficiency.

The Martin approach to the Class 3 Nova embodies air-augmentation to improve propulsion efficiency. The engines are arranged in a ring around the major diameter of a single-stage vehicle. The hydrogen tank forms a large plug, and a toroidal oxygen tank is mounted forward. Rockets are enclosed in an air duct which has adjustable inlets.

A jettisonable shroud extends the mixing area downstream of the rockets. A payload fairing serves as an inlet spike during the boost phase. Air enters through the inlet, mixes with rocket exhaust, where it is heated, then expands past the plug-shaped afterbody for additional thrust.

After leaving the atmosphere, the engines operate as pure rockets. After payload separation, flaps are extended, and the vehicle re-enters.

President's Award

Washington—The President's Award for Distinguished Civilian Service, the highest honor that can be given government career employes will be presented June 12 to:

- Dr. Alain C. Enthoven, deputy assistant secretary of defense (comptroller) for systems analysis.
- Dr. Fred L. Whipple, director, Smithsonian Institution Astrophysical Observatory, Cambridge, Mass.
- David D. Thomas, director, Air Traffic Service, Federal Aviation Agency.

McClellan Dubious About Legality Of Rubel Procurement Proposals

By George C. Wilson

Washington—Chairman John L. McClellan (D.-Ark.) of the Senate subcommittee investigating the F-111 (TFX) contract award said last week that Defense Dept. proposals to eliminate military source selection boards "appear to circumvent" procurement laws already on the books.

He made this charge after John H. Rubel, outgoing deputy director of Defense Dept. research and engineering, testified before the Senate Permanent Investigations Subcommittee on his proposals for improving the procurement process by concentrating contractor selection in the hands of civilian defense leaders.

Rubel said after the closed hearing that no one argues the basic point that the defense secretary has the authority to overrule military source selection boards. The central question, Rubel said, is how to provide the defense secretary with the best advice so he can make the right decision on major procurements.

Authority Shift

In a memorandum last August, Rubel proposed eliminating the military source selection boards altogether and transferring their selection authority to the service secretaries and the defense secretary. But his original proposal has been revised since then and is still being studied by the Defense Industry Advisory Council. Rubel said he did not know whether Defense Secretary Robert S. McNamara has read his procurement recommendations, declaring they were developed largely in consultation with Roswell E. Gilpatric, deputy defense secretary.

Revisions of the original Rubel memo include a provision to have the military source selection boards advise the defense secretary on a major procurement. But the military still would not recommend the selection of a specific contractor.

Other changes made during the three revisions of the original Rubel plan include one by the Advisory Council's three-man subcommittee to inform contractors in advance of the approximate weight to be given during evaluation to such factors as range, speed, accuracy, reliability, delivery schedule and cost.

Sen. McClellan referred to a section of the 1956 Armed Forces Act which states that military source selection boards in aircraft competitions shall select the winning design and forward it to the defense secretary, who can approve it or ask for another appraisal. Defense Dept. lawyers are expected to review these and other laws to see if they conflict with recommended procurement revisions.

Procurement Influence

Several members of the McClellan subcommittee fear that Rubel's recommendation would give military leaders too little influence in procurement. Sen. McClellan has said McNamara abused his powers in the abrupt way he reversed the unanimous recommendations of USAF-Navy source selection boards to give the F-111 contract to Boeing rather than General Dynamics (AW Apr. 15, p. 29). These are the principal differences between the Rubel proposal of last August and the process followed in the F-111 competition:

- **Evaluation groups.** The F-111 case involved an evaluation group of more than 200 persons broken into specialized units to evaluate company proposals for the USAF-Navy tactical fighter. The group's work was submitted to the joint USAF-Navy source selection board in a report nearly 2 in. thick. The chairman of the evaluation group recommended Boeing as the source.

Under the Rubel plan, the evaluation group would approach its job about the same way but "would evaluate only," not make any recommendation as to which contractor should get the job. Also, Defense Dept. civilian leaders, rather than the military source selection board, would furnish the criteria for the evaluation group to use in analyzing contractor proposals. In still another difference, the evaluation group would not be told what weights would be assigned to such individual criteria as management abilities, equipment and financial stability.

In his August memorandum, Rubel said his plan would make the evaluation groups "the instrument panel by which the pilot is able to fly." He conceded that putting selection authority so completely in the hands of civilian Defense Dept. leaders would subject them "to considerably more contractor and political pressure" than is now the case. "However," he added, "major decisions which in the aggregate (and even one-by-one) have a major impact on our national business and defense posture should be made by the most responsible decision makers."

- **Source selection boards.** USAF and Navy were represented on the source selection board that recommended Boeing for the F-111 award after hearing the presentation by the head of the evaluation group.

Rubel argued in his memo that transferring this authority to civilian secretaries would "put the senior, responsible people in the position of making, rather than approving or merely presiding, over decisions already made. Above all it would mean that one could consider the relative merit of one selection in comparison with another by noting the effect of slight perturbation in the value assigned to the evaluation criteria. Sometimes a very small percentage change in these alters the outcome of the evaluation completely. Those are the circumstances under which the over-all judgment of the most senior and responsible officials is not only needed but is indispensable, for otherwise selection almost automatically results from evaluation."

- **Bidding procedure.** In the F-111 competition, six bidders presented elaborate proposals. Rubel recommends streamlining this process to save both time and money by requiring at first rather sketchy proposals called "screening bids." These screening bids outlining the contractor's proposed approach and capabilities would be used to narrow the field to between three and five bidders. After this screening phase, Rubel said the final bidding "would be handled largely as it is now."

Orbital Lab Studies

Washington—Boeing Co. and Douglas Aircraft Co. are expected to be awarded three-month contracts to study a manned orbital research laboratory capable of missions up to a year in length (see p. 141), the National Aeronautics and Space Administration said last week.

The two firms were selected by NASA's Langley Research Center from among 11 bidders. Contracts valued at nearly $400,000 are to be issued to Boeing and Douglas later this month.

USAF Recovery Areas

Washington—Air Force is installing electronic equipment for manned space vehicle land recovery at Edwards, Calif., Holloman, N. Mex., and Wendover, Utah, Air Force bases. Mission control center will be located at Sunnyvale, Calif.

These facilities will be used for recovery of X-20 and advanced manned spacecraft.

Expanded X-15 Program Planned; Hypersonic, Higher Flights Sought

Washington—Air Force has proposed that the X-15 research aircraft program be extended from the high supersonic to the hypersonic speed range, that altitude goals be substantially increased and that the heat toleration point be doubled.

A letter contract for the project has been signed with North American Aviation, Inc., manufacturer of the aircraft, but work has not started because Defense Dept. and the National Aeronautics and Space Administration are discussing funding problems.

Speed regime of the aircraft would be increased to Mach 8, or about 6,000 mph. Highest speed attained with the present series of three research aircraft was 4,159 mph. June 27, 1962, during a flight with NASA Pilot Joseph A. Walker at the controls. Air Force Maj. Robert M. White had achieved what had been considered the maximum design speed goal Nov. 9, 1961, when he attained 4,093 mph.

New Goal

The new altitude goal will be 400,000 ft. The original design altitude was 250,000 ft., but this was exceeded by Maj. White July 17, 1962 (AW July 23, p. 25) when he reached 314,750 ft.—59.6 miles—qualifying him for astronaut wings. On Apr. 30, 1962, Walker had reached the approximate design limit, attaining 246,700 ft.

The X-15's black Inconel-X nickel alloy skin had been designed to withstand 1,200F temperatures during high-speed flight in the atmosphere and during re-entry into the atmosphere. The new goal would be 2,400F. Highest heat recorded during the 83-flight program which began in 1959 was 1,323F. Much of the heat-limit testing was done by Navy Cdr. Forrest Petersen.

Changes proposed in order to gain greater speed, altitude and heat tolerance are: extension of the fuselage by 24 in., making it 52 ft. long; extension of the main landing gear struts which are attached to the steel skids; addition of a drop tank capable of holding 12,500 lb. of additional fuel; and addition of ablative material to the leading edges of the wings and empennage.

The extra altitude and speed would be possible by extending the burning time of the Thiokol (formerly Reaction Motors, Inc.) XLR-99 liquid propellant rocket engine. This engine provides 57,000 lb. of thrust and is throttleable between 30 and 100%. It burns liquid oxygen and liquid ammonia. The current aircraft burn 20,000 lb. of fuel in 90 sec. at full throttle. Increased heat tolerance would be achieved by heat being absorbed by the ablative material.

Two auxiliary power units weighing 48 lb. each provide hydraulic and electrical power. They are independent of the main propulsion engine and are powered with hydrogen peroxide fuel.

Two Aircraft Available

At present, two aircraft are in flying status, No. 1 and No. 3. No. 2 aircraft was extensively damaged last fall when its engine failed to start after launch from the Boeing B-52 mother aircraft and it had to make a landing with full fuel load. The aircraft flipped on its back during the landing run.

Most recent X-15 flight was on May 29, when Walker flew the No. 3 aircraft to 92,000 ft. and a maximum speed of 3,750 mph.

First X-15 flight was an unpowered glide after dropping from a B-52. Scott Crossfield of North American was the pilot for that flight, made on Oct. 15, 1958. Crossfield also made the first powered flight Sept. 17, 1959, during which he attained a speed of Mach 2.1 (1,350 mph.) and 52,341-ft. altitude.

Milton O. Thompson, NASA, and Joe H. Engle, USAF, were named as new X-15 pilots last week.

Prediction that the X-15 would eventually be able to exceed the original design goals was made in AVIATION WEEK & SPACE TECHNOLOGY (Feb. 3, 1958, p. 26).

Mi-6 Export Planned

Moscow—Russia's aircraft export agency, Aviaexport, is planning to offer the twin-turbine Mil Mi-6 helicopter in foreign markets for the first time.

Yuri Dolgov, head of the Russian monopoly, said about 2,000 Soviet commercial planes and helicopters are now operating in 30 foreign countries. He said that "demand for Soviet aircraft and helicopters is constantly growing abroad." The Mi-6 will be offered in conjunction with the Tu-124 twin-jet and the An-24 twin-turboprop medium-range transports, he said. Dolgov described the Tu-124 and An-24 as "magnificently suited for intra-continental flights."

The Russian press emphasized recently that selling Soviet aircraft abroad is a "demanding and complex matter." It cited the "big stack of technical documentation" that must accompany each sale and the extensive training program required for foreign personnel working with Russian planes.

MA-10 Discussions

Washington—Backers of another Mercury flight presented their case directly to U. S. space agency Administrator James E. Webb, but no decision had been announced late last week.

After a meeting June 8, Webb said that those favoring an MA-10 flight had presented "a very persuasive case." Walter C. Williams, deputy director of the National Aeronautics and Space Administration's Manned Spacecraft Center, contended that another Mercury flight would prove valuable to the Gemini and Apollo programs (AW May 27, p. 23).

Webb and Brainerd Holmes, director of manned space flight programs, had concluded that the 22-orbit flight by USAF Maj. Gordon Cooper effectively ended the Mercury program, and the space agency should now concentrate its efforts on Gemini and Apollo. But the astronauts themselves have been among those pressing hard for another flight.

These efforts led Webb to withhold his decision until last week's summit meeting on MA-10. Besides Webb and Williams, those attending included Holmes and Robert R. Gilruth, director of the Manned Spacecraft Center. Webb said a number of new factors had been presented during the meeting, but cautioned that there was just so much money to go around. Rep. Olin E. Teague (D.-Tex.), chairman of the House space subcommittee handling NASA's manned space flight budget authorization, said he favored another Mercury flight because it appeared that much additional knowledge would be gained.

Applicants Are Sought For Astronaut Training

Washington — National Aeronautics and Space Administration will select a group of 10 to 15 new astronaut trainees this summer. The group will be picked from civilian and military volunteers.

July 1 will be the cutoff date for civilian applicants. Volunteers from the Air Force, Navy and Marine Corps will have until July 15.

The agency also announced it will begin discussions with the scientific community on "finding the earliest practicable way in which scientists can be included in the Apollo mission," a move apparently designed to ease criticism of NASA for not including scientists in its pool of astronauts (AW June 3, p. 21).

Pilots who are selected will join the astronaut pilot pool at NASA's Manned Spacecraft Center in Houston in October.

In addition to the seven original Mercury astronauts, NASA selected nine trainees in 1962.

Rules Outlined to Prevent Study Firms From Gaining Unfair Edge

By Katherine Johnsen

Washington—Rules to prevent study contractors from attaining an unfair advantage in obtaining hardware business were spelled out last week by Defense Dept. in an eight-page directive (AW May 13, p. 29).

The key officials in drafting the rules were Adam Yarmolinsky, special assistant to Defense Secretary Robert S. McNamara, and Eugene Fubini, deputy director for research and information systems.

In clear-cut instances in which companies serve as technical advisers or systems engineers, Defense Dept. has applied the hardware ban on a case-by-case basis. Examples are Aerospace Corp. in the intercontinental ballistic missile program, and International Telephone & Telegraph Corp. in the military communications satellite program.

They anticipated that these will be the two major outgrowths:

• **Two—or possibly more—"study"** contracts, instead of one, will be awarded to establish the approach, requirements, or specifications for a new weapons system. This will enable Defense Dept. to make its own evaluation. The original study contractors would be released to bid on a Defense Dept.-determined system.

• **Defense Dept.'s in-house capability** for technical direction and systems engineering will be increased "as fast as we know how." The preamble of the new directive indicates that the trend will be to terminate relationships with non-profit organizations now advising the Defense Dept., and sponsor no more. It states:

"It is the policy . . . that such organizations are created only under extraordinary circumstances, when private resources are not available to accomplish a necessary objective beyond the scope of in-house capabilities. Their termination is governed by the organic statutes of the individual organizations. These rules should make it even less likely that any additional government-financed non-profit organizations need be created. While these organizations are in existence they will be treated by the Department on an arms length basis. . . ."

Fubini commented that a goal of the new directive is "to avoid pseudo-competition"—such as instances where the Defense Dept. has theoretically established its own technical requirements but actually embraced the proposals of an outside firm.

Defense Dept. stated that the "ultimate test" around which the new rules are written is: "Is the contractor placed in a position where his judgment may be biased, or where he has an unfair competitive advantage?"

These are the four basic rules of the directive:

• **Contractor serving** as technical director or systems engineer may not subsequently bid on hardware for the system. This would not ban a company serving as technical director for a powerplant from bidding on hardware for components of a ship or aircraft unrelated to the powerplant. The qualification to the general rule is the contractor who assumes over-all contractual responsibility, as well as technical direction, for a system at the outset.

• **A contractor furnishing** complete specifications for a competitive procurement may not bid on the procurement "for a reasonable period of time, including, at least, the initial procurement."

There are three exceptions to this rule: a contractor who gives the Defense Dept. data or specifications on a product he has already produced may bid on any subsequent procurements; if the Defense Dept. supervises and controls the drafting of specifications, firms that have given industry advice are free to bid on the procurement; and all contracts for development or prototype items are exempted. For these items, the firm drafting the specifications is generally the best qualified for the development phase.

• **A contractor participating** in establishing a "statement of work" may not bid on work resulting from the statement. Defense Dept. explained: "The various services related to a statement of work to be used in a competitive procurement should normally be performed by the Dept. of Defense. However, when it is necessary to seek the assistance of contractors, they may often be in a position to favor their own products or capabilities. To overcome this possibility of bias, such contractors are to be prohibited from supplying a system or services procured on the basis of work statements growing out of their services."

• **An "advice" or "study" contractor** who requires access to the proprietary data of other companies must reach an agreement with these other companies on unauthorized use or disclosure. The contractor is also banned from using the proprietary data himself to bid on hardware contracts or on additional study contracts.

News Digest

Heated-gas propulsion system for use by astronauts in maneuvering outside a spacecraft will be evaluated by Ling-Temco-Vought under a USAF Aeronautical Systems Div. contract. Several gases and heating methods will be investigated.

Aero Spacelines, Inc., Van Nuys, Calif., has been awarded a Marshall Space Flight Center contract valued at $194,850 for transportation of Saturn rocket stages, engines and other components in a specially modified Boeing Stratocruiser. The aircraft, a B-377 (PG), will handle stages as large as the 18-ft. dia. Saturn S-4 stage.

Bendix Corp. last week purchased assets of Motorola Aviation Electronics, Inc., Culver City, Calif., a subsidiary of Motorola, Inc. The Culver City company, the former Lear Cal Div., will be operated by the Bendix Radio Avionics Products Group.

Air Force Maj. Robert M. White last week was awarded the National Geographic Society's Gen. Thomas D. White Space Trophy for his flights in the North American X-15.

Astronautics Div. of General Dynamics has received an 18-month contract for development of a life support system capable of sustaining four men for six months. The $932,000 contract calls for delivery of a prototype system to the National Aeronautics and Space Administration's Langley Research Center later in 1964.

Hamilton Standard Div. of United Aircraft Corp. last week was awarded a $4,880,000 contract for development and manufacture of engine air inlet controls for the Air Force-Navy TFX.

First Sikorsky CH-3C USAF twin-turbine long-range support helicopter was rolled out last week at the company's plant in Stratford, Conn., three weeks ahead of schedule. USAF has ordered 22 of the aircraft.

American Airlines Convair 990 was destroyed by fire May 30 while parked at Newark Airport. Only mail and cargo was aboard. Cause of fire, which started in a rear lavatory, is still undetermined.

Senate Foreign Relations Committee last week voted a $20-million limitation on funds for Arms Control and Disarmament Agency for the next two years. The action modified a previous vote which limited the amount to $15 million (AW June 3, p. 33).

Concorde Order Spurs U.S. SST Action

Kennedy reveals supersonic transport plans after Pan Am discloses it will buy Anglo-French aircraft.

By L. L. Doty

Washington—President Kennedy's failure to persuade Pan American World Airways to postpone disclosure of its order for six Anglo-French Mach 2.2 Concorde supersonic transports last week apparently led him to announce, earlier than planned, that the U.S. has decided to build a slightly faster transport.

Most observers here believe that the Pan American action prompted the President to interpolate the disclosure in a formal speech at the Air Force Academy in Colorado Springs June 5. The President reportedly had wanted more time to prepare a message to Congress asking for funds to support a supersonic transport project before making the White House decision public (AW, Apr. 1, p. 58).

Both President Kennedy and Federal Aviation Agency Administrator N. E. Halaby personally made several attempts to dissuade Pan American President Juan T. Trippe from releasing the announcement of the airline's plan to buy the Concorde, which is under joint development by Britain and France. Trippe refused, and after the announcement was made at 5 p.m. June 4, Halaby, in New York, was called from a television stage, where a program in which he was participating was being taped, by an urgent telephone call from the White House. Presumably, it was at this point the decision was made to announce the U.S. project the next day.

Committee Recommendations

The remarks the President inserted in his speech were drawn directly from recommendations given him by the inter-agency committee, headed by Vice President Lyndon B. Johnson, which conducted the supersonic transport study. The recommendations are not specific on performance characteristics of the proposed aircraft, but focus attention on the economic feasibility of the project.

President Kennedy, noting this point, said that should the development program show that it is impossible to build a transport that will operate "safely, swiftly and at prices passengers can afford," then the program should be abandoned. However, the President emphasized the importance of the U.S. maintaining its lead in the manufacture of jet transport aircraft, and pointed out that Congress should be prepared to supplement private risk capital with federal funds if the project is to be successful.

With respect to speed, the committee study recommends only that the U.S. aircraft should be developed to operate at Mach speeds above those of foreign competitors. The Mach 2.2 speed proposed for the Concorde, engineers agree, is the very maximum speed that a plane constructed of aluminum alloy can be operated. The committee study calls for the use of titanium and steel in the proposed U.S. transport. Johnson is known to favor a Mach 3 speed range.

Industry impatience over the delay in the U.S. decision to build or not build a supersonic transport has been growing rapidly. In addition, inability of the committee to develop firmer details of the proposed aircraft has evoked great industry dissatisfaction with the entire project.

Pan American officials insist that an order for the Concorde was placed only as assurance that the airline would remain competitive in international operations. One spokesman said that if the order spurred the U.S. to accelerate its supersonic transport program, then this is a "happy by-product." Neither Air France nor BOAC had officially announced an order for the Concorde as of late last week, although Pan American, in its announcement, said the "production program will provide" for all three carriers.

Pan American has made other purchases from the drawing board in the past, such as the proposed Republic Rainbow jet transport, which was never built, and the first de Havilland Comet, which was grounded because of metal fatigue problems.

Cost of the six Concordes has been estimated at about $60 million. So far, Congress has appropriated $30 million for the Federal Aviation Agency to conduct research and development in the supersonic transport field.

Industry hopes that the U.S. program would be accelerated early this year were dashed when the President failed to request funds for the project in his Fiscal 1964 budget (AW Jan. 21, p. 40). Later, Halaby, in a bid to keep the U.S. abreast of supersonic transport development, proposed a share-the-cost program with the British, but they bluntly rejected it (AW Mar. 4, p. 46). Estimated cost for the U.S. program has been placed at about $1 billion.

Reaction of Congress to the Pan American announcement was mixed. Rep. H. R. Gross (R.-Iowa) deplored the purchase of foreign aircraft by a U.S. firm, but Rep. Oren Harris (D.-Ark.) commended Pan American for its "foresight." His view was echoed by Rep. Wayne Hays (D.-Ohio) who said, "I agree with Mr. Harris that Pan Am contracted for the planes to keep themselves in business."

Rep. Harris headed a group of six congressmen who were authorized by the House last week to fly to Paris to study European "aviation matters," as a direct result of the Pan American Concorde order.

The group was to leave the U.S. late last week.

Under the contract, Pan American Air France and BOAC each will receive one of the first three Concordes produced, according to the Pan American announcement. The same sequence would continue until each airline has received six, Pan American said.

SST Prototype

The prototype aircraft is expected to fly in the summer of 1966, and the first production aircraft is to be available in 1968. It has been estimated that the earliest the U.S. can now produce its prototype—if the project is launched immediately—is 1969, with a production model in 1971 or 1972.

Pan American's purchase of the Concorde is conditioned on the aircraft meeting design specification and obtaining airworthiness certification by the governments of France, Great Britain and the U.S. Pan American has specified that the plane must be operationally compatible with traffic patterns of subsonic aircraft. If Pan American terminates the contract at a later date, it would pay an agreed penalty. The contract contains several escape clauses.

The Concorde will be powered with four Bristol Siddeley/Snecma Olympus 593 turbojet engines each generating 28,000 lb. of thrust (see p. 61).

The plane will carry 100 passengers on transatlantic flights.

Firm Quizzed on Foreign Airline Choice

Washington—Civil Aeronautics Board has queried at least one U. S. air freight forwarder about why it shows a preference for foreign flag carriers over U. S. airlines on international consignments.

In a letter to one freight forwarder, J. W. Rosenthal, chief of CAB's routes and agreement division, noted that the "bulk of your international freight services have been with foreign flag carriers." He added:

"In light of the Board's promotional responsibilities with regard to the development of an international air route system meeting the needs of the commerce of the U. S. . . . we would appreciate being advised as to the circumstances and conditions which led you to use foreign flag carriers services in preference . . . to U. S. flag carriers. In this connection, we are interested in ascertaining what, if any, steps we may properly take to encourage or assist U. S. flag carriers in providing services which would be more attractive to U. S. freight forwarders."

Foreign Carrier Concern Growing As Tourists Shift to U.S. Airlines

By James R. Ashlock

New York—Foreign flag carriers are watching with concern a pronounced shift in preference among U.S. tourists for this country's airlines over the North Atlantic.

Pan American World Airways and Trans World Airlines are finding their increases in transatlantic frequencies this summer complemented by an apparent wave of national identification by Europe-bound Americans.

Varied reasons are advanced for the trend, with many feeling that international events of recent months have contributed toward what one airline official termed a "swell of patriotism."

"This situation wasn't so apparent three or four years ago," one European airline spokesman said. "But President Kennedy has stressed national pride throughout his campaign, and it evidently is catching on."

One airline official dates the trend to 1961, when the "save the gold" drive was initiated and duty restrictions were tightened up. Since then, political developments have occurred that he feels could be turning Americans more toward national preference.

Major share of traffic increases to and from Paris has been going to Pan American and TWA, sources say. Speculation is expressed that this may be reaction among Americans to President Charles DeGaulle's friction with the U. S.

Recent controversy over transatlantic fares, from which TWA and Pan American emerged as "lower fare advocates" (AW June 3, p. 36), also is a factor, and it spurred British Overseas Airways Corp. to counter the possibility of its being labeled as a high fare airline. BOAC ran large newspaper advertisements proclaiming that no carrier's fares to Europe were lower than its own.

Pan American and TWA both reaped business diverted from foreign carriers during the 2¼ weeks that they delayed in charging the $14 IATA increase. Alitalia noted a sudden 13% drop in eastbound business in May. BOAC said it felt the impact at first, but that things were evening out now that the two U.S. airlines are charging the IATA fares.

While the effect of nationalism is largely speculative, foreign carriers feel Pan American and TWA's improvement is due to their service expansion.

Pan American has put 204 weekly jet flights, including both east and westbound, onto the North Atlantic this summer. It had 184 last year. This gives Pan American 438,000 seats for the season, compared with 400,000 at the peak of the 1962 tourist season.

TWA, its transatlantic fleet swelled to 17 by the addition of five Boeing 707-320Bs, is offering 122 flights, or 17,300 seats, a week. Last year it had 92 flights weekly, providing 12,880 seats. With its expanded service, TWA is now providing four non-stops a week to Rome from New York, plus doubling its frequencies into Geneva and Zurich.

"For the first time we're offering the frequency that we lacked in the past," a TWA official said. "It appears that travelers are reacting to it."

Pan American and TWA's service increases are coming at a time when most foreign flag carriers are holding the line on capacity, doing little other than shifting to other U.S. cities in quest of business outside the saturated New York gateway.

Two areas receiving the most attention are Chicago and the West Coast. BOAC has initiated three flights each week from Los Angeles to London plus a daily service from Chicago to London via Detroit and Montreal. Swissair, which had no service from Chicago last year, put in three flights a week to Zurich this season. It pulled two flights out of New York to serve Chicago, leaving 14 departures weekly from Idlewild.

But TWA and Pan American, both using 320Bs with polar non-stop capability, are strong from both the Midwest and West Coast. TWA even put in a direct Denver-Paris flight, with one stop at Chicago.

Industry statistics at the end of the 1963 summer season aren't expected to show any substantial improvement in the load factor for all the North Atlantic carriers, officials said. Traditional situation, in which some carriers profit while others suffer is expected.

Such speculation arises from the fact that transatlantic traffic is expected to increase about 15% this summer, which is generally labeled a comfortable, normal growth figure. But what has many of the foreign flag carriers disturbed is that TWA and Pan American stand to reap the lion's share of the total volume.

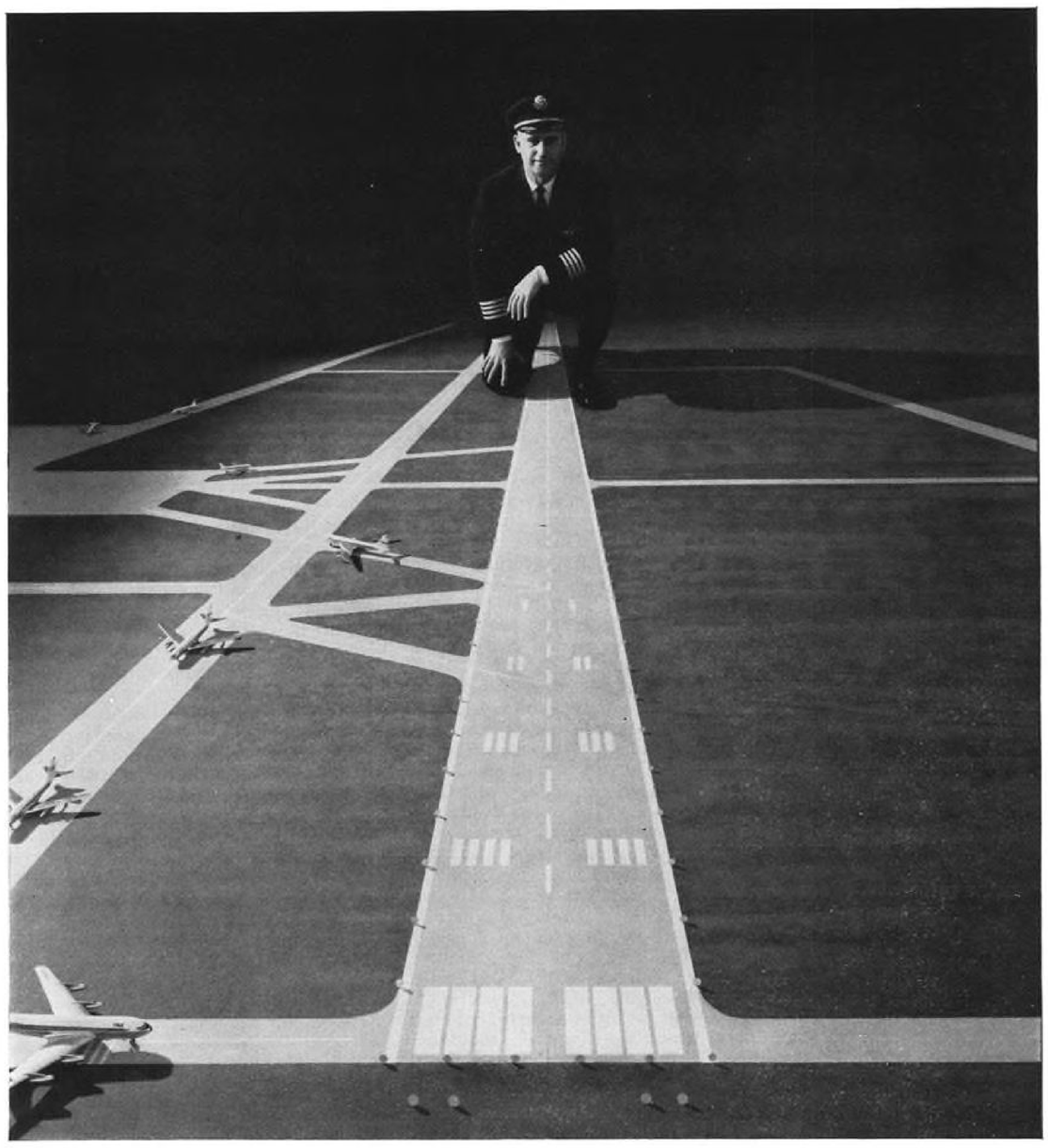
Pan American's advanced bookings for June and July are up 12-14% over the same months of 1962. TWA, which carried considerably fewer passengers last year than Pan American, reports an impressive 55% increase in eastbound advance bookings for July, 24.7% for August and 25.6% for September. TWA's westbound bookings for August are up 65%.

Numerous foreign carriers say their advance bookings are about matching last year's levels. Some, like BOAC, are recording increases of 7-10% for the June-September period. Alitalia, with Italy remaining a popular tourist attraction, had a 23% advance booking increase as of June 1.

The year could develop into a rough one for some foreign carriers if expected increases in the industry volume don't materialize. Last year, from June 1 through August 31, the IATA records showed 408,000 eastbound transatlantic travelers. Forecasts of a 15% increase over this figure in the same period of 1963 are speculative, with many carriers counting on the current tendency toward last minute bookings.

One yardstick often relied on by the airlines is the forecast of the passport office of the U.S. State Dept. This year the forecast is for 185,000 citizen departures, both air and sea, in June for Europe, which is practically no increase over the same month of a year ago.

However, some carriers tend to discount this prediction, recalling that the June, 1962, forecast was for a 3.3% increase over June, 1961. But the actual departures for June, 1962, were 184,767, which topped the passport office's prediction by 16.7%. The foreign carriers also find some comfort in knowing that many non-citizen residents of the U.S. make European trips in the summer, and they count heavily on this.



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Small Hawaiian Carrier Defies FAA, CAB in Jurisdiction Dispute

Honolulu—Question of whether inter-island services in Hawaii constitute intrastate operations or flights over international waters has led to a bitter clash between the Federal Aviation Agency and the Civil Aeronautics Board, and Island Airlines, an aspiring, cut-rate, sky-bus operator.

The new company began its inter-island scheduled service May 24 with a single Douglas DC-4 transport leased from Alaskan Airlines. It promptly collided with both federal agencies over the issue of state-versus-federal jurisdiction over the air channels between the islands. Defying both agencies, Island Airlines continued operations. At one point, it took passengers aboard without charge and "passed the hat" aloft to help defray flight costs.

This is the background of the dispute which late last month brought Island Airlines to buy full-page newspaper ads charging FAA with "arbitrary and dictatorial" action:

- **Island Airlines petitioned** the Hawaii state Public Utilities Commission in 1961 for a certificate to operate intrastate sky-bus services at rates substantially less than standard rates charged by the two CAB-certificated carriers, Aloha Airlines and Hawaiian Airlines. The commission issued a decision and order on Aug. 16, 1962, directing the company to start operations on or before Oct. 26.
- **Island requested** an FAA operating certificate—all that is required to conduct intrastate operations, since CAB jurisdiction is confined to interstate services.
- **FAA said it would process** Island Airlines for certification as a commercial contract operator, but not as a scheduled airline until the question of jurisdiction was settled.
- **In a complaint filed** by U.S. Attorney Herman T. F. Lum, acting for the CAB, the Board took this position. ". . . this proposed and threatened transportation of passengers by air by the defendant [Island] as a carrier is interstate air transportation . . . in that the proposed flights by the defendant between the islands of the State of Hawaii must necessarily pass through the airspace over the international waters extending beyond the three-mile belt of coastal waters of the various islands of the State of Hawaii."

While the battle over jurisdiction was being waged, Island moved ahead with its plans to begin its service. In April of this year, FAA informed Island President Walton E. Wood that only five apparent discrepancies still barred certification as a contract carrier. Wood responded by announcing publicly that operations would begin with or without FAA certification, and charged that Island had met all FAA certification requirements.

Late in April, and again on May 1, the DC-4 made a round-trip flight between Oahu and Kauai. On May 23, the FAA sent Wood official notices of investigation and followed these with formal civil penalty letters, offering to settle out of court for $8,000. FAA further warned that failure to agree to the compromise could result in a court action to collect the full $12,000, maximum fine for the violations.

The airline began regular four-day-a-week service to neighbor islands on May 24, and the FAA promptly launched investigations of the flights with a view toward citing the carrier for additional penalties in each instance.

On May 27, Island legal counsel filed a motion to dismiss Lum's complaint. Island argued that the complaint was "premature;" that it "is an attempt to enjoin a state rate order, and is, therefore, beyond the jurisdiction of this court;" that the "State of Hawaii, being an indispensable party, jurisdiction of this matter is vested in the Supreme Court of the U.S. under the constitution."

The next day, Federal Judge Martin Pence issued a temporary restraining order against further Island flights. In support of his request for the restraining order, Lum had filed with the court an affidavit from Irving Roth, director of the CAB bureau of economic regulation, in which fear was expressed that federal subsidies to Aloha and Hawaiian airlines might be increased from $3 million to $4 million if Island were allowed to fly. Roth also noted that Island's operation might jeopardize Aloha's CAB guaranteed loans which enabled Aloha to purchase its Fairchild F-27 fleet.

Wood promptly announced the sky-bus would fly despite the restraining order. He said no fares would be charged, that previous reservations would be honored and that the plane's other seats would be filled on a first-come, first-served basis.

By the time a U.S. marshal boarded the sky-bus at 7:45 a.m. on May 29 to serve the restraining order on the flight crew, there were already 62 persons aboard. On the same day, Judge Pence lifted his restraining order after Island's attorney pointed out in open court that the notary public who had witnessed Roth's signature on the supporting affidavit had failed to affix the notary seal to the original document and that the notary's commission had expired on Jan. 14, 1963.

Island flew a special Memorial Day round trip between Honolulu and Hilo on May 30, and the 81-seat aircraft was filled to capacity. No charge was made for the seats. During the two days of free flights, Island passed the hat for donations to the "Sky-Bus Relief Fund." The airline claimed that donations amounted to about one-half of what it would have received from the sale of tickets.

On the following day, schedules were resumed on a revenue basis and the airline increased flight frequencies from four to six weekly.

Last week, Judge Pence issued a second restraining order, but this was again disallowed when Island's attorney pointed out illegal technicalities in the language of the order. Specifically, he noted that the order instructed Island Airlines to stop air services between "certain islands." This, the attorney stated, was too vague to act upon, and the judge agreed.

As a result, Lum late last week began the preparations of a third restraining order. At the same time, FAA completed plans to file a complaint of violations against Island Airlines in a federal court here. Meanwhile, Island continued to conduct its operations, unmoved by the legal furor surrounding it.

Load Factor Increases For Lufthansa Shuttle

Cologne—Lufthansa West German Airlines carried 10,000 passengers during the first two months of operation over its new non-stop domestic air shuttle between Frankfurt/Main and Hamburg. Service was introduced Apr. 1 on a one-year trial basis (AW Mar. 4, p. 45).

Load factor for the 86-passenger Lockheed 1049G Super Constellations used on the shuttle increased from 31% during the first week of operation to 46% near the end of May. Lufthansa officials say they expect this trend to continue over this heavily traveled segment of the carrier's domestic network.

The service, first of its kind to be introduced in Europe, is based on established U.S. techniques. Only difference is that Lufthansa passengers have no seat guarantee at a specific flight time.

Flights are operated on a three times daily basis in each direction, leaving Frankfurt at 8 a.m., 2 and 8 p.m. and Hamburg at 8 and 10 a.m. and 8 p.m., Mondays through Fridays. On Saturdays and Sundays services are reduced to two daily, at 8 a.m. and 8 p.m., in each direction. Flying time over the 325-mi. route is 1 hr. 20 min.

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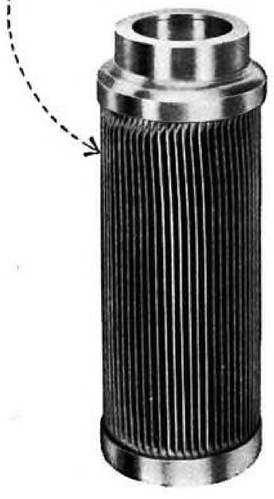

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RAHWAY, NEW JERSEY, AND VAN NUYS, CALIFORNIA

Western Shuns Mergers, System Growth

Los Angeles—Western Air Lines, shunning all merger bids, believes its traffic will grow steadily without adding route mileage other than the long-sought West Coast-Hawaii route.

Terrell C. Drinkwater, the carrier's president, told AVIATION WEEK & SPACE TECHNOLOGY that he has no intention of expanding Western's services east of the Mississippi River or south of Mexico City. He feels his airline should be confined to the regions identified by the corporate name; that population growth and the accompanying expansion of industry and tourism in the West are sufficient stimulants to maintain a profitable operation without mergers or additional routes.

As to the Hawaiian route, Drinkwater said: "We won't go broke without it, but the route is essential to the maintenance of our strength in the West."

Western was certificated to operate a route from San Francisco, Los Angeles and San Diego to Honolulu by the Civil Aeronautics Board in January, 1961. However, CAB fixed a temporary stay order to its decision, thus delaying the effectiveness of Western's Hawaiian service. The stay order was issued following a recommendation by former President Eisenhower, who disapproved the international phase of the Transpacific Route Service Case, and suggested that the domestic route awards in the case be reconsidered as part of the over-all Pacific route pattern.

In June, the CAB lifted the stay order, opening the door for other carriers interested in the route to file petitions for reconsideration. Last month, the Board heard oral arguments on the case. Western, of course, is pinning its hopes on a CAB denial of all petitions for reconsideration.

Jet Equipment

The airline is fully equipped to begin the service with jet equipment. Last month, it accepted delivery on the last of its order of 10 Boeing 720B turbofan transports, all of which are equipped for over-water operations. The airline's fleet also includes 12 Lockheed Electra turboprop transports—five of which are operated as all-coach aircraft and 16 Douglas DC-6B transports, which were written down to residual value in 1962.

Three DC-6Bs have been sold to Japan Air Lines, and the company is currently training about 200 Japan Air Lines pilots in Salt Lake City. During the next few years, the piston-engine fleet will be phased out entirely.

Western plans to replace its Lockheed Electras in 1966, when they will have been fully depreciated, with short-range jet transports. At present, the airline is considering both the Douglas DC-9 and the BAC 111, and will make its decision this summer, probably in August (AW May 6, p. 42).

The airline will require no additional financing to purchase these jets.

Drinkwater operates in a stringent economic atmosphere, and relies heavily on his management group for the conduct of the company's affairs. He said he frowns upon the "individualism" which identifies so many airline heads, and prefers to stay in the background as part of his management team. He keeps the group and staff echelons small to prevent "red tape and Parkinson's Law" from marring efficiency.

Tourism Factor

He termed Western a "home town" airline with respect to the West, and has given full rein to Arthur F. Kelly, sales vice president, to make it just that. Kelly views tourism as a major factor in the development of Western's traffic, and works closely with travel agents, hotel operators and representatives of other modes of transportation in generating this type of traffic.

Kelly likes outdoor advertising, since he feels the average Californian is always "on the go" and is frequently exposed to billboards. The drive for this business is reflected by the fact that coach now accounts for about 90% of all Western traffic.

Average yield for the airline has declined from 6.53 cents per seat-mile to 6.09 cents for the first quarter as a result of the swing to coach. Nevertheless, during the first quarter of 1963, available seat miles increased 20% over the same quarter last year and seat miles sold rose 19% in the same period. As a result, total operating revenues jumped 14% during the period to a new high of $22.2 million.

Operating Expenses

At the same time, operating expenses were held to a 3.5% increase, resulting in a sharp decline in the breakeven load factor from 48% to 43%. During the period, depreciation costs were cut 34%.

The airline earned a net profit of $1.7 million in the first quarter compared with $1 million last year. The 1963 earnings came solely from operations. The 1962 first quarter profit included $290,000 from the sale of surplus aircraft. Western has paid stockholders a dividend for 48 consecutive quarters.

Western has applications with the CAB for a route from Denver to Houston via Dallas and Ft. Worth and one from Salt Lake City to Spokane, Seattle and Vancouver. Under the terms of the bilateral agreement between the U. S. and Mexico, the airline is limited to one flight daily between Los Angeles, San Diego and Mexico City.

Earlier this year, it added a Douglas DC-6B schedule to the route, but the demand for first-class jet service to and from Mexico runs high. The route is profitable but Drinkwater sees no promise in an extension of the route into other parts of Latin America.

West Germans Design Short-haul STOL

Siat Super STOL 311A, 20-passenger short-haul turbojet transport, is being designed by West Germany's Siebelwerke-ATG GmbH. Aircraft could carry two tons of cargo in an alternate freighter configuration. Design takeoff distance over a 34-ft. obstacle is 984 ft. and landing distance over a 49-ft. obstacle is 918 ft. Maximum range is 1,242 mi. Cruise speed is 441 mph. and landing speed, 62 mph.

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Short- and medium-haul airliner

The most advanced design
Good for many years ahead
Most competitive operating costs
—per aircraft-mile, per seat-mile
Basically designed for automatic landing
—for regularity and safety in bad visibility
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Entirely new standards of speed, spaciousness,
comfort, safety, regularity, simplicity—and economy

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Airline Income and Expenses – March 1963

(In Thousands of Dollars)	OPERATING REVENUES						Total Operating Expense	Net Profit (or Loss)
	Passenger	Cargo	Other Non-Mail	U. S. & For. Mail	Federal Subsidy	Total		
DOMESTIC TRUNKS								
American	32,712	3,423	91	919	.....	37,145	36,961	159
Braniff	6,408	372	113	221	.....	7,114	6,814	86
Continental	5,561	312	60	115	.....	6,048	5,462	217
Delta	16,745	987	53	355	.....	18,140	14,901	1,403
Eastern	25,550	1,350	250	465	.....	27,615	26,805	284
National	9,245	617	47	160	.....	10,069	8,245	719
Northeast	4,835	215	79	53	.....	5,182	5,043	23
Northwest	7,860	667	49	236	.....	8,812	8,340	115
Trans-World	23,285	1,770	126	694	.....	25,875	26,897	(1,268)
United	40,877	2,761	300	1,474	.....	45,412	45,686	(774)
Western	6,656	257	77	105	.....	7,095	5,709	590
Trunk Total	179,734	12,731	1,245	4,797	.....	198,507	190,863	1,554
INTERNATIONAL								
American	805	66	23	8	.....	902	567	169
Braniff	745	85	37	46	.....	913	1,149	(125)
Caribair	521	36	8	4	.....	569	497	47
Delta	197	26	.....	1	.....	224	293	(35)
Eastern	3,165	172	1	81	.....	3,419	3,184	156
Mackey	171	7	15	.....	.....	193	183	4
Northwest	2,603	492	223	904	.....	4,222	3,262	417
Panagra	1,327	313	164	129	.....	1,933	1,725	93
Pan American	29,956	4,800	3,124	3,937	.....	41,817	40,127	276
South Pacific	36	1	.....	1	.....	38	83	(58)
Trans-Caribbean				Not Available				
Trans-World	6,107	892	349	1,252	.....	8,600	8,029	61
United	2,039	81	34	131	.....	2,285	1,582	606
Western	676	18	6	7	.....	707	470	109
International Total	48,348	6,989	3,984	6,501	.....	65,822	61,151	1,720
LOCAL SERVICE								
Allegheny	1,282	87	18	26	537	1,950	1,969	(44)
Bonanza	821	24	6	5	230	1,086	834	97
Central	451	27	16	17	346	857	859	(6)
Frontier	762	31	14	18	762	1,587	1,370	96
Lake Central	462	27	19	11	312	831	927	(109)
Mohawk	1,661	70	38	23	401	2,193	2,167	(3)
North Central	1,337	97	34	37	665	2,170	2,166	(14)
Ozark	868	64	7	22	406	1,367	1,382	(65)
Pacific	579	23	14	16	317	949	954	(15)
Piedmont	1,150	50	16	23	481	1,720	1,641	17
Southern	686	32	28	23	505	1,274	1,236	64
Trans-Texas	555	38	10	18	395	1,016	990	6
West Coast	533	20	10	10	431	1,004	942	10
Local Service Total	11,147	590	230	249	5,788	18,004	17,437	34
ALASKA & HAWAIIAN								
Alaska Airlines	242	39	348	62	180	871	827	2
Alaska Coastal	106	22	8	14	113	263	263	(3)
Aloha	380	6	(18)	2	20	390	443	(75)
Cordova	17	10	30	5	52	114	110	5
Hawaiian	484	84	(12)	4	.....	560	673	(128)
Kodiak	12	2	2	1	6	23	42	(20)
No. Consolidated	57	29	41	77	145	349	283	26
Pacific Northern	517	124	10	143	101	895	1,147	(144)
Reeve Aleutian	81	25	39	58	.....	203	219	50
Western Alaska	6	2	1	2	17	28	26	2
Wien Alaska	65	40	169	80	233	587	564	25
Alaska & Hawaiian Total	1,967	383	618	448	867	4,283	4,597	(260)
HELICOPTERS								
Chicago	21	1	1	2	98	123	134	(4)
Los Angeles	80	23	1	13	153	270	250	23
New York	152	5	12	2	172	343	381	(45)
Helicopter Total	253	29	14	17	423	736	765	(26)
CARGO & OTHERS								
Aerovias				Not Available				
Avalon[1]	9	1	21	1	.....	32	39	(5)
Flying Tiger	.....	958	1,537	.....	.....	2,495	3,243	(470)
Riddle	.....	744	302	.....	.....	1,046	1,185	(263)
Seaboard	.....	863	874	398	.....	2,135	2,014	(84)
Slick	.....	.....	1,118	.....	.....	1,118	1,334	(336)
Cargo & Other Total	9	2,566	3,852	399	.....	6,826	7,815	(1,158)
Industry Total	241,458	23,288	9,943	12,411	7,078	294,178	282,628	1,864

[1] One-third of first quarter 1963 report

Prepared By Ray & Ray

Vertical profile of Caravelle Super A shows modified wing and bulkier engine nacelles for General Electric CJ805-23C aft-fan powerplants.

Sud Caravelle Super A Undergoes Flight Tests

Beefed-up tail area is characterized by tapered anti-shock body on Super A, feature not included on earlier Caravelles shown in background.

Over-all performance of Super A is improved by CJ805-23C engines, which produce 16,000 lb. thrust.

With New Powerplants

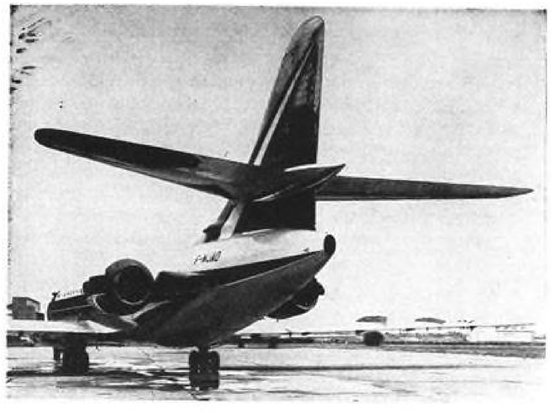
Sud Caravelle Super A transport, formerly called the Horizon, is undergoing flight tests at Toulouse, France, with certification expected in July. The aircraft displays exterior modifications required with installation of the General Electric CJ805-23C aft-fan powerplants.

A sleeve has been placed on the wing's leading edge near the root, and an anti-shock body installed at the intersection of the horizontal and vertical stabilizers, increasing the aircraft's Mach limitation to .81, compared with .77 on the Rolls Royce Avon-powered Caravelle 6R. The CJ805-23C engine is rated at 16,000 lb. thrust, while the Avon produces 12,080 lb. Fairings just aft of the engine mount pylons are exhausts for heat exchangers located in the stubs, the exchangers providing a complete cycle of cabin air every 4 min. Hole in the aft tip of the fuselage is the exhaust for an auxiliary power unit, proposed as standard equipment on the Super A.

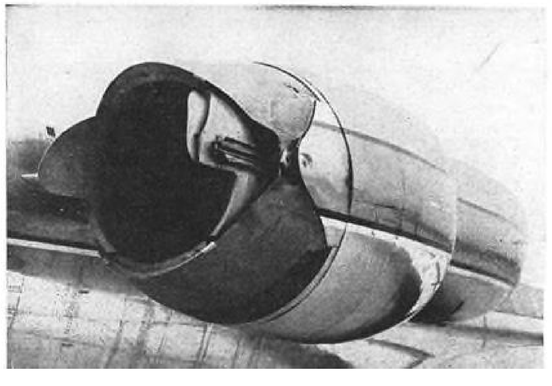
The aircraft is also equipped with double-slotted flaps, which facilitate takeoff within 6,080 ft. at maximum takeoff weight of 114,640 lb. Landing distance at maximum landing weight of 109,128 lb., is 5,180 ft. Maximum cruising speed at 25,000 ft. is 473 kt., compared with 435 kt. for the Caravelle 6R. The fuselage has been lengthened 3 ft. 4 in. to 108 ft. 4 in., increasing high-density passenger capacity from 64 to 68.

The eight-pane cockpit windscreen has been expanded to give 50% more visibility than on the 6R. The heavier engine also required strengthening and minor repositioning of the fuselage-engine attachment frame.

Trans World Airlines originally expressed interest in the Super A, but financial difficulties resulted in cancellation of a $100-million order for 20 aircraft (AW Mar. 19, 1962, p. 41). Only one of the series has been built.



Large hole in aft tip of fuselage is exhaust for auxiliary power unit (above), which eliminates need for ground power units on Super A. Neat fairing of exposed clamshell thrust reversers on aft-fan engines is evident in bottom photo.



AIRLINE OBSERVER

► Investor interest in domestic trunkline common stocks continues to push airline issues to new highs for the year on the New York Stock Exchange. Brokers now feel that the industry has passed the problems of jet transitional costs which, coupled with a promising traffic growth, will improve net earnings for the year. With the exception of Northeast Airlines common stock, which is listed on the American Stock Exchange, all trunkline stocks have reflected this interest by showing substantial gains since the first of the year.

► **U. S. domestic trunklines had a net loss of $14.9 million in first quarter of 1963, compared with a net loss of $17.5 million in the same period last year, according to the Air Transport Assn. Operating revenues were $560.8 million for the quarter, compared with $536.3 million in the same quarter of 1962. Operating expenses were $564.7 million against $548.3 million in the comparative periods. Industry net loss for March was $1.5 million, contrasted to $3.3 million in March, 1962.**

► Alitalia is studying the "American market" for its equipment requirements in the medium-range operating area. Carrier is undertaking a $130-million expansion program, and plans a fleet of 40 jets and 11 turboprops by 1966. Carrier now operates 11 Douglas DC-8s and 14 Caravelles, in addition to numerous piston-engine aircraft which will be retired.

► **Aeroflot's diversion of Tu-114 turboprop transports to the strategic Moscow-Havana route has apparently slowed expansion of nonstop trans-Siberian Tu-114 service. Tu-114s carrying a maximum of 170 passengers are making only two round trips daily on the 4,350-mi. Moscow-Khabarovsk route, according to the new spring timetable. This is the frequency originally scheduled for 1962. An-10s, Il-18s and Tu-104As continue to carry the bulk of Aeroflot's long-haul Siberian traffic.**

► National Airlines will continue to serve Washington, D. C., with Lockheed Electra turboprop transports rather than jet aircraft because, according to National President L. B. Maytag, Jr., "Dulles is so far out it adds an extra hour onto passenger's traveling time—it takes about that long to get to and from the city." He noted that carriers serving Dulles, Washington's jet airport, have had to set schedules 20-to-30 min. ahead so the mobile lounges can be loaded. "All this is an inconvenience and wasted time to passengers and we're selling speed and convenience," he said.

► **British Overseas Airways Corp.'s gradual withdrawal of navigators from de Havilland Comet flights has brought new wage increase demands from the British Air Line Pilots Assn. BALPA contends that one third of the salary of the displaced navigator should go to each of the three remaining crewmen. BOAC, backed by a recent ruling of the British Industrial Court, has refused to grant the wage demands.**

► Civil Aeronautics Board Examiner Herbert K. Bryan last week recommended that Northwest Airlines be authorized to operate unrestricted service between Chicago and Cleveland, between Cleveland and Philadelphia and between Detroit and Philadelphia, and that American Airlines operate unrestricted service between Cleveland and New York. At the present, only United Air Lines is permitted to operate unrestricted service in these markets. Continental Air Lines' bid for an extension of its West Coast-Chicago route to Cleveland and New York was rejected in the initial decision on grounds that an "additional transcontinental carrier would adversely affect United and other" carriers.

► **Further evidence of the diminishing demand for first-class service, particularly on international routes, is Trans World Airlines' elimination of another first-class seat row from jet aircraft operating over transatlantic routes. Addition of another economy row leaves aircraft with only 16 first-class seats, compared with 126 in economy section. Pan American World Airways said 80% of its traffic in 1962 was economy class.**

SHORTLINES

► **Alitalia Airlines** has reported net earnings of $2.6 million for 1962 on gross revenues of $129 million, compared with $95 million in 1961. The carrier, which operates without government subsidy, has operated profitably every year since 1952 except in 1958, when it began North Atlantic service.

► **Allegheny Airlines'** car rental affiliate, ALCAR, is joining with National Car Rental System in a cooperative program that will be operated under license to the National Car Rental System. Project is designed to stimulate more fly-drive travel on short-haul routes.

► **American Airlines** has added a late night Boeing 707 flight to its New York-Los Angeles nonstop service to accommodate cargo shipments between the two points. Flights will carry passengers, but are scheduled to permit early morning delivery of cargo.

► **Braniff Airways** has reported traffic gains in each month of 1963 through April. Revenue passenger miles increased 8.8% in April over the same month last year, while a 3.1% rise was reported in January, and 4.6% in both February and March.

► **Continental Air Lines** is attributing a 34% increase in revenue passenger miles during May to bargain fares, a stronger economy and "quickening defense and space activity." Passenger revenues for the month showed a 20% increase over passenger revenues in May, 1962.

► **Northwest Airlines** has reported net earnings of $499,241 for the month of April. Net earnings for the first four months of 1963 total $994,948, compared with a net loss of $440,923 in the same period last year.

► **Russia's Aeroflot** has inaugurated direct service between Moscow and Ulan Bator, Mongolia, with Il-18 turboprop transports. Scheduled time is 9 hr. Moscow-Ulan Bator passengers formerly had to change planes at Irkutsk.

► **U. S. domestic trunklines** and all-cargo scheduled airlines flew 69.8 million ton miles of air cargo in domestic operations during April, a 12.5% gain over the volume carried in the same month last year. Freight ton miles increased 14.2% during the month, express rose 7.3% and mail volume improved by 14.4%.

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Your flight may have arrived late at night, or in the middle of a rainstorm. But as soon as the engines stopped, this man was right there searching, testing, making sure.

In industry terms he's called a line mechanic. And he and hundreds like him throughout United Air Lines are extremely important . . . to us and to you. *Their job:* to see to it that your plane is absolutely airworthy before it takes off again. *Their training:* extremely thorough and continually updated. *Their responsibility:* your safety and comfort and—only after these are assured—getting your flight off on time.

Because they know how important it is for you to leave and arrive on schedule, our line maintenance people have done some special things to prevent delays.

you'd want to know about travel on time

Faster and better

They have invented many special tools to do their work faster and better; they have made up preplanned tool kits so no time is lost looking for the right tools; they use walkie-talkies to speed work on the ramp or between ramp and hangar; they have their own private line telephone system providing instant connection among United stations all over the nation; they use this system to anticipate needs, get advance information, parts, decisions, whatever is necessary to avoid delay. They are constantly developing many other aids to on-time dependability.

Extra care—for people

All this effort and ingenuity on the part of our line mechanics springs from a policy that goes for all the rest of us at United Air Lines—no matter what our jobs are—all the way from the president right on through the organization.

This policy says very specifically that the welfare of our customers as individuals must come first in everything we do—and that a genuine concern for people must be part of all who work with us.

Extra care—for *people*—is the heart of it.

With the great human responsibilities involved, there can be no better basis for running—or choosing—an airline.

UNITED

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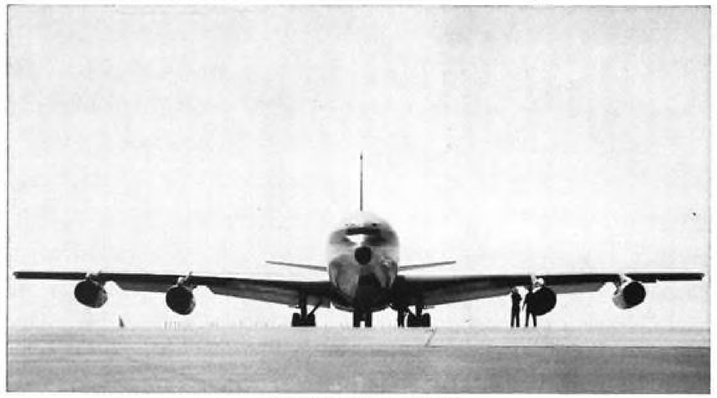
707 PROTOTYPE

720

707



707 INTERCONTINENTAL

BOEING
727

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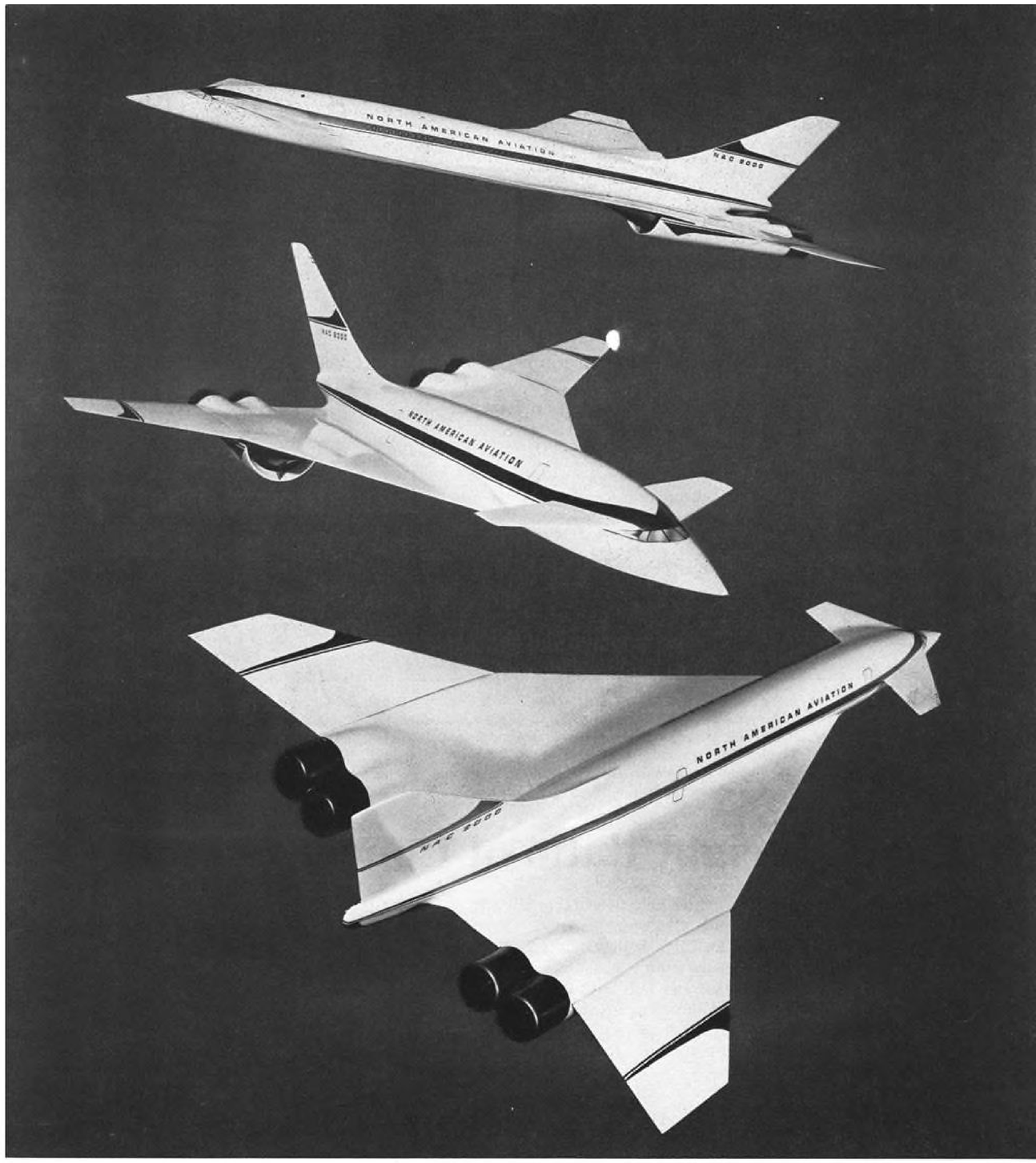
No other jetliner in the world springs from such an illustrious ancestral line.

It begins with the historic Boeing 707 prototype, America's first jet transport, and the famous 707, first American jet to enter commercial service.

The 707 Intercontinental, next, is the world's largest, longest-range jetliner. The medium-range 720 is the fastest commercial airliner in service. In all, more than 330 Boeing jets are now in service. They hold more than 500 speed and distance records, and serve 191 cities in 93 countries.

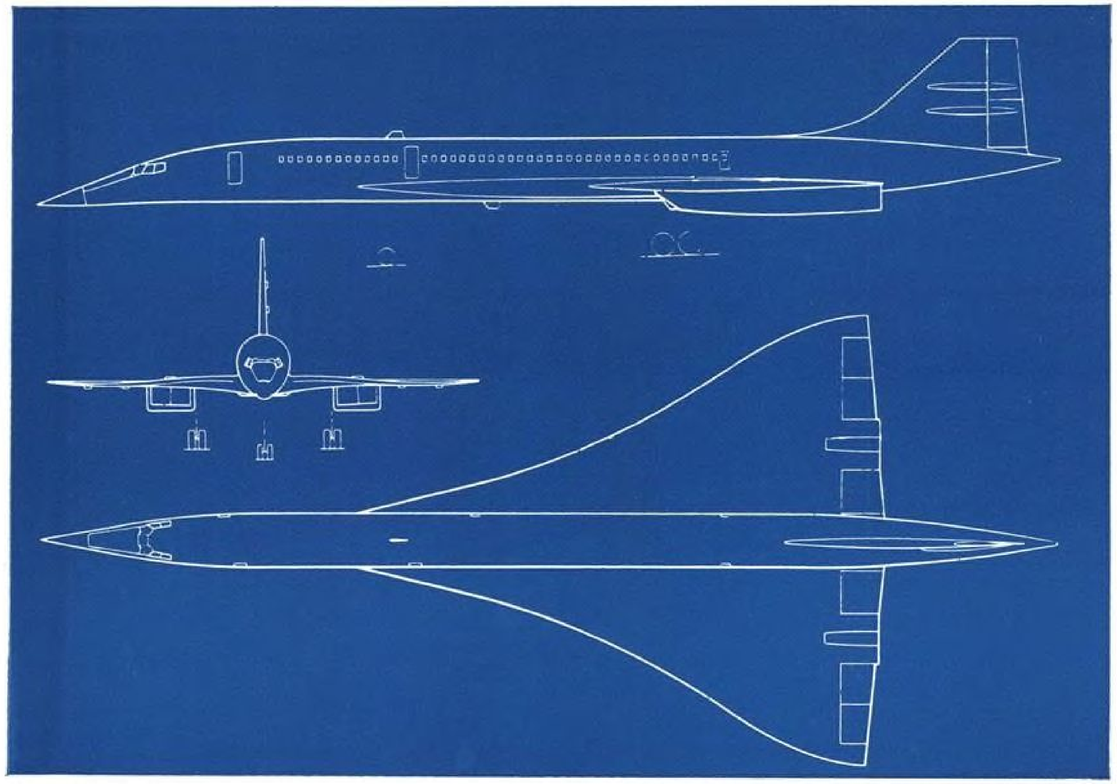
The new 727 will fill out the family tree by serving short-range routes. Able to operate from 5000-foot runways, it will bring the advantages of jet travel to hundreds of additional cities. The 727 enters service early next year, after the most intensive test program in airliner history.

These airlines have already ordered 131 Boeing 727s: American, Ansett-ANA, Eastern, Lufthansa, Trans-Australia, TWA and United.



North American Displays Delta Wing Concept for SST

Study model of one of North American Aviation's design concepts for a supersonic transport shows the modified delta wing and canard surface characterizing the aircraft's geometry. Wingtips fold down during cruise at high Mach number to increase the lift-drag ratio. Paired powerplants, mounted in underwing nacelles, feature spiked, half-annular inlets. Engines for this configuration would be turbofan types with duct burning. Canard surface is all-movable, and has a trailing-edge flap for lift control. Lateral and longitudinal control is handled by elevons, directional control by standard rudder. Interior is planned around a mixed load equivalent to 130 passengers. This model and a smaller study concept featuring a variable-geometry wing are on display this week at the French International Air Show.



EXTERNAL FEATURES of the Anglo-French Mach 2.2 transport show fairings for control surface power-boost systems. Two fairings are evident on the port side of the vertical stabilizer, one for each half of the split rudder. Others, apparently for aileron, flap and engine outlet control, are located on the wing trailing edges. Adjustable fairing between the cockpit and radome streamlines the windshield during supersonic cruise, then lowers for better visibility at subsonic speeds. Nose gear strut is also longer than in earlier drawings, indicating a slight nose-up attitude on the ground for optimum takeoff performance. Second passenger door over the wing is offered with the long-range transatlantic version, being built by the British, to serve the economy section of a dual-class seating configuration.

Range/Weight Ratio of Concorde Studied

Paris—Technical and administrative officials working towards development of the 110-passenger Anglo-French Concorde Mach 2.2 supersonic transport are pushing for agreement on final design details in an effort to keep their time lead over potential U.S. competitors.

Spurred by the knowledge that the U.S. also may adopt a compromise design within the Mach 2 range rather than attempt to advance directly to an advanced steel and titanium Mach 3 aircraft, the Concorde planners still have a number of problems to overcome. These are described by some as natural growing pains to be expected from any project of similar dimensions in design scope and ambition.

One worry in both French and British circles is that the contemplated ranges for the two aircraft types in the program may be difficult to attain within the framework of the gross weight currently under consideration. Initial estimates of the amount of aerodynamic drag and specific fuel consumption by the powerplant package also are believed to be optimistic by some officials concerned with the program.

Maximum gross weight of the 3,250-mi.-range transatlantic version of the Concorde to be built by British Aircraft Corp. is now pegged at approximately 250,000 lb. The medium-range—2,500-mi.—aircraft to be produced by France's Sud Aviation now has a gross weight of about 200,000 lb., but some observers believe that the figures for both versions eventually must be increased if the projected ranges are to be met.

Breakeven minimum stage-length for the medium-range version also reportedly has risen to 1,600 mi., while Sud officials as recently as last fall were placing the stage-length figure in the 1,000-mi. category.

Another question still under consideration is whether the four 33,000-lb.-thrust Bristol Siddeley Olympus 593 powerplants, to be paired in pods beneath the aircraft's ogee delta wing, should be fitted with the proposed Snecma-designed afterburner to help accelerate the Concorde through the transonic zone and into the supersonic flight regime (see p. 61).

