

# Aviation Week & Space Technology

June 25, 1962

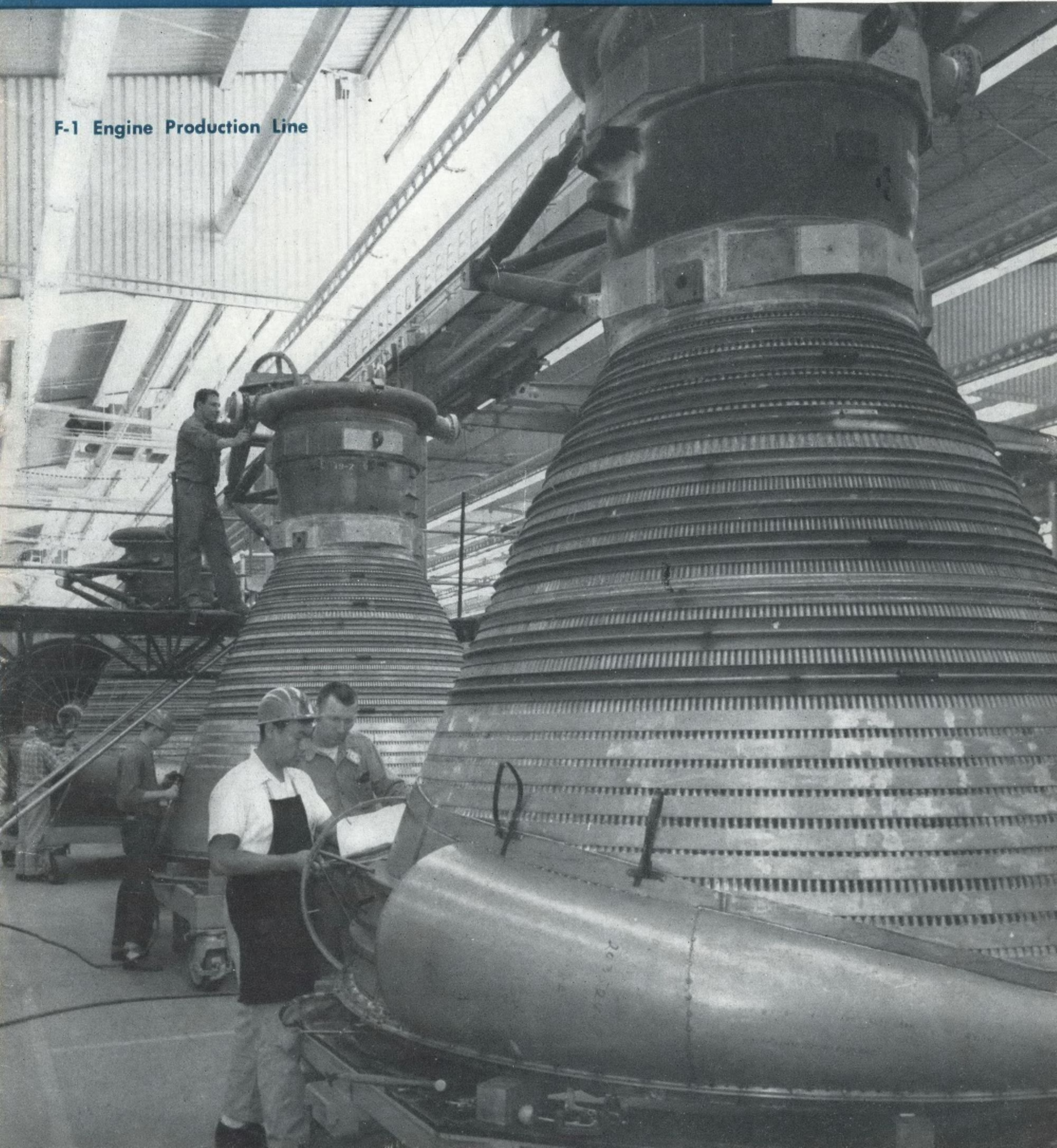
Vought Builds  
Space Pack

USAF Trains  
Guerrilla Force

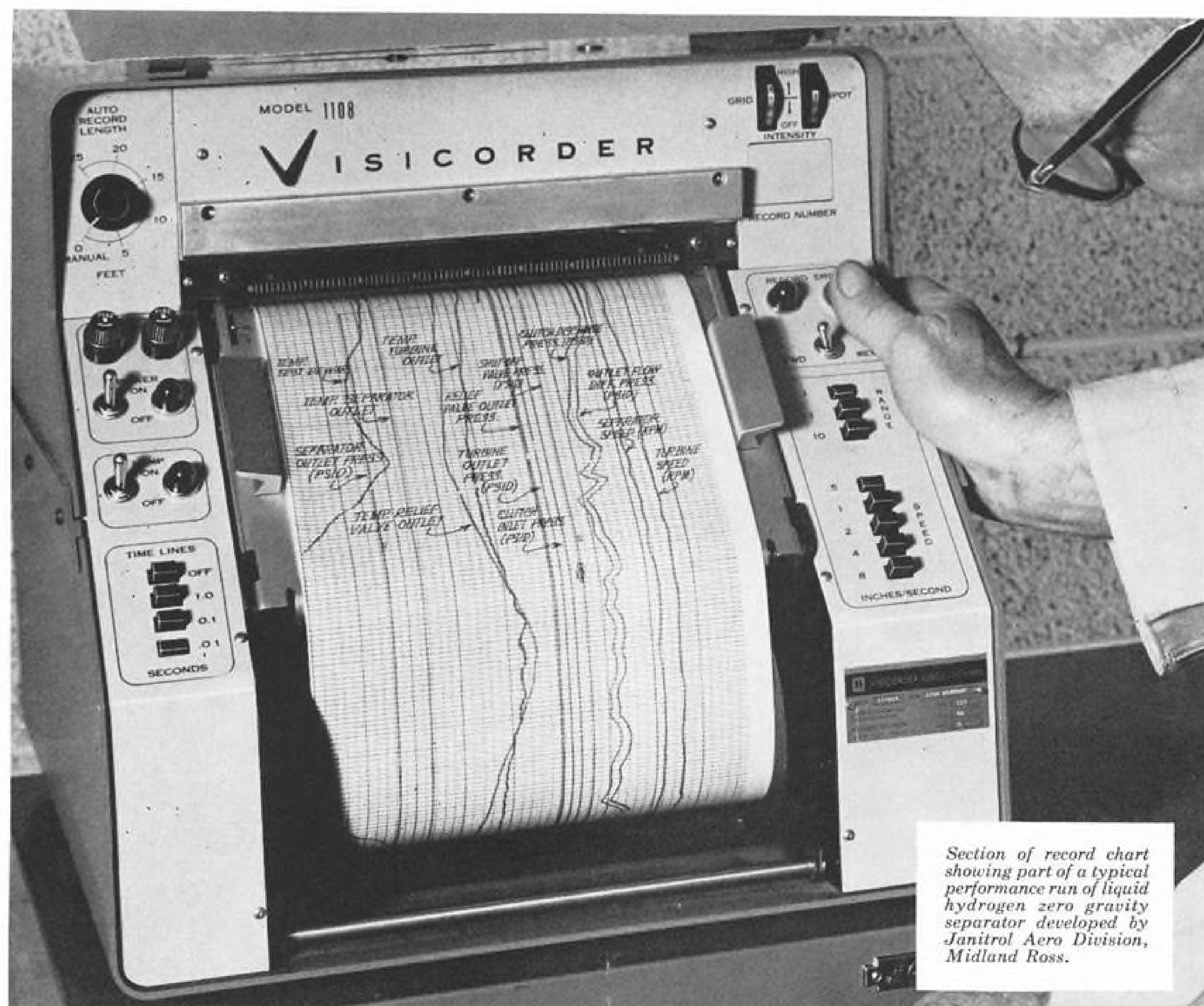
75 Cents

A McGraw-Hill Publication

F-1 Engine Production Line







Section of record chart showing part of a typical performance run of liquid hydrogen zero gravity separator developed by Janitrol Aero Division, Midland Ross.

## The Honeywell Visicorder Oscillograph tests liquid hydrogen systems in "space"

The Janitrol Aero Division of Midland Ross Corporation uses a Model 1108 Honeywell Visicorder Oscillograph to measure and record temperatures and pressures at their new cryogenic test facility at Columbus, Ohio.

In order to simulate conditions as they exist in space, a wide variety of flow rates and pressures must be measured accurately and dependably. The 1108 Visicorder provides Janitrol with direct readout of tests on missile hardware and systems which operate on liquid hydrogen, liquid nitrogen, and other cryogenic fuels.

The new Janitrol facility includes a 500-gallon Dewar, 6' deep and 4' in diameter, that accepts components for static or dynamic test up to this size. Pressures range from 1 psia to 75 psia, and flow rates vary broadly because of the size of the test system.

Honeywell—pioneer in the science of oscillography—offers a wide range of Visicorder Oscillographs to suit your budget and your test requirements. The 36-channel Model 1012 is the most sophisticated; the 6-channel 1406 costs the least per channel. In between are the 8- or 14-channel 906C; the intermediate 24-channel 1108; and the compact

24-channel 1508. Most models record at frequencies from DC to 5000 cps and all have many extra, convenient operating features.

For details, write Minneapolis-Honeywell, Heiland Division, 4800 E. Dry Creek Road, Denver 10, Colorado.



The Honeywell Model 1108 Visicorder Oscillograph in use in the Janitrol test room.

**Honeywell**  
First in Control

## CAPABILITY is spelled f-u-e-l p-u-m-p-s

Inherent high contamination tolerance and pressure balance of vane-type fuel pumps for turbine engines insures high reliability and increased service life even under less-than-ideal operating conditions.

Fuel pumps capable of operating without inlet filters are now a reality as the result of the Vickers Aerospace Division vane-type fuel pumps' ability to meet the rigid contaminant tolerance requirements of MIL-E-5009B.

Benefits resulting from elimination of the inlet filter include: reduced weight, improved system reliability and cavitation characteristics, and reduced maintenance.

**Design Simplicity**—Because vane-type fuel pump components are much simpler than those required with other designs, they are manufactured from a broad range of materials. Thus, Vickers design engineers can select materials with high contamination tolerance, exceptional corrosion and cavitation resistance, and permit handling of fluids having low lubricity.

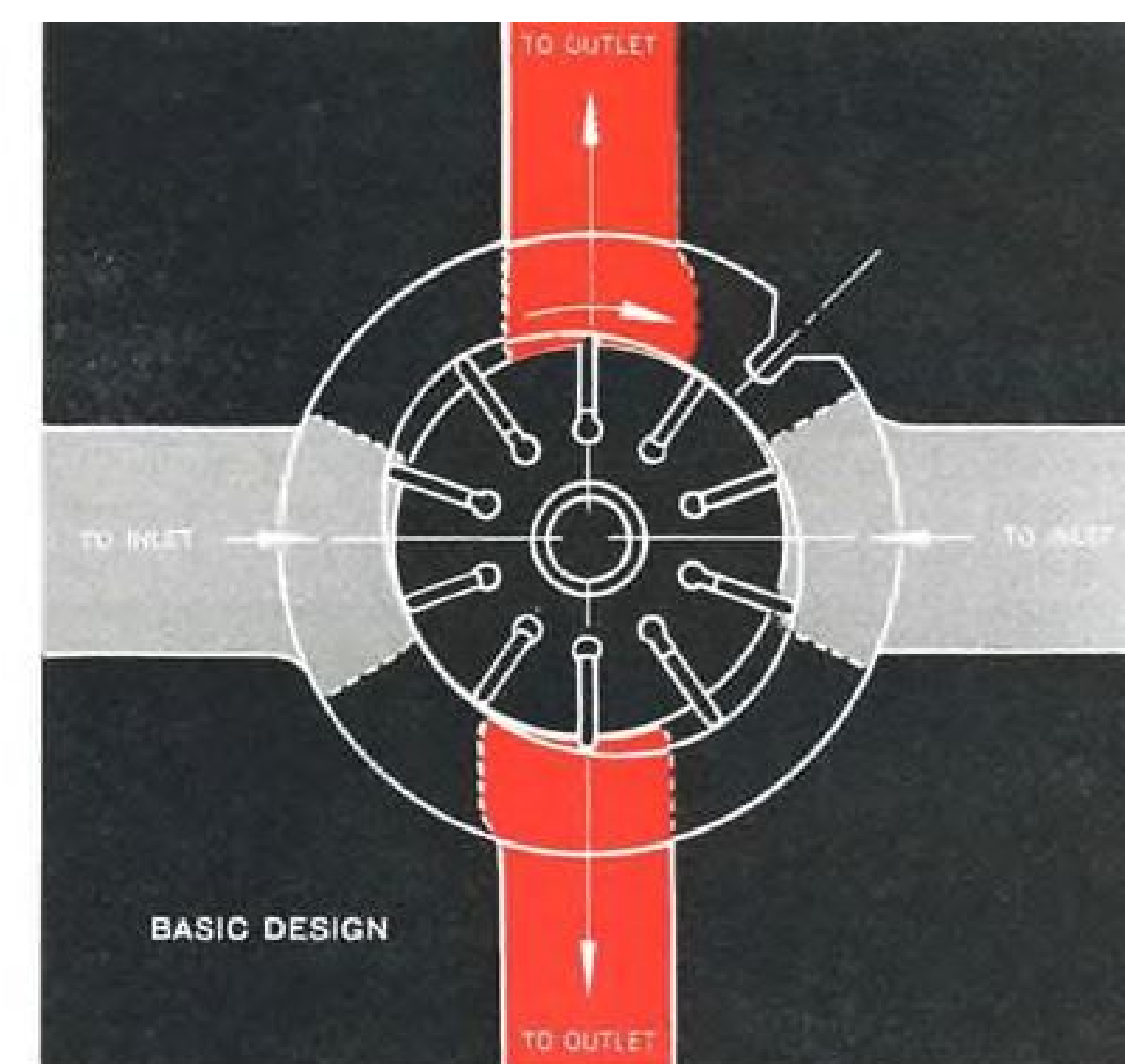
**Pressure Balance**—All pressure induced radial forces are balanced resulting in zero radial loading on the shaft bearings. Direct benefits are: low bearing and journal wear, reduced weight, higher speed and pressure capabilities, increased reliability and service life.

**Mounting Flexibility**—Basic pump cartridge can be an integral part of a fuel control body or provided as an independent pump with or without provision for fuel control mounting. Weight and over-all package size reductions are substantial with integrated designs.

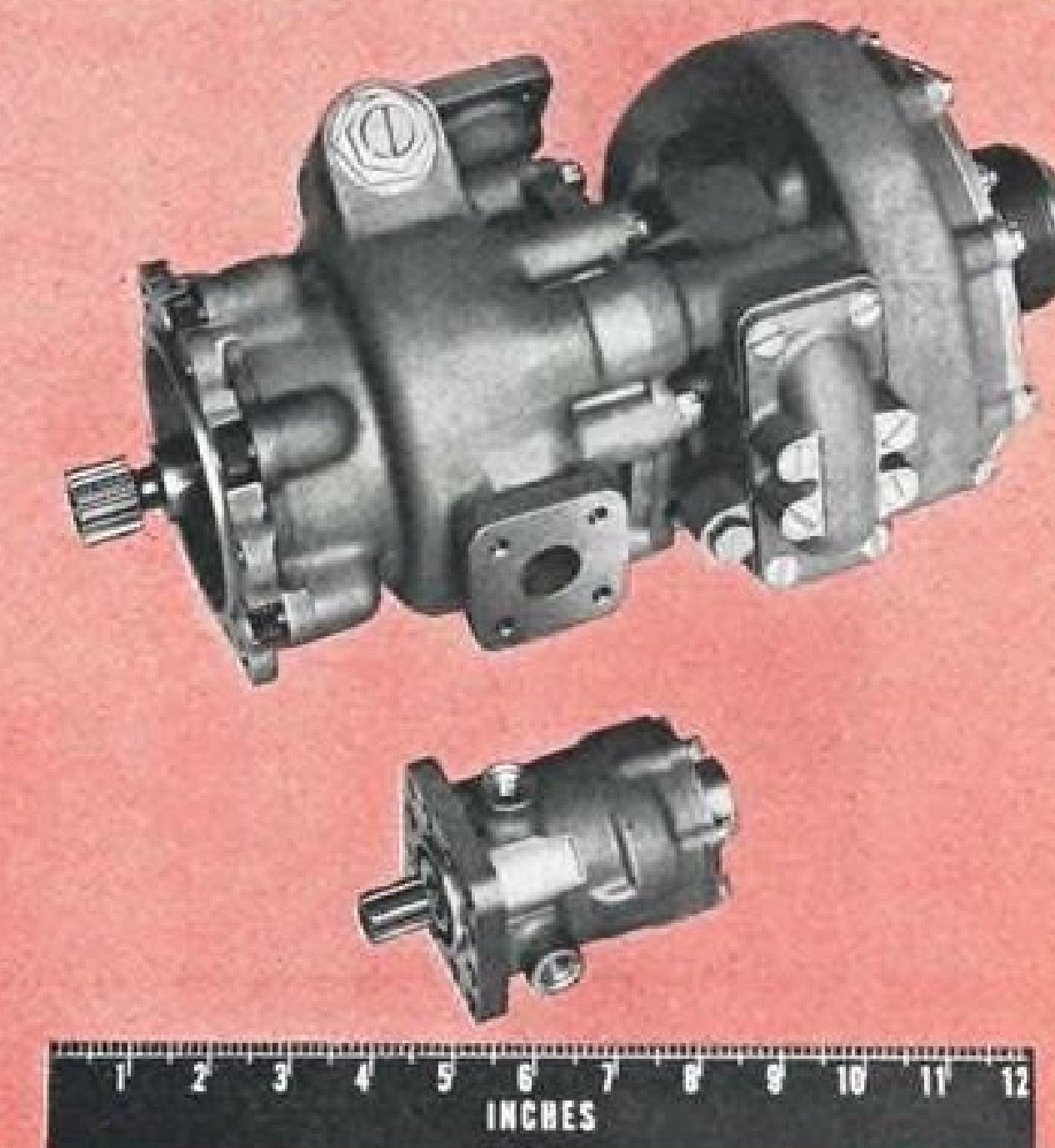
Vickers vane-type fuel pumps are capable of operating at pressures ranging to 1000 psi and higher at normal pad speeds . . . small size units can operate at speeds to 20,000 rpm. They can be produced in sizes providing 100 to 70,000 pounds per hour.

Get more data in Bulletin A-5242A. Vickers Incorporated, Detroit 32, Michigan.

Contaminant, prepared to meet MIL-E-5009B (iron oxide, sharp silica sand, coarse Arizona road dust and lint), is delivered continuously by conveyor at rate of 41 grams per 1000 gallons of fuel during contamination tests. Liquid contaminants are added simultaneously.



Because pressure induced radial loads are balanced, need for making rotor and bearing journals integral is eliminated. Spline drive allows rotor to align itself properly with side plates, independent of bearing journals and journal wear.



Two vane-type fuel pumps, typical of the Vickers line currently available, include the unit in background rated at 60 gpm at 3800 rpm and 1000 psi and the unit in foreground rated at 4.5 gpm at 6200 rpm and 1000 psi.

**VICKERS**  
DIVISION OF SPERRY RAND CORPORATION

PROGRAMED POWER IN:  
POWER TRANSMISSION  
POWER CONVERSION  
FLUID TRANSFER



# Stops leaks permanently



## New rubbery adhesive seals out moisture, dust, contaminants

Here's a really durable, silicone rubber sealant that sets-up at room temperature and bonds permanently to most materials, including metals and plastics. Silastic® RTV 731 has the easy-to-use consistency of toothpaste and is supplied ready for application in handy tubes.

Silastic RTV 731 flows out smoothly, clings to most materials, won't sag or slump when applied to vertical surfaces. It quickly sets-up on exposure

to air and cures *without heat* to form a tough, flexible silicone rubber seal.

Seals made of Silastic RTV 731 show no loss of flexibility when exposed to low pressure steam, moisture, high humidity or corrosive atmospheres at temperatures ranging from -100 to 500 F. This sealant offers solutions to all types of sealing and bonding problems. Wherever your designs call for sealing, it will pay you to look into Silastic RTV 731.

Write for "Greater Versatility with Silastic RTV," Address Dept. 0906, Dow Corning Corporation, Midland, Michigan.



**Dow Corning**

## AEROSPACE CALENDAR

- July 9-13—Reliability Training Conference, Princeton Inn, Princeton, N. J. Sponsors: Institute of Radio Engineers; American Society for Quality Control.
- July 12-13—12th General Assembly, NATO Advisory Group for Aeronautical Research and Development, Paris, France.
- July 17-19—Lunar Missions Meeting, American Rocket Society, Pick Carter and Statler Hilton Hotels, Cleveland, Ohio.
- July 24-Aug. 2—National Soaring Championships, El Mirage, Calif. For information: National Soaring Championships, P.O. Box 997, Victorville, Calif.
- July 30-Aug. 1—PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) Seminars, ITT Data Processing Center, Paramus, N. J.
- Aug. 1-3—Engineering Foundation's Engineering Research Conference on Composite Materials, Tilton School, Tilton, N. H.
- Aug. 1-5—Experimental Aircraft Assn. Fly-In, Rockford Airport, Rockford, Ill.
- Aug. 7-9—Low Level Wind Conference, Texas Western College, El Paso, Tex. Sponsors: American Meteorological Society; U. S. Army Signal Missile Support Agency. (Aug. 9 session in Dallas.)
- Aug. 8-10—1962 Standards Laboratory Conference, National Bureau of Standards' Boulder Laboratories, Boulder, Colo.
- Aug. 10-11—IAS National Specialists Meeting, Man-Machine Competition, Olympic Hotel, Seattle, Wash.
- Aug. 11-Sept. 3—Sixth World Parachuting

(Continued on page 7)

## AVIATION WEEK and Space Technology

June 25, 1962

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AVIATION WEEK and SPACE TECHNOLOGY, June 25, 1962

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**Design Engineering**

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\*United States Patent No. 2931532. Qualifies under NAS Specification 1400 and meets Standard Pages NAS 1398 and 1399. For technical data on the Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

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## AEROSPACE CALENDAR

(Continued from page 5)

Championship, Orange, Mass. Sponsors: National Aeronautic Assn.; Parachute Club of America.

Aug. 13-16—Pacific Energy Conversion Conference, American Institute of Electrical Engineers, Fairmont Hotel, San Francisco.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

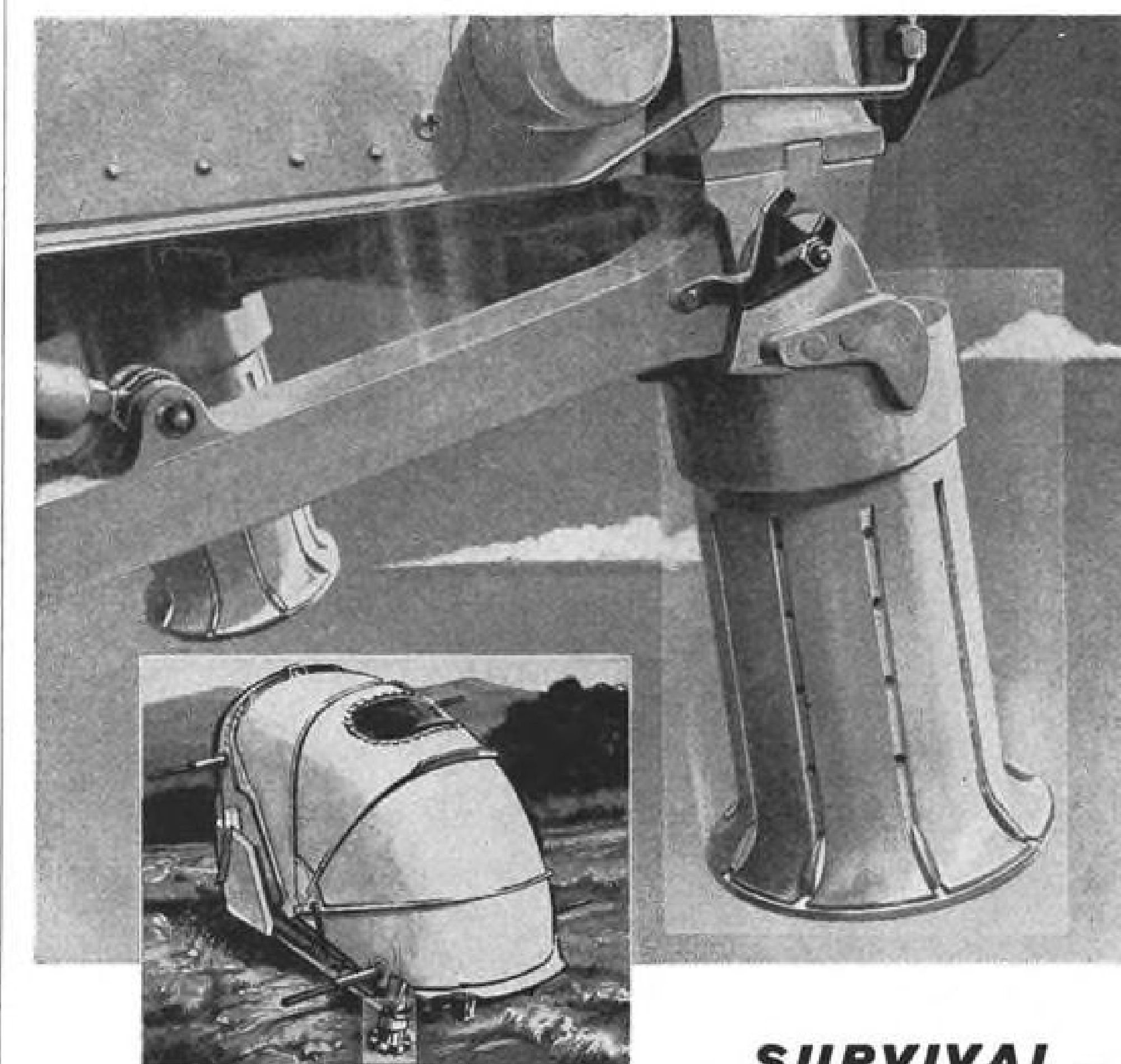
Aug. 28-30—Fourth Conference on Maintainability of Electronic Equipment, Electronic Industries Assn. (in cooperation with Department of Defense), University of Colorado, Boulder, Colo.

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

Sept. 3-7—International Symposium on In-

(Continued on page 9)

*Involvement: LIFE*



**SURVIVAL...**

Where the safety and preservation of human life is concerned, every element involved has vital responsibility. The Stanley-developed impact attenuator illustrated above, for instance, while weighing only 2 lbs. and occupying only 60 cubic inches, is capable of absorbing 4000 ft.-lbs. of energy. Extreme in performance efficiency, the unique "flower pot" helps cushion the landing impact of the survival capsule now operational on Convair's B-58 bomber.

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Polaris-bearing submarines roam the seas with a hot cargo—their guidance systems programmed to assigned targets—alert for immediate launching. But the missions of these submarines require constant and complete monitoring of their combat-ready Polaris missiles to maintain that state of instant readiness.

Special automatic Missile Test and Readiness Equipment (MTRE) provides this launching readiness. Conceived by the Special Projects Branch of the U. S. Navy, it incorporates sensing and instrumentation equipment developed by the *creative design engineers* of Lockheed Electronics Company.

Lockheed Electronics' engineers used their long experience with Navy problems to assure *practical packaging*

of this concept in a design best-suited for the rugged requirements of submarine environment.

Lockheed's experienced *engineering follow-through teams* are aiding in installation and checkout, training Navy operators and maintenance specialists, and staying with the equipment until maximum performance and crew efficiency is achieved.

Lockheed Electronics offers these *creative, practical and follow-through* capabilities to defense and civilian industries alike. LEC is the electronics gateway to several thousand scientists, engineers and technologists who work for Lockheed.

*Engineers and Scientists:* For unique advancement opportunities with this talented team, please contact our Professional Placement Office, Plainfield, N.J.

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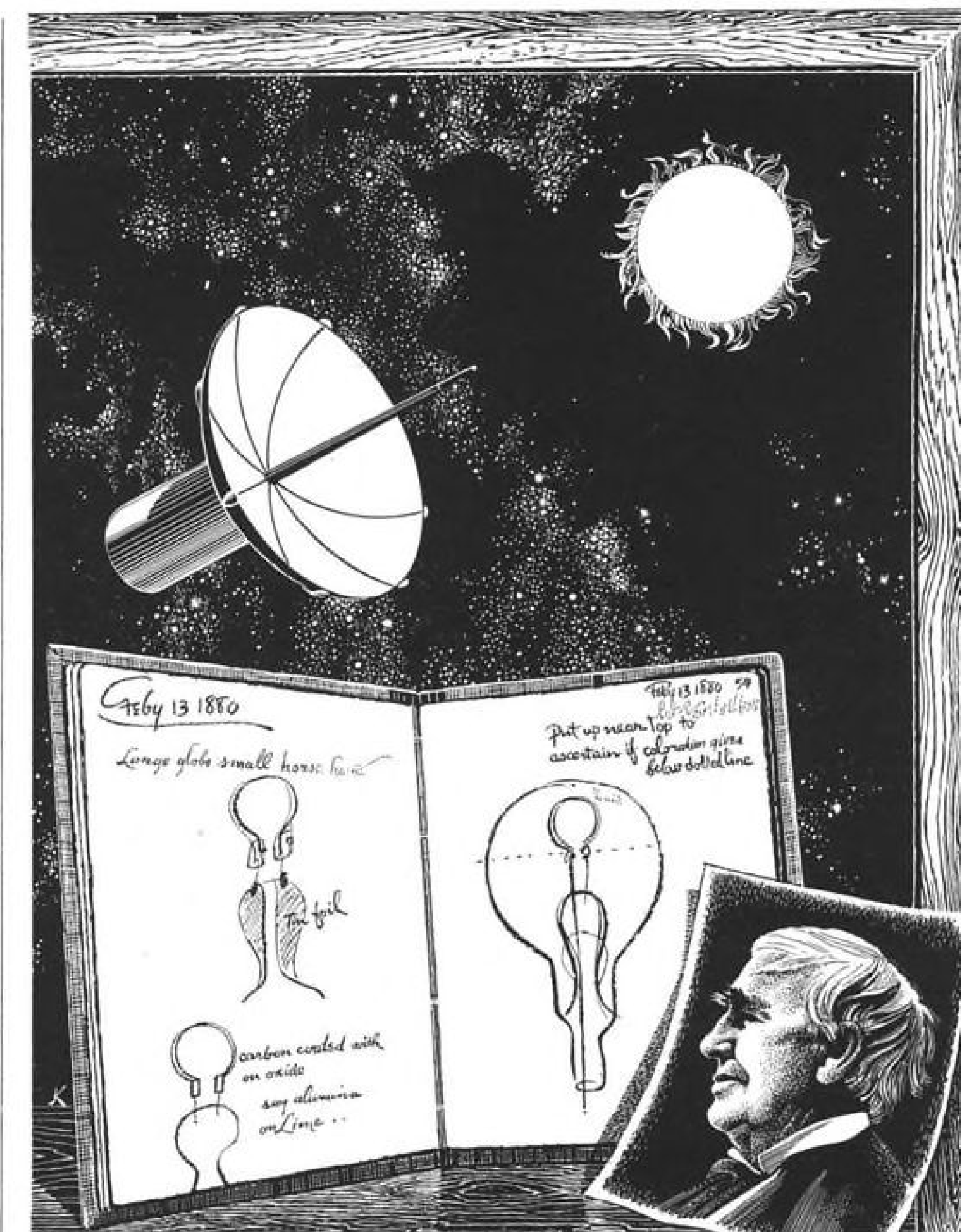
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A Division of Lockheed Aircraft Corporation

## AEROSPACE CALENDAR

(Continued from page 7)

- formation Theory, Institute of Radio Engineers, Brussels, Belgium.
- Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.
- Sept. 5-7—Symposium on Measurement of Thermal Radiation Properties of Solids, Biltmore Hotel, Dayton, Ohio. Sponsors: Aeronautical Systems Division, USAF; National Bureau of Standards; NASA.
- Sept. 10-14—Fourth National Conference on Applied Meteorology, American Meteorological Society, Hampton, Va.
- Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin.
- Sept. 13-14—10th Annual Engineering Management Conference, IRE, Hotel Roosevelt, New Orleans, La.
- Sept. 17-18—Hydrofoil & Air Cushion Vehicles Meeting, Institute of the Aerospace Sciences, Shoreham Hotel, Washington.
- Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.
- Sept. 19-20—Technical Manpower Utilization Meeting, Institute of the Aerospace Sciences, Hotel Commodore, New York.
- Sept. 19-20—Operations & Maintenance Symposium, Airwork Corp., Millville, N. J.
- Sept. 19-21—Sixth National Conference on Tube Techniques, Western Union Auditorium, New York, N. Y. Sponsor: Advisory Group on Electron Devices.
- Sept. 19-22—Second International Agricultural Aviation Congress, National Superior Agronomy School, Grignon, France.
- Sept. 24-28—13th International Astronautical Congress, American Rocket Society, Sofia, Bulgaria.
- Sept. 25-28—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.
- Sept. 26-Oct. 2—1962 General Conference, Federation Aeronautique Internationale, Athens, Greece.
- Sept. 28-29—Society of Experimental Test Pilots' Sixth Annual Awards Banquet & Symposium, Beverly-Hilton Hotel, Beverly Hills, Calif.
- Oct. 1-3—Seventh Annual Exposition & Symposium, Air Traffic Control Assn., Flamingo Hotel, Las Vegas, Nev.
- Oct. 2-4—Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio. Co-sponsors: AFOSR, General Electric.
- Oct. 15-17—ASW Meeting, Somerset Hotel, Boston, Mass. Sponsors: Institute of the Aerospace Sciences; U. S. Navy.
- Oct. 15-18—International Symposium on Space Phenomena and Measurement, Institute of Radio Engineers, Statler-Hilton Hotel, Detroit, Mich.
- Oct. 29-31—Symposium on Dynamics of Manned Lifting Planetary Entry, Philadelphia, Pa. Attendance limited; for information: Sinclair M. Scala, General Chairman, Room M7023A, General Electric Co., MSVD, Valley Forge Space Technology Center, Box 8555, Philadelphia 1, Pa. Co-sponsor: AFOSR.
- Nov. 13-18—17th Annual Meeting and Space Flight Exposition, American Rocket Society, Pan Pacific Auditorium, Los Angeles, Calif.



IN AEROSPACE, MARQUARDT MEANS...

## Thermionic Pioneer

Thomas Edison, in 1883, first noted electron emission from a hot cathode to a cooler anode during his development of the incandescent light bulb. Today, this basic *effect* is being used for the direct conversion of nuclear, solar, and chemical heat to electricity.

As a leader in the field of energy conversion, The Marquardt Corporation is engaged in projects extending into the major areas of direct conversion — thermionic, magnetohydrodynamic, and electrochemical. These projects are resulting in new orders of efficiency and reliability — and are opening unusual terrestrial and extra-terrestrial applications.

Energy conversion typifies only one aspect of Marquardt's continuing efforts in advanced research and development. Scientists interested in participating in these are invited to contact us.

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We have big plans for these little animals at Northrop Space Laboratories. Nature could scarcely have designed an instrument more ideally adapted to investigate the long-term effects of space radiation and weightlessness.

A box just 6" by 6" by 10" could hold 100 hibernating pocket mice—enough to comprise a reliable sample—and everything needed to keep them alive in space for several weeks. Such a package could be

put into orbit quite easily, left there as long as necessary, and recovered for study with the mice still quietly sleeping.

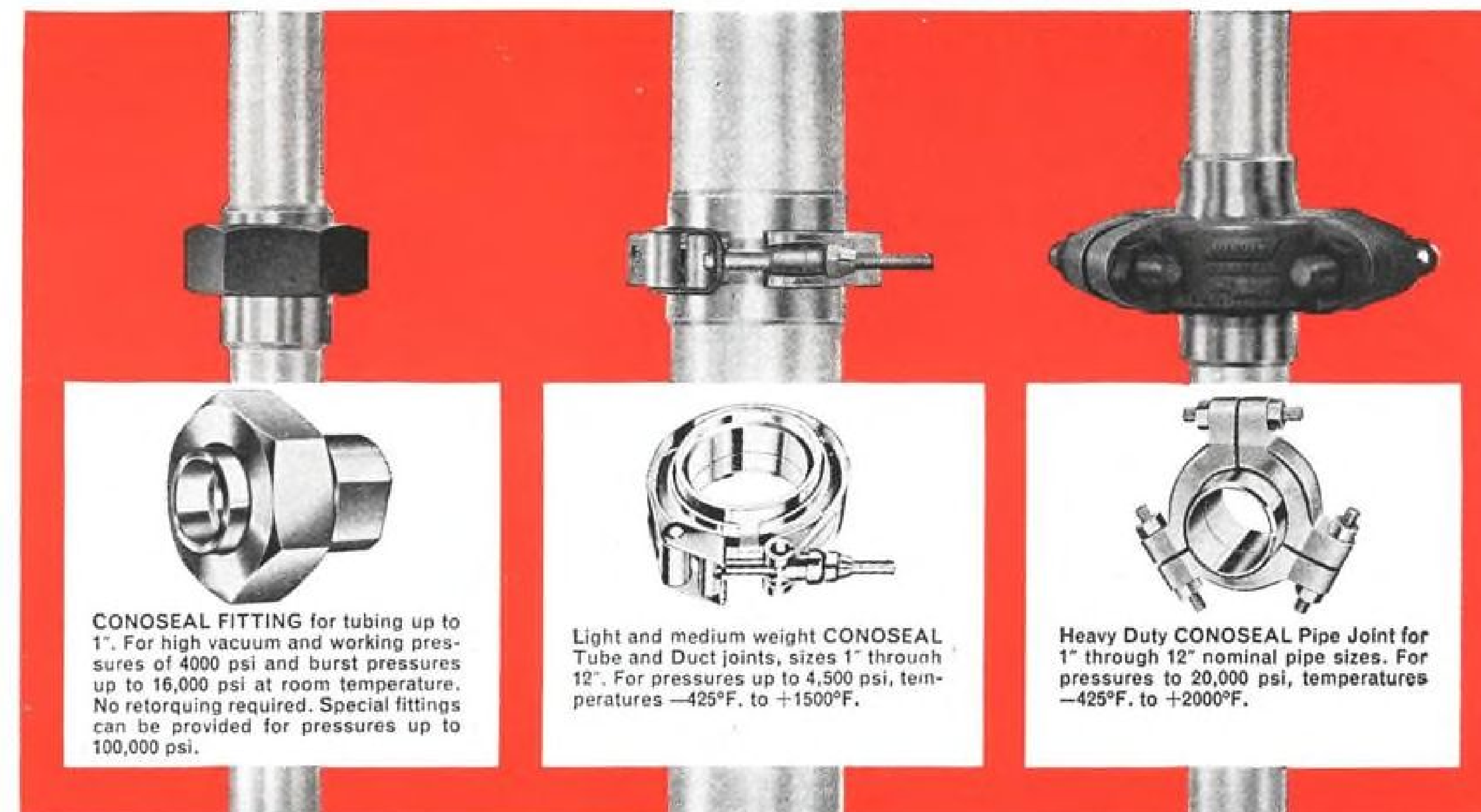
This is just one of the many projects we have in work at Northrop Space Laboratories. Others cover such fields as plasma and nuclear physics, planetary physics and chemistry, materials and structures research, and space systems engineering as well as the manifold aspects of life support systems for space environments.

We have much to learn about the hazards of prolonged exposure to space conditions before we can afford to risk men on such long term projects as moon exploration or manned space stations. The Little Pocket Mouse may well give us a reliable and inexpensive short cut to much of this knowledge. **NORTHROP**

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## All-Metal Pipe and Tube Joints for Zero Leakage in Aircraft, Missiles, Ground Support Equipment

Unique CONOSEAL Joints have capabilities up to 100,000 psi, temperatures from  $-425^{\circ}\text{F.}$  to  $+2000^{\circ}\text{F.}$  with zero leakage.



You are assured high performance dependability when you choose Marman All-Metal Pipe and Tube Joints for aircraft, missile and ground support equipment applications. Absolutely leakproof at extreme temperatures and pressures, CONOSEAL Joints are providing optimum performance in a wide variety of aircraft and missile systems. Examples: Liquid sodium, liquid helium, pressuriza-

tion systems, liquid oxygen and RP-1 systems are a few of the types of applications CONOSEAL Joints will handle with ease. Compact and lightweight, CONOSEAL Joints will meet your most demanding specifications, including connection of dissimilar metals.

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1. The CONOSEAL Joint consists of a male and female flange, frusto-conical shaped gasket and V-retainer coupling. Gasket shown between flanges before torquing the coupling.
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3. Completely compressed gasket—leverage of V-retainer and CONOSEAL design induce plastic flow on sealing edges, insuring 100% metal to metal contact. Mechanical advantage of the V-retainer is approximately seven to one over bolted flanges.

**Aeroquip**

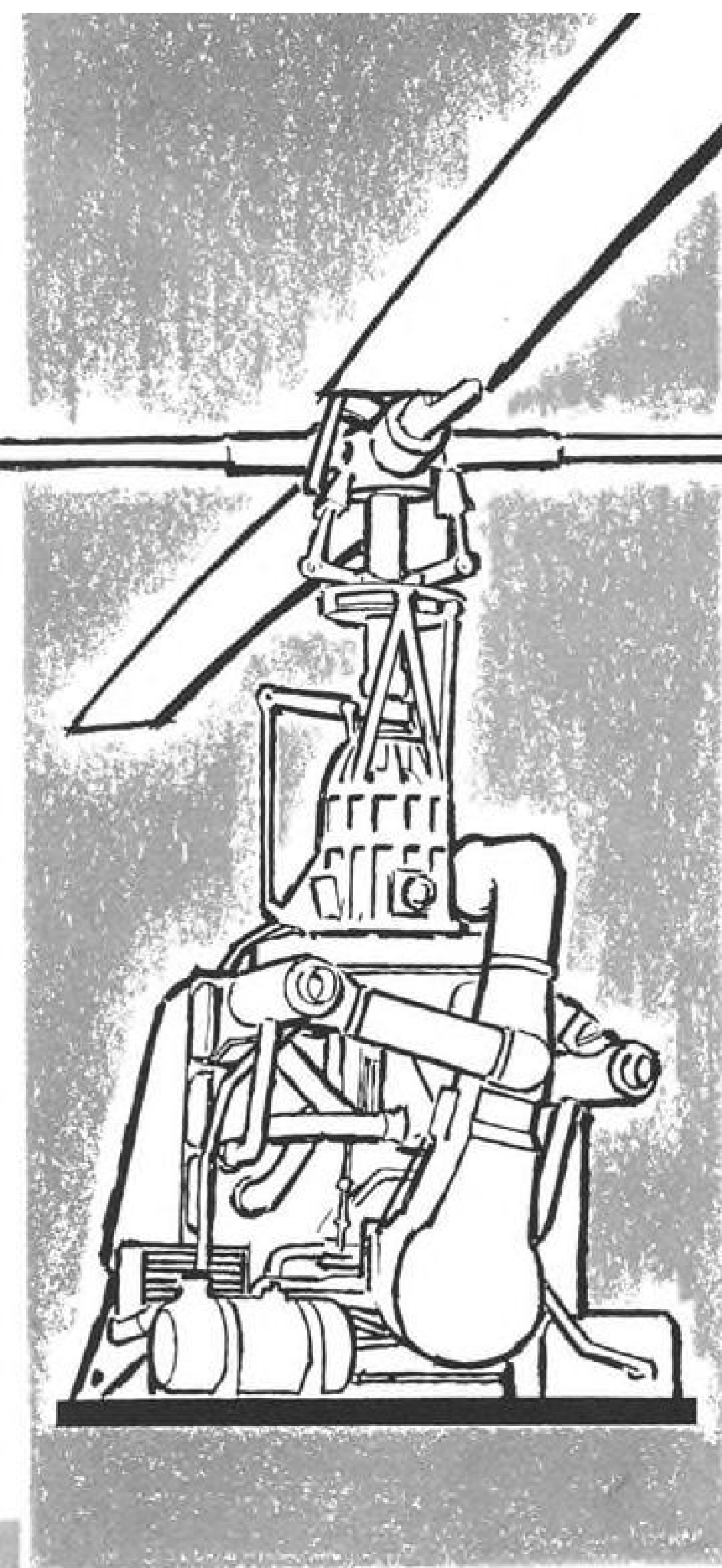
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# POWER

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Today's tactical maneuvers at tree-top level have put new demands on helicopter capabilities. Out of the Hiller growth-planned family of rotorcraft comes the H-23D-1, to meet these demands with common sense qualities which it alone possesses:

**Highest Power in Its Class** — A continuous rating of 305 horsepower with the Lycoming VO-540 engine, now Standard in the Army H-23F.

**Performance Where It Counts** — More power means more maneuverability with greater safety. Example: The H-23D-1 has unmatched vertical climb at military-specified gross weight.

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**Ruggedness** — An obvious requirement in an agile, top-performing aircraft. The H-23D-1 is designed to the highest flight and landing load safety factors in its class.

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The H-23D-1 offers today's capabilities — not yesterday's — within today's logistics system — not tomorrow's.



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**Forward Rotor Transmission**  
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**Engine Gearbox**  
**Aft Rotor Transmission**

**BOEING VERTOL HC-1B CHINOOK**  
Primary Tactical Transport Aircraft

Ultimate reliability, extended overhaul periods, and maintainability were primary requirements in the design of the Boeing Vertol HC-1B helicopter. For development manufacturing and production of the all-important transmissions for what has been called America's "most powerful helicopter," Boeing Vertol looked to Foote Bros.' total capability for the answer. In production and flying, the Chinook is meeting—in full—all of the U.S. Army's primary requirements.

### Foote Bros. offers coordinated facilities in these areas:

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A completely staffed Design Engineering Group with a solid record of achievement in systems and component design and development.

**TEST PROGRAMMING**  
Extensive test facilities plus test stand design and procedure experience ensure to-the-letter compliance with specifications.

**DEVELOPMENT MANUFACTURING**  
Long experience in working with many prime contractors gives us the ability to move quickly and surely to successful completion of preliminary development.

**PRODUCTION**  
Foote Bros. production facilities and craftsmen are keeping pace with the ever-increasing demands of the aero/space industry for greater product reliability.

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*POWER TRANSMISSION DRIVES*



# SEAL SKYDROL

## EP O-RING SEALS DEVELOPED BY PARKER SEAL COMPANY

A new O-Ring material for sealing Skydrol 500A has been released by the Parker Seal Company.

Believed to be "a first," the manufacturer reports that the development of an Ethylene Propylene Rubber O-Ring compound has resulted in a major improvement in physical properties essential to sealing Skydrol 500A. This achievement has been confirmed by functional-environmental tests at both the manufacturer's testing laboratories and in customers' units.

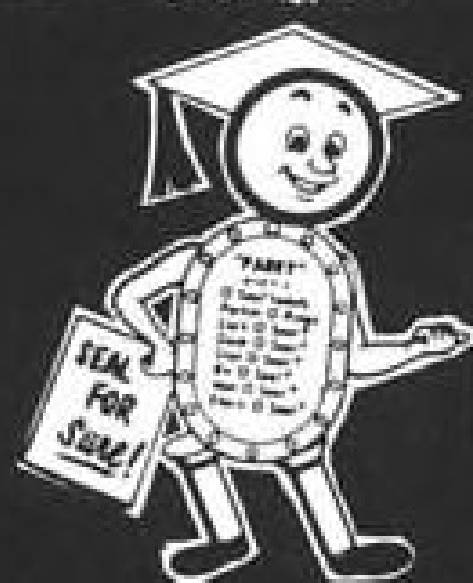
The new compound, E515-8, exhibits outstanding resistance to Skydrol 500A fluid as evidenced by the fact it does not continue to soften during long-term aging, will not extrude readily under high pressure, and provides excellent wear resistance in critical dynamic applications.

Perhaps the most significant contribution to Skydrol sealing is the resistance of E515-8 to high temperatures. All testing to date demonstrates that this compound is effective over a temperature range of  $-65^{\circ}\text{F}$  to  $300^{\circ}\text{F}$ . This lessens the danger of premature seal failure caused by inadvertent heating of Skydrol by "hot spots" in the hydraulic system.

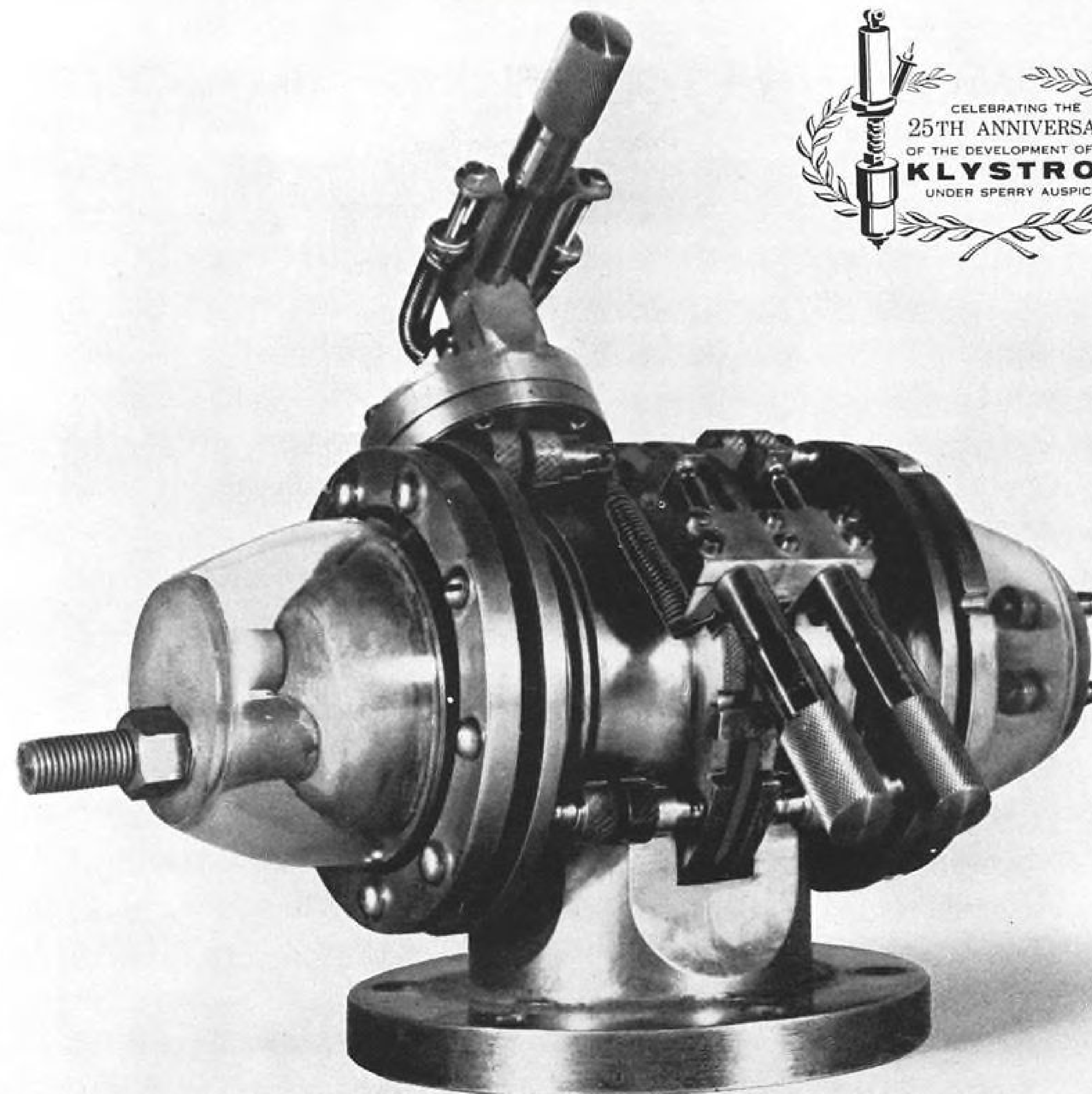
In addition, E515-8 exhibits excellent abrasion resistance and is practically unaffected by ozone and weathering.

*These new EPR O-rings are now available in all AN and MS sizes, Parker Seal Company's standard sizes, and in special sizes with some additional lead time.*

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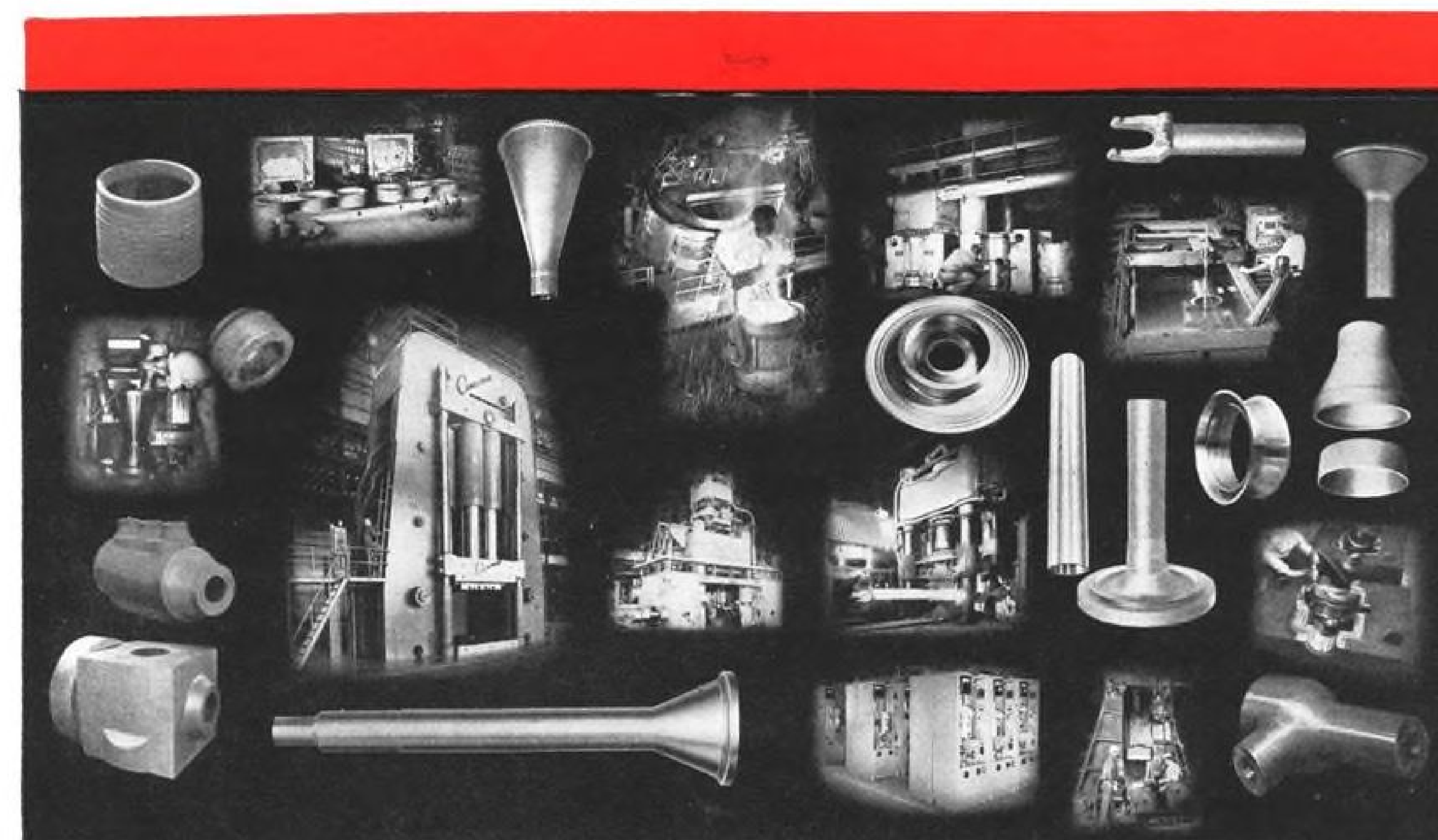
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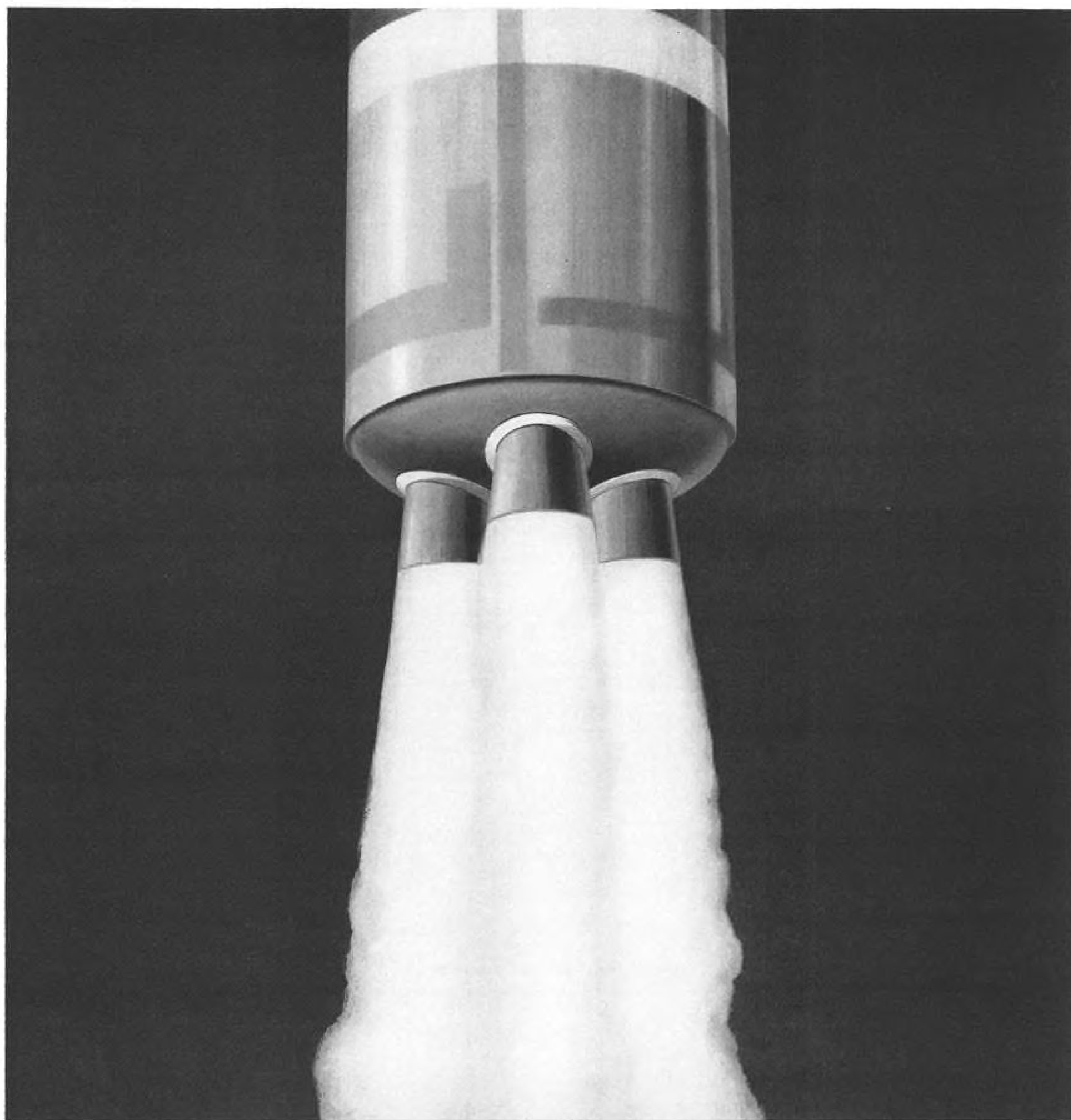
**COVER:** First photograph released of the thrust chamber assembly line for F-1 liquid propellant, 150,000-lb.-thrust rocket engines shows the chambers at the Canoga Park, Calif., plant of North American Aviation's Rocketdyne Division. F-1, the most powerful engine currently under development in the U. S., will be used in a cluster of five to provide 7.5 million lb. thrust for the first stage of National Aeronautics and Space Administration's Saturn C-5 vehicle. Chambers are shipped from the plant to Edwards AFB, Calif., for test firings, then returned to Canoga Park for installation in a complete engine.

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## EDITORIAL

### Reflections at Midyear

As 1962 approaches the midway mark it is evident that this year will be one of the liveliest and most significant in the recent history of the aerospace industry and its customers. While the rest of the nation relaxes into the summer vacation doldrums the aerospace industry is facing tense months of ferment and major policy decisions that will determine the pattern of its technology and economics for many years to come.

Major decision looming in space technology will be National Aeronautics and Space Administration's action in mid-July to chart a top priority path to a manned lunar landing. This decision is being billed as a choice between the earth orbital rendezvous with tanker mode, advanced by the Marshall Space Flight Center, and the lunar rendezvous shuttle bug technique, originating along NASA's Langley-Houston Manned Space Flight Center axis. But we suspect that what will finally emerge from the NASA decision-making machinery before the end of July will contain a good bit of both techniques organized into a solid two-pronged push rather than a plunger's bet on any single technique.

Another product of the summer's ferment will be the radical shakeup demanded of the Army and Air Force's non-nuclear war tactics by Defense Secretary Robert S. McNamara (see p. 26). This is a goading long overdue. Out of the workings of the Howze board and its related groups should come a truly modern concept of air mobility that will keep industry hopping to develop the required equipment.

#### Merger Questions

On the airline front the shadow of two titanic mergers dominates the attention of the Civil Aeronautics Board and the airline industry. Whether the proposed American-Eastern Air Lines merger will develop into a domestic air transport giant, and whether Juan Terry Trippe will attain his long-sought goal of domestic routes and a chosen-instrument U.S. monopoly in the international field through a merger of Pan American with TWA are the decisions that will shape commercial air transport's future.

The abrupt departure of Gen. Frederic Smith, USAF's vice chief of staff, and the appointment of non-pilot Gen. William Fulton "Bozo" McKee to this No. 2 spot portend some interesting shifts in the high command for

next year that will be reflected in maneuvering for the remainder of 1962. It seems most unlikely that a non-pilot would be appointed to succeed Gen. Curtis LeMay when his term as USAF chief of staff expires about a year hence. Big question in the Pentagon is: For whom is Gen. McKee keeping that chair warm?

Aerospace Industries Assn. faces some hard personnel decisions in finding an adequate replacement for August C. Esenwein as its president. His successor will need the ability to continue the program he had begun to shake out the mediocrity from its professional staff and transform this group into an effective working agent for the aerospace industry. Air Transport Assn. must handle a similar problem in bolstering the professional quality of its staff. Both segments of the industry will face increasing complexities in their relations with the government.

#### Military Space Dilemma

Another major decision that must come from the White House is whether the Pentagon is going to be permitted to develop an adequate military space program. If such a decision is not forthcoming soon, the prospects for being badly out-manuevered in this field by the Soviet Union will increase. It is worth recalling that our ICBM and space technology programs were organized only after it was evident that the Soviets were moving faster in these technologies. As a result we unnecessarily sacrificed the advantages of initiative and eroded our position of international leadership. To make a similar mistake in the military applications of space technology at this late date could be fatal.

How much the recent Pentagon military space security directive will retard the pace of space technology through its "need to know" provisions should become evident during the rest of this year. Both industry and Congress should watch carefully for any attempts by the authors of this "need to know" provision to use it as a device to achieve despotic control of technology.

The first six months of this year have forced the aerospace industry to change many of its traditional concepts of management, technology and financing. The prospects are strong that the impact from these months will seem mild in retrospect as the policy decisions come reverberating out of the steamy summer months and continue far into the fall.

—Robert Hotz

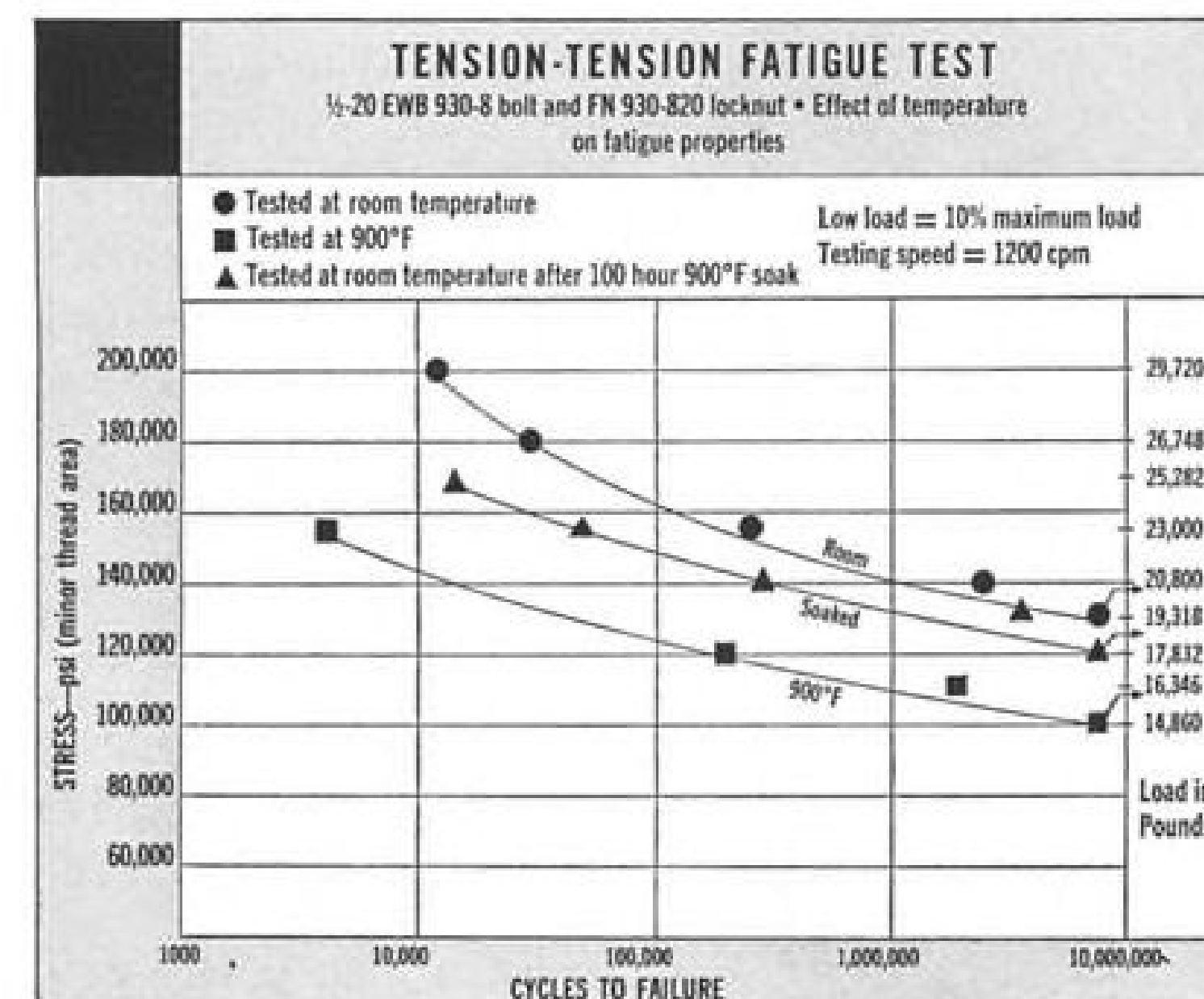


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## WHO'S WHERE

### In the Front Office

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Dr. S. Dean Wanlass, a vice president, Philco Corp., Philadelphia, Pa., and general manager of the Computer Division.

John H. Mangle, executive vice president, Cook Electric Co., Chicago, Ill.

Brig. Gen. Charles S. Hays (USA, ret.), a vice president, Maxson Electronics Corp., New York, N. Y., and president of Maxson Electronics Division.

Paul Jennings, vice president-marketing and sales, Camloc Fastener Corp., Paramus, N. J.

Dr. Winston E. Kock, vice president-research, The Bendix Corp., Detroit, Mich.

Bert W. Holloway, Lockheed's corporate director of advertising, publicity and sales promotion, elected a director of Astro-Science Corp., Culver City, Calif.

Col. Pedro A. Chapa, president, Mexicana Airlines (CMA).

Grumman Aircraft Engineering Corp., Bethpage, N. Y., has announced the following appointments: William J. Hoffman, formerly vice president-manufacturing, now a member of the Executive Committee; Edward Nezbeda, director, Manufacturing Department; Joseph Harrison, production manager; Leonard Wheeler, manufacturing engineering manager; Byron Brown, manager, Manufacturing Training Program.

Dr. Gerhard W. Braun, chief scientist, Pacific Missile Range, Pt. Mugu, Calif.

### Honors and Elections

John R. Moore, vice president of North American Aviation, Inc., and president of the Autonetics Division, has been named recipient of the Thurlow Navigation Award for 1961 by the Institute of Navigation.

Neil A. Armstrong, an X-15 pilot for the National Aeronautics and Space Administration's Flight Research Center, has been named recipient of the 1962 Octave Chanute Award by the Institute of the Aerospace Sciences for his assistance in development of an experimental adaptive control system for the X-15.

Lawrence W. Gardenhire, associate director of Radiation, Inc.'s Advanced Communications Group, has received the National Telemetry Conference's annual Telemetry Man of the Year Award.

J. Y. McClure, director of reliability and quality control for General Dynamics/San Diego, has been named board chairman and chief presiding officer of the American Society for Quality Control.

C. J. McCarthy, aeronautical consultant and former board chairman of Chance Vought Corp., has been elected president of the Flight Safety Foundation.

Flight Safety Foundation's award for distinguished service in achieving safer utilization of aircraft has been presented to Squadron Leader A. C. Bryan of the Royal Canadian Air Force's Institute of Aviation Medicine. The Foundation's distinguished service awards are sponsored by AVIATION WEEK and SPACE TECHNOLOGY.

(Continued on page 92)

## INDUSTRY OBSERVER

► Industry complaints over the sole-source nature of negotiations with six companies to conduct studies of the manned 621A—or manned Saint—program were a factor in their termination. Requirements for the studies (AW June 4, p. 34) which touched off angry reaction in the White House (AW June 18, p. 26) were left intact, and USAF's Space Systems Division is expected to conduct an industry-wide competition soon instead of negotiated procurement.

► USAF's proposed Project Moss (Manned Orbital Space Station), formerly called MTSS (Manned Test Space Station), would use Apollo capsules bought from National Aeronautics and Space Administration and North American Aviation, Inc., as initial step, but would eventually lead to permanently-orbiting structure. Permanent structure initially would be experimental bioastronautics facility, then become space command and control center. It also probably would serve as refueling and resupply base for manned Saint vehicles.

► Program to develop a facility for mechanized manufacture of microcircuits, using electron or photon beams, which can deposit wide range of conductive and non-conductive materials, multiple semiconductor junctions and make spot welds within a single vacuum chamber, is planned by USAF's Aeronautical Systems Division. Qualified companies interested in making proposals must notify ASD by July 4.

► Industry proposals for Phase 2 study contract of Project Albatross, Navy plan for an orbiting sea surveillance satellite which could indicate numbers of ships in particular foreign waters, are being evaluated by Navy at Pacific Missile Range, Pt. Mugu, Calif. Albatross is an outgrowth of the earlier Navy Yo-Yo program which envisaged a single-orbit surveillance satellite. Present Albatross program is in early study phase, receiving low-level funding.

► National Aeronautics and Space Administration is considering launching Little Joe-2 Apollo boilerplate models from a new pad to be constructed at White Sands Missile Range, N. M. Original plans was to adapt Redstone Pad No. 5 at Atlantic Missile Range for this purpose, but firing schedule at AMR is so crowded that White Sands entered the picture.

► Air Force planning study, called RIPS (Range Instrumentation Planning Study), which is to investigate likely missile range instrumentation requirements during 1965 to 1970, will be awarded to industry by USAF's Electronic Systems Division. Study proposals were requested recently.

► McDonnell Aircraft Corp. has proposed to Defense Department a growth version of F4H-1 Phantom 2 twin-engine jet fighter which would improve performance in some areas as much as 35%. This version would use Allison AR168 engine with higher thrust-to-weight ratio. Over-all performance parameters would approach or equal proposed F-111A (formerly TFX) variable geometry-wing tactical fighter.

► Companies expected to submit proposals for outfitting a third ship and estimating cost of a fourth in Atlantic Range Instrumentation Ship (ARIS) series include General Dynamics, International Telephone & Telegraph, Lear Siegler, Radio Corp. of America, Raytheon, Sperry Rand and Westinghouse. Air Force specifications strongly imply that RCA FPQ-6 radar is to be employed in ships 3 and 4 rather than the integrated Sperry system based on C-band tracking radar in ships 1 and 2 (AW June 11, p. 101).

► Army Ordnance Missile Command is considering the possibility of testing an advanced, anti-satellite version of the Nike Zeus missile against a low-orbiting earth satellite during the Kwajalein test series. Anti-satellite missile would be an extremely high-acceleration solid propellant weapon.

► Aeronutronic Division of Ford Motor Co. is conducting theoretical studies for USAF Space Systems Division on infrared radiation characteristics of exhaust flames and atmospheric gases, aimed at refinement of satellite-borne early-warning ballistic missile launch detection sensors.





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## Washington Roundup

### Secrecy Controversy

Defense Secretary Robert S. McNamara has directed the Air Force to try to draft an unclassified version of the directive cloaking military space activities in secrecy. Air Force, in the last few days, has been working with the House Special Government Information Subcommittee which requested the declassification in a letter to McNamara (AW June 11, p. 25).

But it is still uncertain whether Subcommittee Chairman John Moss will go ahead with hearings on the new secrecy policy. He told Aviation Week he would like to have an unclassified version of the directive in hand first as well as more direct comment from industry on the impact of the secrecy policy. Despite growing concern, industry groups have been reluctant to put their fears on record—much to Rep. Moss' dismay.

Rep. Olin Teague, second ranking Democrat on the House space committee, is pursuing an opposite course by pressing for more space secrecy, not less. He feels State Department and White House officials have been giving him the run-around in his effort to persuade the Kennedy Administration that the National Aeronautics and Space Administration is revealing too much valuable information. Rep. Teague now plans to take his case directly to President Kennedy.

### Centaur Slipping

Centaur's second flight test may slip from its scheduled October launch date to early 1963 because of damage inflicted on the vehicle by a shock wave from the recent explosion of an Atlas F-1 at the General Dynamics/Astronautics testing facility in Sycamore Canyon, near San Diego, Calif.

Damage was so major that General Dynamics had to disassemble the Centaur tankage, thus putting the program off schedule. National Aeronautics and Space Administration is trying to find ways to make the October launch date, but the outlook is gloomy.

The probable delay comes amidst widespread exasperation in Congress and elsewhere about the whole Centaur program. Chairman Joseph Karth of the House Space Sciences Subcommittee last week wrote NASA that he "felt reasonably assured" during the Centaur hearings that the second launching would not be delayed, but had since heard unofficially the date had slipped to January, 1963. NASA declined public comment.

Rep. Karth's subcommittee is putting the finishing touches on a report which strongly criticizes the management of the Centaur program. The report probably will be released this week.

### High-Energy Fuels

Congress is displaying a peculiar attitude toward such high-energy fuels as fluorine and boron combinations. The House authorized NASA to spend \$500,000 to test these fuels and the Senate space committee doubled that amount, but did not transfer the money to the research and development account as industry wished (AW June 11, p. 25). So the money will do little to help develop these high-energy fuels.

The high-energy fuel industry received another setback when Chairman George Miller of the House space committee refused to let its representatives attend the hearing June 15 when NASA and Air Force witnesses discussed results of fluorine and boron research. One reason for the ban was the Air Force request for a restricted and closed hearing. Another was Chairman Miller's reluctance to provoke a new controversy about space research efforts.

But Rep. Karth emerged from the hearing dismayed about the lack of emphasis on high-energy fuel research. He said his space sciences subcommittee, which called the hearing, will press for more emphasis in this field.

### Red China Buildup

Civilian and military intelligence officials are split in assessing the Chinese Communist buildup of air and ground forces on the coast opposite Quemoy and Matsu. Civilian authorities contend the concentration may signal the start of an actual attempt to capture the islands to bolster the prestige of the Red Chinese government both at home and abroad. But military estimates interpret the buildup as a show of force, not the prelude to an offensive. The White House said last week that President Kennedy was watching developments "with concern."

General Accounting Office is expected to start paying more attention to NASA contracts. Several members of the House appropriations committee have urged a closer look at the space agency's operations and GAO has promised to do so. GAO, however, has quietly called off its study of NASA-Air Force duplication at the Atlantic Missile Range on grounds there are too many policy questions involved.

—Washington Staff



# DOD Orders Army Shift to Air Mobility

**McNamara directs sweeping revision; warns USAF it must fulfill or lose close combat support mission.**

By Larry Booda

Washington—Defense Secretary Robert S. McNamara has told the Army to revise its traditional concepts of tactical mobility by shifting to air transport, and warned the Air Force that it must fulfill its role of close combat air support or lose it to the Army.

In directives sent to the two services in mid-April, McNamara emphasized that he desired that every possible unconventional concept be explored to enable the foot soldier to fight better in difficult surroundings such as those now being encountered in Southeast Asia. First changes will go into effect next year, and long-term plans will extend to 1975.

AVIATION WEEK was told that highest Administration officials are directly interested and active in reshaping strategy and forces to fight less than an all-out war, especially counter-insurgency actions. The aviation industry has been asked to help in exploring new ideas and will participate in developing new vehicles, especially of the short takeoff and landing (STOL) and vertical take-off and landing (VTOL) types.

Guidelines also indicated that the close troop support aircraft of the future would be designed for relatively low speed operation, leaving the role of defeating enemy fighters to air superiority fighters overhead.

Army Secretary Elvis J. Stahr, Jr., after a specific suggestion by McNamara, appointed Lt. Gen. Hamilton H. Howze, the first Director of Army Aviation, to head a board to undertake the studies. A general outline of the studies was sent to McNamara May 15. A final report to him is due by July 31

and recommendations for consideration by the National Security Council and the President will be completed by Sept. 1.

## Air Force Action

Air Force responded by activating a special air warfare center at Eglin AFB, Fla., to provide increased counter-insurgency tactical air capability. Heading the center is Brig. Gen. Gilbert L. Pritchard. Two groups comprise the center—the 1st Air Commando Group and the 1st Combat Applications Group. Deadlines similar to those assigned the Army were given to the Air Force (see p. 74).

Gen. Howze, who commands the Strategic Army Command (STRAC) and the 18th Airborne Corps at Ft. Bragg, N.C., appointed 17 generals, other officers and civilians to participate in seven working groups.

Although no studies have yet been

completed by either service, these are the significant recommendations expected to emerge:

- **Development of airborne vehicles**, probably with VTOL and STOL capabilities, that can carry 40 to 50 tons in any combat theater where the Army would be involved.
- **Increased emphasis on development of lightweight weapons** at the expense of conventional heavy armament.
- **Elimination of all conventional means of ground transportation** and the forces needed to maintain it.
- **Reorientation of logistic support.**
- **Development of new tactics** to fit the altered environment and hardware.

Army sources indicated that the McNamara guidelines are so sweeping that top officials were instructed that the results of the Howze board were not to be reviewed by conservatives in the Army who would dilute or veto its recommendations. It is notable that many members of the board have identified themselves with air mobility in the past.

## Industry Aid Sought

One of the first actions of the Army Tactical Mobility Requirements Board, which is the formal name of the Howze group, was to ask the aviation industry for ideas. In a letter sent May 25 to every company with capabilities in developing airborne vehicles, Maj. Gen. Clifton F. Von Kann, acting for Gen. Howze, stated that the studies are being conducted with high priority on a very tight deadline and "in an atmosphere completely divorced from traditional viewpoints, current doctrine and present programs."

"By consideration of fresh, bold, unorthodox concepts," he continued, "we seek to exploit fully the technological, doctrinal and organizational potentials with a view toward quantum improvements in the critical categories of all combat functions including reconnaissance, surveillance, target acquisition, mobility or maneuverability, firepower, logistical support and command and control."

The letter requested voluntary submissions of ideas, including conceptual drawings, charts, graphs, photographs and motion pictures. Submissions were to reach the board by June 18.

Because of the extended period to be covered by the board—1963 to 1975—companies were asked to indicate the time frame of their suggestions and when the system or piece of hardware would be available. The suggestions were to be made at no cost to the government.

Companies were assured that proprie-

tary material would be protected and that distribution would be limited to official sources on a "need to know" basis.

Von Kann, who is also a former Director of Army Aviation, is head of the combined arms working group under Gen. Howze. His permanent duty assignment is Deputy Chief of Staff for Operations of the U. S. Strike Command.

## USAF Effort

The Air Force effort, centered in the 1st Combat Applications Group, is not as widespread as that of the Army. It is faced with trying to retrieve the responsibility given it in several facets of the Roles and Missions of the Armed Forces, written in November of 1956, which the Administration had accused it of neglecting. Specifically, these are close combat air support, and to a lesser extent, tactical reconnaissance and interdiction of the battlefield with less than nuclear weapons.

Army demands for relatively slow, large load-carrying and long endurance aircraft for close combat support were largely ignored until recently. The first Air Force action to obtain interim hardware for this need was the recent purchase from the Army of two Grumman AO-1 Mohawk twin-turboprop aircraft, which will be configured to carry close support armament. These will be evaluated to determine whether such an aircraft fills the need in counter-insurgency actions.

Otherwise, the Air Force has concentrated on air commando operations. This includes training of allied crews in all phases of airborne operations such as low-level drop techniques, support for counter-guerrilla forces, rapid deployment to areas of suspected guerrilla activity, reconnaissance and interdiction raids.

The Air Force counter-insurgency effort so far has resulted in a number of North American T-28 aircraft, formerly used by the Air Force and the Navy as trainers, being configured for jungle warfare. Other reconfigurations have been applied to the Douglas B-26 twin-engine bomber, the Helio Courier L-28 ultra-light transport and the Douglas C-47 light transport.

Repercussions in the Army from the Howze board studies could result in changing the structure of that service. For instance, it has been proven that air transport in the Army's combat zone is radically cheaper than conventional means. Considering the cost of building roads and bridges, maintaining transportation pools, building warehouses for storage of material, establishing and maintaining forward hospitals and many other activities tied to slow ground transportation, the savings become apparent.

## Short Bros. May Cease Operation

London—Short Brothers & Harland may go out of business by 1965 unless more orders for the Short Belfast turboprop tactical freighter are forthcoming from either civil or military customers.

The warning came at Belfast last week from C. E. Wrangham, chairman, who said breakeven point for the Belfast is thirty airplanes. So far, the Royal Air Force has ordered 10 and last week indicated there would be no more added to that figure, as it has said in the past (AW Mar. 19, p. 39).

Wrangham said Short Brothers will "stand or fall by the Belfast." The company currently is pushing a blown-wing version of the Belfast as the Royal Air Force's tactical transport replacement (AW Apr. 30, p. 34), using Rolls-Royce lift engines mounted in a fuselage hump to provide blowing air. Initial RAF requirement probably will be for at least thirty airplanes. Competitors are Hawker Siddeley, Bristol Airplane Co., and Lockheed Aircraft Corp.

Meanwhile, the Short Skyvan light business transport first flight has slipped from mid-summer to at least October and the airplane will not be shown at the annual Farnborough Air Show as planned. Short Brothers spokesman said there has been no particular engineering problem connected with the slippage, pointing out that it never has been a high priority program. Wings have been fitted to the main fuselage but two Continental engines are not yet installed.

A civil version of the Belfast has been submitted to world airlines, including British Overseas Airways Corp. (AW Nov. 6, p. 65) but no sales have been made. Company is primarily basing its RAF tactical transport replacement hopes on the fact that development costs of a new airplane, such as the Hawker Siddeley or Bristol Airplane designs, will be prohibitive to the British economy.

Elimination or reduction of these functions would affect the combat engineers, quartermaster corps, hospital corps and transportation corps.

Proponents of air mobility point out that there would be savings not only in money but in manpower, releasing rear echelon troops for active front line combat.

Armor and armament would be radically changed in character. New lightweight weapons enable one man to fire a rocket that packs the same power as a large howitzer or artillery piece. Tanks would no longer be necessary. Conventional large field cannon would be replaced by missile systems.

## Working Groups

The Army Tactical Mobility Requirements Board is divided into the following working groups, in addition to the combined arms group mentioned above:

- **Long-range group**, headed by Brig. Gen. Robert R. Williams, Ft. Rucker, Ala. Williams was formerly on the staff of the Director of Defense Research and Engineering.
- **Strategic area group**, headed by Brig. Gen. Charles Billingslea, Washington, D. C.
- **Inter-theater and communications zone logistical operation group**, headed by Maj. Gen. Norman H. Vissering, Ft. Eustis, Va.
- **Operations research group**, headed by Frank A. Parker, Jr., Washington, D. C. Parker is president of the Research Analysis Corp. here, a non-profit company sponsored by the Army. He was formerly a member of the staff of DDRE.

• **Field tests group**, headed by Brig. Gen. Edward L. Rowny, Ft. Bragg, N. C.

• **Programming and budget group**, headed by Col. William B. Lynn, Ft. Bragg.

The board's central steering committee includes Brig. Gen. Walter B. Richardson, director of combat developments, Army headquarters, Brig. Gen. Delk M. Oden, present Director of Army Aviation, and the working group heads.

Senior civilians on the board, other than Parker, are Edward H. Heinemann, executive vice president, Guidance Technology, Inc., Santa Monica, Calif., and formerly of Douglas Aircraft; Dr. Edwin W. Paxson, Rand Corp., Santa Monica, Calif.; Fred W. Wolcott, Aeronutronic Division of Ford Motor Co. Board secretary is Col. Allen M. Burdett, executive officer to Dr. Finn J. Larsen, Assistant Secretary of the Army for Research and Development.

Other general officers on the board are the following:

Maj. Gen. George W. Power, Brig. Gen. John J. Lane, Brig. Gen. Hallett D. Edson, Brig. Gen. David B. Parker, Maj. Gen. Stanley R. Larson and Brig. Gen. Frederick W. Boye.

Other officers on the board are Col. George W. Putnam, Col. A. J. Rankin, Col. John Norton, Col. George S. Beatty, Col. Jack Marinelli, Col. John Klingenhagen, Col. William E. Depuy, Lt. Col. Richard J. Glikes, Lt. Col. Robert Rigg, Lt. Col. Guy Jones and Lt. Col. Jesse Ugalde.

Implementation of air mobility would complete a top-to-bottom reorganization of the Army (AW Apr. 16, p. 120).

## Boeing Studies Anti-Satellite System

Boeing Co. is conducting internally-funded studies of an anti-satellite weapon system with the assistance of a team of aerospace companies including General Electric, Hughes Aircraft, Minneapolis-Honeywell and Sylvania Electric.

The studies are being pursued under Project STEDI (Space Thrust Evaluation and Disposal Investigation), a follow-on to an earlier in-house study program for an anti-satellite system called PRIOR (Program for In-Orbit Rendezvous).

At least one anticipated mode of STEDI operation calls for a manned spacecraft system.

Each of the four companies assisting Boeing on Project STEDI is responsible for different technological phases of the program. Hughes' contribution, for example, is believed to be in the sensor and guidance area.

Unlike an earlier partially Air Force-funded Boeing program, the Boss-Wedge program, the STEDI effort is built around spacecraft concepts not directly akin to the Dyna-Soar boost glide vehicle which Boeing is developing for the Air Force.