Jointly financed by the British and French governments, the $500-million Concorde development program provides for the construction of two flying prototypes and at least two pre-production models.

One prototype incorporating the essential features of the longer-range aircraft will be assembled by BAC at Filton, while the medium-range prototype will be rolled out from Sud's Caravelle production plant at Toulouse. Both are still scheduled to be flying by 1966.

Two pre-production models are expected to be in the air by 1968—original date for initial customer deliveries—with the aircraft available for operational service by 1970.

Slippage in the time schedule for the first customer deliveries coupled with any firm U.S. decision to enter the Mach 2 field could be costly to the Concorde program as such.

Essentially the Concorde is an outgrowth of a Sud development program, although BAC subsequently has supplied considerable design detail. The Concorde was envisioned as a logical follow-on to the Caravelle medium-range jet transport project. Contributing to the international sales success of the Caravelle was Sud's decision to build an aircraft to fill a specific, and vacant, niche within the jet transport spectrum, one in which there was no prospective competition from the U.S. An extension of this philosophy played a major role in the evolvement of the Concorde.

The original Sud proposal, bearing a strong resemblance to the present Concorde configuration, was shown in model form at the last Paris Air Show in 1961 (AW June 5, 1961, p. 40).

Sud's president, retired Air Force Gen. Andre Puget, believes the Concorde can be placed on the market at the relatively attractive price of $8-9 million per aircraft (AW Jan. 7, p. 42), based upon the expectation of a sales potential of about 130 transports through 1975 and because of the development support from the two governments.

Original Sud estimates placed direct operating costs over route segments of 1,000 mi. and beyond at $1.50-2 per nautical mile. Seat mile costs over route segments of 1,000 mi. were placed at 1½-2 cents per nautical mile.

Lucien Servanty, Sud chief design engineer for aircraft, has said initial studies indicate that the annual utilization rates required for either version of the aircraft to reach the breakeven point should not exceed those established for the present generation of jet aircraft now flying.

First major airline to reveal an order for the Concorde is Pan American World Airways, but orders from both British Overseas Airways Corp. for the transatlantic version and Air France for the medium-range model are also expected. Both these airlines have made it clear, however, that they will hold off on any production orders until the aircraft has shown it can meet their operational requirements (AW Jan. 28, p. 39; Dec. 19, p. 50).

Specifically, Air France says it must be satisfied that the Concorde meets all the safety criteria for its specialized type of operation, that it can be integrated into the present air traffic control system designed for subsonic jets, that its seat-mile costs do not exceed those of the present jets, and that it can be handled at existing airports on the airline's route structure.

Regarding the latter point, Sud says the medium-range version of the aircraft, at a gross weight of 200,000 lb., should be capable of taking off in distances about the same as those for current jets. Speed over the threshold on landing approach is estimated at 162 mph., and Snecma is developing a clamshell reverser unit to aid in braking during ground roll.

With a slender delta wing planform and a slightly swept tail, the aircraft will be constructed primarily of aluminum alloys, with some titanium or stainless steel incorporated in localized areas. Anticipated structural temperature at cruise speed is expected to reach a maximum of 130C.

Present wing span is set as 77 ft., fuselage length at 170 ft. The Concorde also will use adjustable ramps in the engine intakes to obtain optimum air flow at the varying flight speeds, and, in another move to improve flow, the forward canopy will be covered by a retractable fairing.

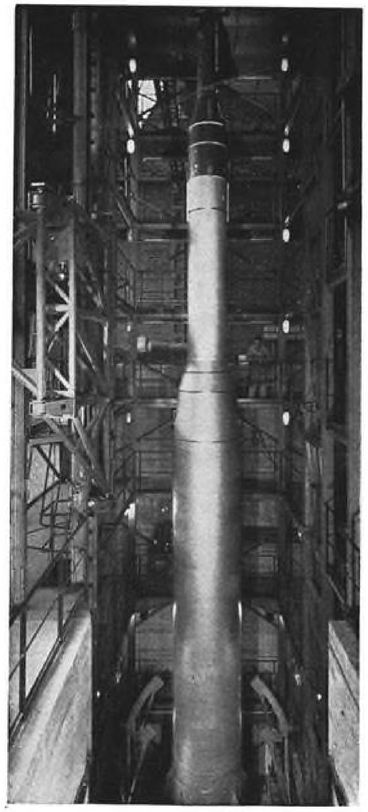
Incorporation of the same basic design plus maximum interchangability of components has been emphasized in the development and production programs of the two different versions—Britain's transatlantic model and France's medium-range aircraft. Present differences between the two include:

- **Transatlantic version** will carry fuel in all parts of its modified delta wing as well as in the center portion of the fuselage. Fuel in the medium-range aircraft will be carried in only a portion of the wing, and the fuselage center section will be used as an additional cargo hold.
- **Landing gear** and other structural units will be substantially strengthened on the transatlantic aircraft in order to accept the higher gross weights involved.
- **Larger vertical stabilizer** will be used on the transatlantic version.

In the work division between the two countries, efforts are being made to avoid any duplication in tooling, with both BAC and Sud gaining the capability of producing parts for either the transatlantic or the medium-range aircraft.

Once production is fully under way, work distribution between the two airframe firms will be handled on a roughly 50-50 basis. BAC, using quantities of French-supplied components, will build the initial batch of transatlantic aircraft, while Sud will do the same on the medium-range version. Later, work on the two types could be redistributed to provide for a more equal work load for each company should one of the two versions prove to be more marketable and outstrip the other in the number of total orders.

Acceptable envelope for supersonic flight by the aircraft is described by Sud officials as between 43,000 and 62,000 ft., while cruise altitude will roughly correspond with the latter figure. For takeoff, approach and holding purposes, one Sud engineer says the aircraft can operate economically at subsonic speeds over ranges of up to 200 naut. mi. without appreciably affecting the over-all estimated cost figures for cruise stage lengths covering a minimum of 1,000 naut. mi.



French Unveil Diamant

First two stages of French Diamant space booster will be displayed at the French International Air Show. First stage, called Emeraude, is 33 ft. long and burns liquid propellants. The second, called Topaze, is solid fueled and contains the guidance system. A third, solid propellant stage, designated Saphir, has not yet been built. A French consortium under direction of Sereb is developing the booster, scheduled to put a 175 lb. satellite into orbit in 1965. First stage develops 62,000 lb. thrust and burns 88 sec.; the second stage, 33,000 lb. thrust, burning 42 sec. Last stage develops 11,700 lb. thrust and burns 47 sec.

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Heat Stressed in Concorde Engine Tests

Bristol, England – Comprehensive series of test installations for development of the Olympus 593 turbojet engine powering the Anglo-French Concorde supersonic transport will concentrate on heating conditions in excess of 1,300K.

With 15 engines earmarked for the development program, Bristol Siddeley is modifying facilities used in the Olympus 301 military program, including the following:

- **High-altitude test plant,** presently used in the ramjet program. This facility can test a scaled single powerplant for a supersonic aircraft by utilizing a Bristol Siddeley Viper engine, and complete flight plan simulation can be conducted between Mach 1.4 and Mach 2.5.
- **Several test stands** with capacity for engines of up to 50,000 lb. thrust.
- **New intake air heater** for testing the Olympus family at simulated supersonic conditions. The heater can pass an air mass flow of up to 400 lb./sec. at temperatures up to 180C.

In France, Snecma, which has responsibility for development of intake and exhaust geometry, the afterburner, and the thrust reversal system, already is testing reverser components at high Mach numbers using an Atar 9 exhaust system.

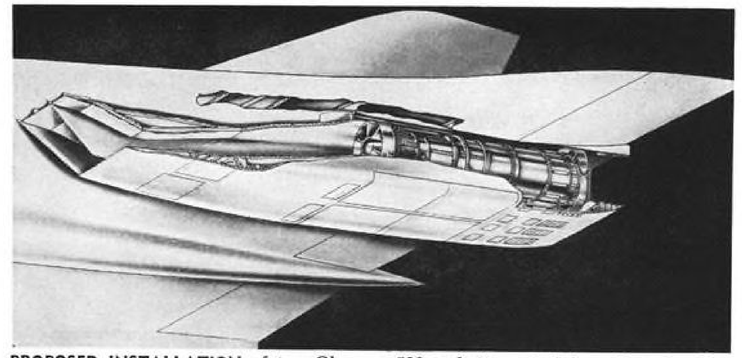
The company will have an adapted test stand for the Olympus 593 by the end of this year and a similar stand with pre-heating facilities will be available at the end of 1964.

Another altitude simulation facility for testing a complete Olympus 593 will be constructed at Centre d'Essais des Propulseurs where tests are now under way on models of the afterburning system and nozzles, and of an aircraft nacelle for one or two engines.

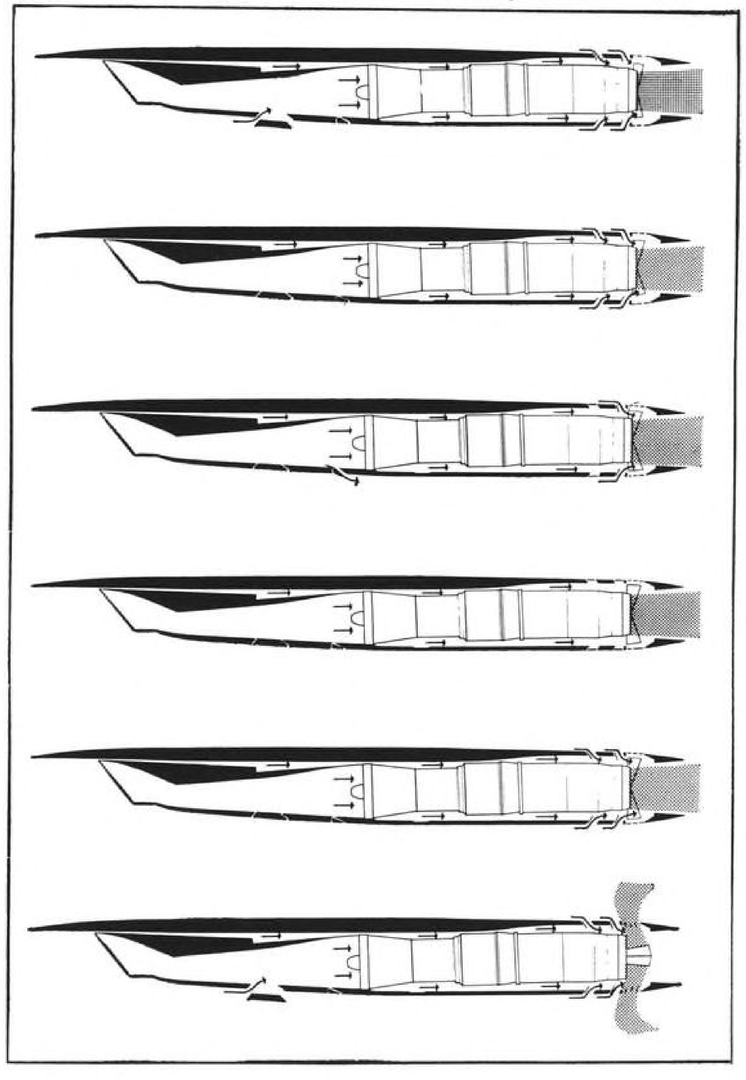
The Olympus 593 is the civil derivative of the Olympus 22-R supersonic engine under development for the British Aircraft Corp. TSR-2 strike fighter. This airplane is scheduled to make its first flight late this year.

Selection of the Olympus 593 to power the BAC-Sud Aviation Concorde resulted from calculations which showed that a high temperature, high pressure ratio turbojet gave the lowest engine-plus-fuel weight for a Mach 2.2 transport on medium and long hauls. Research covered a wide operational range, including takeoff, subsonic climb, transonic acceleration, supersonic cruise, descent, and subsonic standoff.

Possibility of using a turbofan engine was explored, according to Pierre Young, assistant chief engineer, who noted that turbofan fuel consumption is lower than that of a turbojet, but is



PROPOSED INSTALLATION of two Olympus 593 turbojets paired in pods under Concorde wing is shown in cutaway. Note rectangular intakes and wing boundary layer bleed on top. Variable intake and exhaust systems are diagramed (below) from top: takeoff; climb; transonic acceleration; Mach 2.2 cruise; approach, and landing with thrust reversal.



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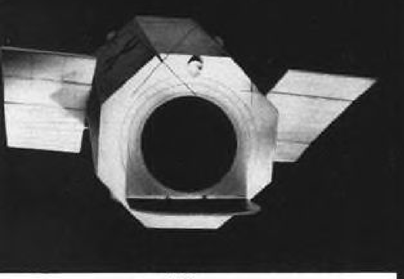

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offset by the higher installed weight because of greater air mass flow.

Probably the most important factor was that the Olympus, which began bench testing in May, 1959, has piled up operational time in Avro Vulcan V-bombers, and the TSR-2 requirement made it a natural for development of a civil version. Flight testing of the TSR-2 engine began in a Vulcan testbed in February, 1962.

Another advantage was the high pressure characteristics of the Olympus, which has a twin spool compressor system. Although the pressure ratio of each spool is comparatively low, the over-all pressure ratio can be considerably more than 12 to 1.

At its present stage of development, the Olympus can deliver 33,000 lb. of thrust, using the afterburning system developed for the engine by Solar. The 593 version probably will develop 38,000 lb. of thrust with use of the afterburner system now under consideration at Snecma.

It is doubtful that the French Concorde, which will fly medium-range stage lengths, will use the afterburner system. School of thought at Sud and Snecma is that the penalty in drag and fuel is not worth the extra boost across the transonic stage. The British, however, want the afterburner system and it will be used on the long-range Concorde, designed for transatlantic stage lengths. End result most likely will be a simplified system as a compromise.

Engines will be paired and hung in squared nacelles under the wing. Each engine has its own rectangular intake, which features variable geometry for high efficiency in the entire speed range. Variable angle ramps are fitted in the upper surface of each intake throat to achieve this.

Besides altering the intake throat area, the ramp will adjust the pattern of shock waves at supersonic speeds. To keep the shock pattern constant, a spill is fitted in the air intake diffuser, thus balancing the air mass flow supplied by the intake and that required by the engine.

When the engine is throttled back during supersonic flight, and the amount of air required is reduced, spillage could occur past the intake lip, causing a drag penalty and aerodynamic "buzzing" which could damage the airplane.

To prevent this the intake will provide an auxiliary door in the lower intake section which may be opened to dump excess air during periods of low thrust.

Wing boundary layer air is bled away by a duct between the intake upper leading edge and the lower wing surface. A portion of the boundary layer is ducted through the nacelle into an annular duct surrounding the tailpipe,

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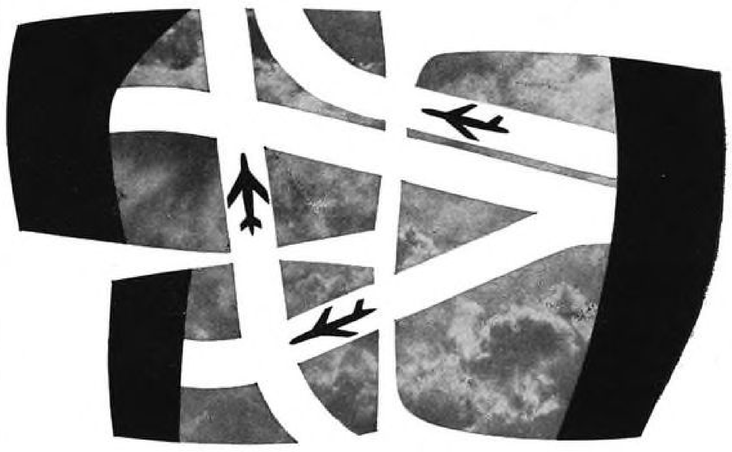

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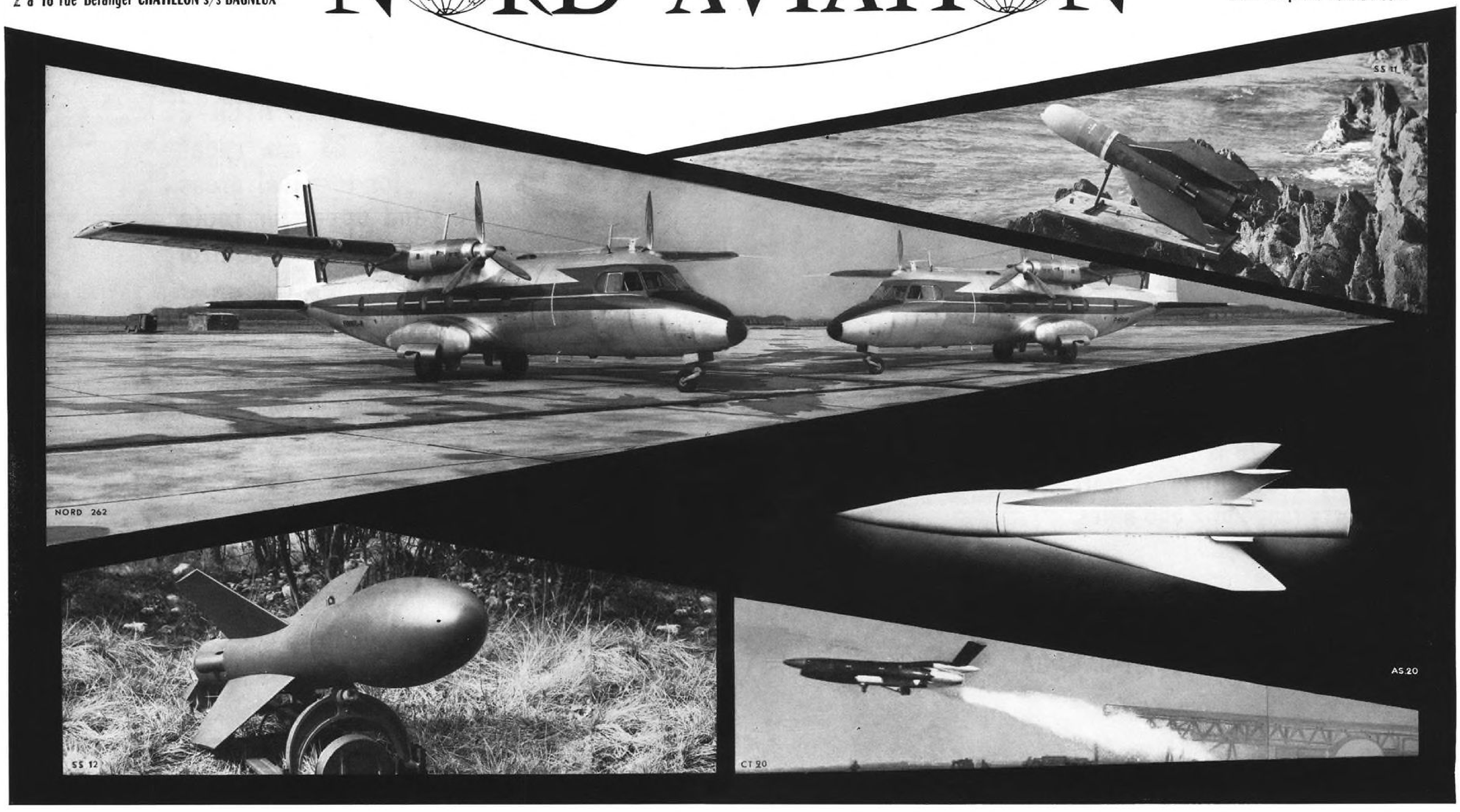

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becoming the secondary airflow around the variable primary nozzle.

The exhaust system is a multi-flap variable area convergent nozzle that incorporates the afterburner and noise suppressor. A secondary divergent nozzle of fixed area, and a thrust reverser, also are included. The tailpipe itself is connected to the powerplant by an articulated joint and flexible bellows, and is cooled by the boundary layer air bled from the wing. Young said the thrust reverser unit will be retracted in flight and will give reversing thrust of about 45% of inflight power.

Mounting of the engine in the nacelle is by two main trunnions, one on each side of the high pressure compressor delivery casing, and a forward suspension link on the engine intake casing. Main trunnions take the engine thrust, vertical and transverse loads, and gyroscopic couples. Forward suspension link is free to swing, allowing for axial and radial expansion forward of the main trunnions.

A fireproof metal shield surrounds each engine and its accessories and all fuel and hydraulic pipes are shrouded. The accessory gear-box is mounted beneath the intermediate casing of each engine, and air for the cabin is bled from the high pressure compressor.

Complete simulation of the Concorde fuel system has been accomplished by Shell Oil Co. and is currently undergoing tests and modifications, using hot fuel. Because of the high temperatures involved, considerable research is going into selection of engine oils.

Young said final configuration of the Concorde has been frozen, clearing the way for powerplant design teams. The French meet with the British every three months, alternating between Britain and France, but there is considerable cross-channel flow almost weekly.

Rolls System Bonds Metal With Ceramic

Derby—Rolls-Royce Advanced Research Group has succeeded in bonding ceramic fibers with metal to create a new high temperature, high strength metal for potential use in engine manufacture and in airframe construction.

Dr. A. M. Smith, chief physicist, said Rolls currently is considering a pilot plant to investigate the development further before making a decision on quantity production.

New material, Dr. Smith said, is 10% lighter than aluminum with considerably higher heat resistant properties, better fatigue life and with a higher strength to weight ratio. Ceramic used in tests is silica.

In most recent tests, a specimen showed a strength of 40,000 psi. at a temperature of 400C.

Snecma Builds Design Capabilities With Fully Modulated Afterburner

Paris—Snecma is beginning to reap capital as well as design profit from its established lead in the development and production of fully-modulated afterburner sections that can produce significant increases in speed as well as major savings in fuel consumption when compared with more conventional units.

With a number of fully-modulated systems already in service on French combat aircraft, the company now is busily refining designs for the Dassault Mirage 3V supersonic VTOL fighter, the Mirage 4A *Force de Frappe* nuclear bomber and the planned Mirage 4-106, a follow-on aircraft projected for the 1970-72 period with about twice the weight of the present Mirage 4 series.

Snecma (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation) also is moving into the commercial field, particularly towards the development of reversers that can be mated with turbofan engines.

Projects in this category include the design and development of a reverser and powerplant nacelle for the 14,000-lb.-static-thrust Pratt & Whitney JT8D-1 turbofan engine scheduled for the Sud Caravelle 10B jet transport. Snecma and Pratt & Whitney officials hope the package also may be adopted for the Douglas DC-9.

JT12 Reverser

In related work, the French firm has developed a reverser for the Pratt & Whitney JT12 currently powering the Dassault Mystere 20 executive jet transport and the General Electric CJ610 installation for the Hamburger Flugzeugbau HFB320.

Snecma has been given responsibility for major components for the Bristol Siddeley Olympus 593, four of which will power the Anglo-French Concorde supersonic transport.

Work here includes the design, development and eventual production of a relatively small afterburner section, whose primary task will be to provide the engine with approximately 20% additional thrust in order to push the Concorde through the transonic speed regime and into supersonic flight; the noise suppressor, a major project in its own right; the reverser, and a variable intake. The latter is designed to help provide a low noise level at takeoff power, work with the afterburner to provide maximum thrust at transonic speeds, make for low internal and external drag during Mach 2 cruise and, finally, provide relatively small thrust and low fuel consumption during subsonic holding.

Design work for the Olympus components is well under way, and the French government has channeled in a certain amount of funding to keep the project moving, although a firm development contract has not yet been signed. There also still remains some dispute as to whether the installation of an afterburner, with its additional weight and drag, is a required feature for the Concorde.

Mirage 3V Engine

Snecma cut its teeth on the design of afterburners for fan engines with its work on the 11,680-lb.-static thrust TF-106 engine for the Mirage 3V. At full power, the modulated afterburner unit can boost the thrust of the TF-106 to a total of 20,497 lb. If the Mirage 4-106 follow-on aircraft develops beyond the drawing board stage, it would also use this engine.

Basis of the TF-106 is the Pratt & Whitney JTF10. United Aircraft Corp., Pratt & Whitney's parent firm, holds 10.9% of Snecma's stock. Aside from addition of an afterburner, engineering changes needed to boost the JTF10 to a Mach 2.3 capability have included redesign of the gas generator and the internal engine aerodynamics plus growth of the engine from two to three stages.

After beginning design work on the TF-106 in May, 1960, Snecma purchased several JTF10s directly from Pratt & Whitney in order to test the basic design and configuration for an afterburner mated to a fan engine. These remodeled and still subsonic powerplants, designated the TF-104, have been flown aboard a Sud Armagnac testbed, and one soon will be installed in the Dassault Mirage 3T for further evaluation.

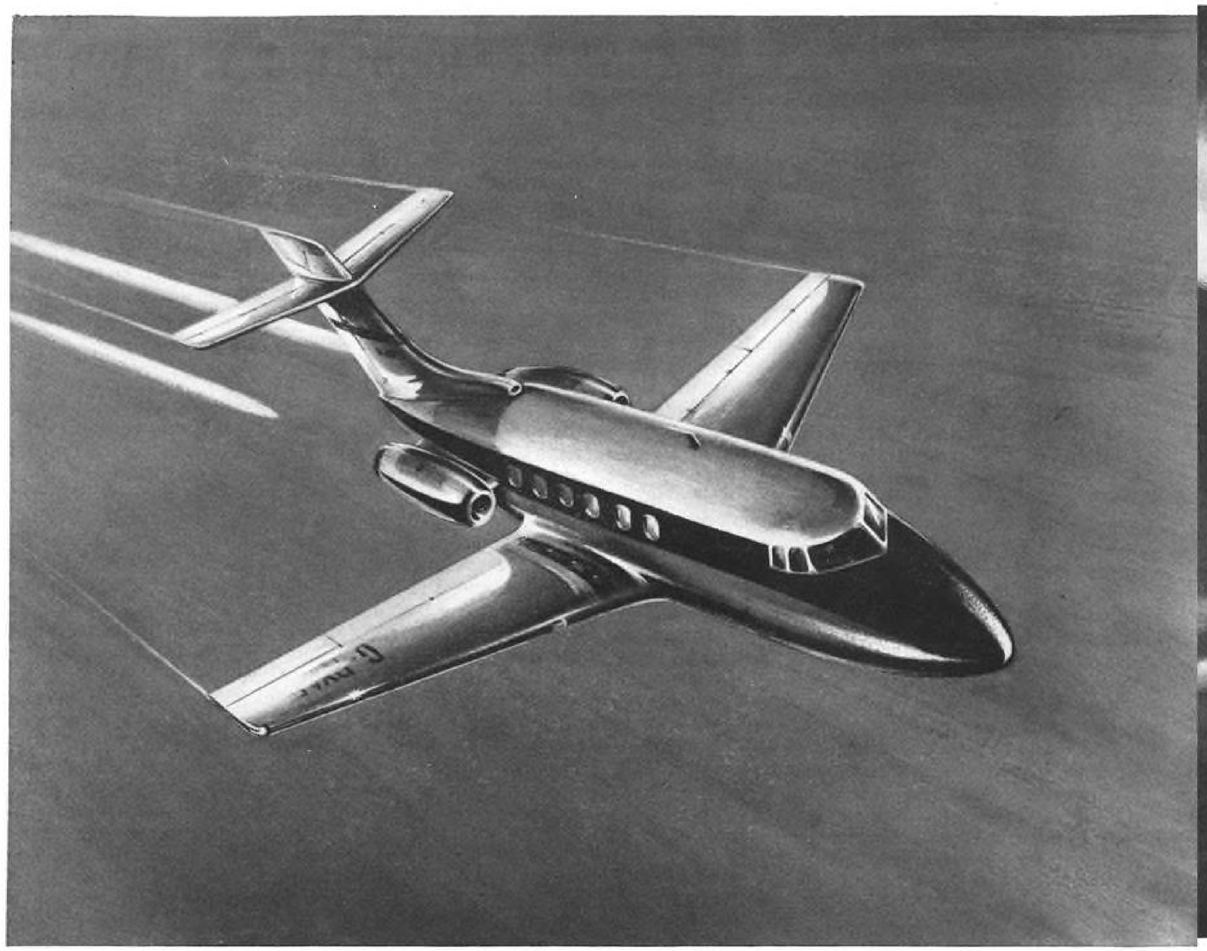
Afterburner Test

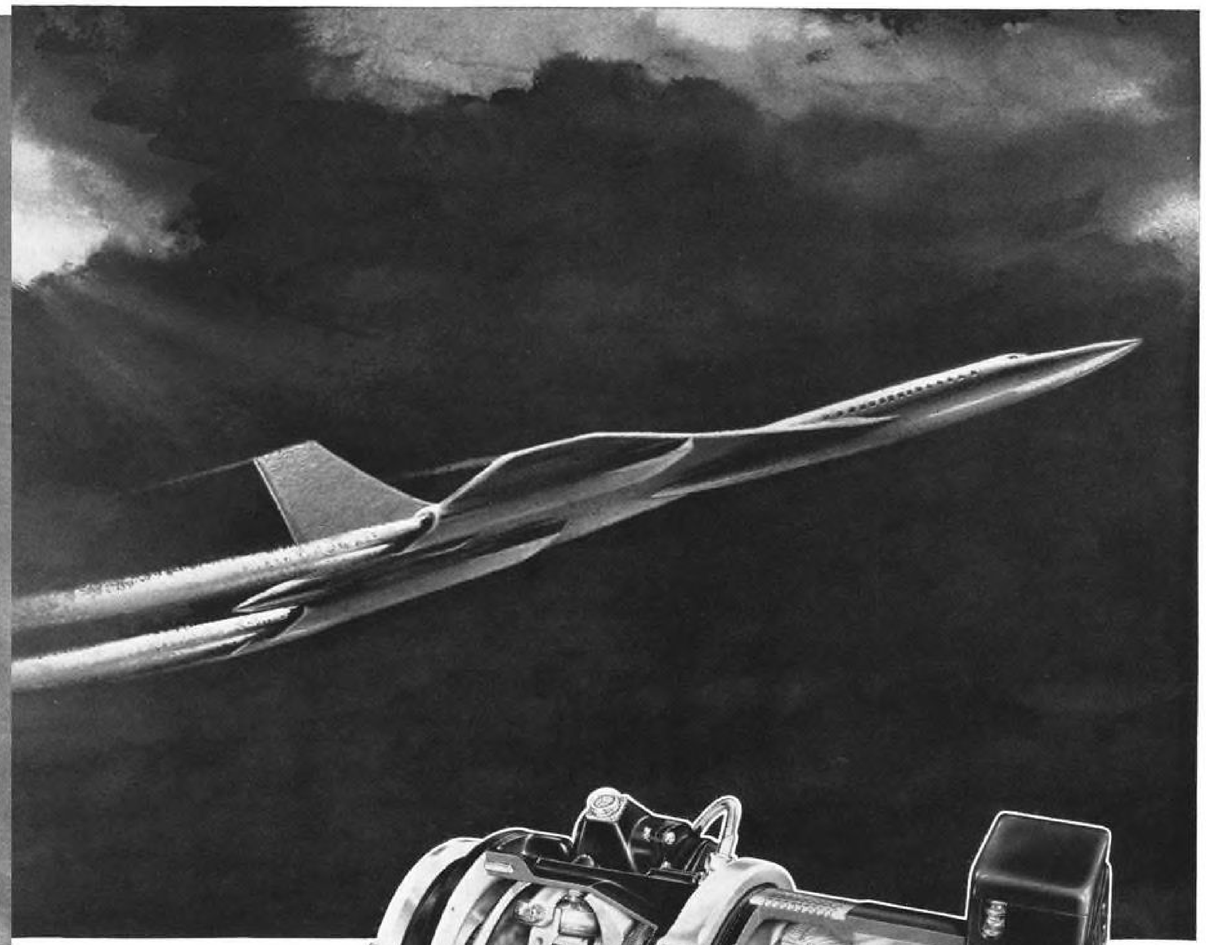
Afterburner for the TF-106 prototype is now running in a test cell. First engine is scheduled to leave the factory on July 1, flying initially on the Armagnac testbed and then, in July 1964, in the Mirage 3T.

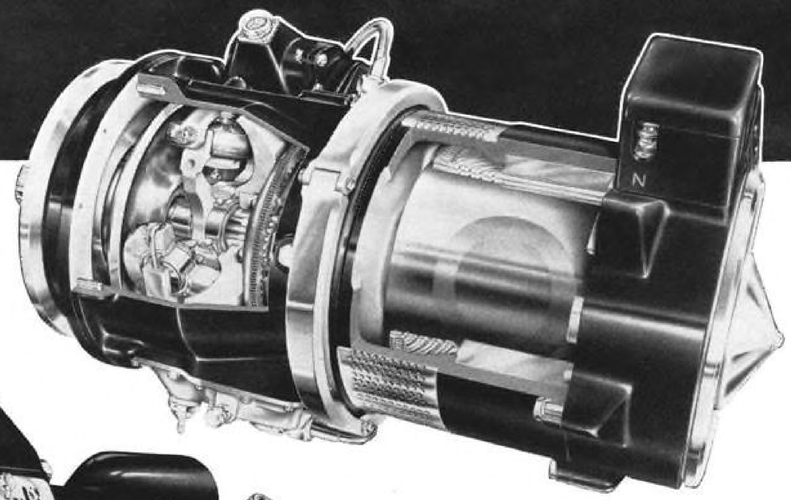
Series production probably will get under way sometime in 1966.

Snecma, which has been working in the afterburner field for the past 10 years, also has developed fully modulated units for the 13,225 lb.-static-thrust Atar 9B on the Mirage 3 fighter and the 9,900-lb.-thrust Atar 101G on the Dassault Super Mystere as well as the Atar 9K, two of which power the Mirage 4A.

The Atar 9K engine has a static







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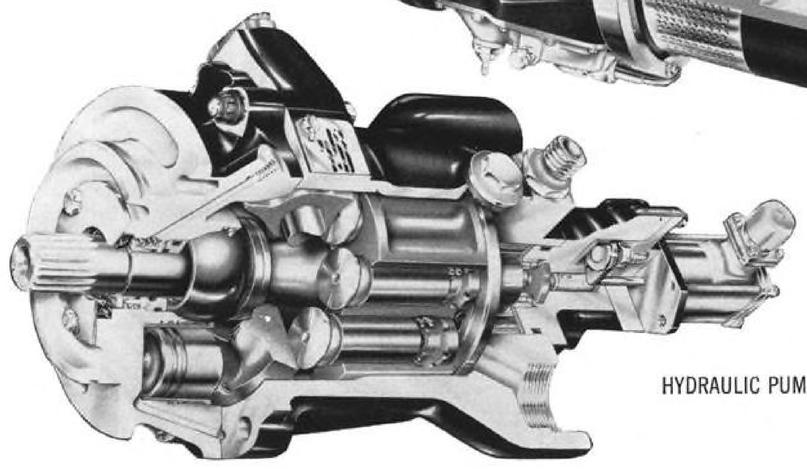

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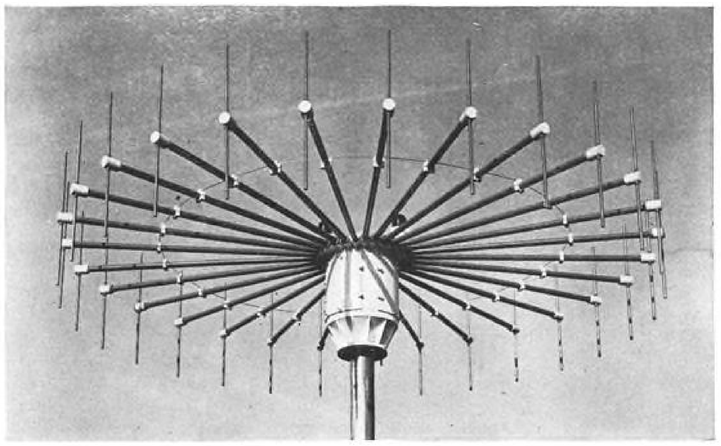

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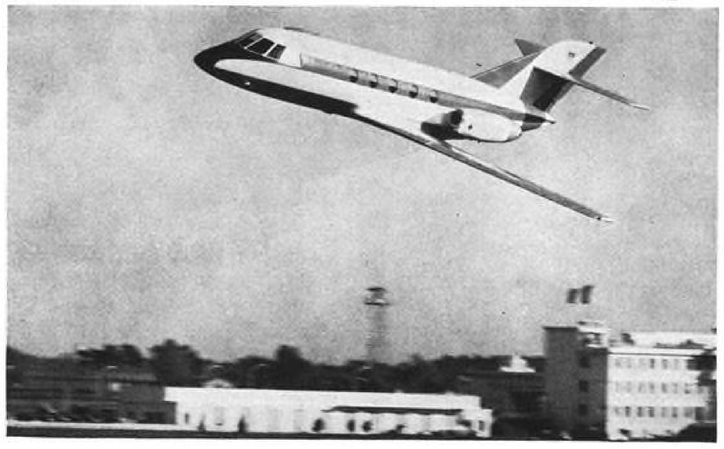

AVION D'AFFAIRES , DE LIAISON
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thrust of 13,225 lb., which can be pushed up to 15,430 lb. with afterburner.

Modulation, built around a variable exhaust nozzle, permits the pilot to set his afterburner thrust rating from near zero to maximum power and can contribute towards significant savings on long combat missions where more than normal thrust is required over prolonged periods.

The Mirage 4, for example, has a mission requirement for one hour of afterburning at various power settings during a long-range penetration flight.

Afterburner Control

In the cockpit, the power setting for the afterburner works off the throttle. With the control handle pushed forward to the 100% dry power setting, the pilot can then ignite the afterburner by pulling the throttle slightly upwards. This move also unlocks the throttle which then, in its advanced regime, can be used to regulate the afterburner thrust while the engine itself remains at maximum power.

Snecma, formed in 1945 in a consolidation of several prewar firms, made the move to modulated afterburners naturally without any transition through the fixed-nozzle design dominant in the U. S. and elsewhere.

First engine in the Atar series, the production backbone of Snecma throughout the company's existence and one that is still being developed further, was designed in 1945 and, as part of its basic fuel control system, included a fully modulated exhaust nozzle.

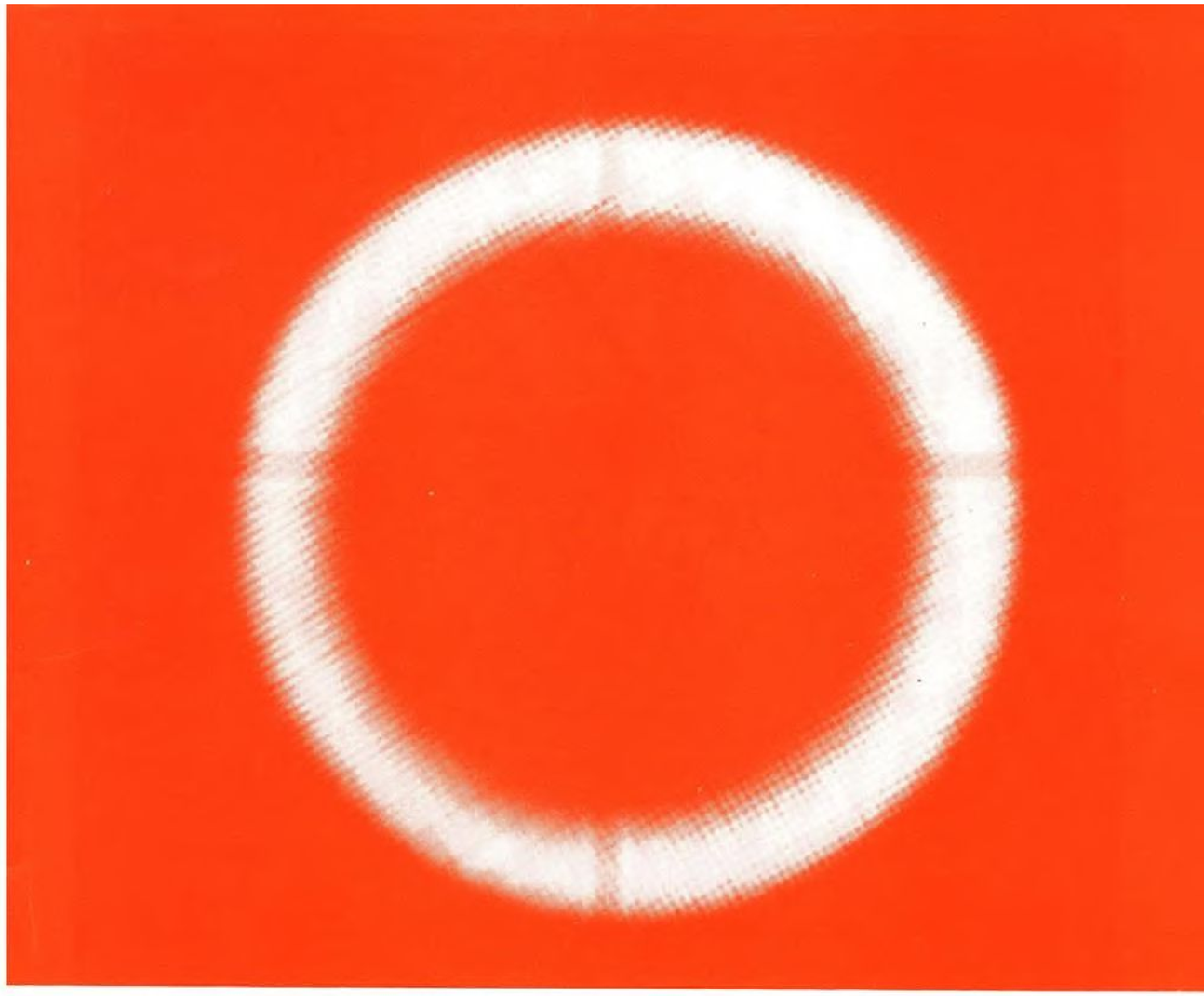
When Snecma began its work on afterburners several years later, it adopted the same principle, and all of the company's units developed thus far incorporate the fully-modulated design for the afterburner.

Atar Growth

Snecma production of the first model in the Atar series, a 3,747-lb-thrust engine, began in 1947. During the powerplant's growth to the present 9K design, engine diameter has remained almost constant, although additional staging has added considerably to the length of the later developments of the Atar engine series.

In addition to its own production, Snecma has granted licensed-production rights for the Atar 9C to Australia and Switzerland for use in the Mirage 3, which also will be manufactured in these two countries.

The company now has a total work force of approximately 12,000 employes, the great majority of them assigned to the various aircraft facilities. Snecma, however, also has expanded into the nuclear propulsion field; avionics, now a separate division, and industrial and marine turbine power.



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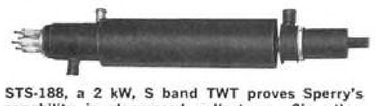

STS-188, a 2 kW, S band TWT proves Sperry's capability in depressed collectors. Six other models ranging through S, C, and X bands, are also operational at 10 W, 20 W and 2 kW power levels.

This photograph of a hollow, high-perveance electron beam helps us measure our progress toward a goal of higher efficiency for traveling wave tubes. That's because its halo shows us how we're doing on beam control, and lets us know how our higher perveance electron gun designs are working out.

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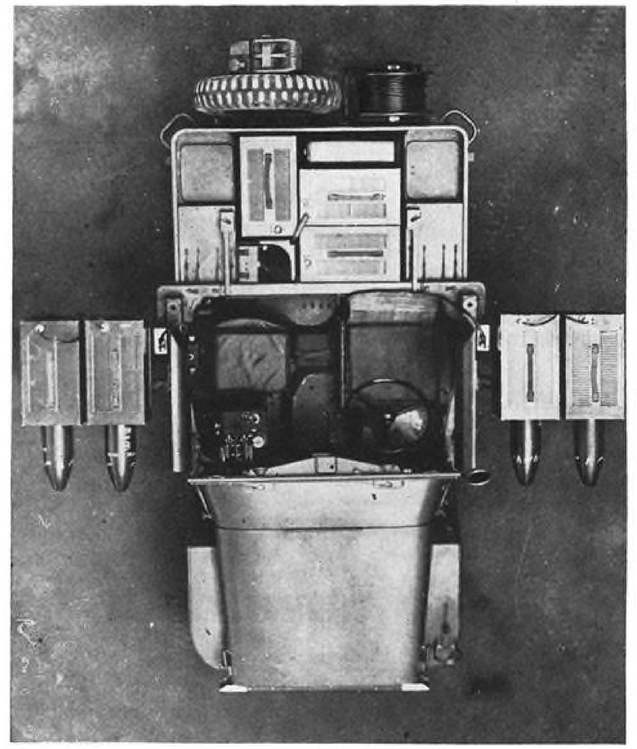
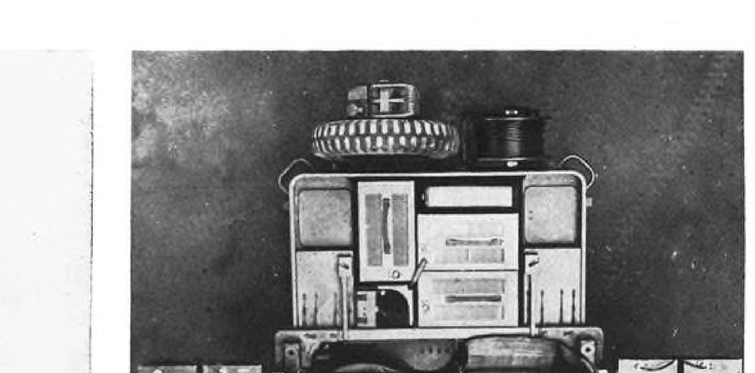


France Stresses Battlefield Missile Development

U. S. Army is among those of 10 nations that have ordered French battlefield missiles, primarily the Entac (above), developed by DEFA and produced by Nord, or the Nord SS.11 (below). Entac, whose jeep carrying system is shown in an unusual top view (above, right), is a solid propellant, wire guided weapon with a range of 6,600 ft. Belgium and France also have bought the Entac. The SS.11, the latest in Nord's family of wire-guided anti-tank weapons, is launched from a tank as carrier (below). Jeep carrier also is used (right). As of this spring, Nord had produced a total of 100,000 missiles of all types.



BREGUET 1150 ATLANTIC prototype is shown during test flight. Aircraft has maintained schedule well, despite multi-national nature.

Atlantic Surmounts Nationalism Barriers

Paris—North Atlantic Treaty Organization officials concerned with the development and production success of the multilateral program for the Breguet 1150 Atlantic long-range turboprop anti-submarine patrol aircraft believe the project may become a financial as well as a managerial and political success.

The Atlantic has now broken the sales barrier within the NATO nations involved—never an easy task—with an order of 20 each from France and West Germany on the basis of prototype evaluation data available thus far.

As the aircraft continues to prove itself, NATO officials say, they expect firm follow-on orders from these two countries of at least the same dimensions, and others from interested nations that could raise the final total to 100-200.

Included in the larger number are hoped-for orders from the U. S., a financial and technological contributor to the Atlantic program but a nation with a similar aircraft, the Lockheed P3A. The reasoning here is that the reputedly lower cost of the Atlantic may induce the U. S. Navy to order the aircraft or else complete a license-production contract for its manufacture within the U. S., as that service continues to phase out its large numbers of Lockheed P2V piston-engine ASW patrol planes.

U. S. industry already stands to profit from the Atlantic program in several areas. Primarily this is through the sale of a large number of avionic components, although the retractable belly radome unit is supplied by France's CSF (Compagnie Generale de Telegraphie sans Fil).

Despite the loss of the program's 02 prototype last Apr. 19, the test and construction program thus far has matched or exceeded the original schedules. Evaluation of the accident data, however, will delay the series production delivery program by about six months. Under initial planning, first fleet delivery of the aircraft had been scheduled for October, 1964.

Both French and U. S. officials here connected with the program contend that investigation of the accident has raised no questions with the basic design of the aircraft, particularly the extensive use of honeycomb structure in the upper and lower wing surfaces and in the fuselage.

This concept came under criticism in some quarters shortly after the accident, which took the lives of the three crewmen aboard.

Over-all performance of the 01 aircraft, which began flying in October, 1961, and the third prototype, which first flew in February of this year, and the limited experience gained with the 02 aircraft, generally has exceeded original specifications, according to officials here.

Breguet Atlantic 1150

Wing span	124 ft., 9 in.
Length	92 ft., 7 in.
Max. gross weight	90,390 lb.
Max. speed	Approx. 400 mph.
Max. range	5,600 mi.
Endurance	12-18 hr.
Powerplants	Two Rolls-Royce Tyne R. Ty. 20 turboprops of 6,105 shp. each.

A more fundamental point, however, is that the project reached the hardware stage at all and that its four-nation production program has met the original schedules.

Although only two countries have ordered the aircraft thus far, the Atlantic stands out as a unique achievement. There have been many programs instituted within NATO for development and production of a common weapon system, but most have run aground on the shoals of nationalism, each country supporting a pet project and refusing to consider any other—technical, financial and performance considerations not withstanding.

Commenting on this tendency, French Navy Capt. Rene Bloch, permanent chairman of the Breguet 1150 technical subcommittee within NATO and a participant in the program from its inception, said recently:

"Unfortunately, these days, a NATO requirement is born, not only when national or international military authorities need something, but more and more often when a certain national industry has something to show or something in the making.

"Such a situation cannot but lead to political and industrial disappointments, since very few people can in this case afford to be objective.

"Therefore, before any program is given the status of a NATO requirement, it should be nothing but a program, and a program for which national requirements, if not commitments, can be stated with enough clarity—perhaps not to indicate that production funds are already available in budgets five or six years away—but to constitute a commitment by the interested defense authorities to request such appropriations when the time comes with a sufficient degree of priority."

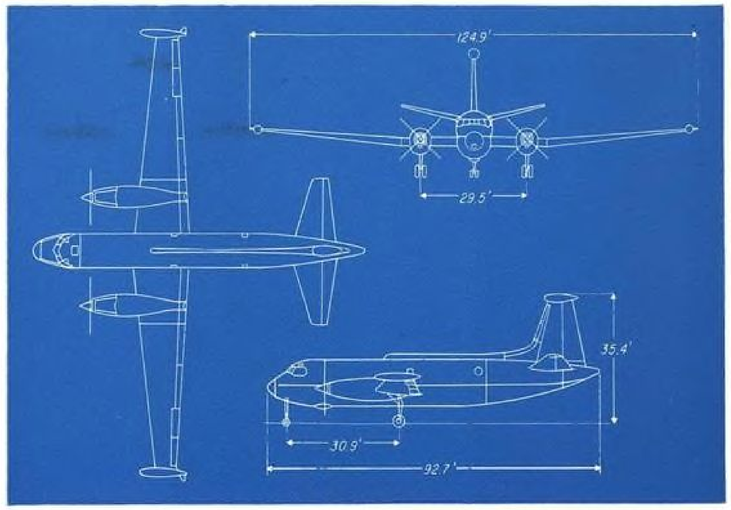
The program for a long-range NATO patrol aircraft as a Lockheed P2V replacement, when first conceived in 1956, did come at a time when no European nation had a firm program in hand, although individual companies in several countries had paper projects. So, the Atlantic largely escaped the barrier of nationalism.

Another compelling reason behind the initial cooperation among 14 countries—a number that, admittedly, has now been reduced to financial support from five—was the over-all cost of the program as such. Block explains:

"Under present day techniques, long-range maritime reconnaissance is so exacting as regards flight autonomy, speed and electronic equipment that it can only be entrusted to an aircraft of approximately 100,000 lb., that is to say an aircraft for which—quite apart from the engine and equipment development costs—at least $70 million must be spent before production units can run off the line.

"At the time it was called for, such a financial effort was only conceivable in the U. S. or within the multinational framework provided by NATO. It was within the latter that, at the end of 1956, the problem of the maritime patrol aircraft was finally considered."

Other factors that have contributed to the program's success include:



THREE-VIEW shows general configuration of the Atlantic, which has a gross weight of 90,390 lb. and a maximum speed of approximately 400 mph.

• **Minimum number** of persons—seven—on the project's steering committee, the long tenure of most members, and an agreed principle that decisions must be made with a minimum of delay. "Our secret," one member says, "is that we've been keeping politics out of this by moving fast."

Capt. Bloch, in evaluating the program's progress, points out that, "the more people assemble, the more the lobbies and the political elements enter the picture, the less objective the competition will become, the more difficult a choice will be and, therefore, the less successful the result will be. As we all know, the real difficulty always lies in the basic opposition which each government experiences between its international defense imperatives and its national economy requirement . . ."

• **Designation of Breguet,** winner of the competition for the NATO aircraft, as prime contractor for the project, with all the authority and responsibility the term implies.

• **Willingness of the French** government to fund the program in its initial phases, while approvals from other participating nations went through the usual governmental delays—five months in one case, 18 in another.

As a consequence, the program not only has met its deadlines with a regularity that belies a multilateral program, but one that would do credit to a purely national effort.

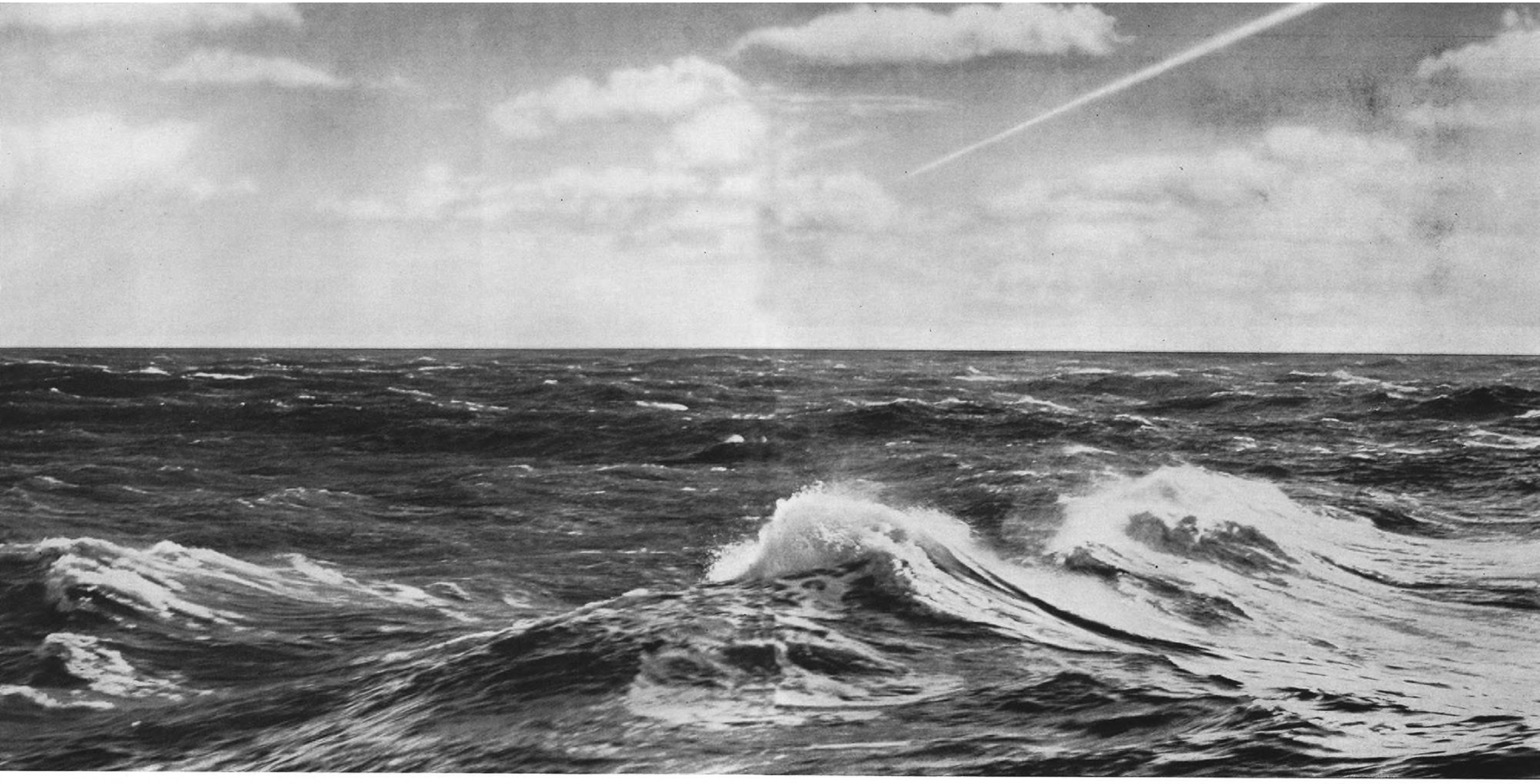
The competition stipulated from the beginning that any production should be on a multilateral basis, and, as it evolved, Breguet retained responsibility for final assembly and flight test, and for construction of the forward and center fuselage sections.

Sud Aviation gained construction responsibility for the outer wing panels, while Holland's Fokker manufactures the wing center section. In West Germany, Dornier and Siebel have formed a group known as Seeflug to build the rear fuselage section and the tail unit. Belgium's SABCA, Fairey and Belgium FN also have formed a group for the consortium, the Association Belge Pour l'Avion Patrouilleur, for construction of the aircraft's engine nacelles.

Here is how the program evolved, how the schedules have been met thus far and an estimate of future progress:

• **Mar. 5, 1957**—NATO's Armaments Committee establishes a group of experts to study the requirements for a new long-range patrol aircraft. Here, too, the group was kept small, never

MAGNETIC AIRBORNE DETECTION gear (MAD) tail boom is shown on the third Atlantic prototype.



Oceans into ponds

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numbering more than 30 persons, although 14 nations were then involved. NATO designation for the group was A/C 126.

• **Apr. 16, 1957**—A/C 126 holds its first meeting and asks the NATO Standing Group in Washington to define its operational requirement for such an aircraft.

• **September, 1957**—The Standing Group defines its requirements.

• **Oct. 12, 1957**—A/C 126 reconvenes to study requirements and consider a general operational program.

• **Jan. 16, 1958**—A/C 126 agrees upon general operational requirements and program for the aircraft.

• **Mar. 10, 1958**—Specifications for the patrol plane are approved unanimously. Nations represented at this meeting included the U.S., United Kingdom, France, Belgium, Canada, Germany, Italy, The Netherlands and Norway. Belgium entered the program when the United Kingdom withdrew.

• **Mar. 21, 1958**—Specifications for bid proposals are submitted through the various national agencies to 22 companies in Europe and Canada. NATO officials say that the U.S. at this time advised the group that it was "not interested" in forwarding the specifications to any American companies. Later this stand was reversed, and 10 U.S. companies were provided with the specifications. Few were able to meet the deadline for submission of proposals.

• **July 7-10, 1958**—Consideration is begun of the 20 submitted proposals. Fifteen are considered valid, and, of these, twelve are discarded during the four-day session. Companies represented in the proposals for which there had been a June 21 deadline, included those from Belgium, Canada, France, Germany, Italy, The Netherlands, United Kingdom and the U.S.

• **Sept. 16-18, 1958**—The group reconvenes to hear presentations from the three companies still under consideration—Breguet with the Atlantic, Nord, and Britain's Avro with an aircraft designated the 745. By the end of the final day, the group, including U.S. and British members, provisionally agreed that the Breguet proposal looked best, with Avro and Nord following in that order. The Nord aircraft was considered too large, the Avro 745 too small.

• **Oct. 21, 1958**—A/C 126 unanimously agrees on the Breguet 1150 proposal as the final choice.

• **Jan. 30, 1959**—Armaments Committee approves the choice of the group.

• **Feb. 11, 1959**—First contract is issued to Breguet and the other participating industrial firms, with the French government accepting funding responsibility without awaiting formal approval of the other nations concerned. Without this, there could have been a five-month delay in the program.

• **Jan. 6, 1960**—Final definition of the basic weapon system, including avionic components, is completed by the group. Original target date for this had been Jan. 1.

• **Mar. 30, 1960**—Mockup of the Atlantic is approved by A/C 126. Scheduled date had been Mar. 30.

• **June 18, 1960**—Complete prototype specifications are completed, well ahead of the July 1 target date.

Oct. 21, 1961—First prototype makes its initial flight from Breguet's Toulouse production facility. Original schedule had called for Nov. 1.

• **Feb. 23, 1962**—Second prototype makes its first flight approximately one week ahead of schedule.

• **Feb. 25, 1963**—Third prototype makes its initial flight, again about one week ahead of schedule.

• **July 1, 1964**—Scheduled date for the first flight of the initial production prototype model of the 1150.

• **Mid-October, 1964**—Original timetable for initial deliveries of the production version, a date which has now slipped by about six months, primarily because of the loss of the second prototype.

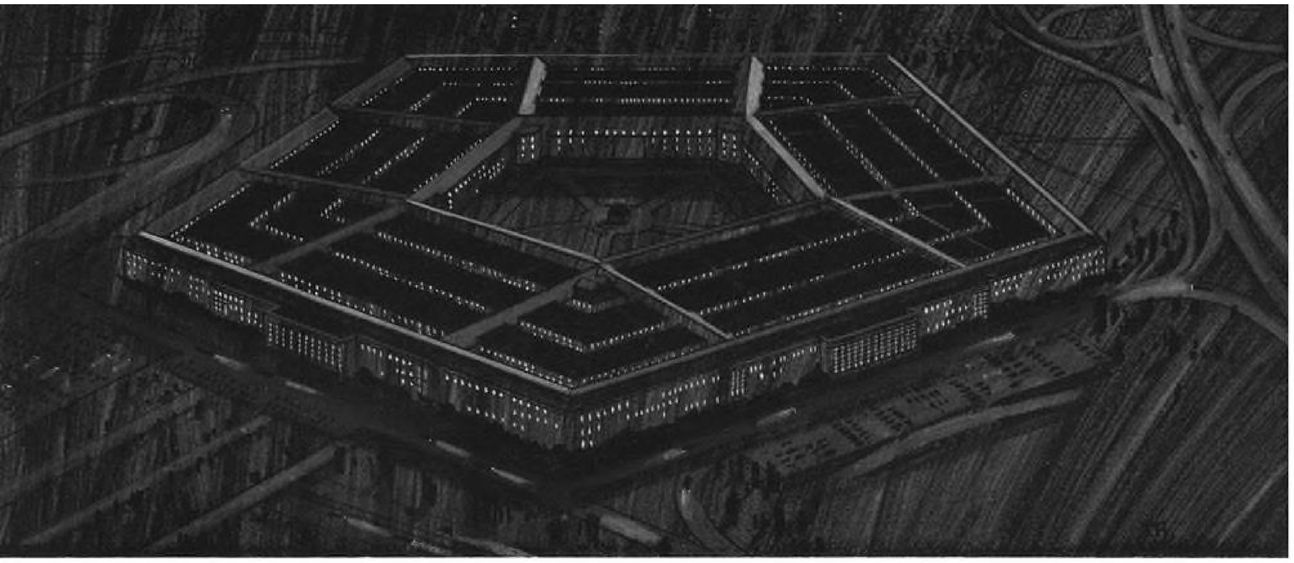
The Atlantic program has been organized into five distinct phases. Phase 1 involved the design and construction of the first two prototypes, plus flight test development work. Phase 2, also initially financed by France alone beginning in early 1961, encompassed the third prototype, procurement of a complete set of production tooling, construction of full-scale static and fatigue models, and the initial production prototype aircraft.

The four other countries involved in the financing—the U.S., West Germany, Belgium and The Netherlands—signed the necessary agreements for Phase 2 on June 29, 1962.

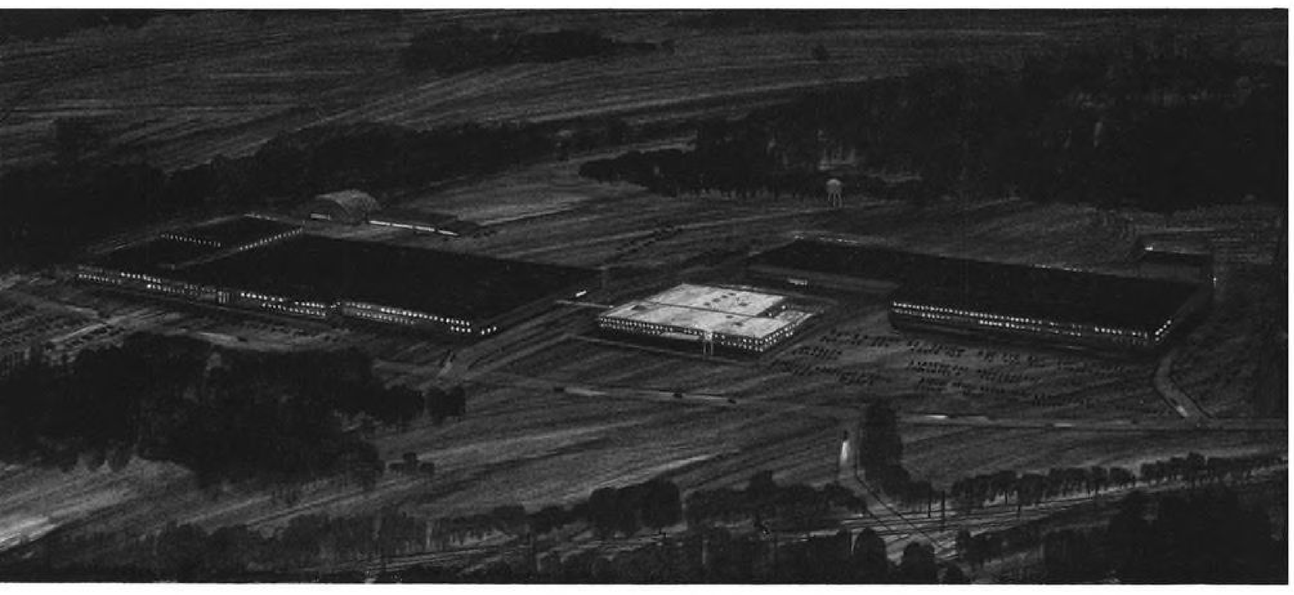
Phase 3 will cover the procurement of any additional tooling required for the still to be determined monthly production rate, and production test installations; Phase 4, the acquisition of simulators, for which the contractors will be selected on a competitive basis, and Phase 5, the initial group of production aircraft, spare parts and ground equipment.

On the funding side, Capt. Bloch says, Phase 1 has cost approximately 10% less than expected, primarily because schedules were met. Phase 2 thus far has spent about 40% of its planned budget, but well over 50% of the work envisioned for that phase already has been completed.

With the U.S. contributing a previously-established share of the cost in proportion to the total budget, the other four nations are being assessed in relation to the amount of prototype production assigned to their respective national industries.



Defense Center



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FIRST PROTOTYPE of the Franco-German Transall C-160 medium-range turboprop transport (foreground) is trailed by prototype of the Nord 262 turboprop short-range transport and executive aircraft. The 262, a pressurized follow-on to the Super Broussard, bears a strong family resemblance to the larger Transall, a project on which Nord played a major design role. Transall three view shows over-all dimensions and configuration of the cargo-transport. Aft fuselage has provisions for rear loading.

200 Orders Promised in Transall Program

Paris—Franco-German partners for development and production of the Transall C-160 medium-range twin-turboprop cargo transport believe the Paris Air Show may serve as a springboard for their aircraft into the export market.

The Le Bourget exhibition marks the Transall's first major showing to officials outside the program's two member nations.

With two prototypes now flying and promises by West Germany to place an initial order for 150 of the aircraft and the French for a minimum buy of 50, the Transall consortium is now looking towards the export market for additional sales, both military and civil.

The group—France's Nord-Aviation and Germany's Weser Flugzeugbau and Hamburger Flugzeugbau—also expects follow-on production orders within their own two countries, possibly an additional 150 by France and 50 by West Germany, to give each nation a total of 200 of the aircraft. It has been designed primarily as a replacement for the piston-powered Nord Noratlas.

Other air forces now using the Noratlas as their primary cargo aircraft are regarded here as the best potential export customers for the Transall, at least during the initial sales campaigns. Both prototypes, the second of which made its first flight late last month, were scheduled to be at the Paris Air Show for flight demonstrations and inspection by potential customers.

First prototype, flying since Feb. 25, had compiled approximately 40 flight hours by late last month in operations from the Istres Flight Test Center.

Transall C-160

GENERAL DIMENSIONS:

Wing span	131.25 ft.
Wing area	172.0 sq. ft.
Wing aspect ratio	10
Length	103.5 ft.
Propeller diameter	18.7 ft.
Main gear track	16.7 ft.

CABIN DIMENSIONS:
(without rear loading door)

Length	42.6 ft.
Width (effective)	10.33 ft.
Height (max. effective)	9.75 ft.
Volume	3,920 cu. ft.

DOOR DIMENSIONS:

Rear loading door—length	11.75 ft.
Width	10.33 ft.
Forward cargo door—width	6.5 ft.
Height	5.9 ft.

MAXIMUM GROSS WEIGHTS:

Military version	102,600 lb.
Civil version	107,000 lb.

ENGINES:
Two Rolls-Royce Tyne R. Ty. 20
Takeoff rating sea level (i. s. a.) 5,665 shp.
Normal rating, sea level (i. s. a.) 4,480 shp.

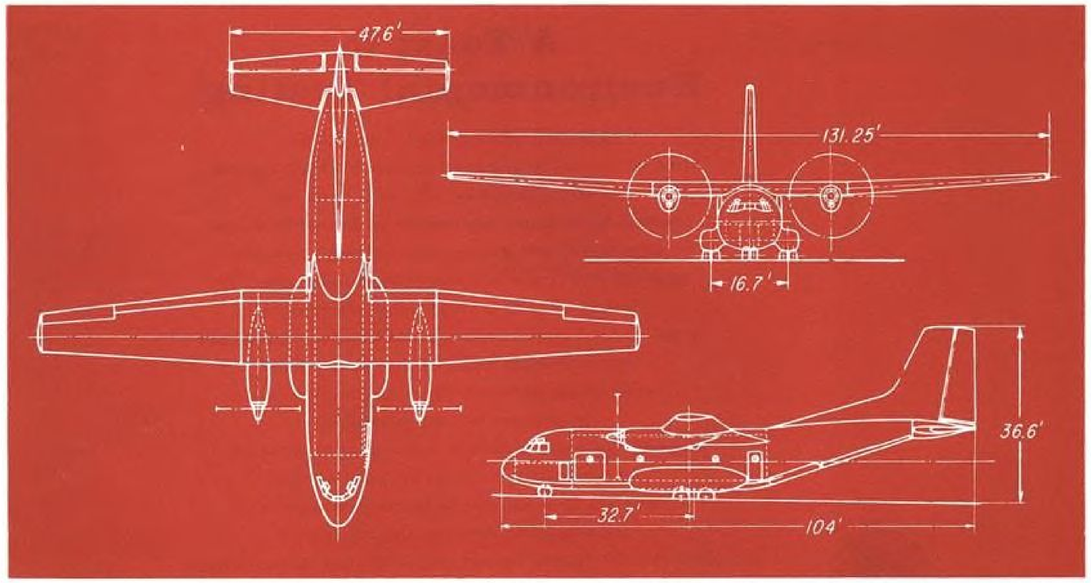
Nord officials say the aircraft's performance thus far generally has conformed with the original design specifications.

Design figures, largely laid down by the German and French governments, give the aircraft a cruise speed of 310 mph. at an altitude of 26,250 ft. and a two-engine service ceiling of 29,035 ft. Normal payload of 17,640 lb. can be ferried over a maximum range of 2,795 mi. With a maximum payload of 33,070 lb., the aircraft has a range of 932 mi. Maximum gross weight for the Transall in its military configuration is 102,600 lb.

Sea level takeoff distance over a 35-ft. obstacle at a gross weight of 94,800 lb. is given as 1,903 ft. to 2,132 ft., depending upon the condition of the runway. Landing distance over a 50-ft. obstacle with the aircraft weighing 86,640 lb. is quoted at 1,970 ft. With a wide-track landing gear designed by Messier, the Transall also has a rough-field capability.

The aircraft, which can carry up to 81 troops in two side rows and two center rows of bucket-type seats along the fuselage, has a normal crew complement of four: pilot, co-pilot, navigator, and flight engineer.

It also can be configured for air evacuation missions, carrying 62 litters, or for paratroop and air cargo drops through two rear fuselage doors or off the cargo ramp.



First prototype, assembled at Nord's Villaroche plant, was rolled out in November to begin a series of ground tests before its first flight. Modifications in this phase of testing were minor, according to Nord officials, and included such complaints as the comfort of the pilot's seat.

Initial step in the airborne test program called for an increment of four flights to provide a total of 6 hr. in the air, followed by a partial tear down and complete examination of the aircraft. This included removal and substitution of the two Rolls-Royce Tyne R. Ty 20 turboprop powerplants.

Inspection at this time revealed cracks within the core of the center section of the horizontal tailplane, attributed by Nord engineers to an overloading of the aircraft during the ground-test phase. Subsequently the stabilizer was replaced by a reinforced unit, and flight tests were resumed.

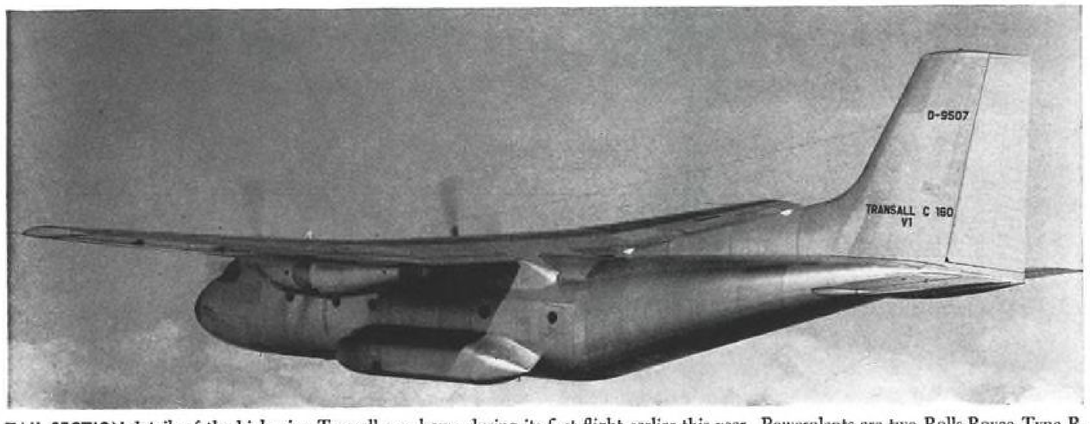
In the prototype program, Weser was given responsibility for final assembly of the second prototype at its plant in Bremen. Hamburger Flugzeugbau, third member of the consortium, is responsible for final assembly of the last flight-test prototype, now scheduled to begin flying sometime this fall, probably in October.

Two static test prototypes, complete except for powerplant installations, also are being built. One will be used for static tests by Weser, the second for dynamic testing by France's Establissement Aeronautique de Toulouse under Nord supervision.

Over-all, production responsibility for the Transall among the three partners follows these lines:

- **Nord**—Center and outer wing sections, engine nacelles and control units for the landing gear and four-bladed de Havilland propellers.
- **Weser Flugzeugbau**—Fuselage center section, landing gear nacelles, forward door and two doors along rear of either side of the fuselage intended primarily for paratroop drops.
- **Hamburger Flugzeugbau** – Forward and rear fuselage sections, vertical stabilizer, loading ramp and rear loading door.

The consortium also has a Franco-



TAIL SECTION details of the high-wing Transall are shown during its first flight earlier this year. Powerplants are two Rolls-Royce Tyne R. Ty. 20 turboprop engines of 5,665 shp. each.

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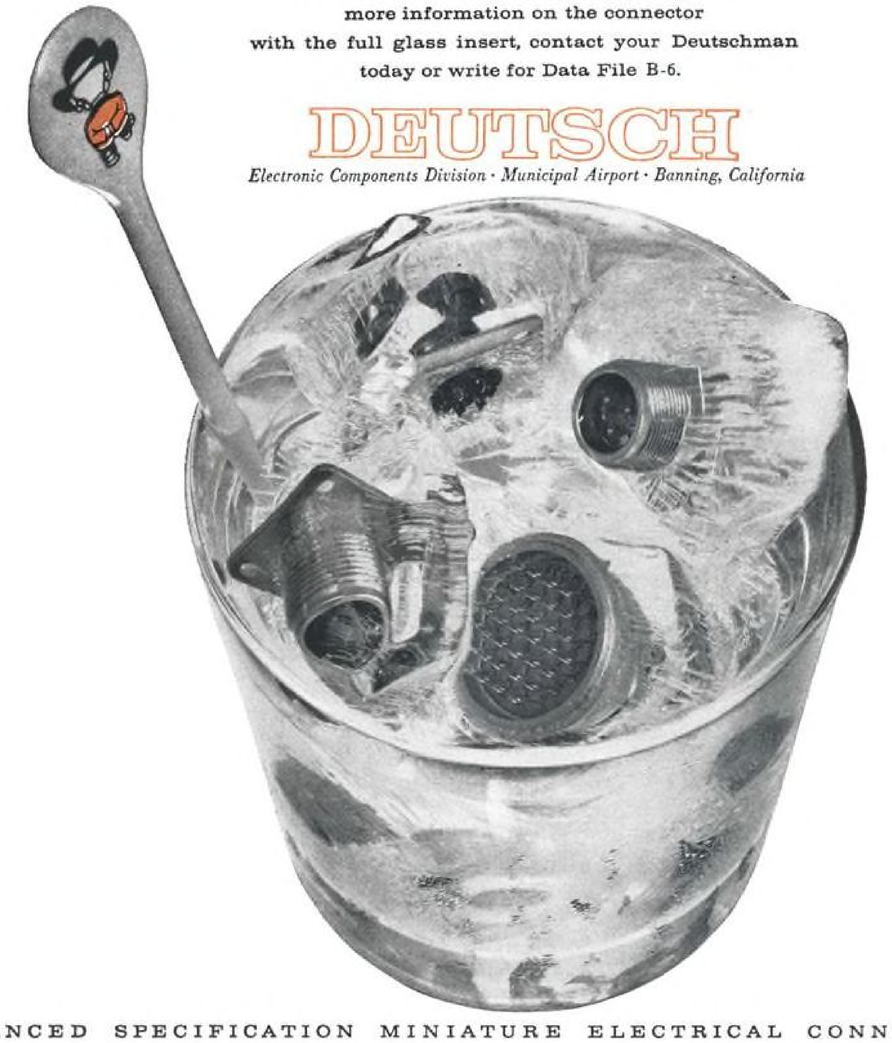

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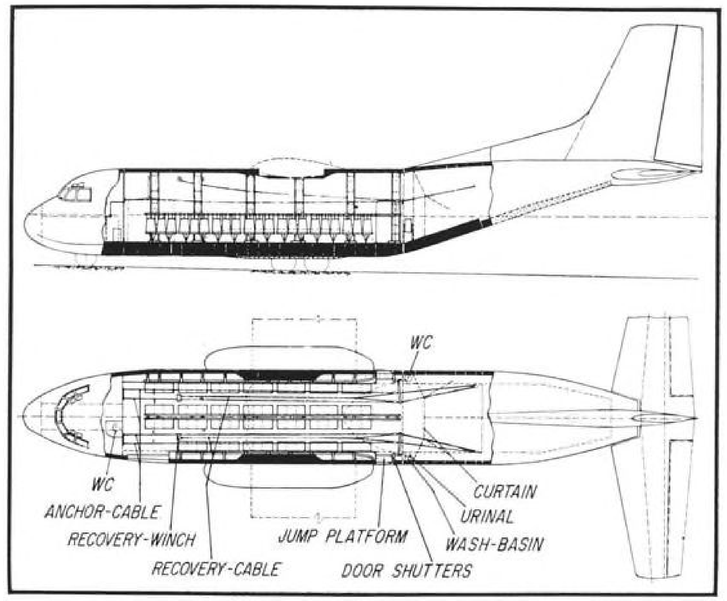
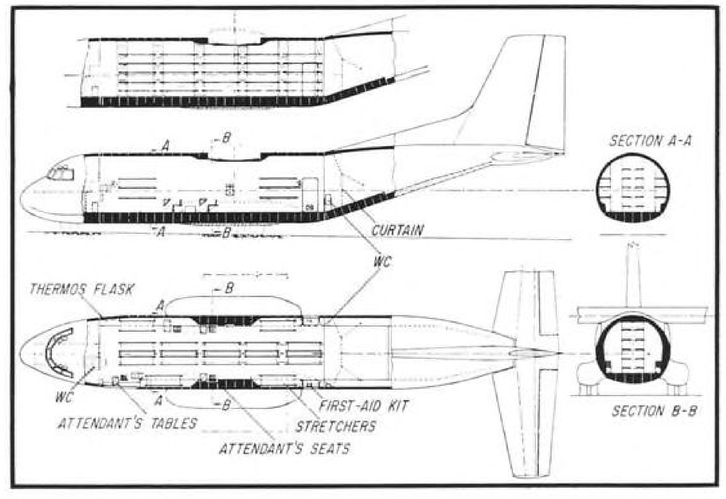


DIAGRAM (ABOVE) SHOWS THE TRANSALL in its troop-carrier configuration. Total of 81 troops can be accommodated in four rows of bucket-type seats. On an air evacuation mission, (below), the Transall could carry 62 litters arranged five-high in two rows down the center aisle plus additional banks along the sides of the forward and rear fuselage sections.



German order for six pre-production aircraft—first of which should be flying sometime next year—for use by the air forces of the two nations in their final evaluations.

Certification tests began in late May, and final type approval for the Transall is expected before the end of the year.

First production deliveries to the two governments currently are scheduled for 1966, with initial construction beginning next year. Planned consortium rollout rate is a total for four aircraft per month once the program is fully under way. For the production aircraft, it has not yet been decided whether a final assembly line will be established in both France and Germany, but, in view of its larger initial order, first priority probably will be given to the latter.

Material used in the high-wing aircraft, whose final design stemmed from a marriage of competing German and French proposals, consists primarily of clad and anodized aluminum alloys. Three major assemblies comprise the wing: a rectangular center section and two trapezoidal wing panels, all a responsibility of Nord. Stressed spar for

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the wing is a two-web box structure, and the three components are mated by use of bolts spaced along light alloy attachment fittings.

Other design and construction features include:

• **Fuselage, designed essentially to fit** a military requirement that the cargo compartment's width and height should conform along its full length to the European rail loading gauge, has a transverse cross section of two almost circular frames intersecting just below the floor level. Effective width is 10.33 ft., height 9.75 ft. Frames, with their flanges, are attached directly to the outer skin, and cutouts have been provided for the passage of false spars as well as the flanges of the longitudinal stringers. Cargo compartment and flight deck are automatically pressurized to an interior maximum altitude of 11,480 ft. when the aircraft is at 26,250 ft.

• **Tail unit** incorporates a shell-type construction. Fin attachment to the fuselage is by a series of bolts, and the stabilizer is mounted on four fixed points.

• **Messier tricycle landing gear,** with normal-weight low-pressure tires of 42.7 psi., permits operations from unprepared or makeshift runways. Twin tandem, retractable main gear is housed in a fairing on either side of the fuselage. Steerable nose gear is fitted with two independent wheels.

• **Fuel system** is composed of two integral tanks mounted in each of the outer wing panels with a total capacity of 4,293 U.S. gal.

• **Fuselage flooring** is stressed to accommodate vehicles with a floor pressure of 70 to 85.3 psi., including tracked vehicles.

• **Hydraulic system** provides power to servo-controls, landing gear, wheel brakes, wing flaps, spoilers, airbrakes, nose wheel steering, etc.

Management of the project is vested in a bilateral group which meets on a once-a-month basis, the site alternating between Paris and Bremen. Technical bureau for the program is stationed permanently in Bremen.

Organizationally, this is how the Transall program progressed:

• **December, 1958**—French and German defense ministries agree to collaborate on the design and production of a prototype replacement for the Noratlas. Preliminary joint design and operational requirements are stated.

• **Jan. 28-29, 1959**—Bilateral group agrees upon the composition of a working group for the project to be known as Transall (Transport-alliance) at a meeting in Bonn.

• **June, 1959**—Final proposal is forwarded to the two governments.

• **January, 1960**—Construction of the first prototype begins.

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PROBLEMATICAL RECREATIONS 174

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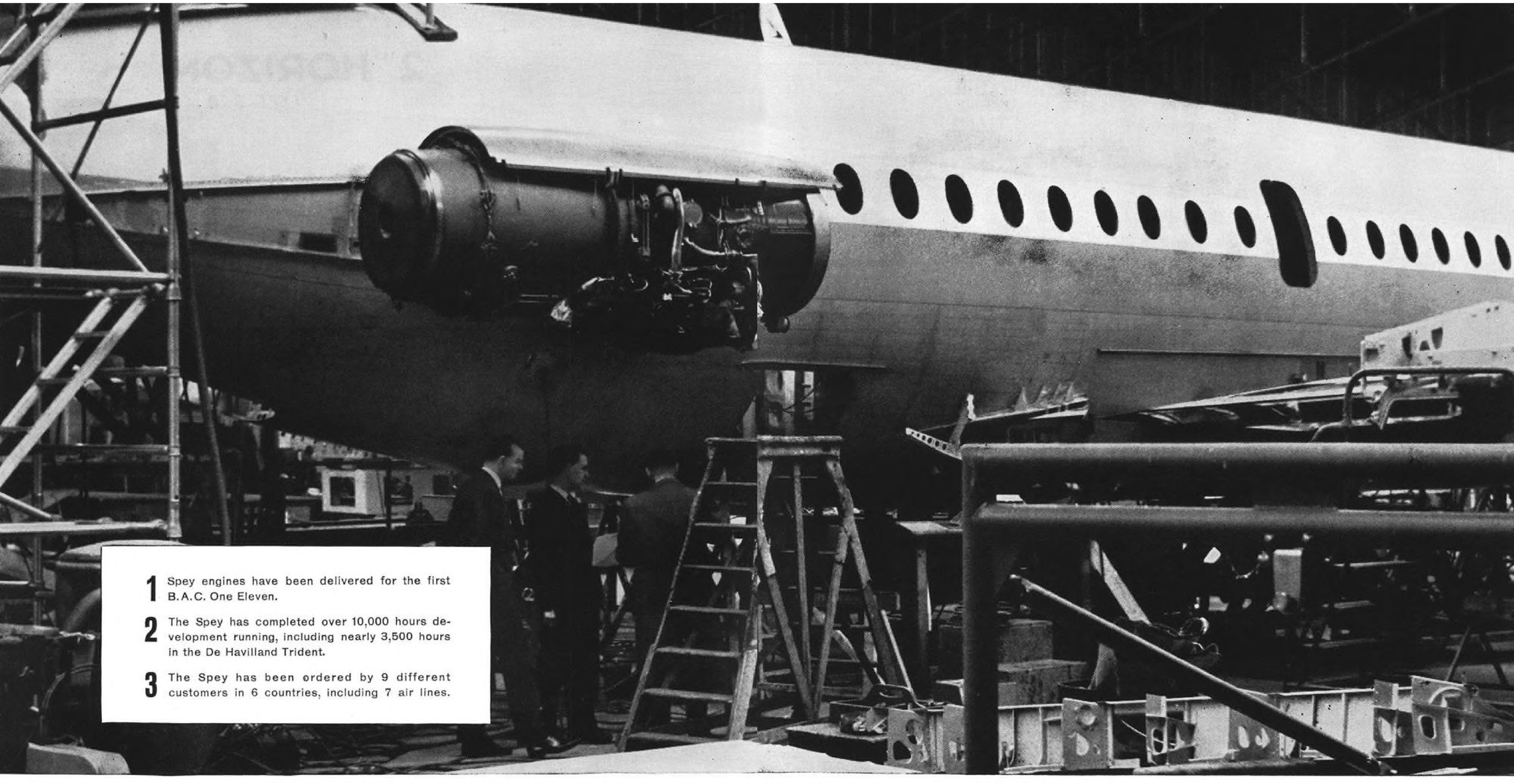

1 Spey engines have been delivered for the first B.A.C. One Eleven.

2 The Spey has completed over 10,000 hours development running, including nearly 3,500 hours in the De Havilland Trident.

3 The Spey has been ordered by 9 different customers in 6 countries, including 7 air lines.

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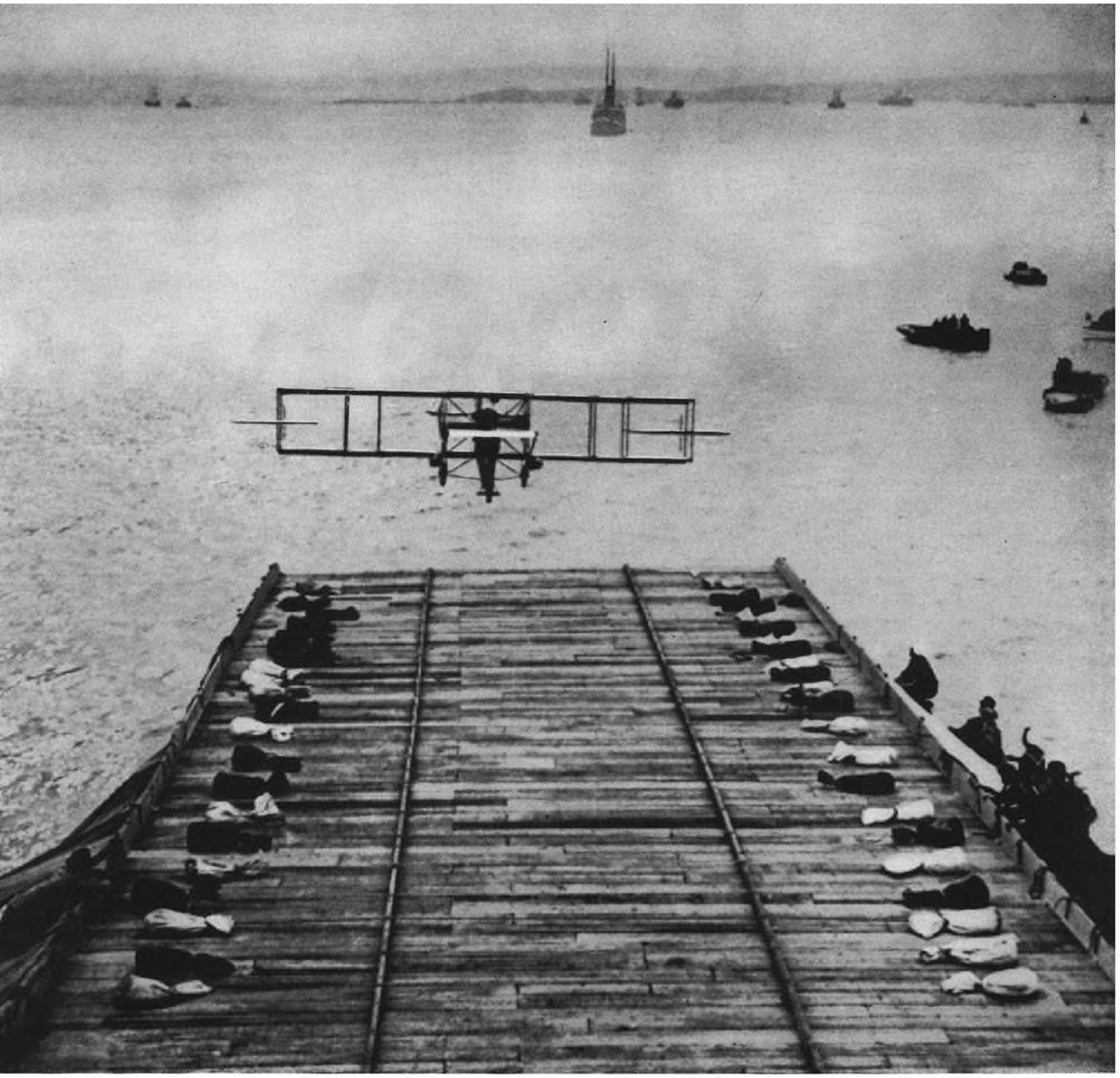

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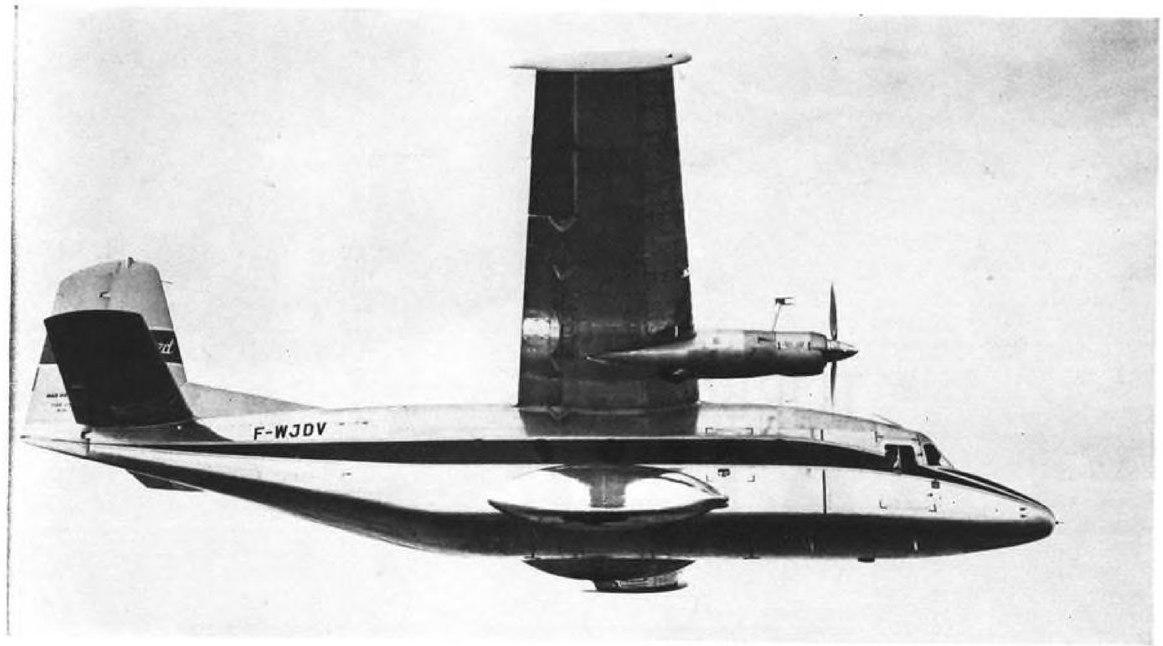
French Compete for Turboprop Market

Customer preference for a pressurized airplane is causing Nord Aviation to concentrate on production of the Model 262 (above) and to discontinue the unpressurized Model 260 Super-Broussard (below) after completion of the initial batch of 10 aircraft. Eight 260s are now flying. Air Inter, a French domestic airline, is negotiating an order for the 262s, scheduled for a two-per-month production rate in 1964. Competing in the turboprop executive area (bottom) is the Potez 840, being marketed in the U. S. by Turbo Flight, Inc.



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PARKING POSITION on ramp at Bordeaux next to an Air France Caravelle gives indication of the size of the Dassault/Sud Mystere 20.

Dassault Studies Turbofan for Mystere 20

Paris—Marcel Dassault is seriously considering adoption of the 4,200-lb.-thrust General Electric CF700 aft-fan engine for its Mystere 20 multi-purpose 8-18 place twin-jet transport in order to boost the aircraft's over-all performance and range capability.

As a basic powerplant for the Mystere 20, the CF700 has been under serious study here for the past several weeks following a General Electric announcement that it now plans to continue its development for use on executive-type aircraft, if not for commercial transports.

The General Electric design appears to offer improved performance in several areas, including specific fuel consumption. Dassault is still weighing other possible installations as part of the firm's drive to attract a wide international market. These include the 3,300-lb.-thrust Pratt & Whitney JT12A-8 for the U.S. as an alternative to the CF700, and the 3,000-lb.-thrust Bristol Siddeley Viper 20 for potential British Commonwealth customers.

The JT12-powered, privately-financed Mystere 20 prototype, which made its first flight in early May and is scheduled to appear at the Paris Air Show, already has demonstrated a capability of exceeding initial performance estimates for maximum speed—Mach .83 at 30,000 ft. as compared with projections of Mach .8—and in specific fuel consumption.

No further production is planned until an initial quantity of orders is in hand.

Officials say, however, that large numbers of orders are not necessary before production can begin if the French government agrees to underwrite the cost of the tooling, as it is expected to do.

The French Air Force also plans to buy the Mystere 20 in its eight-passenger executive version, and possibly as an 18-passenger troop transport and as a navigation trainer. But the purchases probably will be made in small increments, without a single large buy made as a matter of policy to assure the project's success as has been done in some instances in the past.

"They [the government] are getting tired of subsidizing the cost of early production and then watching other people step in to take advantage of it," one observer explains. "This time, they plan to space out their orders."

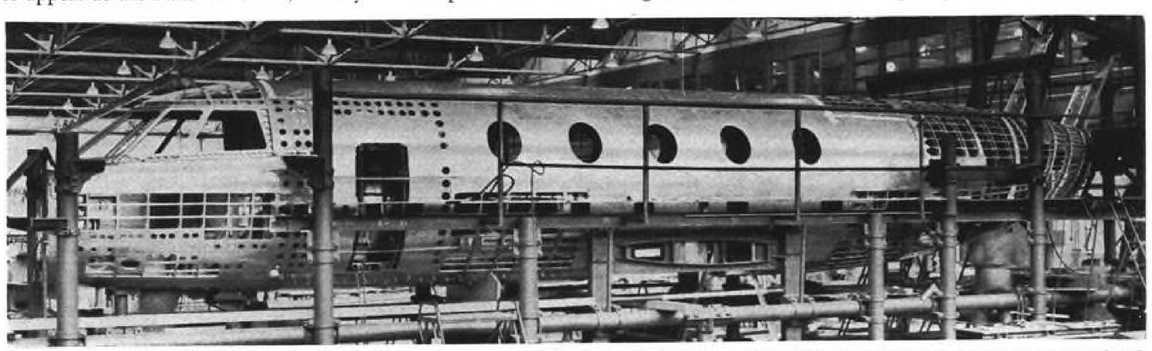
Despite the lack of a government-guaranteed production base, Dassault officials say they are confident that the program will be a success, particularly within the U.S., where they contend there are no direct domestic competitors, and within the Common Market area as national customs regulations and travel restrictions are lowered to a point where executive flying becomes more attractive.

As matters now stand, executive flying within Europe can lose much of its appeal when the aircraft is forced to make an interim stop at an airport with customs facilities, both in its home country and in the nation of destination, rather than making a direct point-to-point flight to the desired terminal airport.

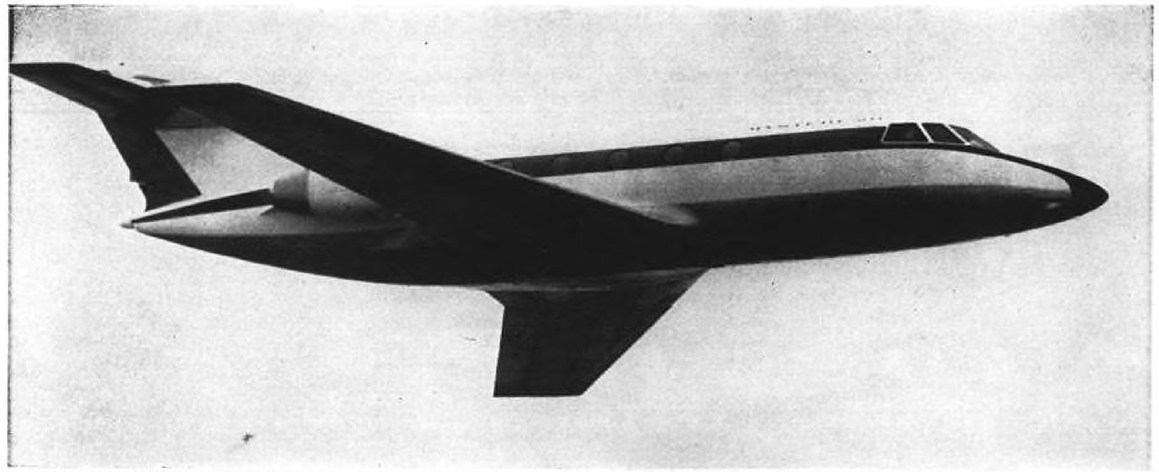
Considering over-all potential sales for the Mystere 20, one Dassault executive says:

"To be conservative, I will say we will sell at least 500. To be on the optimistic side, I will say 1,000. This aircraft has a sales life over the next 10-15 years. I don't see a supersonic or VTOL executive jet coming along within this time."

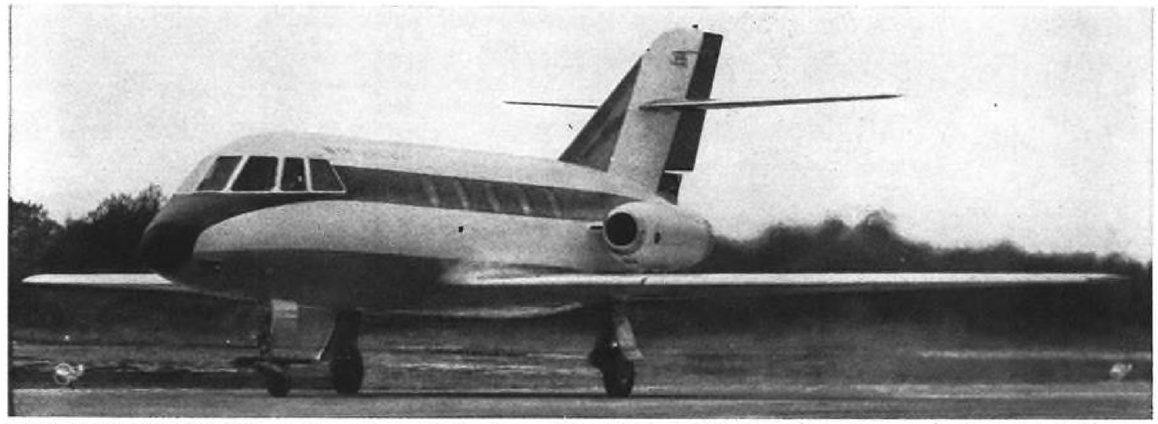
There are reports, unconfirmed by the company, that Dassault is making tentative long-range studies on an even-



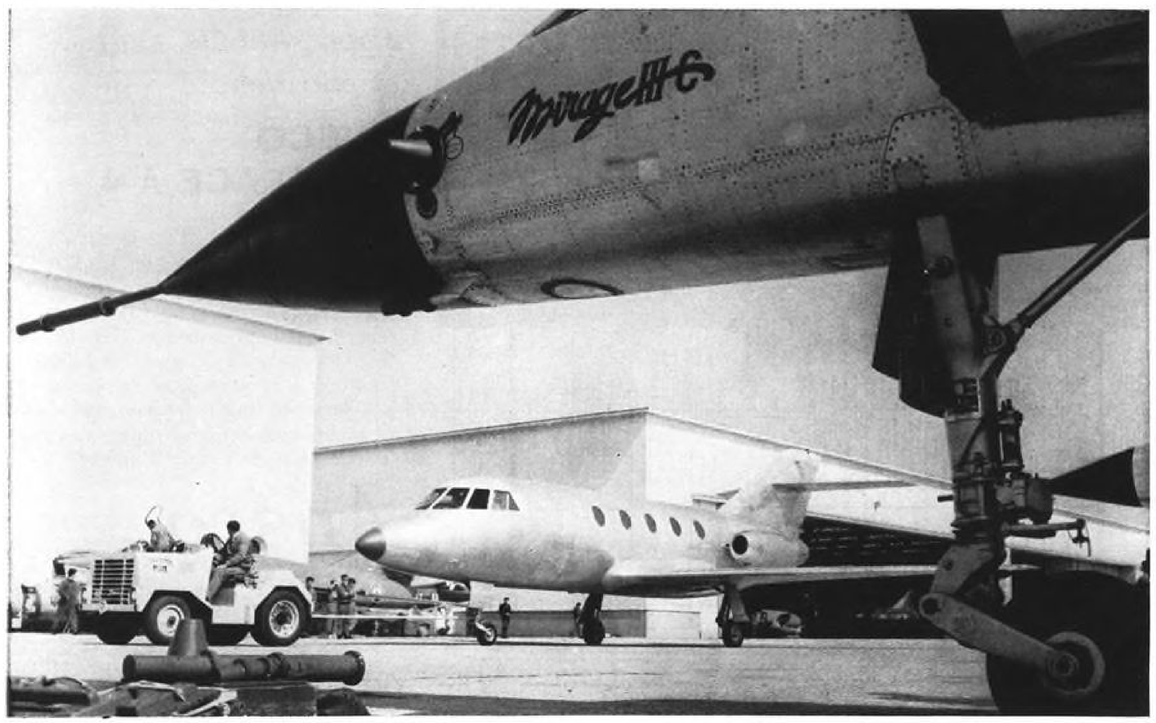
SKIN is shown being fitted to the fuselage at Dassault plant last fall. Sud Aviation has responsibility for construction of the wing and tail.

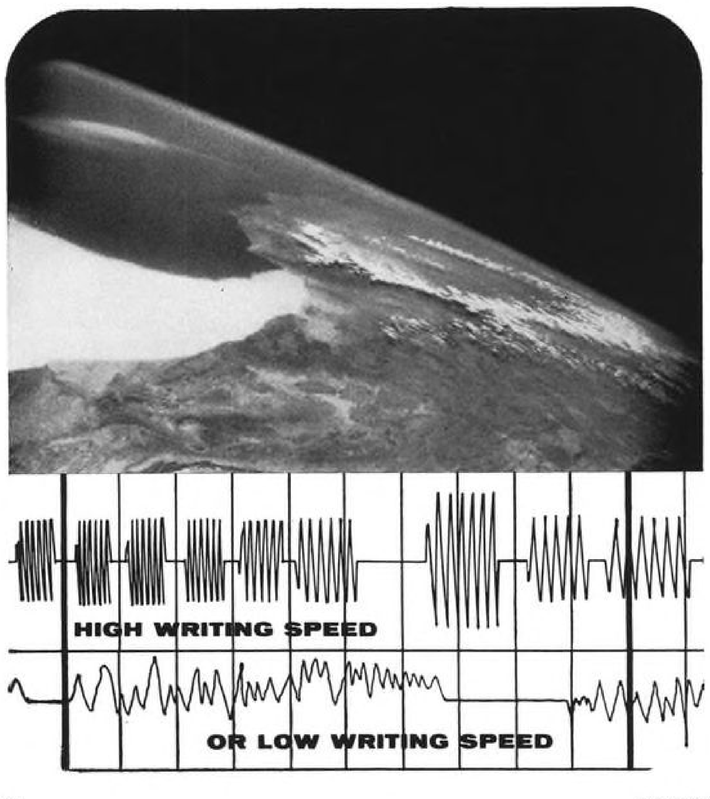


DASSAULT-DESIGNED MYSTERE 20 twin-jet executive jet transport is shown during its initial flight trial early last month. Prototype powerplants are two Pratt & Whitney JT12A-8 turbojets of 3,300 lb. thrust each.



UNPAINTED PROTOTYPE is towed from the production hangar (below) in the initial rollout. Prototype was privately funded by Dassault. Nose of a Dassault Mirage 3C jet fighter is in the foreground.





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tual supersonic replacement for the Mystere 20.

Dassault sales officials recognize that cracking the traditionally "buy domestic" U. S. aircraft market will not be an easy task, but their success in selling the Mirage 3 jet fighter in Australia has bolstered their confidence that there are areas open other than those that normally turn to France.

To avoid the possible pitfall of maintaining large and costly spares stocks overseas, normal replacement items on aircraft sold within the U. S. will be almost wholly American-made. Through use of American powerplants and avionic systems, the aircraft will be a 50-50 Franco-U. S. plane, one Dassault spokesman says.

One major boost towards the company's goal for an effective penetration of the U. S. would be a successful conclusion to current negotiations with Pan American World Airways whereby the U. S. carrier would purchase possibly as many as 40 Mystere 20s directly for sale or lease, take an option on a large number of others, and acquire North American distribution rights for the aircraft (AW May 27, p. 27).

Pan American, seriously studying the possibility of entering the executive jet field in one capacity or another, also has been examining Britain's de Havilland DH-125, an aircraft which Dassault considers as its prime direct competitor.

Purchase price for the Mystere 20 has not been determined as yet, although it probably will be somewhere within the $600,000 range fully-equipped, somewhat higher than the asking price for the DH-125. Dassault officials contend that projected performance and equipment advantages, including the use of servo controls, will more than offset the difference in cost.

Production rate also still is under consideration—and will be until some firmer indication of potential orders is in hand. Current projections, however, range from four to eight aircraft off the line each month.

Full performance specifications have been completed by Dassault thus far only for the JT12A-8 and the Bristol Siddeley Viper 20-powered designs, since the CF700 is a new entry.

Primarily because of a different approach towards the projected engine installation, design empty weight of the Viper-powered aircraft is more than 400 lb. greater than that for the Pratt & Whitney version—10,847 lb. as compared with 10,406 lb.

With the JT12 aircraft configured for an eight-passenger operation and the Viper for six-passenger, maximum takeoff weight for both versions evens out at 19,290 lb.

Design maximum speed of the Pratt & Whitney version, carrying two additional passengers, is 543 mph. at 30,000 ft. as opposed to 568 mph. for the Viper-powered aircraft. Maximum cruise speeds at the same altitude are quoted at 522 mph. and 543 mph. respectively. Economical cruise speed is quoted at 484 and 512 mph.

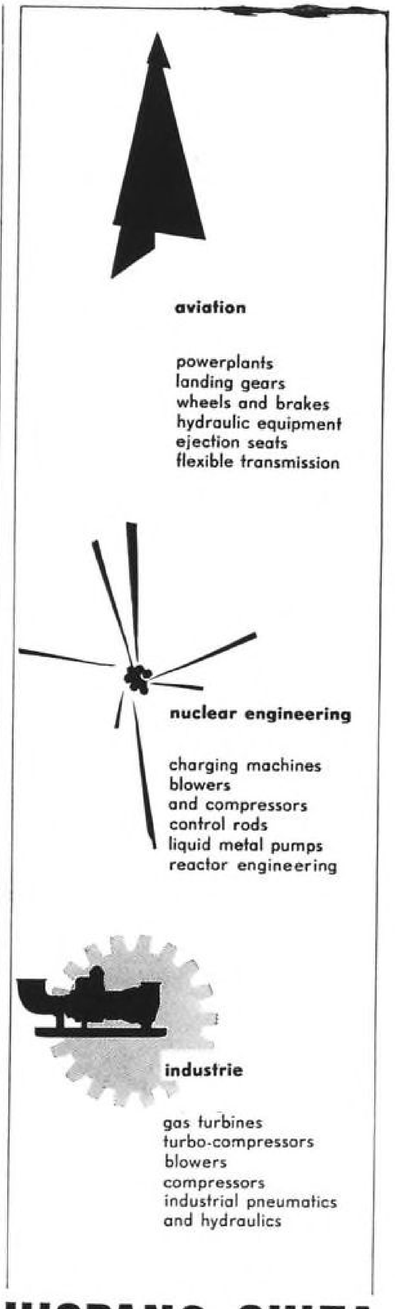
Takeoff distance for the JT12 version is given as 3,117 ft. as compared with 3,543 ft. for the Viper. Landing distance for both is 2,624 ft.

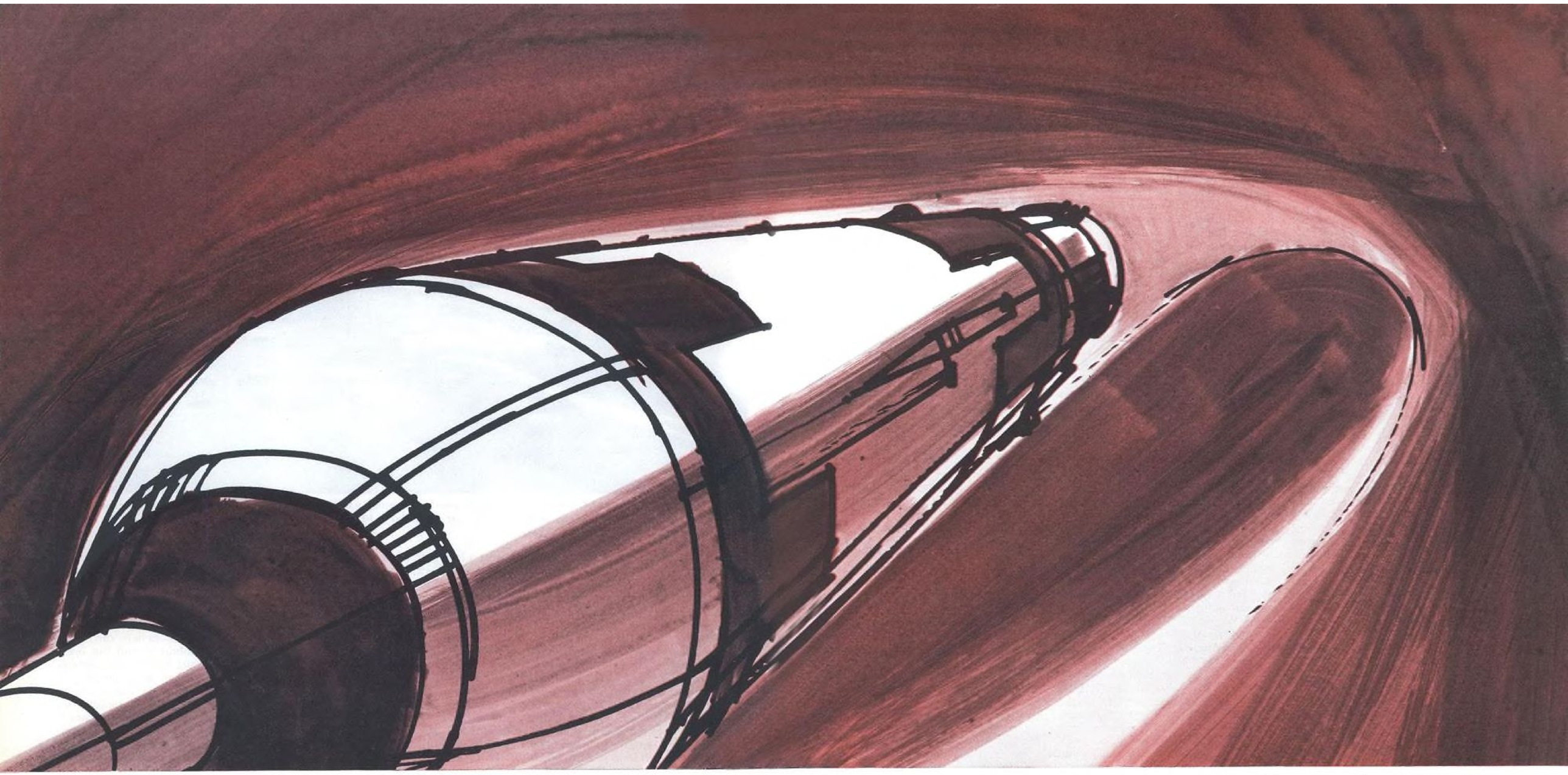
Maximum range with IFR reserves is 1,366 mi. for aircraft with either engine configuration. Takeoff and approach speeds also are the same—117 and 110 kt. respectively. Climbing speed is quoted at 59 fps. for the Pratt & Whitney aircraft and at 66 fps. for the Bristol Siddeley version.

Wing span of the basic aircraft is 47.6 ft. Over-all fuselage length is 51.5 ft., and cabin length is 22 ft. Cabin, at an actual altitude of 40,000 ft., is pressurized to an equivalent of 8,000 ft.

SFERMA Marquis Production Line

Four Beech Aircraft Corp. Baron fuselages are shown at Sud Aviation's SFERMA Div. plant where they will become the first production units of the Marquis executive aircraft, powered by Turbomeca Astazou 2 turboprops. Production is set at two a month.





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FIRST PROTOTYPE of Sud's SA 3210 Super Frelon heavy turbine helicopter (above) was built essentially to French Army specifications. Second prototype will be configured for Navy use. Sud plans a redesign of the rear cargo ramp on the prototypes in order to obtain a better aerodynamic flow pattern. Present door creates some turbulence around rear fuselage and tail boom. Head-on view of the SA 3210 shows the wide tread of the main landing gear system, made by Messier, and gives an indication of the good visibility from the cockpit.

Firm Super Frelon Orders Await French TypeApproval

Marignane, France—Sud Aviation officials here hope to obtain formal French government type approval for the company's SA/3210 Super Frelon heavy turbine helicopter by September, with initial production-line deliveries to the Army and Navy beginning sometime within the next two years.

Intensive flight tests of the first Super Frelon prototype began on Jan. 4 and, by late last month, the helicopter and its six-blade main rotor system had accumulated approximately 80 hr. in the air. Most results, including maximum and optimum cruise speeds above original design specifications, have been encouraging, according to Sud engineering officials working on the project here.

The company hopes that these and subsequent test results will lead to a firm production order from the French government in time for series production to begin late this fall. The government thus far has released funds for the production of two prototypes and four preproduction models of the large helicopter, which is powered by three Turbomeca Turmo 3C turbine engines with a rating of 1,320 shp. each. In later models, the engine rating is scheduled to be increased to 1,500 shp. Turbomeca powerplants in the two prototypes are prototypes in themselves and designated the Turmo 3B.

France, in the past, also had anticipated a substantial German order for the Super Frelon, possibly as many as 150, and a smaller purchase by Italy. Italy now appears to be definitely out as a potential customer, and Germany is re-evaluating its position, taking a second look at the competing Sikorsky S-61 family.

Second prototype—this one configured to Navy specifications—was scheduled for completion by late last month, and both helicopters were to be demonstrated at the 25th French International Air Show now under way at Le Bourget Airport, Paris.

The four preproduction models are now under construction here, and their primary role will be the test and evaluation of various avionic packages planned for the 3210, including the ASW detection gear for the Navy version. Two of the four are being configured to Army specifications, two to Navy.

Principal present external difference between the two prototypes is the addition of a pontoon float system over each of the two main landing gear units for the Navy version. Both aircraft have boat-hull fuselages.

Elimination of the rear cargo door present on both prototypes probably will be ordered by the Navy in order to improve the helicopter's over-all aerodynamic structure. A torpedo rack will be installed on each side of the fuselage in the Navy version to provide the Super Frelon with an ASW kill as well as search capability.

Another innovation for the Navy helicopter will be a Sikorsky-provided folding main rotor blade system for easier stowage aboard ship.

Under present planning, the external configuration of the Army version will remain virtually the same as that for the original prototypes. Only major change currently contemplated is the substitution of the present rear cargo door/ramp, which folds upward and inward to form the rear of the fuselage, by one with improved aerodynamic characteristics.

Prototype testing has shown that the present door configuration tends to break up the air flow in some flight regimes, causing a resultant vibration along the rear fuselage and tail boom. A number of possible new door design shapes are now being subjected to a series of wind tunnel tests.

Door/ramp size was a major consideration in the over-all design of the Super Frelon. A basic Army requirement was that the helicopter ramp should be capable of accommodating a jeep-size vehicle. Present rear ramp clearance, which probably will remain unchanged, is 5 ft. in height, 3.93 ft. in width.

Fuselage cabin has a length of 22 ft., 11½ in., a width of 6 ft., 2¾ in., and headroom of 6 ft., enough to accommodate two jeeps in line or, alternately, 28 troops plus their gear. In an air evacuation mode, Super Frelon will carry 18 litter patients plus two attendants.

Over-all length of the helicopter, including cabin and tail boom, is 55 ft., 8 in. with blade and vertical tail section folded.

One contemplated internal change on production models will be an increase of the width of the instrument console to meet a Navy request that the artificial horizon be located directly in front of the pilot. On the present, narrower console, the instrument is positioned slightly to the right of the pilot's forward view.

In flight tests of the 01 prototype, a maximum speed of 183 mph. has been attained as opposed to the 155 mph. originally proposed in the design specifications. Cruise speed at maximum gross weight, originally estimated at 137 mph., is now being pegged at 149 mph. as a result of the 3210's test flight performance thus far.

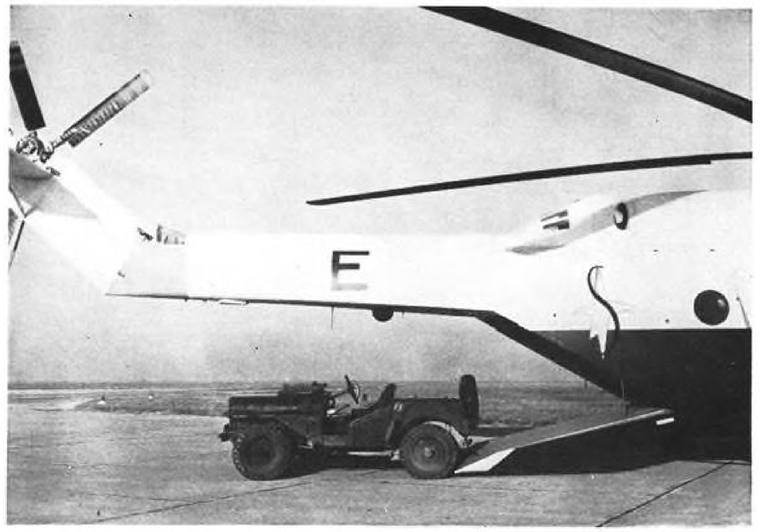
Planned maximum gross weight for the helicopter is 25,350 lb., and normal weight is 24,200 lb. Maximum sea level range at normal gross weight is quoted at 495 naut. mi. with a 30 min. fuel reserve. With a two-jeep payload total-

Alouette Sales

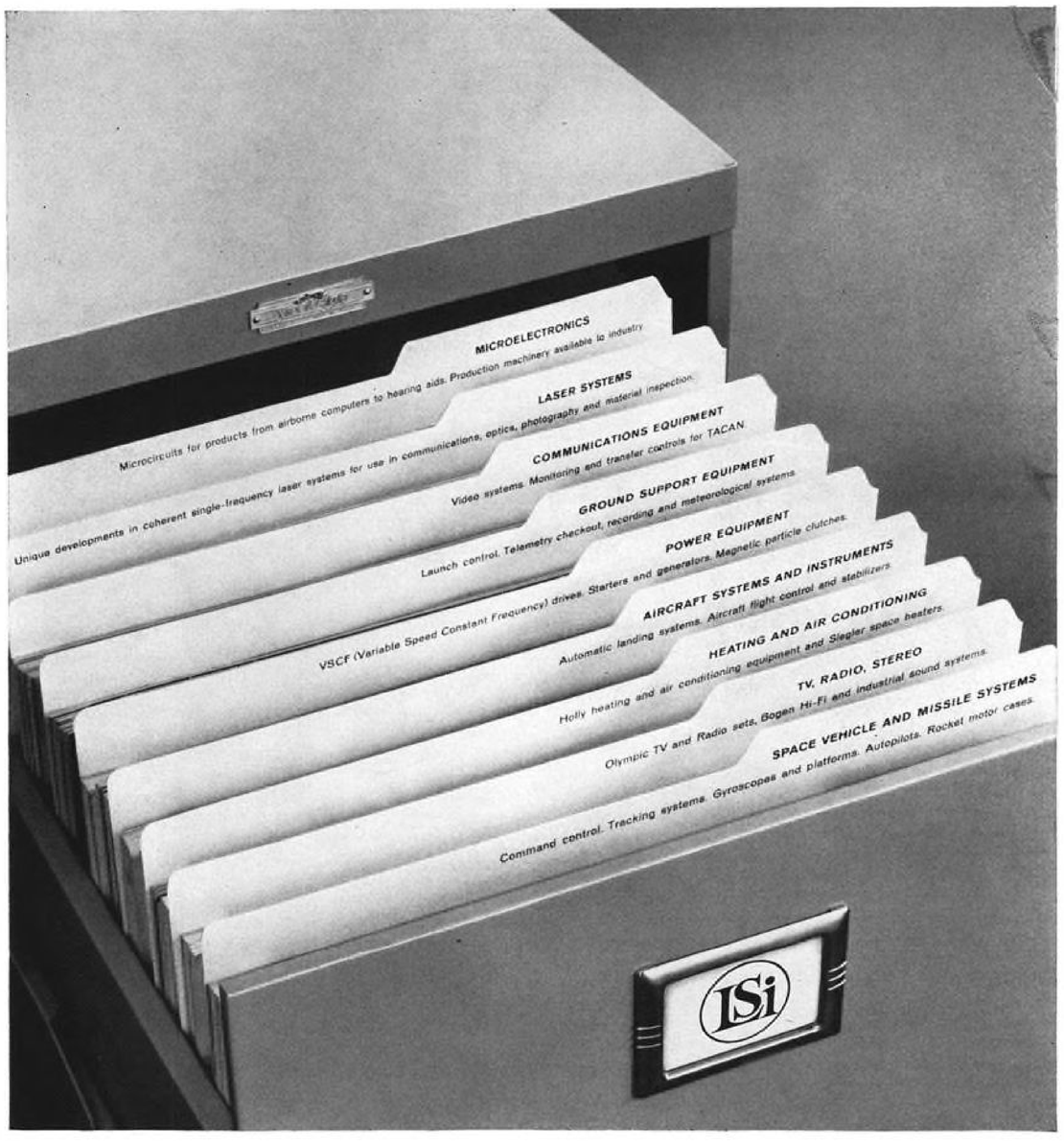
Marignane, France—Sud Alouette 2 lightweight helicopter and its follow-on, the Alouette 3, are making a sizable impact on the export market as well as within France.

Total sales for the Alouette 2 had reached 875 by late last month. Of these, approximately 460 had been sold abroad with a total of 27 nations represented.

Alouette 3 orders by late last month stood at 127. Over 70 of these came from outside France and included purchasers in Denmark, Sweden, South Africa, Rhodesia, Peru, Lebanon, Burma, India and South Vietnam. Switzerland also is expected to order the helicopter.



HYDRAULICALLY OPERATED rear loading door with dimensions large enough to accommodate a jeep-size vehicle was a basic Army specification laid down for the Super Frelon. Door probably will be eliminated on Navy models. Prototype 01 is shown in flight (below).



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ing 6,600 lb., range is given as 324 naut mi. Using its hoist system, the 3210 can carry a maximum load of about 7,900 lb.

In the Navy configuration, with a dipping sonar unit lowered from the cabin and a torpedo on either side of the fuselage, the helicopter has a design ASW search capability of 3 hr. with a 30-min. fuel reserve when operations are confined to a radius of 40 naut. mi. from base. At a 160 mi. radius, the 3210 can remain in the search area for an hour.

Hovering ceiling out of ground effect is about 9,000 ft. In ground effect, the figure is increased to 10,500 ft. Service ceiling is about 14,000 ft.

Cockpit of the 3210 is entered through a sliding panel door located on the starboard side of the forward fuselage. Its dual control system incorporates dual-cylinder servo units supplied by two separate sources.

The Super Frelon as such is an outgrowth of the smaller SE 3200 Frelon prototype vehicle which first flew in June, 1959, and performed at the 1961 Paris Air Show. Aside from the generally larger dimensions and payload capability of the Super Frelon—the 3200 had a maximum gross weight of 17,640 lb.-major design differences between the two vehicles include:

• **Use of a six-bladed** main rotor system with a 62 ft. diameter on the Super Frelon as opposed to a 49 ft., 2¼ in. diameter four-bladed unit on the 3200. Main rotor and rotor head for the Super Frelon were developed under contract by the Sikorsky Aircraft Div. of United Aircraft Corp., and are being supplied to Sud directly from the U. S.

French officials say, however, that they probably would seek licensed-production rights for the dynamic components should substantial orders for the helicopter be received. Under a previous agreement, Sud built 184 Sikorsky S-58 piston-powered helicopters under license, including the four-bladed main rotor and rotor head.

• **Substantial lengthening** of the tail boom on the 3210, along with incorporation of a vertical tail fin section mounting the horizontal stabilizer and tail rotor on alternate sides. Original Frelon, built to Navy specifications requiring a compact vehicle for easy stowage aboard ship, had an exceptionally short tail boom, and the horizontal fin and tail rotor were attached directly to it. Result was that during flight the stabilizer was sometimes within the envelope of the air flow from the main rotor and sometimes outside, depending upon the position and attitude of the helicopter.

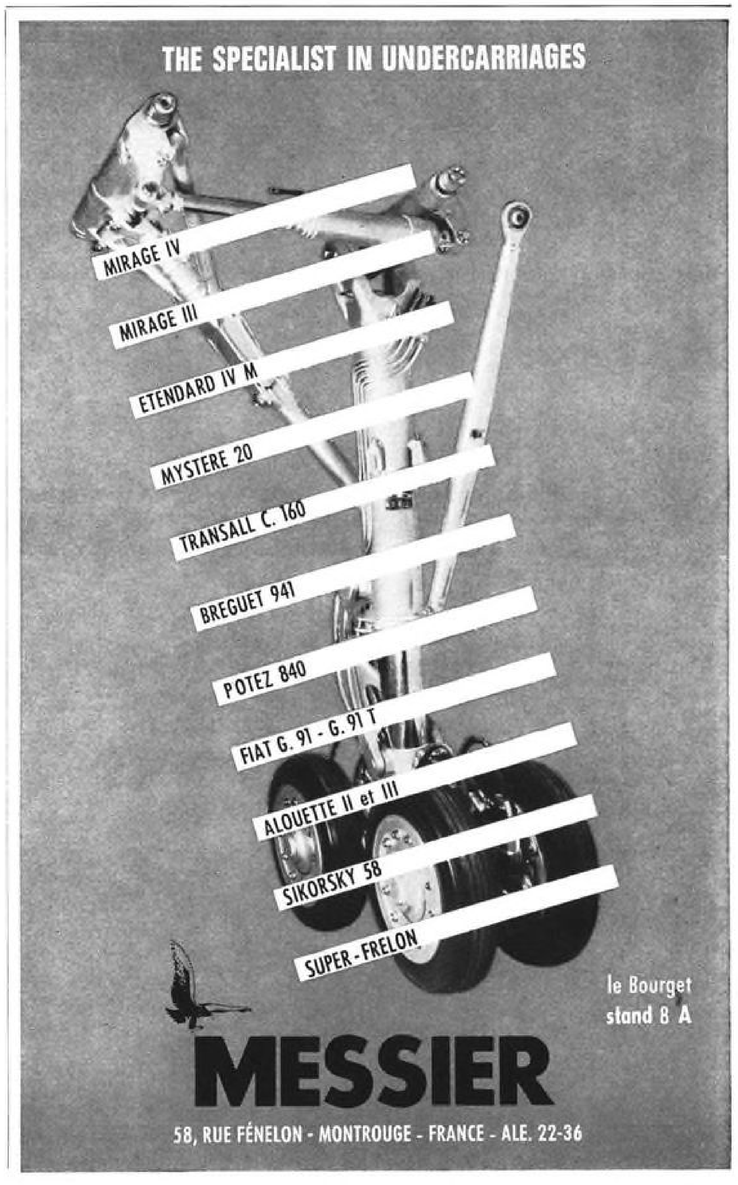
Consequent effect on control and general flight characteristics placed an added burden on the pilot and convinced Sud engineers that they should adopt an alternate system for the 3210. In this design, the stabilizer always remains outside the air flow and turbulence from the main rotor system.

• **Greater speed and range** for the Super Frelon. Maximum speed of the Frelon was 131 mph. as opposed to the new 183-mph. figure for the 3210. Maximum range of the 3200 with payload was about 250 mi. as compared with 495 naut. mi. at normal gross weight for the Super Frelon.

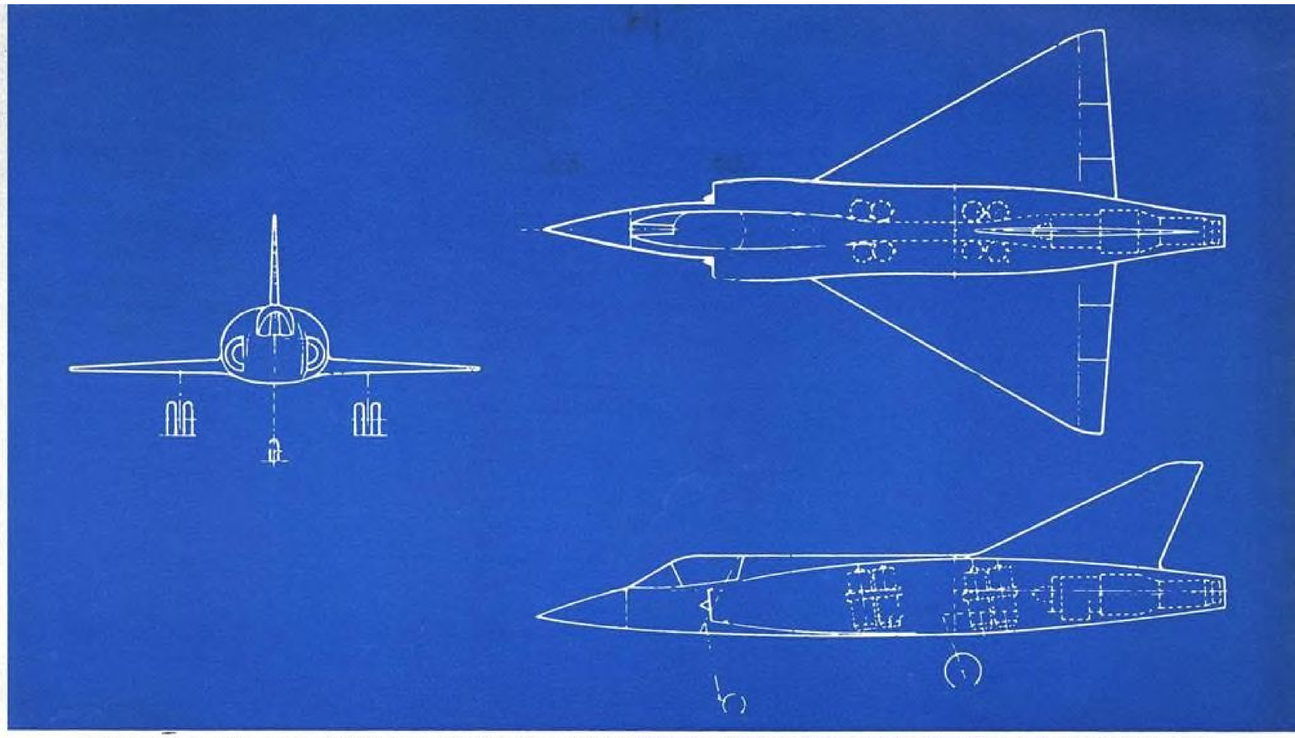
• **Provision** on the Super Frelon for housing all fuel internally in three fuselage belly tanks, each with a capacity of 290 U.S. gal. Fuel for the Frelon was carried in two external tanks, one mounted on each side of the fuselage.

Engine mounting for the two helicopters remains substantially the same. Two of the Super Frelon's Turmo 3C powerplants are located along the top of the fuselage in a side-by-side position in front of the gear box. The third is centered along the fuselage behind the gear box. A similar mounting was employed on the Frelon for its three Turmo engines of 800 shp. each.

First metal for the 01 Super Frelon prototype was cut in mid-1961, although actual construction did not begin until early 1962. First flight—made in order to gain a 1962 date—was made in early December. The helicopter was rolled back into hangar for instrumentation with test gear, and flight program was begun in earnest in January.



HEAVY STRENGTH fixed landing gear on the Mirage Balzac VTOL testbed has been replaced with retractable system for continuation of test program. Placement of Rolls-Royce RB.108 lift and Bristol Siddeley Orpheus 7 forward thrust engines is shown in three view.



DASSAULT Chief Test Pilot Rene Bigand leaves Balzac cockpit after first flight.

Rollout Due

Paris—Dassault Mirage 3T, a second flying test vehicle designed to complement the Balzac V-001 in the component design and systems evaluation program for France's projected Mach 2.3 Mirage 3V VTOL fighter, may begin its initial flight program sometime next month.

Like the Balzac, the 3T essentially is a member of the Mirage 3 conventional fighter family, but, in this case, it will retain its conventional characteristics. Its primary objective is to test the Snecma TF-106 main powerplant for the 3V, while the Balzac explores the vertical regimes and VTOL systems involved.

The 3T will begin its flight tests with a TF-104 testbed powerplant, a Snecma modified Pratt & Whitney JTF-10 turbofan engine. Redesign was directed primarily toward the problem of fitting a Snecma afterburner to a turbofan engine. While the JTF-10 has a static thrust of 10,500 lb., the follow-on TF-106 is scheduled to have an eventual rating of 19,845 lb. with afterburner.

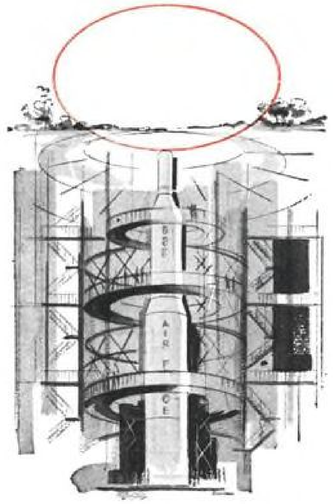
Initial tests of the Mirage 3T with a TF-106 installation are scheduled to begin in approximately one year.

Dassault officials also hope that the TF-106-powered Mirage 3T may emerge as an operational-type aircraft attractive to the French Air Force as a long-range

For Second Mirage 3V Program Testbed

GROUND CREWMEN prepare the Balzac for flight prior to demonstration. Note louvers for lift engine air intake on fuselage. Balzac testbed is used to explore vertical regimes and VTOL systems as part of France's Mirage 3V VTOL fighter program.

UNDERGROUND CORROSION PROBLEMS?



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interceptor or strike fighter because of the lower specific fuel consumption and greater range potential of a turbofan engine.

First of two Mirage 3V prototypes on order by the French Air Force is still scheduled to fly before the end of this year, possibly with a TF-104 powerplant. Observers close to the program, however, believe that the earliest practicable flight date is in early 1964. French planners still hope to meet a 1966 operational date for the aircraft, however.

One reason behind the belief that the Mirage 3V will not fly before 1964 is the knowledge that Dassault, Snecma and the government all will need time to evaluate the data from the Mirage 3T program as it begins to accumulate.

The Balzac, a conversion from the Mirage 3-001 experimental aircraft used in the initial development of the Mirage 3 family, also has suffered delays, but the program is now believed to be running according to schedule.