Boss-Wedge was a series of studies aimed at evaluating several concepts, largely Dyna-Soar oriented, of unmanned and manned military spacecraft for missions such as reconnaissance and bombing (AW Apr. 10, 1961, p. 26).

It began with the Air Force Special Weapons Center "Bomb Orbital Strategic Systems" (Boss) contract, Number AF29/601/-2836, and extended through several Air Force study requirements and other studies. Among the companies which worked with Boeing on Boss-Wedge were the four in the STEDI project.



# NASA Sole Judge in New Incentive Plan

By Katherine Johnson

Washington—National Aeronautics and Space Administration plans to retain complete discretionary power to decide whether its contractors should be paid merit profits or fees under its new incentive-type contracting program.

Even the criteria by which contractors' performance will be judged will be discretionary with NASA.

The precedent for this policy was established in NASA's recent \$10-million award to Bendix Corp.'s Radio Division to operate five Project Mercury tracking and communications stations (AW June 11, p. 39). The contract provides that NASA, unfettered by any contractual formula, will determine—after performance—whether the company merits an incentive profit. It was the first contract of this type to be let by a government agency.

NASA hopes to apply the policy to the \$400-million Gemini spacecraft contract being negotiated with McDonnell Aircraft Corp. (AW Apr. 23, p. 22).

## Incentive Emphasis

Ernest R. Brackett, NASA's director of procurement and supply, told AVIATION WEEK that the agency intends to use incentive-type contracts to the maximum extent possible. NASA's contracts are now running 82% cost plus fixed-fee, 17% fixed price, and 1% other types.

John Courtney, counsel of the House Armed Services Committee, welcomed NASA's approach to incentive-type contracting.

"In advanced technology projects, where neither design and performance

specifications nor costs can be estimated with any precision, the only sensible thing to do is to let the contractor perform and then judge," he said.

Initial industry reaction to the NASA policy of judging performance after the fact was largely one of complete opposition. Comments to AVIATION WEEK by industry spokesmen included: "Very dangerous . . . If there are no precise and fixed ground rules, how does the contractor know what he should work toward to achieve a reward? . . . It's like telling someone to run a race to 'somewhere' . . . What incentive has a contractor to perform exceptionally when someone may later decide unilaterally that he has not. . . ."

Courtney said he expected industry resistance and pressure to block any wide application of the NASA policy on incentive contracts.

## Defense Plan Favored

Industry is an enthusiastic supporter of the Defense Department's program. Under this, performance, schedule, and cost targets are initially negotiated, and the contractor rewarded or penalized to the extent that he meets or excels these targets. This evaluation of the contractor's performance is a matter of negotiation between the contractor and Defense procurement officials, based on the ground rules established before work is begun.

Defense Department's past incentive-type contracts—based solely on cost targets—stirred strong opposition in Congress, led by Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee, and Sen. John McClellan (D.-Ark.), chairman

of the Senate Permanent Investigating Subcommittee, with backing from the General Accounting Office. They have contended that fictitious cost targets were set with the result that contractors reaped "windfall profits" by under-running these targets (AW May 28, p. 36).

Thomas D. Morris, assistant secretary of defense for installations and logistics, explained the department's present program of incentive contracting:

"In the early development of new weapons, only a fraction of the incentive will hinge on cost. For example, in a missile, performance factors—such as range, payload, accuracy, reliability—might constitute about one-half of the incentive, and time of completion another one-third. That portion of the fee based on cost reduction would then contribute only one-sixth. However, by the time development has reached the stage of production for test, performance and time might be expected to control about half the fee, and costs incurred the remaining half." This policy is now being applied in contract negotiations for the Air Force 624A (formerly Titan 3) program (see p. 35).

Courtney said it will be no more possible to set realistic targets on performance and time schedules for advanced projects than it has been to set realistic cost targets in the past.

## Bendix Contract Details

Under the NASA contract with Bendix, the company will receive a fixed fee amounting to approximately 3% of the \$10-million two-year contract, or \$300,000. Bendix' performance will be evaluated every three months by a team from NASA's Goddard Space Flight Center, and the company will be eligible for an additional profit of up to \$50,000, or 7%, for the quarter.

The reason the Bendix fee is a comparatively low 3% is because of the strong competition for the contract, Brackett said. There were seven other proposals, with Radio Corp. of America running Bendix a close second, he said. The contract will be effective Jan. 1, 1963. Under Bendix' existing contract to operate the five stations, the profit amounts to approximately 5%.

Brackett believes the company will aim to reduce costs because its 3% fee is fixed, and it would be rewarded for economy under the incentive feature of the contract.

Factors NASA will consider in evaluating Bendix' performance include:

- Personnel attrition. NASA considers a high rate of turnover inefficient.

- Logistics, such as keeping the stations operational without lapses.
- Engineering improvements suggested.
- General mission performance.
- Cost record, as disclosed by audit.

Brackett said NASA may add new criteria as it proceeds in monitoring the Bendix operation.

Another NASA precedent established in the Bendix contract is a provision which will enable a smooth transfer of Bendix personnel if NASA awards the Mercury operation to another contractor when the Bendix contract expires. Under this provision, Bendix has agreed to do such things as transfer employee fringe benefits to the new company and release employees from contracts without penalty.

NASA also has the option to extend Bendix contract on the same terms.

## Nuclear Talk Aimed At Citizens of NATO

Washington—Defense Secretary Robert S. McNamara's speech on the role of nuclear weapons in the North Atlantic Treaty Organization was interpreted here as a U.S. attempt to tell the people of the NATO nations and especially France—rather than their leaders—that there can be only one indivisible nuclear deterrent in the Alliance.

In speaking at the University of Michigan June 16, McNamara said: "Limited nuclear capabilities, operating independently, are dangerous, expensive, prone to obsolescence and lacking in credibility as a deterrent. Clearly, the United States nuclear contribution to the Alliance is neither obsolete nor disposable." The Defense Secretary had given the same message last month.

McNamara confirmed a U.S. policy that military targets take precedence over enemy cities by saying: "Principal military objectives, in the event of a nuclear war stemming from a major attack on the Alliance, should be destruction of the enemy's military forces, not of his civilian population."

## Minuteman Electronics

Los Angeles—USAF is evaluating industry proposals in a competition for USAF/Boeing Wing 5 and follow-on Minuteman ICBM ground electronic system.

The system will evolve both cable and radio techniques for data processing, communications, and systems support required to monitor, control, and launch the missile. Decision in the competition is due next month.

Electrical connection between control center and missile in the first four programed Minuteman wings has been by cable only.

He did not rule out attacking cities under all circumstances, however. "The very strength and nature of the Alliance forces make it possible for us to retain, even in the face of a massive surprise attack, sufficient reserve striking power to destroy an enemy society if driven to it," he said.

In referring to a relatively weak national nuclear force, obviously France, he stated: "In the event of war, the use of such a force against the cities of a major nuclear power would be tantamount to suicide, whereas its employment against significant military targets would have a negligible effect on the outcome of the conflict."

The U.S. is as much concerned with the portion of Soviet nuclear striking power that can reach Western Europe as with that part that also can reach the United States, he said. "In short, we have undertaken the nuclear defense of NATO on a global basis," he said.

McNamara reiterated that the main emphasis of the U.S. defense effort is on the nuclear deterrent, but that a buildup of conventional forces is necessary to meet less than nuclear war threats in Europe and elsewhere. Central control of a nuclear campaign is mandatory, he said.

In Paris, French officials rebuffed renewed U.S. suggestions that it abandon its efforts to build an independent nuclear missile and bomber force, but indicated France may be willing to coordinate its atomic posture within framework of the Western alliance, either within or outside basic structure of NATO.

New attempts by Secretary of State Dean Rusk here last week to dissuade France from its drive towards own nuclear defense force by the mid-1960s were flatly rebuffed by Foreign Minister Maurice Couve de Murville.

## Senate Talkers Delay Comsat Bill Action

Washington—Long-promised talkathon against Administration-sponsored legislation setting up a privately-financed corporation to develop a communications satellite system (AW Apr. 2, p. 20) got under way last week in the Senate with the introduction of 23 amendments by nine Democratic senators.

They are: Estes Kefauver (D.-Tenn.), Albert Gore (D.-Tenn.), Wayne Morse (D.-Ore.), Maurine Neuberger (D.-Ore.), Ralph Yarborough (D.-Tex.), Quentin Burdick (D.-N.D.), Ernest Gruening (D.-Alaska), Joseph Clark (D.-Pa.), and Russell Long (D.-La.).

Their master strategy is to delay a vote on the legislation, already passed by the House, until the Senate adjourns for elections.

As there was little indication that public interest in the ownership of a communications satellite program was being aroused, sponsors of the Administration legislation were predicting that the talkers would give up in another week or ten days.

Eight of the Senators favor government ownership. Long has taken no position on government versus private ownership. He simply wants the satellite system to be competitive with the existing system of American Telephone & Telegraph Co. and other overseas carriers. He is adamant in insisting that AT&T will dominate the corporation proposed in the Administration bill.

Long dominated the first week of the talkathon, contending that:

- AT&T is the only entity that "really" wants legislation passed at this time. Long and his eight colleagues argue that it would be well to wait a year or two, until low-altitude random-orbit satellites and high-altitude fixed-orbit satellites have been developed and then decide on the management for a system. They have industry support on this from Radio Corp. of America and Western Union Co.

- AT&T, after achieving dominance in the proposed corporation, would commit the U.S. to the low-orbit system because of its large investment in ground facilities for the Telstar low-orbit satellite. Long maintained that all indications now are that the high-altitude system will be proved feasible and will be far preferable technically and economically.

Sen. John O. Pastore (D.-R.I.), chairman of the Commerce Communications Subcommittee and floor manager of the Administration measure, vigorously refuted Long's contentions.

## MMRBM Guidance

Los Angeles—Contract to study a backup inertial guidance system for the mobile medium-range ballistic missile (MMRBM) may be awarded by July 3 to one of several bidders, believed to include Bell Aerosystems, Autonetics, Nortronics, Bendix, Sperry, International Business Machines and General Electric.

In addition, at least one of three contractors studying a potential stellar-inertial guidance system (STINGS), which probably will employ a dual star tracker (AW Dec. 25, p. 11), will be awarded a contract, giving Air Force at least two guidance and control subsystem contractors during the MMRBM program definition phase.

General Precision is expected to get the nod to continue the STINGS effort. The inertial guidance system may incorporate a gyro compass system to aid in establishing inertial missile position for the initial system.

## AIAA to Seek Government Contracts

Los Angeles—American Institute of Aeronautics and Astronautics, to be formed by the merger of the present American Rocket Society and Institute of the Aerospace Sciences, will increasingly seek government contracts in various fields, according to Eugene Root, IAS president.

AIAA would be interested in abstracting current technical literature, translating foreign technical publications, studying the problem of technical information exchange and perhaps managing a centralized interchange of technical information.

Root said such programs would not be intended to compete with industry or government agencies. The contracts are wanted as a means of solving AIAA financial problems. Root said he had discussed these plans with 63 of the 105 corporate members of the IAS and they had indicated their approval.

If the current merger attempt fails, Root added, neither the IAS nor the ARS can afford to repeat the expenditure of time and money incurred in present efforts to consolidate the two societies. He made the statement in a "get out the vote" plea to members of both societies during the annual summer meeting of the IAS here. Members of the ARS were invited to attend the meeting and exercise most of the privileges of IAS members as a gesture of unity.

Early returns from an opinion poll of members of both societies (AW June 18, p. 28), indicate approval of the consolidation seems assured. With nearly 10% of the combined membership reporting, returns were running 97% in favor of the merger. First returns were said to be well distributed geographically.



# Tiros 5 Orbit Elliptical, But Photos Good

Washington—Thor-Delta vehicle's ninth consecutive successful launch last week propelled the Tiros 5 weather satellite into an elliptical orbit—a satisfactory but not ideal station for monitoring the growth and track of tropical storms.

Goal of National Aeronautics and Space Administration was to inject the cylindrical, 285-lb. satellite into a nearly circular orbit about 350 stat. mi. above the earth's surface. But because of a malfunction in the radio command guidance system carried by the vehicle's second stage, orbit actually achieved has an apogee of 604 stat. mi. and a perigee of 367 stat. mi.

Nevertheless, according to early reports from the U.S. Weather Bureau, television pictures transmitted by Tiros 5 probably will be equal in quality to those relayed by Tiros 3 and 4 from similar orbits. Tiros 3 spotted Hurricane Esther last summer two days before aircraft would have detected the storm's position. Tiros 4 transmitted about 30,000 usable pictures before quality became unacceptable last month, 121 days after launch.

NASA and Weather Bureau scientists last week were predicting that Tiros 5 would have a useful camera life of three to five months. If this holds true, next launch in the series will be attempted during the fourth quarter of this year, in order to keep at least one active Tiros in orbit continuously.

According to the Weather Bureau, precise quality of pictures transmitted by the satellite from altitudes near its

apogee cannot be determined for about three weeks. However, because the area of camera coverage increases with satellite altitude, there undoubtedly will be somewhat less detail in the photographs than there would have been had Tiros achieved its planned orbit.

Tiros 5 carries two cameras, the same as did its predecessor. With a capability for storing up to 32 successive pictures on each of two magnetic tape recorders, the cameras on command are to photograph both the iceberg pattern in the Arctic and the Northern Hemisphere's hurricane and typhoon spawning grounds.

Inclination of Tiros 5 is 58 deg., or exactly what was sought. This should prove adequate to collect photographic data on ice flow conditions as far north as the 65th parallel, which touches northern Scandinavia, Iceland and Fairbanks, Alaska.

## Antarctic Inspection

With a period of 100.5 min., Tiros 5 should orbit the Northern Hemisphere from June 19, its date of launch, until June 29, then circle over the southern hemisphere for 38 days, and swing north again. In its southern orbit, the satellite is expected to photograph the fringes of the ice pack surrounding the Antarctic continent.

Forecast orbital track will put Tiros 5 over the Northern Hemisphere hurricane belt during August and September, the height of the storm season.

Because of the malfunction in the Bell command guidance system, the Delta second stage engines could not

be shut down, and, as a result, they continued to generate thrust until fuel was exhausted. This gave the satellite a slightly higher velocity than had been intended, which pushed it into the elliptical orbit. All Delta stages and systems functioned satisfactorily with this exception, NASA said.

A computer technique is being used with Tiros 5 which results in an ability to determine and predict up to three weeks in advance where the satellite's fixed cameras will be pointed. This allows pre-determination of the part of the earth to be photographed, and the photographic angle when pictures are taken.

The technique was developed jointly by Dr. Joseph Siry of NASA's Goddard Space Flight Center, who devised a mathematical prediction formula, and an International Business Machines Federal Systems Division group, headed by Robin Mowlem, which converted the formula to instructions for an IBM 7090 computer.

Stored in the computer are mapping and prediction instructions, earth magnetic and gravity field variables, and satellite eddy currents. With this information, the computer is fed satellite orientation data obtained from horizon scanners to make camera angle predictions.

Because Tiros cameras operate on command, meteorologists are able to program cloud cover pictures when they will be most useful by knowing the camera angle. The camera angle can be altered within limits by energizing a magnetic coil wrapped around the satellite structure which develops a torque.

The 7090 also computes Tiros orbital elements and sun angle.

Tiros series satellites are built by Radio Corp. of America under technical direction furnished by NASA's Goddard Space Flight Center.

## Ryan VTOL Simulator Will Cost \$450,000

Flight simulator for use in development of General Electric-Ryan VZ-11 fan-in-wing V/STOL research aircraft for Army is nearing completion at the Ryan Aeronautical Co. plant in San Diego.

A 6,000-sq. ft. Systems Dynamics and Simulation Building will house the instrumented cockpit, hydraulic and control system mock-up and an analog computer to supply the simulated stability and control characteristics. Cost of the facility and its equipment is \$450,000. The simulator is to be installed in July.

# Europeans Plan 500 Launches During Coming Eight-Year Period

By Cecil Brownlow

Paris—European Space Research Organization (ESRO), its convention formally ratified by 10 nations, is planning approximately 500 probes and satellite launchings over a projected eight-year period beginning in 1963, with firings of at least 10 sounding rockets.

Sounding rocket launchings to touch off ESRO's ambitious program are looked upon as first step toward placing Western Europe and United Kingdom firmly within the realm of concrete space research and probably will be made from sites in Great Britain and from Italy's Texas Tower sites located in the Indian Ocean off the coast of Somalia.

Newly formed but long planned, ESRO is expected to concentrate on development of specific payload packages with the complementary European Launcher Development Organization (ELDO) providing booster vehicles for envisioned satellite probes.

## Nations Committed

Seven nations have committed themselves to ELDO thus far (AW Apr. 23, p. 29), six of them signatories of the ESRO convention in Paris. A seventh old member, Australia, is contributing to the project primarily through projected use of its Woomera rocket range for satellite launchings. ESRO members and their relations to ELDO are: • **United Kingdom**, France, West Germany, Italy, The Netherlands and Belgium are members of both organizations.

• **Spain**, Switzerland, Austria and Sweden were participants in original ELDO discussions, but all four nations subsequently withdrew from that agency.

All nations participating in both ELDO and ESRO also are members of North Atlantic Treaty Organization, while four countries participating in ESRO alone are outside NATO. In addition to the present 10 signers of the ESRO convention, Denmark and Norway also are expected to participate in the program. Both are NATO members and both had participated in original ELDO discussions, but later withdrew.

As the program now stands, the ESRO budget over the eight-year period is planned to be \$300 million, with three major contributors, Great Britain, France and West Germany, providing 74.4% of the total. The remaining 25.6% will be divided among other participating nations.

After its formal move forward in 1963, ESRO planned to accelerate to about 40 space launch probes in 1964, most of them in the sounding rocket field. A series of satellite launchings in connection with ELDO is scheduled to get under way in 1967.

A French scientist who participated in formation of ESRO said last week that, while the venture has no direct connection with recent United Nations sessions in Geneva proposing increased international collaboration in space ventures (see p. 57), the organization obviously will work closely with the U.N. and with the Committee on Space Research (Cospar). Major objectives, he said, include meteorological and geomagnetic probes as well as launches toward the vicinity of the moon and studies of the solar system as a whole.

Director general of the new organization is Prof. Pierre V. Auger, president of France's National Center of Space Research and his country's representative at Geneva sessions of the technical subcommittee of the U.N. Committee on Peaceful Uses of Outer Space.

Envisioned satellite booster vehicles for ESRO probes will be built around ELDO's de Havilland Blue Streak as primary booster, a French second stage and a West German third stage (AW Apr. 9, p. 28).

Meanwhile, a growing non-profit European industry association, Eurospace, with more than 50 active members is gaining momentum, with the intention of placing Europe and European firms on a parity with U.S. and Soviet efforts and capability over the next decade.

Present objective, according to an association statement, is to "bring Europe within 10 years to a technological level equal to other countries through original solutions," working where possible with ESRO and ELDO as well as on its own in areas of original research planning.

A number of American companies, including several large aircraft manufacturers, also have joined as associate members of Eurospace. Active members include aircraft, electronics, chemical, steel and machinery firms in Belgium, France, Italy, The Netherlands, Switzerland, United Kingdom and Germany.

Eurospace, which hopes to avoid duplication of effort among its members and to take advantage of research work already done in the U.S., plans to act as a clearing house for European space work and arrange team proposals designed to meet ESRO and ELDO objectives.

## Advanced Syncom

Washington—Hughes Aircraft Co. will receive a contract for about \$2.5 million from National Aeronautics and Space Administration to develop long lead-time subsystems for an advanced synchronous orbit communication satellite, a follow-on to the 75-lb. Syncom which Hughes is now developing for NASA.

The advanced Syncom, expected to measure about 5 ft. in diameter and weigh about 500 lb., is intended to be launched into a synchronous equatorial orbit using an Atlas-Agena vehicle. The advanced Syncom will use a relatively simple spin stabilization technique in combination with counter-rotating antenna beam to avoid the need for more complex earth-oriented stabilization (AW June 11, p. 88).

Bendix Corp. has received \$2.2 million of additional Army funds for construction of three mobile ground stations which will be used in NASA's initial Syncom communication satellite tests.

## DOD to Study Shift Of Contracting in U.S.

Washington—Study of implications of the shift in geographic distribution of defense contracts has been initiated by the Defense Department.

Report released by Deputy Secretary of Defense Roswell L. Gilpatric last week revealed a heavy shift in production and research and development business from the upper midwest to the southern tier of states, especially California, from Fiscal 1951 to Fiscal 1961. Gilpatric said the report was compiled as a result of inquiries, many from New York and midwestern congressmen.

Dr. Robert F. Steadman, economic adjustment adviser to the assistant secretary of defense for installations and logistics, will undertake the study, which will consider the effect of the shift on the national economy and individual communities, and whether the nation's research and development capacity is being fully utilized.

California's share of prime production contract business rose from 13.6% to 23.9% in the 10-year period. Biggest loser was Michigan, which dropped from 9.5% to 2.7%. Other states which gained are Massachusetts, from 2.8% to 4.8%; Texas, from 3.2% to 5.1%; and Colorado, from 0.2% to 2.2%. Other losers were Indiana, from 4.5% to 1.6%; Illinois, from 5.0% to 2.0%; Ohio, from 6.3% to 4.5%; and Wisconsin, from 2.0% to 1.0%.

In the area of research, development, test and engineering, California led in Fiscal 1961 with 41.3%. New York followed with 12.2%.



## Mockup Shows StarLifter Design Detail

Mockup photo shows details of Lockheed C-141 design as construction work began recently at Marietta, Ga. Flight station, above, has relatively simple instrument layout, with linear readouts replacing conventional dial instruments in some cases.





Pershing missile battery moves to pre-selected launch site during firing demonstration. Lead vehicle carries missile body on erector-launcher. Other vehicles carry the warhead and communications equipment. Demonstration took place at Orlando, Fla.

## Pershing Firing Demonstration Shows Field Use



Army crew, above, mates warhead to missile, while other crewmen prepare missile for launch. Erection to firing position takes about one minute. Separation of umbilical mast signifies firing of missile. Operation took less than 15 min.



## Industry Study Outlines Measures To Cut Cost of DOD Procurement

Washington—Defense industry last week outlined its recommendations for eliminating unnecessary costs in military purchases in a detailed study submitted to Secretary of Defense Robert S. McNamara.

General theme of the study, requested by McNamara in March, 1961, is better use of the profit motive to encourage greater efficiency. E. V. Huggins, president of the National Security Industrial Assn. and executive vice president of Westinghouse Electric Corp., headed the task force which began its work shortly after an NSIA symposium on cost reduction last June. About 200 persons from 62 companies were members of the 10 task groups which conducted the study.

The study's key recommendation is that incentive type contracts be exempted from renegotiation under the Renegotiation Board's exemption authority. If the Board does not agree to use exemptions permitted in its regulations, then the Defense Department should recommend to Congress that the Renegotiation Act be amended to make the exemptions mandatory.

### Profit Limitations

In addition, the study said that the profit-limiting-provisions of the Vinson-Trammel Act and the Merchant Marine Act be repealed or amended to exclude incentive type contracts.

The Renegotiation Board recently announced that it would be willing to consider exempting incentive type contracts (AW May 7, p. 25), but made no firm commitment.

These specific means of making cost reduction efforts more effective were submitted:

- Use more firm fixed-price contracts and use them earlier in the procurement cycle.
- Use incentive and penalty features when cost-reimbursement or cost-redeemable contracts are appropriate.
- Emphasize price analysis rather than cost analysis in buying.
- Eliminate overlapping and multiple reviews of contractor and subcontractor purchasing systems, estimating systems, small business programs and other related items.
- Place technical and procurement groups under a common leadership and responsibility.
- Encourage alternative proposals which offer product-improvement and cost-reduction possibilities.
- Reduce government control of defense industry in order to permit the defense program to benefit from the inherent

set of cost controls and incentives provided by the free enterprise system.

One major area studied was simplification of specifications. It was stated that uncontrolled preparation, issuance and interpretation of specifications has led to duplication and misapplication of effort.

Mixing of administrative data and technical requirements within a single specification may result in noncomparable bids and inconsistent compliance and performance, the study said.

### Standardization Urged

There is also a lack of standardization of numbering systems, difficulty in identifying requirements and pyramiding of specifications, the study said. Documents are often hard to find and an excessive amount of time is spent in finding them, resulting in increased costs and program delays.

The cure for this, NSIA says, is the establishment of one specification authority at the Defense Department level with full responsibility and capability for management of all technical documents relating to procurement.

The "program package" concept received strong endorsement as the key government-industry tool in planning.

## Early Action Due on Renegotiation

Washington—Two-year extension of the renegotiation law, without change, was being rushed through Congress last week.

The House approved the extension on a voice vote, after a few minutes of debate, a few days after it was recommended by the House Ways and Means Committee. No Senate opposition is expected. Present law expires June 30.

Rep. Carl Vinson (D-Ga.), chairman of the Armed Services Committee, expressed disappointment that renegotiation is not to be made permanent law. He told the House that renegotiation is "salutary" because it provides for recapture of unconscionable profits and "preventative" because it spurs determined efforts in contract negotiations to keep profits reasonable.

Rep. Wilbur Mills (D-Ark.), chairman of the Ways and Means Committee, said his group favored short-term extensions and periodic reviews of renegotiation by Congress because "the committee is still deeply concerned with the problem that renegotiation is a process which requires, to an unusual extent, the exercise of judgment by men where the basic principles underlying

initiating and funding major weapon systems.

Programs should be classified for budget review as accelerated programs, optimum programs or stretched programs. The first would cost more to save time, the second would have the time-cost relationship in balance and the last would save money at the expense of time.

### Feasibility Studies

Broad studies of technical, cost and schedule feasibility for new weapon systems were endorsed. Bonus-penalty provisions in contracts for research and development should be considered as a means of motivating industry, the study recommended.

In order to arrive at reliable cost estimates, it was recommended that strict application of Armed Services Procurement Regulations (ASPR) be pressed. An improvement in efficient cost estimating by defense industries in the past year was noted. At the same time, the ASPR should be continuously improved and changed to meet new conditions.

Separate service regulations that require different ground rules should be eliminated, the study said.

Expense of preparing proposals was singled out as needing corrective action. Economical use of talent and time in industry, through reducing the number of proposals requested, was also recommended.

the judgment cannot be clearly and thoroughly set down as a matter of law." Mills said the committee did not have time to consider adequately numerous recommendations for amendments which were submitted. No hearings were held.

Aerospace Industries Assn., in a letter, had urged the committee to end renegotiation because "current procurement practices, together with the income tax laws, adequately protect against the receipt and retention of unconscionable profits."

AIA said that renegotiation "is unwisely and seriously hampering the efforts of the Department of Defense to lower the cost of national defense by the broader use of incentive type contracts. The harmful effect of renegotiation . . . in this area has been publicly referred to by the Secretary of Defense. . . ."

If the law is to be continued, AIA recommended amendments that would place the "burden of proof" of excessive profits on the Renegotiation Board and give contractors the right to appeal renegotiation determinations decided by the U. S. Tax Court.



# Defense Denies Bid for NASA Programs

By George C. Wilson

Washington—Senate Aeronautical and Space Sciences Committee approved the National Aeronautics and Space Administration Fiscal 1963 budget with minor changes after hearings in which Defense Department leaders said they had no intention of duplicating or taking over NASA programs.

The committee added money to the House-passed authorization bill, in addition to restoring many of the cuts. The major addition was \$32 million to enable the space agency to buy 14,800 acres adjacent to its present holdings at Cape Canaveral. Another \$500,000 was added for testing high energy fuels, such as boron and fluorine combinations.

All told, the Senate space committee authorized \$3,820,515,250 for NASA for Fiscal 1963. This is \$33,239,250 more than the \$3,787,276,000 NASA originally requested and \$78,353,250 more than the \$3,742,162,000 the House authorized (AW May 21, p. 38). The authorization figure the House and Senate finally agree upon will be the maximum amount of money that can be appropriated to the space agency. The legislation actually appropriating the funds has not yet reached the floor in either chamber.

The House reduced the NASA budget requests by \$116 million. The Senate committee restored \$45,853,250 of the cut; \$23,316,250 to the research and development account and \$22,537,000 to facilities construction. NASA asked the Senate to restore all the cuts except for \$32 million of the \$60,630,000 the house slashed from the \$79.5 million requested for the Nova launch complex. NASA Administrator James E. Webb said the agency would obtain the \$32 million for the Cape Canaveral expansion from Nova funds.

## Funds Restored

The Senate committee restored completely these House cuts in NASA research and development account: Mercury program, \$1 million; scientific satellites, \$8,758,250. The Senate restored \$13,558,000 of the \$23,558,000 sought for lunar and planetary exploration, thus going along with the House contention that the Prospector roving lunar vehicle was not needed. It is uncertain whether the Senate, in cutting \$10 million from the \$10.4 million requested for Prospector, intended to earmark the remaining \$400,000 to start the program.

Senate restored completely these House cuts in NASA's facilities construction account: Mississippi test facil-

ity, \$12 million; Advanced Saturn launch complex, \$3 million; facility planning, \$5 million; Far East data acquisition station, \$1,940,000; Johannesburg and Woomera deep space antenna facilities, \$597,000.

Language inserted by the House giving NASA jurisdiction over the land it acquires was approved by the Senate committee. Deputy Defense Secretary Roswell L. Gilpatric, in private meetings with congressional space leaders, opposed this language, claiming it would interfere with the Air Force's "flexibility" as operator of the Atlantic Missile Range (AW June 18, p. 25).

## Military Role

A substantial part of the authorization hearings was devoted to questions on the Defense Department plans for space programs (AW June 18, p. 26). Defense leaders said they were not embarking on operational military space programs, but wanted to make sure the technology was being developed in case a military space mission arose. They said they were relying primarily on NASA to develop this technology.

Harold Brown, director of defense research and engineering, said: "We have no intention to pre-empt those areas which are the proper pursuit of NASA and, as a sign of this, their planned effort for next year in space is very much larger than those within the Department of Defense . . . At this point in time, it is difficult to define accurately the specific characteristics that future military operational systems of many kinds ought to have. We must, therefore, engage in a broad program covering basic building blocks which will develop technological capabilities to meet many possible contingencies. In this way, we will provide necessary insurance against military surprise in space by advancing our knowledge on a systematic basis so as to permit the shortest possible time lag in undertaking full-scale development programs as

specific needs are identified."

Chairman Robert S. Kerr (D-Okla.) said this "building block" claim could justify all kinds of military space programs. Brown replied that by using this term "I did not mean to imply that it was the responsibility of DOD to build all or to carry out the development of all, or even most, of these building blocks." These were other points made by Brown on military space programs:

- **Dyna-Soar.** He said this has been presented improperly in the past as an operational system. "That has never been accepted as the purpose by the DOD and it is not now so accepted. What was accepted as a program was a vehicle which would serve to develop the technologies associated with manned space flight and with some particular applications—not uses—but some particular emphasis on things which might be important militarily later on, such as the ability to de-orbit on short notice and to land at a pre-selected point, or the ability to take off or land in an all weather environment—both of which might be important militarily. However, we have not supported specific military uses for such a vehicle, be it destructive of other vehicles, be it maintenance and repair of satellites or whatever, because it is not possible to lay down military needs which would be fulfilled in an obviously useful way by such a vehicle."

- **Manned space flight.** "In the past, and again now, I have expressed my own doubts that manned military space vehicles will be a requirement. But they may be. If in the future they may be, we want the country to have the technology developed which would enable us to move rapidly to take advantage of that or to make proper defense. It is not necessary for the DOD to develop all this technology. NASA can develop much of it or even most of it. . . ."

"There is no definable need at this time, or military requirement at this time" for a manned military space program, he said. "If eight years from now, or five years from now, it develops there are military operations in space, or if military operations in space are forced upon us, we don't want to be caught at that time with a program that takes five years to develop the technology. So we want to now develop some of the technology. We don't have plans for military systems to be made out of this. But we do want to develop the technology as best we can now."

Asked why it would not be more efficient to let NASA develop the type of technology which will be gained from such manned space flight pro-

## Titan 3 Stage

Aerojet-General Corp. has begun negotiations with Air Force for development of thrust chambers for the Titan 3 transtage (4th stage) positioned above vehicle's Titan 2 core. No contract will be awarded until Titan 3 development program has received final approval from Department of Defense. Martin Marietta Corp. is scheduled to act as over-all integration contractor for the Titan 3 vehicle—two 120-in.-dia. solid rockets strapped to Titan 2 cone topped by the transtage—including aerospace ground equipment.

grams as Dyna-Soar, Brown said:

"There is no civilian program which has as its aim the controlled re-entry which would allow one to de-orbit and reach an airfield several thousand miles from where the vehicle happened to be while it was in orbit." He described the Dyna-Soar program as "good insurance" for such a capability. "We are not attempting nor do we have any intention or any reason to compete or duplicate the large variety of orbital missions which are planned as part of the national space program by NASA," he said.

- **Space rendezvous techniques.** "It is clear that if there is a satellite up there, you may want to rendezvous with it with an unmanned satellite, take pictures of it, examine it, see what it is up to . . . When it comes to manned orbital systems for rendezvous, it is not at all clear that there is a military need. Neither is there a military program for manned orbital rendezvous. We are cooperating with NASA in their Gemini program." Brown did not mention projected Air Force studies for manned satellite systems (AW June 4, p. 34).

- **Solid rocket development.** In contrast to Air Force contentions that the military should place more emphasis on the development of large solid rockets, Brown said that 260-in. solid rockets "are so large that they can't be transported by rail. They have to be powered in place. That doesn't make a terribly attractive military system because it is pretty immobile and unwieldy . . . The bigger they get, the more difficult it is to use them on short notice and at an arbitrary place . . . Certainly we are not spending as much money as we could if our purpose was to develop large solid rockets or still larger solid boosters as fast as we could . . . But the need has not been clearly expressed so far."

However, he said Defense "still plans advanced technology efforts toward very large solid rockets" in case actual development of them is needed some time in the future.

In a related development, President Kennedy, at his news conference June 14, said that in the national space program, "the military have an important and significant role, though the primary responsibility is held by NASA, and it is primarily peace, and I think the proportion of that mix should continue."

He said "The American people have supported the effort in space, realizing its significance, and also that it involves a great many possibilities in the future which are still almost unknown to us and just coming over the horizon. As far as where we are, I don't think that the United States is first yet in space, but I think a major effort is being made which will produce important results in the coming months and years."

## News Digest

Management and union officials of Republic Aviation Corp. are awaiting notice from the National Mediation Board on resumption of negotiations for a new contract for 9,000 of the company's 15,000 employees. Striking workers have returned to their jobs under an 80-day injunction granted by a federal court.

Lt. Gen. H. M. Estes, deputy commander AFSC for aerospace systems, is scheduled to assume command of AFSC's Space Systems Div., a post formerly held by Maj. Gen. O. J. Ritland, now deputy to Commander AFSC for Manned Space Flight. Vice Commanders under Gen. Estes in SSD will be Maj. Gen. R. E. Greer, vice commander for technical programs, and Brig. Gen. H. M. Powell, vice commander for support functions. In addition to his position as commander of SSD, Gen. Estes also will continue as deputy commander AFSC.

Thailand Police Department has ordered two Sikorsky S-62A single-turbine, amphibious helicopters, one for carrying government leaders and visiting dignitaries, the other for air rescue and border patrol operations.

George F. Metcalf, General Electric regional vice president for defense activities since 1958, has been named vice president-engineering of the Martin Co., Baltimore, Md. Metcalf is chairman of Aerospace Industries Assn.'s missile and space council and a trustee of the National Security Industrial Assn. He succeeds Dr. Albert C. Hall, who was appointed last January as general manager of Martin's Space Systems Div., Middle River, Md.

North American Aviation, Inc., has established a Basic Science Center with temporary quarters in Canoga Park, Calif. The center, organized as a division of NAA, is directed by Dr. Howard Reiss. Researchers will concentrate on helping create the science the company will utilize in development work.

Thomas B. McFadden, vice president and national sales manager of National Broadcasting Company television network, will join TWA in mid-July as vice president of marketing. The position is a new one within TWA, replacing the now abolished title of vice president and general sales manager, formerly held by L. P. Marechal. Marechal resigned former position earlier this month, but continues with TWA as a vice president. McFadden, who has been with NBC 28 years, will head TWA's system sales force and initiate new market expansion activities.

Gerald J. Lynch has been elected president and member of the board of directors of Menasco Manufacturing Co. Lynch recently resigned as vice president and general manager of the Ford Motor Co. Aeronutronic Division. He has been given a five-year contract by Menasco and is expected to manage a program of expansion of company product lines in the aerospace industry.

Four Lockheed F-104F two-place Starfighter trainers of the West German air force collided during a formation exercise last week, killing all four pilots, one an American. Accident took place during preparations for an air show at ceremonies marking activation of the first West German F-104F wing at Noervenich Air Base near Cologne.

New altitude record in excess of 250,000 ft. was reached by Air Force Maj. Robert M. White in the No. 3 X-15 June 21. Exact altitude was not immediately known, pending reduction of the recorded data. White also pushed the X-15 to a speed of 3,682 mph. or Mach 4.99 during the flight. It was his second flight in the No. 3 aircraft which is equipped with an adaptive flight control system.

Ramo-Wooldridge Div. of Thompson Ramo Wooldridge, Inc., will conduct a 12-month study of command and control of limited war forces for USAF's Electronic Systems Division under a \$225,000 contract. The company will be assisted in the study by United Aircraft, Airborne Instrument Laboratory and Adler Electronics.

First Vickers VC.10 four-jet transport is scheduled to make its first flight this week from Vickers-Armstrongs Weybridge plant.



## AIR TRANSPORT

# Aeroflot's African Gains Stir U.S. Action

**Soviet plans for South American, Cuban route spur high-level program to expand U. S. airline influence.**

By L. L. Doty

Washington—Steady expansion of Russian air routes throughout Africa, including plans to extend Aeroflot services from that continent to South America and beyond to Cuba, has forced the State Department to expedite development of a firm U.S. air transport policy that will help combat the Soviet threat in Africa.

For at least six months, State Department officials have been trying to formulate a plan that would give the U.S. a prominent role in the evolution of an Africa airline system, currently a hodgepodge resulting from the transition from colonialism to nationalism. In recent weeks, a promising formula, while not yet a firm policy, has emerged that may give the U.S. the foothold it now lacks in many areas of African airline affairs.

There is little support here for a policy that would commit the U.S. to creating an airline system throughout Africa that would match or compete with the Russian route program.

Rather, the feeling is strong that more is to be gained by encouraging the Africans to establish and operate their own airline system with U.S. financial and technical support. To follow the Russian program would be to compete directly with the African nations, a situation which would only

ultimately result in economic and political friction.

U.S. policy on African airline operations now appears to be moving in this direction:

- U.S. funds should be provided for airport and airways development throughout the African airline complex.
- Technical assistance programs should be adopted to encourage internal airline operations on both domestic routes and regional or intra-African routes.

### New Supersonic Transport Study Awards

Washington—Federal Aviation Agency has awarded 12 new contracts totalling \$1,685,552 for supersonic transport research. Under its current \$11-million budget for the research (AW May 28, p. 28), the agency announced these awards:

- Pratt & Whitney Aircraft, a division of United Aircraft Corp., East Hartford, Conn., was awarded \$772,600 for propulsion research, anticipating future contracts totalling \$2,105,000. Previous engine study contracts have been let to General Electric and Curtiss-Wright, under contracts expected to total \$3.5 million.
- Bell Aerosystems Corp., Niagara Falls, N.Y., received a \$145,451 contract to study the stress and strain imposed on airframe materials under the expected high temperatures of supersonic flight.
- Massachusetts Institute of Technology, Cambridge, Mass., received a \$140,500 contract for wing aerodynamic studies.
- North American Aviation, Los Angeles, Calif., was awarded three contracts totalling \$306,891 to study various structures under supersonic flight conditions. Primary areas of exploration here concern studies and analysis of structural stiffness and weight, wing panel flutter problems and landing gear impact loads.
- Shell Development Co., of Emeryville, Calif., was awarded a \$89,947 contract and the Westinghouse Corp., of Pittsburgh, Pa., was awarded an \$83,424 contract to study resin adhesives for use in radomes and radio antenna housings.
- National Engineering Science Co., Pasadena, Calif., received a \$65,155 contract to develop an effective fire extinguishing agent.
- Boeing Co., Wichita, Kan., received a \$36,534 contract to study transparent inter-layer materials for windshield use.
- The Sperry Rand Corp., Phoenix, Ariz., was awarded a \$31,050 contract for instrumentation displays in the supersonic transport cockpit.
- Lear, Inc., Grand Rapids, Mich., won a \$14,000 contract to study experimental flight controls.

Planning calls for inclusion of helicopter services as well as fixed-wing.

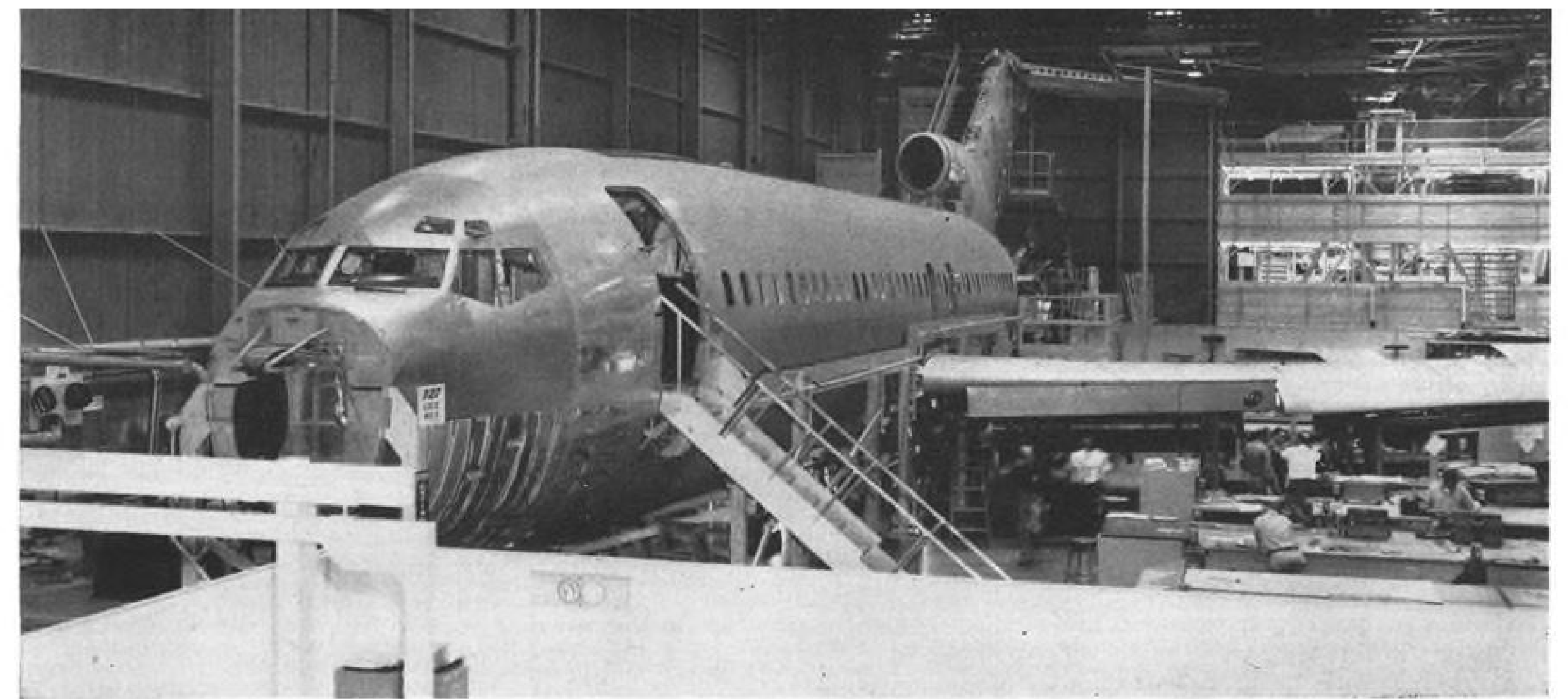
• U.S. international flag carriers should serve major ports of entry on the African continent, connecting with regional routes operated by African national flag carriers. Logistics should be planned to keep the number of these ports of entry at a minimum.

The African problem has been earmarked as a special project in the study now being conducted by the White House (AW June 18, p. 39). The deep concern State Dept. feels on the African issue is underscored by the fact that Joseph H. Fitzgerald has taken leave from the presidency of Ozark Air Lines to serve as a consultant to both the State Dept. and the White House study group.

While the Russians have not been notably successful in selling their aircraft to African nations, nor in the establishment of technical aid projects, they have made impressive gains in developing air routes for the state-owned airline, Aeroflot.

Entry corridor to Africa is through the satellite countries of eastern Europe with Tirana, Albania serving as a main gateway to Cairo. These are the principal routes that Aeroflot plans to operate in its African services:

- Moscow through Tirana, Cairo and the Sudan Republic to Madagascar (the Malagasy Republic). Service is currently operated between Moscow and Cairo and proving flights are now being conducted between Moscow and Khartoum, capital of Sudan.
- East-west route that would traverse most of Arab North Africa, connect with the north-south route at Khartoum, and terminate on the Arabian peninsula. Bilaterals for many portions of this route have not yet been negotiated.
- West coast route. On June 18, a Soviet delegation left Moscow to complete final plans for this route with visits to governments at Rabat, Morocco; Conakry, Guinea; Accra, Ghana; and Bomako, Mali. The delegation was headed by Aeroflot Deputy Chief V. Bashkurov. Agreements for direct flights between Moscow and Accra and Moscow and Bomako already have been signed. Ghana Airways and Air Mali fly the Russian-built Il-18 turboprop transports, and when Air Mali begins service to Moscow, the aircraft will be flown by Soviet crews. Czechoslovakian pilots and technicians are also working for African carriers. Czechoslovak Air-



### Final Configuration Boeing 727 Mockup Takes Shape

Class 3 manufacturing and development mockup of the Boeing 727 three-engine turbojet transport shows what is virtually the final configuration of the aircraft. Metal is being cut on the number one aircraft at the Renton, Wash., factory of Boeing.

lines already is operating a route down the west coast of Africa from Prague to Conakry.

• **Accra-Rio de Janeiro.** Last month a 36-man Russian trade delegation flew the route on a special mission to Rio, presumably as a prelude to opening negotiations on a South Atlantic route to Brazil. Brazil recently denounced its bilateral agreements with The Netherlands and the three Scandinavian nations because of the failure of these countries to purchase coffee from Brazil.

• **South America-Cuba.** Soviet plans to negotiate for this route are still vague and a final decision undoubtedly hinges on the extent to which anti-Castro forces in South America influence the political atmosphere. Such a route would give Aeroflot an important entry into the Western Hemisphere by linking with Czechoslovak Airlines' middle Atlantic route between Prague and Havana. As part of this picture, the Cuban government is reportedly planning to ban Pan American, Delta and Iberia Airlines of Spain from serving Cuba.

The greatest Soviet aircraft sales effort outside the Communist bloc has been directed at the African continent. However, of the same 320 aircraft operated by an estimated 30 African national airlines, about 200 are U.S.-built, 100 were manufactured in Western Europe and Great Britain and only 20 are Russian-built.

The only countries where Russians have made substantial sales are in Ghana, Guinea and Mali. Ghana operates eight Il-18 and several An-12 turboprop transports and Guinea has purchased two Il-18s and several Czech-built Il-14 piston-engine transports for Air Guinea. Air Mali operates four Il-18s and a few smaller Russian aircraft

including single-engine An-2s and helicopters. Latest figures show that Russia has sold a total of 40 Il-18s abroad.

Reports that Ghana is disenchanted with the Il-18 because of high maintenance and operating costs (AW June 4, p. 25) are staunchly denied by the Reds. Recently, a Soviet official stated that "there has not been a single breakdown of any of the Il-18s operating in Ghana. That cannot be said of the Britannia planes, on which engine trouble is frequent."

In fact, a Soviet-built An-12 cargo plane had to carry Britannia engines to London for repairs.

The Russian confidence in the Il-18 is slightly undermined by reports of East German Lufthansa's experience with the aircraft. Maintenance inspection periods on the Il-18's Ivchenko turboprop engines have not increased noticeably since the aircraft were first introduced into service several years ago, according to East German sources.

The Russians have succeeded in expanding Aeroflot routes throughout Africa, largely due to the application of the reciprocity principle: each country which opens its airports to Aeroflot is granted authority to serve Moscow in return. Were the U.S. to adopt such a policy, U.S. gateways would be flooded

with service from aspiring young African nations.

Meanwhile, the airline route structure of Africa remains in a state of flux, complicated by the desire of new nations to create carriers not necessarily to provide badly-needed domestic service, but to carry the national flag over foreign routes.

The Congo Republic immediately organized Air Congo after winning its independence from Belgium, and was able to begin service between Elizabethville and Leopoldville on condition that the carrier's aircraft did not carry troops between the two points.

The Congo Republic, however, still has a vested interest in the Belgian airline, Sabena, since the government has a 25% ownership in that carrier—an interest it inherited with its independence. Thus the Congolese are faced with a certain amount of ambivalence: they are eager to expand their own flag carrier but do not wish to destroy any economic benefits they may derive from a Sabena operation in Africa.

To strengthen their positions economically, many African carriers are forming pools. Air Congo joined forces with Nigerian Airways and East African Airways, and 11 other nations have formed a single carrier, Air Afrique. Further pooling or consolidation of air carriers can be expected as the economic facts of airline operations become more apparent.

Nevertheless, many African nations are expected to continue attempts to provide their own air services. Some have been largely successful, notably Ethiopian Airlines—which is operating under a technical assistance agreement with TWA—as well as carriers operating in southern Africa and United Arab Airlines of Egypt.

### Egyptian Bilateral

Washington—An Egyptian delegation arrived here last week to open talks with the U.S. on an amended bilateral agreement. Egypt's goal: an around-the-world route through the U.S., a request the U.S. is expected to resist. Egypt probably will be granted a Cairo-New York route and was expected to base its request for beyond rights on the principle of reciprocity.



# Traffic Spurs on North Atlantic Routes

By James R. Ashlock

New York—Transatlantic passenger volumes have shown a sharp increase since Apr. 1, and airline traffic officials are debating whether the new IATA group fares are a key factor behind the upturn.

Preliminary figures for June indicate a continuance of the favorable trend recorded in April and May. The two months prior to June 1 saw 176,152 eastbound transatlantic travelers, 36,836 more than in the comparable period of 1961. Westbound traffic also was improved with 160,796 crossings, 36,867 more than in the same two months last year.

Load factors still are unsatisfactory from the individual carrier's standpoint, although preliminary figures compiled by some airlines indicate weekly load factor averages approaching 70%. This reflects the increase in capacity, which in April rose to 141,867 seats on eastbound schedules, 14,027 more than in the same month a year ago. Since April, available seat miles have increased even more as carriers reached summer schedule frequency peaks.

Passenger volume increases as reported by individual airlines vary from 5-10%:

- **Pan American** which increased weekly transatlantic round-trip frequencies to 92 this year compared with 79 in 1961, reports passenger volumes up 5%.
- **TWA**, with its frequency increased to 46 weekly round-trips as against 40 last year, says eastbound loads rose 27% between April 29 and June 9, with load factor up 3.9%.
- **Lufthansa** had a 30% passenger volume increase in May, and says the rise has moved it from sixth to fifth place in total passengers carried.
- **Scandinavian Airlines System** reports eastbound bookings up 10% from New York and 8% on polar routes.
- **Swissair**, which shifted two of its 16 weekly U.S. schedules from New York to Chicago this year, says passenger volumes are up between 10-15%, which Swissair admits is less than it anticipated for the season.
- **Sabena** said that business from May 1 has improved 26% compared with the same period of last year. It attributes rise to renewed American interest in Belgium, evidenced by reports from U.S. passport offices.

Pan Am and TWA both claim their bookings would be much better except for the widely publicized strike threat from flight engineers in recent weeks.

Carrier opinion differs on the effectiveness of the group fares in generating new business. Both Pan Am and TWA

speak favorably of the fares, although both would have preferred earlier approval of them by both IATA and the CAB.

"We feel the group fares, had they been approved earlier, would have generated some 25,000 new passengers this year," a Pan Am official said. "We'll have to hustle to attain that figure now."

TWA estimates that approximately one-third of its June and July advance bookings are group fares. On the other hand, several foreign carriers term the fares marginal or say it's too early to tell so far as new business is concerned. Even so, foreign carrier spokesmen say the group fares are due full support and backing as a potential means of broadening the market.

Economic conditions are a favored talking point among carriers in discussing improved transatlantic situation.

"The economic downturn in 1960 is now viewed as a prime cause of the drop in travel to Europe last year," said one official, "but when the economy began improving in the latter months of 1961, people's confidence apparently returned, and they began planning the trips they are taking now."

There's also the feeling that, in spite of the May stock market fluctuations, the public feels enough confidence in economic conditions to invest in travel. The majority of carriers insist there is no measurable effect on travel as a result of the market drop. However, several airline officials feel that any adverse affect will probably not be felt until late June or early July.

"We think a lot of people who had trips planned for later in the season are probably watching the market right now, waiting to see if their paper losses will be recovered," one spokesman said. "Whether they cancel their trips will probably depend on the way their stocks go."

Carrier opinion sees the growing economy of Europe, coupled with efforts of the U.S. Travel Agency, as a big factor in the rise of westbound passenger volumes. In May, for example, westbound passengers totaled 87,814, compared with 69,520 the same month last year. An official of one U.S. carrier said 12-14% of this westbound increase is being carried by the foreign airlines. But the U.S. airlines are apparently benefiting as well, evidenced by TWA's 32.2% increase in westbound volumes between Apr. 29 and June 9.

The increased share of westbound business going to the foreign carriers has, in the opinion of airline spokesmen, brought two significant changes:

- **It has tended to ease foreign carrier criticism of the U.S. promotion that encourages Americans to fly U.S. flag carriers.**

- **It has brought strong foreign carrier backing of the U.S. Travel Agency's activities abroad.**

Both Pan Am and TWA are well aware that the foreign flag carriers are cashing in on U.S. expenditures overseas promoting travel to this country. Even so, both strongly urge more aggressive "Visit U.S.A." efforts, Pan Am alone having spent \$4,000,000 in such promotion last year.

All the carriers apparently agree that, like the group fares, the "Visit U.S.A." program is a justified endeavor.

"Even though the potential of the campaign has not been realized yet, if can, if promoted properly, bring about an expansion of the market," one official said.

Another factor widely credited for passenger increase this year is the intensified advertising and sales promotion programs by all carriers. Airline spokesmen admit this has resulted from the growing competitive conditions on the North Atlantic.

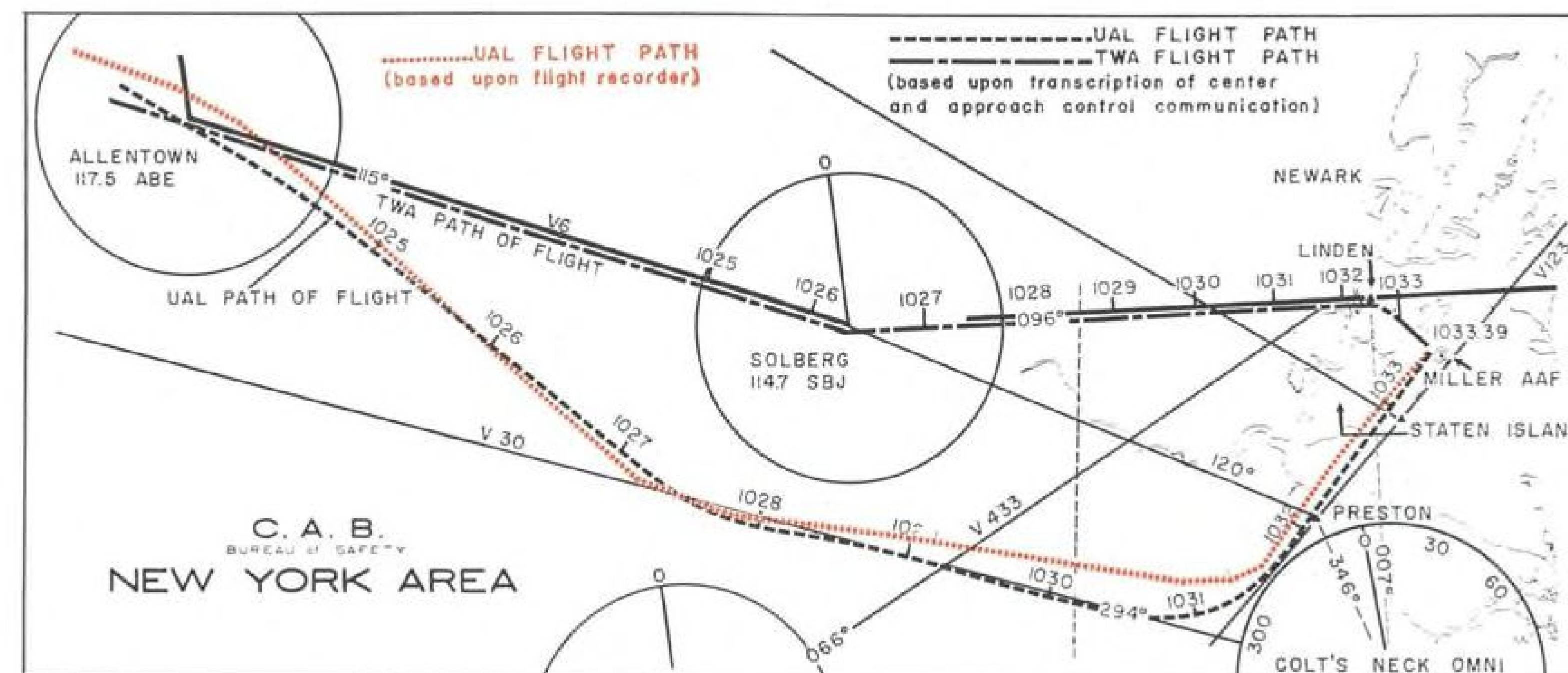
"Every airline flying between the U.S. and Europe has new jets which it is advertising like mad," said one airline marketing official. "In magazines, newspapers, and on radio and television, people are being pounded with the idea of taking a trip to Europe."

Although more people are deciding to travel abroad, many airline sources feel that the public is either growing more spontaneous, or it is becoming increasingly aware of the great capacity available. Whatever the reason, people are reserving space at later dates than ever before. This is creating a real problem in airlines' compiling their forecasts on the basis of advance bookings. An official of one major carrier said there had been a high level recommendation in his company to throw out advance bookings as a forecast formula.

"It isn't so much a problem with weekend flights, when we're generally booked up," one foreign carrier spokesman said. "But so far as weekday forecasts are concerned, we just don't have an accurate barometer anymore."

Nor are the late bookings restricted to business travel, even though this category of transatlantic travel is definitely up this year.

"The big export drive has certainly increased our volume of business travel to Europe," a Pan Am executive said. "But the majority of these late bookings are pleasure travelers."



**DIVERGENCE OF UNITED FLIGHT 826** from reported flight path is shown in red—the flight path computed from the aircraft's flight recorder. Times along routes show positions of the United and TWA flights as they converged. Collision point was computed to be 6,555 ft. northwest of the center of Miller Army Air Field. United flight was to hold at the Preston intersection.

## Pilot Error Cited in United-TWA Collision

By David H. Hoffman

Washington—Pilot error, not the air traffic control system, was responsible for history's worst air disaster, the mid-air collision of a United DC-8 and a TWA Constellation over Staten Island, N.Y., on Dec. 16, 1960, according to a Civil Aeronautics Board finding released last week.

While United still had the report "under study" late last week, reaction from the pilots' union was quick and bitter. Finding fault with most conclusions drawn by CAB from facts brought forth in the investigation, airline captains promptly began debating how to accomplish a common goal: persuade the Board to reverse or modify its first position.

Probable cause of the tragedy, the Board said, was that "United Flight 826 proceeded beyond its clearance limit and the confines of the airspace allocated to the flight by air traffic control." The United jet had overshot the fix at which it was to hold by 11 mi. when the collision occurred. All 128 on board the two aircraft and six persons on the ground died in the accident.

### FAA Absolved

In effect, the CAB report absolved the Federal Aviation Agency from blame by holding that the United pilots, not radar controllers on the ground, were responsible for navigating the DC-8 just prior to the collision. The Board noted that under FAA rules, when radar is used to separate traffic, aircraft are to be kept at least 3 mi. apart.

But CAB did not answer one signi-

ficant question raised by United and the Air Line Pilots Assn, during public hearings here and in New York: How can ATC guarantee a 3 mi. separation to an aircraft without keeping it under continuous radar surveillance?

When the United pilots were told "radar service is terminated" by New York center, they already were well beyond Preston—the fix formed by the intersection of two VOR radials at which the flight had been instructed to hold. The CAB report shed little light on why ATC personnel failed to observe the jet's blip as it passed Preston at an excessively high groundspeed of about 440 kt. (AW Jan. 16, 1961, p. 38).

### Agency Rule

But an FAA rule that acquits ATC of responsibility for what might happen when pilots fail to respond to "the measures taken to control them" was cited by the Board in its report.

Capt. E. J. Bechtold, ALPA regional safety chairman, challenged the report as being riddled with faulty logic and served notice that the pilots would petition CAB for a thorough review. The foundation for the Board's finding, Bechtold said, is an "assumption of FAA infallibility that borders on the reprehensible." In addition, there was not a single mention of spurious airborne instrument signals despite the testimony of expert witnesses that such could have been received by the DC-8 pilots, he said.

ATC had given United's Flight 826 a short-cut clearance to the Preston fix, one that reduced the time needed by the DC-8 pilots to prepare for their hold. From this point on, according to

CAB, operational problems that culminated in the accident began to mount in the cockpit.

One of the two VOR receivers on board the jet was presumed to have failed. Although the pilots informed their company of the malfunction, no one relayed the message to FAA and the flight was not given special consideration. About 7 min. before the collision, the jet still was at 20,000 ft. and indicating more than 450 kt. with the pilots promising an all-out effort to reach 5,000 ft. before Preston.

To explain why the veteran United crew, navigating solely by instruments, overflew Preston and entered the congested area around New York's La Guardia Airport, CAB outlined this theory:

When the new clearance was given the flight—to proceed via a more direct route to Preston—"the crew apparently made no notation of the shortened time and distance," CAB said. This the Board described as a "primary error," as the distance between Preston and the VOR anchoring the airway leading to it was 19 mi. while the distance between Preston and the point at which the jet intersected this airway was only 8 mi.

### Rapid Maneuvering

"It is logical, in view of the rapidity with which the flight was being maneuvered, to assume that the time and distance from the intersection of Victor 30 and Victor 123 (the short-cut) to Preston was not corrected from the original time and distance associated with the Robbinsville/Preston clearance (the original routing)," CAB said.

If this more leisurely time and dis-



tance was embedded in the pilots' minds, it would explain the jet's last known radio call—"approaching Preston at 5,000"—which came after the flight actually had passed its clearance limit. Additional evidence pointing toward this conclusion was induced circumstantially by the Board. It was premised on the pilots' using their No. 1 ADF (automatic direction finder) as a substitute for the inoperative VOR.

With this ADF tuned to the low-frequency beacon on the ship stationed at Scotland, a fix east of Preston, the two pilots could have confused the ADF display with the VOR display to which they were accustomed. If this happened, the ADF pointer would have indicated about 153 deg. when the collision occurred. Such a reading, had it been furnished by the inoperative VOR, would have told the pilot that Preston was still in front of him.

According to CAB, this was the logical way the DC-8's radios would have been tuned by the copilot on the captain's command as the jet neared Preston. The Board took note of the fact that New York area charts then in use did not portray the bearing from Scotland to Preston. But it said that "by inspection a very close approximation of the correct bearing could be obtained."

The assertion of the New York center radar controller who last talked with the United pilot that he had seen the jet's blip 1 to 3 mi. south of Preston when the flight reported out of 6,000 ft., was termed "inconsistent with the

facts" by CAB. The Board also claimed that the flight was being afforded non-radar separation and that it had overshot Preston by 8 to 9 mi. when radar service was ended. Although the Board found no fault with the ATC system, which FAA has held responsible for a mounting number of near collisions (AW May 21, p. 52), it listed these preventive actions taken by the agency since the accident:

- **Issuance of a rule** that requires pilots to report in-flight malfunctions of navigation or communication equipment.
- **Adoption of a timetable** calling for distance measuring equipment (DME) on all turbine-powered equipment by Jan. 1, 1963, and on all others over 12,500 lb. a year later.
- **Use of radar handoffs** on an expanded scale throughout the U.S. and especially in the New York area.
- **Formulation of standard phraseology**—"slow to holding pattern airspeed at least 3 min. before reaching holding fix"—to be given inbound jets.
- **Revision of VOR names** and coded identifications in the New York area to avoid possible confusion.
- **Regulation of airport area speed limits** restricting aircraft below 10,000 ft. from exceeding 250 kt. within 30 naut. mi. of an airport.

The Board did not note, however, that since the 1960 collision FAA has abolished most intersection feeder fixes such as Preston throughout the U.S. and scrapped the specific routing given the United jet by ATC.

long as good business judgment permits."

In the CAB order approving the control, Chairman Alan S. Boyd, delivering the majority opinion, largely adopted the findings of Examiner Merritt Ruhlen in his May 8 initial decision approving the control. The only dissent came from member Chan Gurney, who found the record too meager to support the Board findings.

Boyd said the condition the examiner proposed to limit value of inter-company transactions—without prior CAB approval—to \$200 each with an annual limit of \$10,000 was too low. The Board eliminated the restriction on individual transactions, boosted the annual limit to \$100,000.

Another condition altered was the provision exempting inter-company transactions from the individual and annual limits for purchases of fuel, transportation, repairs, modification, maintenance and overhaul. The Board placed all but transportation under the \$100,000 annual limitation. Transportation must be purchased at regular rates.

Boyd answered four specific arguments against the Hughes Tool acquisition made by Eastern and National:

- **Charge that Hughes Tool** had gained prior control of Northeast without CAB consent. Boyd supported the findings of the examiner, who said that Hughes Tool had not gained control of Northeast within the meaning of the Federal Aviation Act.
- **Contention that CAB** may not use Northeast's existing route structure to justify control approval or determination of public interest without remanding the case to the examiner for a full hearing on the need for Northeast's services. Boyd said the Board rejected this view because Northeast has been providing air service since before the passage of the Federal Aviation Act in 1938. This fact carries with it a "presumed" benefit to the public interest.
- **Assertion that if Northeast** were allowed to fail its New England routes could be divided among Allegheny and Mohawk airlines. In the meantime, National would serve six New England points by exemption. Boyd said to adopt these proposals "would at best be gambling with the public interest."
- **Exclusion of Hughes Tool Co.'s** past management of Trans World Airlines as an issue in the case. Boyd said the condition of Northeast made the issue in the case not whether Northeast would have an efficient management, but whether it would have any management at all.

Boyd emphasized that the approval granted Hughes Tool in the control case was limited to that case alone and that the Board did not consider or pass on any issues in the renewal case or resumption of Hughes control of TWA.

## Thai Considers Obtaining Third 990 Jet

By Cecil Brownlow

**Bangkok**—Thai Airways International, battling head-on jet competition from 23 other international airlines, is considering the possible lease or purchase of at least one additional Convair 990 to bolster its position over the carrier's 12-city Far Eastern route network.

With a route structure ranging across Asia from Calcutta to Tokyo, Thai International now has two 990 medium-range jet transports at its partial disposal under terms of an involved lease-purchase agreement with Scandinavian Airlines System (AW Apr. 30, p. 49). Under provisions of the arrangement, a rotation plan with SAS, the Thai carrier has a 990 available for a scheduled five days on alternate weeks, an average of three days over the interim periods.

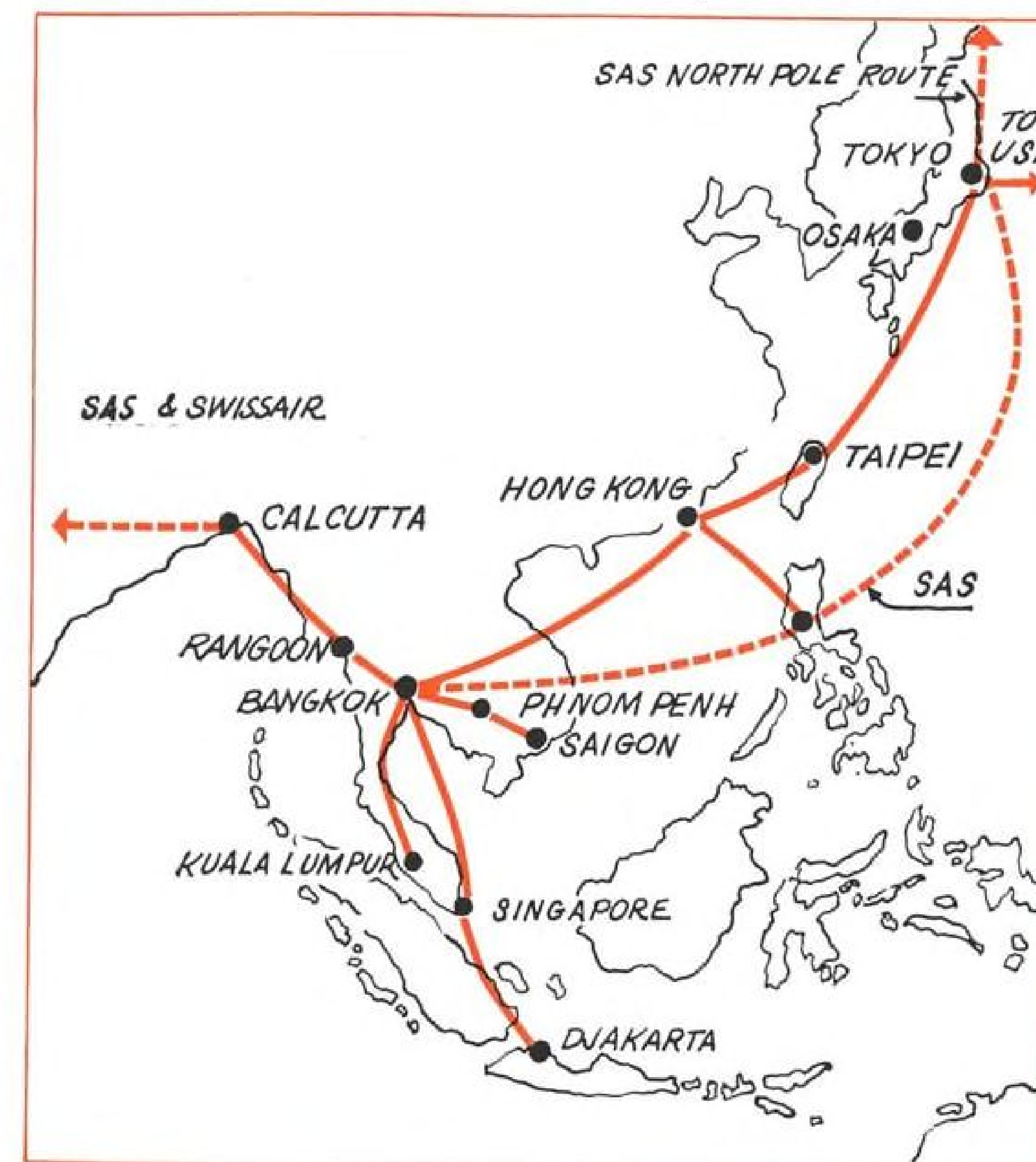
Scheduling within the restrictions of such a program has been difficult, but Thai and SAS have worked out a coordinated plan designed to gain the best possible utilization over the routes involved.

As an example, here is the schedule for a week when Thai International has one of the 990s available on a five-day basis:

- **Monday-Tuesday**—SAS Flight SK983 leaves Copenhagen for Tokyo via the southern route through the Middle East and India. Once in Tokyo, the aircraft overnights.
- **Wednesday**—With Thai International cabin equipment, cuisine and attendants aboard—light purple uniforms and brocade dresses in place of SAS's navy blue—the aircraft departs on a 3,076-mi. TAI schedule to Bangkok via Taipei and Hong Kong. At Bangkok, it is turned around for the 1,900-mi. run to Manila via Hong Kong. Aircraft overnights in Manila.
- **Thursday**—Plane returns to Bangkok by way of Hong Kong and then continues on under a new flight number over the 1,475-mi. route to Jakarta, Indonesia, where it overnights.
- **Friday**—Aircraft returns to Bangkok and then leaves for an overnight stay in Tokyo via Hong Kong and Taipei. While in Bangkok, the Thai plane meets the second 990 flying the SAS Copenhagen-Tokyo schedule. Here, Thai takes over SAS passengers ticketed for Hong Kong and Taipei, while the Scandinavian carrier, in turn, picks up TAI customers bound for its interim stop at Manila.
- **Saturday**—Original TAI aircraft flies from Tokyo to Bangkok by way of Taipei and Hong Kong, boarding Europe-bound passengers en route to make connection with the SAS 990 flight



**TAI DEPENDS LARGELY UPON SERVICE** to attract passengers. Thai cuisine is emphasized, but food on the stewardess' tray includes caviar from Russia, Danish cheese, Australian lobster, Italian olives and American peaches. About 10% of TAI's ticket sales are made in the U. S., 80% are sold to customers in Far East, 8% in Europe and 2% elsewhere.



**LATEST ADDITION** to Thai Airways International route system is Manila, boosting the number of cities in the network to 12. Competition over much of the system is severe, with 23 carriers plus USAF's Military Air Transport Service flying into Bangkok alone.

## Hughes Starts Aid to Northeast After Final Approval of Control

By Ward Wright

**Washington** — Hughes Tool Co. moved quickly last week to aid Northeast Airlines after the Civil Aeronautics Board gave final approval to its acquisition of Atlas Corp.'s controlling interest in the airline for \$5 million (AW May 14, p. 39).

Hughes Tool Executive Vice President Raymond M. Holliday told Northeast that his company would cover the airline's cash needs immediately, and provide funds for a "vigorous" advertising and sales promotion campaign.

First full page ads directed at the summer vacation market were scheduled to appear in all the airline's market areas June 25.

The final obstacle, a restrictive provision of the Investment Company Act of 1940, was cleared when the Securities and Exchange Commission exempted Hughes Tool from the Act June 20, the day after the CAB order.

The specific amount and nature of

Hughes Tool aid to Northeast, Holliday said, "must await the conclusion of extensive studies involving the many complex problems confronting Northeast."

Barring any further attempts to block the CAB approval in the courts, Hughes Tool and Northeast have no legal problems until they clash with Eastern and National Airlines in CAB's New York-Florida Renewal Case over Northeast's authority to participate in the Florida market (AW Jan. 29, p. 45).

The outcome of the renewal case will probably determine Northeast's future. Without the permanent Florida operating authority which Northeast seeks in the renewal case, Hughes Tool would be left with a New England regional carrier requiring large amounts of subsidy.

If this were to happen, a hint of possible Hughes Tool action may lie in Holliday's statement to Northeast's President James W. Austin last week that financial aid would continue "as



# The new TWA Trans World Flight Center at New York International Airport



**"TO EXPRESS  
THE  
EXCITEMENT  
OF TRAVEL"**

...EERO SAARINEN

This is the new Trans World Flight Center in New York. Architect Saarinen designed it to express the special excitement of jet travel. Its soaring roof and sweep of glass enclose a hundred new ideas to speed your departure and arrival—like TWA's fast new jet check-in and boarding, and automatic baggage delivery. International shops are here. Comfortable lounges. Glamorous restaurants. One other fact makes the Trans World Flight Center entirely unique: it's the only airline terminal where routes from 70 cities in the U. S. are linked to routes in Europe, Africa, and Asia. One world under one roof.



**CONVAIR 990** with Thai markings carries the name of both TAI and Scandinavian Airlines System. Thai International operates two aircraft over its Far Eastern routes on an exchange basis with SAS, which uses the planes on its Copenhagen and Tokyo route.

which is returning to Thailand by way of Manila.

In Bangkok, the two aircraft are exchanged, the 990 TAI has been using thus far returning to Europe on the SAS flight. Thai International, meanwhile, takes over the second aircraft and flies it on its schedule to Manila via Hong Kong.

• **Sunday**—Aircraft now operated by TAI returns to Bangkok through Hong Kong and then proceeds on to Tokyo, where it overnights.

• **Monday**—Second aircraft reverts back to SAS as flight SK984 for the trip to Copenhagen.

The shorter three-day availability schedule for the aircraft on alternate weeks is necessary in order to provide time for the normal maintenance routine which the aircraft go through after every second round-trip flight to the Far East.

This, plus other airframe and engine maintenance work, is provided by Swissair in Zurich under terms of the various pacts surrounding operation of the two aircraft.

Technically, SAS has the two 990s on a four-year lease-purchase agreement from Swissair. In turn, SAS, a 30% owner of TAI, has granted a lease-purchase option on one of the two aircraft to the Thai carrier. Under the SAS-Swissair agreement, the latter airline is responsible for the maintenance of the two 990s, which they receive during scheduled stopovers in Zurich. This still holds true for the aircraft TAI has on lease-purchase.

All around, the lease-purchase type pact is necessary so that ownership titles can be exchanged, making it possible for the aircraft to be legally registered in the nation of the user airline and opening the way for it to be painted with the individual colors of the respective carrier involved.

In the case of the two 990s included in the SAS-Thai International agreement, one bears Thai national markings with the fuselage painted with the slogan, "Thai Airways International in co-

operation with Scandinavian Airlines System." The other, still registered with SAS, has the reverse inscription—"Scandinavian Airlines System in Cooperation with Thai Airways International. Since TAI has adopted the red, white and blue colors of SAS, the over-all paint schemes of both are almost identical.

Under the present scheduling, Thai generally is without the use of a 990 between Sunday night and Tuesday night of any given week, a crippling factor in view of the increasing jet service the carrier's major competitors are offering travelers from Bangkok and other key points along the 12-city network. The slack-plus service to points on the route system not served by 990s—must be taken up by the two Douglas DC-6Bs TAI still has on hand under lease from SAS.

## Jet Gap

This jet gap is a major factor behind TAI's desire to obtain at least one additional aircraft. Before the two 990s became available on May 18, one TAI official said:

"We were the only wholly piston operator flying from here, and our load factors were dropping. This is something we will have to build back again—few people realize that Bangkok-Tokyo is almost as far away as London-New York."

Passenger load factors during Thai International's two years of operation with an all-DC-6B fleet averaged out to approximately 55%. For the present summer schedule, Traffic and Sales Manager Christian R. Hunderup, an executive on loan from SAS, anticipates a 50% average passenger load factor for the 990s. The aircraft also place added strain on Hunderup's selling job, since they increase the airline's over-all productivity capability by about 45%. Present total production rate is 100 ton mi. per week.

Thai International's local competition is compounded by the service through Bangkok and other points by a number of major international carriers, including

Pan American, Air France, Lufthansa, British Overseas Airways Corp., Qantas Empire Airways and Japan Air Lines.

Locally, the principal competition comes from Nationalist China's Civil Air Transport and Hong Kong's Cathay Pacific Airways, Ltd., particularly the latter which serves the same 12 points as TAI plus three others. Both CAT and Cathay Pacific are now flying Convaire 880s.

Another trunk carrier serving Bangkok is Swissair, a European pool partner of SAS, whose schedules also are designed to offer a minimum of direct competition to Thai International, according to TAI officials here.

Swissair, which uses 990s over its Far Eastern routes, also could provide a backstop for the Thai carrier should one or both of the SAS-TAI jets go out of service. In this event, Swissair would take over at least some of the 990 schedules normally served by the Thai carrier.

At the moment, including out-of-service periods during the twice-a-month checks, the combined SAS and Thai International schedules for the two 990s are building up to a utilization rate of between 65 and 67 hr. per week for each aircraft.

Once a 990 reaches Bangkok it passes under the effective control of Thai International, although it may continue to operate as a SAS flight, and, in order to meet its own schedules, TAI has the authority to delay a SAS flight by as much as 12 hr. if necessary.

For the moment, all 990 flight crews are SAS personnel, who simply change from navy blue to slate grey uniforms to make the transition. Thai crews, however, will be integrated into the operation as their experience grows. Navigators are now being trained in Europe, and plans are under way for the use of Thai third pilots aboard the 990. Most co-pilots on the DC-6B flights are Thais, and three were recently promoted to captain.

The same blend of European and Thai personnel is evident in both the





## World's fastest helicopter serves USAF

Sikorsky's S-61 is now serving the U. S. Air Force, flying Texas Tower support missions from Otis AFB, Massachusetts.

The S-61 is the world's fastest helicopter. It cuts Tower trip time one-third and flies the entire mission without refueling.

Twin turbines and a boat hull greatly increase range, load, and safety in overwater operation. With its ability to fly 20 men and 700 pounds of equipment off small, windy platforms, the S-61

easily meets Air Force performance requirements. Unlike previous helicopters, it can fly long offshore missions without an escort.

The S-61 has cargo hook, rescue hoist, and automatic stabilization equipment. Production models in military and commercial service have established component durability and extended time between overhaul. The S-61 is the first twin-turbine helicopter certified for passenger service. For additional information, write:

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administrative and technical operations here, with Scandinavians sitting in on some of the more difficult posts with the hope of eventually phasing out as others can be trained and gain the necessary background for the takeover. Normal maintenance work on the DC-6Bs is now conducted at Bangkok's Don Muang Airport, largely by Thai employees.

TAI, still in the red but pushing hard to move into the black over the next few years, was formed two years ago to provide Thailand with an international airline, and SAS was asked to step in

with technical and financial aid as well as equipment. Its partner, and 70% owner, is Thai Airways Co., Ltd., a government-owned carrier operating primarily into the neighboring countries of Malaya, Laos and Cambodia with DC-4 and C-47 equipment.

During its first two years of operation, Thai International flew some 3.7 million mi., logging 15,125 hr. in the air on 5,398 flights.

Passengers carried during the period totaled 150,000 while 4.7 million lb. of cargo plus 882,000 lb. of mail was handled.

## Goldberg Plan Seen as Victory For FEIA; Some Members Balk

By Robert H. Cook

**Washington**—Settlement of the airline industry's hotly-contested jet crew complement issue hit a possible road block late last week as members of the Flight Engineers International Assn. protested their negotiators' agreement to terms offered by Labor Secretary Arthur J. Goldberg in a last-minute effort to avert a strike against Trans World Airlines.

The major objection is that TWA Chapter President H. S. Dietrich disregarded orders from the union's executive council not to negotiate on the aircraft and powerplant mechanics license requirement in the TWA contract.

FEIA headquarters here said members at Pan American World Airways and Eastern Air Lines have registered similar objections, but that the union is still confident the agreement will be ratified by the members.

Goldberg's offer came just as scattered picketing began June 20 and quickly ended pending consideration of the proposals. His action, following strong White House and congressional criticism of the threatened walkout, was regarded as a definite victory by the union in its cockpit jurisdiction fight with the Air Line Pilots Assn. on several major carriers, including Pan American and Eastern.

Industry observers also viewed the last minute offer as an admission by the Administration that it would have been unable to muster sufficient congressional support to obtain legislation to block the strike.

Meanwhile, the government moved to avert a threatened strike of the Transport Workers Union against American Airlines. TWU scheduled a walkout of 10,000 members last Friday in a dispute over wages, and it was anticipated that a presidential emergency board would be appointed to discuss the issues and make recom-

mendations for a settlement within the 60-day period provided by the Railway Labor Act.

Acceptance of the proposal by TWA, FEIA and ALPA is expected to bring a quick settlement of the same issues at Pan American and Eastern.

Immediate recognition and guarantee by the government of FEIA's representation rights for an indefinite time is the backbone of the new package authored by Goldberg, with the aid of W. Willard Wirtz, under secretary of labor; Prof. Nathan P. Feinsinger, who has twice recommended that turbojet crews be reduced to three men and that FEIA merge with ALPA, and Francis A. O'Neil, member of National Mediation Board. Goldberg's offer made these major concessions to FEIA:

- **Labor Department** and the National Mediation Board will guarantee the representation rights of the union. This could mean that the NMB will not undertake any further "class and craft" elections, such as the one that resulted in FEIA losing its representation to ALPA on United Air Lines. Because of a fear that it might be forced into similar elections on other airlines, FEIA shut down six major carriers for five days in February of last year. The protest strike was lifted after the White House appointed Feinsinger to investigate the matter and make recommendations (AW Oct. 22, p. 35).

- **Pilot training** for flight engineers, a major Feinsinger recommendation, will still be required, but with the condition that members who fail to obtain the required commercial and instrument ratings will be given severance pay comparable to the sums recently approved by TWA for its navigators.

- **TWA would agree** to halt its training of pilots as flight engineers and the estimated 60 who have already been trained in this capacity would not be given flight engineer berths until after 65 furloughed FEIA members are re-employed.

- **Possibility of merging** FEIA and ALPA will be studied by a joint committee of flight engineers, pilots, and a member named by Goldberg.

In return, FEIA has agreed to drop its demands that all-newly hired flight engineers have an aircraft and powerplant certificate as a condition of employment.

Agreement on these points opens the way for further negotiations on wages and working conditions. If FEIA and TWA fail to agree on these issues by June 28, they will be settled by a procedure recommended by Feinsinger. The union wants a pay increase of 20% over a three-year period, plus a reduction of monthly flight time from 85 hr. to 75 hr.

A presidential emergency board declined to take a stand on the crew complement issues in its report on the FEIA-TWA dispute last May, but recommended a salary increase totaling about 13% while rejecting the union's request for a lowering of monthly flight times.

One possibility that may complicate settlement is the recent binding arbitration entered into by ALPA and Pan American World Airways (AW May 28, p. 43). FEIA refused to participate in this arbitration and many of the recommendations for pilot training and third pilot qualifications are unacceptable to the flight engineers.

At the same time, Pan American has been threatened by an FEIA strike and is left in a position of having signed an agreement with ALPA containing stipulations which could clash with the Goldberg recommendations designed to settle an almost identical situation at TWA.

Yet it is clear, in comparison with the presidential emergency board findings on the TWA-FEIA dispute, that the Goldberg proposal has answered many of the major FEIA objections to the Board report and may lead to the first implementation of the Feinsinger recommendations for a gradual reduction of turbojet crews to three men.

### California Fares

Three per cent increase in intrastate fares has been granted Trans World Airlines, Inc., and American Airlines, Inc., by the California Public Utilities Commission. Approval was by a three to two vote.

American, with intrastate flights between San Francisco and Oakland and between Los Angeles and San Diego, expects to realize an additional \$8,000 revenue annually as a result of the raise. TWA estimates an increase of \$47,830 in annual revenue, but claims it still will lose more than \$1 million per year on California intrastate flights.