Using a 5,000-lb.-thrust Bristol Siddeley Orpheus 7 turbojet engine for its main propulsion system—as opposed to the 13,225-lb. thrust of the Snecma Atar 9 powering the Mirage 3C—the Balzac gains its vertical thrust from eight fuselage-mounted Rolls-Royce RB.108 lift engines of 2,200 lb. thrust each.

The eight advanced RB.162s scheduled to go into the Mirage 3V, in turn, will have a thrust rating of 4,400 lb. each, and a substantially better thrust-to-weight ratio. The 3V itself, in the projected growth pattern, will be approximately one-third larger than the current Balzac, which generally follows the standard Mirage 3 insofar as overall dimensions are concerned.

The Balzac, initially rolled out in late July, 1962, made its first transition from the vertical to horizontal flight in March during its 17th flight after a series of vertical tests that began last Oct. 13. After three tethered tests, the first free flight was made Oct. 18. The original early August date for the first tethered flight was delayed by a fuel cell fire during an early run-up of the vertical engines (AW Sept. 10, p. 30).

Later in October, the Dassault production facility at Melun-Villaroche near Paris was opened briefly when the Balzac testbed made its ninth free flight. Included in the demonstration was a short transition from the vertical to horizontal flight, accomplished by changing the attitude of the airframe in order to redirect the angle of thrust of the RB.108 lift engines. The Orpheus 7 was not ignited.

Then the aircraft was returned to the shop for installation of a Messier-designed retractable landing gear system to replace the fixed, highly-stressed unit used during the initial hover tests. Other design changes also were made at this time.

In early March, the Balzac made its first conventional flight tests of the Orpheus engine installed in the tail section. Next step was a successful attempt to ignite the lift engines during horizontal flight. This was followed by a transition from vertical to horizontal flight and, later, from the horizontal to the vertical.

Now the program has entered into a second and major phase—extensive test and evaluation of the bleed-air roll, pitch, and yaw stabilization systems planned for the Mirage 3V. These are located under the nose, tail and wings of the aircraft for utilization during VTOL flight.

The system, designed by Dassault with the assistance of Snecma and Rolls-Royce, provides pitch control by use of a louvered bleed-air outlet on each side of the nose radome and two others on the underside of the tail.

Roll corrections can be made by activation of two outlets positioned underneath the rear of each wing. A third set, with an outlet on each side of the rear fuselage, controls yaw.

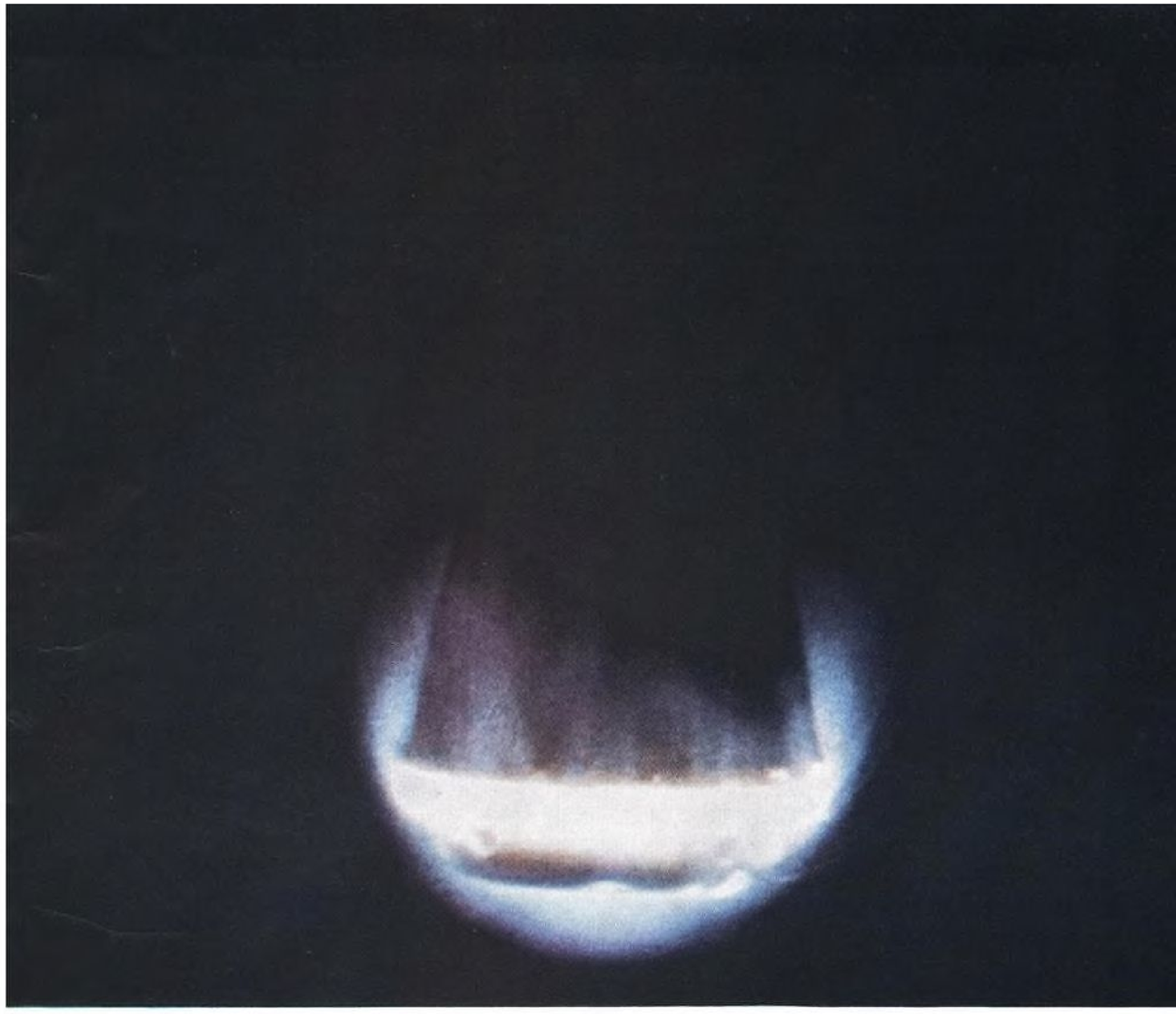
Bleed air for the stabilization system is drawn from all eight RB.108s and then funneled into a common ducting unit for all the outlets. The system can be operated manually by the pilot through the use of two selection panels, but pitch and roll also are automatically compensated for by a Dassault-designed autopilot connected to the vertical control column in the cockpit.

Pilot of the Balzac—Dassault Chief Test Pilot Rene Bigand during the initial series of tests—has three control levels for starting the vertical lift powerplants. Each lever actuates a pair of engines, one located on each side of the fuselage in order to maintain a symmetrical balance during starting. Cockpit also incorporates a lift throttle with a thumb grip that can regulate the thrust of the Orpheus main powerplant during transition from vertical to horizontal flight.

Inlet ducting for the horizontal propulsion system in both the Balzac and Mirage 3V is diverted by an S-shaped ramp into the fuselage to permit positioning of the lift engines just aft of the inlets in the intake fairings.

For the lift engines, a hinged and slotted door rises vertically at the forward end approximately 18 in., and louvers on top of the doors are sprung open for the initial takeoff phase.

Non-louvered doors for the RB.108 exhaust swing to either side from underneath the fuselage. As speed increases, the spring-loaded louvers are closed and, after transition is completed, the door itself clamps to a flush position.



EARTH PROBE

The Lunar, Solar and Venus probes have begun exploring safe interplanetary paths. Safe to the planets . . . and back again. But what happens when a vehicle slams home into the earth's atmosphere? One way to find out: pack a capsule with instruments, blast it into space, and then drive it back into the earth's atmosphere at the full speed of interplanetary return. In short: an earth probe.

NASA conceived the plan, named it "Project Fire" and assigned Republic to produce two vehicles for the mission.

Each Project Fire capsule—weighing 200 pounds—will carry a blunt heat-shield, heat-measuring devices, and telemetry equipment to speed the data to ground stations. Radar and optical tracking will also be used. Data on materials performance, radio signal blackout and surface ablation will be collected the only meaningful way: during an actual re-entry.

We built the two Project Fire capsules and did preliminary testing in our labs. Designs and materials were selected to survive short-duration gas cap temperatures over 20,000°F and velocities above 37,000 feet per second. The capsule above was photographed during ablation tests in our Re-entry Simulation Lab.

Project Fire will pay off twice. First, when the capsule probes the earth. And then again, when a manned vehicle takes the hot ride home.

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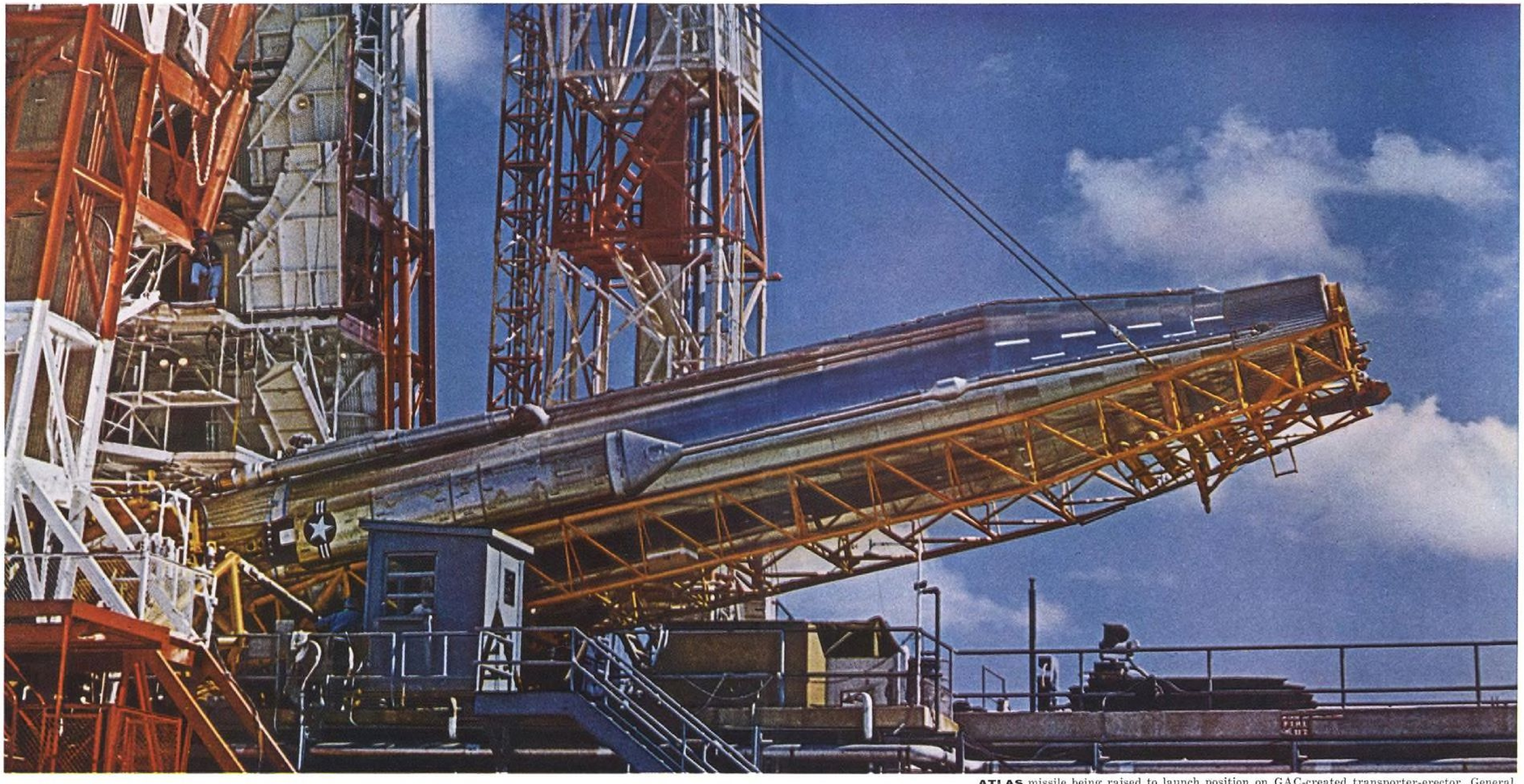

ATLAS missile being raised to launch position on GAC-created transporter-erector. General Dynamics—Astronautics called on GAC experience and capabilities for design and fabrication.

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X-20 Window Arrangement Shown

Full-scale mockup of USAF/Boeing X-20 (Dyna-Soar) space glider shows arrangement of cockpit windows built by Corning Glass Works, Corning, N. Y. Metal heat shield covers three front windows during launch and orbit. Shield is jettisoned after re-entry heat pulse for landing visibility. Other two windows are uncovered at all times.

FINANCIAL BRIEFS

Hallicrafters Co. has recently completed a $6 million financing program composed of $2 million in seven-year unsecured loans and $4 million in three-year revolving credit from two Chicago banks. Funds will be used to retire present short-term debts and to provide working capital for its subsidiaries.

Melpar, Inc., earned $334,000 on sales of nearly $17 million for the first quarter of 1963. Comparable figures last year showed $192,000 earned on sales of $7 million. First quarter per share earnings for 1963 and 1962 totaled 13 cents and 8 cents, respectively.

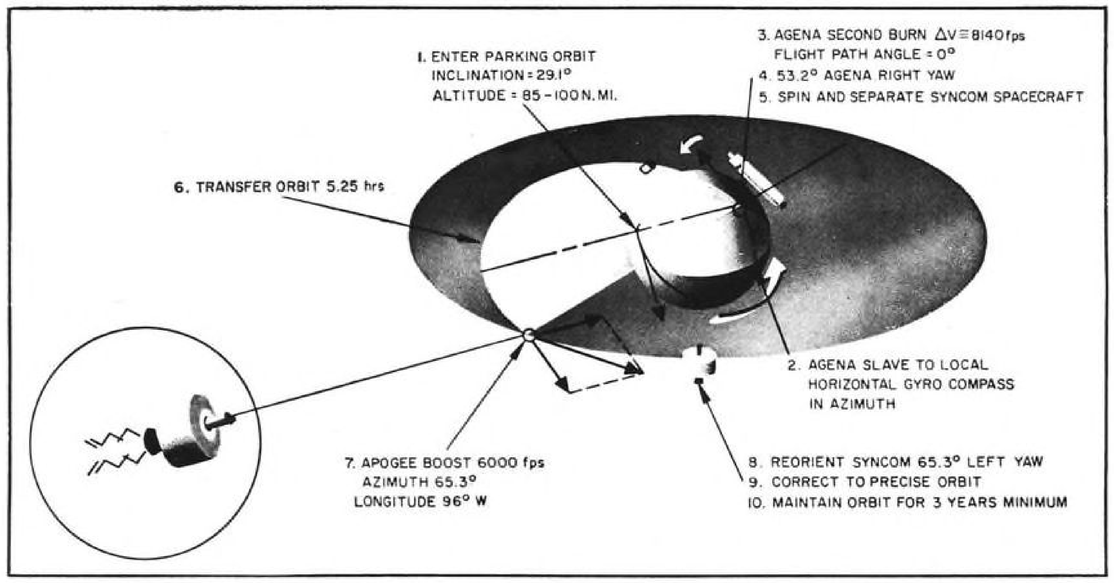
Douglas Aircraft Co. had a net profit of $3.34 million on sales of $198.4 million for the first quarter of Fiscal 1963 ended Feb. 28. Same period last year showed $1.81 million earned on sales of $164 million. Current quarter earnings were 85 cents per share compared with 46 cents per share for the same period in 1962.

North American Aviation, Inc., had a net income of $9.3 million on sales of nearly $490.6 million for the second quarter of its fiscal year ended Mar. 31. Comparable 1962 figures showed earnings of over $8.6 million on sales of $403.4 million. The six months period ended Mar. 31 showed $19.5 million earned on sales of $931.9 million, equal to $2.32 per share. Same period last year showed $16.5 million earned on sales of $724.1 million, equal to $1.98 per share.

Lear Siegler, Inc., earned $3.9 million —after preferred dividend payments of $1 per share on 3.9 million shares outstanding—on sales of nearly $147.6 million for the nine month period ended Mar. 31. Comparable figures for last year are not available, since Lear, Inc., merged with Siegler Corp. in June, 1962.

Republic Aviation Corp. reports first quarter 1963 sales of $91.05 million with earnings of $2.01 million, equal to 71 cents per share. Comparable figures last year showed sales of $91.13 million with earnings of $2.67 million, equal to 92 cents per share. Republic's President, Mundy I. Peale, predicted 1963 per share earnings would be about $3 compared with $2.09 in 1962. The order backlog is $491 million—$9 million above the same period last year.

United States Steel Corp. had first quarter 1963 income of $29.9 million equal to a return of 3.7% on sales of $798.5 million.



PROPOSED LAUNCH SEQUENCE for NASA-Hughes Advanced Syncom satellite, using Atlas-Agena D launch vehicle, is shown. Agena aims satellite apogee motor and spins satellite up to nominal orbital speed prior to separation at perigee of transfer orbit.

Syncom 2 to Use Multiple-Access Devices

By Barry Miller

El Segundo, Calif.—Advanced Syncom communications satellites, intended to demonstrate the feasibility of a "stationary" satellite system, will carry multiple-access transponders.

These devices are designed to enable a large number of voice messages to be received simultaneously from and transmitted to scattered ground stations without complicated on-board multiplexing.

The number of ground stations which could communicate with the satellite would be based on the bandwidth capacity of the satellite transponder. Engineers at Hughes Aircraft Co.'s Space Systems Div. here, which is developing key parts of the satellite for National Aeronautics and Space Administration, propose expanding the number of ground stations which might be tied into early Advanced Syncom satellites.

They also want to increase the capacity of the system by incorporating in each spacecraft four multiple-access transponders, all operating through the same antenna system.

The transponder which Hughes has developed for NASA is a dual unit, having a frequency-translation as well as a multiple-access mode. The former would be more efficient for relay of wide-bandwidth communications, such as television.

Advanced Syncom (also called Syncom 2) constitutes NASA's program for developing the technology and capability for achieving the ultimate in a communications satellite—the 24-hr. "stationary" satellite (see orbit terminology box, p. 109).

Three such satellites, spaced 120 deg. apart around the earth's equator and equipped with multiple-access transponders, could offer world-wide intercontinental communications. The satellites' planned fixed relation to points on the earth, combined with a multiple-access, on-board communications relay capability, would enable nations with less-developed technology throughout the world to tie into the global network with relatively inexpensive fixed-antenna ground terminals, according to Hughes.

The company has been among the more ardent proponents of such a system for several years (AW Dec. 12, 1960, p. 52). Hughes is conducting a company-funded effort to study and test a ground station with a fixed dish suitable for utilization with the Advanced Syncom.

Results of a series of NASA-sponsored Advanced Syncom development efforts covering such items as the dual-mode communications transponder and a phased-array transmitting antenna were demonstrated recently by Hughes. The company now has begun work on the next engineering phase of the program, under contracts estimated to be about equal to the $3.5 million allotted for the first phase. None of this work involves flight hardware, however.

Hughes also is NASA prime contractor for the Syncom 1 satellite project (AW Aug. 20, p. 80) involving a projected series of three launches to demonstrate an inclined synchronous orbit system and to prove-out control and communications techniques.

Advanced Syncom is a direct descendant of Syncom 1, similar in silhouette (see photo) but double the size of Syncom 1 in linear dimensions. It is 8 to 10 times larger than Syncom 1 in weight and volume. Syncom 2 will be 58 in. in diameter and 50 in. high, with its 16-element, phased-array antenna protruding about 23 in. above the cylinder.

Constructed principally of aluminum, with a minimum amount of magnesium, the satellite's total estimated weight at booster separation is about 1,500 lb., including apogee motor case and propellant, roughly 10 times the weight of the Syncom 1 satellite at a similar point in its trajectory.

Weight of Advanced Syncom at injection into a synchronous orbit, including the spent apogee rocket motor case which is not jettisoned, will be about 750 lb. Fuel and oxidizer of the bipropellant reaction control system constitute 130 lb. of that total.

Apogee motor, being developed for NASA by Jet Propulsion Laboratory, will be a larger version of a similar motor which JPL supplies for Syncom 1. It will contain 750 lb. of solid fuel (10 times that of the Syncom 1 motor) having the same specific impulse but a larger total impulse.

Thrust will be about 7,000 lb., and the motor is to be capable of supplying about 6,100 fps. velocity increment. This will be enough to inject the satellite into a stationary orbit from the apogee point of its long transfer ellipse after booster separation.

Satellite orbital weight will be divided approximately as follows:

- **Electronics**—135 lb.
- **Wiring harness**—20 lb.
- **Structure**—140 lb.
- **Power supply**—105 lb.
- **Controls**—50 lb.
- **Inert propulsion**—120 lb.
- **Miscellaneous**—55 lb.

Hughes is proposing that the satellite's payload include four dual transponders with multiple-access capability, quadruple telemetry and command systems (four transmitters and four receivers) and four independent control systems for antennas and control jets. The satellite will derive its energy from low-resistivity, high-efficiency N-on-P solar cells covering its cylindrical length.

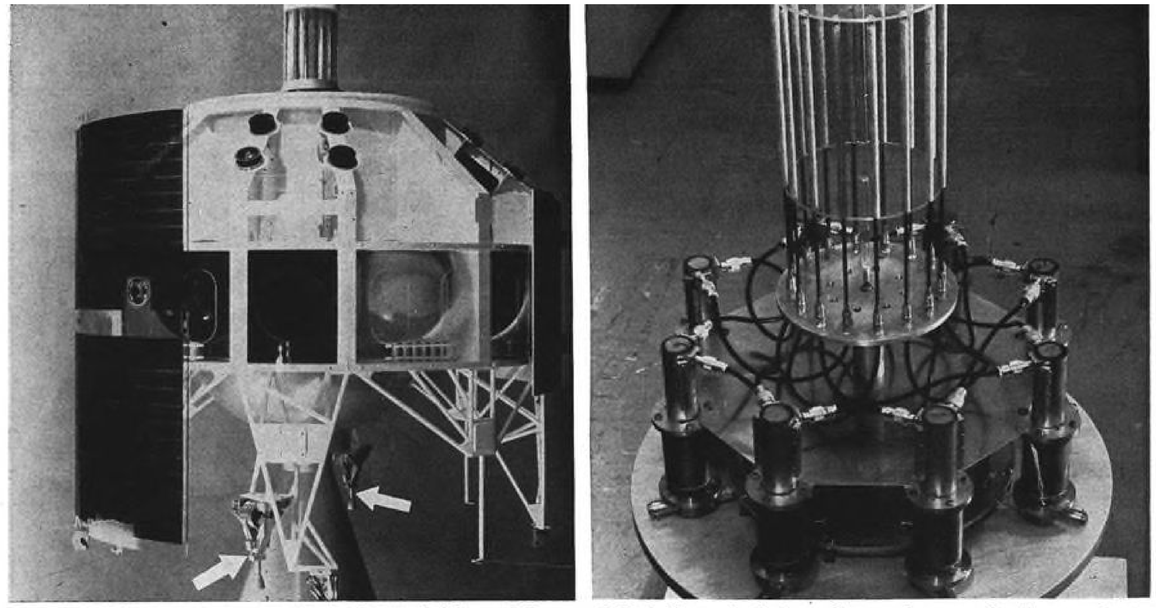
Advanced Syncom contracts have centered on development of:

- **Dual-mode communications** transponder. In the multiple-access mode, signals are transmitted to the satellite from up to 100 ground stations in frequency division-multiplexed, suppressed-carrier single sideband form and converted to high-index, phase-modulation form for transmission to ground

Syncom 2 Funding

National Aeronautics and Space Administration has requested about $41.1 million in funds for Advanced Syncom in its Fiscal 1964 budget. This total includes $16.6 million for the spacecraft and $12.5 million for four Atlas-Agena D boost vehicles.

The future of the Advanced Syncom program—particularly the immediate flight hardware phase—will hinge on congressional approval of this budget request. The request has aroused some criticism from members of Congress.

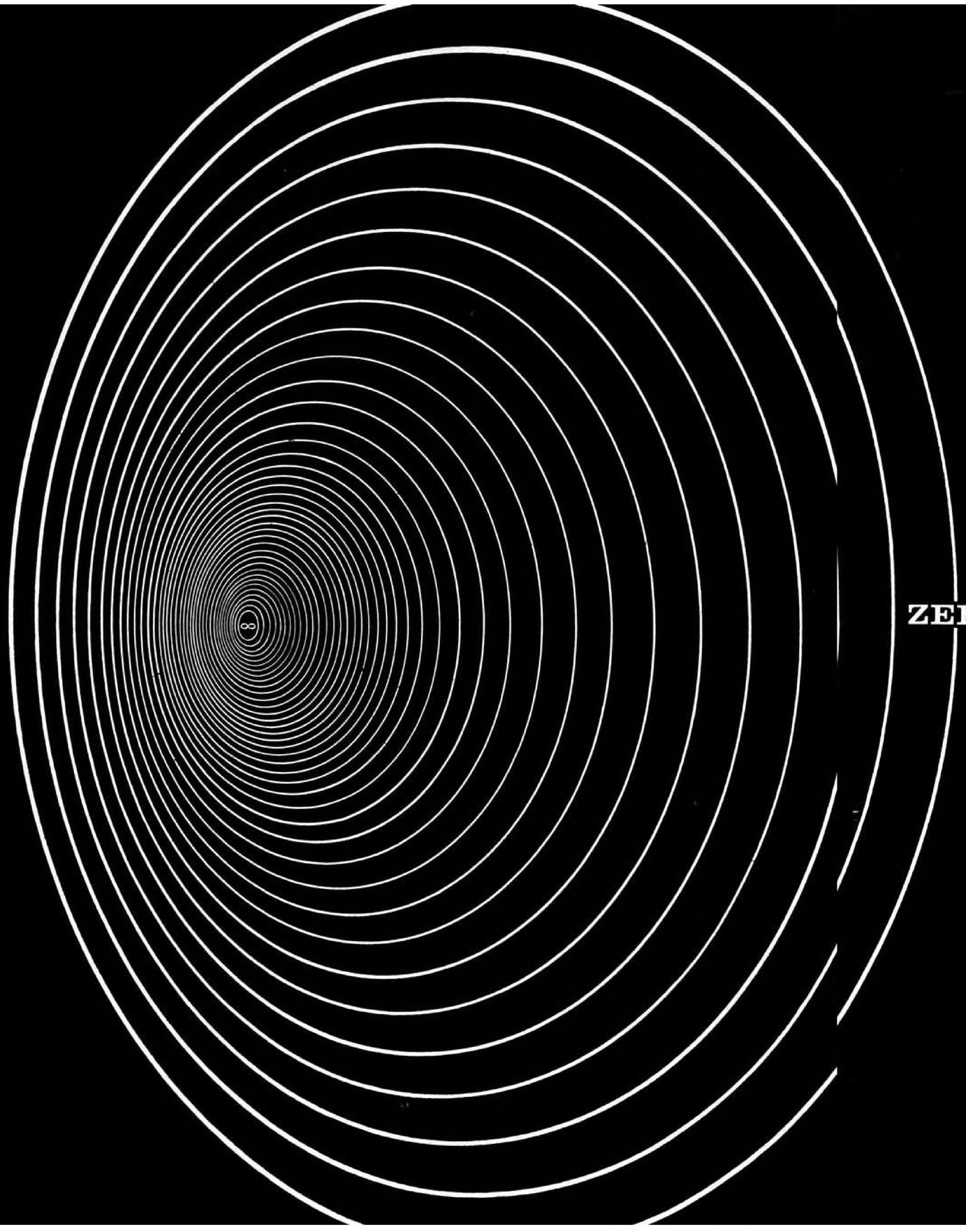


PARTIALLY ASSEMBLED WOODEN MOCKUP of Advanced Syncom (left) indicates similarity to Syncom 1 spacecraft. Arrows point to axial jets which provide a measure of orbital speed (spin) control. Spherical tanks contain control system fuel and oxidizer. Phased-array transmitting antenna breadboard (right) has 16 array elements equally spaced around circle whose center is spacecraft's spin axis and whose radius is one wavelength. Exciting signals supply equal power to each element, but are phased to be reinforced toward earth.

Comsat Orbit Terminology

Terms frequently used in describing communications satellite orbits include:

- Circular orbit—one which describes a complete constant altitude revolution around the earth.
- Equatorial orbit—an orbit in the plane of the earth's equator.
- Synchronous orbit—one with a period of 24 sidereal hours, the same period as that of the earth revolving about its axis. "Synchronous" means that the satellite rotational speed and the earth's speed of rotation are in synchronism, creating a satellite orbital period identical to that of the earth. There are many possible synchronous orbits, but for each circular, synchronous orbit there is a uniquely defined altitude of 22,752 naut. mi. from the earth's center—or roughly 22,300 stat. mi. above the average altitude of the earth's equator. If the synchronous orbit is elliptical, the semi-major axis of the ellipse will be 22,752 naut. mi.
- Stationary orbit—a circular, equatorial and synchronous orbit. This is the type of orbit for which Advanced Syncom (Syncom 2) is intended. In this orbit, the satellite appears stationary with respect to any point on the earth's surface because satellite altitude and speed with respect to the earth's rotation keep it in a fixed relation to points on the earth. Thus, stationary and synchronous are not synonymous. A stationary orbit must be synchronous, though the reverse need not be true.
- Inclined synchronous orbit—a specific example of a non-equatorial, (hence non-stationary), synchronous and circular orbit. Syncom 1 satellites (AW Aug. 20, p. 80) are planned to have such orbits, inclined by 33 deg. with respect to the equator. The satellite's orbital period is 24 hr., but points on the earth have a changing relation to it. The first Syncom 1 spacecraft, launched from Cape Canaveral on Feb. 14, is virtually in such an orbit, with its longitudinal position drifting eastward, according to astronomical observations.
- Figure eight—a ground projection of points over which the non-stationary, synchronous satellite, such as Syncom 1, would appear during a 24-hr. period. The top of the elongated figure eight in this case would be at 33 deg. north latitude, the bottom at 33 deg. south latitude, the center of the figure at the earth's equator. The satellite longitude would not change daily.



SCIENTISTS AND ENGINEERS:

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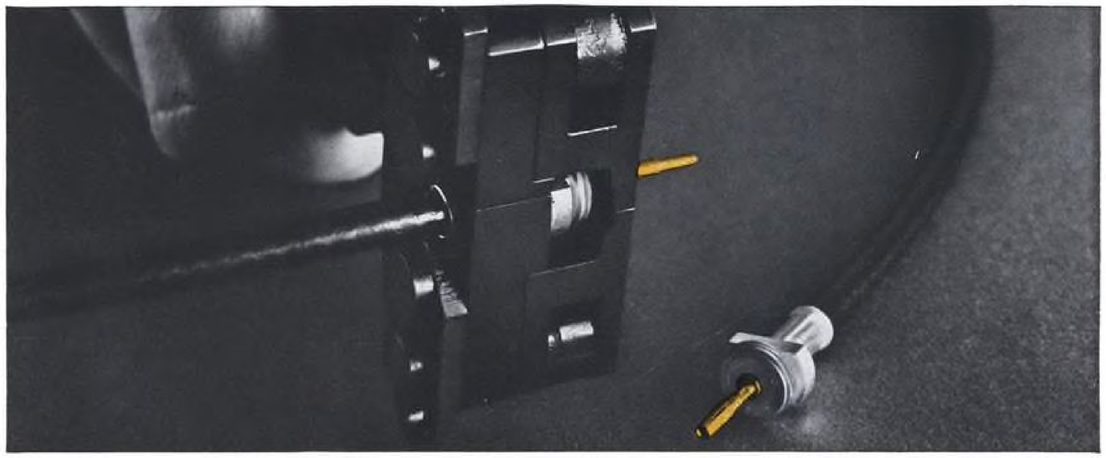

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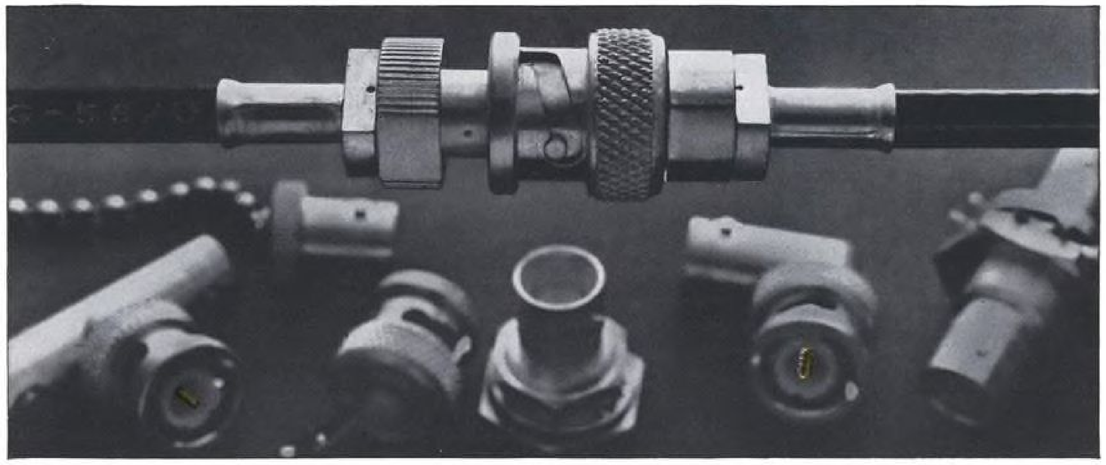

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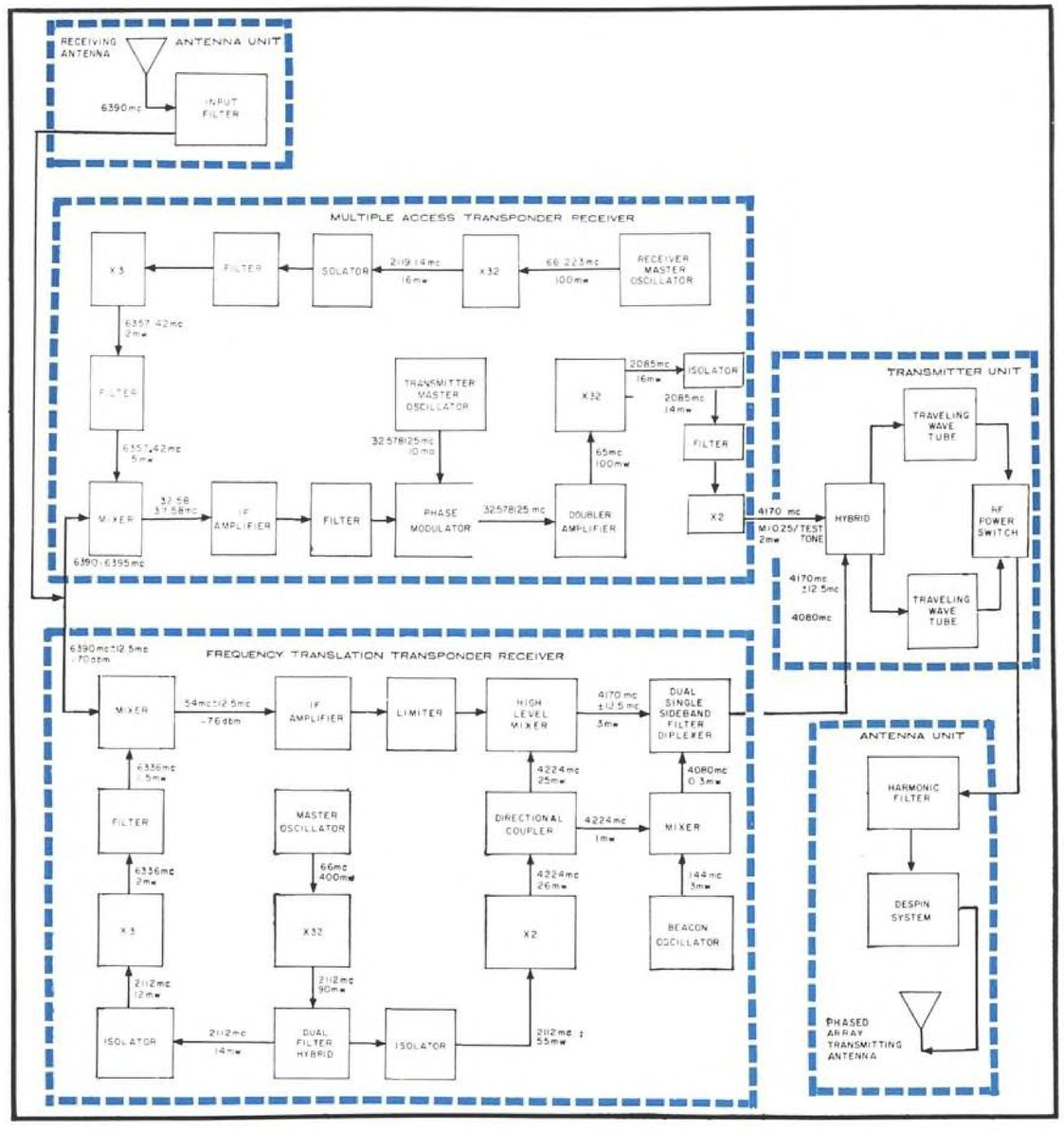

BLOCK DIAGRAM of satellite communications transponder, being developed for Advanced Syncom, is shown above. Each of four such transponders on the satellite would be capable of receiving and transmitting one TV channel or 600 two-way voice conversations when linked to 85-ft. ground dishes. TV would be accommodated by frequency-translation mode. Alternate multiple-access mode will simultaneously receive multiplexed voice messages from scattered ground stations, convert and transmit them as phase-modulated signals. Outputs from either mode can drive either of two redundant traveling wave tube power amplifiers.

stations. Ground-to-satellite transmission frequency will be about 6 gc. (kmc.), 4 gc. satellite-to-ground. Bandwidth for the multiple-access mode will be 5 mc. on the up-link, 25 mc. down. Bandwidth for the frequency-translation system is 25 mc. Each voice channel is 4 kc. This would allow 1,200 contiguous voice channels or 600 two-way voice channels in a 4.8-mc. band used with 85-ft. dishes on the ground. If only 40-ft. dishes are employed, the capacity will be reduced to 120 two-way conversations.

NASA plans to develop only two of four assigned 25-mc. multiple-access bands, each with the 600 two-way voice channel capacity. The remaining space in the Syncom 2 vehicle probably would be devoted to scientific experiments not directly connected to communications. It is planned to multiplex all bands for use of a single phased-array transmitting antenna.

• **Phased-array antenna,** a 16-element array in which the phase of each element is controlled to produce a pencil beam pointed at the earth. Its phase varies with satellite spin rate to keep the beam earth-oriented (AW June 11, p. 88). Beam angle is about 20 deg., sufficient to encompass the facing portion of the earth from the synchronous-

Published monthly by Giannini Controls Corporation: 1. In self-recognition of our unusual Measurement and Control capabilities for Aerospace and Industry. 2. For painless, incremental reading. 3. To advance our belief that the truth need not be dull.

STAMP OUT GREASY COMPONENTS

At our subsidiary, Powertron, we are now producing a miniature, stainless steel ultrasonic vapor degreaser. This small, $3,300, 25″x20″x40″ device is ideal for unmucking greasy hid stuff in small, intricate electronic and missile parts. It's called the PVD 3004. Delivery is 45 days. If you'd like more information, just send us your name, company and address.

Put a steel band around the earth. Splice a 10′ section into it. Then, can you step over the band, under it, or sit on it? *Answer up alongside pipe d.*

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Model 34628CS . . . 2-axis gyro . . . relatively drift free . . . takes shock and acceleration to 75 G's . . . 3½″ diameter . . . has synchro pickoffs and torquers on both gimbals . . . outer gimbal travels 360° . . . inner gimbal stops at 84° to prevent tumbling . . . 20 G rms random vibration . . . .5° per min. drift . . . fast runup spin motor good for more than 500 hours . . . swell for tactical weaponry . . . missiles and rockets . . . or what have you? If you'd like more specs, drop us a line.

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We grow a lot. So, if you're an experienced, down-to-earth, degree-holding technical man with aerospace measurement and control experience who enjoys a hard-headed, light-hearted & expanding, environment, you ought to consider joining GCC. Write Tom Harriman, our V.P., Engineering. Tell him you're interested in doing hard, unglamorous work that produces great hardware and lots of money.

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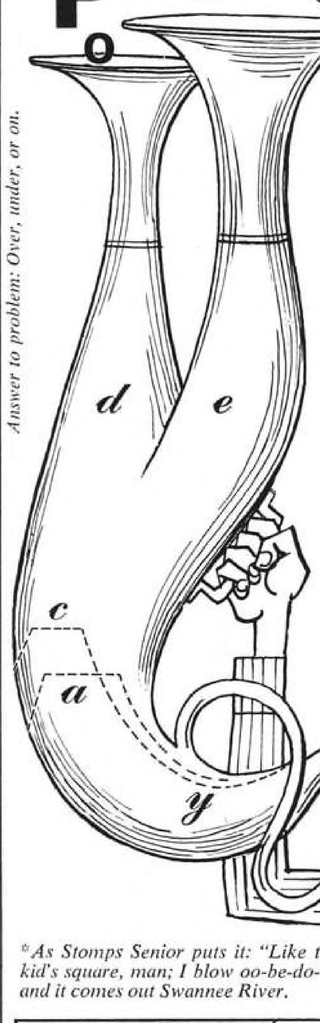
POOOTPOURRI

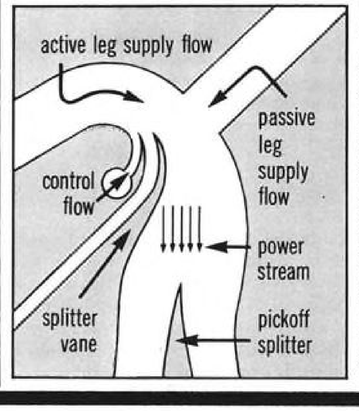
Answer to problem: Over, under, or on.



DIG FLUID CONTROL?

Below, actuating the Zisfein-o-fone, are Stomps Farquar & Son. Their instrument is loosely based on an aerodynamic fluid state amplification technique currently under study at GCC's Astromechanics Research Division. Here's how it works:
Stomps Senior's air flow naturally separates from the right hand wall of the Zisfein-o-fone as it rounds curve (Y). The velocity distribution of the air flow then looks like dotted line (A). Guess what happens when Junior blows his small counterflow directly into the separated boundary layer area? That's right! This small incoming counter-flow causes a proportional amount of premature separation and thus has a major effect on the velocity curve of the main flow so that it looks like dotted line (C). In other words, when and how hard Junior blows controls the vectoring of air flow through horns (D) and (E). If he blows hard enough, the whole stream heads for horn (D).*

**As Stomps Senior puts it: "Like the kid's square, man; I blow oo-be-do-ba and it comes out Swannee River.*



NOW, FOR THE REAL McCOY

At the left is a diagram of a real, live, GCC-developed fluid state device. We anatomically call it the Double Leg Elbow (not "Hip", says Farquar Sr.) Amplifier. As fluid state devices go—and few of them go very well yet—it's a nice piece of work: This no-moving-parts, non-electronic, non-hydraulic, non-mechanical, non-available proportional mass flow amplifier has yielded very linear single stage differential flow gains over 200:1. That *is* worth knowing more about, isn't it? For a detailed report on how the Double Leg Elbow Amplifier works plus disclosure of a whole batch of data developed during our fluid state endeavors, send us your name and address on a company letterhead.

Improvements Planned for Second Syncom 1

Quality control and design improvements are being made in the second NASA/Hughes Syncom 1 spacecraft, which will be launched by a Thor Delta rocket from Cape Canaveral this summer.

Improvements are intended to avoid a recurrence of the power failure which silenced the first Syncom satellite last February before it achieved its goals.

Telemetry output from that spacecraft abruptly ceased 1 sec. before burnout of its apogee motor, which was to boost the satellite into a synchronous orbit.

Neither an alternate, redundant telemetry system nor the satellite's dual communications transponder responded to activation commands, suggesting that an opening in the B+ of the power system might be responsible for the failure.

This, Hughes engineers believe, could have resulted from:

- Wire failure under fatigue, even though they had been subjected before flight to 1½ times anticipated flight loads.
- Explosion aboard the spacecraft, probably traceable to a nitrogen bottle in the spacecraft's control system. In an effort to duplicate conditions of this possibility, engineers recently exploded a nitrogen bottle on a Syncom mockup. Sufficient damage resulted that this condition has been tabbed as the probable origin of the failure.

Other possible on-board sources of explosion—in the hydrogen peroxide control pressurization system and in the apogee rocket—were reviewed and ruled out. The former was dismissed as a probable cause because it lacked sufficient energy to produce the damage, type of explosion and the resulting velocity increment experienced by the satellite.

The apogee motor at burnout also lacked enough energy to produce the explosion.

Hughes' Syncom personnel blame insufficient quality control, rather than design flaws, for the first satellite's difficulties. But they are assuming weaknesses in the wiring harness and nitrogen system.

Second Syncom 1 vehicle will use heavier-gage, highly redundant harnessing with wiring logic design arranged to ensure that no single open circuit will result in a major failure. Extreme care will be used in manufacture of the wiring. Quality problems in the nitrogen bottles hopefully can be spotted in a test program.

To assure that telemetry will continue in the event of another major failure, one of the redundant telemetry systems will be powered during critical flight phase by a battery, separate from the spacecraft power system.

When this telemetry is operating, as it will be prior to apogee motor firing, its power will be derived from the normal satellite power system. Prior to the start of apogee motor burn, the first telemetry system will be switched off, the second on. At this point, the first telemetry will revert to its own battery supply and will operate until the battery supply is drained, after about 40 min. Thus, during the critical burn period, both telemetry systems will be working.

In another move to increase chances for success with the next Syncom 1, the satellite is being subjected to combined acceleration-vibration environments in an attempt to cause a failure. The first Syncom 1 was subjected to a wide spectrum of accelerations and vibrations, but not simultaneously.

Combined stresses coupled together might produce a failure, and this possibility is being checked exhaustively. An axial accelerometer will be added to the satellite to measure acceleration and vibration during the boost phase.

A Jet Propulsion Laboratory rocket motor with a lighter case and improved mass fraction is being substituted for the Thiokol TE 375 solid-propellant motor used for apogee boost. This affords a 7-8 lb. weight saving that can be used for added harnessing and the telemetry battery supply.

The first Syncom 1 is now drifting slowly eastward in a near-synchronous orbit of 23 hr. 45 min. period, according to astronomical observations. The satellite was within a 26-ft./sec. velocity increment of being synchronous. This was better than the anticipated 112 ft./sec. error, which was to have been smoothed out by vernier control.

Hughes is confident that one goal of the Syncom 1 program—to obtain synchronous orbit using injection technique of spin stabilization to aim the apogee motor—has been achieved.

Promising evidence of the quality of communications was also secured, but the premature termination of communications thwarted evaluation of the system in orbit. The final goal, demonstration of pulse-jet control and its ability to provide station-keeping and control over a long period of time, must await the future Syncom 1 launches.

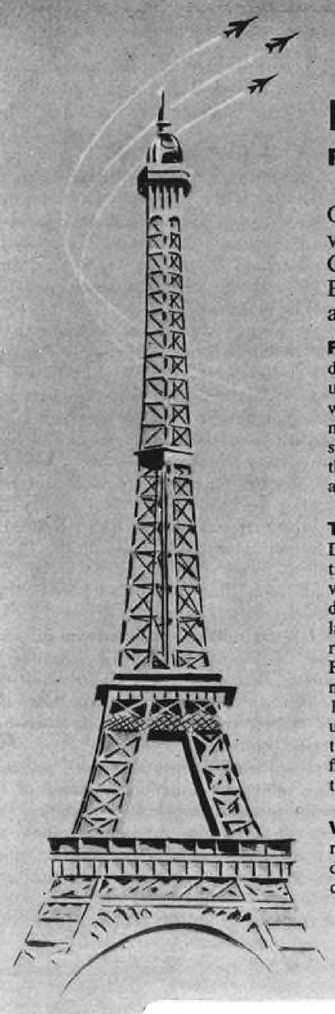
orbit altitude. A breadboard model, giving a 10-db. improvement over the pancake-shaped antenna pattern used with Syncom 1, is complete and an engineering model is being developed.

- **Traveling wave tube** offering a bandwidth of 1,000 mc. centered at 4 gc. with 40-db. gain, which supplies 4 w. output power at an efficiency of 35%, has been developed by Hughes. Each transponder will use two of these periodic, permanent magnet-beam focusing tubes. Frequency-multiplied and transistor power-amplified outputs from either mode of the transponder can be power-amplified by either of these redundant tubes.
- **Apogee motor,** under development at JPL.
- **Reaction control system** is being developed for Hughes by Marquardt Corp. This will be a dual, bipropellant (monomethyl hydrazine and nitrogen tetroxide), high-performance system. It will provide a 3,200-fps. velocity increment capability (1,600 fps. per individual unit), compared with 300 fps. available from the cold nitrogen and hydrogen peroxide system in Syncom 1. The bipropellant rocket reaction jets will control the satellite once it reaches a nominally stationary orbit. In Syncom 1, the chief function of the control system was to correct launch errors. In Syncom 2, its functions will include keeping satellite inclination from building up and maintaining a stationary position for several years. Holding against a year's buildup in inclination requires about 200 fps. of velocity increment. Thus, each unit of the dual system will have a four-year capability.

Velocity corrections will be made either by the axial jet operating in continuously or the radial jet in a pulsed mode. The axial jet in a synchronously pulsed mode can precess the spin axis. A ground synchronous controller, which provides phased signal pulses for the on-board jets in Syncom 1, serves only as a backup for the on-board synchronous counter and logic network in the Advanced Syncom. The advanced satellite also will have a pair of gimbaled jets for spin rate control, controlling to 100 rpm., ±25 rpm.

Spacecraft transponder modes are selectable from the ground via the spacecraft command system. The frequency-translation mode will accept wideband frequency-modulated (FM) signals and translate the carrier frequency, typically 6,390 mc. to 4,170 mc., without changing the modulation technique. This mode is identical to the communications technique of Syncom 1, which carries a redundant transponder, both channels of which are of this frequency-translation type. Syncom 1 receives signals at 7,361-63 mc., translates these to 1,814-16 mc., and transmits them.

In the multiple-access mode, the use



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Computing Devices of Canada Limited cordially invites you to visit their display areas in the Canadian Department of Trade and Commerce booth in Hall "C", and in the Bendix International Booth in Hall "B" during the exposition. Advanced Air Navigation and Photo-Optical Systems displayed will be –

PHI – The Position and Homing Indicator, the prime navigation system used by the Air Forces of 10 nations will be demonstrated. The PHI-200, most advanced helicopter navigation system, will be presented, as well as the PHI-100 series for VTOL fighter and transport aircraft.

TMMD – The Tactical Moving Map Display, will be shown for the first time in Europe. This sophisticated and versatile instrument shows on one indicator a continuous projection of large scale topographical detail surrounding present aircraft position. Fully automatic map movement permits tactical flexibility within an area 1800 x 1800 nautical miles at speeds up to 2000 knots; and a display of track error, track, range and course to fly for up to 12 preselected destinations.

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CHS – The Central Heading System consists of a pilot's control indicator, a navigator's control indicator and a ¼ ATR repeater. Controlled by either the pilot or navigator, it accepts heading from two sources, makes two continuous independent heading computations – either of which can be selected by the pilot. It also provides from either heading source, the multiple independent outputs of heading required in large aircraft.

SAC – Synchronous Astro Compass provides an operationally proven semi-automatic, low-cost method of accurate alignment of heading sources by the use of visual sighting and slaving controls. A sub-system of Computing Devices' GAINS system, the SAC is currently used by civil airlines and military services.

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Samuel de Champlain, born at Brouage, France, successfully explored the great wilderness using his ancient navigation instrument, the ASTROLABE, to advance the frontiers of knowledge for the service of man.

The spirit of exploration, exemplified in the statue of Champlain overlooking the Parliament Buildings in Ottawa, is carried on in nearby Computing Devices of Canada. Here, explorations into the unknown have resulted in discovery and development of the most advanced air navigation aids for the age of supersonic speed.

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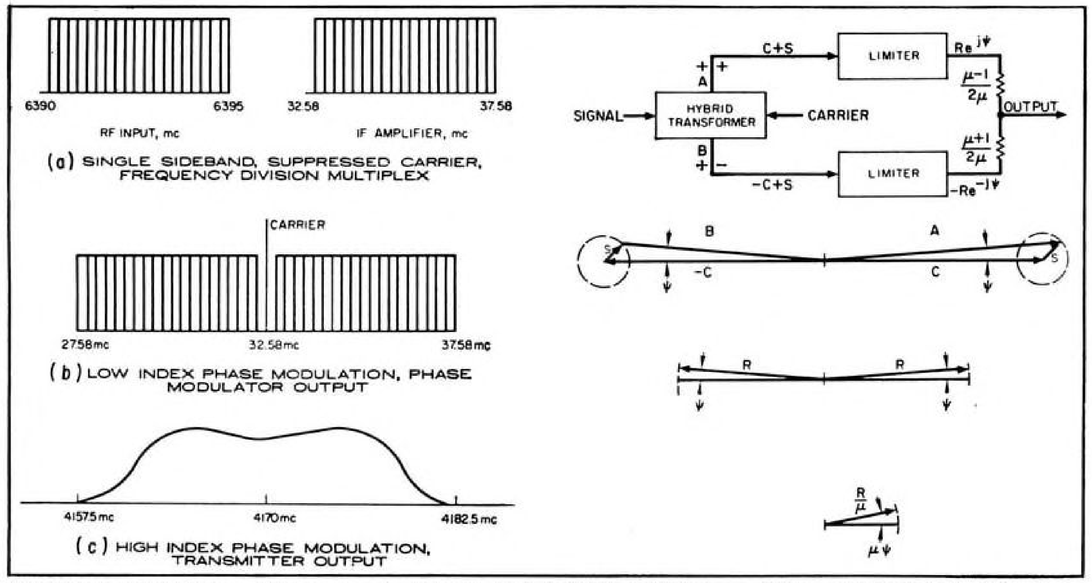


SPECTRUM OF SIGNALS in multiple access mode of transponder is indicated as (a) frequency division multiplexed single sideband suppressed carrier input in 6 gc. band, succeeded after mixing by an intermediate frequency centered at about 35 mc. Output of phase modulator (b) is low index phase modulation with carrier and other sideband introduced. After necessary multiplication and power amplification, high index phase modulation is available from spacecraft transmitter in 4 gc. band. Simplified block diagram of phase modulator which converts suppressed carrier single sideband to phase modulation, and carrier signal vector relations are shown at right.

of single sideband permits reception and addition in a single transponder of many voice channels. The addition of FM voice channels from several stations, on the other hand, probably would be impossible without widely separating the bands–if that could be achieved, according to Hughes. The conversion to phase modulation for the down-link tends to enhance the signal-to-noise ratio. This technique also avoids distortion introduced by intermodulation products, generated by permitting the traveling wave tube and a transistor preamplifier to operate in saturation for maximum efficiency.

For TV transmission, the over-all ratio of peak-to-peak signal to weighted noise is 55.2 db., about 4.2 db. better than the value recommended by the International Radio Consultantive Committee, according to Hughes. Useful lifetime design objective of Syncom 2 is three years in orbit. Echo suppressors will be used to prevent delayed echoes from interfering with subscriber use.

No On-board Detection

Conversion of single sideband signals into low-index phase modulation is accomplished in a modulator which eliminates the need for on-board detection of signals.

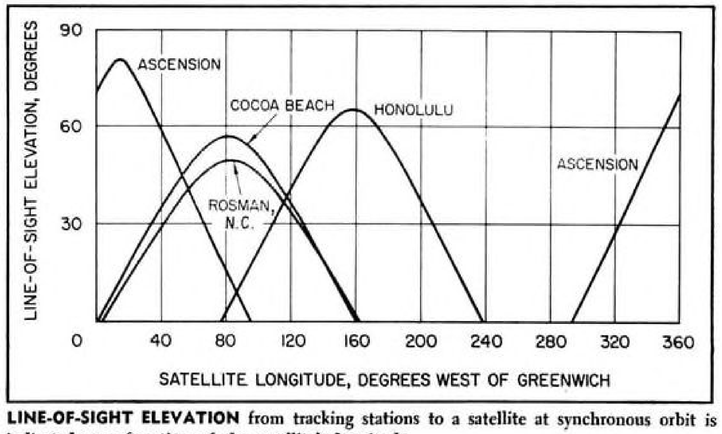
Incoming single sideband signals are mixed with a signal of 6357.42 mc. generated by multiplication of a 66 plus mc. crystal master receiver oscillator signal. The resulting IF signal (32.58 to 37.58 mc.) is amplified in a 5.8-mc. bandwidth amplifier centered at about 35 mc. Output of the amplifier is linear and low-power, thus avoiding generation of excessive intermodulation products.

This IF signal and a transmitter master oscillator signal (local carrier) are inputs to the phase modulator, which converts the single sideband to phase modulation, and is the heart of the multiple-access mode. It generates the carrier and introduces the other sideband.

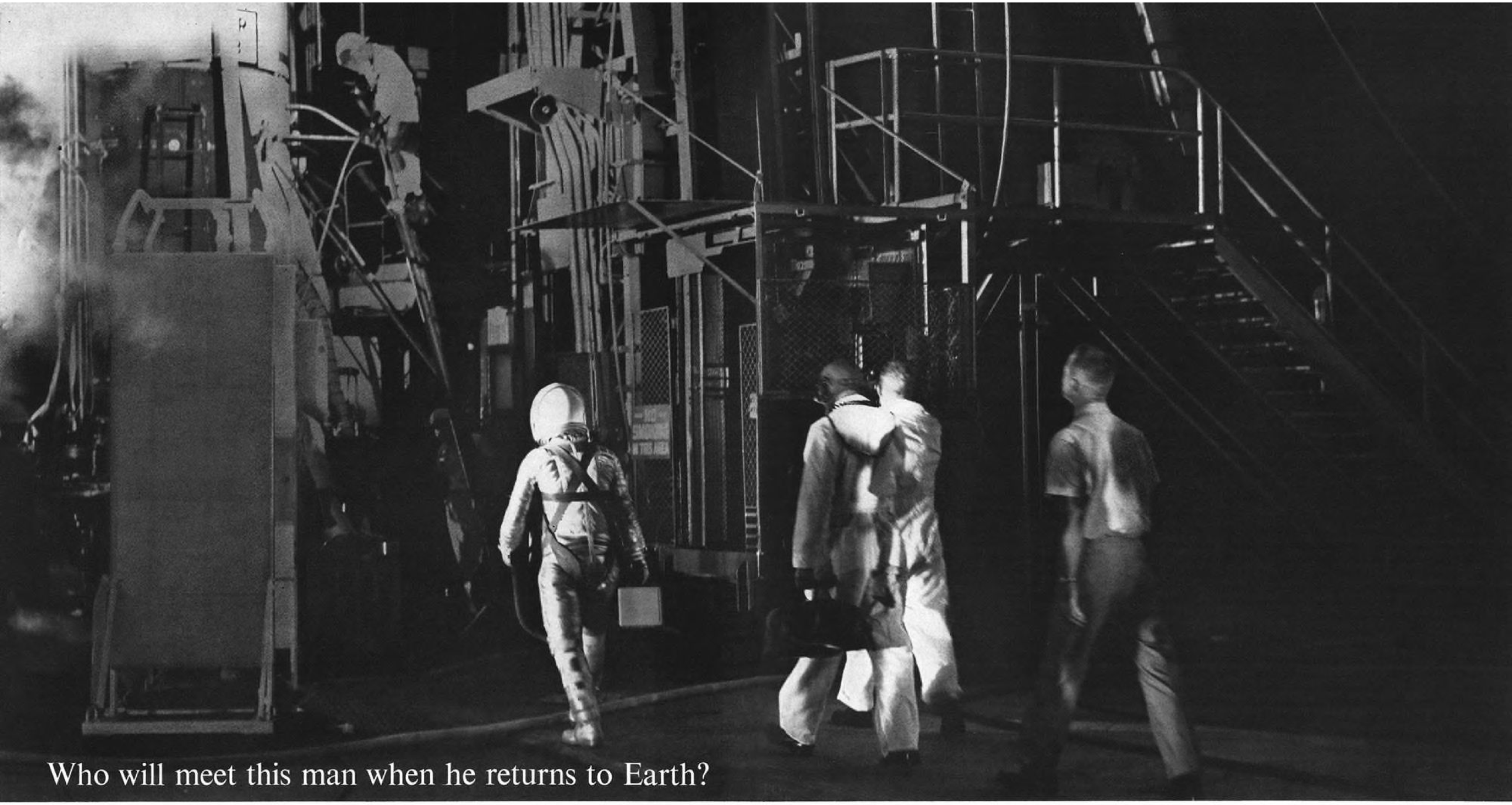
In-phase vectors are produced by the IF signal applied to a hybrid transformer at the input to the modulator. Out-of-phase carrier vectors are produced at the transformer output terminals. A pair of biased-diode balanced limiters restricts the amplitude of the resultant vectors to a constant value, so that modulation is low-index phase modulation (see drawing, above).

High Ratio

The limited resultant vectors are added in an output-summing network. This modulator enables the carrier-to-signal ratio to be sufficiently high before limiting, according to Hughes, to hold intermodulation products low and yet permit the modulation index to be



LINE-OF-SIGHT ELEVATION from tracking stations to a satellite at synchronous orbit is indicated as a function of the satellite's longitude.



Who will meet this man when he returns to Earth?

As America's man-in-space program gathers momentum, the need grows more urgent for advanced methods and equipment—to back up NASA's carefully planned recovery operations.

The big Lockheed Hercules propjet transport—in the new HC-130E configuration—is made to order for space support recovery missions of MATS' Air Rescue Service. It has brute strength, huge cargo capacity—and can handle special retrieval systems. It has the speed and range to cover wide recovery areas. And Hercules is noted for its endurance which allows it to loiter for long periods.

In fact, the HC-130E is designed for many of the missions performed by ARS—including dropping pararescuemen on land or sea; carrying out disaster evacuation missions; supporting overseas deployment of fighter airplanes; as well as performing the classic ARS mission of retrieving lost or stranded people.

True airlifter design continues to stand the Lockheed Hercules in good stead throughout the world. Straight-in-rear-loading on a truckbed-height floor — plus rear-door, in-flight, outsize paradrops — and over-all ruggedness, reliability, and rough-field landing and take-off capability — continue to make it possible for the C-130 Hercules to perform an ever-increasing variety of airlift work.

C-130 Hercules

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

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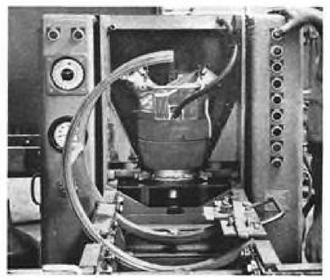
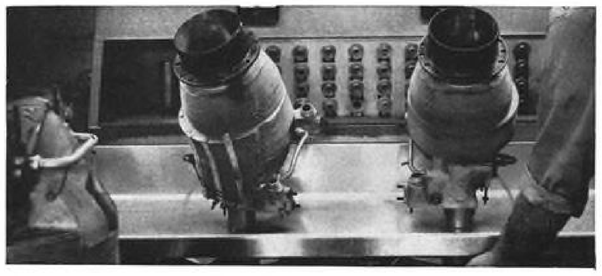
For example, Airwork replaces all valve guides at overhaul. The new valve guides are reamed to exactly fit (within .0015") their mating valve stem. The valves are measured, then put in a special board that shows exactly which one goes with the cylinder being reamed. The operator mikes the valve stem, then selects the right size reamer from the more than 200 stored in the cabinet in the background.

To maintain accuracy, the normal .006" taper in the valve stem has been reduced to not more than .002" on a special honing machine before it reaches this station. The combination of a less barrel shaped valve stem and a more accurately fitted valve guide provides maximum protection against oil leaks.

Airwork uses automation to reduce the physical effort involved in handling 28-pound cylinders . . . but keeps all the skills a quality overhaul demands. This is progress —without loss of craftsmanship—one more reason an Airwork overhauled engine will provide a long, trouble-free operating life.





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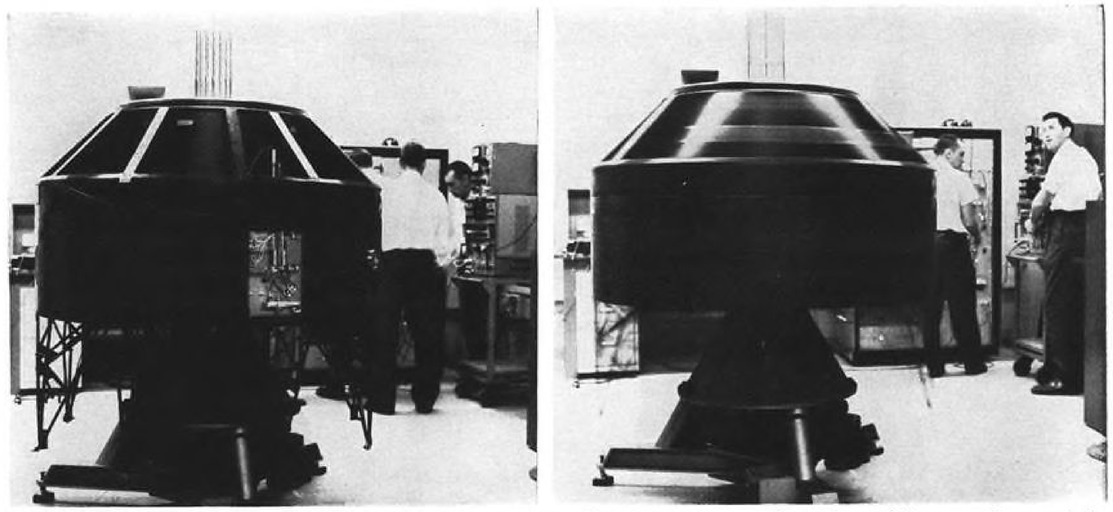


ENGINEERING STRUCTURAL MODEL of Advanced Syncom (Syncom 2) communications satellite is shown (left) mounted on a spin fixture for a recent demonstration at Hughes Aircraft Co., prime contractor for the satellite. At right, the model is spun at anticipated nominal orbital speed of 100 rpm. Visible from top of structure are antenna elements, part of a new phased array transmitting system employing 16 collinear elements which will form a relatively high gain (18 db.) pencil beam pattern continually directed at the earth as the spacecraft spins about its axis, which is to be perpendicular to the plane of the earth's equator.

adjusted later to a level required by the communication system.

Modulator outputs are then doubled, transistor power-amplified, and multiplied again up to 2,085 mc., doubled and fed to the traveling wave tube, which brings signal level up to 4 w.

Portions of the phased-array antenna system, including microwave parts, phase shifters and control electronics, have been completed. The phased-array antenna system was selected to boost gain, and the expected improvement will be about 10 db. The 16 antenna elements are equally spaced around a circle one wavelength from the center, which corresponds to the satellite's spin axis.

Besides the 16 antenna elements, the unit includes a power splitter that divides the transmitter output into eight equal-amplitude and equal-phased components. These are coupled to ferrite tubes in a circular waveguide within a four-pole, two-phase motor stator, then coupled into eight output couplers.

The latter convert the RF output into two equal amplitude signals with differing phase shifts. Output phases are controlled so that all elements radiate in equal phase in the desired beam direction.

Control signals for the phased-array antenna are also used for reference firing of the control jets, since they provide a convenient reference to spacecraft angular position.

Phased-array offers these advantages, according to Dr. Harold Rosen, technical director and associate Syncom project manager:

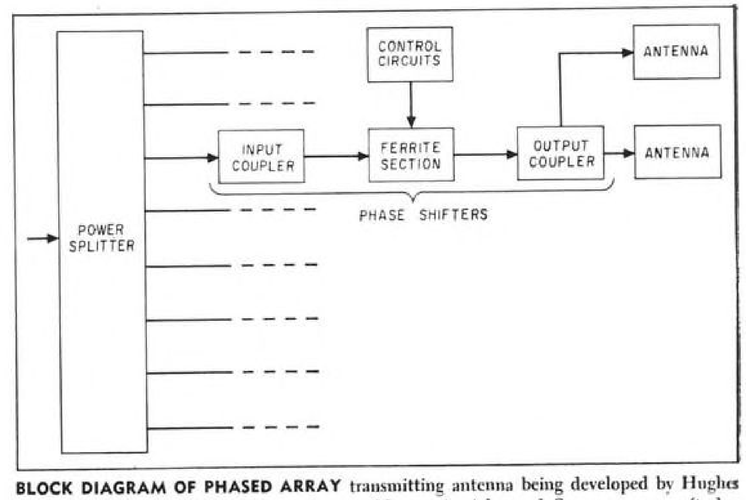
• **Degradation in output** would be "graceful" in the event of failures, since the output is not dependent upon any single element.

• **In initial operation** (for guidance in the transfer orbit), if all phase shifters are off, the antenna pattern becomes omnidirectional around the spin axis of the spacecraft. In a "fail-safe" mode, if there are a number of element failures, the antenna will revert to a figure-of-revolution mode, like that of Syncom 1. This would reduce the number of channels which could be handled by a factor of 10.