# World Airways Provides New Wings for the Nation's Air Arm



## World Airways orders giant Boeing 707-320C convertible cargo/passenger jet transports . . .

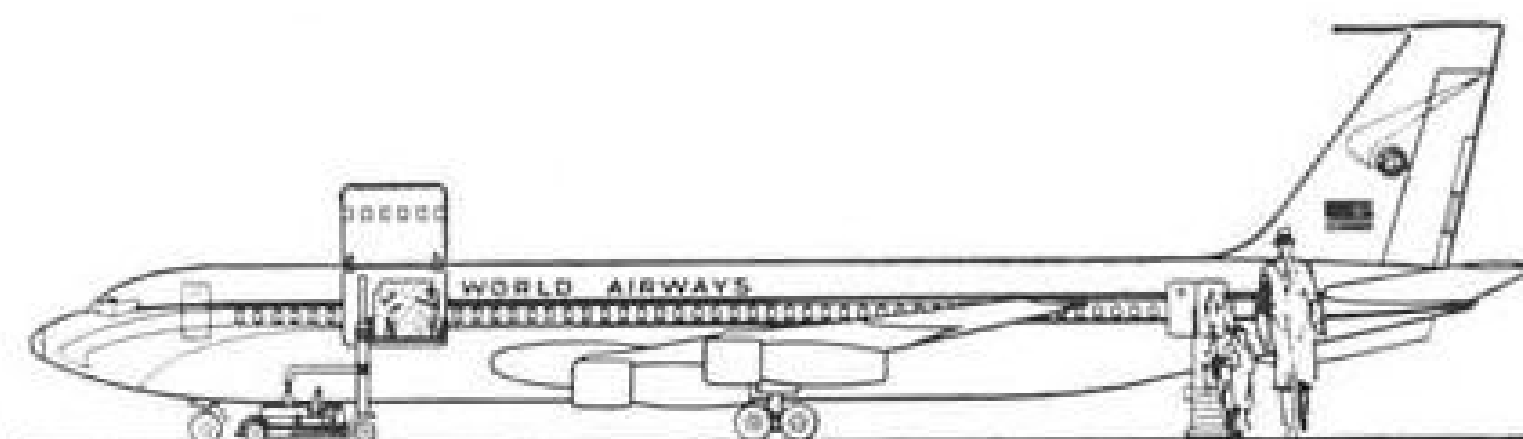
- to provide high-volume, jet-speed airlift for the U.S. Air Force's Military Air Transport Service,
- to offer the nation a truly jet-age charter and common carriage service for both passengers and freight.

Beginning in July, 1963, World Airways will put at the service of MATS, as well as commercial air transportation customers, the world's longest-range jet transports: new Boeing 707-320Cs.

These new Boeing -320C Intercontinental jets will carry more payload a longer distance than any other commercial cargo aircraft. They will provide "next morning" cargo delivery in transatlantic, transpacific and transcontinental service.

These giant, convertible jets can carry 90,000 pounds of cargo, or 188 economy-class passengers, or any combination of the two. Maximum range is more than 6500 miles. Cruise speed, with full payload, is 575 mph. The -320C's cargo doors are the largest on any commercial aircraft, permitting the handling of missiles and palletized cargo meeting MATS specifications. A simplified loading system saves ground time for both military and commercial cargo.

World Airways' new turbofan Boeing jets constitute an important addition to the U.S. Civil Reserve Air Fleet—a logistics reserve fleet



"in being" and instantly available to serve the nation in time of emergency.

World Airways, already operating a fleet of 13 four-engine convertible aircraft, is the first airline to purchase the new Boeing 707-320C jets.

World Airways operates contract MATS services over Pacific and Atlantic routes, as well as providing logistics support (LOGAIR) for military installations within the U.S. continental limits. World Airways also conducts common carriage operations and contract assignments for commercial organizations—such as providing air transport support of the Nike Zeus program for Western Electric Company.

The addition of new high-performance Boeing jets to the World Airways fleet is an important addition to the nation's air arm. It provides the superior speed, range and volume capability that can help assure continuing United States leadership in air transport, both military and civilian.



Oakland International Airport • Oakland, California

## SHORTLINES

► **American Airlines** will increase its pattern of turbojet flights to several major cities next month. As of July 1, the carrier will operate 14 daily Boeing 707 and Convair 990 trips from New York to Chicago and nine from New York to Detroit. Additional new jet flights will also be provided on the Chicago-Los Angeles and Cleveland-Boston routes.

► **Civil Aeronautics Board** has approved a new regulation permitting airlines to adjust the costs of fares to Canada when tickets are purchased with lower value Canadian dollars. The Board's order, effective July 16, notes that carriers have suffered significant losses because of the approximately 8% exchange difference in the currencies.

► **Delta Air Lines** recorded a 56% gain in revenue ton miles of airfreight flown last month and a 31% increase in air express ton miles compared with May, 1961. Total volume for May was 2,369,000 ton miles of airfreight and 428,000 ton miles of air express.

► **Eastern Air Lines** on July 1 will add a daily DC-7B flight to its Air Bus service between Miami and Boston, Providence, Philadelphia, Washington, D. C. and Ft. Lauderdale. Two more jet flights will also be added to the airline's Puerto Rico service on that date between New York, Boston, Philadelphia and San Juan.

► **Federal Aviation Agency** has selected three concessionaires to provide flight food service at Dulles International Airport. Identical contracts extending through 1983 were awarded to Union News Co. of New York, Hot Shoppes, Inc., of Washington, D. C. and Gladieux Corp., of Toledo, Ohio.

► **National Airlines** last week extended coach service to Key West, Fla., becoming the first trunkline to provide this type service for every city on its system.

► **Northwest Airlines'** revenue passenger miles rose 25.7% last month over the May, 1961, figure. System load factor was 50.6%, as compared with 47.8% for the same month last year.

► **Trans World Airlines** estimates that nearly a third of its transatlantic group tour bookings this month will fly at the new group fare discount rates. Savings of \$186 to \$285 below the regular transatlantic economy round-trip fares are possible for each person traveling in a group of 25 or more.

## AIRLINE OBSERVER

► **Pan American World Airways** is considering purchase of two Vertol 107 twin-turbine helicopters for operation from the planned heliport on top of the new 59-story Pan American Building now under construction over Grand Central Station in New York. Pan Am had approached New York Airways on an exclusive service from the heliport to Pan Am's terminal at New York International Airport at Idlewild, but NYA decided against the arrangement. New York Airways also plans service from the heliport.

► Watch for British Parliament argument this week over proposed joint operation of British Overseas Airways Corp. and Cunard Eagle Airways on transatlantic routes (AW June 11, p. 41). Labor Party members will ask whether BOAC, a nationalized corporation, is expected to absorb privately-owned Cunard Eagle's losses in return for two Boeing 707 transports. In another action, Cunard Eagle union leaders are surveying comparable wages paid by the carriers to bring both airlines in salary perspective. Meanwhile, British Minister of Aviation Peter Thorneycroft lifted his restriction on U. S. charter flights into the United Kingdom (AW May 28, p. 43), since Cunard Eagle had withdrawn its disputed request for similar rights into the U. S.

► **White House study** on international air transportation (AW June 18, p. 39) is progressing on schedule. Private contractors conducting the analytical survey reported to the White House steering committee last week that the draft report will be completed by mid-August.

► **Aim of National Airlines'** new management, headed by Lewis B. Maytag, Jr., is to re-equip to an all-jet fleet "as soon as possible." Carrier hopes to retire its fleet of Douglas DC-7 and Lockheed 1049H Constellation transports by the end of the year.

► **Intra-European passenger traffic** on scheduled airlines increased 7% during the first quarter of 1962, but a 9% increase in capacity pulled the load factor of carriers operating European routes down 1.3% to 47.5%.

► **New version of the BAC 111** transport incorporating lift-reduction spoilers, nose-wheel braking and Spey engines of approximately 10% higher thrust—reducing the twin-jet transport's current field length requirement by some 10%—is being discussed by British Aircraft Corp. with carriers who must operate on fields where the airplane's current performance is considered marginal.

► **Braniff International Airways**, which now has 12 BAC 111s on order—including six options—may require 20-30 of the transports, according to the airline's senior vice president, R. V. Carleton. Braniff is to receive its first BAC 111 in October, 1964. At that time, a total of 27 of the airplanes is expected to be in service, and 40 are due to be in operation by the summer of 1965, according to a BAC spokesman.

► **Rep. Oren Harris** (D.-Ark.) last week called upon Fairfax County, Va., officials to avoid hasty action in zoning areas surrounding the new Dulles International Airport which will serve Washington, D. C., beginning this fall. He noted that because the new airport is located in a sparsely populated area, "a unique opportunity is offered for avoiding or at least minimizing a noise problem."

► **Flow of near-collision reports** into Federal Aviation Agency is continuing at what Administrator N. E. Halaby calls an "unacceptable" pace despite redoubled agency efforts to ensure IFR aircraft adequate separation. Pilots reported that on June 12 an American DC-6 and an Eastern DC-7, both following IFR flight plans, missed each other by 200 ft. over the Solberg, N. J., VOR. Both were working New York center on the same frequency. Meanwhile, FAA was investigating another report of two aircraft entering the holding pattern over Springfield, Va., at the same time and altitude, the second such incident there in recent months (AW Apr. 30, p. 41).





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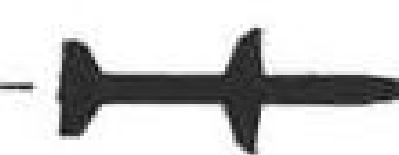
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# Test for Anti-Collision Systems Developed

By Philip J. Klass

Washington — Computer simulation technique which for the first time permits rapid evaluation of airborne anti-collision systems in a high-density terminal area environment, including risk of false alarms which might produce collisions where no hazard existed, has been shown by Collins Radio Co.

A computer simulation of a type of anti-collision system which makes range and altitude separation measurements and uses a vertical escape maneuver shows a negligible false alarm rate in a high traffic area. This was reported by Collins to the Air Transport Assn.'s anti-collision group at its recent meeting in Cedar Rapids, Iowa (AW May 7, p. 99). The anti-collision system which has been developed by Bendix Radio is a range-altitude type system (AW Feb. 15, 1960, p. 67).

The ATA has advised its member airlines that the new Collins technique "appears to offer very substantial technical and economic benefits in optimizing a collision avoidance system and evaluating its capabilities before a costly program to develop and test the airborne hardware need be undertaken."

The ATA plans to recommend that the Federal Aviation Agency fund additional computer simulations of other proposed collision avoidance system techniques. Initial work by Collins in developing the simulation techniques, funded by the company, cost approximately \$35,000.

An FAA spokesman terms the Collins developed technique "extremely valuable" and said that company representatives were scheduled to meet with the agency to discuss a continuing program late last week.

The new technique should permit more rapid evaluation of the dozens of anti-collision system concepts proposed each year to the FAA and the ATA. Many are suggested by amateur inventors or others who are unfamiliar with the workings of the existing air traffic control system. They usually see the problem only in its simplest terms—two converging aircraft with no other aircraft within a hundred miles.

If this were the basic problem, a variety of systems proposed would be feasible. But the air collision problem is most acute in the terminal area where dozens of aircraft are in close proximity, normally under radar control (see p. 39). An airborne collision avoidance system which might prevent a "Grand Canyon" type collision once every decade but which produced frequent false alarm warnings in the terminal area, resulting in dozens of aircraft taking

sudden evasive action, could create chaos and cause collisions where no real hazard existed.

Previous analyses of the performance of anti-collision systems have been made using only the two vehicles involved in the threat, because of the difficulty of carrying out a multi-aircraft analysis and the lack of realistic data for use in a terminal area study. It was theoretically possible to synthesize an idealized terminal area traffic situation, but this would not reflect the true situation that occurs because of errors in aircraft navigation equipment and procedural errors by pilots and traffic controllers.

## Recent Advance

Only recently, with the installation and use of two large flight track simulators, capable of simulating up to 50 aircraft in simultaneous flight, at the FAA's National Aviation Facilities Experimental Center (NAFEC) has it become possible to obtain data for realistic anti-collision system analyses.

Collins, which has been interested in the anti-collision system field for some years, decided that it could not evaluate the merit of different techniques unless they could be tested in a crowded terminal area environment. This was too costly and time consuming if carried out in actual flight tests, suggesting the need for development of a computer simulation technique.

Such a technique had to evaluate system performance in averting near-misses and collisions as well as the frequency of false alarm maneuvers when no hazard existed. The simulation should also evaluate the effect of such evasive maneuvers on the air traffic control system.

Using a program devised for an IBM 7070 computer, with taped data obtained from the NAFEC flight simulator and actual radar data from a study made of the Atlanta terminal area in 1959, Collins tried out the new technique on a range-altitude collision avoid-

ance system of the type developed by Bendix Radio.

Because the two companies are keen competitors for airline avionics equipment, the Collins results, which endorse the basic feasibility of the Bendix range-altitude type system, testify to the fact that industry is cooperating to the fullest to find a solution to the air collision problem as part of the ATA's anti-collision working group.

A range-altitude system provides adequate warning time for a vertical evasive maneuver if both aircraft are flying a straight path and not climbing or descending at more than 1,000 ft./min., the simulation indicates.

Moderate turning rates, less than 3 deg. per sec., do not produce many false alarms in the terminal area, but the warning time available for an evasive maneuver may be sharply reduced, the analysis shows. This is particularly true when two aircraft are flying closely spaced parallel paths and one begins to turn into the other.

The computer analyses show that the false alarm rate in high-density areas is sensitive to the air traffic control practices employed by FAA. For example, if two aircraft at the same altitude are on opposing courses or making turning maneuvers under radar control with safe separations, an airborne range-altitude type system may erroneously sense a collision threat, Collins' Eugene O. Frye reported to the ATA group.

While the studies to date appear to confirm the feasibility of a range-altitude type systems, the simulation is based on only 2½ hr. of real time data involving 34 incidents of which 12 were potential collisions, Frye cautioned.

Another company spokesman points out that while the analysis indicates the range-altitude type system is feasible, the simulation did not include noise and system measurement inaccuracies that may result from the use of the ground-bounce technique which Bendix proposes to use to obtain distance between aircraft. He adds that there may be superior methods of obtaining distance between aircraft.

Frye also suggested that computer simulation of the airborne collision avoidance system operation might be tried at NAFEC as part of its terminal area simulation, so that the relationship between the airborne and ground traffic system could be investigated. This would enable simulator "pilots" to obtain a cockpit collision alarm and take evasive action. It also would allow the FAA to determine how ground traffic controllers can best handle such an emergency, and its effect on control of other aircraft in the area.



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the LGP-30's big sister (or brother)—the RPC-4000. Completely transistorized, 8008 word memory, computing speeds up to 230,000 operations per minute. It's the desk-size computer with room-size computer capacity. For more information about rental or purchase, write Commercial Computer Division.



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## Short-Haul Transport

Washington—Air Transport Assn. is seeking comments from member airlines in developing specifications for new short-haul aircraft for both trunk and local service carriers (AW May 21, p. 42).

ATA believes it may be necessary to develop two different short-haul aircraft, one for the trunklines and the other for the local service carriers. Once generally agreed to by the airlines, these specifications would be circulated to airframe manufacturers for comment and possible proposals to the individual carriers.



# Hardware?

Maybe connectors were "hardware" twenty years ago.

That's when the P-38 was the hottest fighter plane we had. Pilots were proud when they could hit 300 MPH and go up to 50 or 60 thousand feet. With this kind of performance requirement, most connectors worked without a hitch. You just connected them and forgot about them, like nuts and bolts.

## HOW TIMES HAVE CHANGED

Now we're up around Mach 5 and altitude has been pushed into outer space. Nose cones light up like giant soldering irons and components have to operate in a near vacuum.

Fortunately, Amphenol engineers saw that the old "hardware" concept was headed out the window. Programs coming up were going to need connectors that could put up with terrific environmental conditions of heat and altitude cycling. For example, at high temperatures most of the elastomers used as insert materials or connector seals either melt into a puddle, turn into a cinder, or set-up and lose compression.

What's more, connectors now have to keep on functioning *all* the time, with no allowance for failure. So—Amphenol designers went to work developing a connector to meet the new space-age standards.

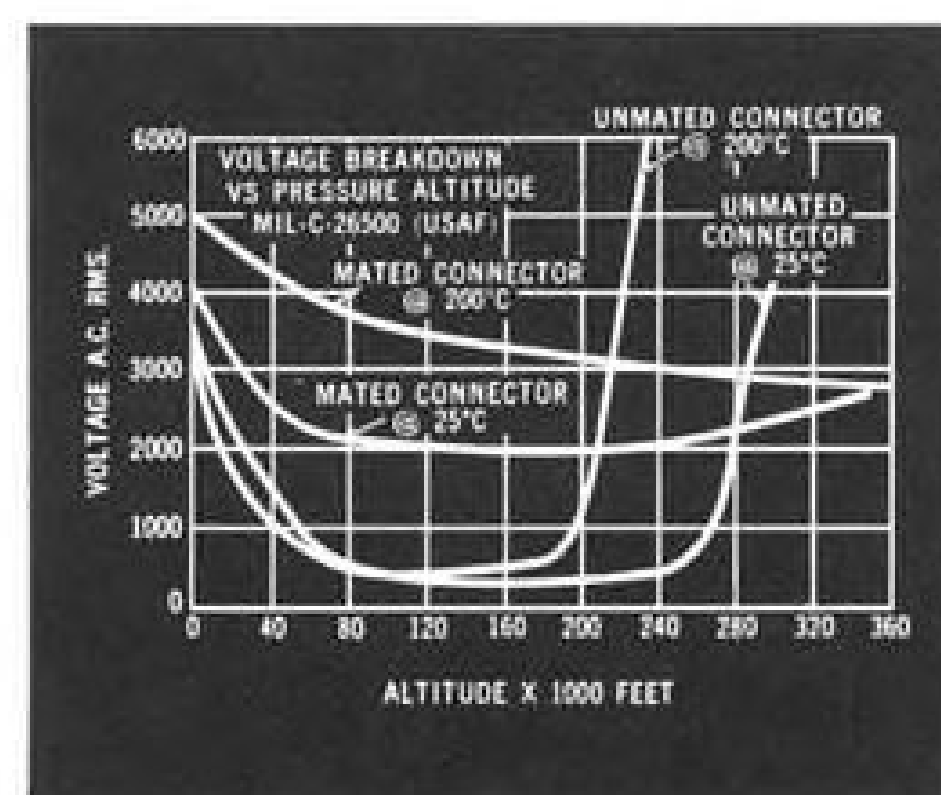
## DISSECTING MOLECULES

The Amphenol Materials Lab, with the help of a shiny new infra-red photospectrometer, began dissecting elastomer molecules. They were able

to pinpoint the weak spots in molecular structure where breakdowns begin. Then they were able to plan and build new molecules, with built-in "armor" to protect against failure. Result: an exclusive silicone rubber compound that maintains its integrity and elasticity under severe temperature extremes and also withstands exposure to violent new propellants like hydrazine and nitrogen tetroxide.

At the same time, Amphenol design engineers were hard at work perfecting metal-to-metal shouldering of mating shells that allowed precision control over compression of the sealing ring. In addition, the metal-to-metal design damped vibrational stress nine times more effectively than resilient damping. Finally, they incorporated a semi-rigid anti-deflection disc to control insert expansion under thermal stress.

Having all the pieces, we put them together, called it the Amphenol 48 Series, and started testing. In the vacu-

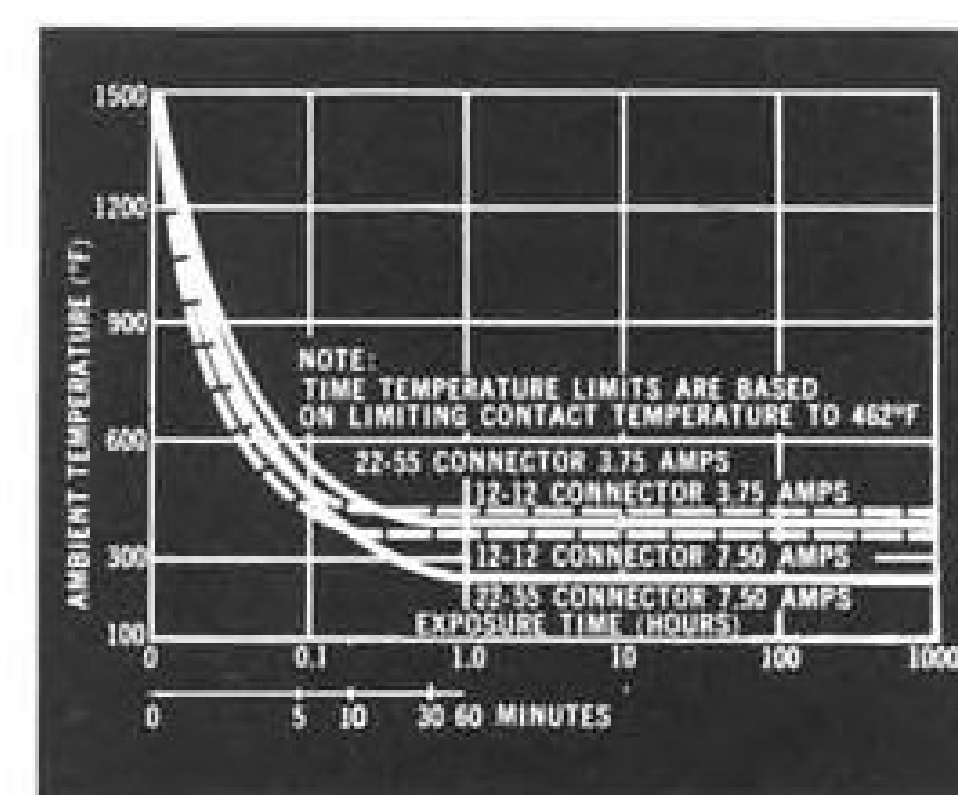


High altitude air has low dielectric strength. By maintaining an air-tight seal 48 Series Connectors enjoy extremely high voltage safety factors.

um chamber, 48 Series connectors operate very nicely at a simulated altitude of 500,000 feet. They are quite comfortable in the hot box at 200°C ambient, *carrying full rated current*. They don't even mind going up to 600°C, if they don't have to stay too long. In short, Amphenol 48's can take almost anything you throw at them.

## PROJECTS WANTED

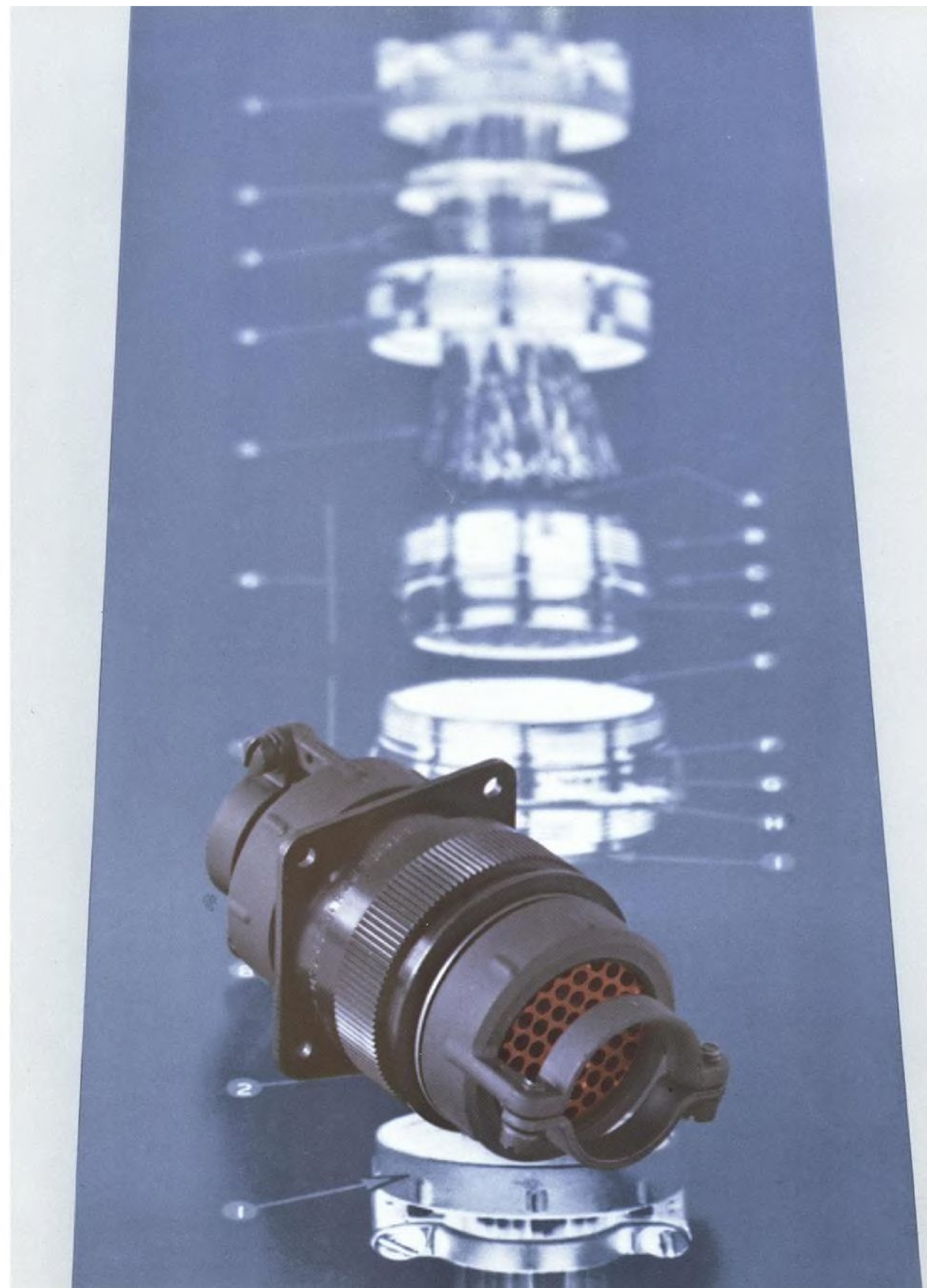
Amphenol designers have established criteria for determining connector time-temperature-current capability. This information will be especially valuable to engineers presently engaged in "exotic" projects, perhaps the kind of project where previous connectors have failed to measure up to the new space-age standards. If this is the case, contact an Amphenol sales engineer. He's a "space-age hardware" expert. Or, write directly to Bob Dorrell, Vice President, Engineering, Amphenol Connector Division, 1830 South 54th Avenue, Chicago 50, Illinois.



While Amphenol 48 Series Connectors are nominally rated at 200°C, they can also withstand considerably higher short-time temperature exposures.

Amphenol 48 Series Meets Mil C 26500 (USAF).

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

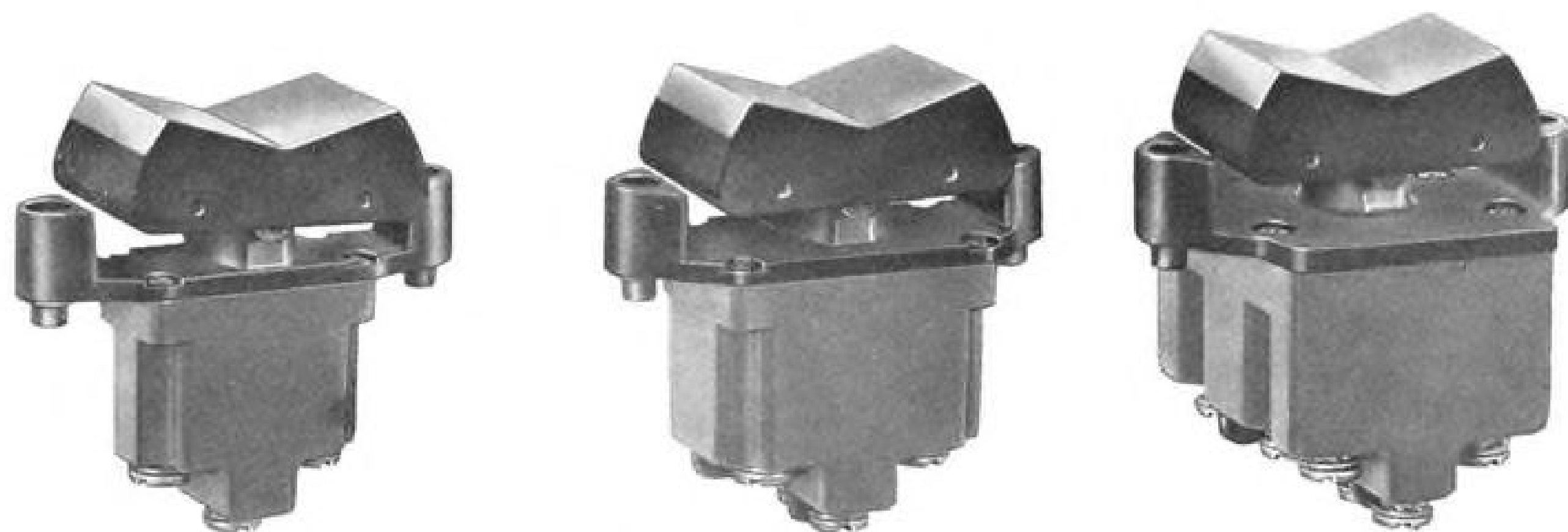




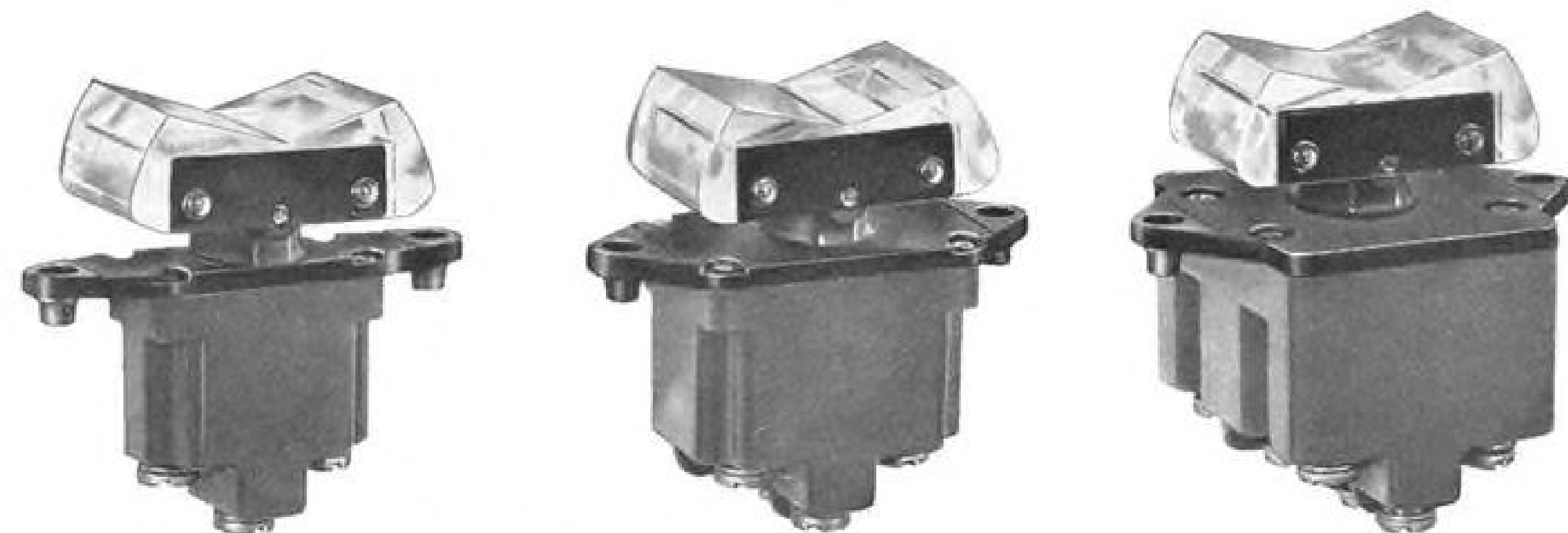


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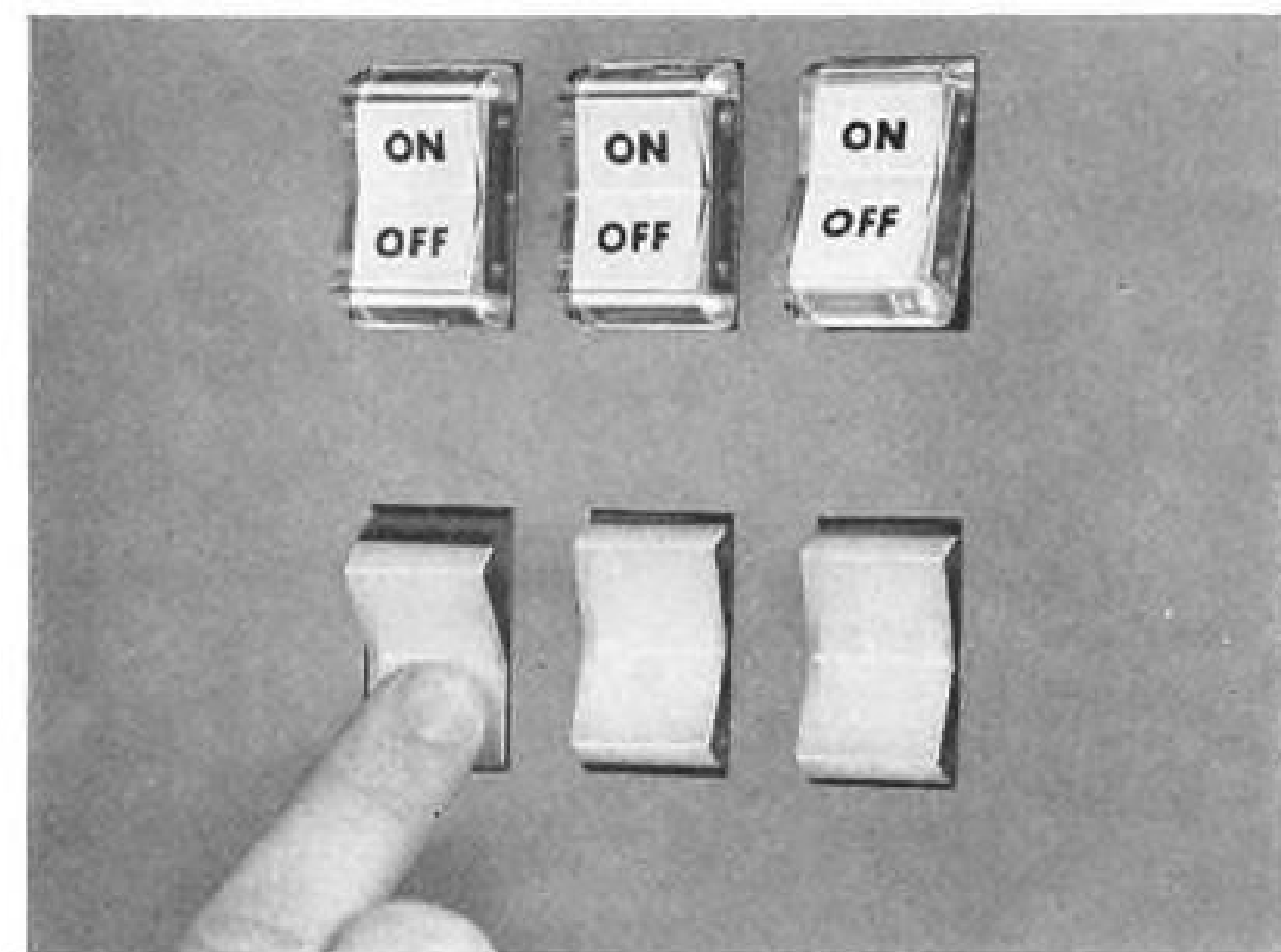
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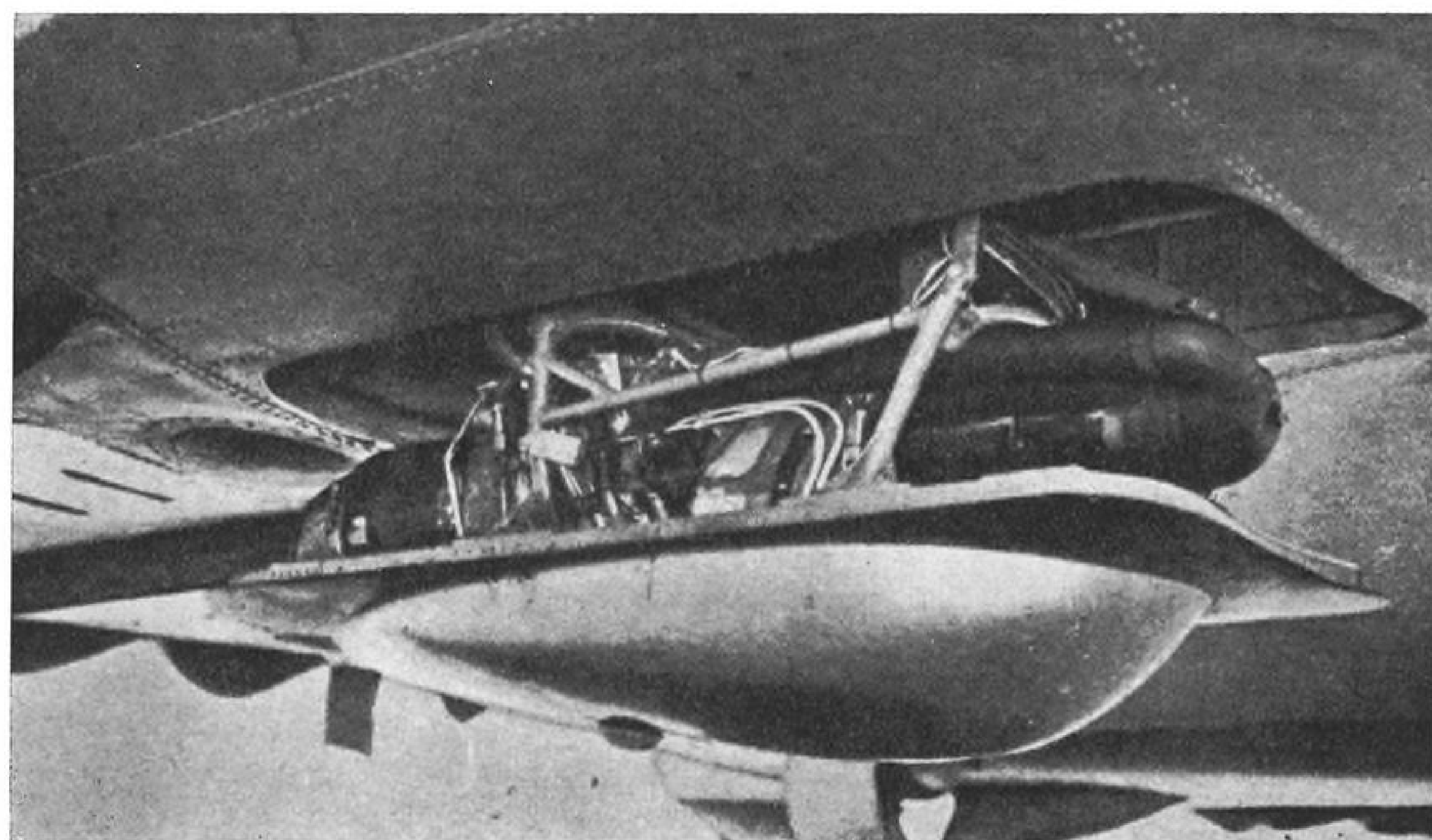
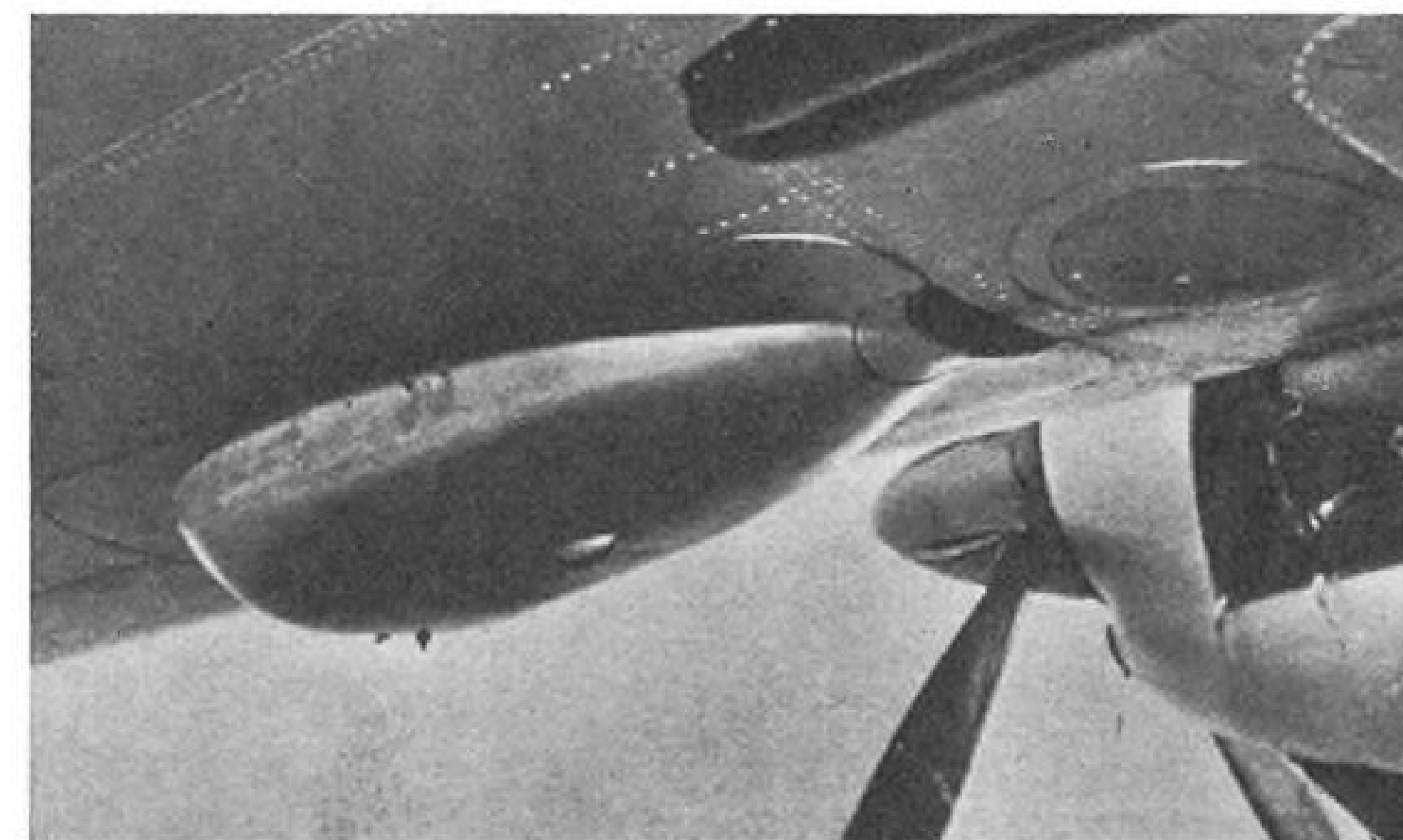
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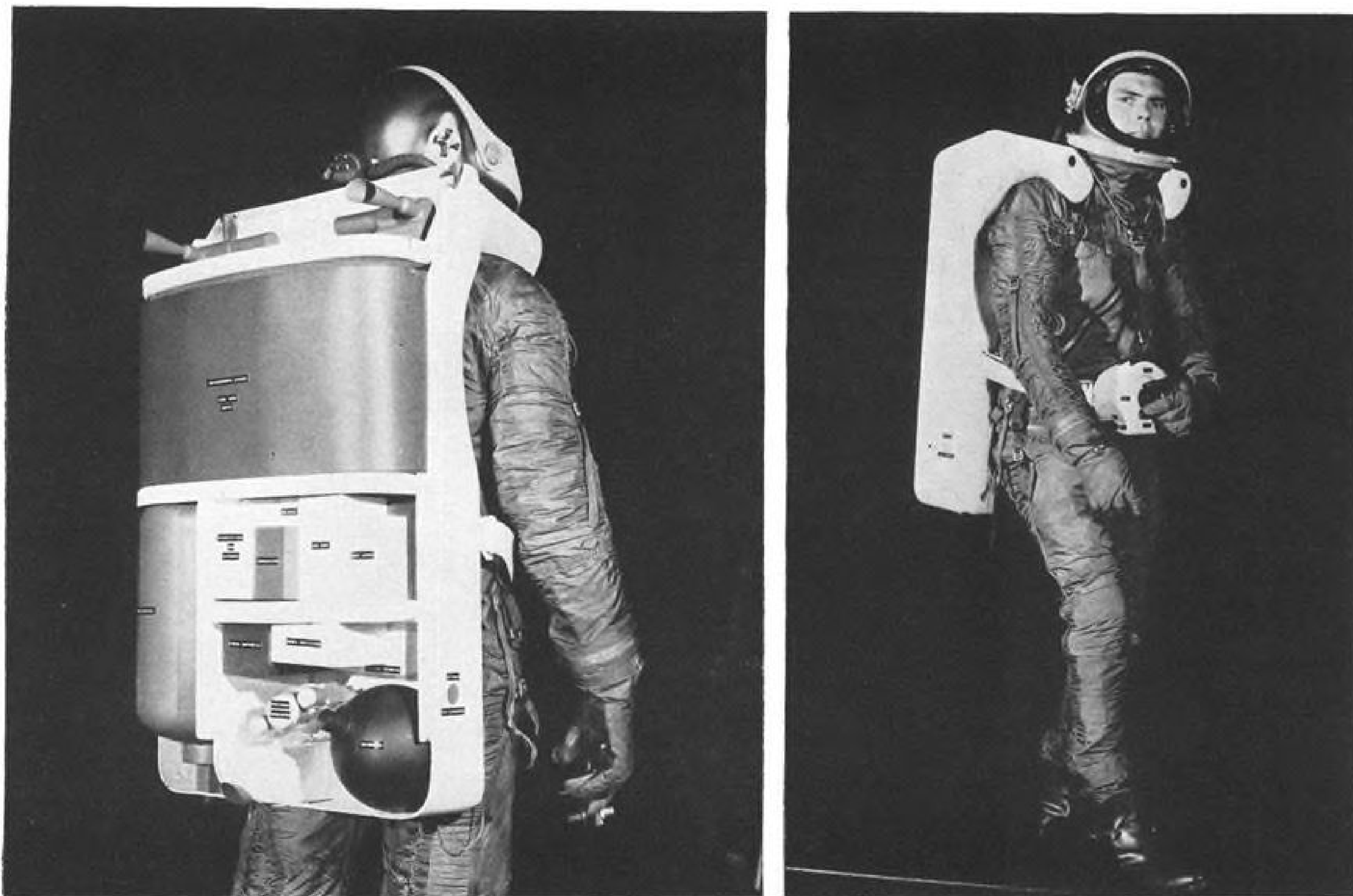
Aeroflot has released more details on its four-turboprop IL-18I transport, which will rank just below the Tu-114 in long-range capability and is expected to be the prime Soviet commercial airliner from the standpoint of productivity and ton-mile cost.