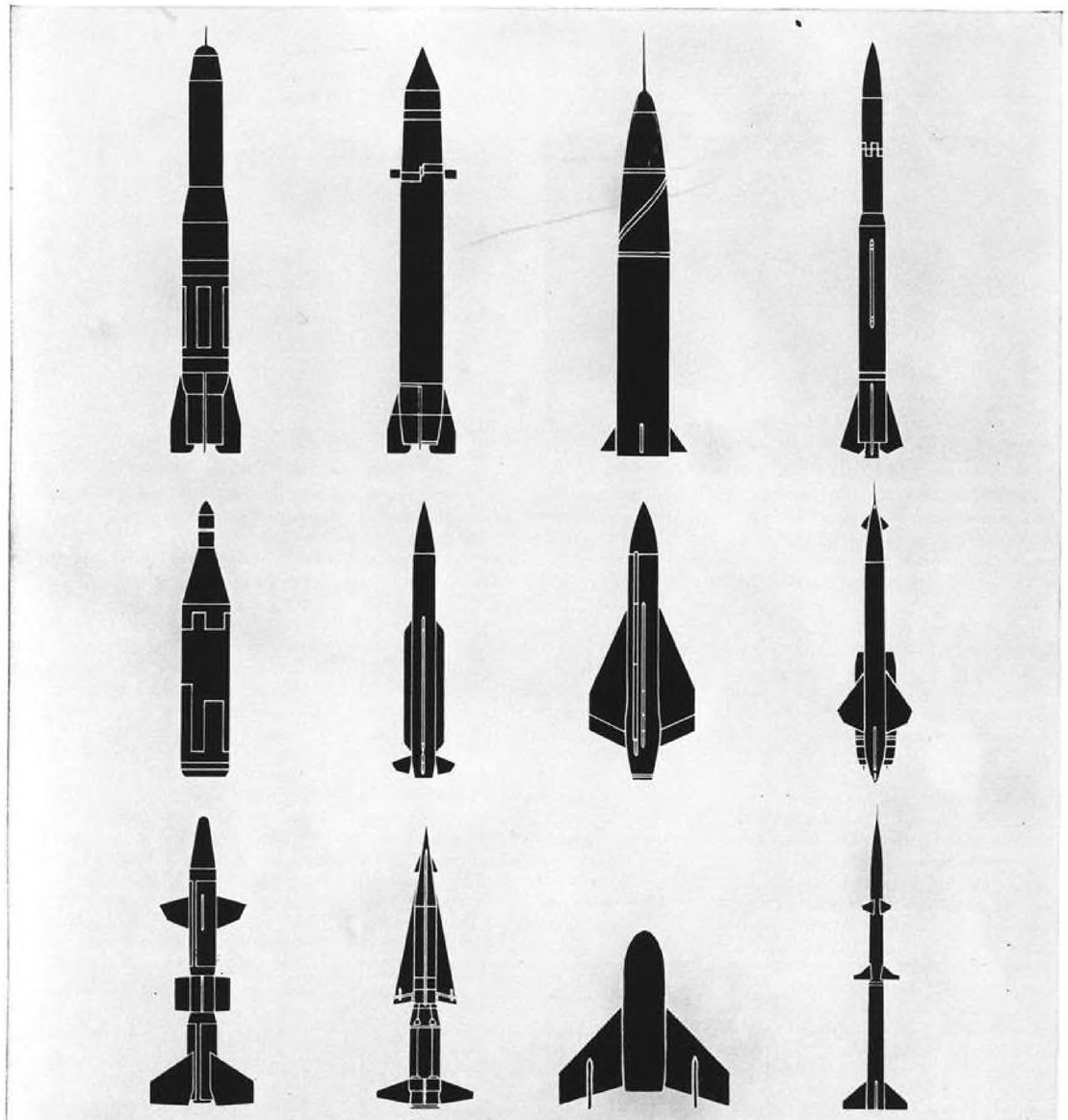
Advanced Syncom would be launched from Cape Canaveral by an Atlas Agena D. This makes the stationary orbit possible, partly because of the Agena's restart capability and partly due to its ability to put the spacecraft into a transfer ellipse with perigee and apogee over the equator. This will permit proper aiming of the satellite's apogee motor.

The spacecraft would be launched eastward from the Cape and would be placed into a circular parking orbit at approximately 90 naut. mi. altitude after the Agena's first burn period. It would remain in this orbit for about 1 hr. 7 min., at which time it would be crossing the equator for the second time, with the cross-over point above Canton Island in the Pacific.

The Agena then will fire again and



BLOCK DIAGRAM OF PHASED ARRAY transmitting antenna being developed by Hughes Aircraft Co. under NASA contract for possible use in Advanced Syncom spacecraft, has eight phase shifters driving the 16 elements of the system.



Copycats!

(they all rely on Sonotone batteries)

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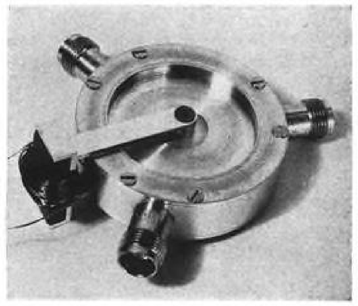

THREE-PORT FERRITE CIRCULATOR, the field direction of which is switched electronically, connects either of two traveling wave tube final power amplifier outputs to Syncom 2's phased array transmitting antenna. Device has low insertion loss between transmission terminals, requires little power, and operates at 4 gc. It eliminates moving parts required in functionally equivalent relay employed in Syncom 1 transponder.

inject the spin-stabilized satellite into an elliptical transfer orbit with an apogee radius of 22,752 naut. mi. Perigee of the transfer orbit will be above the equator.

Syncom satellite velocity is boosted from 25,000 fps. prior to Agena restart to 33,000 fps. after the second Agena burn period, according to the planned launch sequence.

Yaw Maneuver

After Agena cutoff, the booster's guidance will program a 53.2-deg. right yaw maneuver to aim the spacecraft's apogee rocket, which is aligned to the satellite spin axis, then spin the satellite up to 100 rpm. on a spin table mounted on the Agena.

Once this is done, the Atlas-Agena D booster is separated from the Syncom satellite.

Duration of the transfer ellipse is about 5 hr. 15 min. At apogee of this orbit, with spacecraft velocity decayed to about 5,200 fps., the apogee motor is fired to give the necessary velocity increment of about 6,000 fps. This corrects for 30 deg. inclination and puts the spacecraft in a nominal synchronous, circular and equatorial—thus, stationary—orbit.

Spin Axis

The satellite will be precessed through about 65 deg. in yaw until its spin axis is parallel to the earth's spin axis. In this way, its transmitting antenna will be beamed toward the earth. The velocity control jet system eliminates orbital eccentricity; the orientation jet eliminates inclination, according to Hughes.

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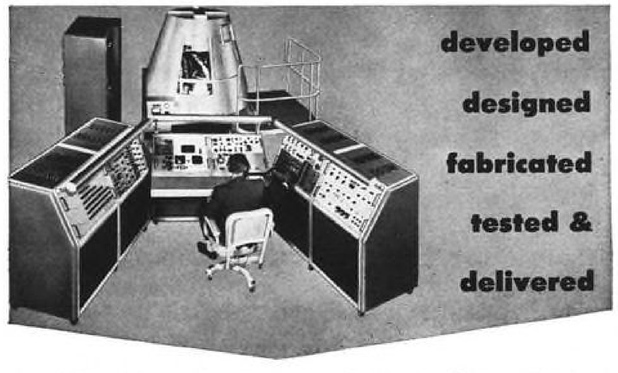

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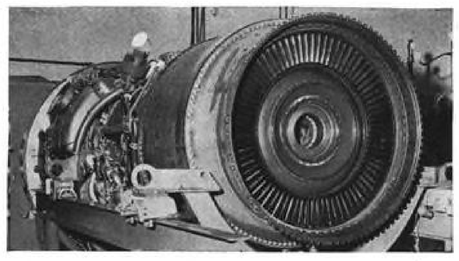

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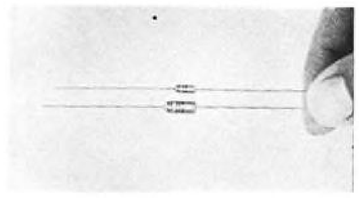
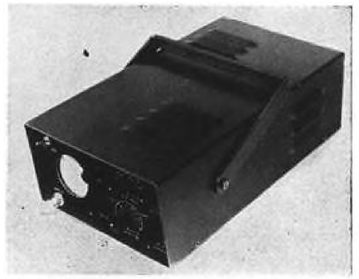


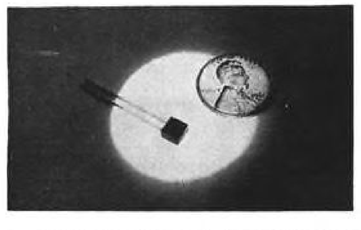
case measuring 0.25 in. long. The larger 0.138 in. dia. x 0.39 in. long units are available with values of 15 mfd. at 6 v. to 0.82 mfd. at 75 v. Engineering bulletin No. 3530 gives added data. Manufacturer: Sprague Electric Co., Marshall St., North Adams, Mass.

• **Battery-powered oscilloscope,** Model 250, fully transistorized scope has flat frequency response from d.c. to 1 mc. and can be used to 1.5 mc., with sensitivity of 50 mv. to 50 v. per cm. Sweep is 30 to 100 kc. in eight steps. Device weighs 6½ lb., measures 6 x 3½ x 12 in. Manufacturer: Electro Instruments, Inc., 8611 Balboa Ave., San Diego 12, Calif.



• **Thin-film microcircuit flip-flop,** Model 1010FF, operates at frequencies up to 2 mc. with supply voltage of 5 v. Device, which measures 0.8 x 0.8 in., uses deposited resistors, capacitors and connections plus micro-diodes and transistors. Device requires 7 mw. power and operates over temperature range of −55C to 85C. Manufacturer: Halex, Inc., 139 Maryland St., El Segundo, Calif.

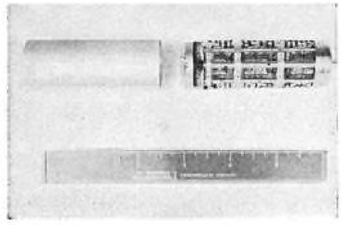
• **Subminiature toroidal inductors,** Series 93, covering inductance range from 10-1,000 microhenries are available with dimensions of 0.27 x 0.27 x 0.15 in.



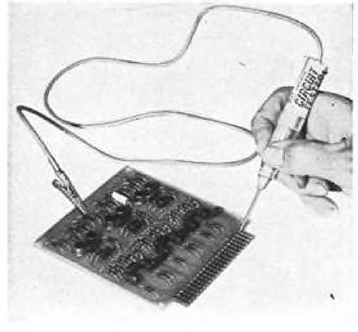
Inductors are vacuum encapsulated, designed to meet MIL-C-15305, grade 1, class B. Bulletin T-9-3 gives added data. Manufacturer: Vanguard Electronics Co., 930 West Hyde Park Blvd., Inglewood, Calif.

• **High-power laser system,** Model 3220, with outputs up to 500 joules, includes 12-in. long 0.645-in. dia. ruby rod pumped by eight 5,000 joule xenon flash lamps in separate elliptical cavities. Alternate cavities are available for 18 and 36-in. long ruby rods. Liquid nitrogen is used to cool both ends of ruby rod by conduction. Complete system is priced at $49,500. Manufacturer: Radiation at Stanford, Palo Alto, Calif.

• **Miniature digital encoder,** Size 2, can provide up to 50,000 pure binary code sampling rates per minute for outputs of up to 0-99,999 or 0-359.9 degrees. Each encoder contains OR gating and is designed for serial interrogation. Noise is less than 10% of the leading edge of least significant bit and torque required is 0.3 in.-oz. maximum. Device weighs 5 oz. Manufacturer: Kearfott Div., General Precision Aerospace Group, Little Falls, N.J.



• **Pro-Glo Circuit Tester,** simple low-cost device for checking circuit continuity, contains penlight battery and indicating light in plastic shell of probe.



When circuit continuity exists between probe and alligator clip at end of 3-ft. lead, translucent probe case glows brightly. Manufacturer: AMF Instrument Div., P.O. Box 929, Alexandria, Va.

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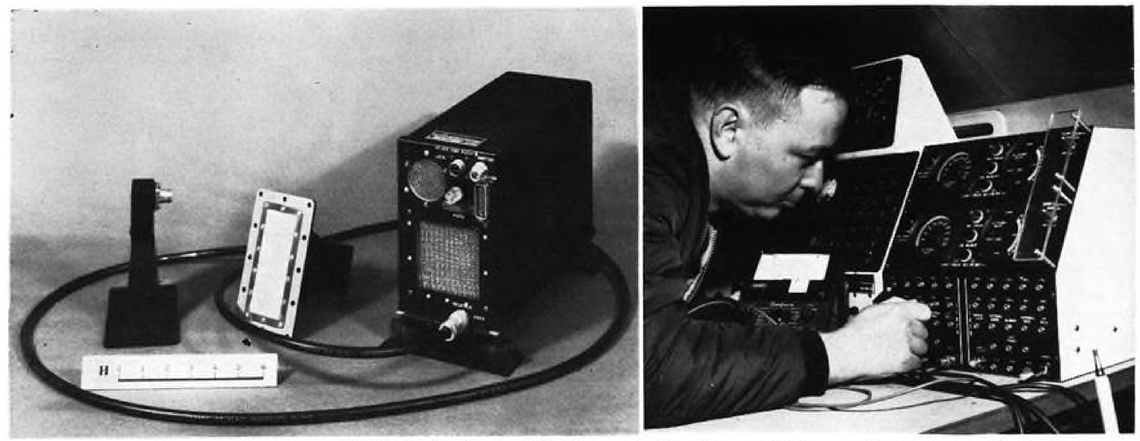

LOW-ALTITUDE PULSE-TYPE RADAR ALTIMETER developed by Honeywell has demonstrated very high accuracy as flare-out sensor in FAA automatic landing tests. Two Honeywell altimeters currently are installed in agency's DC-7 auto-land aircraft (right) for side-by-side tests. Altimeter measures altitude to within 1½ ft. under 100 ft.

Pulse Altimeter Shows Extreme Accuracy

By Philip J. Klass

Washington—Lightweight, pulse-type radar altimeter developed by Minneapolis-Honeywell is the first to demonstrate the extreme accuracy which the Federal Aviation Agency believes is needed for low-minimum approaches and automatic landing.

The 16-lb. radar altimeter exhibited errors of less than 1½ ft. in determining terrain clearance of aircraft at altitudes below 100 ft., making it well suited for automatic landing systems, terrain avoidance and helicopter hovering applications. General Dynamics recently selected the Honeywell device for use on the F-111 (TFX).

In extensive FAA flight tests, the Honeywell altimeter has demonstrated higher accuracy than any competitive device tested by the agency. In automatic flare-out tests on the FAA's DC-7 auto-land test vehicle, the new altimeter performed slightly better than a British device which weighs more than three times as much, an FAA engineer says. Prior to these tests the British altimeter, made by Standard Telephone & Cables, Ltd., had been the most accurate equipment FAA had tested.

The agency expects to demonstrate the new altimeter in its DC-7 to airline pilots and representatives in the immediate future.

For two months, Pan American World Airways has been using a Honeywell altimeter, provided by the FAA, on a Boeing 707 as part of the carrier's low-approach system investigations. Accuracy of the device appears to live up to Honeywell specifications as far as can be determined without precise optical instrumentation used in FAA tests, according to Pan American's Ben McLeod, who heads the airline's all-weather landing program.

Air Force's Aeronautical Systems Div. in Dayton recently installed a Honeywell altimeter on a North American T-39 jet trainer and plans to install units on two T-39s to be used in USAF's Pilot Factors Program. This is a low-approach flight-test program being carried out by the service's Instrument Pilot Training School in San Antonio. Based on limited tests to date, an ASD official says the new altimeter is doing a "commendable job."

The device is completely transistorized, except for three power-modulator tubes. It operates at altitudes up to 5,000 ft., with a low-altitude scale factor for operating at 0-500 ft. The set operates at an S-band frequency of 4,300 mc., has a peak power output of 100 w. and consumes 65 w. of 115-v., 400-cps. power.

Except for the panel indicator and two small flush antennas, the unit is contained in a ⅜-short ATR-size case having a volume of 340 cu. in.

The unit can supply altitude rate-of-change information as well as height above terrain.

The altimeter is an outgrowth of advanced techniques developed several years ago by Warren Leyde of Honeywell's Seattle Development Laboratory for use with proximity fuses.

These include techniques for generating extremely short pulses with durations measured in tens of nanoseconds (milli-microseconds) and the ability to measure echo travel time using the leading edge of the returning pulse, referred to as leading-edge tracking. Generally, the range resolution of a radar is a direct function of the shortness of its pulses and the accuracy of measuring transit time for return of the transmitted pulse.

Because the returning echo pulse may contain energy from a variety of reflecting surfaces, it tends to be broader than the transmitted pulse. Without the use of leading-edge tracking, the transit time normally is measured to the centroid (center of gravity) of the broadened echo, introducing errors under low-altitude/short transit-time conditions.

Most previous low-altitude radar altimeters have been of a different basic type, continuous-wave/frequency modulation (CW/FM), with consequent operational limitations. In a typical CW/FM altimeter, the continuously radiated carrier is frequency-modulated by a sawtooth generator. The modulation frequency of the returning echo is compared with the transmitted value to measure transit time, which is proportional to aircraft altitude.

This approach means, however, that it is difficult to distinguish between the Doppler shift of frequency caused by aircraft velocity and that due to transit time. Another limitation is that CW/FM altimeters usually measure the frequency shift by counting the number of beat-note cycles between transmitted and received signal which limits the altitude resolution obtainable, according to Leyde.

For example, if an FM modulation of 50 mc. is used, the obtainable resolution is limited to 10 ft. This is a problem currently hampering a CW/FM altimeter which Sanders Associates is developing for the FAA, according to an agency spokesman. Honeywell's technique can obtain resolutions of only 2 in. over a smooth surface, Leyde says.

The use of pulse techniques in com-

Along the desert coast of Arabia, above the Arctic Circle, in the Himalayas, from carrier decks at sea—General Electric's high-endurance T58 turboshaft engine is performing on helicopters in the varied climates of 14 countries. Its stamina is indicated by exceptionally high ratings for Time Between Overhaul: current TBO's range from 400 to 800 hours in military use and from 1000 to 1200 hours in civil operation.

The T58 was developed to meet the U.S. Navy's demanding requirements for helicopters capable of hovering for long periods close to the surface of the sea. Delivering the highest power-to-weight ratio of any gas turbine helicopter engine in the 1000 to 1500 horsepower class, the T58's combination of durability, small size, and light weight are the result of advanced design, innovations in manufacturing techniques, and exhaustive testing.

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MARATHON RUNNER

bination with leading-edge tracking offers several other advantages, according to Leyde. It avoids the tendency of a CW/FM system to lock onto a large reflecting surface off to one side at longer range, and it reduces variations in altitude measurement while flying over cluttered terrain.

Simple flush antennas generating broad antenna beams also can be used, reducing the effects of pitch or roll axis motions of the aircraft. The techniques used, in combination with the S-band operating frequency, enable the altimeter to operate in the presence of heavy precipitation, at least 40 mm./hour, according to calculations made by Honeywell.

It also permits accurate operation over thick ice and snow, Honeywell says. Army recently completed tests on the altimeter in a Sikorsky UH-19 helicopter over fine-powdered snow and polar ice at Thule, Greenland. An Army spokesman says the test data still is being analyzed, but Honeywell says the equipment performed well.

Pan American's McLeod expresses some reservations over the potential reliability of the Honeywell altimeter, because of the extremely sophisticated pulse techniques employed, and over the ability of airline technicians to maintain the equipment. Pan American has experienced occasional outages with the equipment, but no more than usual for prototype gear used in flight tests, McLeod says.

Flight Tests

The airline has used the Honeywell altimeter in flight testing split-axis automatic approaches. In these tests, the 707's lateral axis is coupled to the autopilot, while the pilot controls pitch manually using the altimeter sensor for flare-out.

Pilots generally like the device, except for the non-linear scale used to indicate altitude in the 0-500 ft. range, where the scale is expanded at lower altitudes, according to McLeod.

The pilot is much too busy to read the radar altitude indicator precisely at low altitude, and he merely glances at the pointer.

Because of the expanded scale at lower altitudes, the pointer moves faster, giving the pilot the false impression that his rate of descent is increasing, McLeod says.

Pan American pilots say they would like one or several colored lights, each of which can be preset to go on when aircraft reaches critical altitude levels, avoiding the need for the pilot even to glance at the indicator.

FAA has made about 150 test runs on the Honeywell altimeter installed in a company B-25 during a three-month period. About 50 of them were touchdown and climb-out landings, with the approach made over a variety of terrain, including sand, water and trees. Contraves optical trackers were used to measure accurately the aircraft's clearance above the runway for comparison with simultaneous on-board recordings of altimeter readings.

Except for the failure of a few faulty semiconductor diodes, the equipment performed reliably, according to an FAA engineer. The success of these tests prompted FAA to install two of the Honeywell altimeters on its DC-7 auto-land test aircraft to compare the degree of agreement between the two devices.

After a brief checkout on the ground, the Honeywell altimeter was used during the first subsequent flight to make a hands-off automatic landing, which an agency spokesman says was "very soft and comfortable." FAA now is analyzing data from simultaneous readings of the two Honeywell units to determine whether there is sufficiently close correlation between the two at every instant to permit one to be used as a monitor for the other.

Data indicates that when the aircraft is flying over water or a runway, there is close agreement between the two readings. In operating over rough terrain there are discrepancies, but this is believed to result from the relatively short signal averaging time (0.1 sec.) which FAA specified for the equipment. The two altimeters operate without mutual radio-frequency interference, an FAA engineer says.

FAA currently is analyzing the data in the hope of determining an optimum value for averaging time which will not unduly reduce the altimeter's sensitivity to sudden changes in aircraft altitude. The altimeter "memory" provides signal averaging and assures a continuous signal source for the pilot's indicator and approach-flareout coupler in the event of sudden discontinuity in the terrain or short-term loss of signal track for other reasons.

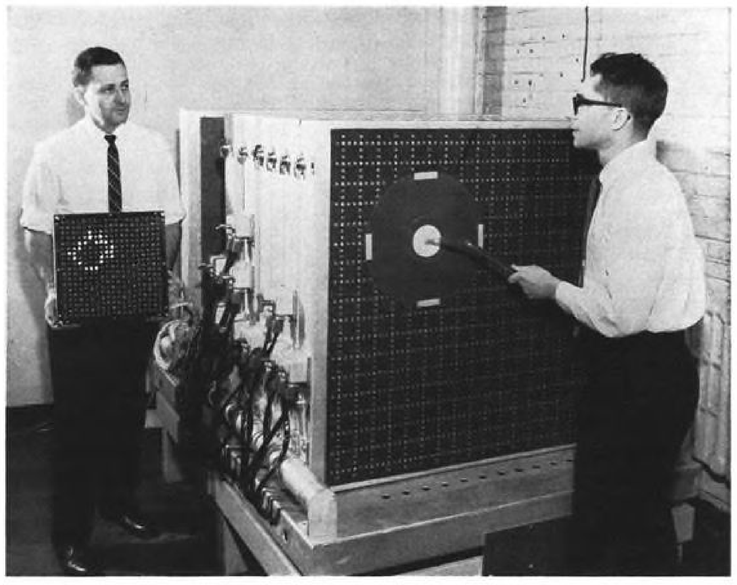
Transmitter Portion

Transmitter portion of the altimeter operates at a free-running pulse repetition rate of 10 kc., with pulse widths of 30 nanoseconds for 0-500 ft. operation and 100-nanosecond pulse widths at higher altitudes. The flush antenna used for transmission generates a beam width of approximately 35 x 35 deg.

Receiver is a superheterodyne type with a 30-mc. intermediate-frequency amplifier.

Sensitivity range control prevents saturation at very low altitudes where returning signal strength is high, and enables the receiver to ignore echoes.

Precision time modulator, gating circuits and a double operational integrator are used to measure pulse transit time. A rate-of-change of altitude signal also is derived by using double integration.



Electronic Eye Developed

RCA electronic device, a forerunner of a new generation of data processing systems, duplicates the functions of a frog's retina. RCA engineers demonstrate the device, which was built for Air Force's Aeronautical Systems Div. The output panel (left background) shows how the frog's eye sees a circular form projected on its retina. The electronic eye extracts five other features from images and movements just as a real frog's eye does.

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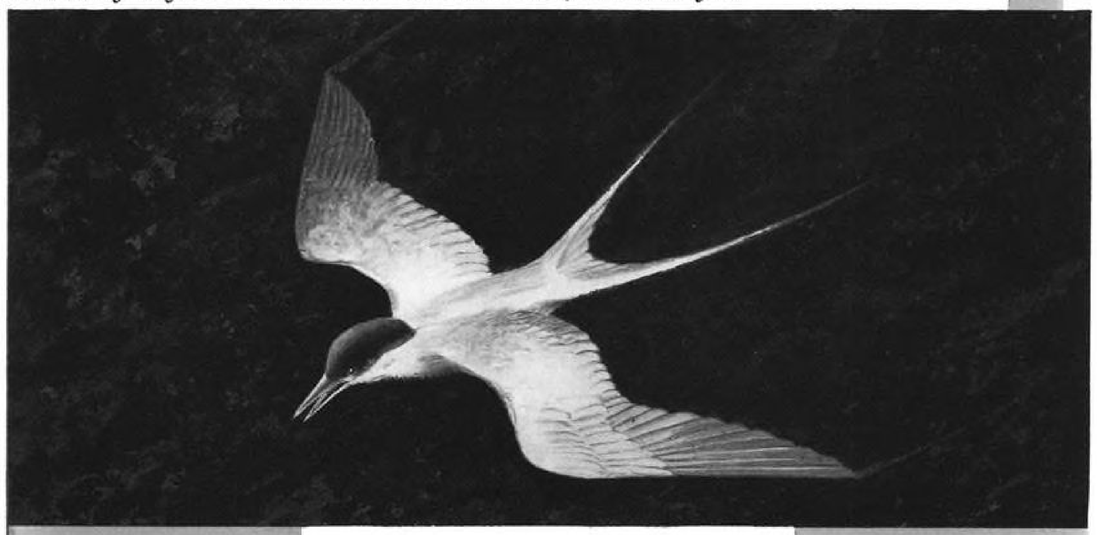

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Melbourne, Fla.—Printer capable of producing 62,550 characters per second or 600,000 six-character words per minute has been developed by Radiation, Inc., as a high-speed output adjunct to high data-rate digital computers.

The printer, which can form letters a through z, numerals 0 through 9 and 26 different symbols, operates on electrically sensitive paper through 600 tungsten-rhenium styli.

Data comes off magnetic computer tapes in six-bit (plus one parity bit) binary form and is passed through a programmer, where it is translated into one of 62 commands (26 letters, 10 numerals, 26 symbols and two operating commands).

Programmer applies a potential of 250 v. across the styli and the resultant arc causes the paper to discolor and form a black dot at the point of arc impingement.

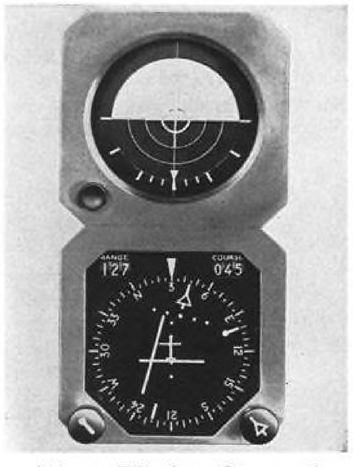
Styli are grouped in 120 blocs of five pens each and each bloc is controlled by 35 magnetic cores, arranged in a five-by-seven configuration.

Of the 35 possible dots which can be created by the styli and magnetic cores, the programmer applies voltage to those cores which will trace out a character similar to the one just taken off the computer tape. For example, to form the letter "L", the programmer would apply a voltage to all seven cores immediately behind the first stylus, thus forming the vertical part of the "L", and then trigger only the last rank of cores behind all five styli to form the horizontal leg of the letter. Letter appears as a series of dots, and over-all, is 0.1-in. high and 0.06-in. wide. Spacing between characters is 0.022-in. and, between lines, 0.055-in.

Printer speed varies with the speed of the input tape and bit density on the tapes. Present upper limit is 62,550 characters per second with a tape speed of 112.5 in. per second and a density of 556 bits per inch. Lower limit is 15,000 characters per second with a tape speed of 75 in. per sec. and a density of 200 bits per in. Print-out paper is driven at the same speed as the tape and is programed to be spaced for top-and-bottom page margins every 67 lines. Paper also is perforated and punched for easy separation into individual pages which can be inserted into ring-type notebooks.

Lawrence Radiation Laboratory of the University of California has ordered the first printer from Radiation, Inc., and will use it in conjunction with an International Business Machines 7090 computer in the performance of Atomic Energy Commission-sponsored programs.

The company says it see other potential markets for the printer, such as in hard-copy quick readouts of space vehicle telemetry.



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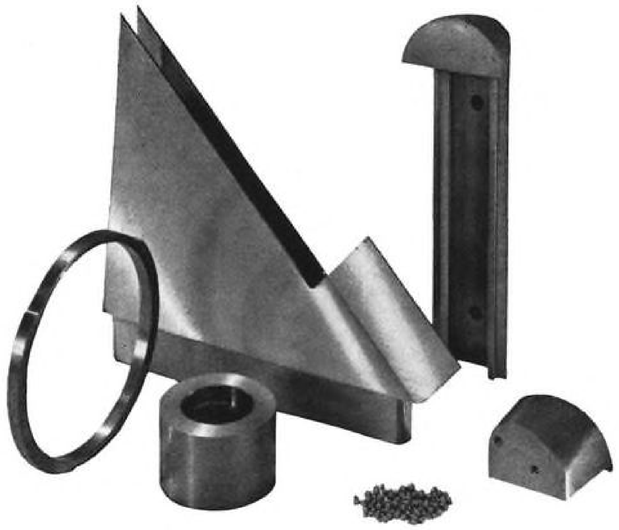

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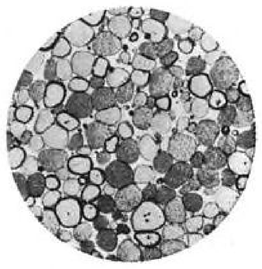

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Report Favors Prototype Development

Rand Corp. last February prepared a confidential report for the Air Force entitled "The Role of Prototypes in Development," by B. H. Klein, T. K. Gleman, Jr., and G. H. Shubert (AW Apr. 22, p. 31). The report concludes that development of prototypes before commitment to production "should be more widely applied to aircraft development programs, particularly where large technological advances are being sought."

Chairman John L. McClellan (D.-Ark.) and several other members of the Senate Permanent Investigations Subcommittee have expressed interest in conducting a flying competition of prototypes between General Dynamics and Boeing before awarding the F-111 (TFX) tactical fighter production contract (AW May 13, p. 27). The Rand report was made part of the subcommittee F-111 hearings recently.

Because of renewed interest in the prototype approach to major weapons systems, Aviation Week & Space Technology *is publishing the bulk of the Rand Corp. report.*

The development-production approach, which would have us specify now an optimal 1970 force and proceed to devote our development resources to securing only the capabilities specified as part of the optimal force, would appear on the face of it the better approach. Following this approach, its advocates argue, enables us to concentrate our resources on the most vital developments, and to get these developments into production with minimum lead times and at minimum cost. It is true, in fact, that were we now certain of the future military need for particular kinds of capabilities and of the technology required to achieve them, there would be no reason not to focus our attention on developing the kinds of aircraft required. In other words, if we somehow could dismiss the idea of strategic, technological, and cost uncertainties, the problem of deciding what particular kinds of capabilities to develop would be a fairly straightforward problem.

But an examination of the last 10 years or so ought to indicate that anyone who believes that these uncertainties can be so easily dismissed is engaged in wishful thinking. It is precisely during this decade that the uncertainties of the strategic situation have become painfully clear: Some big mistakes can be made in judging enemy capabilities 5 to 10 years hence. The Soviet military posture in general has turned out to be of a very different kind than was foreseen 5 or 10 years ago; nor are we certain of the direction in which the Soviets will turn their efforts in the future. While it is entirely conceivable that they will direct a major effort to acquiring a military capability in space, for example, it is also conceivable that they will put their major effort into challenging us in more conventional ways in a number of particular countries. Or they may choose to concentrate on some combination of these actions.

One illustration of the consequences of trying to make long-range forecasts of enemy capabilities and design an optimal response to it is the SAGE system. Not only has the threat for which the system was designed failed to materialize in the magnitudes visualized, but the system performs the tasks necessary to defend against the lesser threat less effectively and at a greater cost than potential alternative systems. In view of our experience, it would seem unlikely that we can now predict the 1970 strategic situation, or the capabilities required to confront it, with a high degree of confidence.

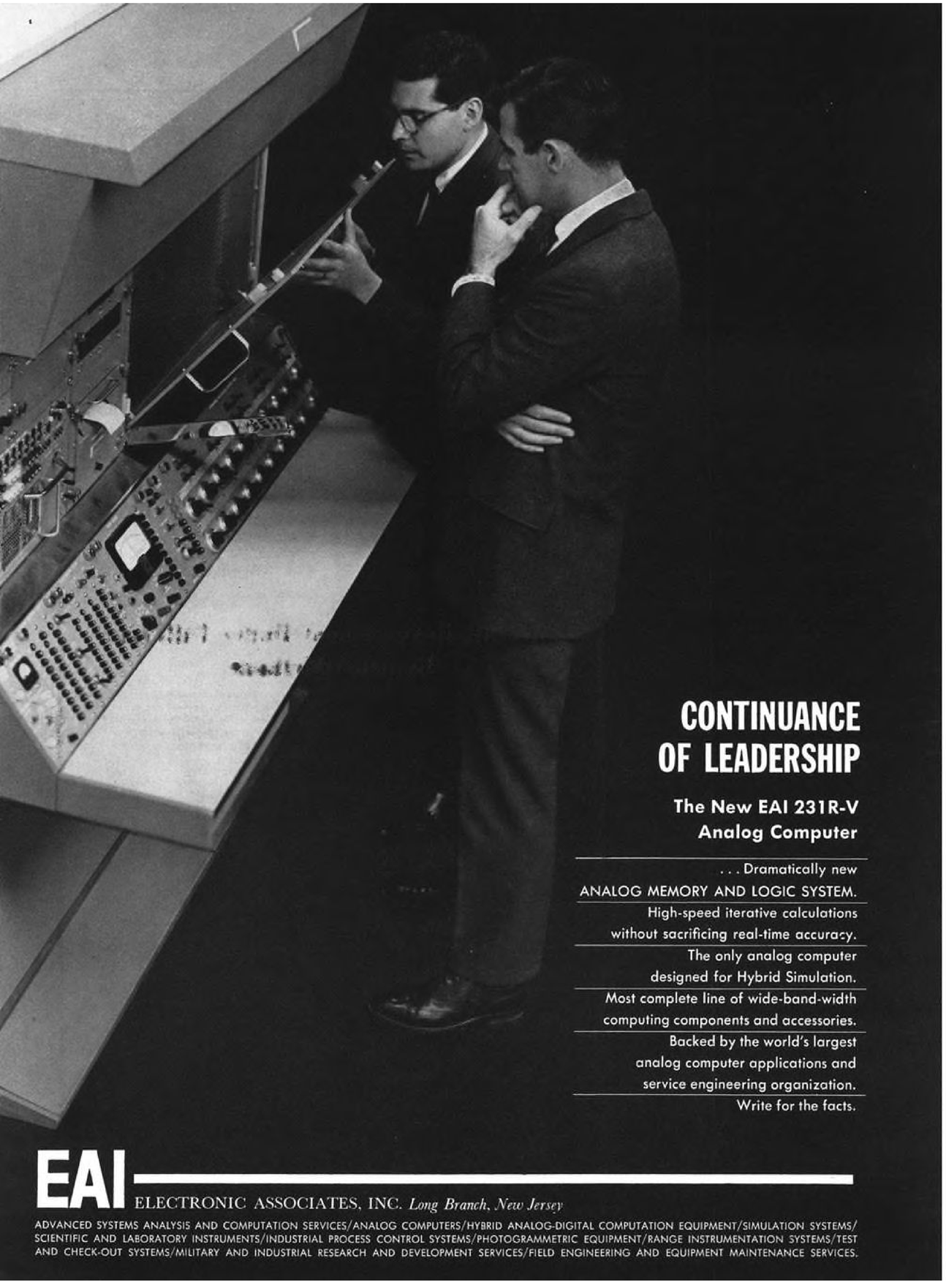
Unfortunately, the experience of the past 10 years also has made it clear that prediction of the course of technology is a task of equal difficulty and uncertainty. Some years ago, for example, it was generally believed that turboprop engines would be relatively simple to develop, and that they would have a very decided advantage in fuel consumption over the turbojet. But the development of the turboprop proved to be enormously more difficult than it was supposed, and, on the other hand, improvements in turbojet engine performance were more rapid than was anticipated. Development of large ramjet engines, too, was regarded as well within the state of the art, although difficulty with the Navaho program later showed otherwise. On the more favorable side, as of the time the decision to proceed with the development of the

Aircraft Development Under Different Contract Methods

This Rand Corp. chart compares the cost and delivery time for aircraft developed under two different contracting methods: (1) when only development of prototypes was assured at the start; (2) when both development and production were virtually committed from the start. Rand said the figures below indicate there is no clear advantage in either time or money to making large commitments at the start of a program.

Contracting Methods	Aircraft on initial contract	Initial commitment (a) (million $)	Years to first squadron delivery (b)
Fighter, prototype only			
F-80	3	2.6	2.0
F-84	3	4.8	2.3
F-86	3	4.7	3.5
F-104A	2	13.0	4.8
Fighter, Development-production			
F-100A	203	185.0	4+ (c)
F-101A	31	117.0	5.3
F-102A	42	210.0	4.8
F-105A/B	15	195.0	6.0
F-106A	17	78.0	5.0
F-107A	9	85.0	...
Bomber, prototype only			
Flying wing	19	83.9	...
XB-45	3	13.1	5.0
XB-47	2	12.0	6.0
XB-48	2	11.0	...
XB-51	2	13.3	...
XB-52	2	70.0	6.0 (d)
Bomber, development-production			
B-58	13	350.0	8+

(a) Covers basic airplane, procurement of engines and testing but not the cost of developing the engines or major subsystems.
(b) Does not include development work done after the first squadron was delivered.
(c) Includes preliminary development work for which contractor was reimbursed.
(d) Excludes time spent on turboprop designs not used.



hydrogen bomb was made, no one foresaw the progress that has been made in reducing the weight of the bomb, and the consequences this would have for weapon systems choices. In fact, if a cost effectiveness study had been made, as of the time of the original decision, on the basis of the forecasts made by Los Alamos—it was estimated that the device would weigh from (blank) and that it would have a yield of about (blank) and on the basis of the forecasted improvements in yields of A-bombs, it is likely that the H-bomb would still be in the program-definition stage of development.

'Risky' Approach

These examples have been selected to illustrate the problem of the untractable nature of technology generally, as it applies to all technical development programs. What makes the development-production approach even more risky is that even if we are right on the general kinds of capabilities that will be required in the future, and even if we were able to account for the more dramatic uncertainties of technology, the detailed decisions made now on the particular types of airplanes and the particular technical approaches that would best provide the required capabilities and best utilize existing technology might be wrong. Despite all the attention that is normally given in initial design studies to choosing the optimal technical approach, ideas on the best set of technological ingredients more often than not have to be substantially revised in the course of developing even a single airplane. For example, of the last six fighter planes developed by the Air Force, four ended up with different engines, three with different electronic systems, and five with airframes substantially modified from the initial designs.

In short, in most of the cases the systems that came out of development were distinctly different from those initially planned. . . .

Program Costs

[The report then referred to a secret chart which traced 22 weapon system programs to compare their costs and technological difficulties. The chart indicated, the report said, that the larger the technological advance the larger the cost overruns and technical problems. Further, the chart showed that as the development progresses, the estimates become more accurate.]

It is on the basis of evidence such as this that we state that, if major development and procurement decisions must be made very early and on the basis of design studies, the only accurate cost comparisons that can be made are those between alternatives that involve only very modest advances, such as those typical of commercial airliner developments.

All of these uncertainties, then—strategic, technical, and cost—seem compelling reasons for trying to find some approach to acquiring new capabilities than the development-production approach, which is currently so dominant. The expedited prototype approach calls for putting airplanes and subsystems (where subsystems development is indicated) very quickly into test so that when big money decisions are made there can be a good basis for making them. This approach seems to us to offer some decided advantages. We will deal with its alleged disadvantages—which we think have been considerably exaggerated—in a later section.

The first major advantage of the prototype approach is that for a given sum of money it is possible to have more programs under way at any given time, and hence we can cover a wider range of strategic contingencies. The initial commitment to a development-production program is usually several times as large as that to a prototype program, and thus reduces correspondingly the number of different systems which can be investigated and the scope of the contingencies which can be faced. We have then, in a variety of prototype developments, a hedge against strategic uncertainty.

Second Advantage

The second major advantage of prototype programs is that they can provide a hedge against technological uncertainty. Thus having under development several alternative aircraft to perform a given mission or a group of missions means that there is a higher probability of achieving the desired capability. What little experience we have indicates that prototypes are likely to represent between 5 and 8% of the total cost of a 500-airframe program; in the case of the B-47, for example, it was about 2% of the 500-airframe cost, and a much smaller percentage of the total program cost. It seems likely that in most cases where relatively ambitious advances are being sought, this additional 5% is an insurance premium which will be well worth paying. (It might well be asked whether the prototype programs which we have conducted have been as efficiently conceived as is possible in view of their role in demonstrating technological feasibility. Perhaps such insurance can be obtained more cheaply in the future.)

Third, even in a case where a group of prototypes is not funded but only a single program is instituted to obtain a capability, the prototype approach promises an efficient and relatively economical method of determining what is being bought. This is not to say, of course, that once two or three prototypes are flying, production can be expected to proceed without unexpected problems. This is certainly not the case. On the other hand, having some prototypes flying does provide a good deal more information than that available on the basis of design studies and wind tunnel tests. . . .

Supposing that we start with the kind of information on performance, cost, and development time that is usually available on the basis of design studies—namely, bad information. The question is how to go about getting better information. If the only option open were that illustrated by Case 1—one in which the entire amount involved in the development of a system would have to be spent before any knowledge better than that gained on the basis of a design study would be achieved—then there would only be one thing to do: to make the gamble (or to worry longer before it is made). But it is seldom really necessary to make this kind of decision. Putting development hardware to test very quickly usually makes it possible to get decided improvements in information, and at a cost that is far less than the cost of developing an entire system.

While it is true that, generally speaking, the possibilities for buying information are something as shown in Case 2, the actual shapes of the curves will de-

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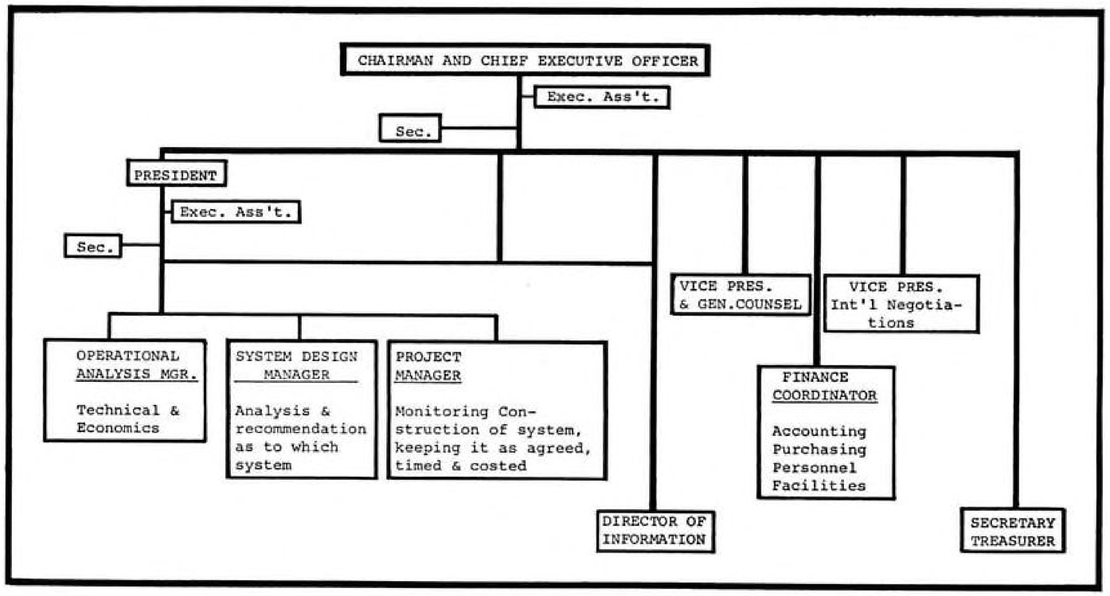


Comsat Corp. Management Organization Shown

Chart of top management organization of Communications Satellite Corp. was submitted by Leo Welch, chairman and chief executive officer, to the House Space Committee. Fourth key post was filled recently when Matthew Gordon, in charge of U. N. press services for 15 years, was named director of information. Other officers named are: Joseph Charyk, president; and Allen Throop, vice-president and general counsel (AW May 20, p. 38). Most recent appointments are Sidney Metzger, manager for components development and systems research; S. H. Reiger, manager for systems analysis, and Edwin J. Istvan, technical assistant to Charyk.

pend a good deal on the kind of technology involved. For example, in the field of electronics where the cost of experimentation is relatively cheap, the curve will rise somewhat less rapidly than if one is talking about a new airplane; and if one is talking about a large solid-fuel rocket, the slope of the curve is initially likely to be smaller than in the case of an airplane. To illustrate further: development of a crude but working prototype of the Sidewinder cost about 15% of the total development cost; a similar prototype of the J-57 engine came to some 11% of the total development cost, while the APQ-56 prototype ran only about 7% of the system development cost.

DC-8 Program

The shapes of the curves will also depend on the size of the advance being sought. For example, when we are considering the size of advance undertaken, say, in the DC-8 program, the information we have to start with will be much better than in Case 2, and consequently there will be much less advantage in proceeding with an experimental or prototype model. Even in the case of the DC-8, however, there are some knowledgable people at Douglas who believe that things might have turned out better if Douglas had started off with a prototype—as Boeing did in the case of the 707.

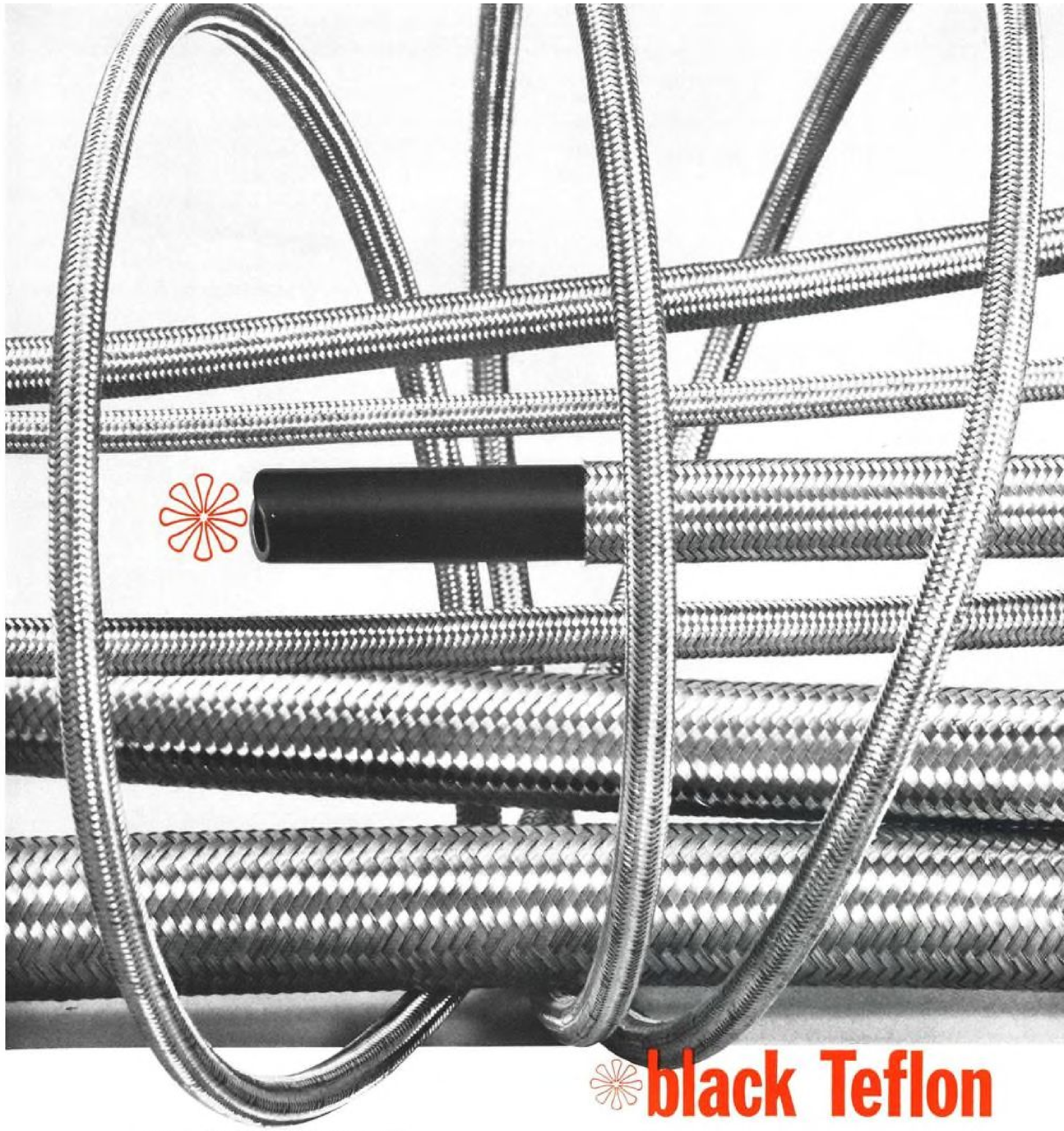
Can we know beforehand just what the shapes of these curves are likely to be and, therefore, just how to undertake the project? Probably not, and therefore we must rely a good deal on judgment and experience. It does seem clear, however, that not nearly enough attention is given to the best way to buy information; that in development planning relatively too much attention is given to deciding on the details of the end product, and too little attention to designing efficient development strategies that will provide the basis for making good decisions on end products.

An exception to the desirability of prototype developments may not occur in the case where an immediate demonstration force is needed whether or not it works. The ICBM program is perhaps a case in point, for the experimentation and operational deployment occurred to some degree simultaneously. However, the circumstances forcing this particular development and the costs attendant upon it make it unlikely that many cases of this type will arise in the future.

These comments can be made more meaningful by illustrating them with examples taken from the history of aircraft development. A current and quite relevant example of strategic uncertainty is the shift in the emphasis on warfighting capabilities: from central to local war capabilities. This shift has left us in a rather unfortunate state of unpreparedness with respect to new and useful aircraft for use in such conflicts. Another illustration of the adjustment to changing strategic requirements is the shift in emphasis from retaliatory to counterforce attacks with the attendant requirements for high resolution radars, specialized weapons, and better intelligence-gathering and processing techniques.

B-47 Development

Illustrative of the advantages of having alternative approaches available for obtaining a particular capability is the selection of medium bombers in the late 1940s. Suppose the Air Force had decided on the bomber on the basis of a design competition, what kind of a capability would SAC have ended up with? There can be little doubt that after the Flying Wing program floundered, SAC would have ended up with the B-45; as a matter of fact, it was actually ordered into production. But fortunately several planes were then in development, and it was only for this reason that SAC was able to obtain the much better B-47. The B-47 may not have been developed in an optimal manner. But for its time, the B-47 was a far better bomber than the Russians (or the British for that matter) had, and it represents the kind of accomplishment we would be glad to see duplicated today. What was the cost of getting this kind of capability, including not only the cost of the B-47 prototype program, but also that of its less successful competitors? The cost of all of them was less than $100 million, a tiny fraction



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CH-47A Chinook Airlifts T-33

Boeing Vertol-Army CH-47A Chinook helicopter is shown airlifting an obsolete T-33 jet trainer from Maxwell AFB, Ala., to Tuscaloosa, Ala., where it was put on permanent display. The Chinook, one of 11 CH-47As assigned to Fort Rucker, Ala., ferried the jet the 85 mi. between the cities as part of the U. S. Army Aviation Test Board's user test program.

of the $4.5 billion that was spent on the procurement of the B-47 force.

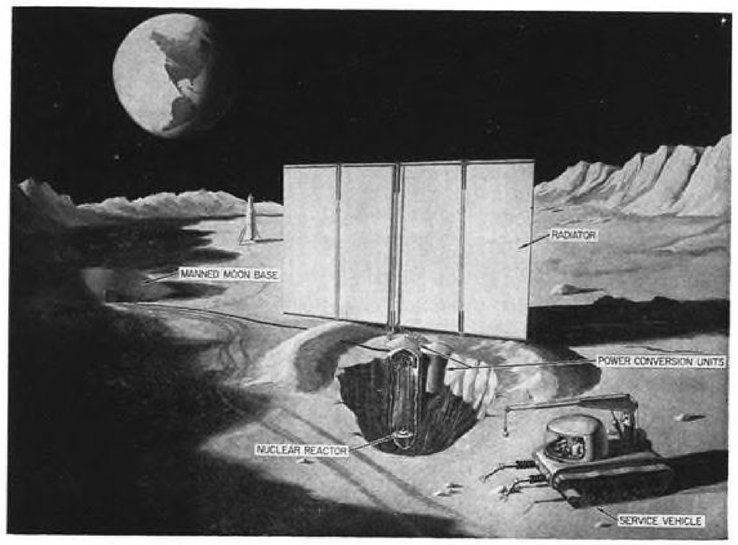
The quest for an air defense fighter in the middle 1950s provides another example of the value of having alternatives available. The F-102/106 was the first choice for this mission, but it was fortunate that we had the F-101 under development when the F-102 program encountered serious difficulty. Although the F-101 was begun as a strategic escort, and although little attention was given to making it into an air defense fighter until about three years after the F-102 program was started, the F-101 did provide a reliable air defense capability earlier than the F-102. Indeed the F-101 still provides an important proportion of ADC's capability today. And of course the Navy has sometimes provided good alternatives—the F4H, for example—but it might not be wise to count on the Navy to provide an adequate menu of alternatives for the Air Force.

Finally, the history of fighter development projects in the early 1950s illustrates the desirability of using prototypes in development. We earlier noted the large number of switches which occurred in engines and fire control systems and the necessary changes in airframe designs. In view of the extent of these changes, it is likely that prototype developments would have reduced the costs of adjusting to these changes substantially.

More generally speaking, the range of development projects that we had under way during the 1950s provided the flexibility for doing many things which otherwise would have been much more difficult, if not impossible, to do. The U-2 is an outstanding example. Or when it came to developing an ICBM, it was fortunate indeed that the Navaho had a rocket booster associated with it. Of course, in the Navaho project a very significant part of the funds went for purposes other than new technology. The essential reason for starting such projects on a modest basis is that, with a limited R&D budget, this is the only way a reasonable amount of flexibility can be obtained.

There are some other important kinds of advantages in using a prototype approach. When the initial investment in a program is relatively modest, it is likely to be somewhat easier to get the program started, or changed to take advantage of new technology, or, if need be, to get it stopped. We are not alone in an awareness that it has been several years since a completely new aircraft was put into development; in the fighter field, for example, an interval of nearly five years occurred between the go-ahead on the F-108 and the TFX. One of the factors responsible for the lack of aircraft development programs has been simply that, faced with an apparent choice between multi-billion dollar development commitments and no development commitments at all, choice of the second alternative has usually proved easier to make. Were initial commitments more modest, we have little doubt that several additional aircraft would be under development today. Of course, the advantage in getting programs started in an expeditious manner could be made even greater if the Air Force would postpone the imposition of detailed requirements, and if higher echelons could be persuaded to postpone their program definition activities until there was something that could be meaningfully defined.

Finally, because the expedited prototype approach requires relatively small investments, the correspondingly larger number of programs that can be undertaken holds promise of reintroducing competitive spirit into the aircraft industry—beyond that involved in the writing of design brochures. This point does not require further elaboration



Moon Nuclear Power Station

Compact nuclear reactor for manned moon base electric power generation is shown in artist's drawing. NASA's Lewis Research Center has contracted North American Aviation's Atomics International Div. to study applications of SNAP reactor for use in such a system.

here, but it might prove to be an important factor in improving the industry's efficiency.

Given the statements we have made regarding the uncertainties that plague the development-production approach, and the advantages of the selective prototype approach, one might well inquire at this point regarding the advantages of the former over the latter. Why, after all, was integrated development undertaken, and is it not reasonable to assume that the arguments favoring it are precisely those arguments most telling against the prototype approach?

During the 1950s it was widely held that in order to minimize the time between the decision to proceed with a development program and the introduction of the resulting weapon system into the force, a large, integrated development program must be undertaken. It is necessary, the argument ran, to have tooling and long lead-time components ready so that once the procurement decision is made, system production can start immediately; further, it is necessary to have a large number of test articles which more closely resemble the production article than had been typical of the prototype development programs of the late 1940s. Finally, the "wasteful duplication" inherent in the prototype approach was attacked as a major cost factor, and it was maintained by many that the development-production approach results not only in shorter lead times but also in lower program costs, since this duplication is eliminated by comprehensive detailed planning . . . [see box, p. 135].

[Since "the actual effect of size and complexity of an aircraft on the cost and length of development is likely to confound any arguments on the merits of prototypes vs. development production programs," Rand said, it analyzed for the study the costs incurred by airframe companies for 12 different aircraft development programs, not including the cost of electronic systems supplied by the contractor. The cost analysis was based on the first 25 aircraft, including any prototypes. The study used empty weight as a measure of size and speed as a measure of complexity. "What is missing," Rand conceded in discussing the mathematic bases, "is a notion of the degree to which a plane represents an advance in the state of the art."]

On the basis of our analysis:

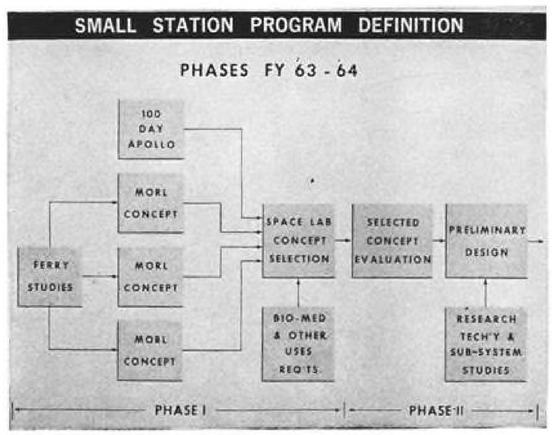
- **We have found no statistical** support for the hypothesis that development programs involving large initial commitments have cost less than prototype programs.
- **We have found no statistical** support for the hypothesis that development-production programs have resulted in substantially reduced development times. Further, in no case has the gain or loss in time been more than about eight months from what would be expected for a plane of a given weight and speed.

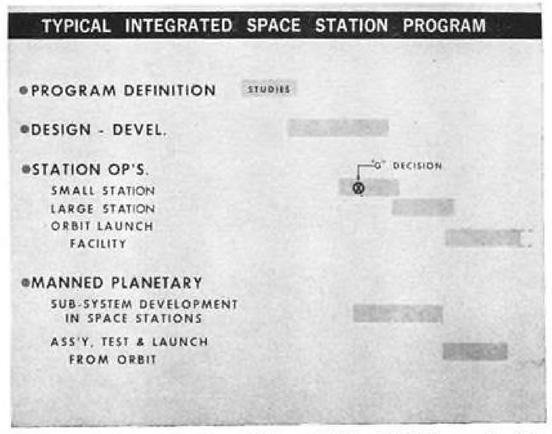
It should be noted that the distinction between development-production and prototype programs is not a hard and fast one. In fact, there is a spectrum of cases from the B-47 and F-104 on one extreme to the F-105 and the B-58 on the other. It may reasonably be held that the F-86 was a prototype for the F-86D, the F-86 series was a prototype for the F-100, and so on. However it does not appear that any reasonable regrouping of the data would alter our conclusions.

Why do we not find support for the supposed advantages of the development-production approach? It would appear that the advantages in reduced cost accruing to a program due to trying to build in the first instance the "final" airplane and from trying to turn out a number of test vehicles in rapid order are outweighed by the cost and time necessary to make changes in the development and production programs in the event of unexpected problems. More particularly, while the tenth test vehicle may be obtained earlier using the development-production approach, many deficiencies may be indicated on the basis of testing the first two vehicles and the time and cost of making it an effective test vehicle and of modifying the existing tooling and aircraft in process may be so great as to eliminate any initial advantages the program would have . . .

A striking example of these effects is found in the F-102 program. Early in the program the contractor was authorized to construct an initial quantity of 42 test aircraft and to tool up for a production of 125 a month. One hundred million dollars had been committed to the airframe portion of the program alone, before first flight test. By the time it was proved that the plane was subsonic and required application of the area-progression rule, the first 10 vehicles were so far along the production line they had to be built in the original configuration. The contractor then had to retool, but the next model was also unsatisfactory, because it was too heavy. Four of the overweight versions were produced before the contractor was able to tool up a third time for the first acceptable version of the F-102. At least $30 million worth of tooling were discarded in this process. And a far greater amount was spent on airframes that either had to be substantially reworked or handled as salvage. This is a rather extreme example but in a number of other cases, the F-101 and the F-105 for instance, a number of fairly major changes have had to be made on the basis of testing the first two or three vehicles.

We have attempted to examine and compare the advantages of two approaches to development: the development-production and the expedited prototype methods. We have been unable to find consistent support for the advantages claimed for the first method, whereas the second seems to offer substantial practical advantages.





SMALL MANNED SPACE STATION program (above, left), divided into Phase 1 (Fiscal 1963) and Phase 2 (Fiscal 1964) may lead to hardware in Fiscal 1965. Manned Orbiting Research Laboratory (MORL) concepts are being studied by Langley Research Center. Hundred-day Apollo study is the only section of Phase 1 that has not been funded. Time periods (above, right) represented by bars are relative to each other in sequence and are not drawn to a particular time scale. In the integrated space station program, only program definition has been approved thus far. Manned planetary items are shown separately, but would be accomplished during space station operations. "G" decision refers to decision on whether artificial gravity is necessary for stations.

Small Space Station Planned for 1967-68

By C. M. Plattner

Los Angeles—National Aeronautics and Space Administration's manned space station program now calls for orbiting a small 4- to 6-man station prior to deployment of a large 12- to 24-man station. Primary justification for small station is to determine whether or not an artificial gravity environment will be required in long-duration, manned missions.

The space agency's present thinking on space station deployment was outlined at a Manned Space Laboratory Conference here by Emanuel Schnitzer, chief of space station planning at NASA Headquarters, Office of Manned Space Flight.

The conference was sponsored jointly by the Aerospace Medical Assn. and the American Institute of Aeronautics and Astronautics.

Responsibility Split

Responsibility within NASA for space station studies generally is split into large and small station categories. Large manned space station studies are being supported by NASA's Manned Spacecraft Center and small space station concepts are being investigated by Langley Research Center in its Manned Orbiting Research Laboratory (MORL) program.

"With space station feasibility established during previous years, NASA began this year to define the space station mission by evaluating its potential uses," Schnitzer said.

"From a preliminary evaluation of these uses," he said, "we feel that the primary justification for the space station would be to answer the question of whether long-duration missions can be designed for zero gravity or if artificial gravity is required."

Space station feasibility studies initiated prior to 1963, which provided background for NASA's decision, include North American Aviation's study of a large erectable torus (AW Nov. 12, p. 56), operations analysis, qualification testing, and structural seals studies. Related research studies on structures, materials, dynamics and stabilization, temperature balance, and advanced life support systems components also were completed. Majority of these studies was initiated by Langley Research Center.

With these studies defining the feasibility of orbiting a manned space station, NASA determined from a preliminary evaluation of suggested uses for a space station, both from within the space agency and from industry, that answering the zero-gravity or artificial-gravity questions as early as possible, was of great importance.

NASA has appointed a number of panels to further evaluate and screen specific space station applications in the biomedical, engineering and scientific fields. These panels are expected to present recommendations on space station missions and uses later this year. The recommendations will help determine space station size, complexity and crew requirements for the small station.

The manned space station program has not yet received project approval, but NASA is moving out of study phase toward preliminary design in hopes that political and funding problems do not ensnarl the program.

Station Guidelines

General guidelines established for the small station include:

- **One-year mission** with periodic resupply and a 4- to 6-man crew.
- **Conducting program** on a non-interference basis with Project Apollo, in usage of such systems as launch facilities and boosters developed for that program.
- **Maximum usage** of existing hardware developed for other space programs.
- **Booster of Saturn 1 class,** which would be man-rated through its use in other programs.

NASA feels the small station is the most economical way to obtain the information on which to base a decision on artificial gravity requirements.

This information is needed as soon as possible to better define second generation space stations and planetary spacecraft.

After the gravity decision, both small and large space stations would be available in sequence for development and testing of planetary spacecraft subsys-

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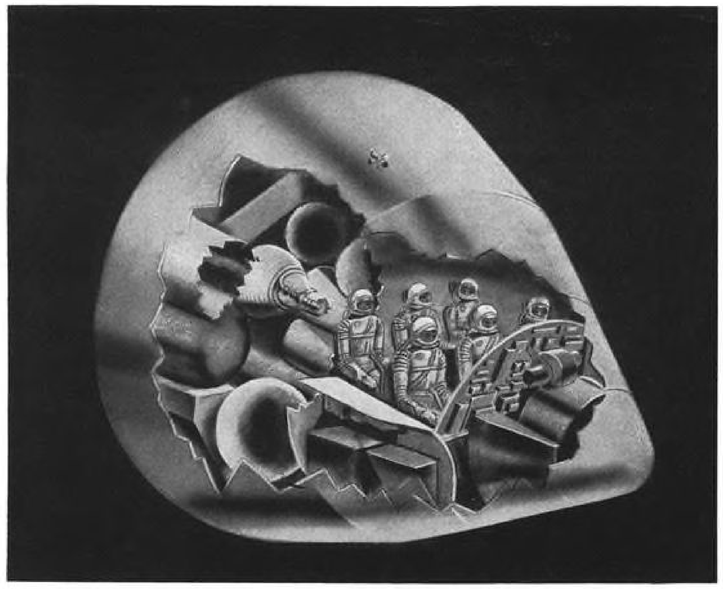


ADAPTATION OF AN APOLLO command module as a logistics spacecraft for a manned space station program, shown here in artist's concept would carry cargo in a separate conical cargo module aft of the spacecraft. Difference in equipment and storage requirements between Apollo and the space station ferry would allow greater seating capacity.

tems and for scientific, functional and engineering tests.

An orbital launch facility eventually evolving from space station and other space-project experience could be used for assembly, test and launch of manned planetary missions from earth orbit. Study of definition of such a facility has recently been awarded to Ling-Temco-Vought.

Small station program, as projected by NASA is divided into two phases. Phase one was approved and funded in Fiscal 1963 and includes:

- **Ferry and resupply studies** using modified Gemini and Apollo spacecraft—Apollo ferry study is applicable to both large and small stations.
- **Conceptual hardware studies** (MORL) initiated by Langley. NASA also is considering, but has not yet funded, another study of converting Apollo spacecraft into a 2- to 3-man orbiting laboratory with 100-day mission duration. Similar study was conducted early in Apollo program.
- **Biomedical and human factors studies.**

A preferred small space station concept will be selected after evaluation of the various MORL concepts and consideration of the biomedical studies and panel recommendations on space station missions and uses.

Selection of the preferred concept will end phase one.

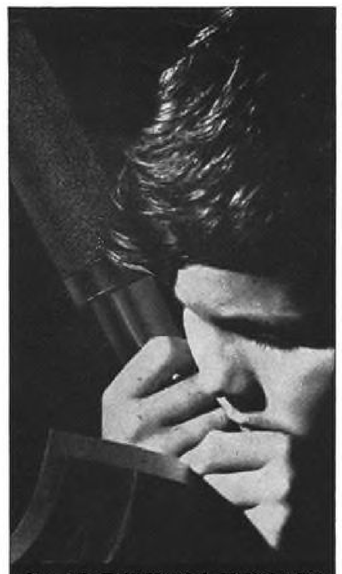
Phase two, which is proposed for Fiscal 1964 but not yet approved, involves evaluation of the selected concept followed by preliminary design to ensure engineering feasibility. Backup research, technology and subsystem studies now under way (largely in-house) will be integrated into the program at this time.

Although no predictions have been offered beyond phase two, if funding for a hardware program is provided in Fiscal 1965, a small station could be deployed in about three years (1967-68 period) after implementation of the hardware program, according to NASA officials.

Further amplification of possible basic features of the small manned orbiting station were presented at the conference by James B. Edson of NASA's Office of Advanced Research and Technology. Edson indicated that one essential feature, which probably would be incorporated into the small station would be an environment exposure test facility for engineering material specimens.

Development of a simple, reliable airlock mechanism for moving small specimens in and out of the laboratory with minimum loss of air is needed, Edson said.

Test machinery will be needed for mechanical and other testing of specimens outside the station without contamination of the specimens or interference with its exposure to the space environment. Another requirement, he said, will be a small solar furnace for melting specimens in vacua while the specimens are floating at zero gravity in the focus of and out of contact with



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In order to qualify for these and other positions, you should have at least five years' experience and, preferably, an advanced degree. Qualified applicants are invited to contact Aerospace Corporation, an equal-opportunity employer. Please write to Mr. R. E. Durant, Room 101, P.O. Box 249, San Bernardino, California.

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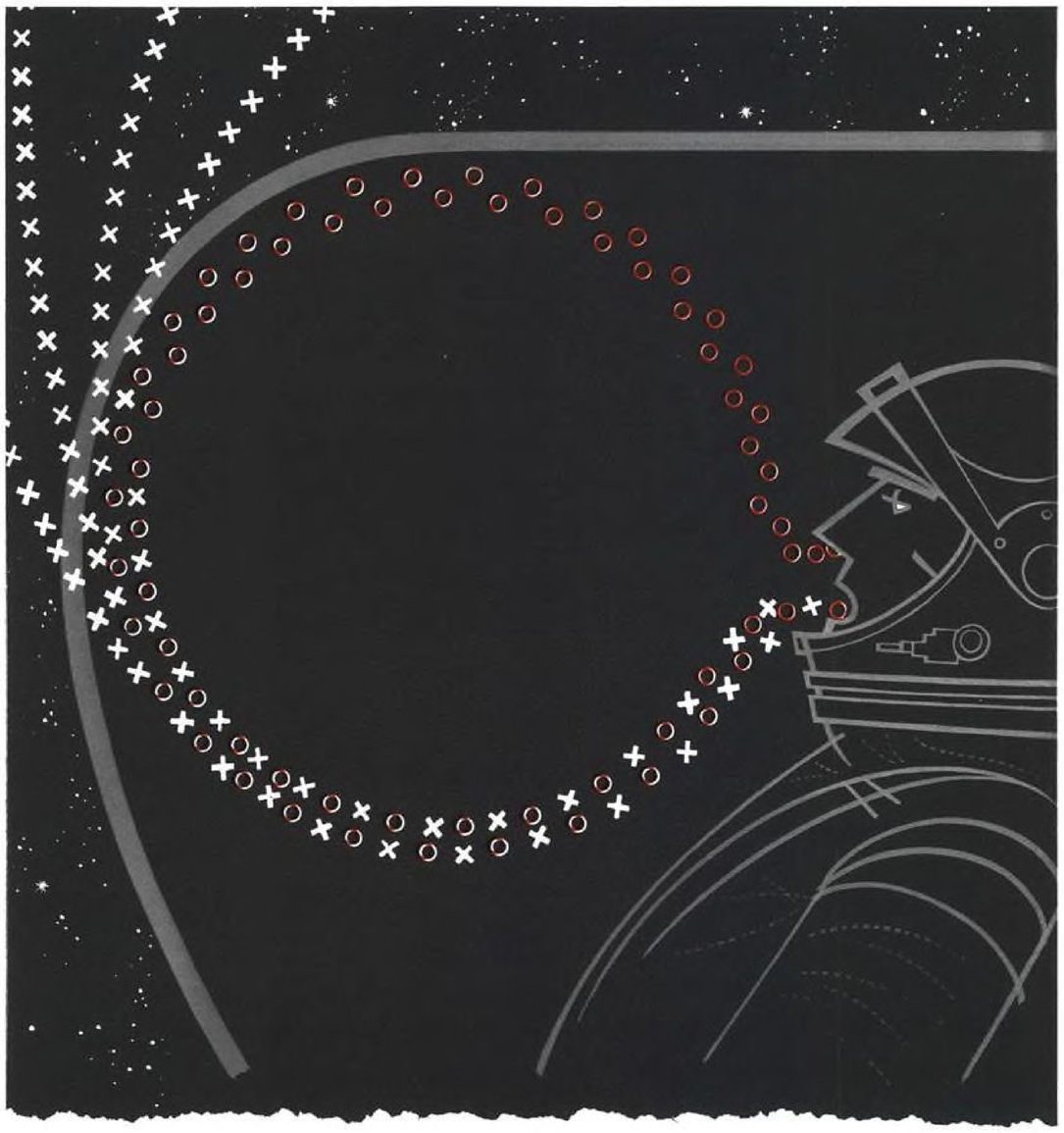

BREATHE EASY

Hamilton Standard's experience in contaminant removal is being focused increasingly on new space life-support systems. Present work includes a contract to design and produce integrated space-suit assemblies for NASA's Project Apollo and extensive development of life-support systems and components for manned space capsules.

Hamilton Standard's life-support program applies diversified experience in hydraulics, pneumatics, mechanics, electronics, and packaging. Hamilton Standard blends and develops these basic technologies to achieve an integrated systems approach to life-support equipment.

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U.S., Russian Space Studies Detailed

Results of U. S. and USSR studies on ability of astronauts and cosmonauts to survive in space environment were detailed recently by Lt. Col. Stanley C. White, USAF (MC), assigned to National Aeronautics and Space Administration's Manned Spacecraft Center.

Presented by White prior to the MA-9 flight, the findings were detailed in a report, co-authored by Lt. Col. Charles A. Berry, USAF (MC), at the 34th annual Aerospace Medical Assn. conference in Los Angeles.

White pointed out that many projected bioscience problems associated with manned space flight have not been borne out in flight experience. There is increasing evidence that any change to be observed will appear as a slow shifting from the normal values, he said.

White detailed the following results of the U. S. manned flight program and reports from USSR scientists on their manned flight experience:

• Preflight and postflight examinations by both U. S. and Russian doctors have revealed no significant previously unknown physical abnormality in astronauts or cosmonauts. Only evidence of a physical change after Mercury space flights has been a fluctuation of pulse and systolic blood pressure with changes in body position, supine to standing, for about 21 hours after recovery. This condition was caused by pooling of blood in lower extremities (AW Feb. 25, p. 80). It is considered a minimal finding, but needs further study. Detailed blood examinations by both U. S. and Russia have shown no significant changes from preflight values.

• In-flight monitoring of the physiological state of the crew has been characterized by the lack of significant abnormal changes. Abnormalities, such as variations in pulse rate from 56 to 170 beats per minute are considered normal physiological responses, considering the dynamic situation in which the pulse variations occurred.

• Demonstration of man's capability to control spacecraft has resulted in design changes from original Mercury design, calling for a completely automatic control system with man acting only as a back-up, to Gemini spacecraft where man will be able to control full shutdown in the launch vehicle. Designing man into the system has afforded great weight saving, less complexity and increased reliability.

• Current Mercury spacecraft leak rate of 600 cc. per min. or less has been maintained in spite of changing systems, replacing parts and cutting new penetrations through the walls.

• Environmental system used in the Russian manned program consists of a chemical-oxygen regeneration system, backed up by an emergency high-pressure oxygen supply. Flight duration is reported as 12 days. Ventilation of the cosmonaut is by pumping cabin air (nitrogen and oxygen maintained at normal sea level pressure and gaseous partial pressure) through the suit and exhausting it back into cabin.

• Definition of the Gemini and Apollo suit based on confidence gained with Mercury suit has resulted in numerous recent decisions. Gemini suit will incorporate a partial undress concept with zipper placement designed to permit removal of body wastes from inside of suit. Gemini personal life support system will be developed for extravehicular activity. System incorporates complete environmental control, communications and tether subsystems. Development of lunar extravehicular suit has started utilizing a balanced convolute (bellow type joint with restraining cables) system. Recently, it has been demonstrated that conventional suit materials now available can handle solar energy load at lunar surface. This will relieve temperature load requirements of lunar personal life support system.

• Increasing flight duration in U. S. manned space flight program has necessitated new waste handling techniques. Mercury suit now has a urine pumping system installed, allowing suit pressure integrity to be maintained. Defecation so far has been controlled by use of a low-residue diet but studies are under way to develop a plastic bag for collection, cessation of bacteria activity and suppression of odors of fecal wastes. Russian scientists report normal sensations and defecation habits using waste collection and storage method.

• Effects of weightlessness need careful study during longer-duration flights. Data from past flights has been limited because astronauts have been strapped down and have had adequate visual and kinesthetic (sense of touch) cues. Body functions have been normal in U. S. and USSR flights up to four days, with exception of Titov's nausea, which appears to be an individual idiosyncrasy. Russian reports indicate that free-floating for 50 to 60 min. each day on 3- and 4-day flights of Vostok 3 and 4 resulted in no difficulty from such exposure, nor did 3- and 4-day exposure cause any problem at time of re-entry.

• Orientation, once thought to pose difficulties of the magnitude predicted for weightlessness, has been discounted by astronauts as unimportant. During orientation tests when they were not aware of which direction they were flying or whether they were upside down or backward, they were always able to orient themselves visually by reference to the instruments and looking through the window. Tests indicated that continuous orientation was not important.

• Radiation problem has not been serious at current orbit altitudes and unless additional artificial radiation belts are established, no serious problems are expected during extra-vehicular activities on Gemini flights.

any container, which might contaminate them.

One additional feature mentioned as a possible asset for first generation space stations might be an "Igloon," a portable, inflatable shelter. Construction of tough, laminated plastic with inflatable ribs and spherical shape with an internal pressure of 10 psi, would allow crewmen to work on experiments with bare or lightly-gloved hands and faceplates up.

In first generation stations, power requirements will be modest, Edson said. Human muscle power will play a significant role and where advantageous, it can be used to generate modest amounts of electrical, thermal, potential and kinetic energy.

Scientific personnel probably will have training and experience in astronomy, experimental physics, electronics research and materials research. Possible combination of experience and training in small station crew might be one man versed in astronomy and electronics and a second versed in experimental physics and materials research.

Program definition for the large space station is defined by planetary mission requirements but will follow along the general study framework of the small station program. Study areas in the large station program initial phase include:

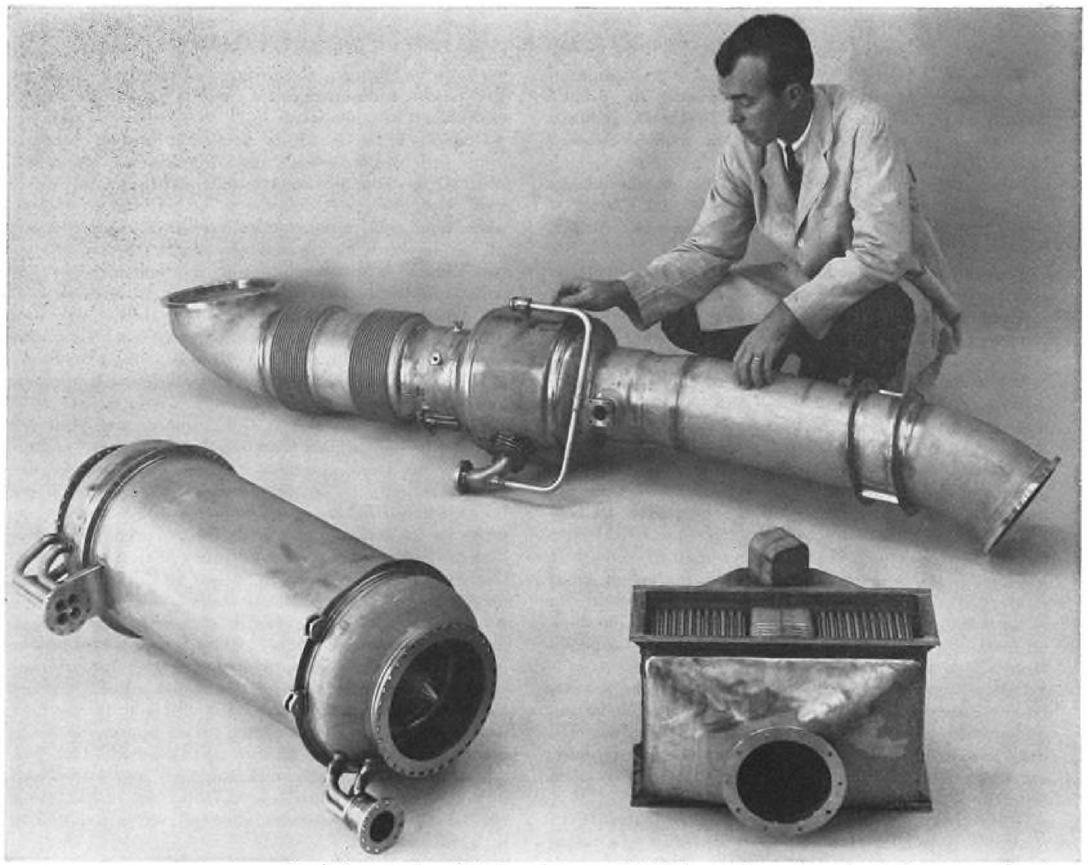
• **Station concepts** of a zero-gravity and rotating stations.

• **Operations and supply.** Studies include operations and logistics, 6-man modified Apollo ferry vehicle, 12-man ballistic ferry, and 12-man lifting body ferry.

• **Subsystems.** Studies include electric power systems and life-support and environmental control systems.

Guidelines established to define the large 12- to 24-man second generation space station (AW Apr. 1, p. 70; Apr. 15, p. 61) were outlined at the conference by Edward H. Olling, head of Space Station Project Office at NASA's Manned Spacecraft Center. Report was co-authored by C. W. Mathews, acting manager of Gemini Project at MSC.

With the primary objective of the large station set down as providing a means to establish, test and validate concepts involved in a long-duration



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If you would like more information about lightweight, efficient heat exchangers or Solar's metallurgical capabilities, write Solar, Department L-111, San Diego 12, California.

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manned mission in space. Olling listed the following guidelines used to generally define the station:

• **Space station lifetime** must be greater than one year to include minimum 1975 Mars mission time of 1 to 1½ yr. Mars mission time is defined by en route velocity requirements. Propulsive velocities commensurate with booster vehicle and desired mission duration are achieved for a 400- to 500-day mission with velocities increasing significantly for shorter-duration missions. Earth re-entry velocity of 64,000 fps. for 400 to 500 day mission—compared with 35,000 fps. for Apollo re-entry—increases to 68,000 fps. as mission time decreases to 200 days, indicating an additional undesirable feature of short missions.

• **Orbital altitude of 200** to 300 naut. mi., with same inclination as that used in Project Mercury, is selected in view of orbit lifetime, minimization of launch-performance requirements, utilization of existing launch and tracking facilities and radiation belts.

• **Launch vehicles will be provided** by existing programs. First two stages of Saturn 5 will boost space station (maximum payload of 200,000 lb.), while Saturn 1B or Titan 3 vehicle will boost logistic spacecraft needed for resupply.

• **Station will be continuously manned** and, in event of emergency, redundant module concept is desirable with provisions for rapid crew evacuation from module or from the entire space station.

• **Logistics spacecraft** should be recovered and reused and number of launches should be kept to a minimum, since the launch vehicle is the most expensive cost item. If booster recovery system is used, large costs associated with its development must be throughly justified on basis of need with respect to space-station program.

• **Dimensions of the partial-gravity** station are defined by gravity and rotational considerations. Based on a rotating-environment testing program in a 1g earth field, a comfort zone for space station crewmen has been established. Anticipated problems in crew locomotion have dictated setting comfort-zone boundaries, which restrict length of rotating radii to 50 to 100 ft. and rotational speeds to 3 to 6 rpm. Gravity levels of ⅓ to ⅔g are most desirable. Radii longer than 100 ft. present peripheral velocity problems and related Coriolis effects at low rpm. Coriolis effects increase to equivalent of ⅓g at 4 to 6 rpm. with radii longer than 100 ft. Radii of 75 ft. and rotation of 4 rpm. accordingly have been established to provide minimum comfort level.

• **General configuration** has been determined by requirement that station have basic inherent stability and provide a platform on which activities can be performed without disturbance. Basic fly-wheel type of station achieves this stability. Such a configuration also minimizes orientation of the space station's solar panels. Mass control systems, not yet fully defined, will assist in counterbalancing the movement of large masses from one area of the station to the other, especially during transfer of cargo and docking of spacecraft. Various fluids such as water, propellants or urine might be transferred rapidly to accomplish this.

In another report, William W. Haythorn of the National Naval Medical Center, Bethesda, Md., proposed that research and development of a personnel subsystem be initiated as soon as possible in view of long lead times. Such a program would pay particular attention to personnel recruitment, selection, screening and training, since crewmen other than astronauts will be used.

Methods of psychiatric and psychological screening of individuals have proven effective when correlated with actual findings in Navy's Operation Deep Freeze in the Antarctic, Haythorn said. Developing a method to screen individuals has proven necessary because the nature of interpersonal relationships among members of small crews is a critical determinant of individual and crew effectiveness. Haythorn suggested as original selection criteria that the individual be a top man technically in his field and in a good state of health.

Future Space Missions Outlined

Los Angeles—Future manned space missions and deployment dates tentatively have been defined by National Aeronautics and Space Administration to facilitate scheduling of research programs.

Missions were outlined by Robert F. Trapp, Chief of NASA's Man-Systems Integration Div., Biotechnology and Human Research in Office of Advance Research and Technology recently at the Manned Space Laboratory Conference here:

• Lunar base mission, scheduled for 1970, would establish housing and experimental facilities on the lunar surface or subsurface after the initial Apollo exploration. Base would be expandable in size and would have a crew of 12 to 24 men, which would be rotated every six months. Post-Saturn 5 boosters would be required for support.

• Operational space station, also scheduled for 1970, would be used for observation of earth and space as well as experimentation in the space environment. Like the lunar base, it would have a crew of 12-24 men, rotated every six months. It would orbit above the drag regime and below the radiation belts (200 to 300 naut. mi. altitude) and would require a Saturn 5 booster.

• Planetary fly-by mission would provide direct visual observations of Mars, Venus or both from close proximity through a hyperbolic grazing trajectory. Scheduled for 1971-73, it would use a 3-5 man crew and have a minimum duration of one year. A Saturn 5 booster and earth rendezvous might be used, although nuclear power would be preferred.

• Planetary landing mission would put men on the surface of Mars or Venus for manned exploration. This 1975 mission would have a crew of 3-5 men and would be limited in duration to less than two years. Nuclear stages would be required and some portions of the spacecraft system may be reusable. The mission may take place in the following steps: earth orbital rendezvous, establish orbit around other planet, aerodynamic entry to planet's surface, exploration period of approximately 30 days, orbital rendezvous after takeoff and return to earth for aerodynamic entry and landing.

PRODUCTION BRIEFING

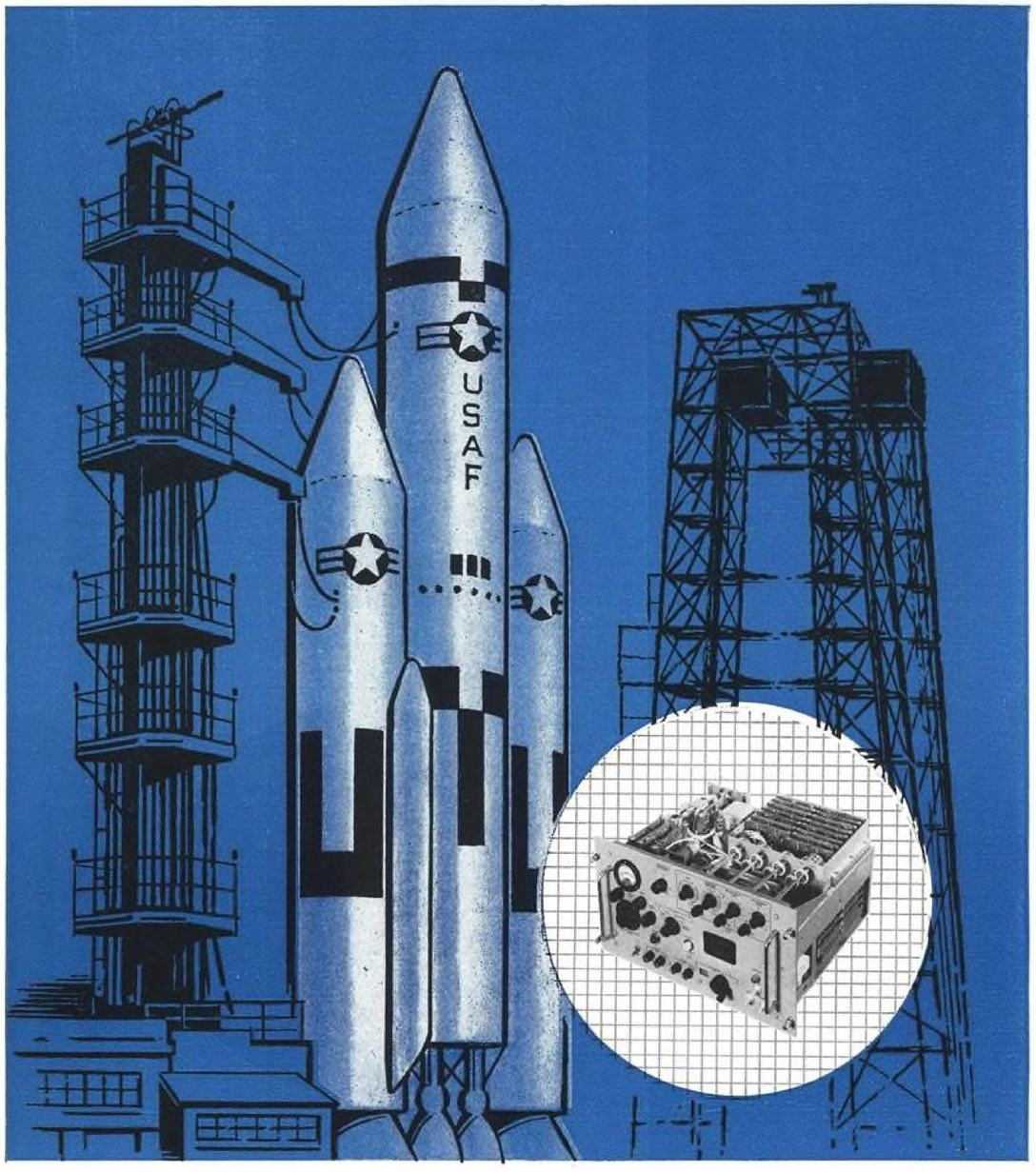
Sylvania Electric Products, Inc., has a $202,000 contract to study and recommend ways to verify arms control and disarmament agreements from the Arms Control and Disarmament Agency. Completion of the project is expected in early 1964.

Aerojet-General Corp., El Monte, Calif., has a $1-million supplemental Air Force contract for research and development of stage two Minuteman missile motors. Work will be done in Sacramento, Calif.

Rocket Power, Inc., of Mesa, Ariz., has a $250,000 contract from Lockheed Missiles and Space Co., Sunnyvale, Calif., to develop and produce a two-stage solid fuel sounding rocket. New vehicle will be called Phoenix 2. First stage will deliver 6,100 lb. of thrust for 5.5 sec. and the second stage will deliver 2,000 lb. of thrust for 8 sec.

North American Aviation, Inc., has a letter contract from Air Force for modification and overhaul of 21 T-28 aircraft, with an initial appropriation of $1.2 million. Modification will include replacement of the original 800-hp. engines with 1,300-hp. engines.

Pacific Airmotive Corp., Burbank,



Stool Pigeon for the Big Birds. Missile borne beacons scheduled to ride the big birds in the Titan III and Polaris evaluation programs are being thoroughly checked out by Sperry C-band beacon test sets. Pre-testing assures proper beacon flight performance. □ Inherent self-test capabilities of this new C-band beacon tester assure extreme accuracy and enhance the value of the data collected during test flights. Sperry's proven ability in producing precise test equipment guarantees peak performance. □ This advanced unit will satisfy virtually any present C-band beacon test requirement. Sets are available for two-pulse code systems and coding can be extended to all 3- and 4-pulse systems in conformance with IRIG specifications. □ For complete information and data on C- and S-band beacon test sets, write or call *SPERRY MICROWAVE ELECTRONICS COMPANY, Clearwater, Florida.*

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Calif., will supply Wright engines and propellers for T-28D aircraft conversions under a $500,000 contract from North American Aviation, Inc.

Valley Metallurgical Processing Co. will supply 350 tons of aluminum powder as a component of propellant for second-stage rocket engines for Air Force Minuteman ICBMs, under a $896,356 contract from Aerojet-General Corp.

Cubic Corp., San Diego, Calif., will build a timing distribution system, under a $321,000 contract, for tracking of high performance aircraft at the Air Force Flight Test Center, Edwards AFB, Calif.

Giannini Controls Corp., Duarte, Calif., has completed a feasibility study on an advanced fuzing system for reentry vehicles, under a $337,000 contract from Air Force Ballistic Systems Div., Norton AFB, San Bernardino, Calif.

General Dynamics' General Atomic Div. will design and develop a 4 to 10 w. thermoelectric generator, under a $98,000 contract from Atomic Energy Commission.

Solar, an International Harvester Co. subsidiary, San Diego, will supply United Aircraft's Sikorsky Aircraft Div. with 27 Titan gas turbine engines to drive auxiliary power units in Air Force CH-3C (Sikorsky S-61R) helicopters.

Douglas Aircraft Co. has received a $6.2-million contract from NASA for launch support and trajectory plotting of Douglas Delta space vehicle missions to Dec. 31, 1963.

Texas Instruments Corp., of Dallas, has a $1.6-million Bureau of Naval Weapons contract for guidance control equipment and airframes for the Shrike missile program.

Bendix-Pacific Div. of Bendix Corp. has a $2.5-million contract for modification of B-58 Hustler hydraulic power control units. The award, from General Dynamics Corp., involves modification of flow control valves and actuating cylinders. Cylinder modification calls for manufacture and installation of stainless steel piston rod glands and new pistons flame-plated with tungsten carbide.

A vibration system will be built for United Technology Center by Ling-Temco-Vought's Electronic Div. to test the capability of flight-weight hardware for the 120-in. solid-propellant motor for the first stage of Air Force Titan 3C launch vehicle to withstand launch en-

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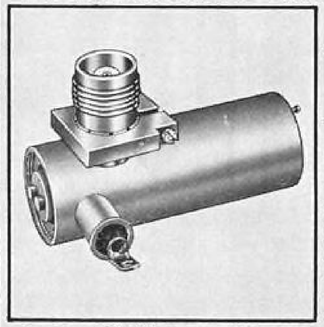

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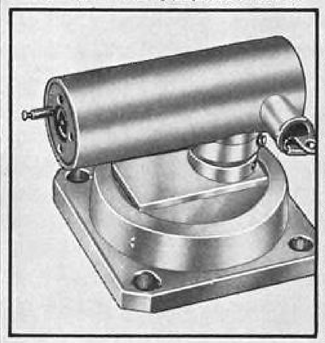

Trak Type 9170-1002: Same as above, but modified with a UG39 X-Band wave guide output. Weight: 5 ounces.

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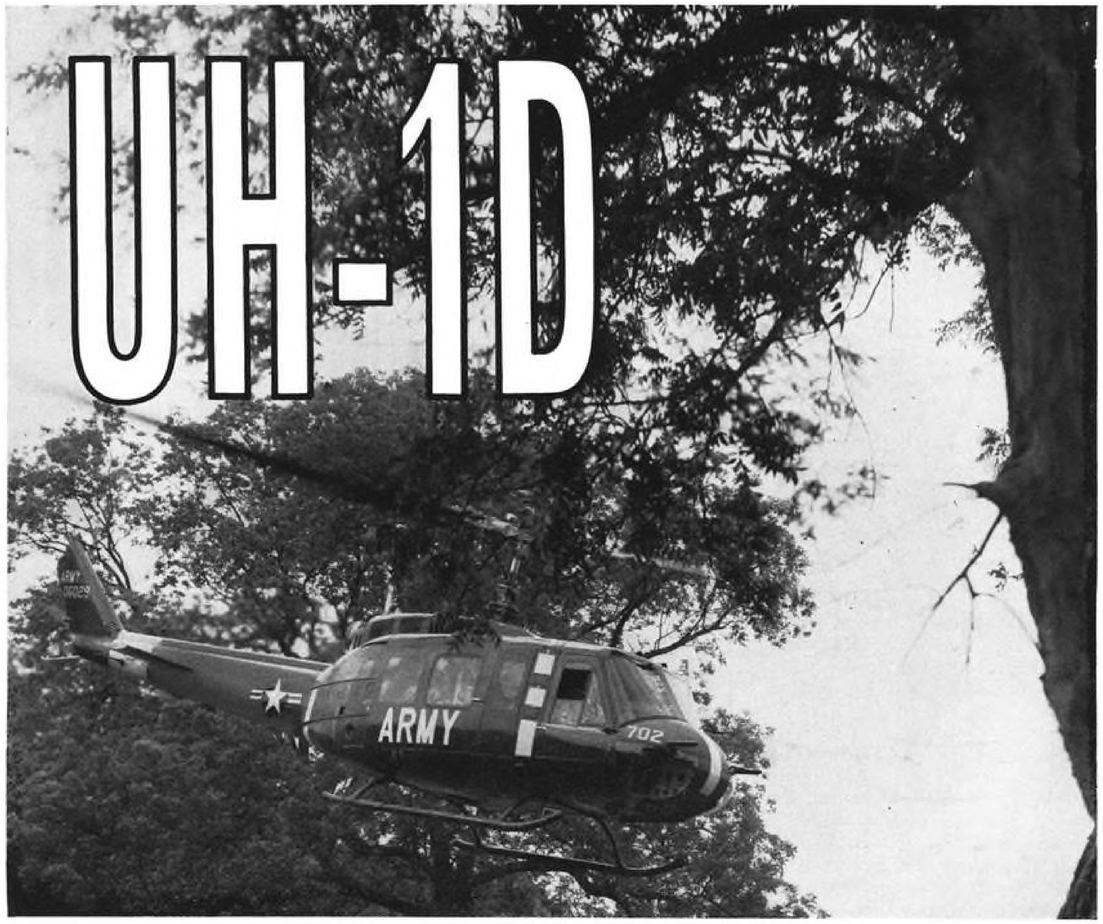

..GOES OPERATIONAL

The first production line UH-1D Iroquois are now being delivered to the U. S. Army, *on schedule*. This new helicopter is an organic part of the air mobility concept. With this ship, the tactical integrity of the squad is retained with 12 fully-equipped men, plus pilot, dispatched as a unit. Externally the UH-1D is similar to the UH-1B . . compact, low silhouette . . air transportable . . easy to maintain. The fuel tanks have been relocated and the cabin rearranged to gain the 50% passenger increase and the 57% increase in internal cargo space (220 cubic feet) over the UH-1B. The UH-1B's dynamic components are retained assuring the same proven, dependable Iroquois performance. UH-1B weapons kits are interchangeable. ■ This Iroquois can be converted from a personnel carrier . . to an armed assault ship . . to an aeromedical ambulance . . as fast as the situation demands. It gives field commanders another dimension . . *surprise by air* . . in the tactical deployment of their units.

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vironment. It will be installed in August at UTC's development, processing, and test center located at Coyote, Calif.

Westinghouse Electric Corp. has a $949,000 contract from National Aeronautics and Space Administration's Manned Spacecraft Center, Houston, Tex., for design and delivery of the main drive system for the flight acceleration facility to be built at MSC's Clear Lake site. Drive system will power a 50 ft. arm which will be used to rotate gondolas that will contain men or equipment.

Lear Siegler, Inc., is planning construction of a $1.3-million, 100,000 sq. ft. administrative and purchasing building for the Instrument Div. at the company's Grand Rapids, Mich., site.

Ford Motor Co.'s Aeronutronic Div., of Newport Beach, Calif., has two production contracts from Air Force's Ballistic Systems Div., totaling more than $19 million for manufacture of decoy subsystems to be carried by Atlas "F" and Titan 2 ICBMs.

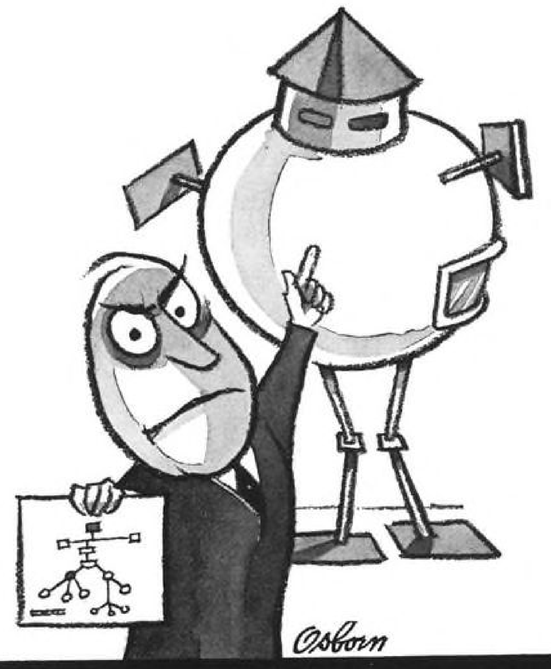
Thiokol Chemical Corp. of Bristol, Pa., has been awarded a $17.7 million contract for production of pre-packaged liquid engines for the Bullpup A missile. The motors will be used by Navy and Air Force.

Jet Propulsion Laboratory, Pasadena, Calif., reports construction has reached the half-way mark on its $2-million Space Flight Operations Facility being built by NASA. The building is expected to be ready for occupancy in late September.

Melpar, Inc. of Falls Church, Va., has been awarded a $575,000 Air Force contract to study biological contamination of jet fuels and to develop a rapid method of contamination detection.

Thompson Ramo Wooldridge will transfer all numerical control products manufacturing from Michigan City, Ind., to Cleveland, Ohio, during the next six months. Change was dictated by the need for more modern facilities and additional engineering staff support already available at TRW's Tapco Div. in Cleveland.

General Electric Co., Pittsfield, Mass., has been awarded a $6.9-million contract from Navy's Special Projects Office for engineering operational support for Polaris fire control systems and systems management during the period Apr. 1, 1963 to June 30, 1966. Work will be done in Pittsfield.



"Organization Charts are just paper! What management does my project get?"

(From an imaginary but realistic exchange between a Source Selection Board and TAPCO.)

Source Selection Board (cont.): Sure your Organization Chart covers all the decision areas—but how many of these blocks light up on *our* project?

TAPCO: They *all* do. They're *people.*

SSB: Okay, let's say you have the horses. But can they pull our wagon? What's their experience, their record?

TAPCO: I could talk "man years" and "up through the ranks" all day. But look at it this way. Some of these men made the valves for the Spirit of St. Louis. Others developed the booster pumps that made the Hump Run possible. Others have come along since Korea. For example, one of our young men is project manager on Sunflower. Excuse the corn, but what we've got is the kind of mix of old pros and hot rookies that wins pennants.

SSB: What pennants?

TAPCO: Okay. Specifics. We've taken on more than 44,000 specific contracts in aerospace. Delivered more than 10,000,000 subsystems, components, and parts. 2,350 distinct designs. Over $900,000,000 worth.

SSB: . . . at what performance level on your contracts?

TAPCO: We've delivered 93% on time or *ahead* of schedule—at or *below* target cost.

SSB: And the *other* 7%. You didn't deliver?

TAPCO: We delivered. We ran into bugs . . . but we never ran *away* from them. We came in late on some contracts. Who doesn't? But I don't believe any of our customers in these cases held it against us.

SSB: ? ? ?

TAPCO: Because we *always delivered.* And what we delivered did its job.

SSB: Always?

TAPCO: *Always.*

If you'd like to continue this conversation in terms of your specific requirements, write R. A. Paetz, Director, Requirements and Contracts, Tapco, TRW, 23555 Euclid Ave., Cleveland 17, Ohio.

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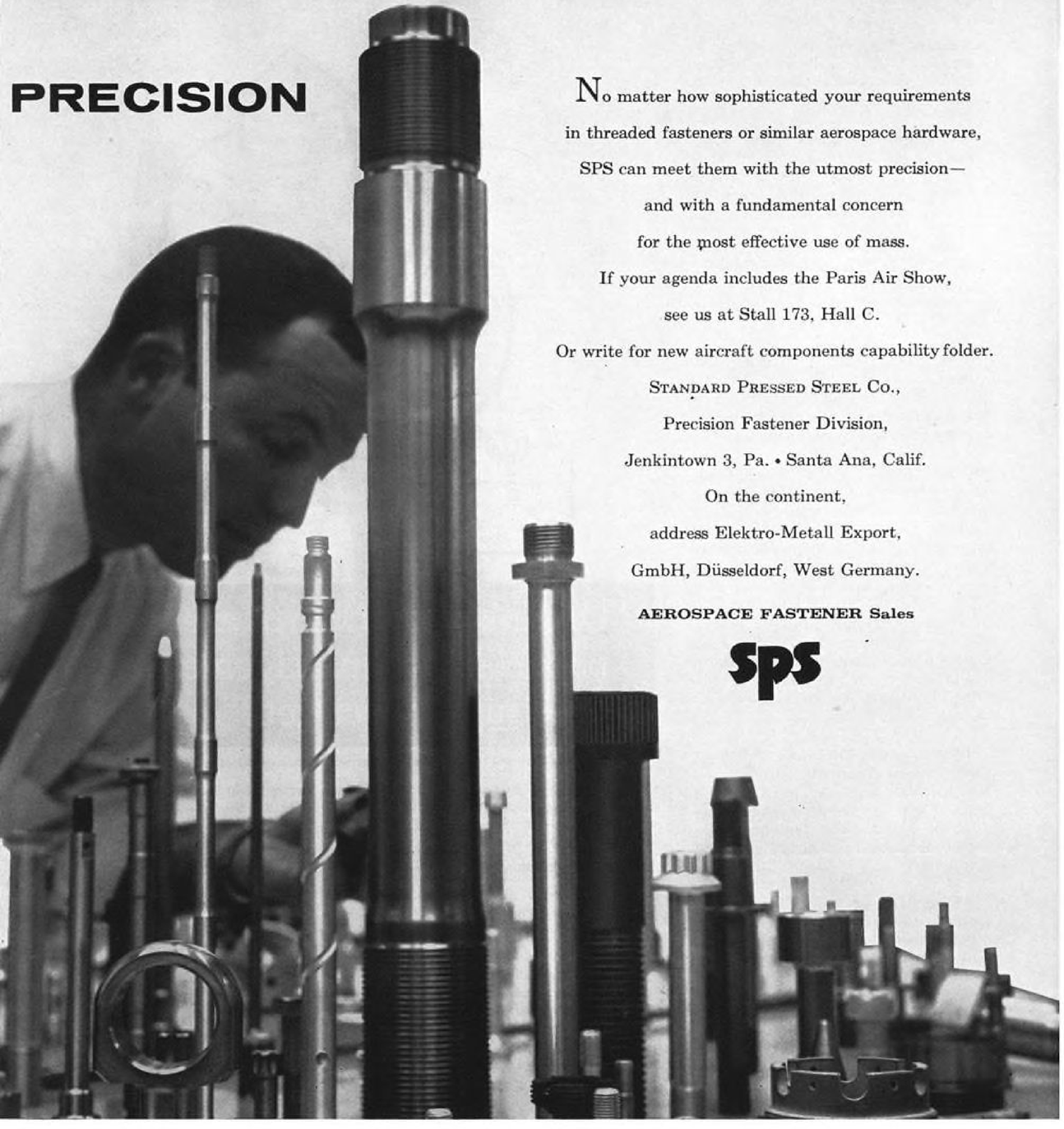

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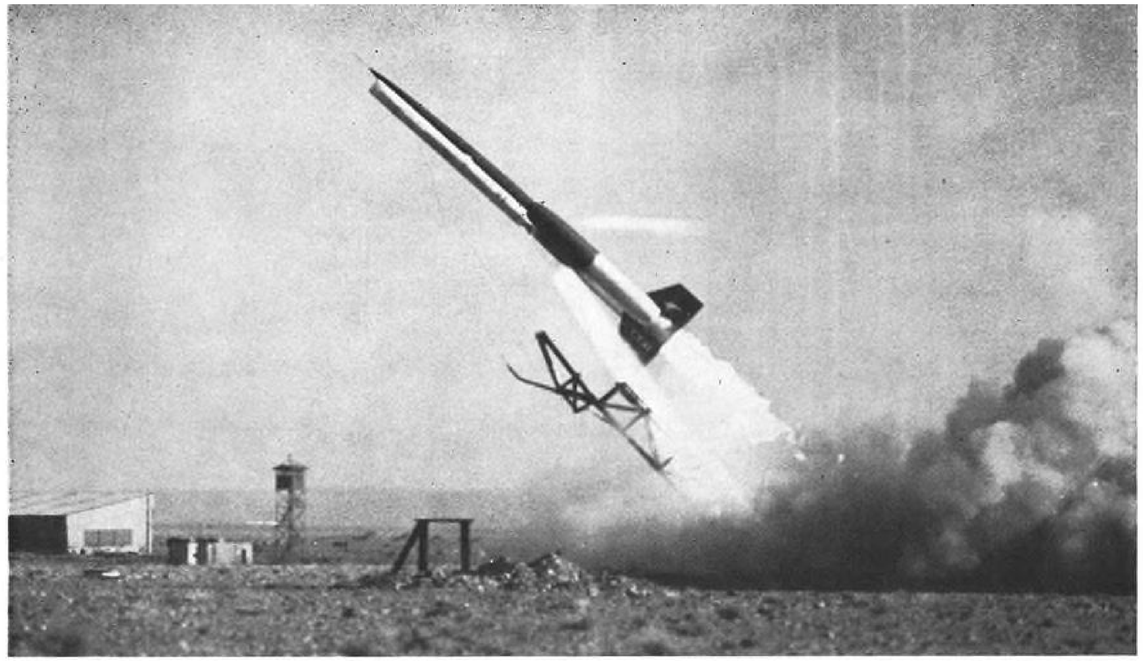
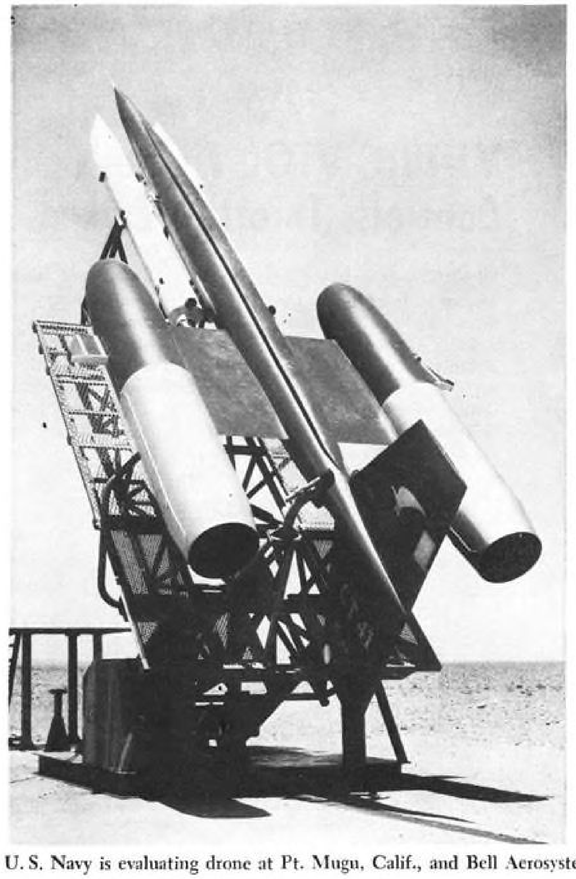
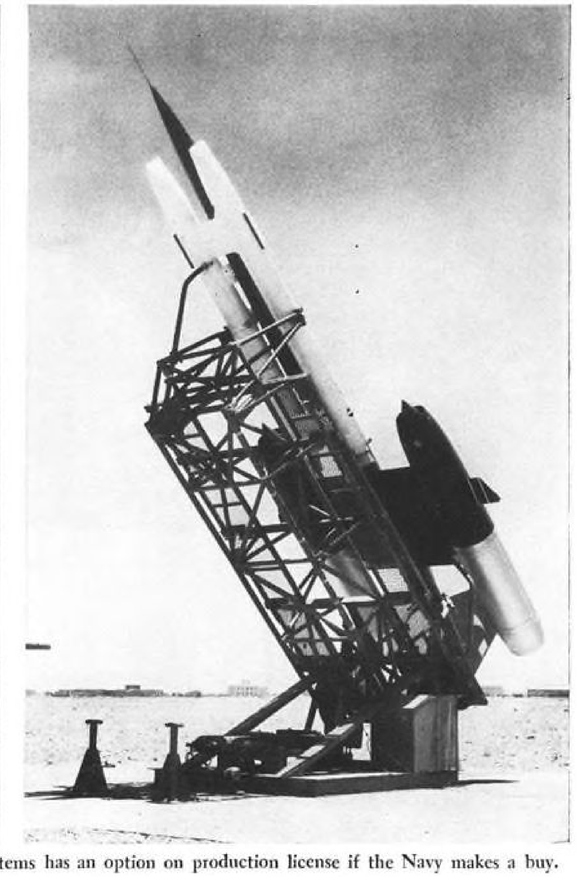


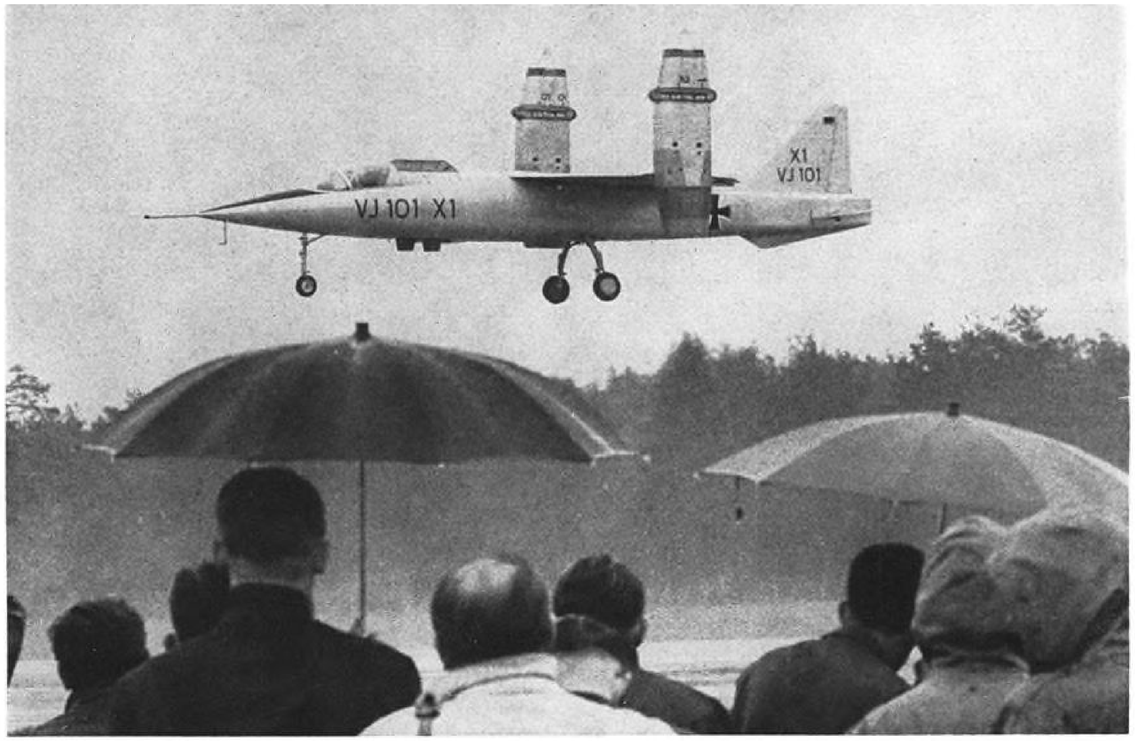
Nord CT-41 supersonic target drone is launched with initial power being provided by two rockets attached forward of the stub wings. Ramjets provide sustainer power for the target drone.

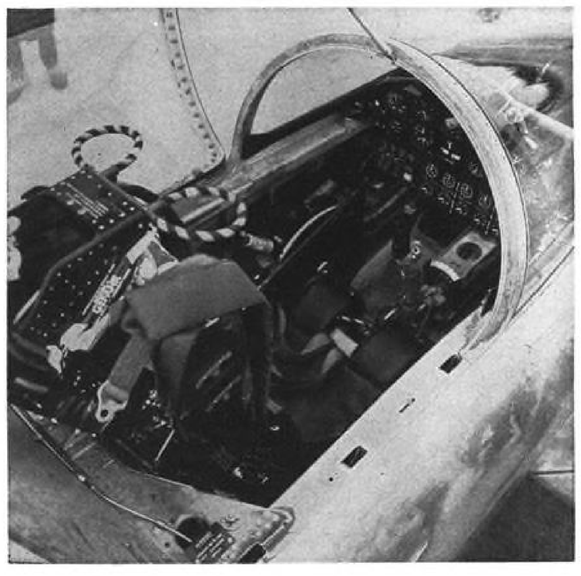
Nord CT-41 Target Drone Launching Shown





U. S. Navy is evaluating drone at Pt. Mugu, Calif., and Bell Aerosystems has an option on production license if the Navy makes a buy.

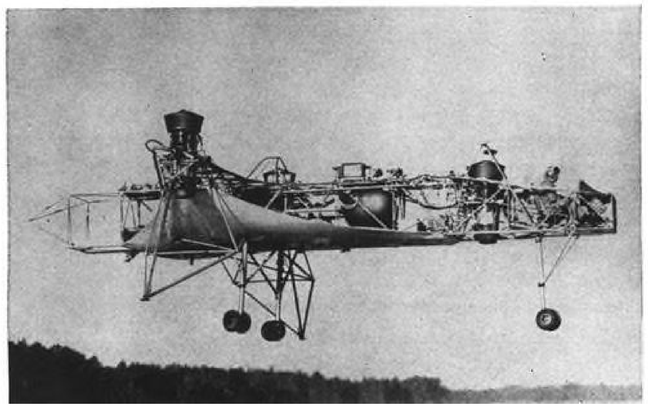


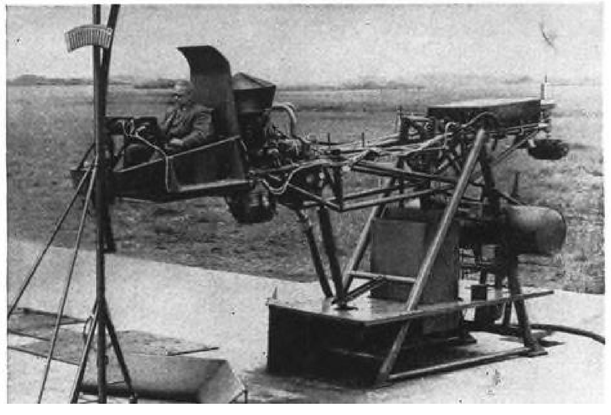


West Germany's VJ-101C, VTOL strike fighter, takes off in the rain on its first flight (AW May 20, p. 38). Aircraft is powered by six Rolls-Royce RB. 145 turbojets; four in swiveling wingtip pods and two in the fuselage behind the cockpit of the aircraft.

VJ-101C VTOL Fighter's Controls, Throttles Linked

VJ-101C cockpit layout (left) appears standard, but control column is linked to the throttles of all six engines for vertical flight. Column movement produces adjustments in throttle linkages and pitch and roll control are achieved by modulating thrust. Note single throttle on left side panel. All six engine throttle linkages are switched to the common lever for vertical flight (AW May 27, p. 70). Free-flying testbed (lower left) was built to test VJ-101C triangular engine placement. Wippe see-saw test rig (right) is used to simulate thrust modulation system for pitch and roll axis control.





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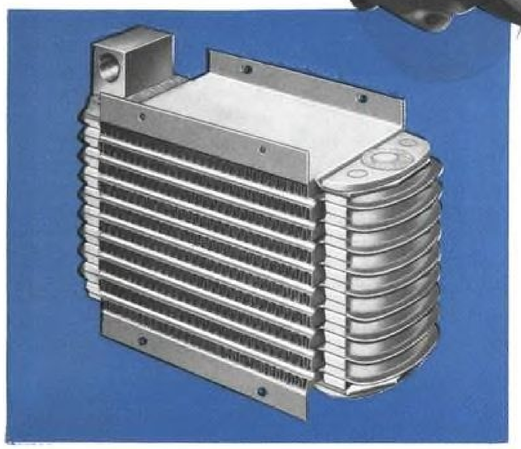

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HONEYWELL ADVANCED TECHNOLOGY REPORT NO. 4

What is the key to successful Program Management?

Program Management techniques cut costs on Polaris platforms

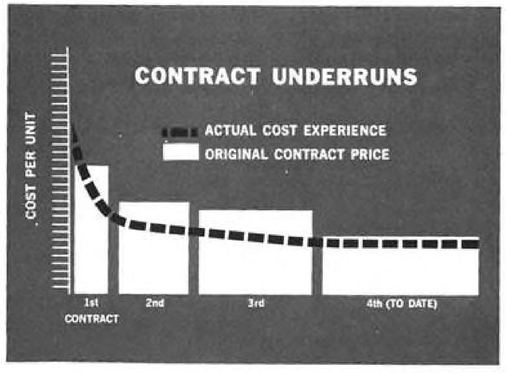
As a result of successful Program Management, the first Mark I inertial platform built by Honeywell for the Polaris guidance system retained the green light throughout the countdown. Utilizing an MIT design on a second source program, Honeywell delivered the unit 30 days ahead of schedule—117 days after the order was received. Every subsequent delivery date has been met.

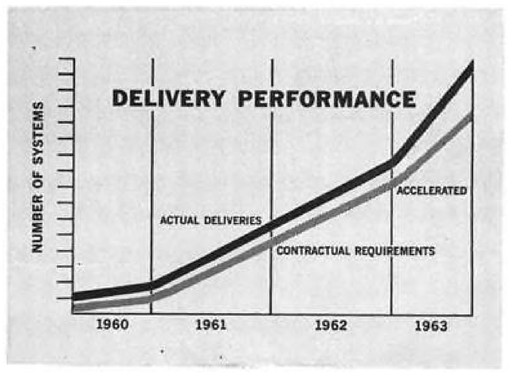
Besides meeting schedules—some of which were sharply accelerated—Honeywell has reduced the unit price on each successive contract while meeting all quality specifications.

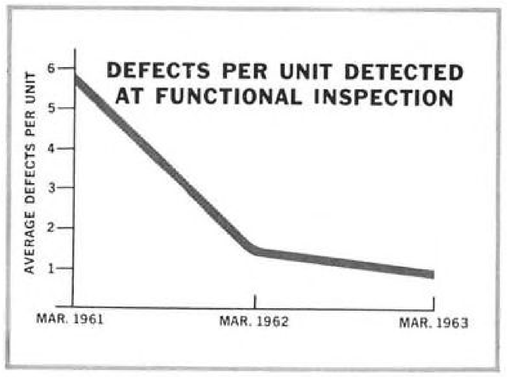
The Program Management techniques that made the Mark I program successful are now being applied to the Mark II system which Honeywell is building for the advanced Polaris A3.

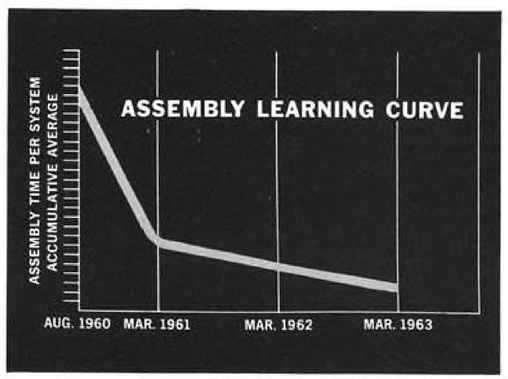
Much of the success of Honeywell's Polaris programs has been credited to its Program Manager organization. This management technique makes the Program Manager fully responsible for the entire program—cost, delivery, performance and reliability. In addition, he is also accountable for production engineering, production control, system engineering, assembly, technical liaison, cost control and, indirectly, quality.

The individuals responsible for these functions devote full time to Polaris, and are located in the same offices to shorten lines of communication and provide quick reaction to any problem areas.









Results of successful Program Management at Honeywell in building the Mark I inertial platforms for the Polaris missile are shown above. Every unit was delivered on or ahead of schedule with cost underruns on each successive contract.

Incentive-type government contracts demand further refinement of management techniques

New procedures in government contracting indicate that in the future more and more emphasis will be placed on the *management* aspects of complex defense and space programs.

At Honeywell, increased emphasis is being put on refining Program Management techniques because: (1) The concepts of Program Management match trends in both government and industry toward centralizing authority and responsibility; and (2) Program Management shows *exactly who* is accountable and who can present the total picture of a program's progress to both top management and the customer.

To make Program Management more effective and efficient, a Program Manager should:

1. Establish cost and technical goals. These must be set—and met—by the Program Manager within limits prescribed by the customer. The Program Manager must have both technical and administrative abilities to direct all tasks on a results-oriented basis.

2. Direct subcontractors. Since up to 75% of all prime contract dollars go to subcontractors, the Program Manager must assist in selecting subcontractors and he must direct this portion of the program. The Program Manager should hold Task Team meetings to discuss all important aspects of the program and present design material in detail. This will expose potential problem areas for action.

3. Maintain design and financial controls. The Program Manager should be supported by financial tools (such as weekly program cost records) which quickly evaluate expenditures and alert him to potential cost problems and technical delays. Value Engineering should be used to seek out less costly alternatives in equipment design and production.

To help the Program Manager carry out these responsibilities, top management must:

1. Delegate authority and responsibility. The Program Manager must in effect run a company-within-a-company.

2. Provide manpower. Technical and financial specialists of the entire company must be available to the Program Manager.

Important as these basics are, they can be made to work only by an *able and experienced* Program Manager. It is at this crucial point that the Program Management concept most often fails.

The *long range development of the individual* is the key to having personnel available and experienced in Program Management. At Honeywell, the potential Program Manager is singled out early in his career and exposed to varied on-the-job training with heavy emphasis on supervisory experience. If he scores consistently high, he is recognized as a potentially successful Program Manager.

At the left and below are examples of the techniques that have helped Honeywell achieve its respected record of Program Management.

Quick build-up results in major production plant in 5 months

A recent step-up in Army Ordnance requirements resulted in the build-up of a 400,000 sq. ft. automated production facility by Honeywell in five months—less than half the time normally required. In 45 days after go-ahead, Honeywell had the first high-volume production lines in operation, and delivery schedules were met within four months. A 5% underrun was achieved during the first eight months and the costs of all successive systems were reduced significantly.

This quick build-up was made possible by:

1. Program Management. A key individual—the Program Manager—was given full authority and held accountable for all phases of the build-up of the new facility.

2. Concurrency. Detailed planning allowed the Program Manager to develop separate elements simultaneously, so that completed elements dovetailed into workable units.

3. Training program. 2,000 new hires were fully trained and ready to begin work as production lines were completed.

4. Communication. The Program Manager kept both the customer and management informed throughout the accelerated build-up.

5. Importance of the individual. Technicians and production personnel were given a sense of urgency and personal importance through their contribution to the program.

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*Both shown actual size

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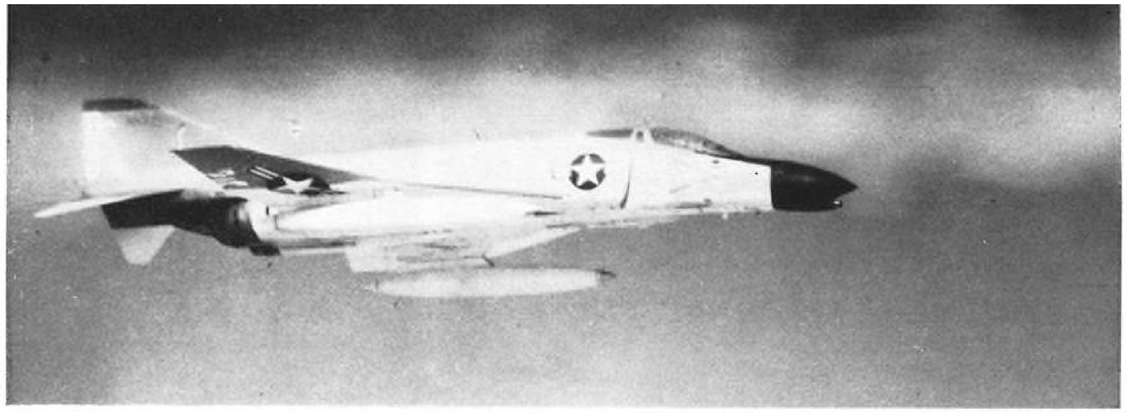
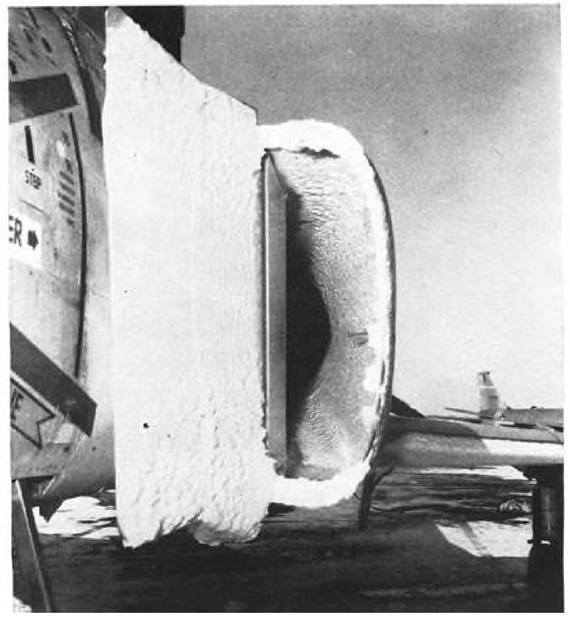
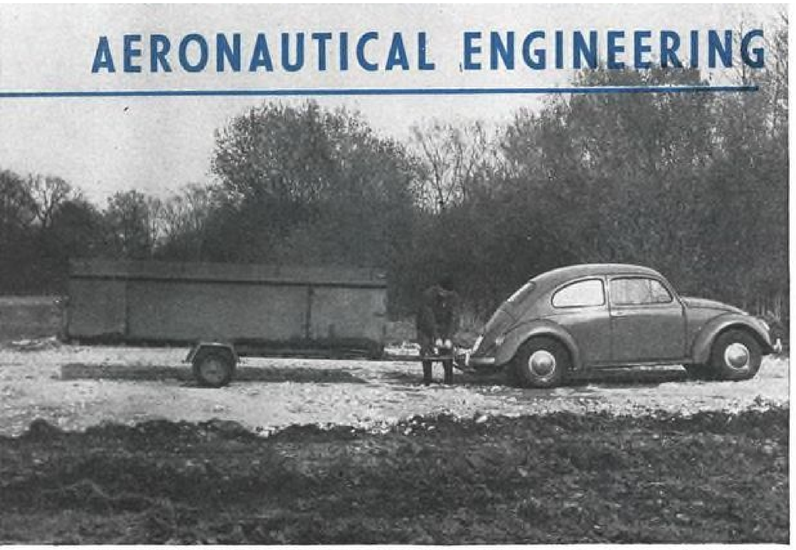


Navy F-4B flys through water spray from a KC-135 tanker during icing tests conducted by Air Force's Aeronautical Systems Div.

F-4B Heaters Evaluated in ASD Icing Tests

About 16,000 gal. of water were pumped from tanker through a 26-nozzle spray ring (above left) to test new pitot and pitch sensor tube heaters. Extent of icing on the airframe is shown at right above. Head-on view (below) shows radome, engine inlets and most of windscreen covered. Heater kept center part clear. Thick coat formed on left engine inlet and inlet ramp.





DORNIER-WERKE Do.32 HELICOPTER is carried in wooden trailer, which folds down, above right, to become a heliport.

Single-place Dornier Helicopter Folds For Transport

By Warren C. Wetmore

Immenstaad, Germany — Dornier-Werke GmbH's first entry in the field of rotary-wing aircraft, the Do.32 one-man helicopter that can be folded into a compact package for stowage and transport, features compressed air-jet rotor drive and automatic transition to autorotation in emergencies.

Foremost design consideration for the helicopter is simplicity, according to Dr. Theodor Laufer, designer of the Do.32 and chief engineer of Dornier's Helicopter Div. "It is intended to be a sort of motorcycle of the air" he said.

Possible uses of the Do.32 include private business and sports use, border, pipeline and high-tension transmission line patrol, agricultural and forestry duty, and port supervision. Military missions might include visual and photographic reconnaissance, courier duty and also spotting for artillery units.

Design of the Do.32 was begun in August, 1960, as an entirely company-funded venture after requests for a subsidy from the German Federal Republic were rejected. The prototype has been undergoing tests since last summer. Total costs to date amount to slightly more than $250,000, including the cost of the prototype.

As yet no orders have been received, but Ryan Aeronautical Co. signed a preliminary licensing contract with Dornier on Jan. 18, which provides for North American demonstration and distribution rights if the Do.32 is put into production.

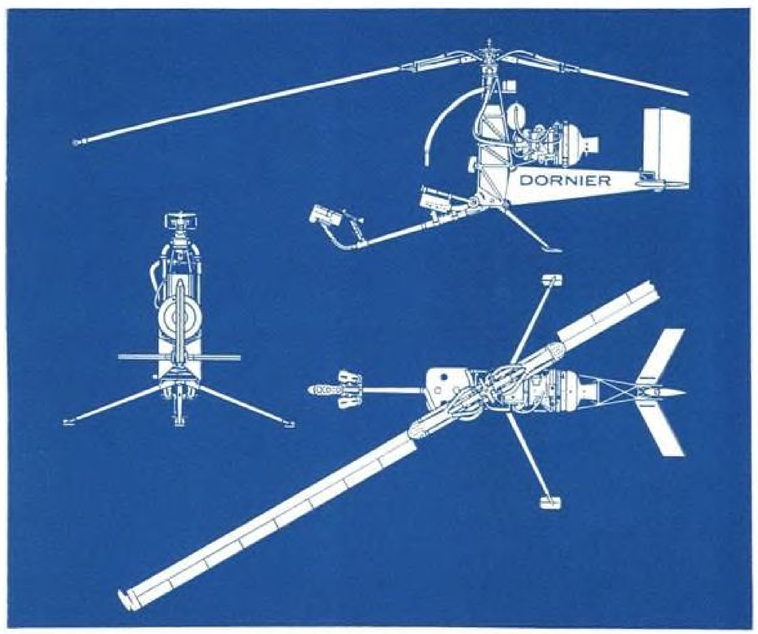
Dornier officials declare that they are now ready to begin mass-producing the helicopter and have set an estimated unit price of $9,100 if as many as 1,000 are built.

Structure is an open framework constructed of welded tubular aluminum. The tail boom supports the gas turbine engine and the aircraft-type empennage, and is fitted with side panels for added lateral stability. Over-all length of the helicopter is 10.5 ft. and height is 6.2 ft.

Vertical pylon houses the 12.7-gal. capacity fuel tank and is topped by the hub, a two-bladed rotor, and a blade-pitch controlling spider. Backrest for the pilot's seat is located one-third of the way up the pylon.

Tripod landing gear is fitted with skids. The pilot's bucket seat is situated on the forward leg as are the rudder pedals and instrument panel.

Flight controls consist of a cyclic control stick—for pitching and rolling the helicopter—suspended in front of the pilot and operated by his right hand. Vertical motion and speed of the helicopter are governed by the collective pitch lever and motorcycle-type twist-grip throttle, situated to the left of the pilot's seat.



DESIGN DETAILS of the single-place Dornier Do.32 helicopter are shown in three-view.

Yaw control is obtained by vectoring the exhaust blast from the engine by use of the rudder on the vertical stabilizer, which is connected to the rudder pedals by cables.

Pitch-compensating horizontal stabilizers are fixed and adjustable only on the ground. Sweep angle is approximately 30 deg., span is 2.4 ft. and chord width is 0.6 ft. Vertical stabilizer has a height of 2.3 ft. and a chord width of 1.2 ft.

Diameter of the rotor is 24.6 ft., which gives a disk area of 474 sq. ft. The blades are hollow Dural aluminum spars, with honeycomb trailing edges covered by thin plates.

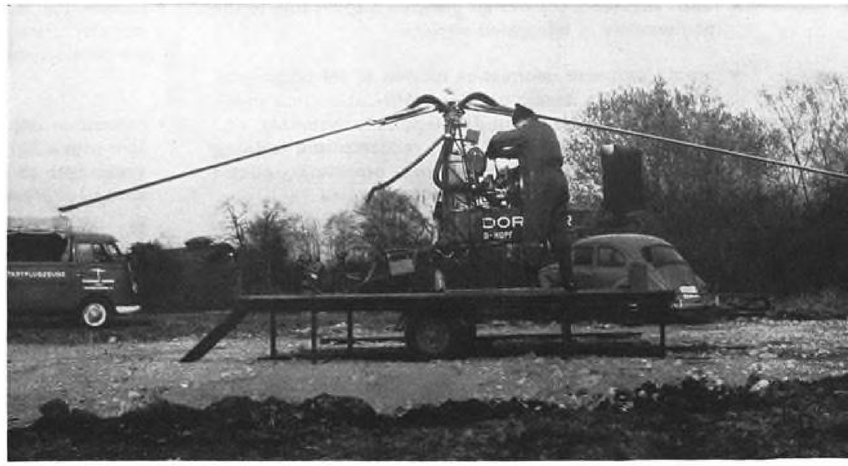
Ciba Hidux was used as the bonding compound. Blade chord is approximately 0.65 ft.