### IL-18 Undergoes Modifications

Payload of the IL-18I has been increased from 29,762 lb. to 30,864 lb., and passenger capacity has risen from 84 in the older version (IL-18) to 119-125. Main modification is in the IL-18I wing, which has a total of 26 fuel tanks providing 27% more fuel capacity. Wing dimensions, however, remain unchanged. Pressurized section in the fuselage also has been enlarged. Turbogenerator installation for starting the AI-20 engines, formerly located in the tail baggage compartment is now in a special compartment in belly of fuselage midsection, and is lowered to operating position.







**MOCKUP OF A SPACE MANEUVERING PACK** designed to stabilize or propel crewmen during assembly work of space vehicles in orbit, shown at left with cover removed, provides four-hour life support system in upper section. Hydrogen peroxide supply of fuel is at lower left; nitrogen pressure sphere, power supplies, stabilization and control units at lower right. Control system location is shown at right.

## Maneuvering Unit to Aid Orbital Assembly

By Erwin J. Bulban

Dallas, Tex.—U.S. Air Force soon will evaluate a full-size experimental space pack, providing maneuvering capability for crew members functioning outside their space craft in a weightless environment.

The experimental equipment has been designed and built by Ling-Temco-Vought's Astronautics Division under a project sponsored by Flight Accessories Laboratory of Aeronautical Systems Division's Logistics Support Technique Section, Wright-Patterson AFB, Ohio.

Vought personnel will perform functional manned tests of the equipment under weightless conditions in a series of ballistic-trajectory flights aboard an ASD jet transport.

In addition, Vought has delivered a non-operating full-scale mockup to ASD at Dayton.

The Space Pack is a back-mounted system containing its own stabilization, control, propulsion and power systems plus provisions for a complete life sup-

port system and is designed for a four-hour mission completely independent of the parent spacecraft.

Equipment is designed to position and stabilize an astronaut during operations outside the spacecraft and provide him with mobility in an orbital assembly area, permit him to transfer from one space vehicle to another or make it possible for the crew member to become a prime-mover vehicle for maneuvering spacecraft sections during orbital assembly operations.

### Pack Components

The necessary equipment to provide all necessary stabilization and maneuvering capabilities is located in a contoured back pack 32-in. high by 18-in. wide and 8-in. deep. Slightly more than one-third the available space is allocated to life support equipment, including oxygen, heat exchangers, carbon-dioxide removal and air circulating equipment.

Pack also includes power and signal batteries, a hydrogen-peroxide container and nitrogen pressure vessel for provid-

ing propulsion, a pressure regulator system, valves, rate gyros which act as position sensors and other electronic equipment. Earth weight of the system is 125 lb. and lunar weight is approximately 20 lb.

The pack has a complete fly-by-wire system, with controls mounted on a small panel located at the crewman's waist for relaying voltage changes to the propulsion system for attitude control or translation. System provides movement in six degrees of freedom—pitch, roll, yaw or combinations of these as well as translation capability induced by thrust from the hydrogen-peroxide jets.

Attitude changes can be made by the astronaut using manual controls to over-ride the automatic attitude hold system. Automatic stabilization frees the astronaut's hands for performing servicing, maintenance and assembly tasks. Controls are designed to be operated either by right or left hands. Releasing the controls automatically stabilizes the astronaut in the position he has selected.

Stabilization and propulsion systems are powered by gas jets, and the system is selective so that the crewman can adjust his position without being propelled from the work site. Jets provide 45-lb. thrust forward and backward and 25-lb. thrust up or down, with lesser amounts for attitude control and stabilization. Vought Astronautics engineers say that the equipment provides an astronaut with an operating radius of more than two miles on a single fuel load plus reserve for multiple short-range trips at the work site and numerous changes of attitude.

### Prime-Mover Mode

In the prime-mover mode, four crew members could accelerate 100,000 lb. of orbiting vehicle materials into position for assembly to a speed of one foot per second, controlling it and stopping it in the desired position, performing this function at least three times after having traveled 1,000 ft. to begin their task.

A two-way radio is contained in the pack.

The three panel-mounted maneuvering controls govern rotation and translation movements of the system. Rotational pitch and yaw are activated by an up-down, right-left control which moves laterally and is located atop the panel. Control of fore-aft and up-down translation is located on the right side of the panel. Also on the eight-in. by five-in. by four-in. panel are a switch which selects full control capability or places the device on standby—power on but no control signals to the jets—and an emergency switch which bypasses the autopilot by means of a separate circuit and permits the crew member to fly by means of the control valves directly.

### Torque Controls

Rotation or torque controls command the system's jets to produce pure couples in order to provide rotation without translation, using a system of switching logic developed by Vought engineers.

The forward-firing jets in the shoulder area and a jet firing forward between the legs are housed in pack extensions which place the nozzle apertures several inches away from the body.

For stabilization and attitude control, Vought engineers studied manual and automatic systems with torque provided by single-axis gyroscopes, twin gyros, inertial wheels, twin inertia wheels and gas jets. While the control system does contain gyros, these are the rate type used strictly as sensors and do not provide power for stabilization.

The various systems are composed of plug-in modules to facilitate maintenance and servicing.

## Cooperative Satellite Programs To Be Discussed by U.S., USSR

By Cecil Brownlow

Geneva—Potential broadening of initial arrangements for cooperation in peaceful space ventures, agreed upon by U.S. and Soviet delegates in recent bilateral negotiations here (AW June 11, p. 39), will be discussed at a proposed follow-on meeting in the near future.

A major item to be covered in talks between representatives of the two countries is the field of communications satellites.

The negotiations, probably to be held in Moscow, will be a continuation of the Geneva discussion in which U.S. and Soviet delegates recommended that data received from their respective weather satellites be shared by the two countries and made available to other interested nations. Formal ratification of the plan by the two governments is expected to be routine.

### Concrete Moves

Described as a "feeble first step" by one U.S. spokesman, the recommendation was one of several concrete moves toward a potentially broad base for international cooperation in space which were threshed out here over the past two weeks. They include:

- **United Nations World Meteorological Organization (WMO)** proposed the establishment of a world-wide weather forecasting system, including the weather satellites of the U.S. and Russia, sounding rockets, balloons and other conventional equipment and techniques.

- **Agreement** in the bilateral negotiations for the establishment of weather data coordination centers in Washington and Moscow by the 1963-65 period to coordinate weather satellite information plus other inputs from WMO's proposed forecasting system. WMO also proposed that a third such center be located in the Southern Hemisphere.

- **Recommendation** by the technical and scientific subcommittee of the U.N.'s Committee on Peaceful Uses of Outer Space that an international equatorial sounding rocket range be established under United Nations auspices.

The subcommittee proposal will be discussed by the full committee in New York this summer and probably placed before the General Assembly for final approval sometime in the fall. In discussions here Italy tentatively offered to put at the U.N.'s disposal its Texas Tower equatorial range in the Indian Ocean off the African Coast.

India also is expected to offer use of its territory for such a range.

Both the U.S. and the Soviet Union were represented on the subcommittee.

In the closing session, U.S. delegate Arnold Frutkin, director of the National Aeronautics and Space Administration's Office of International Programs, told the group that the recommendation "leads to a valuable precedent for the establishment of other similar useful facilities in an economic and effective manner without placing new financial or administrative burdens on the United Nations." He added:

"At this facility, any member state will be able to observe, train, measure, experiment or test for peaceful, scientific purposes under reasonable conditions applicable to all. The undoubted success of the proposed facility may in due course encourage us to further efforts of a like kind."

Officials said there had been no advance coordinated planning for the technical subcommittee to convene here at the same time the WMO and bilateral discussions were under way. One spokesman described the timing as pure coincidence. Another subsidiary group of the parent U.N. Committee on Peaceful Uses of Outer Space—the legal subcommittee—also was in session here at the same time.

Timing of the current WMO discussions and the bilateral negotiations, however, was carefully mapped out in advance, and, during the course of the meetings, each body was advised of the progress being made by the other.

Specifically, the bilateral negotiations were largely designed to lay the groundwork within the vital area of satellite cooperation that could provide the basis for WMO's envisioned comprehensive world-wide weather forecasting system.

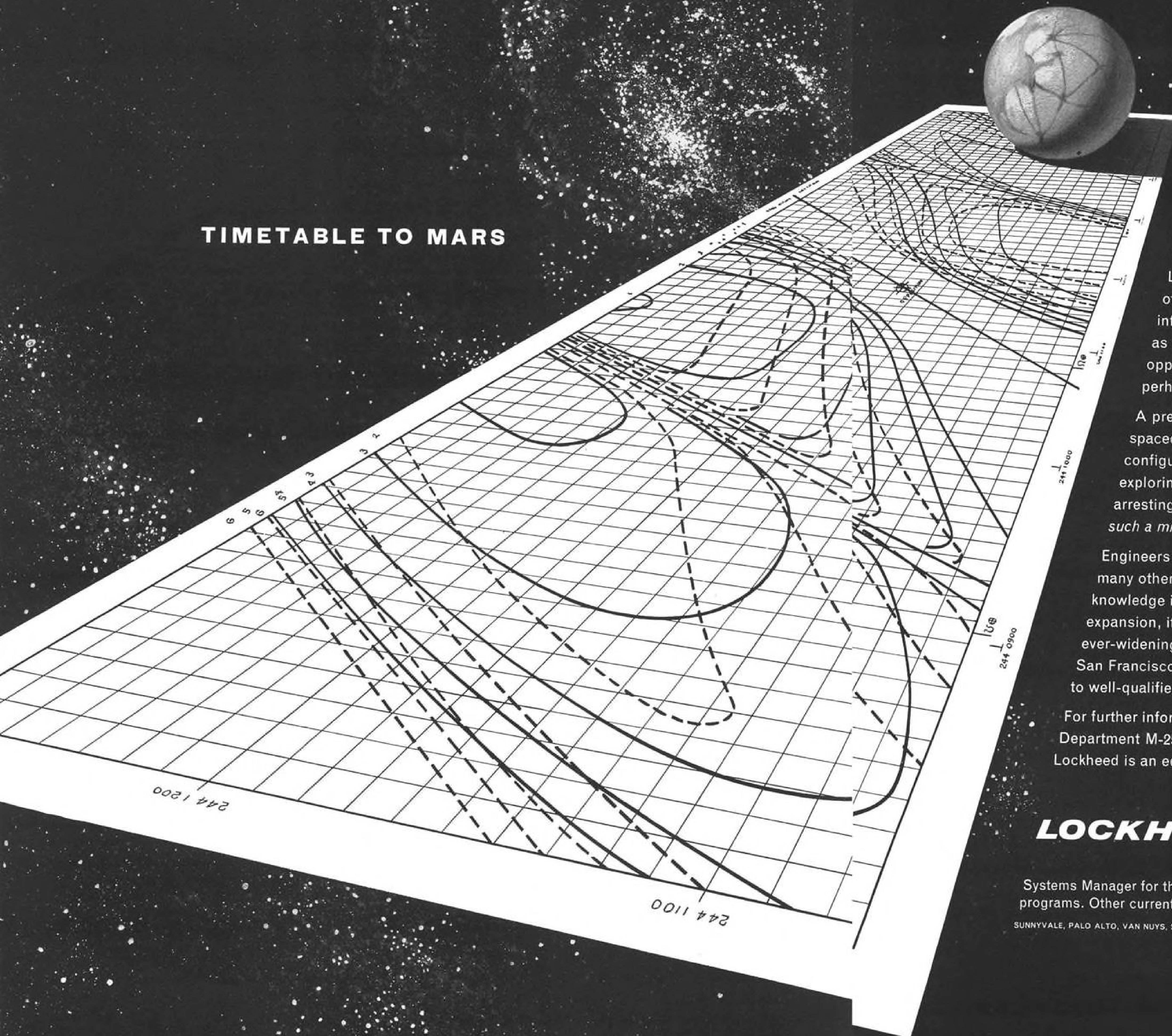
During the bilateral negotiations, U.S. delegate Dr. Hugh L. Dryden, deputy director of NASA, and Soviet Academician Anatoli Blagonravov also discussed the possibility of jointly mapping the earth's magnetic field during the 1964-65 "International Year of the Quiet Sun" planned by the International Union of Geodesy and Geophysics during the time span when there will be a minimum of solar activity.

A joint statement issued by the two delegations said, "such cooperation would probably involve the coordinated launching of a satellite by each country in conjunction with ground observations by many other countries."

Future talks also may include other subjects for cooperation discussed in recent correspondence on the subject be-



## TIMETABLE TO MARS



**Arrive Mars: 10.3 August, 1971** Giant steps were taken recently at Lockheed Missiles & Space Company toward manned exploration of the planets Mars and Venus. For the first time, accurate interplanetary transfer orbits have been plotted to show velocities as related to departure and arrival dates for an entire cycle of planet oppositions. A "fast" round-trip would take a year, allowing perhaps ten days exploration time on Mars.

A preliminary but comprehensive study also was made on the spacecraft's design considerations. Many facets were explored—configuration, single versus multi-stages, weight, thrust, payload, exploring, landing, and return equipment; and many more. The arresting conclusion of Lockheed scientists: *A vehicle can perform such a mission within the present state-of-the-art.*

Engineers and scientists at Lockheed Missiles & Space Company conduct many other feasibility and research studies, probing for advanced knowledge in a wide diversity of disciplines. Lockheed's constant expansion, its growing leadership in missiles and space, its ever-widening scope of projects, its ideal location on the beautiful San Francisco Peninsula—all open new and unusual challenges to well-qualified people.

For further information, please write: Research and Development Staff, Department M-25D, 599 North Mathilda Avenue, Sunnyvale, California. Lockheed is an equal opportunity employer.

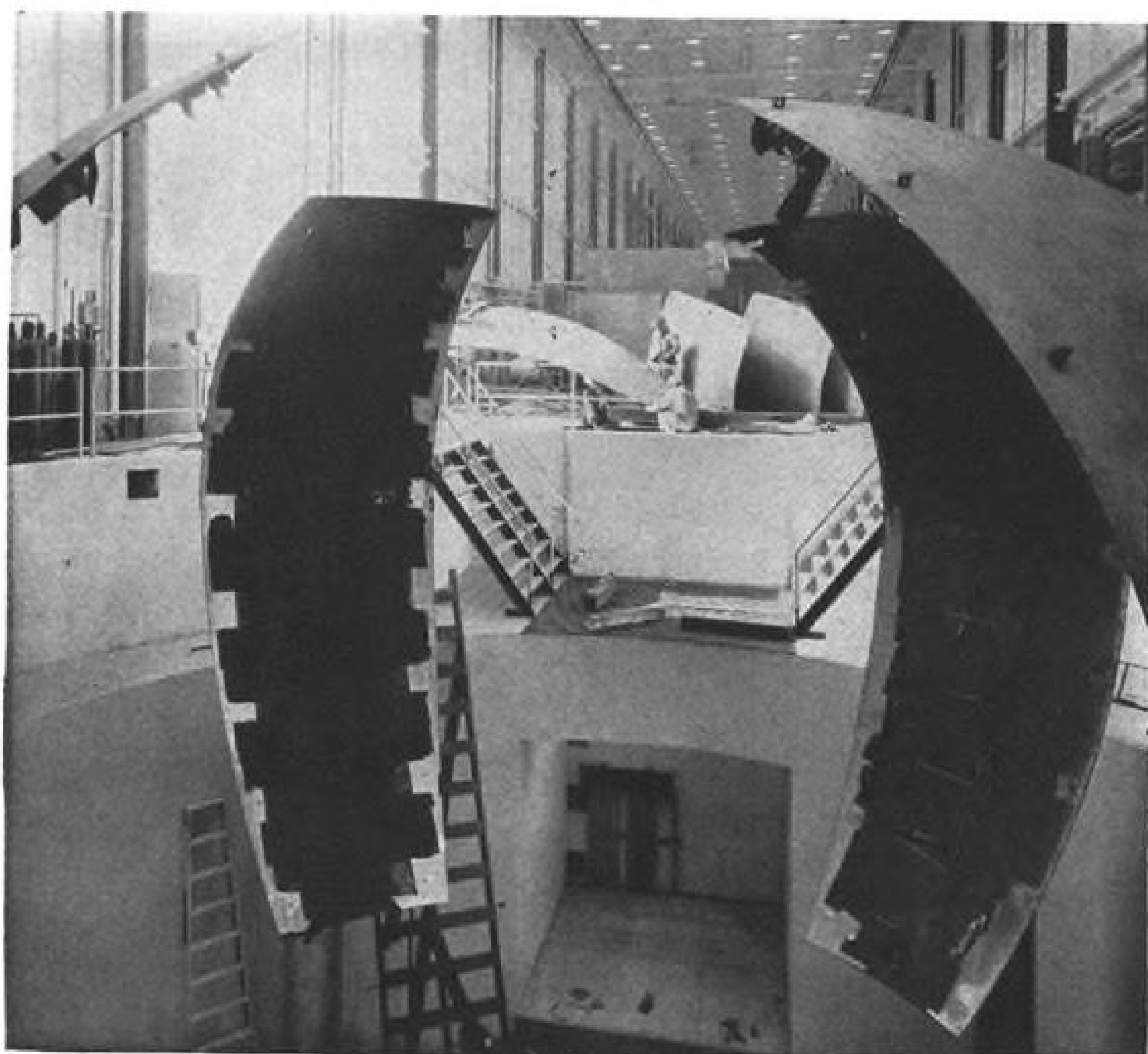
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## Space Environment Simulator Readied

Spherical space environment simulator, capable of duplicating an altitude of 700,000 ft., solar radiation and spectral distribution, is being assembled by Space Technology Laboratories, Inc., Redondo Beach, Calif., and will be completed by October. It will be used to evaluate flight models of the Orbiting Geophysical Observatory, which STL is building for the National Aeronautics and Space Administration.

tween President Kennedy and Soviet Premier Nikita Khrushchev.

Meetings between Dr. Dryden and Blagonravov were begun in New York earlier this year and then transferred to Geneva to dovetail with the sessions of the World Meteorological Organization.

### Weather Data

The lengthy and inter-related proposals advocated by WMO in a report drafted under the direction of Dr. Harry Wexler, director of research for the U.S. Weather Bureau, and Soviet Professor V. A. Bugaev include provisions for a "world weather watch" with a system of international and regional data centers for receiving and disseminating weather data and forecasts obtained from raw material provided by satellites and other media.

Planned Washington and Moscow collection points plus the proposed Southern Hemisphere site would be the primary international centers. In explaining the proposed functions of the two types of centers, a WMO report says:

"The world centers, which would have access to world-wide data coming from the usual meteorological observations, as well as from meteorological satellites, would also have available the

elaborate and costly equipment required for processing and piecing together the available information from satellites and other sources. These world centers would have the necessary staff and also the communications facilities to disseminate speedily the result of their work. . . .

"Regional centers would be established to make available to all countries in the region of each center the vast amount of additional data which meteorological satellites provide. They will in no way replace but rather assist existing national meteorological services."

To close the present gaps in the world's meteorological observation network, the report proposed what it termed a minimum plan for the establishment of 100 automatic surface weather observatories—30 in the Northern Hemisphere, 70 in the Southern—plus 53 new upper air observatories, of which 20 would be located aboard ships, 33 on continents and islands.

While the proposal has yet to receive approval from the WMO executive committee, estimated cost of implementation is \$35.7 million for purchase and installation of the needed equipment and \$16.5 million for annual operations.

Recognizing that the plan in some instances exceeds "national possibili-

ties, international financing will be necessary, especially in the less-developed areas," the report says. To breach this gap, it recommended that "full use should be made of the possibilities for assistance through the United Nations expanded program of technical assistance and the United Nations special fund for economic development."

It also suggested that the U.N. consider the possibility of establishing a "world weather fund" to support the implementation of the WMO plan of action.

In discussing the financial problems involved in establishment of a world-wide system, the report concluded:

"The launching and operation of the meteorological satellites will, it is assumed, continue to be a national responsibility, and the financial aspects of these activities are not therefore discussed."

While emphasizing that weather satellites supplement rather than replace conventional observation systems, the report says data from orbiting vehicles "often reveals cloud and other patterns not previously suspected" even in regions where the network of meteorological stations "is considered dense." It also said observations by U. S. weather satellites thus far have:

- Detected the existence of trough lines, tropical storms and extra tropical depressions "which would not have been possible without satellite observations."
- Yielded information about cloud patterns "which were previously unsuspected and which will be of very great value in a better understanding of atmospheric processes."
- Identified snow and ice fields in a demonstration of their potential for determining the geographic extent of the world's snow-covered land areas. This, the report says, "combined with representative snow depth measurements, should provide information on water resources available for irrigation, river navigation and water power experiments."
- Provided valuable information on solar radiation and the infrared radiation emitted by the earth and its atmosphere. These measurements will continue, "and in the future it will be possible to maintain a close watch on the incoming solar radiation in all wavelengths," the report said. It added that more refined measurements of the upcoming infrared radiation in various wavelength bands may permit determination of the mean temperatures of deep layers of the upper atmosphere and provide "a broad picture of the distribution of water vapor and ozone in the upper atmosphere." By 1965, the report predicted, weather satellites will be capable of providing global in-

formation on precipitating cloud layers, thunderstorm and surface pressures and temperatures; information on the upper winds; partial coverage of the average temperature of thick stratospheric layers, and an indication of the content of water vapor and ozone in the upper atmosphere.

To make maximum use of this potential, the report said, the following requirements must be met:

- Continuous existence of one or more satellites transmitting useful meteorological information.
- Read-out stations "in sufficient number and with adequate facilities to ensure accurate reception and processing of data for global coverage and utilization."
- Interference-free frequency bands for communication with the satellites.
- Adequate network of conventional and auxiliary meteorological observations "to provide the broad-scale framework for the detailed observations obtainable from satellites and to help interpret these observations."
- "Further development of techniques for operational use of satellite data."
- Communications facilities for prompt world-wide dissemination of the processed data.
- "Long-range research program incorporating data from satellites."

To solve the problem of global meteorology, the report added, "we must have global observations which will give us a description of the fields of motion, temperature, momentum, pressure, humidity and ozone to a height of about 80 km. (about 50 mi.) and the fluxes of matter and energy through the lower and upper boundaries."

The present system of conventional observations, it said, is deficient in two major respects—"the number of stations making these observations is insufficient, and the techniques and devices for the systematic measurement of the atmosphere above 30 km. (about 19 mi.) and for the fluxes of heat and moisture from the earth's surface are inadequate."

In an appendix at the report's conclusion, the authors noted that man eventually will be capable of influencing weather and climate on a large scale and added:

"Before starting an experiment on large-scale weather modifications, we must be sure of our capability of forecasting accurately the expected modification in the heat balance and the circulation of the atmosphere. Otherwise, we could face some day the dangerous situation of undesired, irreversible weather and climate dangers."

The report and its recommendations are scheduled to be examined by the U.N.'s Economic and Social Council next month in Geneva and the General Assembly in New York this fall.

## USAF Contracts

Air Force Office of Scientific Research recently awarded 80 grants and contracts valued at more than \$3.7 million:

California Institute of Technology, Pasadena, Calif.—\$63,112 for structure of liquids.

Florida State University, Tallahassee, Fla.—\$90,000 for preparation and properties of reactive intermediates.

Columbia University, New York, N. Y.—\$64,409 for molecular collision processes at low pressure.

Utah State University, Logan, Utah—\$14,747 for pyrolysis of esters.

University of California, Berkeley, Calif.—\$15,000 for three dimensional problems of supersonic and hypersonic flow and panel flutter of cylindrical shells.

University of Chicago, Chicago, Ill.—\$54,765 for experimental investigations of transport properties of partially ionized gases.

University of Minnesota, Minneapolis, Minn.—\$38,685 for study of certain weakly nonlinear vibrating systems.

Cornell University, Ithaca, N. Y.—\$155,628 for theoretical and experimental investigations in high speed aerodynamics.

New York University, New York, N. Y.—\$34,790 for macroscopic magneto-fluid dynamics.

Pennsylvania State University, University Park, Pa.—\$30,137 for effect of experimental conditions on the mechanism of fatigue.

Massachusetts Institute of Technology, Cambridge, Mass.—\$27,650 for research on conduction in ionized gases and ionized gas-surface interactions.

Stevens Institute of Technology, Hoboken, N. J.—\$57,988 for basic studies on the mechanism of, dynamics of, improvement of, and instrumentation for a new high efficiency conical coaxial plasma motor (crater gun).

University of Texas, Austin, Texas—\$41,124 for helium discharge and physics of metastable systems.

National Academy of Sciences, Washington, D.C.—\$7,500 for study of scientific information problems in research.

Yeshiva University, New York, N. Y.—\$15,800 for research in symbolic logic and recursive function theory.

Duke University, Durham, N. C.—\$13,050 for mechanical language analysis and synthesis.

California Academy of Sciences, San Francisco, Calif.—\$30,886 for astronavigation in migratory birds.

Florida State University, Tallahassee, Fla.—\$18,940 for research on photobiology and photochemistry.

Harvard College, Cambridge, Mass.—\$15,000 for hypothalamic secretory factor for adrenocorticotrophic hormone.

University of Texas School of Medicine, Galveston, Tex.—\$17,713 for postganglionic cholinergic mediation of sympathetic nerves.

University of Colorado, Boulder, Colo.—\$6,980 for research on methods of validation of judgment in decision making.

University of Hawaii, Honolulu—\$26,406 for predictive model for intra-group negotiation.

Bucknell University, Lewisburg, Pa.—\$6,612 for comparative study of reinforcement in a verbal learning task.

University of Wisconsin, Madison, Wis.—\$22,650 for studies on the complex precursors of induced enzymes in yeast.

University of Michigan, Ann Arbor, Mich.—\$12,000 for investigation into the theory of spheroidal and mathieu functions.

University of British Columbia, Vancouver, Canada—\$12,990 for numerical integrations of ordinary differential equations.

University of California, Berkeley, Calif.—\$22,300 for algebraic structures for modern functional analysis.

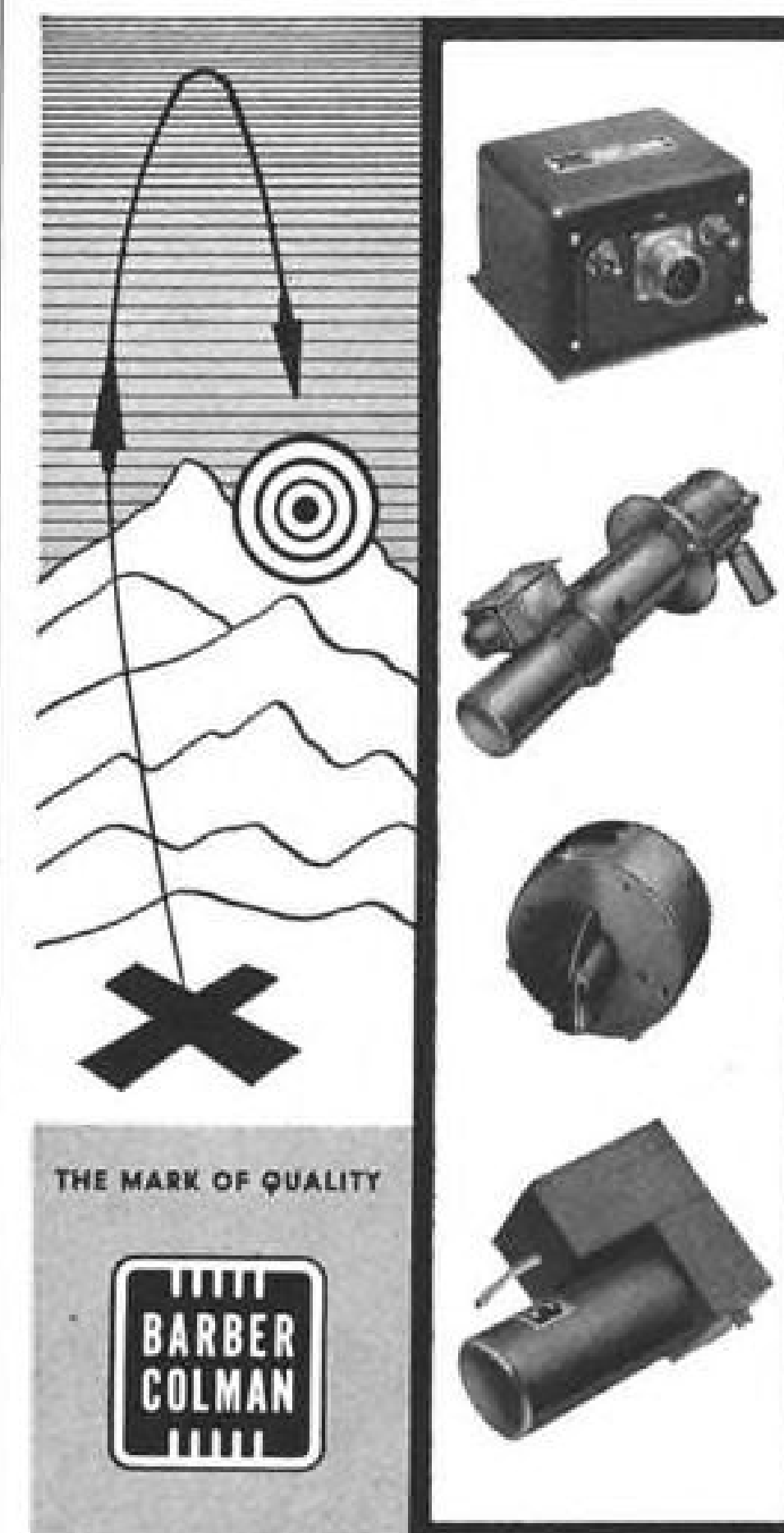
University of California, Riverside, Calif.—\$11,254 for study in probability theory.

University of California, Davis, Calif.—\$8,354 for infinite and doubly homogeneous algebras.

University of Colorado, Boulder, Colo.—

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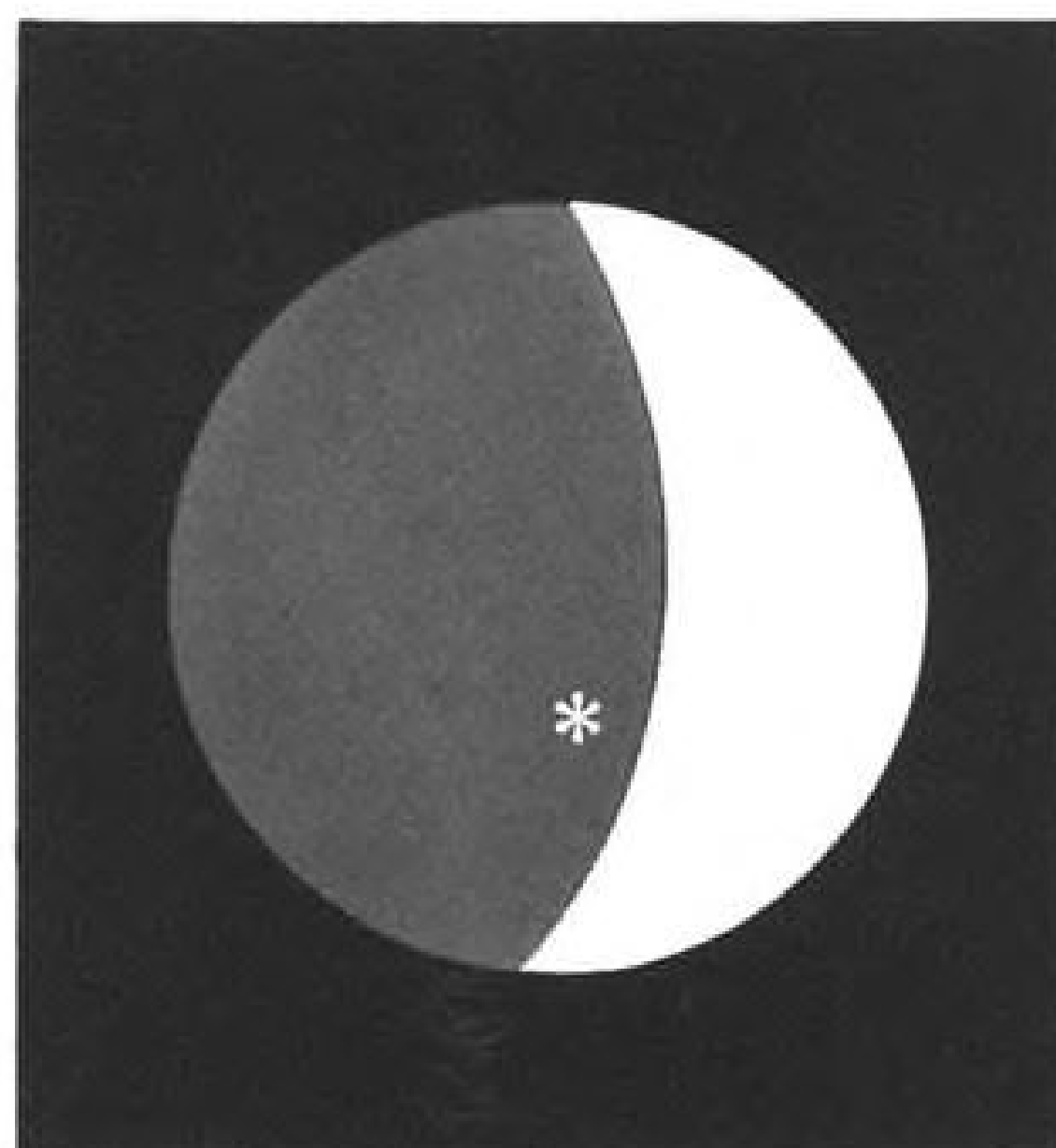
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Aircraft and Missile Products Division  
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\* Mountainous region southeast of the crater Albategnius

## Raytheon laser hits moon



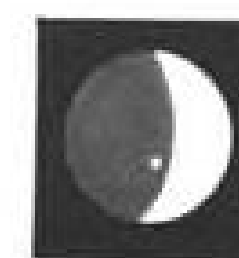
On Wednesday, May 9th, a team of Massachusetts Institute of Technology scientists illuminated the moon's surface and detected and recorded the reflection. The new first was accomplished with 13 bursts of 6934-angstrom light from a 50-joule, 4-barreled Raytheon ruby laser. The new Raytheon laser is the most powerful yet reported. Raytheon is currently investigating laser systems in the areas of communications, ranging, detection, space vehicle guidance, weapon systems, and medicine.\* Write for further information to Martin B. Curran, Raytheon Company, Lexington, Massachusetts.

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\$20,509 for research entitled "Continued Fractions."

**Colorado State University Research Foundation**, Fort Collins, Colo.—\$24,301 for determination of sample size.

**University of Chicago**, Chicago, Ill.—\$35,651 for algebraic mechanism of fiber spaces.

**Harvard College**, Cambridge, Mass.—\$61,997 for research in classical analysis.

**University of Minnesota**, Minneapolis, Minn.—\$4,287 for research in Riemann surfaces.

**University of Missouri**, Columbia, Mo.—\$5,666 for differential equations of growth.

**The Institute for Advanced Study**, Princeton, N. J.—\$58,500 for advanced mathematical research.

**Princeton University**, Princeton, N. J.—\$49,160 for applications of the methods of modern topology.

**Cornell University**, Ithaca, N. Y.—\$38,598 for statistical multiple-decision procedures.

**Yeshiva University**, New York, N. Y.—\$18,500 for existence and use of algorithms.

**University of North Carolina**, Chapel Hill, N. C.—\$52,000 for research on nonparametric influence.

**Lehigh University**, Bethlehem, Pa.—\$10,117 for Riemannian and complex manifolds.

**William Marsh Rice University**, Houston, Tex.—\$4,250 for potential theory and probability theory relationships.

**University of British Columbia**, Vancouver, Canada—\$26,552 for functional analysis and potential theory.

**University of Redlands**, Redlands, Calif.—\$34,992 for research in the electronic structure of rare earth atoms.

**Georgia Tech Research Institute**, Atlanta, Georgia—\$46,472 for mass spectrometric study of ion-molecule reactions occurring at thermal energies under gas-kinetic conditions.

**University of Illinois**, Urbana, Ill.—\$49,975 for modulation of light by electro-optical means.

**University of Minnesota**, Minneapolis, Minn.—\$48,542 for research on rotational motion of superfluid liquid helium.

**Princeton University**, Princeton, N. J.—\$41,485 for study of informative processing in adaptive control systems.

**Polytechnic Institute of Brooklyn**, Brooklyn, N. Y.—\$33,300 for study of plasmas and high density beams.

**Polytechnic Institute of Brooklyn**, Brooklyn, N. Y.—\$175,000 for research in electromagnetic theory and also information processes.

**Essex College**, Assumption University of Windsor, Windsor, Ontario, Canada—\$16,894 for research on optical pumping of alkali metal vapors.

**University of Chicago**, Chicago, Ill.—\$135,544 for cosmic and solar radiation studies and their astrophysical consequences.

**University of Maryland**, College Park, Md.—\$43,846 for studies in rapid cosmic ray variations and also interplanetary physics.

**Bartol Research Foundation of the Franklin Institute**, Swarthmore, Pa.—\$34,000 for study of properties of medium weight nuclei.

**University of Chicago**, Chicago, Ill.—\$61,668 for study of diffusion in solids and liquids at high pressures.

**University of Illinois**, Urbana, Ill.—\$84,294 for study of the electronic structure of ionic crystals.

**Michigan College of Mining and Technology**, Houghton, Mich.—\$65,429 for research on defect behavior in plastically deformed semiconductors.

**Cornell University**, Ithaca, N. Y.—\$82,000 for study of solid state non-stoichiometric compounds.

**Syracuse University**, Syracuse, N. Y.—\$53,990 for study of structure and magnetic properties of transition and lanthanide metal compounds.

**Case Institute of Technology**, Cleveland, Ohio.—\$93,342 for study of Fermi surface of metals and of dilute alloys.

**John Carroll University**, University Heights, Cleveland, Ohio.—\$42,152 for study of magneto-acoustic absorption in solids.

**University of Texas**, Austin, Texas—\$36,132 for study of rare earth phosphides, selenides and tellurides.

**University of California**, Berkeley, Calif.—\$95,000 for acceleration of research on chemical effects of radiation.

**Giannini Controls Corp.**, Duarte, Calif.—\$41,363 for advanced aeroelastic systems studies.

**RIAS Division, The Martin Co.**, Baltimore, Md.—\$99,289 for study of nonlinear mechanics.

**Flight Sciences Laboratory, Inc.**, Buffalo, N. Y.—\$30,566 for stimulation of hypervelocity aerophysical phenomena.

**General Electric Co.**, Philadelphia, Pa.—\$48,997 for study of high altitude shock wave structure.

**General Electric Co.**, Philadelphia, Pa.—\$29,637 for study of two-phase flows.

**Aerofet-General Corp.**, Azusa, Calif.—\$64,384 for study of kinetics of formation of boron nitride from pentaborane and hydrazine.

**Aeronutronic Div. of Ford Motor Co.**, Newport Beach, Calif.—\$60,338 for research on non-equilibrium plasma properties.

**Dynamic Science**, South Pasadena, Calif.—\$43,596 for research on combustion instability.

**RCA**, Princeton, N. J.—\$86,087 for continuation of research on plasma acceleration.

**Stanford Research Institute**, Menlo Park, Calif.—\$26,924 for study of individual information handling problems.

**Raytheon Co., Missile and Space Div.**, Bedford, Mass.—\$14,784 for study of the relationship between measurable and utilities in man-machine systems.

**Department of Applied Mechanics**, University of Louvain, Louvain, Belgium—\$18,000 for study of dynamic behavior of plates and shells under thermal stress.

**Institute of Chemistry**, University of Louvain, Louvain, Belgium—\$5,300 for study of reaction in kinetics in flames.

**University College, Department of Psychology**, London, England—\$28,800 for study of stochastic models and choice behavior.

**Max-Planck Institute for Biology**, Tübingen, Germany—\$5,000 for mathematical studies of the function of the nervous system.

**University of Cambridge**, Cambridge, England—\$6,846 for study of the neurophysiology of the avian brain in relation to certain skills and responses.

**University of Cambridge**, Cambridge, England—\$5,275 for study of unit activity and oxygen tension in the hypothalamo-hypophyseal system.

**The Weizmann Institute of Science**, Rehovoth, Israel—\$5,275 for study of phosphorylation mechanisms in chloroplasts.

**Department of Biochemistry**, University of Leicester, Leicester, England—\$12,900 for study of the metabolism of simple carbon compounds in microorganisms.

**Department of Physiology**, The Medical School, University of Edinburgh, Edinburgh, Scotland—\$5,950 for study of smooth muscle responses as altered by humoral background.

**Department of Pharmacology**, University of Oxford, Oxford, England—\$13,600 for study of biochemistry of the biogenic amines.

**The Gustaf Werner Institute for Nuclear Chemistry**, University of Uppsala, Uppsala, Sweden—\$8,800 for study of localized radio lesions in the CNS.

**University of Goettingen**, Goettingen, Germany—\$8,300 for electro physiological studies of the olfactory bulb.

**Laboratoire de Physiologie**, Faculté de Médecine et de Pharmacie, Université de Lyon, Lyon, France—\$17,200 for study of neurophysiologic inhibitory systems active during sleep.

**University of Stockholm**, Stockholm, Sweden—\$5,500 for study of psychological relations in the perception of space, time and velocity.

**Technion Research and Development Foundation, Ltd.**, Haifa, Israel—\$2,865 for study of the physical tensor and applications.

**Mathematics Institute**, University of Aarhus, Aarhus, Denmark—\$5,200 for study of fluctuations of sums of random variables.

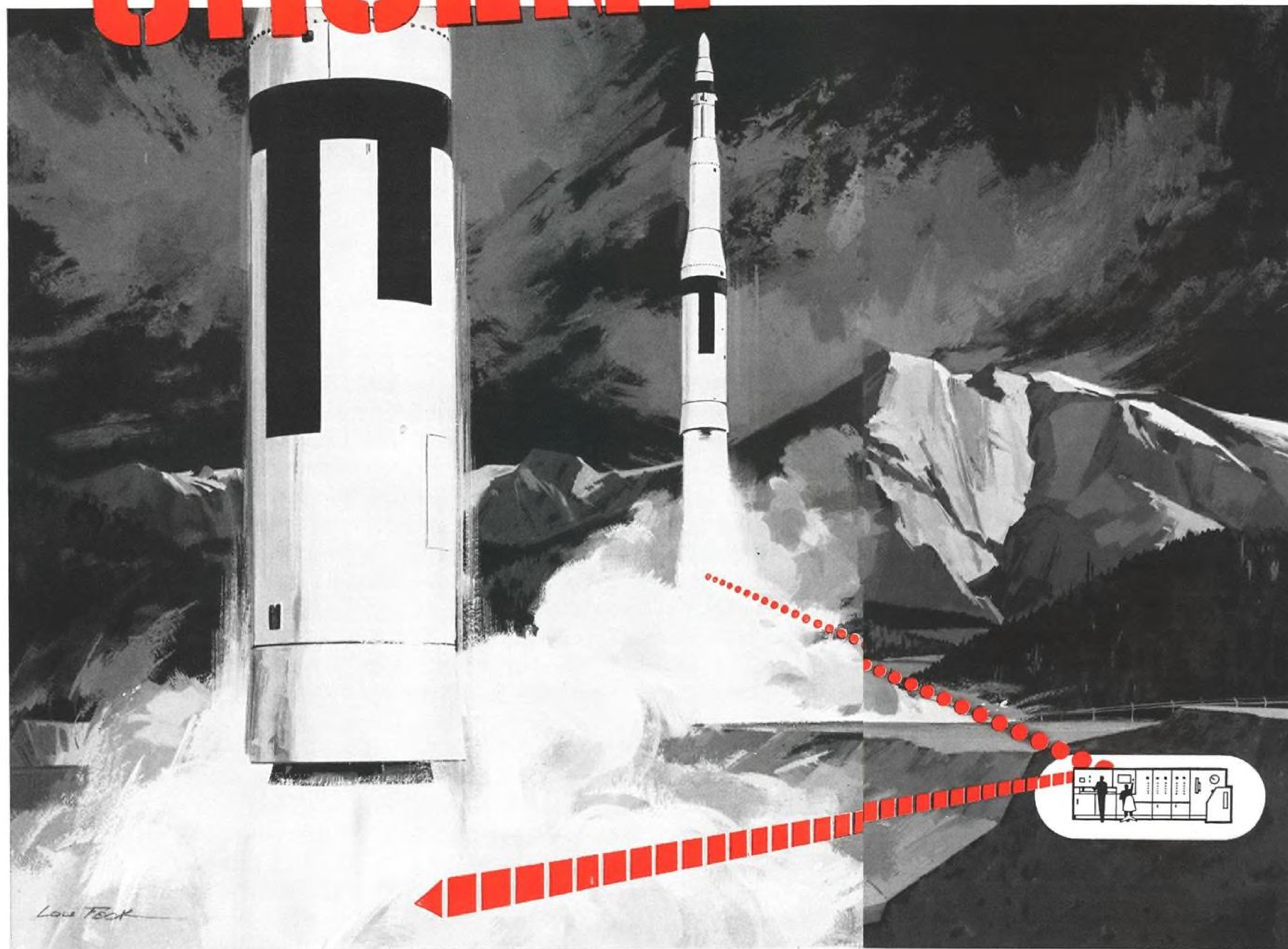
**University of Oxford**, Oxford, England—\$16,300 for study of waves in anisotropic media.

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# AERONAUTICAL ENGINEERING



BELL 47J-2 MOTHER SHIP controls an Army H-13E drone in tests at Bell Helicopter's Ft. Worth, Tex., plant.

## H-13 Drone Tests Battlefield Capability



GROUND-BASED non-pilot drone operator lands the H-13E.

Ft. Worth, Tex.—New tactical uses of helicopters in the battlefield environment, which include the possibility of using relatively unskilled personnel for vital missions, are indicated as a result of flight tests with drone versions of H-13E rotary wing aircraft conducted by Bell Helicopter Co.

Remotely controlled Army H-13E helicopters were flown on simulated military missions by Bell engineers using both ground-based and airborne control equipment demonstrating:

- Takeoff, cross-country flight and landing by remote control from an accompanying mother helicopter.
- Remote control takeoff using a ground unit, picking up control of the drone by a mother ship in the air and transfer to another ground-based unit at the completion of the mission for landing.
- Takeoff by control from a ground unit, locking the drone helicopter on automatic flight, and regaining control for landing at the conclusion of the mission by another ground-based station.

Remote control from the mother helicopter included successful low-level

flights of the drone at 10 ft. to 25 ft.

Basic test objectives to determine the feasibility of the system were achieved, according to Bell engineers, who note that the only deficiencies apparent were a lack of means of measuring the distance between drone and the mother ship and lack of information as to the drone's position and velocity with regard to the ground.

These areas of desired information should be relatively easy to solve, they report, adding that they were surprised at the small amount of information required by the non-pilot remote control equipment operator to fly the drone by the visual technique. The drone system used provided the operator with air-speed, heading and approximate rate of climb and he also used the mother ship's instrument panel as a reference source.

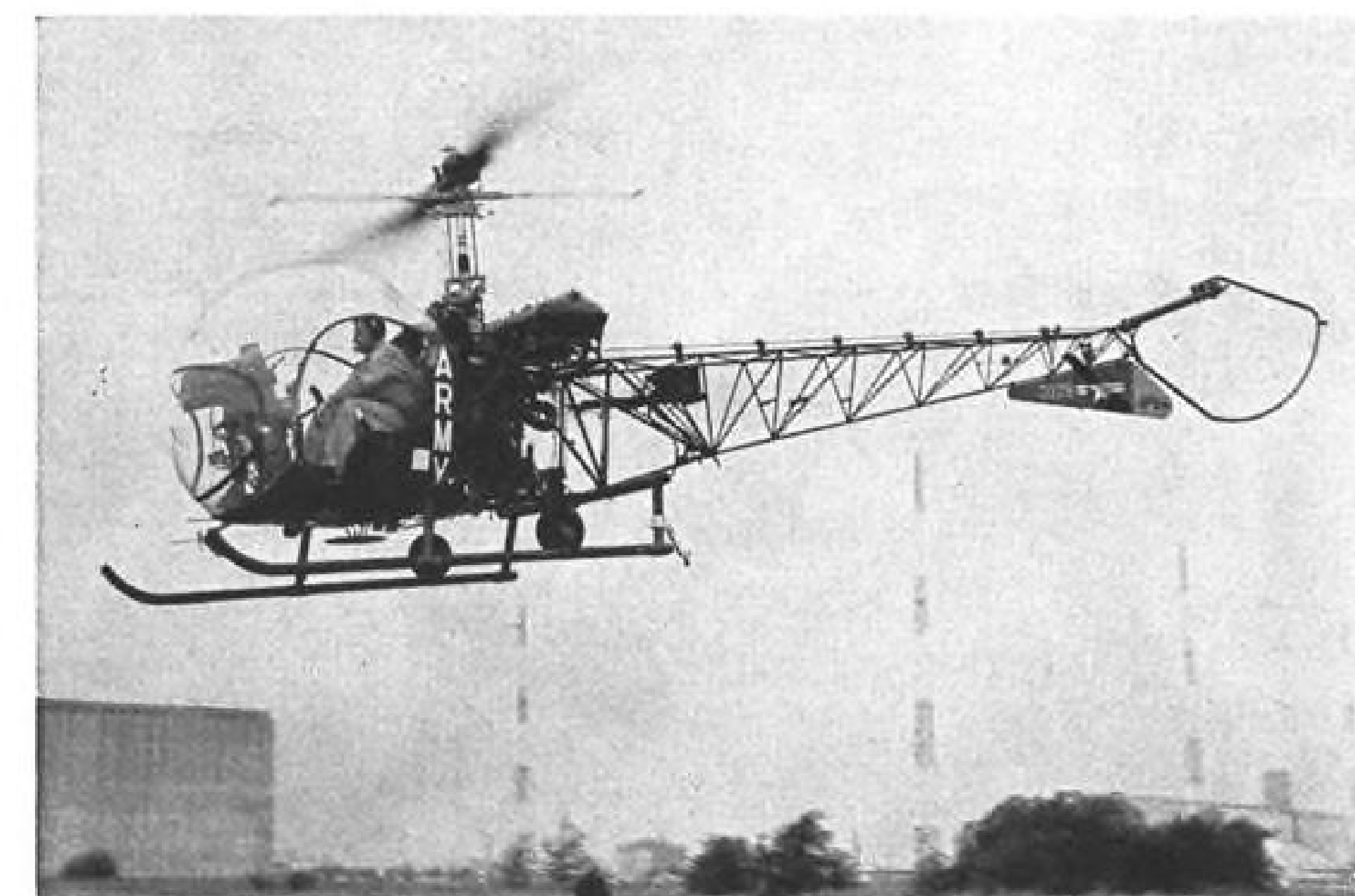
Altitude control is somewhat complicated by the fact that, working on a visual basis, the operator has difficulty in determining whether the drone has climbed or the mother ship has descended should the drone machine be displaced vertically with respect to the mother helicopter. Because the system utilized was relatively unsophisticated, the operator was limited in the degree of maneuver he could impart to the drone. Rate of turn of the drone was fixed at 3 deg. per sec.

For takeoffs, the mother ship was hovered 30 ft. to 150 ft. behind the drone and liftoffs were accomplished easily following some practice in developing judgment as to when the drone was light on the skids and take-off was imminent. Actual flight of the drone was found to be very simple, with the mother ship positioned up to 1.5 mi. in front of, to the side or rear, or above or below the drone. Landings were accomplished from the mother helicopter by flying the drone to approximately  $\frac{1}{4}$  mi. of the remote control ground site and 75-ft. from the ground.

Landing the drone from the mother ship involved positioning the latter in trail behind the drone at a distance of 100 ft. to 500 ft. The drone was flown to an altitude of 5 to 10 feet and an approximate hover, with the mother ship in a similar position. As the hover was achieved, the mother ship moved approximately 50 ft. aft and 30 ft. to the right of the drone, providing the operator with optimum ability to judge longitudinal and lateral translation and drone altitude.

Automatic flights, accomplished by taking the drone off from a ground control position, involved distances of approximately two miles without further commands, with a normal landing accomplished by a ground control site.

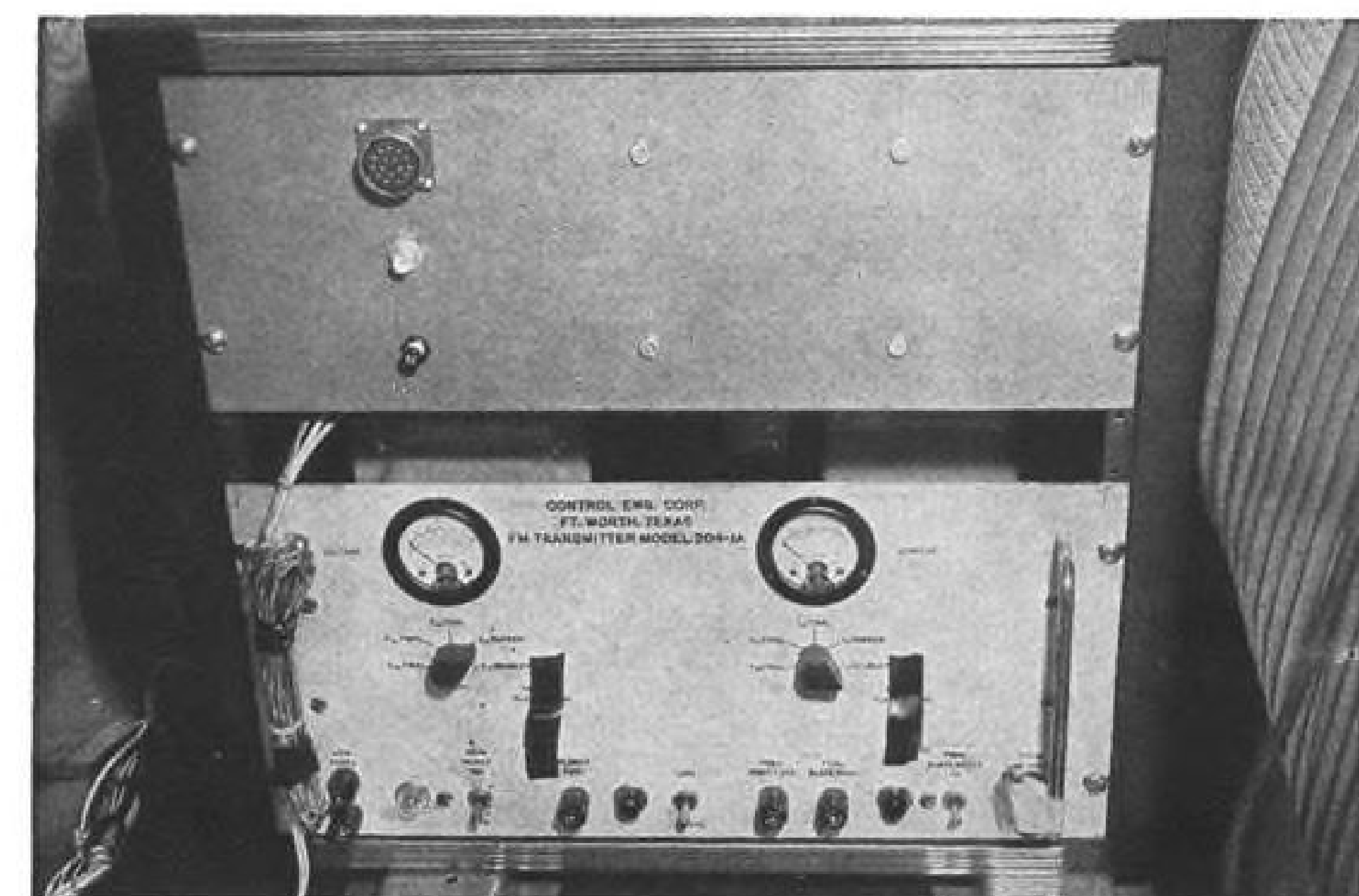
Application of the technique to several military missions became ap-



ARMY H-13E helicopter drone flies under remote control. Bell Helicopter Test Pilot Al Averill is in left hand seat "hands off."



CONTROL PANEL 17 x 13 in. is held by non-pilot drone operator in cabin of 47J-2.



FM TRANSMITTER for sending to drone is mounted on the mother ship floor.





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parent as a result of the tests. These include:

- **Decoy drone concept**, whereby unmanned helicopters would be used as forward and flanking scouts for a convoy of personnel transport or cargo helicopters. Equipped with weapons, they could be used to draw enemy fire thus alerting the main force, or to flush out enemy targets.

- **Re-supply missions**, whereby the unmanned helicopter could be taken off from a ground control point, loaded with supplies, directed to the desired supply point via automatic flight and landed by completely untrained personnel at the site with no special equip-

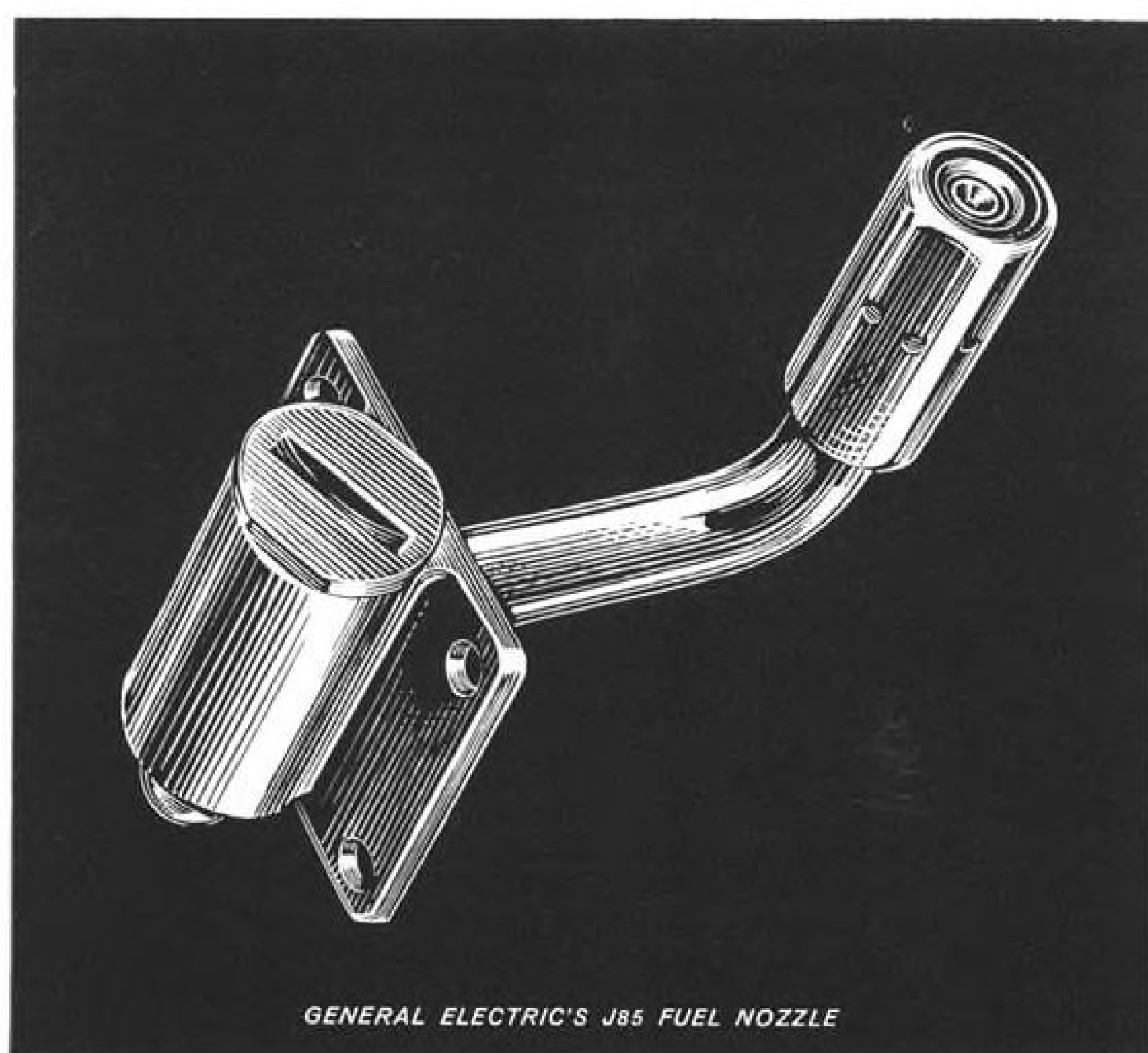
ment except a sheet of instruction. To accomplish this, data as to the location of the site could be inserted in a computer in the drone. When the re-supply drone reaches the landing area and is in sight of ground personnel, a signal consisting of a long "dash" could be sent to the drone using the modulated continuous wave mode of a standard Army communications set. On receipt of this signal, the autopilot would switch off from computer-derived commands to ground commands.

The ground operator would command left turns for the drone by sending a series of dots and right turns

by sending a series of dashes. When the drone is maneuvered over the landing site, a long dash would command the drone to hover and at the same time a stake attached to a cable is unreel. The ground operator would take the stake, drive it into the ground and then actuate a switch on the stake that would signal the cable drum to reel in, drawing the helicopter toward the ground for landing. After unloading, the copter would take off on command, and using information stored in the computer, fly back to its point of origin where it would be retrieved by the ground control site.

Development of airborne control equipment to provide greater latitude in maneuvering the drone helicopter is within the current state of the art, Bell engineers report. A system providing sufficient sophistication for precise maneuvering at low-altitudes to gain optimum benefits of low-level techniques, plus the capability of landing the drone at a distance of a half-mile to a mile from the mother ship, could be done at a cost, in quantities of 100 aircraft, for approximately \$30,000-\$35,000 per system, they estimate.

This would include a television system in the drone with wide-angle and 1.1 lens coverage for landing and an eyeglass-type display equipment for the operator—already developed by Bell—that would present the image seen by the remote TV camera at virtual infinity on the opaque lower-half of the glasses, utilizing a field lens to pick up the image from a fiber rope. The rope projects the display from a miniature TV display, permitting the operator complete freedom of head movement, Bell states. Upper half of the glasses would be clear to permit the operator to flick his eyes from viewing the TV image on the glasses' opaque section to a direct view of the drone to monitor the action.



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on established standards gained through 15 years' experience in gas turbine engine fuel nozzle design.

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### Booster Recovery Kits

Washington—All American Engineering Co. has received an \$81,400 Army contract to design and test two recovery kits for Sikorsky H-37 helicopters to be used at White Sands Missile Range, N. M., for booster, drone and instrument package recovery.

The new recovery systems will be capable of snatching packages weighing up to several thousand pounds, since rocket boosters launched at White Sands reach this weight. The contract calls for the system to be operational this fall.

All American initially developed the system for the USAF Discoverer satellite program. It was later made a part of the recovery procedure for the camera pod carried on board the ballistic payload for the Echo 2 satellite launch.

## AVIONICS

# Midas Auto-Checkout May Initiate Trend

By Barry Miller

Los Angeles—Automatic computer-controlled ground checkout system which is intended to perform factory and pre-launch checkout of Midas infrared early warning satellites and their Agena launch vehicles will be developed by three avionics companies under contracts to be awarded this summer.

The system is also to be applicable to other satellites, possibly including the Samos photographic surveillance satellite, and a number of industry observers expect it to set a pattern for the design of future automatic spacecraft checkout systems.

Industry proposals for the design and development of the system, called SCORE (Satellite Computer Operated Readiness Equipment) were to be submitted last Friday to Lockheed Missiles & Space Co., Van Nuys, Calif., which is conducting the competition. Lockheed is prime contractor for the Midas satellite system which is launched in the second stage Agena B (and in later versions, the Agena D) launch vehicle, also made by Lockheed. Between \$4 and \$5 million is believed to be allocated for the SCORE program, from funds made available by the Air Force from the Midas budget.

### Competing Companies

Organizations believed to have submitted proposals for the SCORE project by deadline last Friday include Beckman Systems, Control Data Corp., Packard Bell, Electronic Specialty, Airborne Instruments, General Electric, Amelco, Autonetics, Hughes, Radio Corp. of America's Data Systems and Aerospace Command & Control Division, a team of International Business Machines and Emerson Electric, a team of Bendix Eclipse Pioneer Division with Thompson Ramo Wooldridge, and a Sperry Rand Corp. team comprising Sperry, Utah, Univac, Sperry Microwave and Wheeler Electronics. About 80 avionics companies attended a four-day SCORE system briefing held here last month.

SCORE will consist of three subsystems:

- Large digital computer and associated equipment, including a digital comparator, control switching and stimuli.
- Ground handling and support equipment.
- RF telemetry equipment.

Each of the bidders can quote on one or more parts, but Lockheed has

indicated no one company will be chosen to develop more than one of the three subsystems. Much of the more controversial competition will center about selection of the digital computer. Lockheed expects to integrate the subsystems, provided by the three prospective contractors, into a unified system.

Initially, SCORE is expected to be used at Lockheed's Sunnyvale factory where Midas is assembled and at an Air Force operated repair, inspection and maintenance facility. Ultimately, another system with only minor changes will be installed at an operational Air Force launch complex to give Midas a factory-to-launch checkout sequence.

Functionally, SCORE will permit three testing levels at factory and Air Force facilities.

In the first level, manual and semi-automatic special test equipment will be used for in-line assembly tests, final component testing involving precise alignment, calibration, adjustment and part and subcomponent receiving inspection.

At the second level, SCORE will provide for semi-automatic go no-go component checkout to isolate and verify no-go conditions on components removed from the vehicle. Tests may also be used as incoming acceptance tests on purchased or subcontracted components. The final testing level will provide complete automatic subsystem and system vehicle checkout.

At the Air Force facilities, automatic simulated launch countdown with Atlas (first stage Midas booster) electrical interface simulation and/or actual electrical mating may be performed with

the aid of launch and service equipment facilities, simulators.

The SCORE system at a launch facility will perform automatic pre-launch checkout as well as automatic launch control monitoring. Actual specifications for the SCORE system represent a composite and refinement of the ideas of many companies currently bidding for a SCORE development contract. Lockheed had briefed industry last year (AW Nov. 13, p. 97) on the system and requested interested companies to submit proposals from which specifications were derived.

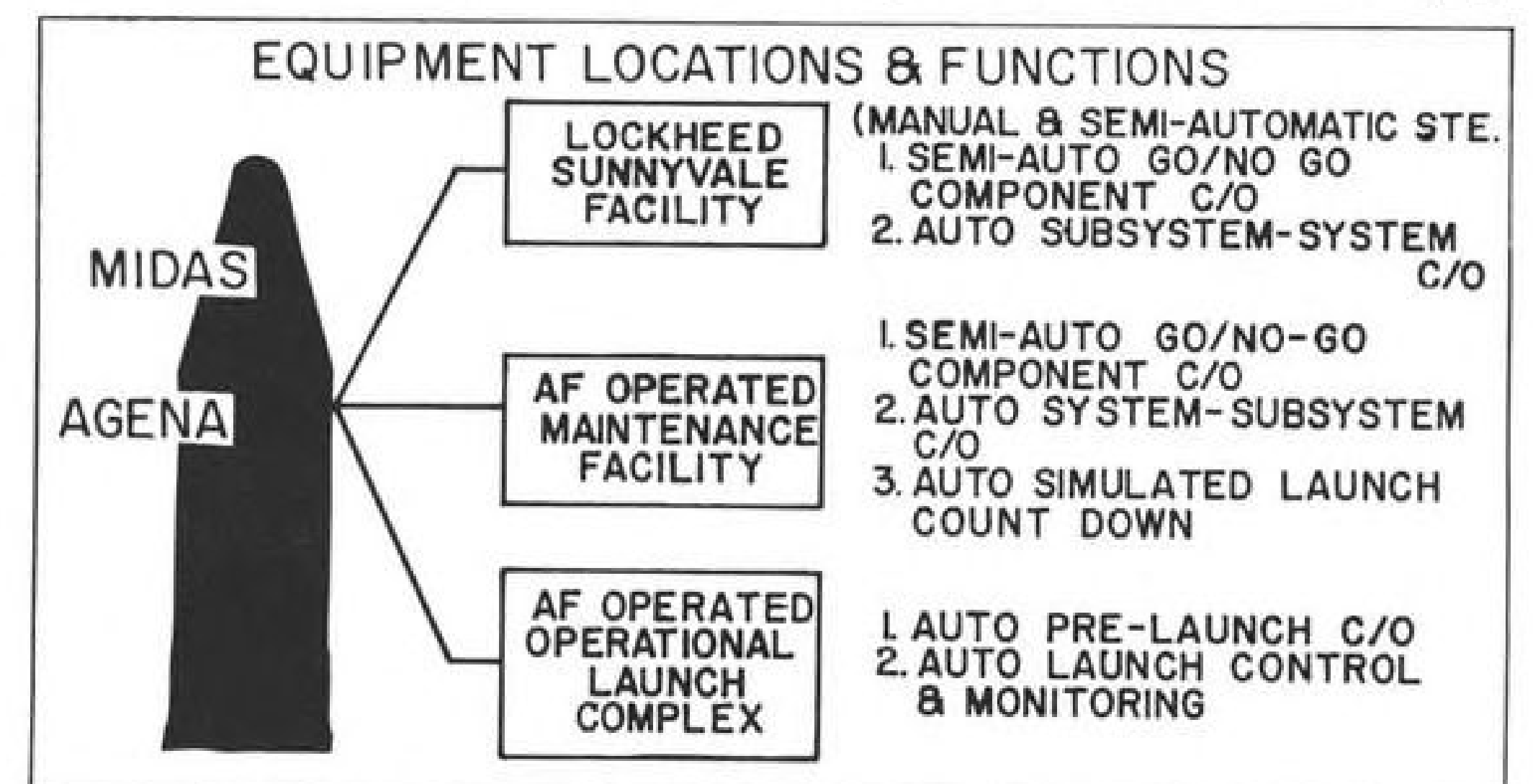
### System Objectives

The specifications as they evolved are thought to represent some of the better ideas about automatic checkout. One of the objectives of the system is to make it adaptable to any future automatic launch control and missile needs with only changes made necessary by new subsystem test requirements, additional control and display requirements and facility differences.

As presently envisioned, however, the SCORE system may run into a few technical roadblocks. Midas is actually contained within the Agena vehicle, which is automatically checked out with the payload. This could present certain problems in compatibility between the SCORE system and the Atlas (first boost stage) checkout.

Among the general design objectives of SCORE are the following:

- **Computer-controlled checkout**—The general purpose, high-speed digital computer will control, evaluate and document test results.
- **Replacement level**—Checkout equip-



MIDAS AUTOMATIC GROUND CHECKOUT EQUIPMENT ultimately is expected to perform factory, maintenance facility and launch pad checkout of both the infrared missile warning satellite system and the Agena second stage launch vehicle. Equipment locations and generalized functions of the equipment are shown here.



ment will isolate malfunctions to the replaceable component level, i. e., velocity meter, power converter, multiplexer, etc.

- **Automating manual equipment**—Proven manual techniques will be automated rather than attempting to develop new techniques which may not be feasible.

- **Comparing real time RF**—Equipment is to handle RF and hardline data and measure it against limits in real time, thus eliminating the six or seven days' delay while waiting for data reduction and analysis after each test run.

- **Dual vehicle capability**—To speed checkout operations, one vehicle can be under test while another undergoes test preparation, aided by rapid connect/disconnect to cut time required in switching from one vehicle to another.

- **Manual over-ride**—Test operator will have manual over-ride to call up pre-specified diagnostic sub-routines for trouble shooting.

- **Modular design**—Modular design concept will be employed in SCORE to ease trouble shooting, simplify maintenance and make future changes necessitated by vehicle growth easier.

- **Self-check and calibration**—SCORE will have self-check and calibration capabilities. It will be able to select and measure all normal stimuli inputs, providing self-check stimuli inputs and secondary standards for resistance, voltage, frequency and time for measurement system calibration.

- **Documenting test results**—All no-go test data and limits will be printed out in real time as physical units during test.

- **Minimum development risk**—The SCORE system is to be built from proven commercial parts meeting Mil specs and is not to include unproven automation techniques or to be predicated on some "breakthrough" whose tardiness could set back scheduled development.

Lockheed is asking potential contractors to quote costs of an initial prototype on a cost-plus-fixed-fee basis as well as specify costs for up to three follow-on units on a similar contractual basis. First prototype is expected to be delivered late next year.

Among supporting equipment for the computer will be a large buffer, electric typewriter, program tape recorder, output tape recorder, high speed printer, control and indicator console, video tape recorder and termination unit.

Launch pad simulator will be necessary to run a simulated countdown as launch facilities and support equipment signals are needed to verify an actual launch sequence program. In addition, a vehicle simulator is necessary to simulate all umbilical and test plug functions. Purpose of these simulators is to reduce vehicle flight hardware testing time, to handle initial de-bugging and acceptance testing, to evaluate and verify test programs, to aid in fault isolation and correction, and to conduct simulated countdown, qualification test programs and training programs.

#### Computer Requirements

The computer requirements divide into two parts. The first, to be performed by a general purpose computer, will be to exercise primary control and computation. The computer is to have flexible instructions, high speed circuitry, a large magnetic core memory, flexible addressing and interrupt capability, buffered input-output and a scientific computational ability.

The second requirement calls for a high-speed comparator—with special purpose, fixed instructions and needing high speed circuitry and a small magnetic core memory with buffered input and output capability. While a single special computer might satisfy both of these Midas requirements, the emphasis Lockheed places on delivery time and use of proven techniques probably

will exclude development of such a device.

The comparator is to provide real time data comparison with internally stored limits. High data rate PAM (pulse amplitude modulation) or multiplexed hardline digitized data are to be entered into its register.

The index register, which resets when triggered by a data train sync signal, instructs the memory to enter appropriate limits in either a high or low register. The two numbers are compared and should the results be go, as detected by the algebraic sign of the sum, the comparator accepts the next data pulse and proceeds as controlled by its fixed logic program.

If the result is no-go, the data point index number, high and low limits and measured value are transferred via program interrupt to the control computer and to a printer for immediate display.

With the required data point index number entered into a register for comparison with the index number of the point being measured, pre-selected data points can be transferred along with limits and index number into the control computer. Control computer can update internally stored limits according to test program and sequence needs.



- **Black Eye Funding Sought**—Air Force's Space Systems Division has asked Systems Command headquarters to approve a five-year, multi-million-dollar study and development program for Project Black Eye, a plan for using high-intensity optical maser beams to disable sensors, such as infrared detectors, aboard hostile space vehicles (AW May 21, p. 23). SSD wants a go-ahead on the project which would get under way with several hundred thousand dollar studies to be followed by feasibility demonstration on earth before attempting to place optical masers in a spaceborne platform. A weapon system of this type is considered to be far more practical at the present state-of-the-art than a lethal laser weapon system.

- **Integrated Circuit Costs**—Present tooling costs of semiconductor integrated circuits made to customer order may be a stumbling block to the wide adoption of these devices in linear circuits used in communications, navigation, radar and other non-digital equipment. Fairchild Semiconductor estimates tooling costs between \$5,000 and \$15,000 per circuit mounted within a conventional transistor can where a new circuit, not just a change in leads, must be synthesized. At Texas Instruments, engineering, tooling, fabrication and testing of several semiconductor circuits of a single integrated operational ampli-

fier type may cost the customer between \$10,000 and \$20,000. Signetics will charge roughly \$12,000 to \$17,000 for a given customer linear circuit. Motorola is understood to be quoting tooling costs of between \$1,000 and \$2,000 for specially produced circuits.

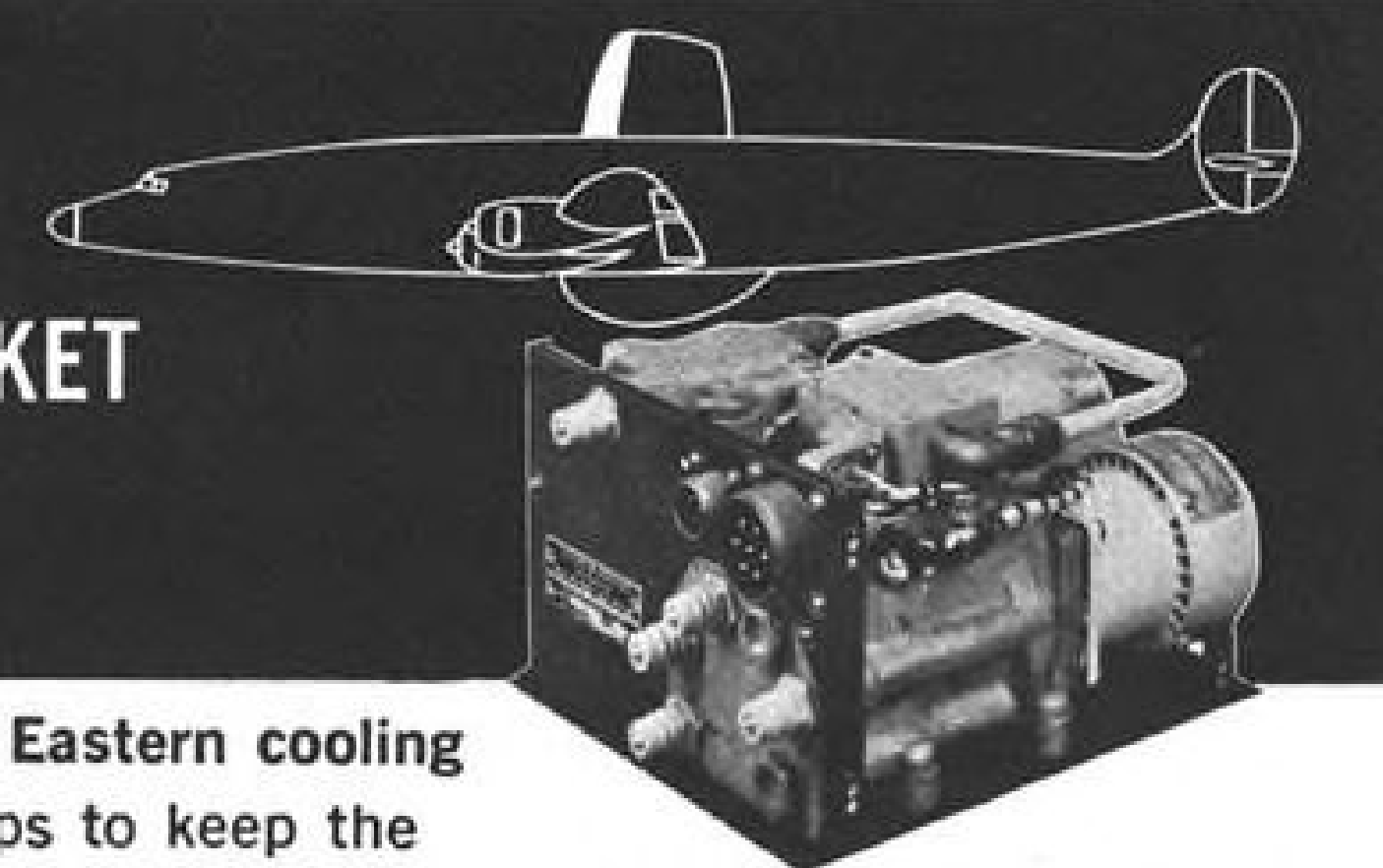
- **Millimeter Wave Maser Reported**—Maser amplifier which operates at 96 gc. (kmc.), using a pumping frequency of only 65 gc., with a gain of 10 db., has been developed by Westinghouse Electric's defense center under Aeronautical Systems Division sponsorship. The development is significant because it makes use of five paramagnetic spin energy levels instead of the usual three to obtain inversion. This permits pump frequency to be considerably lower than signal frequency, removing the previous barrier to operating masers at extremely high frequencies. New maser uses iron-doped titanium oxide (rutile) and operates at a temperature of 2K.

- **Air Data Computer Checkout**—A lightweight, portable central air data computer analyzer, which is capable of quickly rendering "go", "no-go-low" or "no-go-high" decisions at 144 checkpoints has been developed by Aerospace Products Research Corp., Santa Monica, Calif., for USAF's Aeronautical Systems Division. The self-checking device weighs 14 lb., is contained in a small suitcase size and type container and was designed for central computer checkout on the Republic F-105. Analyzer uses small, modular electroluminescent units.

- **New Radar Company on Coast**—Marshall Technology, a subsidiary of Marshall Industries, has been set up in Pomona, Calif., to specialize in design, manufacture and sales of radar systems and subsystems. The new outfit, headed by Edmund W. Baker and Robert Dilks, general manager and vice president-engineering, respectively, intends to delve into R&D in radar evaluation computers, radar simulators and training aids, lasers, countermeasures and air traffic control. Company is located at 2882 Metropolitan Pl., Pomona.

- **Microwave Modulation of Light Reported**—Modulation of a light beam at frequencies of 700 to 1,200 mc., with depth of modulation of 10% to 30%, has been reported by Aircraft Armaments, Inc., Cockeysville, Md. The modulator employs the Pockels Effect in crystalline material, forming a solid-state analog of the Kerr Effect in liquids, whereby the refractive properties of an optical crystal are altered by the application of an electric field. The modulator consists of an electro-optic crystal located within the field of a microwave cavity.

## ABOARD A RADAR PICKET PLANE



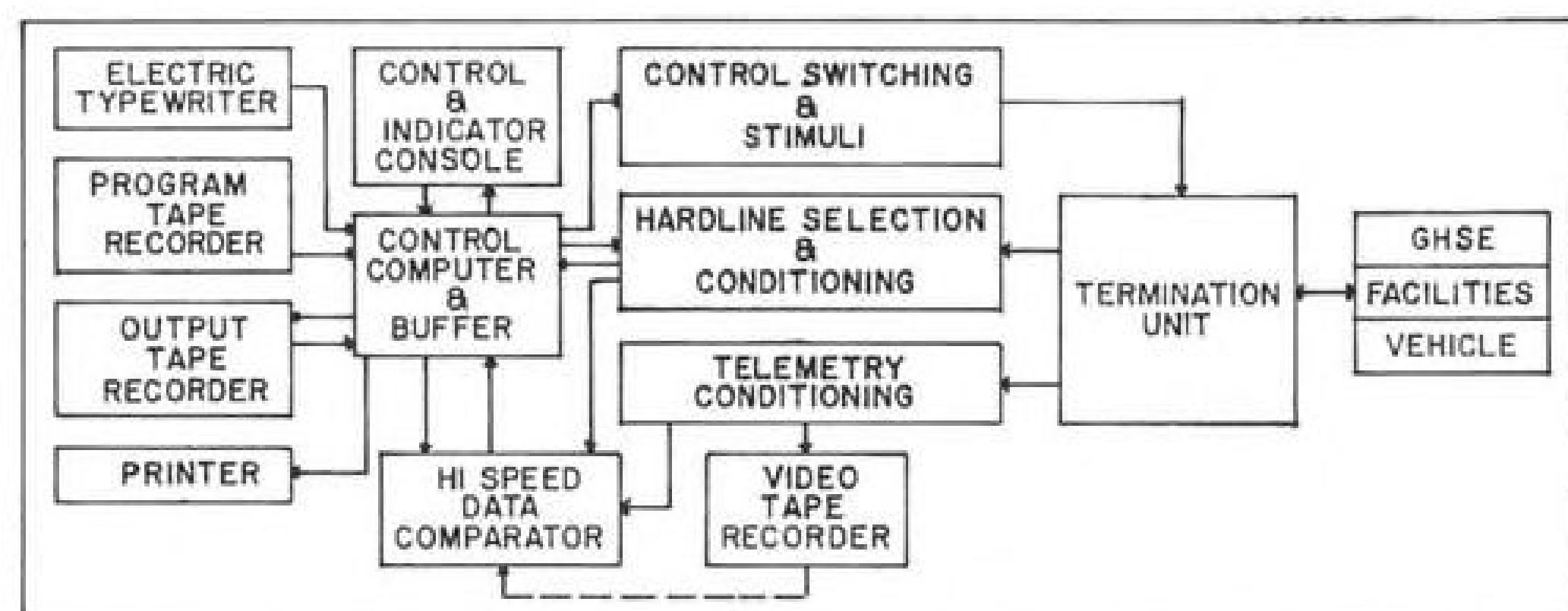
... a new Eastern cooling system helps to keep the

Philco APS-103 search radar on the lookout for bogies and bandits. The liquid cooling unit has a capacity of 1600 watts, but weighs only 15 lbs., and fits into a compact 5-9/32" x 9-7/8" x 7-7/8" volume. Designed for operation to 50,000 feet, it features an ingenious internal manifold which makes for simplicity, reliability, and which eliminates most internal connections. If you need efficient, miniaturized light weight cooling units for airborne electronics cooling, call on Eastern. Eastern is your perfect source for liquid tube cooling units for capacities from 50 to 20,000 watts.