Blades are attached to the rotating hub by means of telescoping swivel shafts and two pairs of steel torsion straps which permit two degrees of freedom—flapping and pitch change. Droop angle of the blades at rest is 10 deg., and twist angle between the root and tip of the blades is 6 deg.

During hovering flight, the rotor is inclined slightly backward to compensate for the 27-lb. exhaust thrust of the gas turbine engine. In the transition phase it swings forward.

For stowage the vertical pylon is folded forward and the rotor backward, with the blades lying along either side of and parallel to the tail boom. The forward leg of the landing gear folds

ROTORS AND ROTOR MAST are unfolded from stowed position and connected to the fuselage.



ENGINE AND AIR HOSES are connected as helicopter is made ready to fly. Note supports which steady trailer bed-heliport. Takeoff, below, is from trailer.

For Companies Planning to Build Integrated Circuit Equipment...

Motorola's NEW INTEGRATED CIRCUIT DESIGN COURSE will:

- **Teach engineers the design principles applicable to the requirements of integrated circuits**
- **Provide complete information on how to set up an integrated circuits breadboarding frabrication line which will enable you to speed development, assembly, and testing . . . develop an in-plant research and training capability . . . maintain control over proprietary circuit information . . . and run feasibility studies**
- **Explain the relationship necessary between equipment manufacturers and integrated circuit manufacturers for the development of optimum system designs**
- **Present an unbiased picture of what can and cannot be done with integrated circuits now . . . advantages and disadvantages of various techniques . . . what to look forward to . . . how to use integrated circuits now.**

Why an Integrated Circuits Course?

There are two factors that prompted Motorola to develop an Integrated Circuits Design Course. First is the fact that integrated circuits have reached the production stage and are being designed into both military and industrial equipment. Second, many technical leaders in our industry have expressed to me personally the need for an orientation of their key design personnel to this new technology, which in time will have as great an effect as the development of the transistor. Interestingly enough, they also stressed the need for a stronger communications link between the equipment manufacturer and integrated circuits manufacturers such as Motorola.

It was in recognition of these needs that we developed this course, which is, as far as we know, an industry first. We have put our key people to developing a concentrated, meaty, educational program with no holds barred. We are going to present in the design section as much practical and necessary theory as it is possible to put across in such a short time. The course will cover the complete scope of integrated circuits including monolithic circuit design, thereby enabling each participant to know both the intricacies and the advantages of this technique. We know that there are many preconceived notions – one might call them prejudices – and we will do our best to present an unbiased, complete picture so that anyone who attends this course will be able to make the correct decisions for his company's program in this area.

The second unit of the course will be primarily a laboratory session. We will provide complete plans, costs, and operational instructions on how to set up a hybrid circuit assembly facility so that you can breadboard and test your own circuits and conduct your own feasibilities studies.

It is our belief that only through the rapid dissemination of information in programs such as this can the equipment industry rapidly and efficiently make use of this new technology.

Motorola Inc.
Semiconductor Products Division

C. L. Hogan
Vice President and General Manager

Here are the Two Courses Motorola is Offering:

UNIT 1

JULY 14-26, 1963

This seminar is designed to present a comprehensive view of integrated circuit technology to enable engineering management to properly direct the efforts of their respective organizations in regard to the utilization of integrated circuitry in future equipment designs. Registration fee $900.

■ *Semiconductor Device Theory* ■ *Semiconductor Processes – wafers, assembly, diffusion, epitaxial growth, packaging* ■ *Thin Film Technology* ■ *Passive Components* ■ *Active Components* ■ *Thermal Design and Heat Sinking* ■ *Reliability Considerations* ■ *Fundamentals of Monolithic Design* ■ *Parasitic Analysis* ■ *Integrated Circuit Laboratory* ■ *Large-Signal Models for Junction Transistors* ■ *Black Box Transistor Model* ■ *Analysis of Logic Circuits* ■ *Design Optimization and Worst-Case Analysis Techniques* ■ *Design Principles of Integrated Circuit Amplifiers*

UNIT 2

JULY 28-AUGUST 2, 1963

This course covers all major areas involved in the fabrication of hybrid (multiple chip) integrated circuits, including Component Layout, Ceramic Preparation, Die Bonding, Wire Bonding, and Facilities Layout. In the laboratory portion of this seminar each participant will fabricate an integrated circuit of his own design to assure a working understanding of the various steps. Registration fee $3,000.

COMPONENT CHARACTERISTICS AND LAYOUT RULES

Components — *size, topological configuration, metallization, types, miscellaneous piece parts, materials*

Layout — *basic rules, establishing component density, component spacing, metallization line widths*

CERAMIC PREPARATION

Patterns — *photographic reduction, silk screen preparation, silk screen use*

Ceramic Processing — *firing, nickel plating, gold plating*

PROBING

The Probe — *use, auxiliary equipment, pressure/sensitivity effects, care of probe tips, available probable characteristics*

TINNING

Materials — *eutectic solders, application, temperature, atmosphere, storage life*

DIE BONDING

Piece Parts — *solder, ceramic, headers, flat packs*

Process — *temperature, procedure, technique, verification, probing after die bonding, repair/replacement*

WIRE BONDING

Equipment — *types of equipment, theory of bonding, comparison of types of bonding for specific applications, technique, common production errors, can/flat pack variations*

Bonding Assurance — *in-process checks, post-process checks, wire pull, centrifuge, drop test, practical limits*

WELDING/ENCAPSULATION FACILITIES AND LAYOUT

Facilities — *parts required for minimum facility, services required, element by element cost estimate, element by element maintenance estimate*

Lab Layout — *space required, work flow, arrangement, lighting and miscellaneous*

MOTOROLA INTEGRATED CIRCUIT DESIGN COURSE
Box 955 • Phoenix 1, Arizona

Please register the following for the meeting(s) indicated:

☐ Unit 1 ($900) ☐ Unit 2 ($3,000)

NAME _____

POSITION _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

☐ *Check enclosed (Make check payable to Motorola Inc.)*
☐ *Please send me the complete brochure on these two courses.*

Mail To: **Registrar, IC Design Course**
Motorola Semiconductor Products Inc.
Box 955 Phoenix 1, Arizona

Motorola reserves the right to limit enrollment to prevent interference with production.

Chairmen of Sessions

Chairmen for various phases of the course are A. B. Phillips, Manager of Integrated Circuit Operations; John C. Haenichen, Manager of New Silicon Device Operations; Dr. Remo A. Pellin, Manager of Materials Operations; Dr. Jan A. Narud, Director of Circuit Research; Dr. I. Arnold Lesk, Manager of Component Research and Development; and George M. Scalise, Manager of Integrated Circuits Production – all from Motorola's Semiconductor Products Division.

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3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.
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7344 Monticello Ave., Skokie, Ill.

DORNIER Do.32 is capable of burning a variety of fuel, including JP-4 and diesel oil.

under the pylon and the two rear legs are dismounted.

The folded configuration is packed in a two-wheeled wooden trailer measuring 12.5 ft. long, 2.8 ft. wide and 3.3 ft. high, which also serves as a convenient launch and recovery platform for the helicopter.

Maximum gross weight of the helicopter is 700 lb., and the empty weight is 324 lb.

Turbine Powerplant

The Do.32 is powered by a 90 hp. Type 6012 L centrifugal flow gas turbine, built by BMW Triebwerkbau GmbH, a subsidiary of the Bavarian automobile and motorcycle manufacturing firm. This engine is able to burn a variety of fuels, including white gasoline, diesel oil and JP-4. Fuel consumption rate is 118 lb. per hr. at maximum rated power. Total weight of the powerplant and auxiliary equipment, such as starting magneto and fuel pump, is 106 lb. Dornier anticipates that improvements in the engine will reduce this weight even further.

Time-between-overhauls (TBO) is now projected to be 250-300 hr., and present plans are for an overhaul lifetime of 2,000 hr. Open mounting of the engine permits complete change in 15 min., according to Dornier officials.

In order to obtain the compressed air for the rotor jets, the shaft of the 6012 L is coupled directly to an auxiliary centrifugal air compressor without the use of clutches or gearing. At the nominal constant operating speed of 45,000 rpm. the auxiliary compressor delivers 1.32 lb. per sec. of air at a pressure of 2.5 atmospheric.

Compressed air is drawn off through two tangential outlets located on the periphery of the compressor and conducted via two flexible rubber tubes to the annular plenum chamber formed by the fixed lower and rotating upper parts of the non-oscillating rotor hub. Rotating air seal is made of graphite.

The air passes from the plenum chamber through two pairs of rubber tubes to the hollow rotor blades. There it is conveyed to the tip jets, expanded and exhausted, thus driving the rotor by reaction force.

Rotor speed, which varies between 365 and 500 rpm., is controlled by regulating the quantity and pressure of the compressed air by means of the twist throttle. Turning the throttle in the power-on direction changes the incidence of the stator blades located upstream of the auxiliary compressor rotor, thereby increasing the airflow through the intake channel. A governor automatically maintains constant engine speed, regardless of the load imposed on the air compressor.

Inherent Advantages

Advantages inherent in this unconventional propulsion scheme include:

- **No counter-torque** required with jet-driven blades, therefore eliminating the tail rotor and its accompanying power transmission system.
- **Rotor speed is independent** of the turbine speed, which permits efficient operation at the latter's optimum speed.
- **No direct mechanical link** between powerplant and the rotor, thus eliminating the need for gears, clutch, flywheel and transmission shaft.
- **Higher payload** to dead weight ratio.
- **No need for blade de-icers,** since the compressed air passing through the blades is sufficiently warm for this purpose.

A further indication of the helicopter's simplicity is to be found in the instrumentation.

The panel in front of the pilot's feet contains, in descending order, the rotor tachometer, turbine exhaust temperature gage and rotor air pressure gage. Warning lights are placed above and below the temperature gage and indicate turbine over and underspeed conditions, oil pressure and fuel level. The latter is activated when less than two gallons remain in the fuel tank.

Pitot tube for the airspeed indicator is mounted in front of the instrument panel. The indicator was temporarily mounted on a bracket between the pilot's legs, but in the production version it will be incorporated into the instrument panel.

A simple skid indicator—consisting of a piece of string attached to an upright wire—also was mounted on the instrument panel.

The VHF communications transceiver is located in the box attached to the collective pitch lever. Antenna protrudes from beneath the tail boom.

Autorotation Feature

Automatic transfer to autorotation is a feature made possible by the compressed air propulsion system.

In the Do.32 the combined effects of rotor centrifugal force—which amounts to approximately 22,000 lb. at flying speed—and the torsion straps linking the blades with the rotor head tend to rotate the blades to minimum pitch. This tendency is effectively

YAW CONTROL of the Do.32 is by deflection of engine exhaust. Tip-jet powered blades create little torque.

counteracted by the control force exerted by the pilot and by the air pressure in the hub plenum chamber, which exerts a piston-like compensating force on the collective pitch linkage passing through the hub.

Should the engine fail during flight the deficiency in the compressed air causes the compensation to vanish, and thus permits the blades to revert to minimum pitch. The pilot is warned by the downward force on the collective lever.

Low Disk Loading

The rotational kinetic energy stored in the comparatively heavy rotor blades provides an added margin of safety during transfer to autorotation. Due to the low disk loading of 1.23 psf. the velocity loss during this transfer is small.

For the flight demonstration the helicopter, was conveyed to a roughly prepared 50-ft. square asphalt pad in its transport trailer, which was towed by a Volkswagen sedan.

The two technicians unhitched the trailer and folded down its sides, supporting them with outrigger legs. The rotor blades were lifted out of their rear crutches, swung forward and the swivel shafts connected.

Engine Starting

The pylon was then erected and the landing gear unfolded and mounted. Dornier's test pilot, Friedel Wissel, strapped himself into his seat after a quick check of the various fasteners and connectors. One of the technicians hand-cranked the engine to its starting speed of 13,500 rpm.—requiring only about 15 sec.—while the other held the rotor stationary.

After starting speed was attained—indicated by the turbine speed light on the instrument panel – Wissel brought the turbine to full idle and the technicians retired to the edge of the pad. The rotor accelerated to maximum speed as power was increased to operating level. Jump take-off was accomplished by lifting sharply the collective lever and thus converting the rotational energy of the blades to downwash thrust.

The helicopter climbed rapidly and transitioned to horizontal flight at an altitude of about 50 ft.

Elapsed time between arrival of the trailer and helicopter takeoff was approximately 5 min. 35 sec. Dornier's record is 4 min. 30 sec.

High-Speed Turns

Helicopter exhibited extreme maneuverability and was able to execute high-speed 180-deg. turns well within the confines of the 5-acre demonstration field.

Banking angles were approximately 60 deg.

During several overhead passes at an altitude of 30 ft. and a speed of 70 mph., there was no noticeable rotor wash, due to the helicopter's low disk loading.

Maximum speed is 75 mph., and design maximum ceiling is 16,300 ft., although to date the helicopter has not flown higher than 13,000 ft.

Rapid Deceleration

Rapid deceleration for transition to hovering flight was accomplished by pitch-up.

Hover was stable, and Wissel performed several stationary 360-deg. yawing turns to left and right by use of the rudder.

Culmination of the flight was the autorotation demonstration. Wissel simulated engine failure by shutting down the engine at an altitude of approximately 200 ft. The helicopter made a controlled 60-deg. descent to 10 ft., where its speed was checked by a flare maneuver. Touchdown was gentle.

Autorotation Tests

Dr. Laufer said that the Do. 32 has successfully performed the autorotation tests prescribed by the U. S. Civil Regulations for helicopters, which include turns to the left and right before landing.

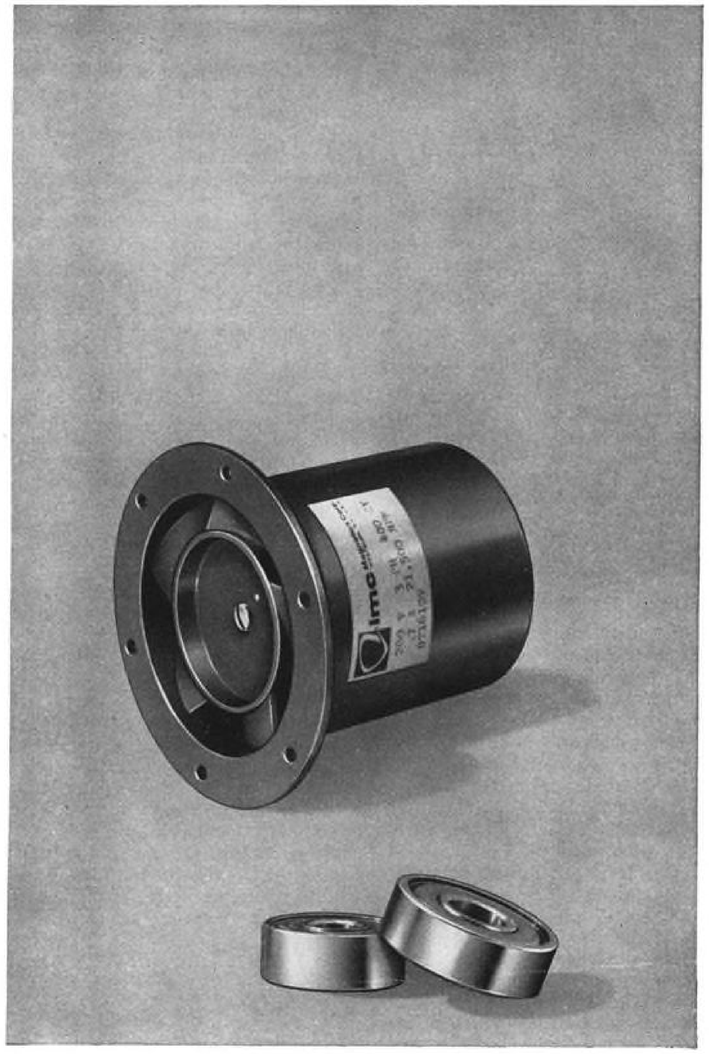
Dornier has conceived of a novel method for training pilots for the Do. 32.

The training plan involves the following steps:

- **Tethered flights**, in which several of the helicopters, complete except for the engines, are connected by flexible tubes to a large central air compressor, which supplies air for the rotors. The flight instructor is thus able to coach several students simultaneously via radio commands.
- **Dual control training** in any available helicopter.
- **Solo flight** in the Do.32.

Do.32 Specifications

Fuselage length	10.5 ft.
Height	6.2 ft.
Landing gear track	6.76 ft.
Rotor diameter	24.6 ft.
Rotor disk area	474 sq. ft.
Rotor chord	0.65 ft.
Empty weight	324 ft.
Normal take-off weight	595 lb.
Maximum gross weight	700 lb.
Maximum speed	75 mph.
Cruise speed	62 mph.
Maximum rate of climb at sea level	1,575 fpm.
Cruise range	56 mi.
Endurance	50 min.



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You can run this fan, continuously, at extreme temperatures for 3, 5, 10, or more years, at any speed.

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No other line of vaneaxial fans have this ability.

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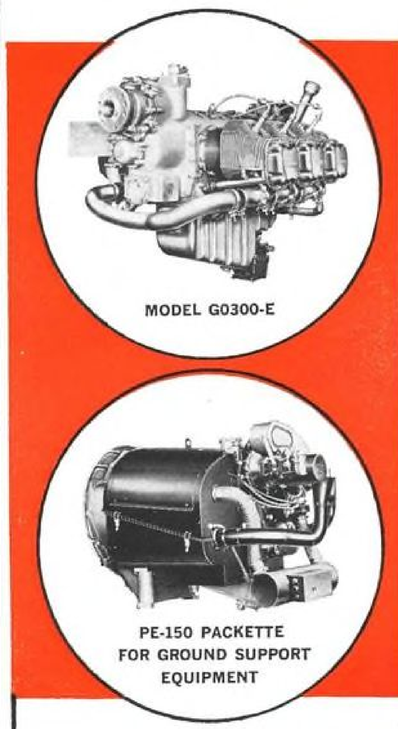

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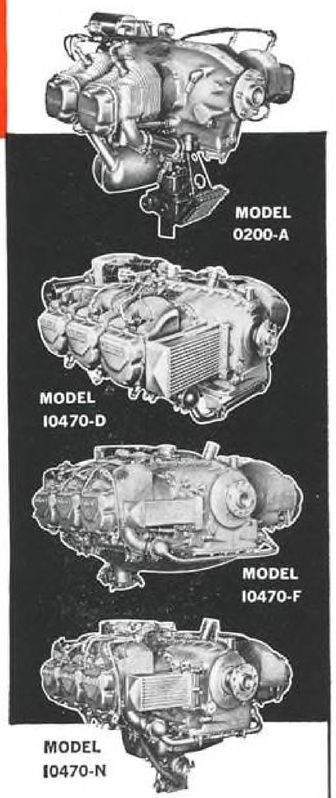

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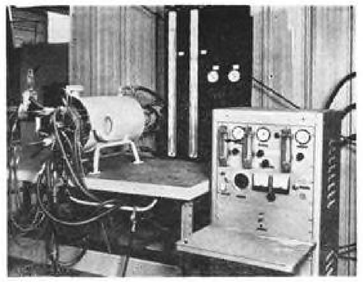
Small scale, arc-heated hyperthermal tunnel simulates temperature and gas density conditions of re-entry. Tunnel consists of a plasma generator, supersonic nozzle, control console, 80 kw. nominal input power supply, test chamber, vacuum pump, piping and power cable package.



It requires approximately 15 × 10 ft. floor area. Basic to the device is a plasma generator which combines an electric arc with a continuously released independent gas source. A high velocity, high temperature nearly neutral plasma stream is discharged by the generator into the aerodynamic mixing chamber and nozzle assembly where it is expanded at supersonic velocity.

Arc is initiated by an automatic starting system. With the stable jet operating, the desired nitrogen and oxygen flow rates and power inputs can be set. A safety interlock between the cooling water and the gas pressure prevents operation of the tunnel without adequate flow rates.

Plasmadyne Corp., Giannini Scientific Co., 3839 S. Main St., Santa Ana, Calif.

Attitude Control Valve

Attitude control valve has response time of 10 milliseconds actuation to full open and a specific impulse of over 70 sec.

Circle Seal V4082 valve is designed for direction or stability control of missiles and space vehicles.

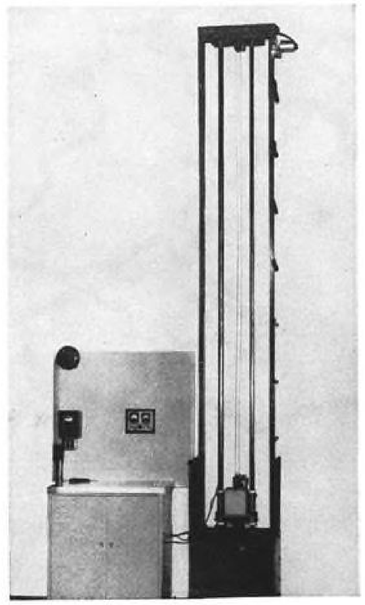
Valve can operate with or without system pressure through internal pilot actuation of interlocked pilot and a bistable poppet valve.

James, Pond & Clark, Inc., 2181 East Foothill Blvd., Pasadena, Calif.

Shock Test Machine

Machine consists of a vertical tower mounted on a reinforced concrete base with a steel target bed. A movable carriage is hoisted to a specified height and allowed to fall vertically by gravity to strike an expendable metal or plastic slug located on the target bed.

Machine is designed for reproducible environmental testing of components up to 3,600g. An accelerometer, which can be mounted in one of several positions on the sample or traveling carriage, provides a dynamic, linear readout.



The shock pulse is recorded photographically from an oscilloscope trace which is actuated at impact on the target.

Livingston Electronic Corp., Montgomeryville, Pa.

Servo Test System

Test system automatically plots data on an X-Y recorder which receives load flow, hysteresis, pressure gain, null shift and bias, leakage and calibration information from a static test console. Frequency response, amplitude ratio and phase lag measurements are made with

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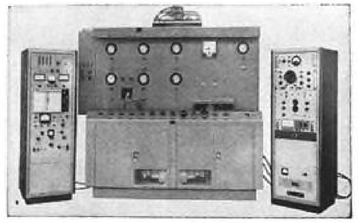

an oscilloscope and vacuum tube voltmeter located in the dynamic testing console.

Unit will test electrohydraulic servovalves and related equipment, according to the manufacturer. The hydraulic power supply is equipped with a variable displacement pump with flow rates up to 10 gpm. and automatic temperature controls associated with a heating and cooling system which allows high or low temperature testing with either console.

Static and dynamic testing can be done individually or simultaneously with two parallel circuits in the hydraulic power supply. Power supply required is 220/440 v.a.c., 60 cps. electricity and water.

Vickers, Inc., Div. of Sperry Rand Corp., Detroit 32, Mich.

Diagramming Machine

Machine produces diagrams and schematics from pencil sketches using standard letters, numerals and symbols. Finished product is a photographic film or paper 28 × 40 in. or larger if an optional roll-film magazine is used.

Machine operator selects and positions symbols required to produce diagram from push-button control panel.

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Mergenthaler Linotype Co., 29 Ryerson St., Brooklyn 5, N. Y.

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*without disabling keyed clamp or dc restorers

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RYAN X-13 VERTIJET, world's first jet VTOL aircraft was developed under Air Force and Navy contracts dating back to 1946. This was the first aircraft to demonstrate feasibility of vertical jet take-off with transition to level flight.

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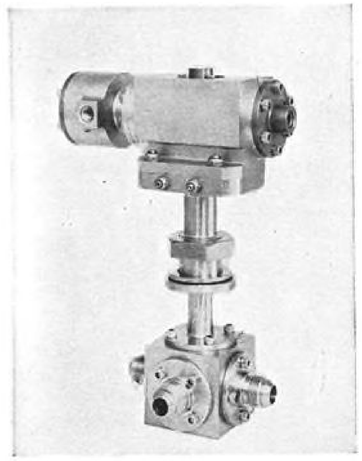
powder to form a seal over the surface of the fire resulting in oxygen deprivation. Available in 40 lb. pails.

Walter Kidde & Co., Inc., Belleville, N. J.

Cryogenic Valve

Three position, three-way cryogenic ball valve will handle liquid hydrogen and helium. A manually or remotely controlled type is available.



Valve is designed to control several flow patterns in a single valve such as cool down, straight-through flow and vent or purge and can be installed in a vacuum chamber with external remote actuator.

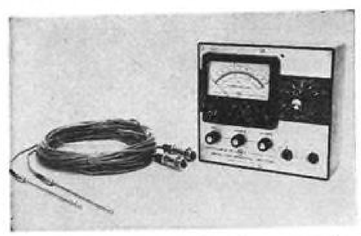
Sizes range from ¼-10 in. with pressures from 150-6,000 psi.

Flodyne Controls, Inc., 1701 Elizabeth Ave., East Linden, N. J.

Differential Temperature Indicator

Model 4116 temperature indicator reads directly differential and absolute temperature on one instrument face.

Temperature differences from 0-100F with a precision of within ¼ deg. can be measured. The absolute temperature scale is from −50 to +300F.



Unit is designed for heat transfer measurements of heat exchangers, refrigeration and air conditioning systems. With slight modification, unit can be used in the cryogenic region, according to the manufacturer.

Winsco Instruments & Controls Co., 1533 26th St., Santa Monica, Calif.

Portable Dividing Head

Model DH-8 portable dividing head makes angular measurements of all types of rotating components. Components are supported from their own shafts by a universal holding arm which prevents force errors. Components can be rotated 360 deg. clockwise or counter-clockwise with an accuracy of ±5 sec. of arc.

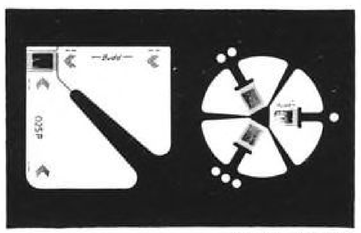
Detent mechanism allows 2 sec. of arc repeatability. Four standard Levin ww-type collets, furnished with each unit, accommodate shaft diameters of 0.093, 0.125, 0.187 and 0.250 in. Other collet sizes and special holding arms are optional.

Dividing head weighs approximately 25 lb., is 12 in. high, 12 in. wide and 13 in. deep.

Gertsch Products, Inc., 3211 S. La Cienega Blvd., Los Angeles, Calif.

Microminiature Strain Gage

Strain gage works in very close quarters and can be applied to missile and aircraft structures, pressure vessels and bulkheads, small scale models, turbine and fragile miniature mechanical components.



Single element gage, CX-F1X1M25, is .1875 x .1875 in. (3/16 in. sq.) with over-all grid lengths and widths of .025 in.; single grid width of .0007 in. and gage thickness of .0001 in.

Three-element rosette gage (120 deg.), CX-F1X1M31R3C, has over-all diameter of .1875 in. with over-all grid lengths and widths of .031 in., .0001 in. gage thickness.

Budd Instrument Division, Box 245, Phoenixville, Pa.

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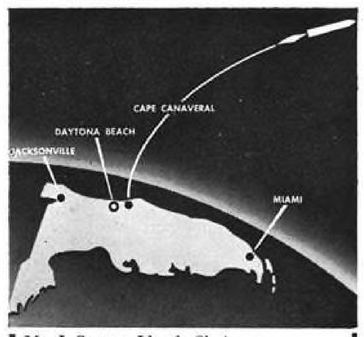

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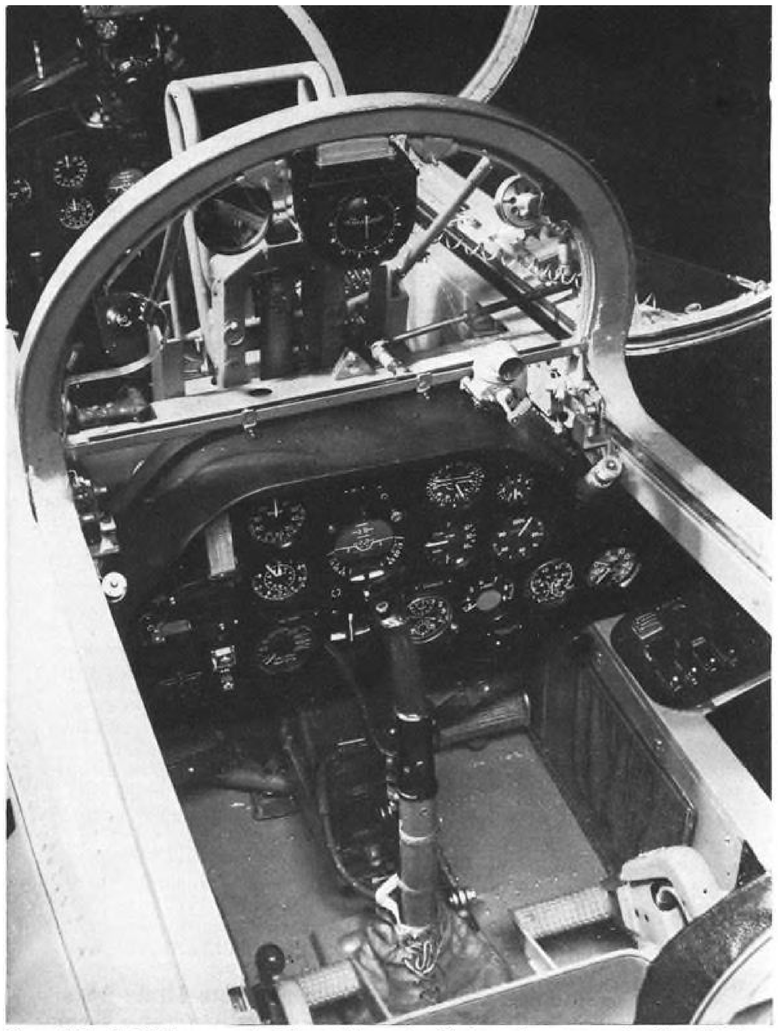
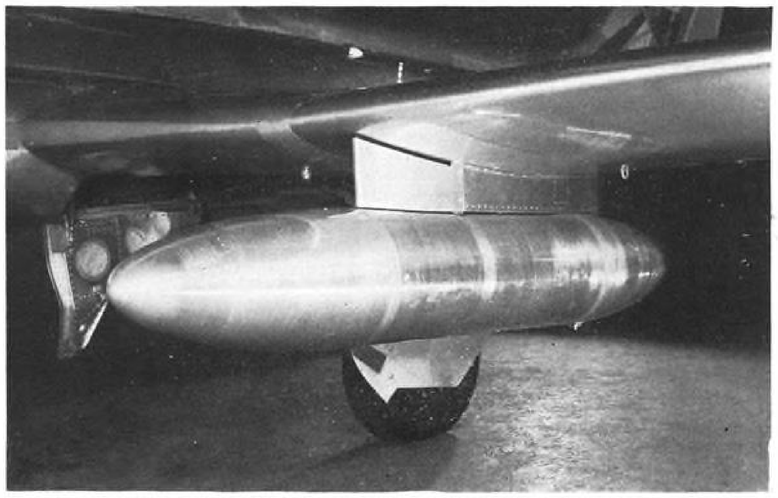


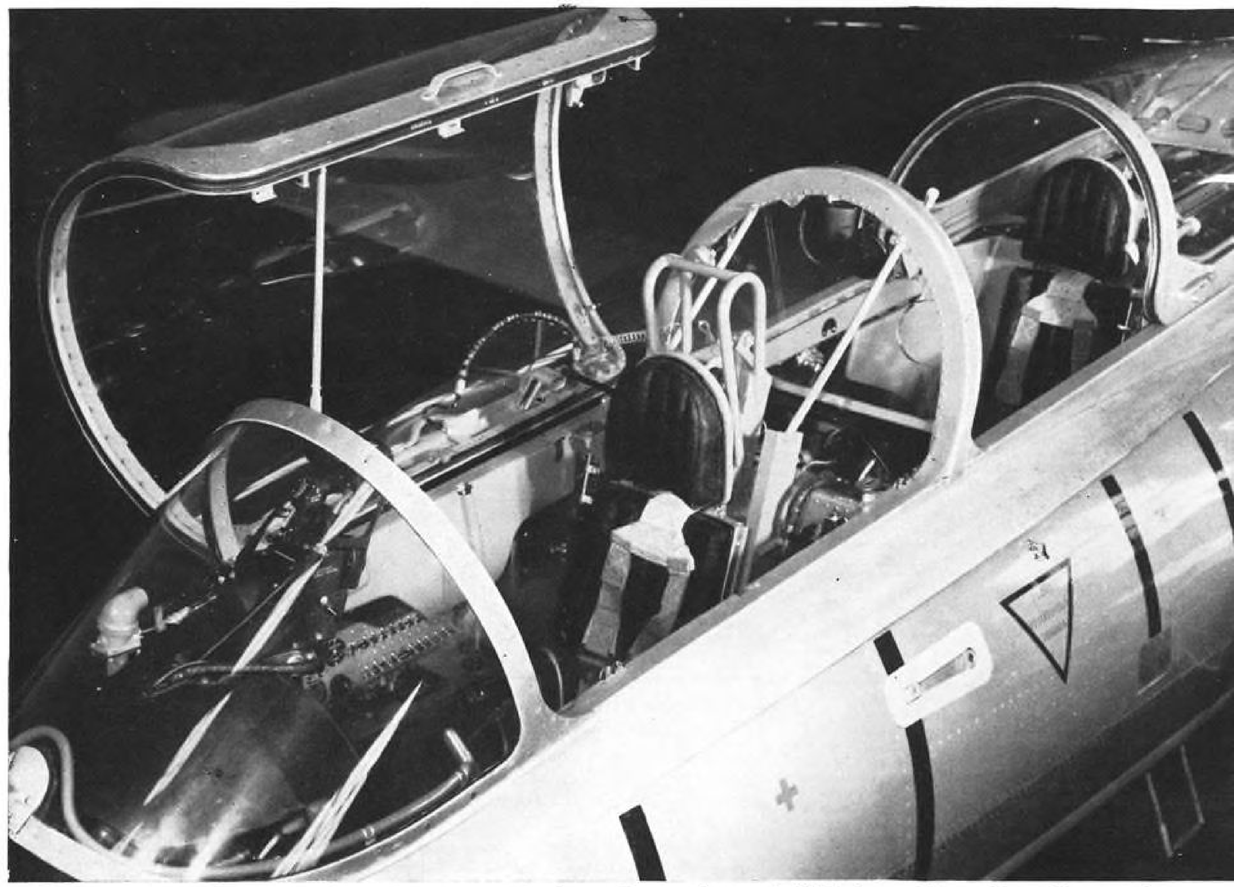
View of Czech L-29's rear cockpit layout shows simplified panel arrangement with attitude indicator in center position. At far left is an instrument which appears to be a warning light, with six positions allocated for various systems.



Use of external fuel tanks on L-29 jet trainer stretches endurance at 16,000 ft. from 107 to 150 min., according to the aircraft's designers. Powerplant is a Walter Minor M-701 turbojet delivering 1,962 lb. thrust.

Czechoslovakia's L-29 jet trainer, first Czech-built jet to go into series production (AW Apr. 22, p. 89), is fitted with auxiliary fuel tanks installed under the wing just outboard of the main landing gear. Trapezoidal straight wing includes slotted flap arrangement. Semi-monocoque fuselage is constructed of aluminum, with steel alloys used in areas of concentrated loads.

L-29 Cockpit Details, Auxiliary Tanks Shown



Cockpit canopy is hand-operated and secured in open position by a rod connection to windshield frame. Note rubber sealing around canopy frame to ensure cabin pressurization. Both seats in the Czech-built trainer have ejection capability.

Carriers File CAB Salary Reports

United Air Lines, Inc.—W. A. Patterson, President, $100,000 salary, 12,642 shares of common stock; **G. E. Keck,** Executive Vice President, General Manager, $63,333 salary, 353 shares of common stock; **Curtis Barkes,** Executive Vice President-Fin. and Prop., $59,333 salary, 8,510 shares of common stock; **D. R. Petty,** Senior Vice President-Flight Operations, $59,333 salary, 3,819 shares of common stock; **R. E. Johnson,** Senior Vice President-Marketing and Serv., $55,333 salary, 3,484 shares of common stock; **A. M. de Voursney,** Executive Vice President-Econ. Planning, $50,000 salary, 1,673 shares of common stock; **W. C. Mentzer,** Senior Vice President-Eng. and Maint., $48,000 salary, 2,854 shares of common stock; **R. F. Ahrens,** Senior Vice President, Assistant to the President, $44,000 salary, 6,410 shares of common stock; **C. F. McErlean,** Senior Vice President-Law, $43,000 salary, 2,569 shares of common stock; **I. E. Sommermeyer,** Vice President-Flying, $39,667 salary, 347 shares of common stock; **C. M. Mason,** Senior Vice President-Personnel, $39,333 salary, 590 shares of common stock; **F. A. Brown,** Senior Vice President-Customer Serv., $39,000 salary, 270 shares of common stock; **W. E. Rhoades,** Vice President-Eng., $36,667 salary, 406 shares of common stock $7,000 debentures; **O. T. Lerson,** Vice President-Customer Serv., West, $36,333 salary, 1,108 shares of common stock; **J. M. Hodgson,** Vice President-Communications, $36,167 salary, 662 shares of common stock, 834 shares of common stock in the name of others; **H. E. Nourse,** Senior Vice President-Econ. Planning, (retired 12/31/62), $36,000 salary, 6,400 shares of common stock; **M. H. Whitlock,** Vice President-Line Maint. $35,000 salary; **B. B. Gregg,** Vice President-Sales Serv., $33,000 salary, 1,652 shares of common stock, 437 shares of common stock in the name of others; **H. J. Merchant,** Vice President, General Sales Manager, $31,500 salary, 495 shares of common stock, 419 shares of common stock in the name of others; **O. C. Enge,** Vice President-Customer Serv. Devel., $31,333 salary, 1,571 shares of common stock; **R. E. Bruno,** Vice President, Treasurer, $31,333 salary, 680 shares of common stock, 59 shares of common stock in the name of others; **R. M. Ruddick,** Vice President, Assistant to the President, $31,333 salary, 317 shares of common stock; **D. V. O'Leary,** Vice President-Purchasing, $30,500 salary, 1,197 shares of common stock; **W. E. Alberts,** Vice President-Management Services and Contr., $28,200 salary, 468 shares of common stock; **C. E. Haneline,** Vice President-Customer Serv., East, $27,667 salary, 337 shares of common stock, 63 shares of common stock in the name of others; **D. C. Meenan,** Vice President-Facil. and Prop., $26,833 salary, 152 shares of common stock; **J. E. Moore,** Vice President-Traffic, $26,533 salary, 2,465 shares of common stock; **P. A. Wood,** Vice President-Maint., $26,333 salary, 189 shares of common stock; **S. P. Martin,** Secretary of the Corporation, $26,000 salary, 2,301 shares of common stock, $1,000 debentures; **L. F. Hampel,** Vice President-Bus. Econ., $23,767 salary, 587 shares of common stock; **G. R. Harms,** Comptroller, $21,333 salary, 41 shares of common stock; **D. S. Ritner,** Vice President-Emp. Devel., $21,333 salary, 411 shares of common stock; **R. L. Mangold,** Vice President-Sales Planning, $20,621 salary, 22 shares of common stock; **Martin C. Ansorge,** Director, $3,400 salary, 1,325 shares of common stock, $3,000 debentures; **Paul A. Bissinger,** Director, $3,100 salary, 1,867 shares of common stock; **H. Templeton Brown,** $3,400 salary, 537 shares of common stock; **Gardner Cowles** Director, $3,300, salary, 106 shares of common stock; **Justin W. Dart,** Director, $3,200 salary, 1,152 shares of common stock; **Thomas F. Gleed,** Director, $3,300 salary, 852 shares of common stock; **Paul G. Hoffman,** Director, $3,100 salary, 1,458 shares of common stock, $7,600 debentures; **Eric A. Johnston,** Director, $3,300 salary, 3,737 shares of common stock; **John J. Mitchell,** Director, $3,300 salary, 6,040 shares of common stock; **Aksel Nielson,** Director, $3,400 salary, 1,286 shares of common stock, $10,000 debentures; **Vernon Stauffer,** Director, $3,300 salary, 2,385 shares of common stock, $10,000 debentures.

Expense figures for United Air Lines' officers will be filed later.

Eastern Air Lines, Inc.—J. H. Brock, Vice President, $26,000 salary, $1,383 expenses, 1,154 shares of common stock; **A. L. Chabat,** Vice President, $32,938 salary, $4,011 expenses, 1,062 shares of common stock; **T. E. Creighton,** Executive Vice President and Secretary, $27,792 salary, $213 expenses, 1,000 shares of common stock; **H. W. Cutshall, Jr.,** Vice President (entered office 9/7/62), $18,771 salary, $270 expenses, 11 shares of common stock; **R. D. Eiland,** Dep. Vice President (entered office 9/7/62), $5,673.55 salary, $442 expenses, 114 shares of common stock; **R. W. Fellows,** Dep. Vice President (entered office 9/7/62), $5,493 salary, $1,510 expenses, 110 shares of common stock; **C. Froesch,** Vice President, $26,000 salary, $1,792 expenses, 2,620 shares of common stock; **L. S. Garlock,** Vice President (entered office 1/23/62), $26,248 salary, $5,925 expenses; **E. E. Hahn,** Assistant Controller, $16,875 salary, $1,967 expenses, 57 shares of common stock; **J. H. Halliburton,** Executive Vice President, $35,000 salary, $1,885 expenses, 600 shares of common stock; **J. O. Jarrard,** Vice President, $28,959 salary, $7,702 expenses; **M. Lethbridge,** Executive Vice President, $27,792 salary, $2,648 expenses, 100 shares of common stock; **R. S. Lipp,** Vice President, $18,292 salary, $332 expenses, 101 shares of common stock; **M. A. MacIntyre,** President, Director, $80,000 salary, $1,100 bonus and indirect compensation, $9,344 expenses, 102 shares of common stock; **R. J. Mahn, Jr.,** Assistant Controller (entered office 12/7/62), $1,466.95 salary, $101 expenses; **C. M. Moni,** Vice President (entered office 9/7/62), $9,948.90 salary, $1,273 expenses; **R. F. Moore,** Dep. Vice President, $24,584 salary, $1,490 expenses; **E. V. Rickenbacker,** Chairman of the Board $49,038.40 salary, $800 bonus and indirect compensation, $11,654 expenses, 24,549 shares of common stock; **V. G. Rowland,** Dep. Vice President (entered office 9/7/62), $10,446.58 salary, $587 expenses, 502 shares of common stock; **M. A. Selinger,** Dep. Vice President, (entered office 9/7/62), $5,069.30 salary, $1,426 expenses, 1 share of common stock; **F. Sharpe,** Executive Vice President (entered office 9/7/62), $27,167 salary, $2,815 expenses, 100 shares of common stock; **C. J. Simons,** Controller, $19,959 salary, $3,401 expenses, 34 shares of common stock; **G. A. Smith,** Vice President, $27,500 salary, $5,270 expenses, 1,530 shares of common stock; **F. A. Stone,** Vice President (entered office 9/7/62), $10,702.14 salary, $280 expenses, 391 shares of common stock; **R. L. Turner,** Director, Senior Executive Vice President (entered office 9/7/62), $38,230 salary, $1,000 bonus and indirect compensation, $4,191 expenses, 102 shares of common stock; **W. Van Dusen,** vice President, $27,217 salary, $3,161 expenses, 1,516 shares of common stock; **C. A. Wallen,** Treasurer and Assistant Secretary, $20,584 salary, $1,481 expenses, 6 shares of common stock; **J. C. Warlick,** Assistant Secretary, $12,250 salary, $143 expenses, 19 shares of common stock; **W. R. Winn, Jr.,** Vice President, $22,584 salary, $2,872 expenses.

Boeing Sales

Boeing Co. management reported to stockholders that first quarter 1963 sales totaled $483.8 million with earnings of more than $4.4 million, equal to 55 cents per share.

Last year's earnings for the same period were $8 million, equal to $1.01 per share. Order backlog on Mar. 31, 1963, was about $1.6 billion.

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The explored and unexplored regions of the future offer endless challenges. Dalmo Victor's contributions in five chosen areas of specialization offer career opportunities to men of vision, imagination and skills:

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2 AEROSPACE TRACKING SYSTEMS Massive ground-based command and control stations provide tracking and communications for vehicles making deep space penetrations. Dalmo Victor has the capabilities of producing complete complexes, from basic design to erection.

3 MICROWAVE SYSTEMS Dalmo Victor has been deeply committed in microwave systems for many years. Leadership has been established in telemetry, automatic tracking, countermeasures, and distance measuring with capabilities for satellite rendezvous control and soft lunar landings.

4 MAGNETIC SYSTEMS Another Dalmo Victor achievement area, involving such unique developments as anti-submarine and undersea warfare systems, space vehicle stabilization and attitude control systems, and other contributions in magnetics, and in related fields.

5 GROUND SUPPORT EQUIPMENT In participation with California Technical Industries, another Textron company, Dalmo Victor supplies a wide range of ground support and ground environment equipment. From a highly effective combination of facilities and talents, Dalmo Victor provides important single-source responsibilty.

The page opposite describes one of the many Dalmo Victor achievements. Scientists and engineers of unusual ability are needed to further this and other Dalmo Victor concepts. If you would like to work in this creative atmosphere, and enjoy the many advantages of living in the San Francisco Peninsula area, investigate a career with Dalmo Victor. It can be most rewarding.

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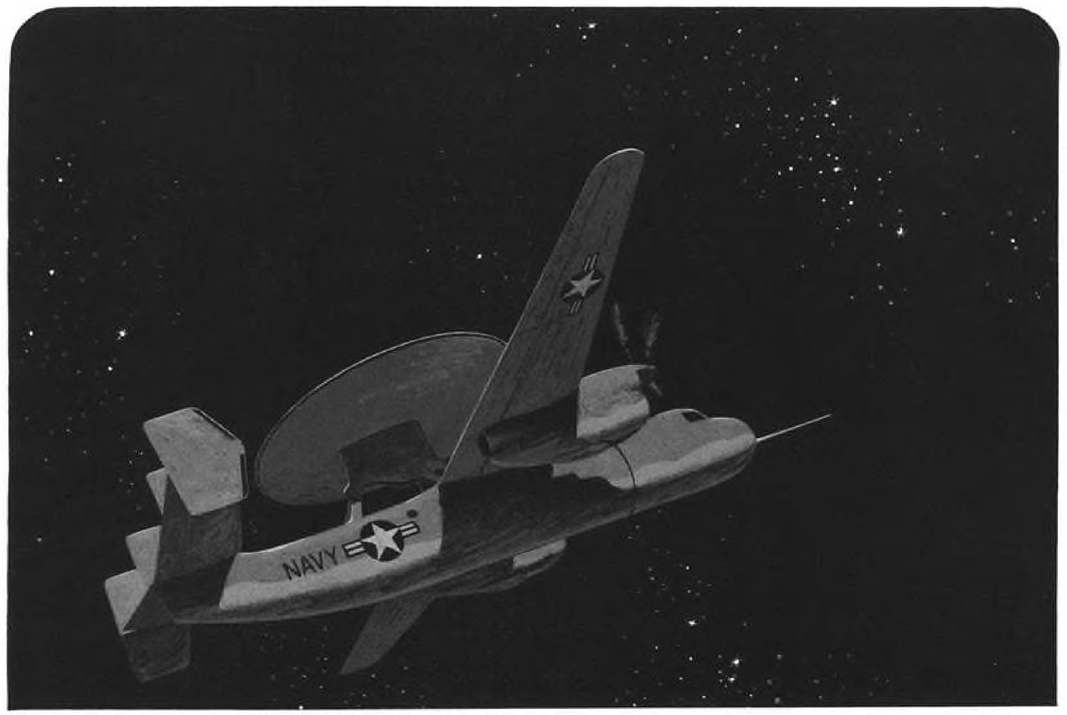

DALMO VICTOR EXTENDS NAVY'S "SEE" AT SEA *"Rotodome" antenna system, a Dalmo Victor development, is a key factor in the early warning system that gives the fleet increased threat detection and weapon deployment. The "Rotodome" antenna structure combines aerodynamics, plastics, microwave and mechanical design concepts into a single unit which is an integral part of the carrier-based Grumman Hawkeyes. This super-sensitive, long-range detection equipment is another example of Dalmo Victor's fully integrated systems capability. Dalmo Victor is in the vanguard of new developments in its major product areas.* ***If you are interested*** *in becoming a part of these challenging programs, Dalmo Victor is currently inviting applications from qualified scientists and engineers. For further information contact: Director, Scientific and Engineering Personnel. An Equal Opportunity Employer.*

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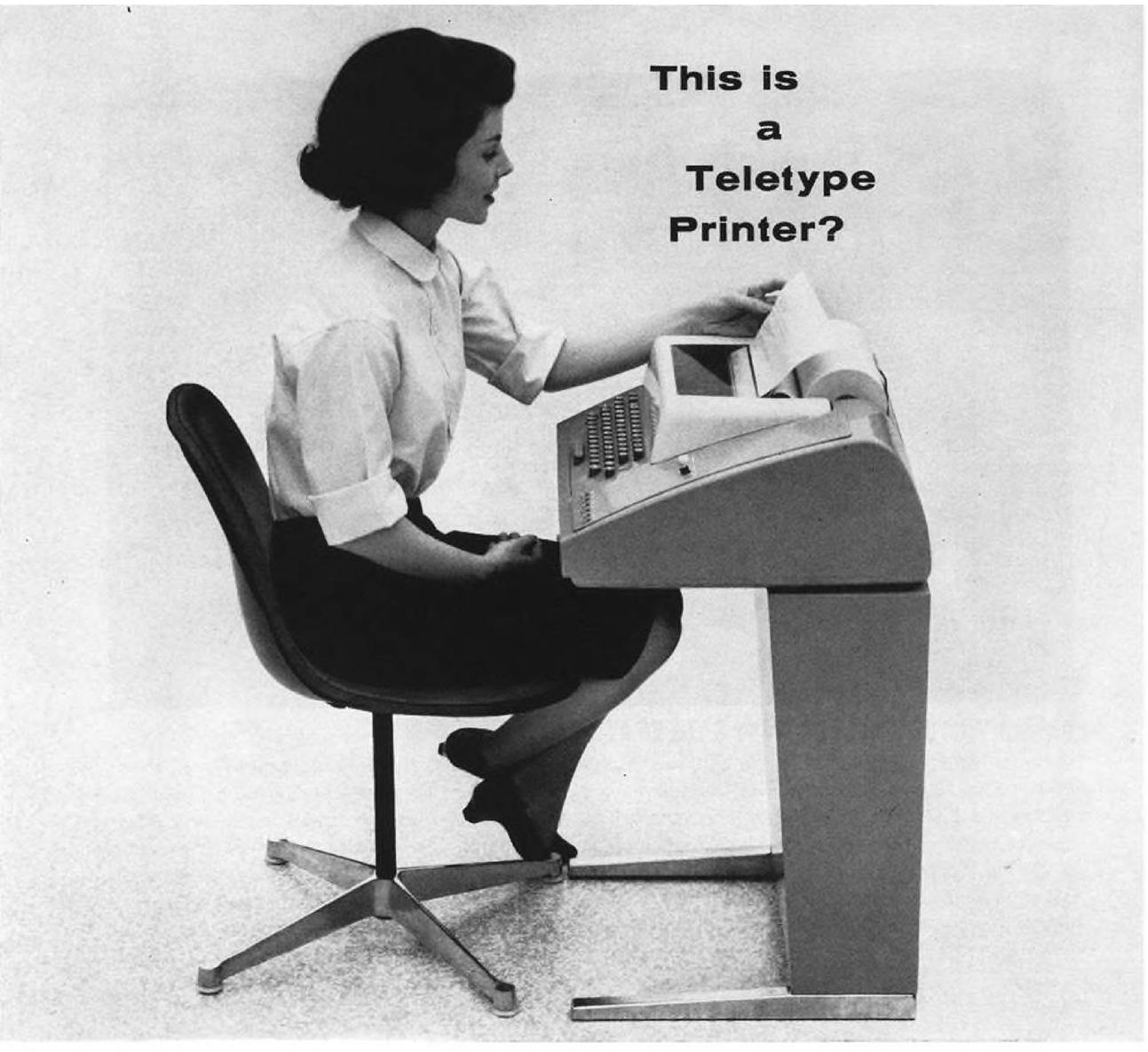

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You see, we designed the Model 33 to fit a new set of requirements. It has a 4-row keyboard that eliminates shifting for figures and common punctuation marks. This saves operator time, cuts errors and means that every typist in your office can be a competent operator with only a few minutes' instruction.

The Model 33 uses a new 8-level message and data communications code. The 8-levels make it compatible with many computers and data handling systems.

Styling—while it's just part of what's new—is smart, functional, and as modern as a man-made satellite. Features include lighted push-button controls, easy paper insertion, and automatic station identification.

There are three models in this compact, economical "33" group—the send-receive printer with keyboard, the receive-only printer without keyboard, and the automatic send-receive set with self-contained tape punch and reader.

For users who require a 5-level communications code, there is a new Model 32 group with similar styling and economy.

We would like to send you more information on this new Teletype message and data communications equipment. Contact: Teletype Corp., Dept. 82F, 5555 Touhy Avenue, Skokie, Illinois.

This equipment is made for the Bell System and others who require dependable communications at the lowest possible cost.

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Industry Doubts Report to Bring Changes

By William H. Gregory

Washington—Industry reaction to a year-long $165,000 industry-government relationship study sponsored by the Aerospace Industries Assn. is generally one of skepticism that it will lead to any fundamental changes.

Completed by the Stanford Research Institute under contract, the study is designed to provide an objective basis for pleading the industry's case in such areas as level of profits or degree of detailed government supervision of contracts.

Industry Dubious

Dubious attitude of industry is due to several causes, one which is touched on only obliquely in the study. This is the current competitive scramble for contracts. As one industry source observed: "The government people must wonder, 'Why are you guys fighting so hard for this kind of business if it's so bad?'"

Two other important reasons are spelled out specifically in the study:

- **Almost complete dependence** of the aerospace industry on government business.
- **Industry's reluctance** to oppose government desires, to argue with the customer, a tradition some government administrators have learned to count on in negotiations.

"The preponderance of bargaining strength in the [industry-government] relationship," the study said, "is clearly on the government's side. Its strength comes through control of funds, definition of goals, timing and technique, encouragement of competition, participation in management, the applications of political pressure, and power to terminate contracts and retroactively to reduce prices and profits."

In the same vein the study adds:

"However much it might wish to the contrary, a major portion of the industry is not 'free enterprise' in the classic sense of the term, and does not operate as such."

In still another context, the report asserts that: ". . . Government regulations and procedure, to some degree, transform the members of the aerospace industry into closely controlled agents of the government for the operation of 'arsenals' for modern weaponry and space exploration. The anomaly is that the aerospace firms are expected to act with the drive, efficiency, and flexibility usually attributed to private enterprise."

Some recommendations are contained in the study, although its central purpose was to assess the state of the industry-government relationship—a state the study describes as one of discomfort and disenchantment on both sides.

Both industry and government should take steps to improve the relationship, the study says, but it places the burden of taking the initiative on industry.

"Industry is usually blamed for the fact that the relationship is not as creative, productive, or satisfactory as it should be," the study said. "As a consequence, industry must either assume a more assertive role in developing the rules of the Industry-Government Aerospace Relationship, or see its own effectiveness continue to diminish."

Creativeness Factor

This creativity, the fact that much of the nation's capability to design and produce the increasingly sophisticated hardware required for national defense, is industry's strongest lever in the relationship, the study says, and it adds:

"Industry collectively retains most of the capability, initiative, and creativeness to accomplish the complex tasks that appear necessary to assure the nation's survival.

"It is industry that is supposed to be able to utilize the nation's resources of manpower, money, and material in the most efficient ways. It is industry that is in a position to recognize the real cost and time delays involved in the govern-

Reduced Supervision Credited for Agena D Savings

"Disengagement"—a reduction in detailed government supervision and review of an aerospace contract—led to significant savings in cost and time in the initial development of the Lockheed Agena D space vehicle, an AIA-sponsored study of industry-government relations asserts.

Air Force sources do not accept disengagement as the reason for the saving, however. Instead they ascribe the principal cause to holding down design changes—freezing the design.

Original estimate for the Agena D program, begun in 1961, called for 15 months to rearrange the vehicle so that it could accept any of various payload packages without modification instead of the special tailoring required with the earlier Agena series. A modest state-of-the-art advance also was contemplated.

This time scale was unsatisfactory to the Air Force, and the program, despite apprehensions on the part of both government and contractor, was given special handling, according to the study performed by the Stanford Research Institute. The results listed by the study:

- Reduction of completion time to 7½ months.
- Cost cut almost in half.
- All vehicles delivered on schedule or within the limited grace period, and all fired successfully.

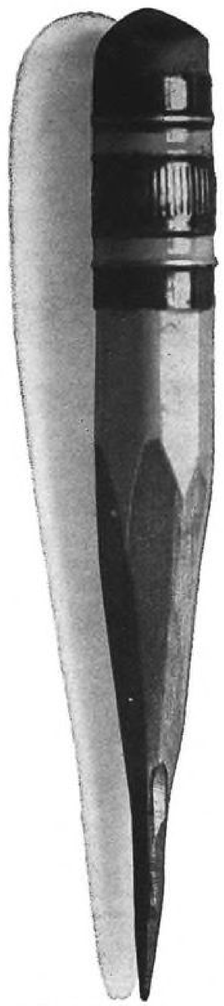
Included in the special handling, according to the AIA report, were assignment of hand-picked Air Force and contractor personnel to the program, the latter relieved of all other company duties; isolation of the program physically at the plant, with only six Air Force personnel allowed access to the area, and assignment of the highest priority in the contractor's plant—DX-1A.

Other key factors credited by the study with the results of the program:

- Air Force and company officers had full responsibility and latitude in their respective areas. Approval by Air Force of vendor selection was obtained on the spot, and the Air Force waived requirements for detailed, formalized engineering reports, and for MIL specification compliance of drawings until the design was made final.
- Specifications were agreed to promptly and changes were kept to a minimum.
- USAF program officer had access to the entire program funding from the inception of the program.
- Significant time saving resulted from shielding the program from technical directive meetings, group visits, and from the briefing of persons not directly concerned with the program.

"In view of those who participated," the study said, "the experiment was a success. Unfortunately, however, it has not been the pattern either for additional experiments or for major operations."

The study did not note that the program may also have been part of the urgent U. S. space surveillance activities. This factor may have been a critical one in the special handling of the program.



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ment's attempts to utilize defense and space contracts to achieve social and economic ends.

"It is industry—not government—that could more aggressively lead the way in developing newer and more efficient means of reaching hardware goals. Industry should recognize these possibilities, these challenges, and not dissipate its talents by devoting its entire attention to defending itself, occasionally without justification, and often ineffectively, against what it considers to be over-regulation and 'overmanagement' by the government.

"Just as the government should be forbearing in the use of its sole customer leverage in dealing with industry, so should industry, through a code of operating principles, avoid what some may construe as unethical practices arising from a tendency, intentional or not, to take advantage of the government's personnel and procedural limitations. 'Let the buyer beware' is an attitude that should not apply in this relationship. Nor should destructive competition be encouraged.

Among the recommendations are some that the study says ought to be initiated by industry, by government, or by both. Industry is encouraged to:

• **Stimulate government** disengagement from its position of overmanaging industry by developing and suggesting simpler, more effective and less costly surveillance techniques.

• **Consolidate** industry's point of view on critical issues.

Government is encouraged to:

• **Depend on end results** not detailed in process review of contractor activities.

Both are urged to:

• **Simplify regulations** and eliminate conflicts and confusion.

• **Organize top level** industry-government discussions of problems, and conduct seminars for working-level personnel on application of policies.

Much of the study is devoted to drawing a financial profile of the aerospace industry, comparing public data as well as proprietary information, obtained through a study questionnaire from a selected group in the industry, with a cross section of 100 manufacturing corporations.

In drawing these comparisons for the aerospace group, based on questionnaire replies from 27 companies covering the years from 1947 to 1961, the study relies heavily on a profit measuring yardstick that rarely has been used in previous evaluations. This is profit margin on total assets.

Though the study also compares profit margin on sales and profit margin on net worth—the two commonly used criteria—the Stanford group favors the total assets rate of return method as a better basis for analyzing results of companies with dissimilar financial structures. This figure indicates the effectiveness with which all of a company's economic resources are employed, the study says, and is thus more an over-all measure of earning performance than return on net worth or total capital.

Rate of Return

For the entire period, the study found the median rate of return for the aerospace group was 7.4% on total assets compared to an 8.3% median for the cross section of manufacturing companies. A subsequent article will cover this complex subject in greater detail.

Two points made by the study in this general area should be noted, however:

• **Greater risks** that current government policy is requiring industry to assume do not appear to be adequately recognized by provision for greater compensation.

• **Aerospace companies** are more comparable to an architect-engineering type of company than to general manufacturing companies.

Transition from a manufacturing type of operation is causing readjustment of industry thinking on overhead costs, the study observes. Traditionally the industry recovered a major part of its costs from overhead charges on its extension production activity that no longer exists.

Technical Profile

A technical as well as a financial profile of the industry was drawn in the study, and a possibly significant trend in employment ratios was found that may be a direct reflection of the increased amount of detailed supervision by government.

Scientists and engineers as a proportion of total employes increased 113% between 1955 and 1961, while the total number of production workers declined.

But an even larger increase—163%—occurred in the figures for personnel that were engaged in management, scheduling and control, procurement and services.

"A significant part of the increase in 'other salaried' employes," the study said, "can be laid to the growing accumulation of regulations, audits, and management liaison and control systems, such as PERT, associated with government procurement."

Reasons for this accumulation is the gist of a key problem area cited by the study—the lack of mutual respect and confidence between industry and government.

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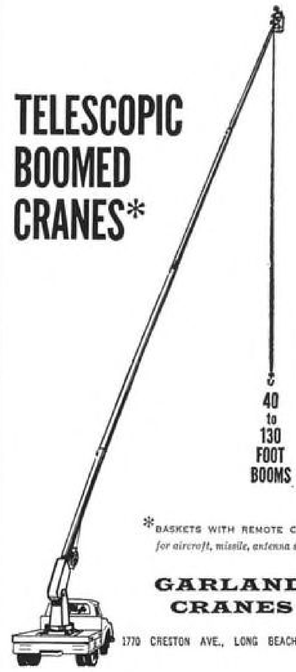

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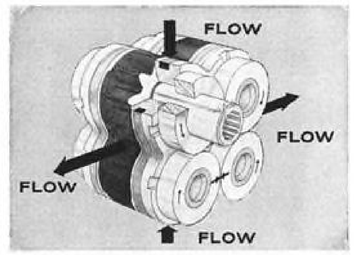

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feel industry can always be depended on to fulfill its contractual obligations on time or at reasonable cost without close supervision or risk-carrying incentives, the study says.

Industry, for its part, is more and more concerned that its technical performance, costs, income and reputation are being adversely affected by over-regulation, conflicting regulations, close and not always capable government surveillance, and the burdening of the procurement process with socio-economic objectives (AW May 14, 1962, p. 26).

Calling attention to the lack of a free market environment to provide a natural adjustment of capacity with requirements, the study also discusses another area of conflict; this one over the role of the non-profit corporations.

Industry, the study says, is not concerned over existence of these corporations, which play an important role in improving program definition so that overruns and slippages can be avoided. Industry is concerned, however, that in their role as advisers to government these non-profit corporations appear to be taking over a portion of industry's role in conceiving new systems and components. They are also becoming increasingly active in research.

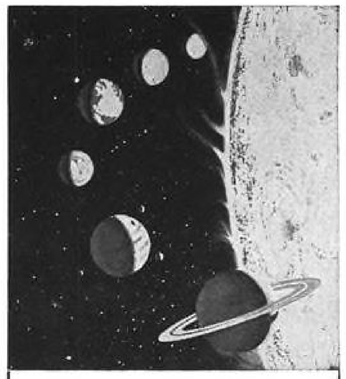
"A critical concern of industry," the study reports, "is the relatively aloof and sometimes competitive attitude of these special organizations in their consideration of industry's ideas. This is important because the livelihood of industry is increasing at the R&D level, where proprietary ideas are crucial."

The study also deals with industry shortcomings, either based on its own findings or from the standpoint of government. One such area, the study says, is industry's failure to appreciate fully the delicate interactions between government agencies in reaching important decisions on relationships with industry. Similarly, industry may not appreciate fully the effect to government officials concerned of overruns or slippages.

Industry, furthermore, does not appear to be exploiting commercial development of defense R&D sufficiently, the study said.

While the study notes the frequency and ease with which cost and contract audits are made, in contrast to the lack of any auditing of technical factors that might tend to even out the score, the study also takes note of specific government complaints resulting from management surveys.

Specifically cited were 13 complaints listed last year by Maj. Gen. W. T. Thurman, Air Force director of procurement management, based on USAF headquarters Industrial Management Assistance Surveys. A similar group later was discussed by Brig. Gen. G. F. Keeling, Air Force Systems Command deputy chief of staff for procurement and production, which also included data based on Systems Command's System Program Management Surveys. The problem areas included:



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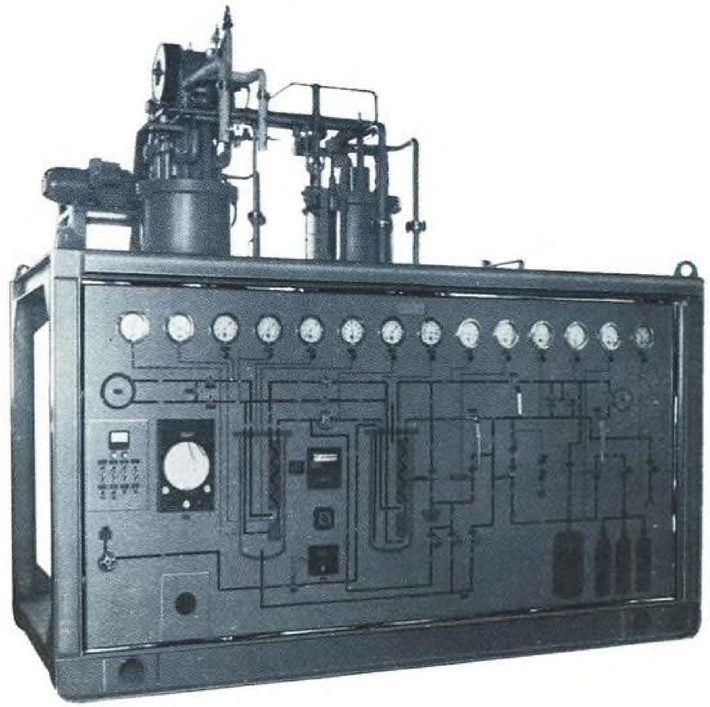
- **Cost control.** This was a broad area encompassing poor estimating, lack of correlation between cost proposals and actual cost experience, and loose budgetary and expenditure controls. One result has been loss of confidence in industry estimates that has led to late definitization of letter contracts caused by protracted negotiation over costs and contract language—in turn leaving a lack of contractual foundation for cost control.
- **Poor configuration control** stemming from inadequate management of engineering groups. At one company cited by Gen. Keeling, program management within the engineering departments had been decentralized to such an extent that no coordinated, effective direction and control of the system engineering program was exercised above the lowest two levels of engineering supervision. Both detailed definition of work and the cost estimates were reviewed and approved at these two levels. Results of poor configuration control are non-standard systems and complicated logistics support problems.
- **Lack of adequate techniques** for relating actual expenditures to task completion.
- **Subcontract management practices.** Noncompetitive awards to a single source without adequate price evaluation has been excessive, Gen. Keeling said, and there has been a serious lack of management of major subcontracts by prime contractors. Gen. Thurman also noted a lack of evaluation in the make-or-buy area called for in Armed Services Procurement Regulations.

"Although these shortcomings were significant," the AIA study comments, "this may be a case of the pot calling the kettle black. In 1958, the Air Force refused to release to the General Accounting Office the results of a not-too-favorable audit of a part of its own operation."

Regardless of the merits of this comment, it helps to illuminate the magnitude of the problem.

Led by the Office of the Secretary of Defense, the trend toward increased centralization of procurement by government shows no sign of abating. At the same time, industry is faced with justification of its own performance while coping with sometimes conflicting and sociological, political or economic requirements generated by other government agencies or Congress. In the case of failures, industry feels that all are penalized for the sins of the few.

Whether any change in this course



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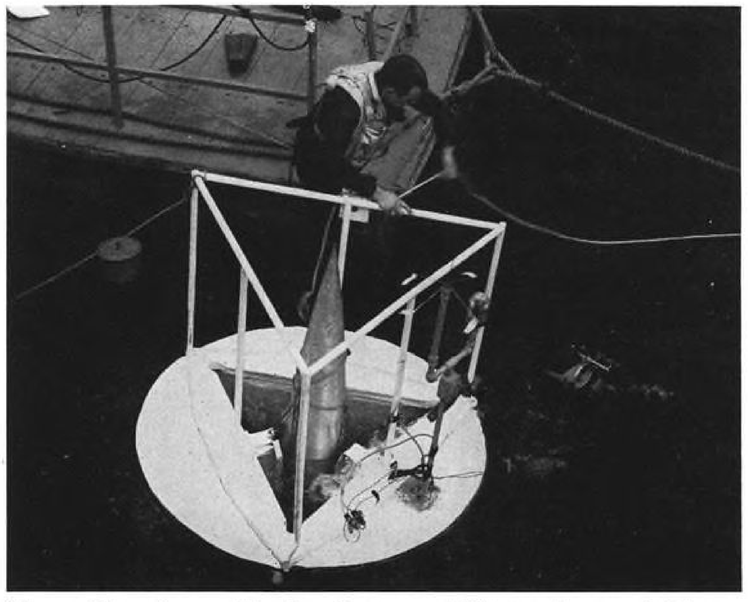


Navy Continues Hydra Concept Water Launch Tests

Two-stage missile will be launched from free-floating, vertical position at Pt. Mugu, Calif., as part of a series of tests being conducted by Navy to determine feasibility of the Hydra concept for launching large missiles. Hydra-Iris vehicle, encased in its submersible launcher, is prepared for launching over the Pacific Missile Range's inner sea test range. Naval Missile Center developed the first stage of the missile and Atlantic Research Corp. developed the Iris second stage. Reusable launcher is a triangular cage, 27 ft. long and 5 ft. in diameter.

of affairs for industry is possible may find a good weathervane in the Cost Reduction Study made by the National Security Industrial Assn. and presented to the Secretary of Defense a year ago. This study contains extensive, specific recommendations for changes in procurement regulations to reduce complexity and, thus in theory, reduce costs. Because of its prior existence, the AIA study avoided covering many of these problems in detail.

The Cost Reduction Study has been in the office of Thomas Morris, assistant secretary of defense-installations and logistics and a response was due late this spring. Some of its proposals are likely to be accepted, but whether any significant group will be adopted is the key question.

NASA Tests Computer System for Data Flow

Washington—U. S. space agency and International Business Machines Corp. are undertaking a 14-month trial of a computer system for alerting scientists quickly to technical reports that fall within their area of interest.

About 500 National Aeronautics and Space Administration scientists, engineers and administrators will participate. Their interests will be described in terms of index words such as "lunar," or "Apollo" and placed on computer tapes. Titles of technical reports will be similarly indexed and recorded.

When comparison of the tapes indicates an appropriate match of interest to the content of a technical paper, a notification card will be sent to the individual, with an abstract of the report.

If the participant wants a copy, he may request it by pushing out a prescored hole in the card. He also may indicate that the report interests him but that he does not want a copy; that he already has seen the report, or that the report, does not interest him.

IBM has been studying this technique, called Selective Dissemination of Information, for several years. The IBM headquarters for the NASA-IBM study will be at Yorktown Heights, N.Y.

Mergers and Acquisitions

Dynamics Corp. of America of New York has acquired International Electronic Research Corp. of Burbank, Calif. IERC, through three divisions and a subsidiary, manufactures heat dissipating devices for electronic and precision equipment. Acquisition was for 100,000 shares of preferred stock and 331,700 common.

Control Data Corp. of Minneapolis, Minn. has acquired the assets of Beck's, Inc., a printed circuit manufacturer of St. Paul, Minn. Control Data will make imbedded, insulated, printed circuitry in accordance with 11 U. S. and foreign patents formerly held by Beck's, Inc.

Sparton Corp. of Jackson, Mich., has acquired the entire capital stock of Colvin Laboratories, Inc. of East Orange N. J. for an undisclosed amount of cash. Colvin had $1.5 million in sales for the last fiscal year in electromechanical devices and instrumentation for guidance, control, and telemetry for guided missiles and piloted aircraft.

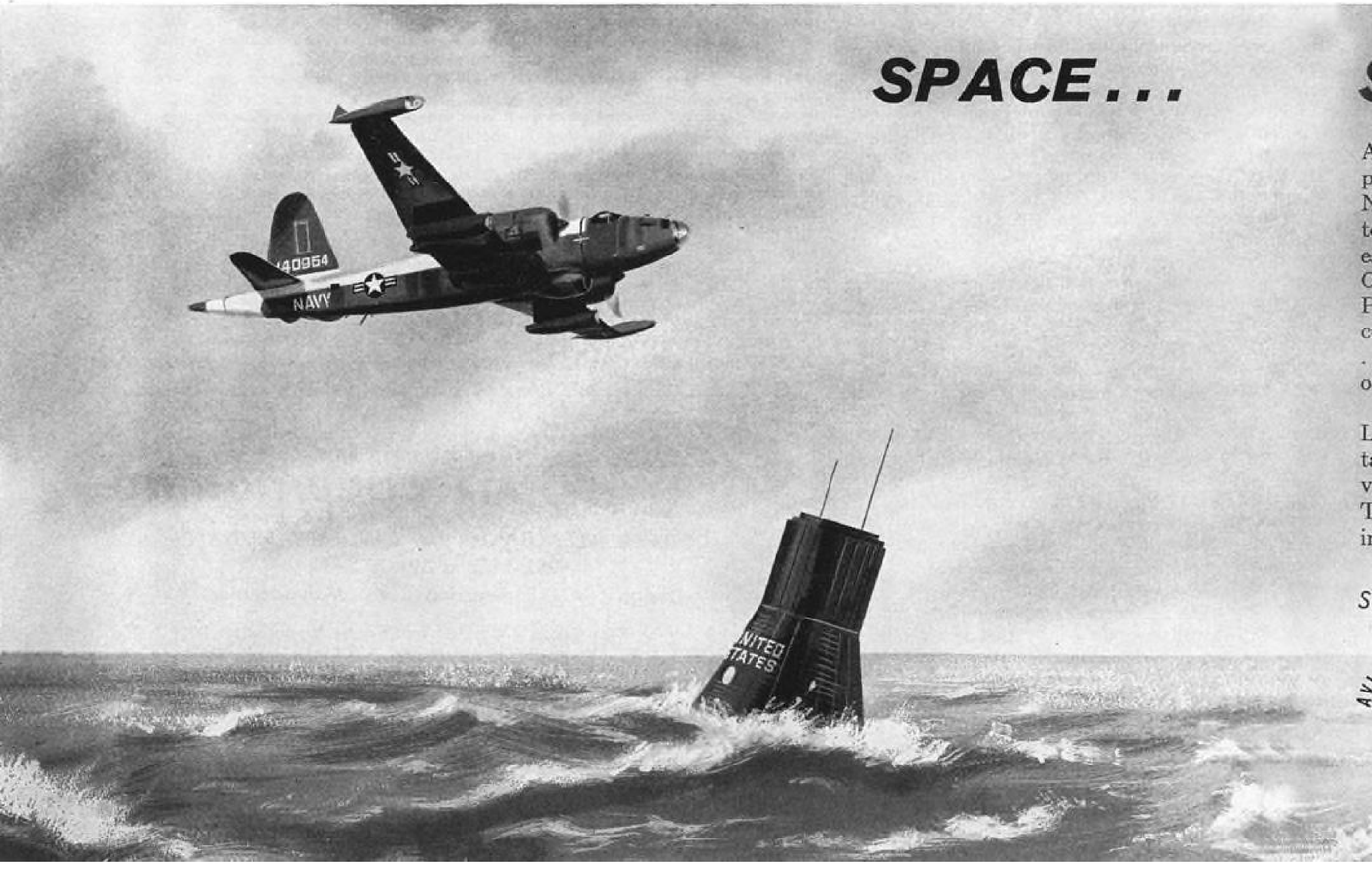
General Technology Corp. of Torrance, Calif., has acquired Scientific Quartz & Metals, Inc., of Long Beach, Calif. The new company will operate as a division of General Technology. Scientific's product line includes filaments, boats and crucibles for vacuum metalizing, and furnace tubes and combustion boats for the semiconductor industry.

Genisco, Inc. of Compton, Calif., has acquired the right to continue business formerly conducted by Airpax Electronics' Pacific Div. for an undisclosed amount of cash. Principal products of the Pacific division are telemetry ground station equipments, wave filters, capacitors, toroidal inductors, airborne magnetic amplifiers and transformers.

Beckman Instruments, Inc., of Fullerton, Calif., has acquired Sharp Laboratories, Inc., of La Jolla, Calif. Plans call for a pooling of interests based on the exchange of 24,000 shares of Beckman common stock for the assets of Sharp. Sharp is a manufacturer of high sensitivity radiation measuring instruments.

Jeppeson & Co., of Denver, Colo., producer of air navigation charts and pilot accessories has acquired Aero-Progress, Inc., of Los Angeles, Calif. Aero Progress makes pilot training phonograph records for use in ground school courses and publishes a reference manual known as the Pilot's Digest.

Rocket Power, Inc., of Mesa, Ariz. has acquired Paranetics Co. of El Monte, Calif. Paranetics is a Federal Aviation Agency-licensed supply outlet and repair center for parachutes and related equipment. The newly acquired company will operate as a department of Rocket Power, Inc.



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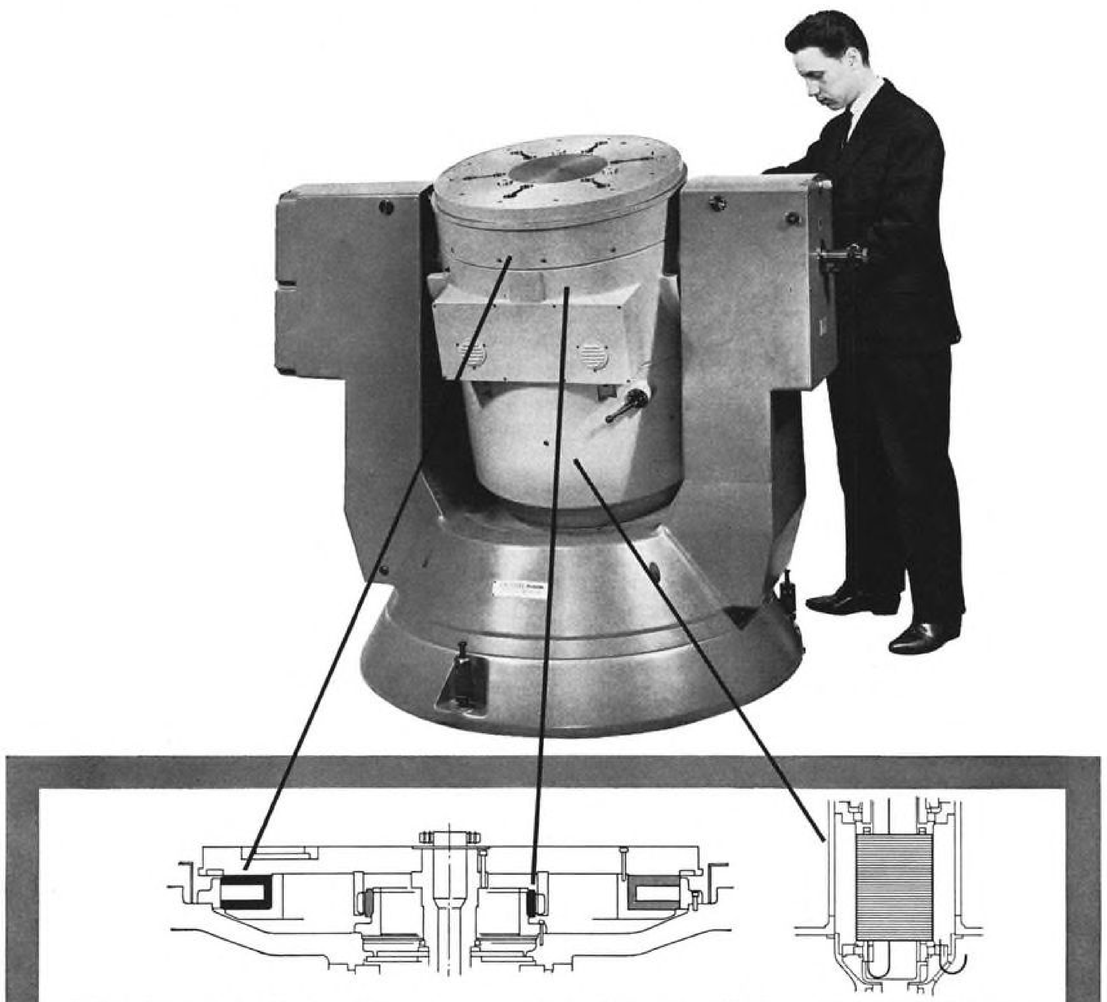

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FAO-4

Aerospace Industry Leads R&D Spending

By Ward Wright

Aerospace industry is the largest performer of research and development of any single industry and accounts for more than a third of the funds spent by all U. S. industry for R&D work.

In 1961, for example, the aerospace industry accounted for 36% of the $10.9 billion spent for R&D. These figures and comments were reported recently in the first of a series of National Science Foundation reviews on the R&D characteristics of leading industries:

• **Relative increase** in total R&D funds used in the aerospace industry compared with all other manufacturing industries. Between 1956 and 1961, total R&D funds for the aerospace industry rose 81% from $2.2 billion to nearly $4 billion. During the same period, dollar value of R&D for all other industries combined increased 57% from $4.4 billion to $6.9 billion.

NSF attributes the phenomenal growth of R&D funding in the aircraft and missile industry to the changing character of the industry itself.

The industry has undergone a fundamental change brought about by the increasing role of the federal government in R&D funding. Responsibility for defense and space exploration has forced the government to spend well over half its total funds set aside for industrial R&D in the aerospace field.

Largely as a result of this, the variety of products produced by the aerospace industry has shifted radically. NSF noted that until a few years ago, the industry was characterized by assembly-line methods and quantity production primarily of aircraft.

With government funding of projects as widely diversified as ballistic and guided missiles, anti-missile missiles, scientific satellites, manned space stations and ion propulsion systems, the industry is today characterized by production of small quantities "of a large variety of highly complex flight and related devices requiring a strong emphasis on research and development," NSF said.

These changes have furthered significant developments outside the industry, inasmuch as the "R&D activities in the aerospace industry have permeated the entire industrial spectrum from spacecraft, missiles, and electronics to fuels, plastics, textiles, and cryogenics.

"It has become normal practice for several thousand firms representing every segment of industry to be involved in the research and development associated with a single major space effort," NSF said. To take part in this effort, NSF noted that a large number of new firms have been established for the primary purpose of performing space and related research and development.

• **Federal role in aircraft** and missile R&D funding. Federal funds for aircraft and missile industry R&D work increased by 56% between 1957 and 1961. For the same period, federal R&D funding for all other industries combined increased only 34%.

The federal government in 1957 provided $2.3 billion in R&D funds to the aircraft and missile industry—86% of the industry's total R&D money. By 1961, the government was providing the industry with $3.5 billion in R&D funds, or 89% of the total. In both cases the remainder of R&D funds were furnished by the company.

• **Company-funded R&D.** Company-funded R&D reached $420 million in 1961, 16% over the $361 million reported for 1957. During this period, R&D financed by all other industries showed greater growth—37% from $3 billion in 1957 to $4.1 billion in 1961.

Greater growth of company-funded R&D outside the aircraft and missile

Canadian CHSS-2 Begins Tests

First Canadian CHSS-2 (Sikorsky S-61) anti-submarine helicopter is shown on a recent test flight. Helicopter is first of nine ordered by the Royal Canadian Navy (AW Dec. 3, p. 30). CHSS-2s will operate from small landing decks on destroyer escorts.

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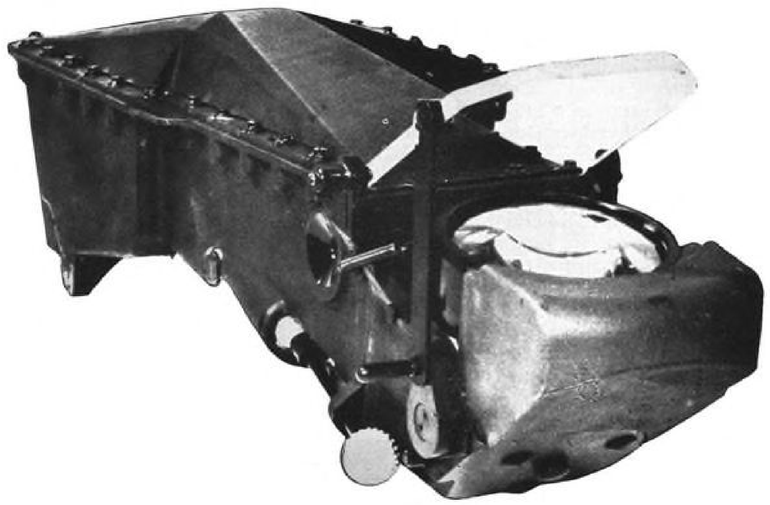

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industry is attributed primarily to the chemical, machinery, and petroleum industries which traditionally have had a heavy company funded R&D schedule.

• **Concentration of R&D money** in a comparatively few companies. In 1961, the four leading aerospace companies, ranked by dollar volume of R&D funds, accounted for 50% of the R&D work done in the industry. However, these same four companies reported only 34% of the industry's net sales and provided only 31% of the total employment.

Moreover, the first 20 companies ranked by size of R&D funds, performed 95% of the R&D work, accounted for 84% of the net sales and employed 82% of all personnel in the aerospace industry.

• **Impact of Defense Dept.** R&D spending. Defense Dept. list of 500 recipients of military prime contracts for experimental, developmental, test and research awards (EDTR) for Fiscal 1962 (AW Feb.11,p.83) showed seven of the first 10 contractors ranked by net value of EDTR to be in the aerospace industry. The seven received $2.6 billion or 75% of the total funding for the group.

The same seven companies accounted for 43% of the $6.1 billion total net value of EDTR prime contracts of $10,000 or more awarded to over 2,000 business and nonprofit organizations during Fiscal 1962.

• **Impact of National Aeronautics** and Space Administration R&D spending. NASA's annual procurement reports for Fiscal 1962 (AW Jan.28,p.34) showed aircraft and missile firms comprising eight out of the top 10 contractors ranked by value of direct procurement awards. These eight firms accounted for $516 million or 90% of the total value of the procurement awards among the first 10 companies.

In addition, the same eight companies received nearly 50% of the total net value of all NASA direct procurement awards for Fiscal 1962, and four of these companies are listed among the top 10 R&D contractors by both Defense Dept. and NASA.

• **R&D fund allotment.** The NSF review found that by far the largest share of funds are used for development rather than basic or applied research.

In 1961, total aerospace industry R&D funds were allotted this way: $51 million for basic research (defined as "original investigation for the advancement of scientific knowledge without specific commercial objectives"); $401 million for applied research (defined as "investigation directed to the application of new and existing knowledge to practical objectives"); and $3.5 billion for development.

• **Basic research funding.** Funding for basic research in the aerospace industry increased from $25 million in 1957 to $51 million in 1961. The 1957 figure represented 90% of the total funding for basic research for all industries combined. The 1961 figure was 13%.

Company-funded share of basic research in the aerospace industry grew from $16 million in 1958 to $27 million in 1961—for an increase of 70%. These figures represented 62% and 53% of the industry's total basic research funds for 1958 and 1961 respectively.

• **Ratio of R&D money** to net sales. In the proportion of R&D funds to net sales of aircraft and missile firms, the NSF review found the ratio had increased from 18.9% in 1957 to 24.2% in 1961. Ratio of R&D funds to net sales for all other industries was about 3% in 1961, the review noted.

• **Employment of R&D scientists** and engineers. The aerospace industries employed 94,000 full-time equivalent R&D scientists and engineers as of January, 1962—more than any other single industry. In January, 1962, the employment of R&D scientists and engineers was nearly 54% higher than the January, 1957, total. In relative growth, the percentage was higher than the 38% increase in R&D scientists and engineers for all other industries.

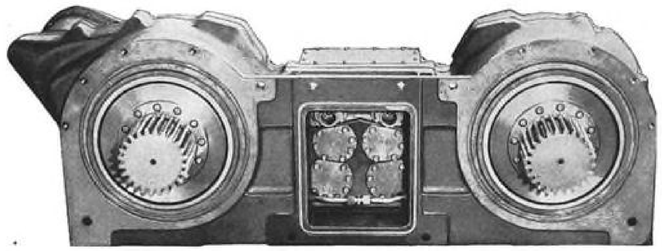
The NSF review noted that in addition to performing 95% of all R&D work in the aerospace industry, firms employing 5,000 or more had over 87,000 R&D scientists and engineers, a concentration considerably higher than other industries of comparable size.

• **Members of R&D scientists** and engineers per 1,000 employes. The ratio has gradually increased from 64 per 1,000 in 1957 to 101 in 1961. Ratio for all other manufacturing industries combined was 23 per 1,000 for 1961.

• **Cost of R&D work performed** per scientist or engineer as an index of the importance of R&D money to an industry. The NSF review observed that the cost of R&D work done per scientist or engineer in the aerospace industry had risen from $43,000 in 1957 to $44,300 in 1961. Comparable figures for all industries combined, including the aerospace industry, were $33,000 per R&D scientist and engineer in 1957 and $34,700 in 1961.

• **Variation of R&D work** cost per scientist or engineer within the aerospace industry. NSF found that of aircraft and missile companies employing 5,000 or more, the lower fourth have an R&D work cost per scientist or engineer of $30,400 or less, while the upper fourth had a cost ranging upward from $55,700.

• **Value of R&D** work per employe. R&D work per employe in the aerospace industry averaged $4,460 in 1961—six times greater than the $670 per employe for all other industries.



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−40 to	300 and	300 to	600	Y, J or T
0 to	300 and	300 to	600	Y, J or T
0 to	400 and	200 to	1000	Y, J or K
0 to	400 and	300 to	1500	Y, J or K
0 to	400 and	300 to	1800	Y, J or K
0 to	600 and	300 to	2500	Type K only

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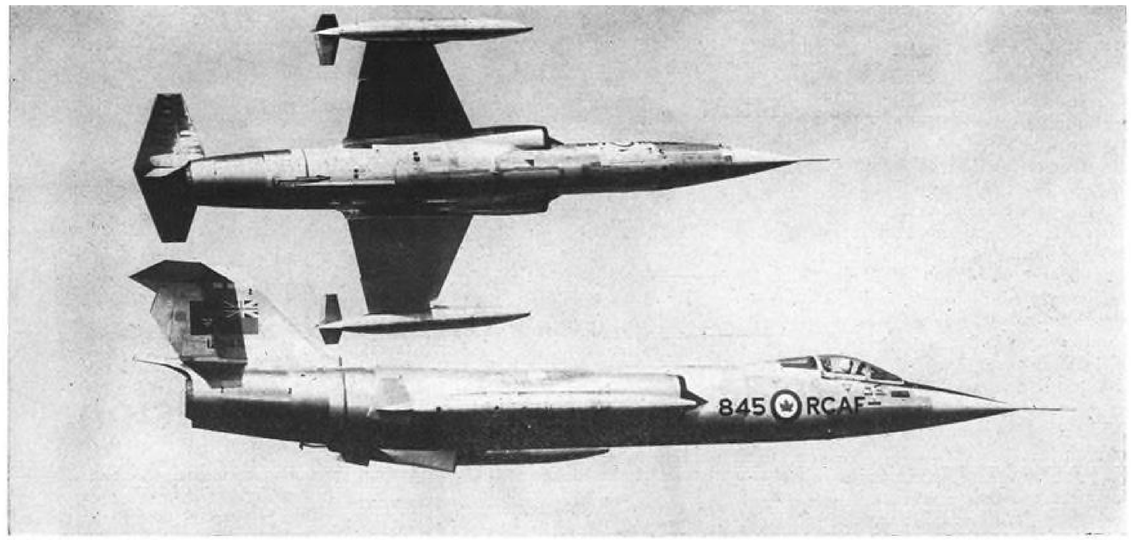
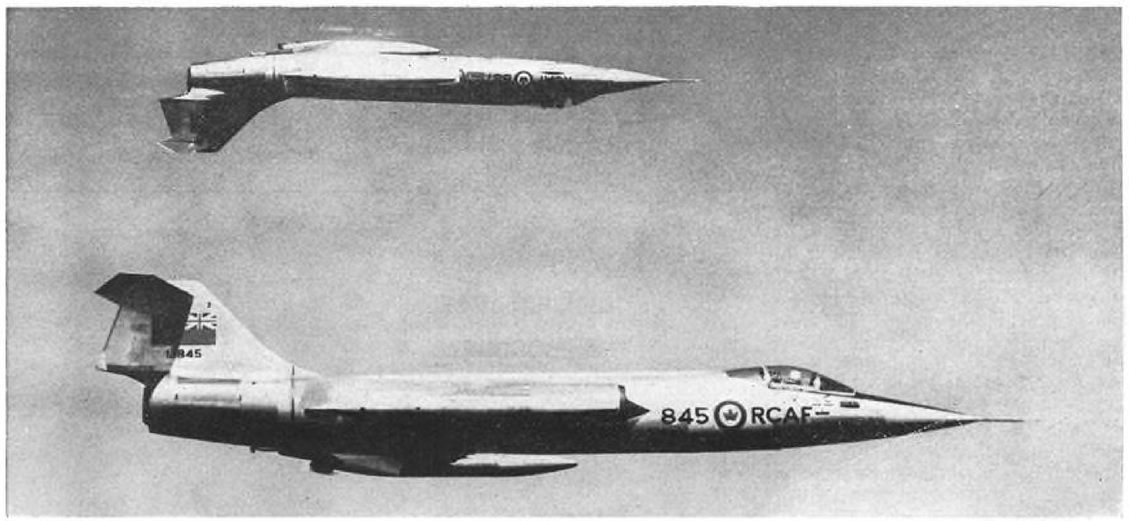


CF-104G Starfighters from the Royal Canadian Air Force are shown performing aerobatic maneuvers during a recent training flight. Canadair, Ltd., Montreal, built 200 of the Lockheed aircraft for Canada's North Atlantic Treaty Organization strike-reconnaissance squadrons.

CF-104 Crews Train For Canadian NATO Squadrons



First CF-104G NATO strike-reconnaissance squadron is in place at Zweibrucken, Germany, and the second is forming at Baden-Soellingen, Germany. Negotiations are under way between the U.S. and Canada to arm them with nuclear weapons. Below, a T-33 photo plane gets a close-up shot of the F-104 formation. Fighters are from RCAF's Cold Lake, Alberta, training station.

CAB Accident Investigation Report:

Low Approach Cited in Adak Island Crash

A Lockheed Constellation, model L-1049H, N 6911C, owned by The Flying Tiger Line Inc., and being operated under contract with the Military Air Transport Service, crashed during the hours of darkness at Adak, Alaska, Mar. 15, 1962, at 1214 G.M.T. Impact and subsequent fire destroyed the aircraft. There were seven occupants, all crew members. Six received minor injuries and one, the duty flight engineer, was trapped in the cockpit and died in the fire.

This was a scheduled cargo flight, designated by the carrier as Flight No. FTL 7816/14. It originated at Travis Air Force Base, California, for Kadena Air Force Base, Okinawa, with stops planned at Cold Bay, Alaska; Adak, Alaska; and Misawa, Japan.

Shortly after departure from Travis Air Force Base, buffeting developed and the aircraft was landed back at Travis. Inspection disclosed an open hydraulic reservoir access door. This was closed and secured and the flight proceeded uneventfully to Cold Bay, Alaska. The flight from Cold Bay to the vicinity of Adak was also uneventful, with the copilot flying the aircraft from the left seat and the captain acting as copilot in the right seat.

Instrument weather prevailed at Adak and a ground controlled approach (GCA) was started. The flight was advised several times that it was below the glide slope and then was advised to execute a missed approach. The aircraft's captain replied that the field was in sight.

The approach continued, visually. At a point 328 ft. short of the runway threshold and 4 ft. below its level the landing gear struck rocks. The main landing gear was torn off and the aircraft slid about 2,000 ft. on the runway coming to rest just off its edge. A severe fire developed.

The Board determines that the probable cause of this accident was the pilot's misjudgment of distance and altitude during the final approach for landing.

Investigation

A Lockheed Constellation, model L-1049H, N 6911C, owned by The Flying Tiger Line Inc., crashed during a landing approach to the Adak Naval Station, Adak, Alaska, during the hours of darkness on Mar. 15, 1962, at 1214 G.M.T.[1] The flight, designated by the carrier as FTL 7816/14, was scheduled to carry freight from Travis Air Force Base, California, to Kadena Air Force Base, Okinawa, with stops at Cold Bay and Adak, both in Alaska, and Misawa, Japan, under contract with the Military Air Transport Service. The flight was conducted under the provisions of Part 42 of the Civil Air Regulations.

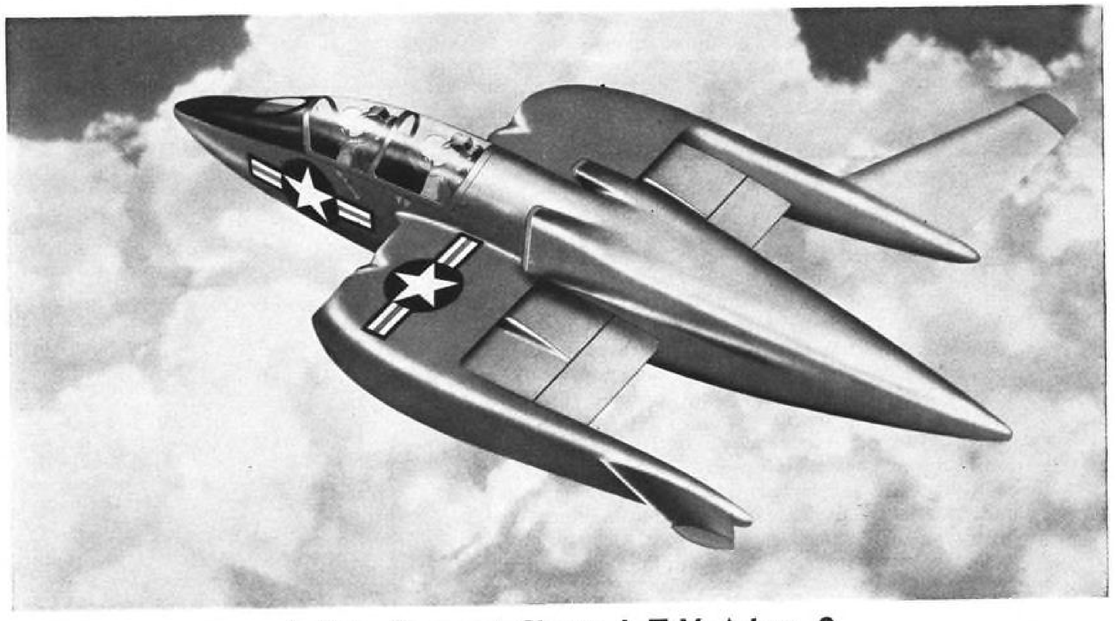
A multiple crew was carried. It consisted of Capt. Morgan W. Hughes (in command), Capt. Thomas M. Mitchell, Copilot Wayne W. Lowe, Flight Engineer Henry Guttman, Flight Engineer James M. Johnstone, Navigator Michael E. Green, and Navigator Kenneth Drusch.

The flight departed Travis AFB for Cold Bay, Alaska, at 2100, Mar. 14. Its gross weight was 142,050 lb. and the center of gravity was at 24.8% of the MAC (Mean Aerodynamic Chord), which was within the prescribed limits of 23% and 32% for the existing gross weight. The maximum allowable takeoff gross weight was 142,100 lb.

Shortly after takeoff, buffeting developed. Capt. Hughes and Flight Engineer Guttman decided that the buffeting was probably caused by an open hydraulic reservoir access door. Capt. Hughes decided to return to Travis AFB where he elected to land overweight rather than to dump fuel. The maximum allowable landing weight was 119,975 lb. and the aircraft's gross weight was well above that figure.

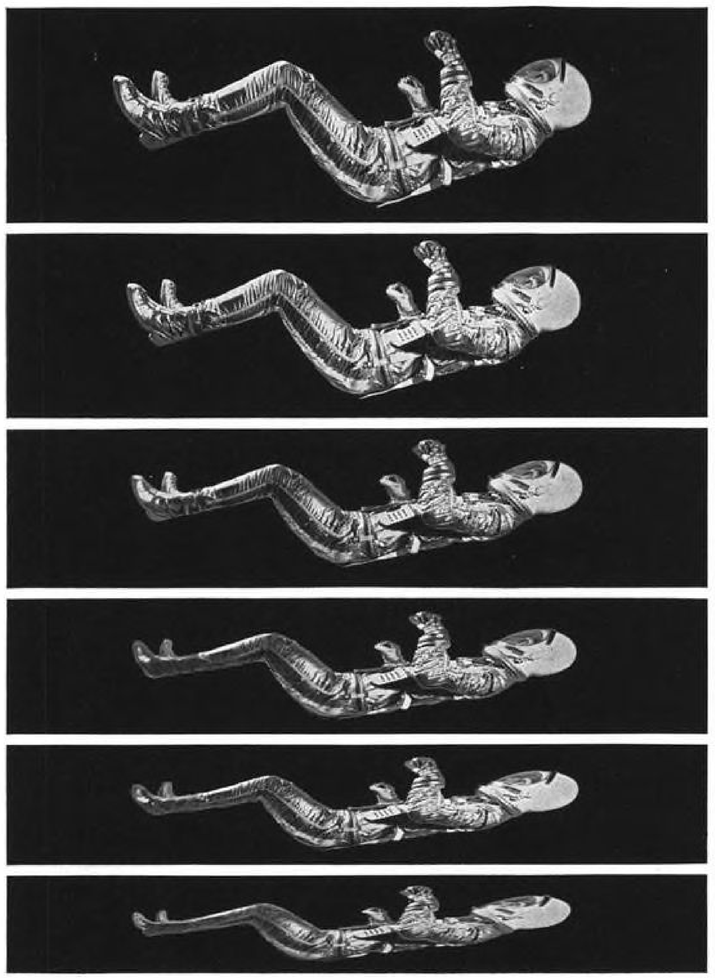
Capt. Mitchell, flying from the left seat,

[1] All times herein are Greenwich Mean based on the 24-hr. clock.



Artists Concept Shows L-T-V Adam 2

Artist's concept of one design being studied in the Ling-Temco-Vought Adam 2 (air deflection and modulation) V/STOL tactical aircraft program has four fans buried in wings. Fans would be powered by turbines driven by gas ducted from fuselage-mounted generators (AW June 3, p. 79). Ducting would deliver gas powering two outboard and two inboard fans independently to prevent asymmetric thrust in case of engine failure. Large trailing edge flaps are principal means of gas flow control.



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made the landing at 2132, and commented to the crew that the aircraft ". . . surely was noseheavy—probably due to excessive weight . . . ."

Examination at the ramp disclosed that the hydraulic reservoir access door on the right side was open.

The door was secured, the fuel tanks topped off, and a satisfactory overweight landing inspection was made by a qualified company representative.

The flight departed Travis AFB at 2230 for Cold Bay, Alaska, with Capt. Hughes in the left pilot seat. There was no further buffeting and the nonstop flight to Cold Bay was without incident. The landing there was at 0805, Mar. 15, 1962. This landing was made by Capt. Hughes, who stated, "the landing was solid as I was unable to make a normal flare due to the nose heavy condition."

The crew filed an instrument flight plan to Adak, listing three hours holding in lieu of an alternate airport. According to Capt. Hughes, it was his intention to return to Cold Bay if he could not land at Adak. The estimated flight time enroute was 2 hr. and 30 min. and the flight departed Cold Bay at 0919. The gross weight at takeoff was 123,249 lb. and the center of gravity was at 22.8% of the MAC which was within the prescribed limits of 21% and 32% for the existing gross weight.

N 6911C contacted Adak Approach Control at 1137, giving its position as 100 mi. northeast, at 12,000 ft., and estimating Adak at 1206. Adak Approach Control transmitted the following clearance: "Tiger 911 is cleared to the Adak Low Frequency Range via direct to descend and maintain eight thousand immediately. Report reaching eight thousand . . ." The flight replied "Roger, understand . . . ," and repeated the clearance.

At 1144, Adak Approach Control gave the flight the following weather: "Two thousand five hundred scattered, estimated ceiling three thousand five hundred, overcast, visibility four, light rain and fog, temperature 42, dewpoint 38, wind east southeast one zero, peak gusts one eight, altimeter two niner eight zero. Runways clear of ice and snow. Braking action good reported by P2V . . . ." This was acknowledged.

Soon after reporting at 8,000 ft. the flight received the following from Adak Approach Control: "Tiger niner one one is cleared to the Adak Low Frequency Range via direct. Descend and maintain seven thousand immediately. Hold southwest. Expect approach clearance at one two zero six. Adak weather same as previously outlined. Expect circling approach runway one eight. Wind now east southeast eight, peak gusts one five. Expect GCA frequencies one three four point one megacycles and three zero three niner kilocycles. Remain this frequency until further advised . . . ." The flight acknowledged.

Subsequently, Adak GCA established radar contact with the flight and precision approach was commenced with Copilot Lowe flying from the left seat and Capt. Hughes occupying the right seat. At this point, Capt. Hughes requested and received clearance for a straight-in approach to runway 23. The landing gear had been extended and locked and the wing flaps extended 60%.

The GCA approach was routine to a point approximately 3 mi. from touchdown where the flight was advised that it was going slightly above glidepath.

The flight next was told that it was coming down on glide slope followed immediately by "below glide slope." Six other transmissions by GCA advised the flight it was below glide slope followed by advice to execute a missed approach. At about the same time Capt. Hughes advised GCA "Roger we have the field in sight, thank you 911." The distance from touchdown at the time of this transmission was approximately 1¾ mi. The captain estimated the altitude at which he became contact as 400 ft. The airport altitude is 17 ft. msl.

The remainder of the approach was conducted under visual flight conditions by Copilot Lowe. He asked Capt. Hughes, serving as copilot, for 80% flaps (from 60% then being carried), but the captain did not comply. Near the approach end of the runway, Capt. Hughes remarked to Copilot Lowe, "you are too low,' and Mr. Lowe added power as Capt. Hughes pulled back on the yoke. Almost concurrently the right landing gear struck rocks short of the runway.

Initial contact was at a point approximately 328 ft. from the threshold lights and 4 ft. below the elevation of runway 23. This runway is 7,610 ft. long. The second contact was with the right inboard tire on a rock approximately 8 ft. forward of initial impact. The aircraft then struck an embankment at the runway threshold approximately 4 ft. below the elevation of the runway and the main gear separated. As the aircraft continued forward it veered to the right leaving the runway at the 1,000-ft. marker. The right wing was torn off while the main portion continued forward until coming to rest on a heading of approximately 30 deg., at a point approximately 2,000 ft. from the approach end of the runway.

Fire came from the aircraft following the separation of the main gear and continued after the aircraft had stopped. Six of the seven crew members evacuated the burning wreckage without serious injury. The seventh, working Flight Engineer Johnstone, was trapped in the cockpit area.

Two crash and rescue trucks were at the scene within an estimated 30 sec. after the crash. The crews extinguished the visible fire within about 10 min. However, fire quickly broke out again and, fed by acetone and oxygen in the cargo, became uncontrollable. Continuing attempts to free the imprisoned engineer were futile and he died in the fire.

The computed gross weight of the aircraft at the time of the accident, allowing for fuel consumption, was 115,150 lb. which was about 4,800 lb. under the maximum allowable landing weight.

Immediately after the accident, and because thereof, a special weather observation was made and it showed: Ceiling indefinite 1,000 ft., sky obscured, visibility 3 mi. light drizzle, fog, temperature 40 deg., dewpoint 38 deg., wind east-southeast 12, gusts to 18, altimeter 29.80, relative humidity 92%.

The weather minimums for The Flying Tiger Line's operation at Adak are 400 ft. ceiling and ¾ of a mi. visibility. (Navy minimums at Adak are 200 ft. and one-half mi.)

Interrogation of the crew following the accident brought forth the allegation that turbulence during the final portion of the approach was a factor causing difficulty in visually aligning the aircraft with the runway. The crew also believed that the actual weather was not as good as the last weather given them although there was no implication that it was not well above their authorized minimums. Capt. Hughes also claimed that the phraseology employed by the Navy GCA controller, in not stating exact distances above or below the glidepath, was unfamiliar to him although he had made one previous GCA approach to Adak.

On Mar. 17, 1962, two days after the accident, the Adak GCA facility was flight checked by the Federal Aviation Agency. It was found to be operating satisfactorily and within tolerances. The FAA flight inspectors also tested the proficiency of the GCA controller who was on duty at the time of the accident and found him to be "well above average" on all Precision Approach Radar (PAR) runs and "satisfactory" for Airport Surveillance Radar (ASR) approaches.

The Adak airport is a facility of the U. S. Navy and no resident FAA inspector is stationed there. Air traffic services for civil aircraft are provided by Navy personnel to the satisfaction of the FAA in accordance with a current letter of agreement between the FAA and the Commanding Officer of the Adak Naval Station.

Investigation disclosed that all pertinent lighting at Adak Airport was turned on and functioning normally at the time of the accident. Runway 23 does not have approach lights.

Investigation of the aircraft structure, of its various systems, and of its powerplants disclosed no evidence of any malfunction of any nature. All four propellers were found in low pitch. A review of maintenance records of aircraft and powerplants disclosed no significant irregularity. The crew stated that they experienced no mechanical difficulty of any type during the flight from Cold Bay or during the final approach.

There was neither evidence nor suspicion that the cargo had shifted prior to or during the approach.

Copilot Lowe had never previously landed at Adak. Capt. Hughes had made one GCA approach and landing there. However, it was during daylight and to a different runway.

Examination of the detailed itinerary of this flight and of the pre-flight rest periods of all crew members indicates that rest and off-duty requirements had been met.

Analysis

An analysis of the evidence adduced in connection with this investigation leads clearly to the conclusion that the accident was caused by faulty piloting judgment during the landing approach.

The aircraft was fully airworthy and in landing configuration. All of its components, including powerplants, functioned normally. All airport facilities, including lighting and the GCA radar, also functioned normally. The operator of that radar performed his duties properly and in accordance with his prescribed Navy procedures, which were acceptable to the FAA. The runway was of adequate length. The weather was definitely better than the minimums authorized by the FAA for the subject operation. It is probably true that some turbulence prevailed during

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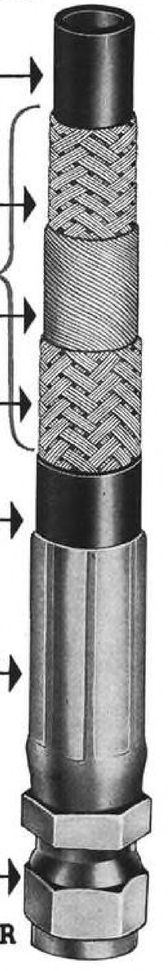

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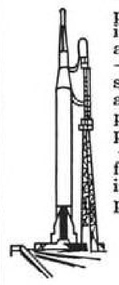

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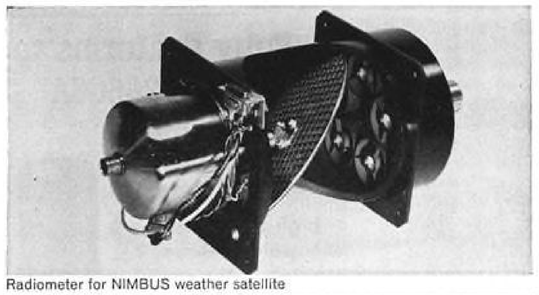
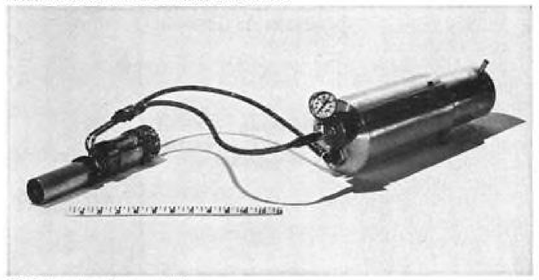

Radiometer for NIMBUS weather satellite

Interceptor IR installation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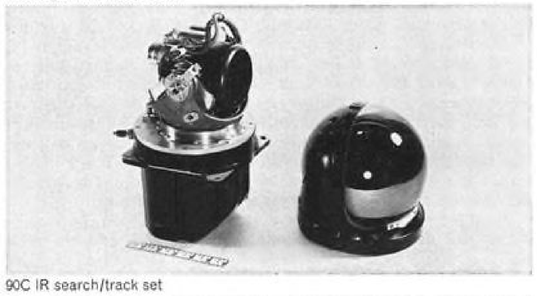
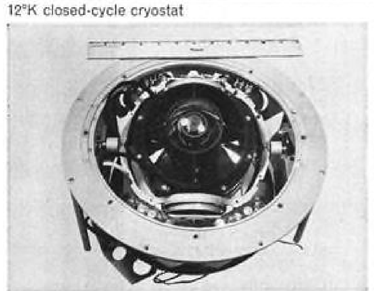
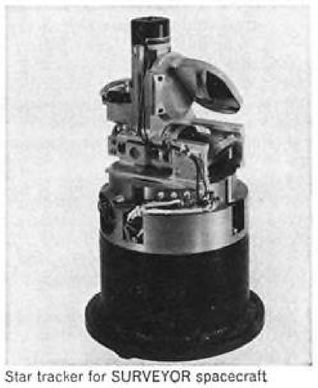
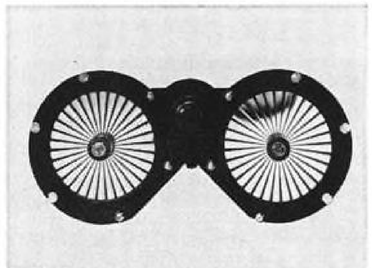
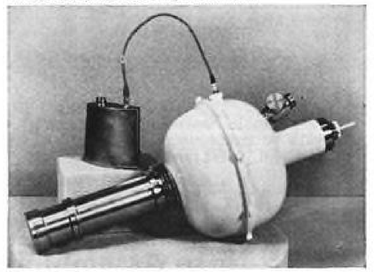

90C IR search/track set


IR multi-channel tracking radiometer


Star tracker for SURVEYOR spacecraft


Modulated IR source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the latter part of the approach, as the crew claimed, but, with the existing wind velocities, its intensity should not have been enough to seriously affect control of the aircraft.

The overweight landing made at Travis AFB at the start of the flight was followed by an overweight landing inspection which disclosed no damage. The incident may therefore be dismissed as not being germane to this accident. The nose heaviness evident at both the Travis and Cold Bay landings, which was commented on at the time, and therefore familiar to all crew members, can be attributed to the cargo loading. Because the cargo had not been rearranged, a somewhat similar nose heaviness should logically have been anticipated at Adak. However, the center of gravity of the aircraft was located within prescribed limits.

The entire planned flight from Travis AFB to Okinawa was lengthy enough to require a multiple crew of qualified airmen. Such a multiple crew was carried. At the time of the accident the total elapsed time from departing Travis was 15 hr. and 14 min., about half of the total planned time. None of the three pilots had been on continuous duty and maximum duty time had not been exceeded. Crew fatigue, therefore, cannot logically be considered as having been a significant factor in the accident.

While on final approach Copilot Lowe asked Capt. Hughes to lower the flaps to 80% (from 60%). The captain stated, however that 60% flap was retained in anticipation of a possible go-around. It is certainly a captain's prerogative to accept or reject requests as he deems best. If 80% flap had been used, as requested, the aircraft's stall speed would have been decreased slightly, but it is doubtful if this factor alone would have allowed the aircraft to reach the runway threshold. Thus this item also appears to be not germane inasmuch as the captain obviously thought it best not to increase the flap extension, and Copilot Lowe later stated that the choppy weather would have made it difficult for him to differentiate between 60% and 80% flap.

When Capt. Hughes told the controller that he had the field in sight, very shortly after being advised to make a missed approach, he did, in fact, assume full responsibility for the conduct of the flight. At that moment the GCA controller was relieved of further responsibility for the approach.

In regard to Capt. Hughes' contention that the phraseology used by the GCA controller was unfamiliar to him, it should be pointed out that Capt. Hughes had made one previous GCA approach at Adak. Further, the fact that there were seven successive advisories of being below glidepath, followed by advice to make a missed approach, should certainly have sufficed to alert the captain to the persistent under flying of the glidepath. Thus the alleged unfamiliarity with the GCA phraseology cannot be demonstrably linked to this accident.

This flight was being operated under Part 42 of the Civil Air Regulations which permits landing at airports where the captain in command has not had specific landing experience.

Probable Cause

The Board determines that the probable cause of this accident was the pilots' misjudgment of distance and altitude during the final approach for landing.

By The Civil Aeronautics Board:

Alan S. Boyd, Chairman; Robert T. Murphy, Vice Chairman; Chan Gurney, Member; G. Joseph Minetti, Member; Whitney Gillilland, Member.

Investigation

The Civil Aeronautics Board was notified of the accident immediately after occurrence. An investigation was initiated at once in accordance with the provisions of Title VII of the Federal Aviation Act of 1958.

The Flying Tiger Line Inc., is a scheduled air carrier incorporated in the State of Delaware with its principal business offices at Burbank, Calif. It operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Federal Aviation Agency. These certificates authorize the company to transport cargo by air over numerous routes within the continental limits of the United States. The subject flight was conducted under an exemption granted by the Civil Aeronautics Board which authorizes the carrier to engage in interstate, overseas, and foreign air transportation of persons and cargo pursuant to contracts with any department of the military establishment.

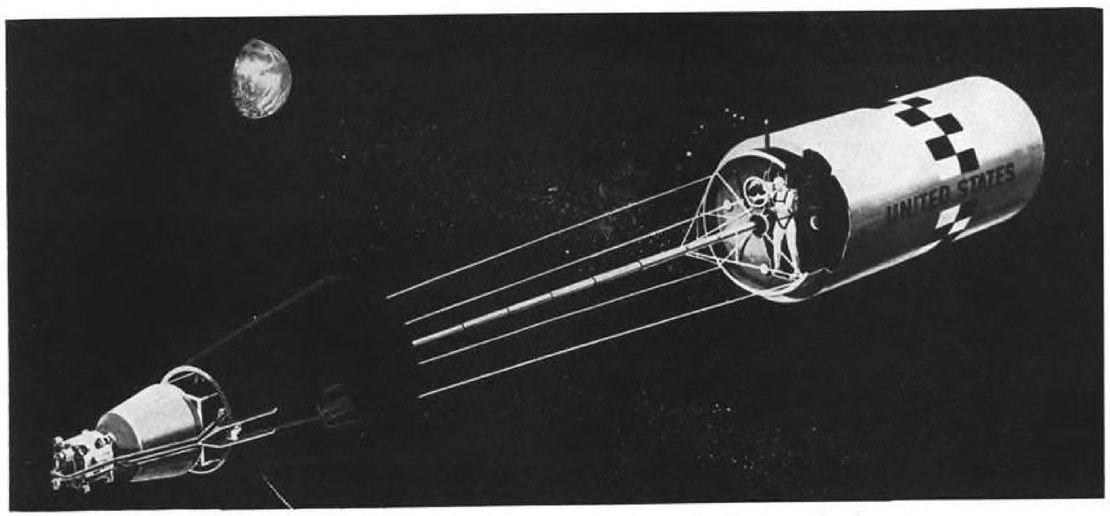
The Aircraft

The aircraft was a Lockheed Constellation, model L-1049H, Serial No. 4804, N 6911C, and was manufactured Jan. 6, 1957. Total operational time on the aircraft was 16,038 hr. of which 3,446 hr. had been since the last overhaul.

The last operational check and the last terminal check inspection had been 14.6 hr. prior to the accident.

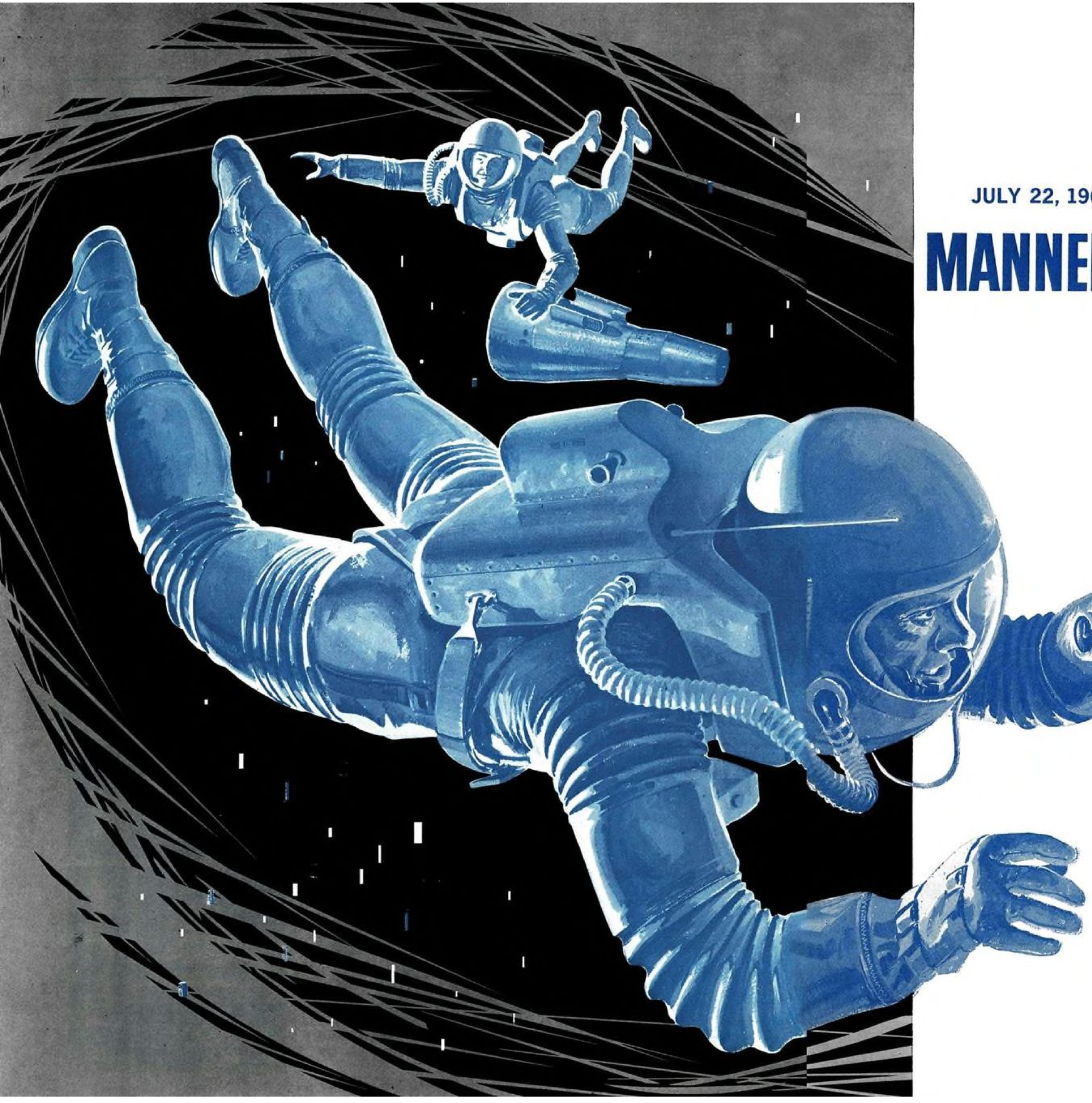
The engine was Wright model 988TC18-EA3. The times since overhaul of all four engines were within prescribed limits. The propellers were Hamilton Standard model 43H60-363. Their times since overhaul were within prescribed limits.

All seven crew members had had adequate rest prior to departing Travis AFB. All held appropriate certificates and ratings from the FAA. Capt. Morgan W. Hughes, age 41, who was in command and who was in the right pilot seat, had a total flight time of 13,000 hr. of which 3,055 hr. had been in L-1049H Constellations. Copilot Wayne W. Lowe, age 46, who made the approach from the left pilot seat, had a total of 19,000 hr. of which 1,211 hr. had been in L-1049H Constellations.



Concept Shows Snap-2-Powered Space Lab

Artist's concept of a manned space laboratory powered by a Snap-2 (Systems for Nuclear Auxiliary Power) reactor. Snap 2 is being developed by Atomics International, Canoga Park, Calif., for eventual use by Air Force. System energy is derived from Uranium-235 fission. Reactor heat is conveyed by liquid sodium-potassium to a mercury boiler, whose vapor drives a 3 kw. turbo-electric system.



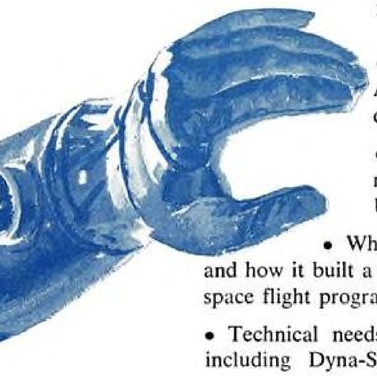
• The most important development of this decade, MANNED SPACE FLIGHT, will be the subject of the July 22, 1963 issue of AVIATION WEEK & SPACE TECHNOLOGY. MANNED SPACE FLIGHT, the major segment of the national space program, is planned at $20 billion for a manned lunar landing. The total space budget requested for fiscal 1964 alone is a record $7.3 billion.

JULY 22, 1963

MANNED SPACE FLIGHT ISSUE

AVIATION WEEK & SPACE TECHNOLOGY has established an unmatched reputation for detailed coverage of technical and industry developments on the plans, operations, facilities, budgets, organization and procurement policies of the national space program. Now, a task force of editors will concentrate on both civilian and military manned space projects in an issue devoted entirely to the subject.

Theme of the issue will stress future programs from Project Apollo to manned permanent moon bases, manned orbiting space stations and interplanetary Mars and Venus flights. Editorial highlights will include:



• Major progress report on Project Apollo, its hardware and technical developments.

• Status Report on Project Gemini two-man spacecraft including joint NASA-USAF operations.

• What we learned from Project Mercury and how it built a technical foundation for future manned space flight programs.

• Technical needs of military in manned space flight, including Dyna-Soar, Aerospace Plane, maneuverable re-entry vehicles, inspector and surveillance satellites.

• Russian manned space flight programs and technical progress.

• New types of support operations required for large-scale manned flight including simulators, control centers, transport and assembly facilities, tracking and data transmission equipment, medical and life support.

There is no better way to identify your company's role in the space program than by scheduling your advertising in the most important issue of 1963, the July 22nd MANNED SPACE FLIGHT ISSUE. Its timeliness and scope of technical detail will insure industry-wide attention and study. Wire or call collect for reservations or additional information.

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WHO'S WHERE

(*Continued from page 23*)

Changes

Rand Araskog, manager of the newly established Space and Armament Systems Group, Honeywell's Aeronautical Div., Minneapolis, Minn.

E. **Victor Larson**, manager-Air Force sales, Electronics Communications, Inc., St. Petersburg, Fla. **Donald P. Clark** succeeds Mr. Larson as manager of ECI's Northeast Region Office, Lexington, Mass.

Keith G. Dugan, chief pilot, Aviation Div., S. Smith & Sons (England) Ltd., Cheltenham, England.

Capt. Philip W. M. Kelshall, general manager, British West Indian Airways, succeeding **John Rahr**, resigned.

Donald W. Madole, chief, Hearing & Reports Div., Bureau of Safety, Civil Aeronautics Board, Washington, D. C.

F. A. Ford, chief-advanced project, Space Engines, Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif.

Edward S. Hicks, Jr., chief, Procurement and Supply Div., National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio. Also: **H. Brock Barkley, Jr.**, chief, Reactor Div. of Plum Brook Station, NASA's Lewis Research Center, Sandusky, Ohio, succeeding **Patrick L. Donoughe**, now technical consultant to the Nuclear Reactor Div., Cleveland.

Gordon Henning, manager-marketing planning, Avco Corp.'s Electronics Div., Cincinnati, Ohio.

Vincent Atalese, chief-quality assurance engineering, United Aircraft Corp.'s Norden Div., Norwalk, Conn.

Joseph W. Duroux, manager-mission objectives, and **Robert V. Keller**, manager-systems evaluation, Aerospace Corp.'s 706 Study Program Office, Los Angeles, Calif.

Michael Michaelis, manager of Arthur D. Little, Inc.'s Washington, D. C. office.

Dr. Allen H. Smith, manager-solid state physics, Research Dept., Aircraft Engine Operations, Allison Div. of General Motors, Indianapolis, Ind.

Dr. B. Dwight Culver, manager of the newly established Life Support Systems Div., Aerojet General Corp., Azusa, Calif.

Herman Pusin, general manager-research and engineering operations, Martin Co., Baltimore, Md., succeeding **John P. Butterfield** (AW Apr. 15, p. 127). **Jeremie U. LaFrance** succeeds Mr. Pusin as director of engineering, Martin's Space Systems Div., and **Walter D. Smith** succeeds Mr. LaFrance as technical director of the Titan 2-Gemini program.

Vernon Benfer, general manager, Cannon Electric Co.'s Phoenix (Ariz.) Div.

Dwain B. Bowen, manager, Quantum Physics Div., Electro-Optical Systems, Inc., Pasadena, Calif., succeeding **Dr. John M. Teem** (AW May 6, p. 19). Other EOS appointments: **Russell A. Temple**, manager-optical design and fabrication; **Elbert Leon Aiton**, manager of reliability; **Wilford E. Beasley, Jr.**, a senior engineer in charge of mechanical design, Electrical Propulsion Flight Test Program Office.

George Street, Jr., manager-radioisotope power projects, General Electric Co.'s Special Purpose Nuclear Systems Operations, Atomic Products Div., Palo Alto, Calif.

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GUIDANCE AND CONTROL SYSTEMS Control system component integration. Accelerometer, rate gyro and other control sensor performance testing and evaluation. Coordination of programming efforts for the Saturn automatic checkout system. Design, development, test and evaluation of flight control systems and/or associated components—electrical, mechanical, hydraulic or pneumatic. Senior and intermediate level openings.

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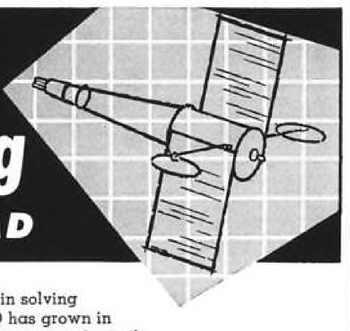

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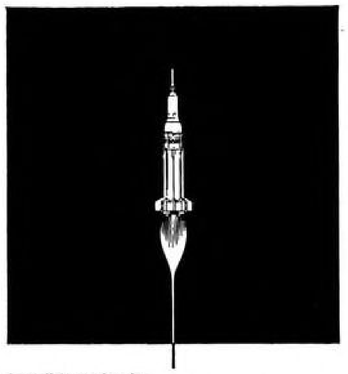

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LETTERS

Beacon Achievements

Subject: Crash Locator Beacon, Wallace L. Brown's letter, AW Apr. 29, p. 110.

Mr. Brown's letter covers a subject that logically divides into two areas of consideration; (1) crash locator beacons; (2) survival beacons. The first item becomes one of engineering a device into the airframe that will not only survive the crash environment, but will as a consequence of the crash become operative for some period of time. The 7th Communications Div. Meeting of ICAO in January, 1962, recognized the need for this type of equipment and recommended that member states engage in the development of such devices.

With respect to over-water survival beacons, the Federal Aviation Agency has recognized the effectiveness of the VHF beacon in expediting the search phase of an SAR mission. FAA regulations now permit U. S. overseas carriers to retire the "war-weary" Gibson Girl and in its place install an approved type of 121.5 mc. VHF beacon. Beacons are commercially available which may be packaged in life rafts so as to be completely automatic in operation when the raft goes into the water. At least one U. S. carrier installs one in each life raft (six per aircraft). Realistic exercises conducted by SAR organizations demonstrate the coverage of these beacons, which is reliably 150-200 naut. mi. at air search altitudes.

The U. S. delegation to ICAO has been the leader in pushing for world-wide adoption of the VHF beacon program by civil aviation. Further to this, the FAA deserves a great deal of credit for an aggressive approach to air safety in approving the use of VHF beacons on U. S. Registry aircraft.

K. A. Moore
Manager, Aviation Products
Granger Associates
Palo Alto, Calif.

I am referring to the letter on the crash locator beacon which appeared in the Apr. 29 issue of Aviation Week (p. 110).

The National Research Council, Ottawa, has been working on this subject for the past seven years, and Crash Position Indicators which are compatible with several types of aircraft are being manufactured in Canada.

David M. Makow
Navigational Aids Section
National Research Council
Canada

Train Watch

The last item in Washington Roundup (AW May 20, p. 25) prompts me to offer this proposal for a "railroad train sensing and position indicating system" to the PMR officials.

I propose that a member of the base Air Police or Shore Patrol (depending on jurisdiction) be dispatched to a position adjacent to the railroad tracks where they enter the launch base property. This would require three men per shift (my maps indicate that the base property is pierced at three points by railroad tracks). Each of these men should be equipped with a two-way radio such as is installed in the base police pickup trucks.

Now for the crux of my proposal. When any of the guards see a train they are to radio headquarters and report this fact. They should report such items as direction of travel, estimated speed, and any other pertinent data. This information would then be available to the range safety officers. This information could also be cross-checked with the railroad time tables.

This proposal meets all of the requirements for detecting the presence and position of railroad trains.

In this day of great advances in technology, it seems that we are overlooking a highly sophisticated and compact sensing, computing and communicating device. There are lots of them available. They are to be found just above our necks.

Martin A. Snyder
Research Specialist
Burbank, Calif.

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Space Investment

Your editorial "Apollo and Its Critics" (AW Apr. 29, p. 17) deserves a reply and it is simplest to discuss it point by point. However, let me establish first that Brainerd Holmes, his engineers and the associated contractors appear to be executing their mission effectively, with admirable imagination and devotion. But that is not the issue.

The "anti-Apollo chorus" must reach a crescendo in spring and dwindle after every manned space flight. No man fights on ground not of his choice if he can avoid it, and certainly no one would argue budget questions at other than the time of congressional decision. These are facts of life for every program, regardless of which side of the fence you favor.

The engineers and pilots who crept into the space program have been there and generally have been running it. During five years of space work in the L. A. area (including the usual gamut of visits to all sorts of facilities and companies) I never ran into a "scientist." There are many former scientists, but they are now engineers simply by virtue of their occupations.

Ex-President Eisenhower was, and is, probably one of the most sincere and devoted servants the nation has known, and history may well show that his efforts to balance the total government problems were indeed correct. It should be clear that this nation is not exclusively in the space business or the farm subsidy business or any other specific occupation, but it is in the business of government. If I may lean on technology for a moment, the optimum sum is not necessarily the sum of the optimum parts. Thus, if we strive to optimize each function of our government, as you suggest we optimize the Apollo program, we may only dissipate ourselves.

With regard to safety, I agree wholeheartedly the MSC team has done an excellent job.

The failures in the Ranger program are traceable to engineering problems, not scientific problems, and it is improper to place the blame on the scientific community.

Yes, there are a "great many valid, vital reasons why this nation must continue to press its exploration of space at the maximum feasible pace." Along with the definition of feasible, properly considered in relation to the whole of this nation's problems, is the question "what constitutes being first on earth." It does not clearly follow that first in space means first on earth; furthermore, first in space needs clarification, for a man on the moon may result in no more than headlines. Historically, many nations have been first, only to end up last. An example is Spain in the New World. Spain's loss in the New World can probably be laid at the door of inept management of her whole government problems rather than a non-optimum program for development and use of large gold transporting galleons.

There is a fundamental problem in the nature of our current space investment, there is little return on it. Certainly there are valuable contributions such as world communications, weather prediction and perhaps control, possible mineral resources, scientific knowledge and the very intriguing idea of finding other forms of life in the universe. These are areas of endeavor that do promise a return and this has been the motivation that has given our country strength. The preponderant and rapid investment in a moon landing is more easily viewed as a public relations endeavor rather than a contribution to this world. The accelerated moon landing has little return for us, for the struggling peoples of the world or for the future of the world.

I think that the poor peasant of the Near and Far East is going to realize more from the tools, advice and food he receives that aid him in making his world better, and the new industry that provides a job. These are real contributions and they stay with him for a lifetime. The knowledge that two men landed on the moon in 1968 instead of 1978 is of no permanent value or solace to him. I am not proposing that we put our $5 billion space budget in foreign aid, nor should we give up space exploration; however I feel that we have not chosen the right distribution of effort.

I am looking forward to your future editorials on this subject.

C. L. Davis
Charlotte, N. C.

Ironic Markings

As fate would ironically have it, the F-4B escorting the Soviet Bear on its passes over the Constellation (AW cover, May 20) would have to have "NK" markings!

I wonder if the Reds got a chuckle out of that (assuming they still chuckle)?

John J. Nestor
Inglewood, Calif.

JUN. 1 1 1963

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