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**GENERALIZED SYSTEM BLOCK DIAGRAM** of the projected Midas checkout equipment shows how primary data—data associated with particular test or test sequences—is selected, measured and compared against limits, and test value, limits and identification are printed in real time for no-go and stored for documentation. Secondary data—associated with safety of equipment and personnel—is monitored in real time, compared against limits and no-go data is printed. Remaining data is monitored and can be compared against limits and no-go information printed.

## HOW BIG?



The JetStar is small enough for low-cost operation and maintenance. Big enough to give a crew and 8 passengers stand-up room. Powered by 4 turbojets.

**LOCKHEED JETSTAR** the compact utility jet



## MANAGEMENT



**USAF SPECIAL AIR WARFARE CENTER** Helio L-28s land Army Special Force troops at a demonstration for President Kennedy at Eglin AFB, Fla. L-28s are used for rapid deployment of troops engaged in counter insurgency operations.



**AIRMEN OF THE FIRST AIR COMMANDO GROUP** (left) wear Australian-style hats. Douglas DC-3s, some equipped with belly mounted loudspeakers for psychological warfare, provide troop carrying capability for commandos. Rocket assisted takeoff is tested (right).



## USAF Revives Commandos, Studies Special

Eglin AFB, Fla.—Major expansion of the Air Force's Special Air Warfare Center here is planned to provide Tactical Air Command with increased counter-guerrilla capabilities.

Program calls for building center strength from its current level of 850 personnel to more than 5,000 men by mid-1963. At the same time development, testing and evaluation of tactics and equipment especially suited for counter-insurgency operations will be accelerated.

A fertile new field for industry participation in weapon systems programs, from new aircraft through a wide variety of sensing devices for reconnaissance and other equipment, appears to be in the making.

Basically, the special Air Warfare Center is training officers and airmen to enable the Tactical Air Command to handle anti-guerrilla suppression missions and providing the Army's special forces with airlift and air support for similar duty. It also is training TAC personnel to act as instructors for aircrews and airmen of friendly foreign nations who may find themselves involved in such a war, particularly those smaller, emerging underdeveloped countries that are the most likely victims of aggression.

Under the Special Air Warfare Center, commanded by Brig. Gen. Gilbert L. Pritchard, two new operational organizations have been established—the 1st Air Commando Group and the 1st Combat Applications Group.

The 1st Air Commando Group, commanded by Col. Chester A. Jack, takes its name from the Air Commando Groups which fought in the China-Burma-India and Pacific theaters dur-

ing World War 2 supporting behind-the-line activities of allied guerrilla forces. Most famous of these probably was the 1st Air Commando Group, commanded by Col. Philip Cochran, which supported British Brigadier Orde C. Wingate's band behind the Japanese lines in Burma with transports, bombers, fighters, helicopters, liaison planes and gliders.

Its current mission, should the U.S. become actively engaged in limited war or guerrilla activity, would closely follow the pattern of its World War 2 predecessor. The current group is an outgrowth of an order in May, 1961, from the Secretary of the Air Force that directed Tactical Air Command to develop a counter-insurgency capability.

The 4400th Combat Crew Training Squadron was formed at Eglin Auxiliary Field 9 with an initial contingent of 350 officers and men assembled by July 1, 1961. An initial detachment from this group was first deployed in August, 1961, on a mission of training paratroops for the newly formed African nation of Mali. In September, 1961, the 4400th was declared operational and a second detachment was deployed to South Vietnam within 60 days to instruct that country's aircrews and airmen in C-47, B-26 and T-28 aircraft.

Specialized training undertaken by the Air Commandos and passed on to aircrews of other countries covers all phases of airborne operations, including low-level drop techniques for personnel, cargo and weapons. Other training phases are skip-bombing, day-and-night close air support, including use of flares for night-time detection and suppression of enemy guerrilla forces and recon-

naissance; cutting off of escape routes by use of anti-personnel weapons, staking out from the air areas of suspected enemy activity, interdiction raids, destruction of supply points, and use of psychological operations—harassment and counter-information programs and aerial broadcasts.

Initially the Commandos have employed World War 2 and early postwar vintage aircraft—the C-46, C-47, B-26 and T-28—since these are types in general use in many countries and also are available from storage for ready deployment where necessary. Also favoring their use was their relative simplicity for operation under primitive conditions from small or hastily prepared bases.

C-46s and C-47s carry out their traditional roles of cargo and paratroop deployment and the C-47 has been rigged with belly loudspeaker systems for aerial broadcasting and fitted with auxiliary rocket motors to shorten takeoff. The B-26s are fitted with 50-cal. machine guns in the nose for strafing and can carry a wide variety of internal and external weapons, including varied types of bombs, napalm tanks, or rocket launchers. They can also be fitted out as high-speed personnel transports carrying up to six fully-equipped special warfare troops in the bomb-bay, seated on specially fitted racks. Two K-17C reconnaissance cameras may also be fitted. T-28s have been converted from the training mission into mixed weapon delivery vehicles, with normal armament comprising two 50-cal. guns in underwing pods, and four wing racks for bombs, napalm tanks and rockets. External auxiliary fuel tanks may also be fitted to extend endurance, when neces-

## War Aircraft

sary, for the delivery of weapons.

Latest addition to the aircraft fleet is the Helio L-28 STOL light transport, capable of airlifting three equipped special warfare commandos or commando engineers or aircraft controllers into very small, unprepared areas.

The L-28 is indicative of the center's interest in newer equipment which fits its mission. Considerable study is going on to improve Air Commando capabilities.

The 1st Combat Applications Group, commanded by Col. Benjamin H. King, is charged with developing, testing and evaluating new tactics and equipment for improving TAC's counter-insurgency capabilities, and works closely with 1st Air Commandos on weapon systems to be used on particular missions and special types of terrain.

Primary directorates concerned with equipment are the Operations Directorate, currently headed by Lt. Col. James C. Pedersen, which has the project offices and does testing, and the Requirements Directorate, commanded by Lt. Col. Harold L. Buffenbarger, which is the group's primary contact with industry in attempting to locate new equipment applicable to the center's mission.

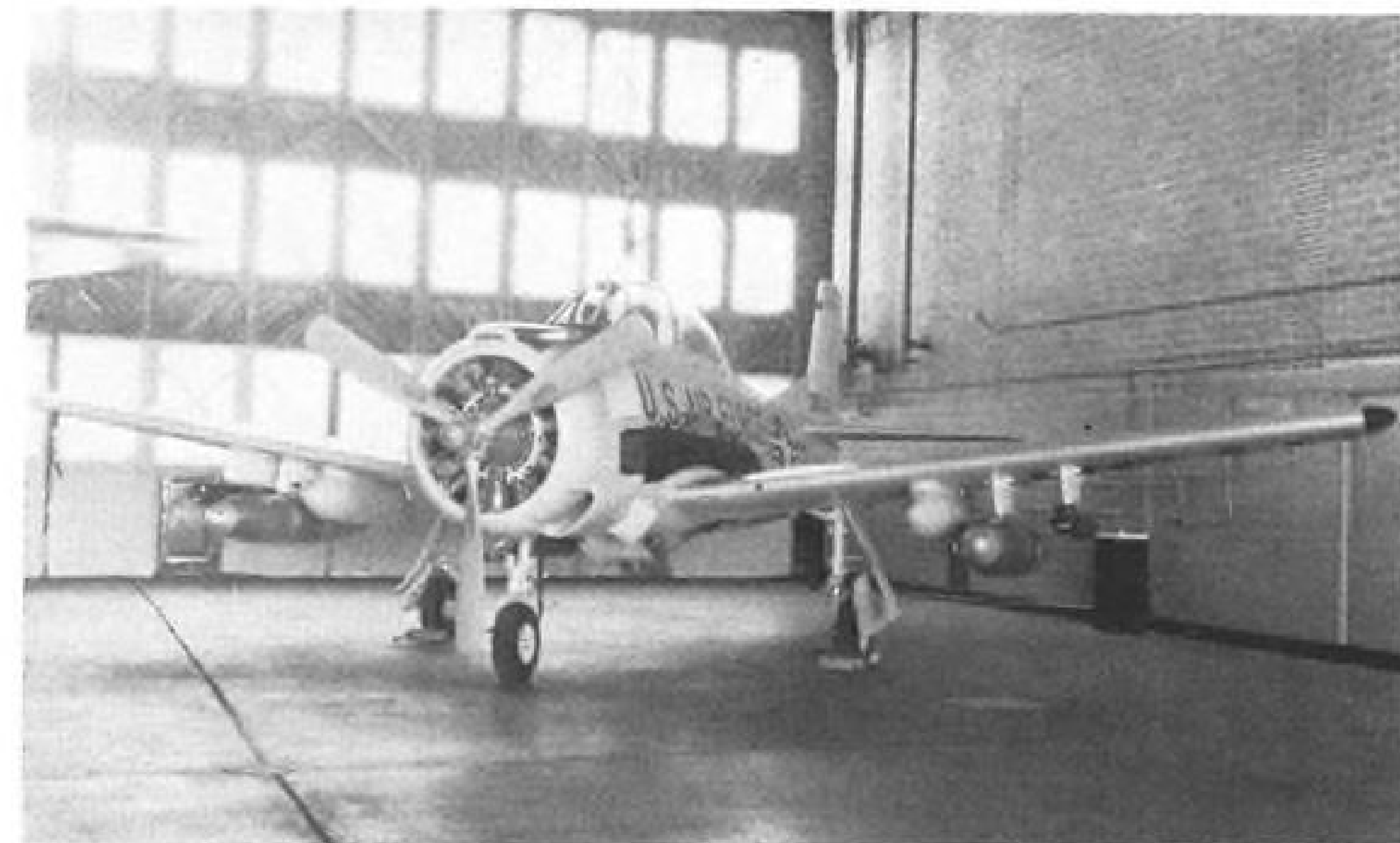
High-priority systems being studied and sought by the applications group:

- All types of sensing devices to locate and record equipment and personnel through heavy overcast or forest cover. Reconnaissance equipment is one of the Special Warfare Center's biggest equipment problems.

- Improved target marking devices that will persist for long periods of time and penetrate and show through dense for-



**DOUGLAS B-26**, is equipped for special warfare with an M116A2 fire bomb; LAU-3A rocket launcher; 500 lb. general purpose bomb, and an LAU-3A fire bomb. On the hangar floor are M1A2 fragmentation bombs.



**NORTH AMERICAN T-28**, under study for turboprop conversion, is equipped with two underwing mounted 50-cal. machine gun packages, two VLU-11/B 500 lb. fire bombs, and two MA-3 rocket launchers.





**DAGE RGS-10** .....

## **GREW UP IN A TOUGH NEIGHBORHOOD**

Shattering rocket engine blasts, high and low temperature extremes, bright sunlight and dim shadows, fog, rain, snow, ice, salt spray, high altitudes . . . these made up the severe military and industrial environments the rugged Dage RGS-10 television system had to overcome in gaining wide acceptance.

After recent tests conducted by the Air Force and the Astronautics Division of General Dynamics, the Dage RGS-10 system was chosen for Atlas weapon system support for the following reasons:

- Camera is certified to contain an internal explosion of 100/130 octane aviation gasoline. (Explosion proof per MIL E 5272B—Proc. 2)
- Certified operation under noise levels of 150 db . . . permits direct, close range observation of rocket engine blasts.
- Acceptable operation with line voltage fluctuations as high as  $\pm 30\%$  from normal.
- Sync stability with power line frequency variations as high as  $\pm 15\%$  from normal 60 cps.
- Excellent resolution and detail with 1000 ft. of interconnecting camera control cable.
- Satisfactory operation in temperatures from  $-30^{\circ}\text{F}$  to  $160^{\circ}\text{F}$ .
- Transistorized EIA sync generator with a proven field use history.
- Insignificant radio frequency interference.
- One-year warranty.

*There are now more than two hundred Dage RGS-10 systems being delivered for use in activation and as support at every operational Atlas base across the nation. Here are a few other applications of Dage television systems:*

Observation of explosive materials  
Army Chemical Center—Maryland  
Boresight tracking  
Patrick Air Force Base—Florida  
Hazardous test observation  
Point Arguello—California  
Rocket engine test observation  
Red Stone Arsenal—Alabama

Rocket Pad observation  
NASA—Wallops Island, Virginia  
Reactor observation  
Hanford—Washington  
Eyes for remote controlled tank  
Fort Belvoir—Virginia  
All-weather runway observation  
Oceana Naval Air Station—Virginia

Other features of the Dage RGS-10 camera:

- 700 lines Horizontal Resolution at 10 mc Bandwidth
- Complete EIA synchronization and scanning exceeds FCC requirements for commercial telecasting
- Multiple camera systems, common or individual EIA sync generators
- Completely transistorized construction
- 17-Watt power requirement
- Incorporates all necessary set-up and operational adjustments
- 4-lens turret, zoom lens, pan and tilt, and remote focus available

The Dage Division of Thompson Ramo Wooldridge provides a complete range of cameras, controls, monitors and other equipment as well as systems engineering and field installation and maintenance service. If you would like to learn more about the Dage RGS-10 or other Dage television systems and development capabilities . . .

Contact the nearest Dage-TRW regional office—Atlanta, Washington, D.C., Los Angeles or Salt Lake City. (or)

Contact Dage Division Direct—Michigan City, Indiana. (or)

Check the Yellow Pages for your nearby Dage distributor.

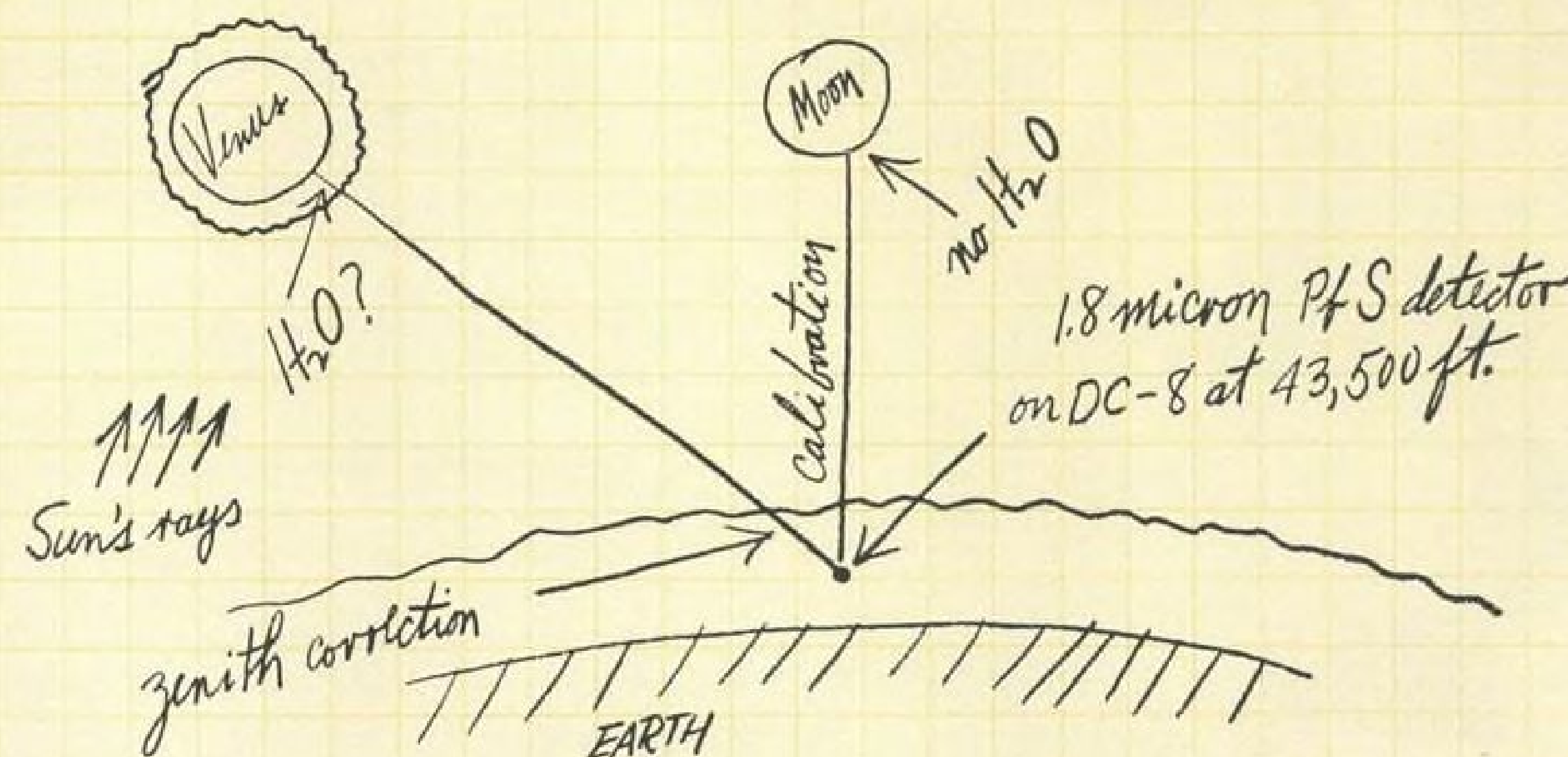


**Thompson Ramo Wooldridge Inc.**

Photo of USAF ICBM Courtesy of General Dynamics/Astronautics



*Of interest to engineers and scientists*



## PLANETARY ENVIRONMENTS

*...one of more than 500 R&D programs under way at Douglas*

The purpose of this Douglas study is to gain a comprehensive insight into the atmospheric characteristics of Venus, Mars and Jupiter. This is to include a detailed knowledge of the following: composition, radiative equilibrium, vertical and horizontal distribution of radiative flux, pressure, temperature, density, and three-dimensional planetary circulation.

Utilizing the most recent observations and advanced theory, working models of these atmospheres are being constructed. New data are being sought through photographic astrometry, spectroscopy and photometry. Feasibility studies of new space instruments are being undertaken as one of many aspects of this investigation.

**Of career interest to engineers and scientists**

Because leadership in tomorrow's technology is a strong Douglas objective, the company is placing great emphasis on expanding its

research and development staff. This has opened outstanding opportunities to scientists and engineers in the multitude of areas related to aerospace, nucleonic and other fields.

An extensive new laboratory complex is being constructed to provide the most modern facilities to aid in R&D operations. If you are seeking a stimulating environment in which to further your career, contact Douglas.

Send us your resume or fill out and mail the coupon. Within 15 days from the receipt of your letter, we will send you specific information on opportunities in your field at Douglas.

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## DOUGLAS

Missile and Space Systems Division

*An equal opportunity employer*

est cover where guerrilla forces operate.  
• **Airborne and ground communications** equipment with high reliability and light weight.

### Studies Under Way

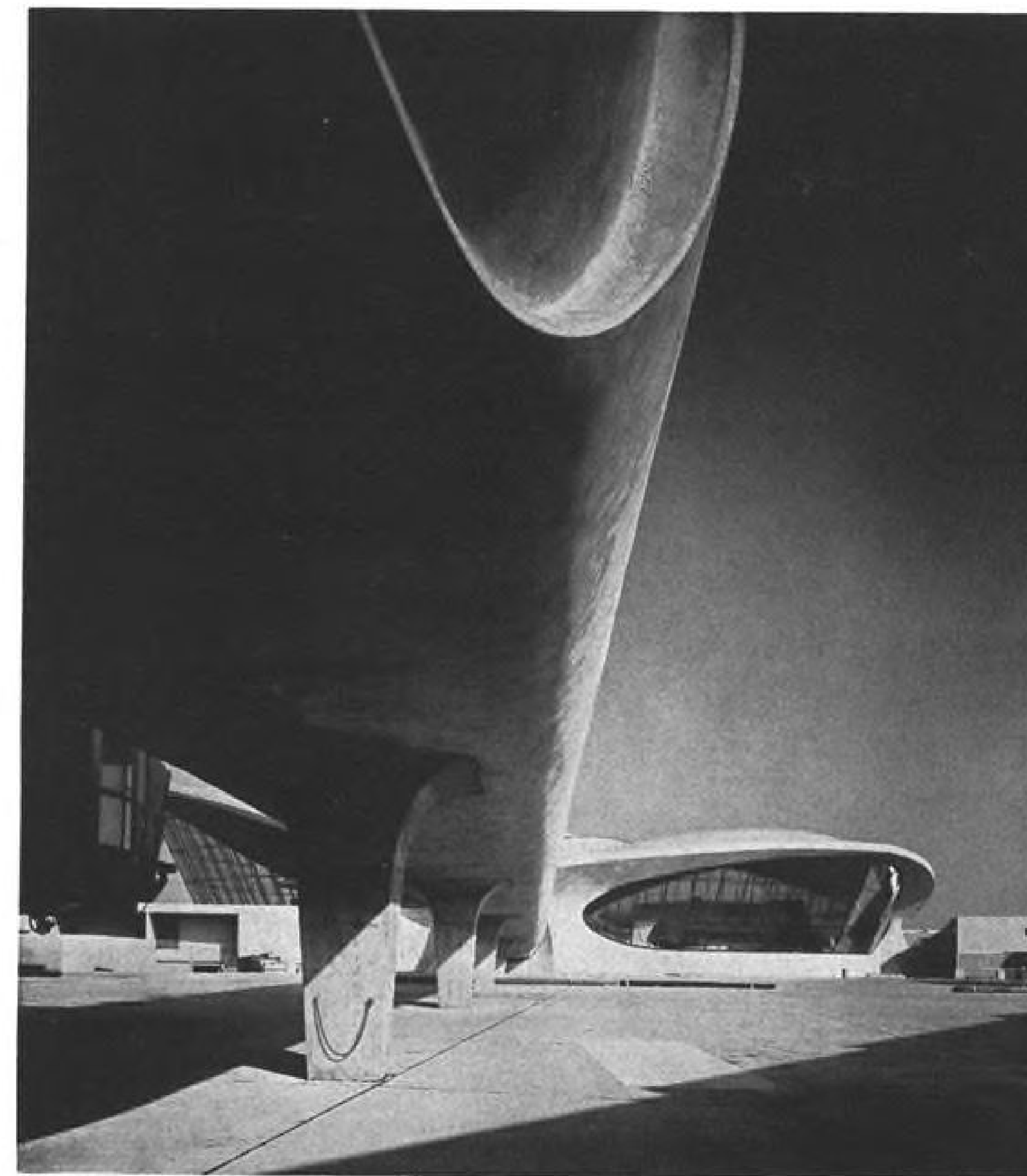
Studies are being made of possibilities for adapting sophisticated reconnaissance and fire control systems used by supersonic aircraft to slower, older aircraft now in use. Some studies have been made of converting some of the conventional aircraft available in large numbers or in use by many small countries, like the T-28 and the AD-5 and AD-6 Skyraider, to turboprop power. A version of the two-seat Cessna T-37 twin-jet trainer using a turboprop engine has also been under study.

The 1st Combat Applications Group

has been assigned the task of writing a requirement for a low-speed, low-altitude aircraft capable of conventional weapons delivery in counter-guerrilla operations (AW June 4, p. 35). Chance Vought has a proposal for a turboprop-powered airplane in this category and North American Aviation has done some studies, one design closely resembling the F-86 Sabre.

### Rotary Wing Types

Indications are that the Special Warfare Center considers that a properly balanced force of support aircraft for its specialized operations should also include rotary wing types and plans are being formulated to include some helicopter types in future evaluations at the center.



## TWA Terminal Features Unique Architecture

Concrete tube, 307 ft. in length, forms an elevated passageway at Trans World Airlines new terminal at Idlewild in New York between central terminal structure (rear) and an outer building where passengers board and deplane. Seven aircraft positions, each equipped with two telescoping boarding ramps, are located around the outer building. Separation of the boarding area and central structure is designed to ease congestion of persons waiting for flights and those checking in or claiming baggage. Plans call for increasing aircraft positions to 14 with construction of a second passageway and boarding area on the opposite side of the central structure. TWA expects the terminal, designed by the late Eero Saarinen to handle passenger volume growth through 1975. Cost of the building was \$15,000,000. The terminal complex is of reinforced concrete construction, with 8,500 sq. ft. of 4-in. thick glass forming the walls of the central structure.

# FINANCIAL

## Two Airlines List Salaries for CAB

Washington—Following are airline officers' salaries, bonuses and indirect compensation, expenses, and stock holdings for the year ending Dec. 31, 1961, reported to Civil Aeronautics Board:

**Los Angeles Airways, Inc.—C. M. Belinn**, president, \$25,000 salary, \$2,706 expenses, 6,163 shares of common stock; **J. T. Kane**, vice president and treasurer, \$15,667 salary, \$1,761 expenses; **F. W. Milam**, vice president-transportation, \$14,667 salary, \$1,261 expenses, 4,560 shares of common stock; **E. H. Slingsby**, assistant treasurer, \$9,300 salary; **R. P. Hubley**, vice president-sales (since May 5, 1961), \$9,707 salary, \$1,330 expenses; **W. C. Jordan**, director, 1,000 shares of common stock; **J. G. Lombardi**, director; **H. Judd**, director, \$344 expenses; **K. W. Dyal**, director; **M. J. Burke**, secretary; **S. J. Slade**, assistant secretary (since Dec. 5, 1961), \$5,677 salary, \$336 expenses. Following firms were paid \$5,000 or more for services rendered during 1961: **Burke, Williams & Sorensen**, legal services, \$6,324; **Gibson, Dunn & Crutcher**, labor relations, \$5,310.

**Mackey Airlines, Inc.—J. C. Mackey**, president and chairman of the board, \$20,000 salary, \$3,141 expenses, 115,834 shares of common stock; **J. H. Popham**, executive vice president, secretary, treasurer, and director, \$15,000 salary, \$808 expenses, 10,001 shares of common stock; **H. E. Johnson**, vice president-traffic and sales, \$10,500 salary, \$1,940 expenses, \$42 shares of common stock; **R. C. Tischler**, vice president-operations, \$15,000 salary, \$629 expenses, 10,148 shares of common stock; **L. J. Povey**, manager non-transport division and director, \$10,000 salary (from non-transport division), 1,745 shares of common stock; **J. B. Fraser, Sr.**, director, \$1,200 bonus and indirect compensation, 20,500 shares of common stock; **L. E. Mallory, 3rd**, director, \$1,200 bonus and indirect compensation, 2,928 shares of common stock, 128 shares of common stock held in trust for son; **W. L. Kroetz**, director, \$1,200 bonus and indirect compensation, 3,000 shares of common stock, 100 shares of common stock held in trust for daughter; **J. Kirkwood, Jr.**, director, \$1,200 bonus and indirect compensation, 16,200 shares of common stock.

The following firms were paid \$5,000 or more for services rendered during 1961: **Adair, Ulmer, Merchison, Kent & Ashby**, legal services, \$18,983; **Aircraft Services, Inc.**, ramp service, \$19,645; **Airwork Corp.**, engine overhaul and aircraft parts, \$37,646; **Air Carrier Engine Service**, engine overhaul and aircraft parts, \$46,177; **Frederick B. Ayer & Associates**, rental DC-6 and engine, \$61,364; **American Airlines**, rental DC-6, \$60,952; **Broward County Commission**, rent and landing fees, \$29,146; **Collector of Customs, Ft. Lauderdale**, customs inspection, \$5,512; **Collector of Customs, West Palm Beach**, customs inspection \$11,563; **Civil Aviation Department, Nassau**, landing fees and rent, \$17,786; **Dade County Port Authority, Miami**, landing fees and rent \$15,830; **Department of Airports, West Palm Beach**, landing fees and rent, \$15,109; **Dispatch Services**, dispatching and ramp services, \$20,441; **Florida Power and Light Co.**, utilities, \$7,392; **Nassau Air Dispatch Service**, dispatching and ramp service, \$8,916; **Olsen & Dickey Advertising, Inc.**, advertising, \$6,881; **Mackey Aviation Services**, gasoline and oil, \$89,094; **Phillips Petroleum Co.**, payment on loan of gasoline, \$56,970; **Standard Oil Co.**, gasoline and oil, \$76,131; **Sullivan Insurance Agency**, insurance, \$57,267; **Southern Bell Telephone Co.**, telecommunications, \$23,757; **Esso International Corp.**, gasoline, \$11,711; **Walmore Equipment Co.**, cylinders, \$29,321; **J. E. Phillips & Co.**, legal and accounting, \$7,675.





***Alcoa capability  
at work...  
ups output  
cuts costs  
of complex capsule***

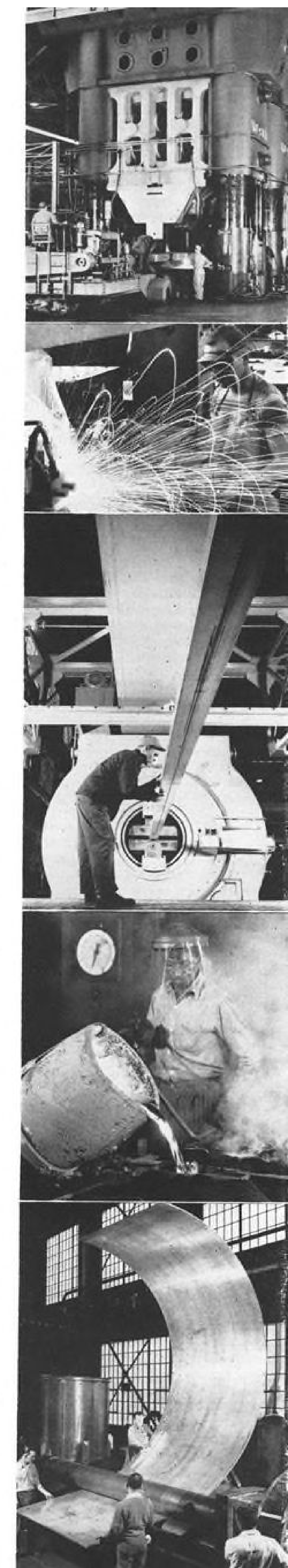
When Alcoa engineers first got a look at this pint-sized aluminum capsule—no bigger than a softball—it took over 100 operations to produce. The Army Chemical Corps asked us to look into forging, extruding and other metal-working processes as a method of simplifying the job. Alcoa capability went to work. By the count: Alcoa know-how slashed away nearly half of the steps in production, resulting in a significant time saving in output and expected cost saving in large-quantity production.

This is another example of what Alcoa total capability can do and is doing every day in the production of scores of defense items for all services.

**World's biggest light-metals workshop**, and Alcoa runs it. No other basic producer can match Alcoa production facilities, or our knowledge of the metal we produce. Alcoa is equipped to fabricate aluminum by every conceivable method. We have no axes to grind for any one process. That's why when you bring Alcoa a production problem, you can be sure you'll get a straight answer on how best to handle it.

Whatever it takes to do the job—castings, forgings, impacts, extrusions—Alcoa can do. Research, engineering, testing—Alcoa can do. How can you use our total capability? Write Aluminum Company of America, Jobbing Division, 1865-F Alcoa Building, Pittsburgh 19, Pa.

 **ALCOA ALUMINUM**  
ALUMINUM COMPANY OF AMERICA





# SAFETY

## U.N. Hammarskjöld Crash Report—Part 2:

# Sabotage, Attack Doubted by Commission

(Following is the second of two AVIATION WEEK articles containing excerpts from the United Nations General Assembly commission report on the DC-6B crash on Sept. 17, 1961, which took the lives of U.N. Secretary-General Dag Hammarskjöld and the other members of his party. The first article (AW June 18, p. 95) contained details on flight preparations and early phases of the flight. The last article is concerned with a description of the crash and commission opinions on the cause.

After passing over the airfield, SE-BDY appears to have executed a turn over the appropriate approach area and to have crashed near the end of the turn as it came back to an easterly heading. In fact, in all test flights conducted by the Rhodesian Board of Investigation in which a procedure turn was made, the test aircraft flew over the crash site on approximately the same heading (120°) as the swath cut through the trees by SE-BDY. The Rhodesian Board of Investigation was satisfied that SE-BDY was carrying out a procedure approach when it crashed.

The time of the crash to the exact minute is difficult to fix. If one accepts as correct the time given by Mr. Martin, that the aircraft was over the airfield at 2210 Z, then the time of the crash was probably about 2213 to 2215 Z. On the other hand four watches which stopped within less than two minutes of each other gave a mean time of 2211 Z and there is some evidence that the aircraft may have passed over the airfield a few minutes earlier than reported in Martin's log. In any event the crash almost certainly occurred between 2210 Z and 2215 Z, or shortly after midnight Ndola time.

### Crash Scene

The spot where the aircraft struck is approximately nine and a half miles west of Ndola airport. The ground elevation at the point of impact was 4,285 feet and the height of the tops of the first trees standing on slightly higher ground, which were brushed by the aircraft, was 4,357 feet. This is nearly 200 feet higher than the elevation of the Ndola airport which is 4,160 feet. There was also a ridge of higher ground lying between the crash site and the airfield which might have obscured the view of the lights of Ndola immediately before the crash.

An examination of the crash site and of the aircraft wreckage appears to establish beyond all doubt that, except for its altitude, the aircraft was in a normal approach position at the time of the crash. The description in the following paragraphs is based on the opinion of experts who participated in the work of the Rhodesian Board of Investigation and who testified before this Commission.

The landing wheels were lowered and

locked, flaps were in an intermediate (30°) position proper for that stage of the approach. Engines appear to have been operating under normal approach power. There were no signs of excessive speed. Moreover, several experts stated that experience had shown that had the aircraft speed at this time been excessive, the nose-wheel housing would almost certainly have become detached from the fuselage before contact with the trees.<sup>9</sup> This, however, had not occurred. The seat belts of at least six of the persons aboard were fastened; the position of others could not be determined. The landing lights were not extended but testimony was given to the effect that they would not necessarily be turned on at that stage of an approach.

### Level Flight

The aircraft was either in level flight or at a very shallow angle (to the order of perhaps one degree) when it first brushed the tree-tops and there were indications that, at this moment, the aircraft was banked slightly to the left. After the initial contact with the tree-tops, the angle of descent and the amount of left bank increased. The angle from the point of first contact to the site of the crash averaged 5°. The first indication of contact was branches severed by the propellers and traces of rubber from the propeller de-icing boots. Almost immediately thereafter the left wing tip was ripped away and the left wing was progressively demolished nearly to the number 1 engine as it tore through the trees at an increasing angle of bank. At about 760 feet from the point where the aircraft first touched the trees, the stub of the left wing struck the ground in front of a 12 foot high ant-hill. The aircraft cart-wheeled to the left coming to rest facing the direction from which it had come. The nose cone was broken off and found intact on the ant-hill. The interval from first contact with the trees to final crash could not have been more than a few seconds.

At the time of the crash, SE-BDY must have had nearly 5 tons of fuel remaining in its tanks. Petrol from the demolished left wing had been spilled over the last 300 to 350 feet of the wreckage trail. The fuel from the right wing, which was broken as

<sup>9</sup> The Swedish Government, however, comments as follows:

"The (Rhodesian) Commission of Inquiry states that the nose wheel doors should have been detached in the air, should there have been great speed, as for instance after a diving movement of the aircraft prior to the impact. The fact that this did not happen indicates in the opinion of the Federal Commission that there had not been any considerable dive towards the ground, followed by a flattening out. We would like to point out, however, that the landing gear was in a lowered position and that the dive, if any, could not mean a loss of height of more than a few hundred yards."

it descended through the trees at the completion of the cart-wheel, must have poured over the main wreckage. The fire which ensued engulfed the wreckage and flashed back along the petrol trail. The intense heat destroyed or melted 75 to 80 per cent of the fuselage and exploded the ammunition and pyrotechnics carried on board the aircraft.

There was no sign of scorching of the tree tops or other indication of fire in flight and a search, conducted for the Rhodesian Board of Investigation, of the area which the aircraft presumably traversed immediately prior to the crash revealed no part of the aircraft prior to contact with the trees. . . .

On the basis of the testimony of the Rhodesian police officers who first reached the crash site, it would appear that at the moment of impact the Secretary-General was thrown clear of the aircraft, falling outside the area subsequently covered by fire. The Rhodesian medical report of Drs. H. D. Ross, P. J. Stevens and J. Hillsdon Smith concluded that the Secretary-General had died instantly from injuries resulting from his fall. On the other hand, on the basis of a study of the Rhodesian medical report made at the request of the Medical Board of Sweden, Drs. A. Frykholm and N. Ringertz expressed the opinion that if Mr. Hammarskjöld had been rescued immediately after the accident and had immediately received medical treatment with the most modern equipment, the survival period might have been somewhat lengthened. In other respects the Swedish report concurred in the findings of the Rhodesian medical report.

### Survivor Found

Sgt. Julien was found alive outside the charred area. He had been burned by fire and had suffered further from exposure and sunburn in the course of the 16 hours that he remained at the crash site. He received first-aid treatment from police who arrived at the scene of the crash and was taken to Ndola hospital at about 16.45 local time. Despite constant medical attention he died at 08.00 on the morning of 21 September 1961. Dr. MacNab, who headed the team of doctors looking after Sgt. Julien, stated that if he had been rescued earlier in the morning and had not suffered the heat of the sun all day he would have had a better chance of surviving. Dr. Lowenthal, who also saw Sgt Julien immediately after his admission to the hospital, testified that his chances of survival would have been infinitely better.

The others aboard the aircraft are believed to have died within seconds after the crash. Some had suffered injuries which would have precluded survival even had no fire ensued, others were considered to have died suddenly from shock.

Bullets were found in the bodies of the two Swedish soldiers. At the outset of the

Rhodesian Investigation some doubt was expressed whether this could be explained by the explosion of cartridges set off by the fire. However, the bullets were relatively superficially sited below the skin and in the muscle, and fragments of exploded shell cases were found in the same wounds. Ballistic examination showed that they bore no rifling marks and had not passed through the barrel of a gun. They were also of the same calibre as the ammunition carried by the soldiers themselves. It was consequently accepted by all experts consulted that the presence of the bullets was in fact the result of cartridges in close contact with the bodies exploding during the fire.

One body was not found until the second day when parts of the wreckage were moved. The absence at first of information concerning the total number of persons aboard undoubtedly contributed to the difficulty of ascertaining that all bodies had been found. The Commission is satisfied that a proper identification was made of the 16 persons aboard the aircraft.

### Possible Causes

In the case of the crash of an aircraft where there are no survivors and where the greater part of the wreckage is destroyed by fire, difficulties may be encountered in determining the cause of the crash. Various theories have been advanced with or without supporting evidence and different conclusions have been reached. Some have been based only on rumor. The Commission considered it among its duties to examine these theories and rumors and to provide the true facts wherever possible. Possible causes of the crash will be considered under four main headings: (1) Sabotage or internal interference; (2) Attack or external interference; (3) Material failure; and (4) Human failure.

Counsel for the governments represented before the Commission have argued the question whether the Commission should require in each case proof beyond reasonable doubt or should reach its conclusions on the preponderance of evidence or the balance of probabilities. The Commission, while accepting that it is not required in expressing an opinion to limit itself to the rules of evidence of any particular legal system in respect to a particular class of cases, believes that it should apply generally the standard of proof required in the search for truth. This standard will be applied equally to all of the possible causes considered by the Commission.

#### 1. Sabotage or internal interference

As no special guard was provided for SE-BDY prior to its departure from Leopoldville, the possibility of an unauthorized approach to the aircraft for purposes of sabotage cannot be excluded. Moreover, although the doors were said to have been locked, access was possible to the hydraulic compartment, the heating system, and the undercarriage of the aircraft.

One possible means of sabotage could be interference with one or more of the aircraft's vital parts, such as the cables operating the control surfaces or the flap or undercarriage mechanism, in order to render these parts inoperative at the time of approach or landing. There is however, no evidence before the Commission of such interference. The technical examination of

the vital parts which had not been destroyed by impact or fire revealed no pre-crash damage. Furthermore, the aircraft had been properly trimmed for an approach and the crash path did not indicate any abnormality in maneuverability or control such as might have been expected if sabotage of this type had occurred.

### Second Possibility

A second possibility which seems most unlikely in the present case is the use of a time bomb. A potential saboteur would scarcely have anticipated that the aircraft would take a route requiring over six hours instead of the direct route requiring only four or five hours flight. Likewise it would have been difficult to guess the exact time of departure.

The possibility might also be considered of an infernal machine, the activation of which was linked to the mechanism operating the undercarriage or wing flaps so as to explode when these were set for landing, to a barometric instrument operating when the aircraft descended to a pre-set altitude, or to some other scientific device. The installation of bombs of this order would require special skill while considerable time would be needed for their manufacture.

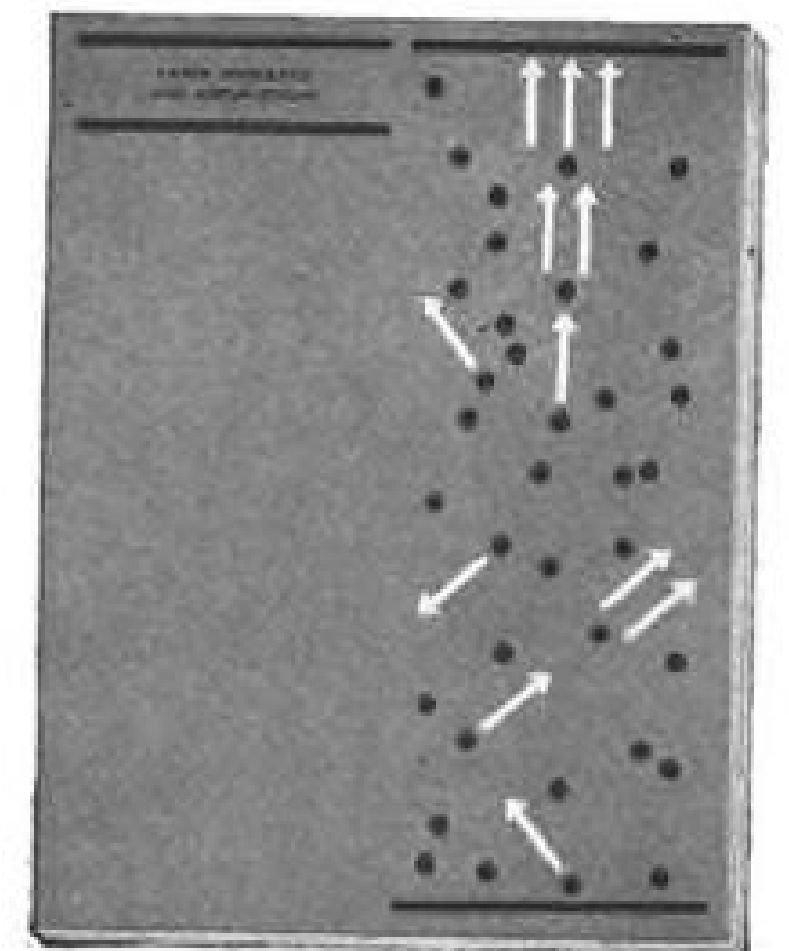
While the detonation of a bomb at the time of landing is not impossible, the Commission must repeat that there is no evidence of a bomb having exploded aboard the aircraft, or in fact of any explosion having occurred while the aircraft was in flight. Specifically, technical examination established that there were no traces of an exploding bomb on the undercarriage or in the vicinity of its housing, or in any other parts of the aircraft which were examined. As described earlier in this report, further scientific experiments are being carried out on the wreckage at the request of the Commission in order to leave no possibility of proving or disproving sabotage unexplored.

### Witness Reports

There is no convincing evidence that any witness heard or saw an explosion before the crash. Certain witnesses testified to explosions at the approximate time of the crash, but in all probability these were exploding fuel tanks and subsequent discharge of ammunition and pyrotechnics carried on board the aircraft. A member of the Northern Rhodesian Police reported that at 2340 Z he saw an exploding light in the sky and and object dropping immediately thereafter. This was approximately an hour and a half after the crash, and what was seen may have been the discharge of one or more of the pyrotechnic signalling cartridges carried by SE-BDY or, as variously suggested by the Rhodesian Commission of Inquiry, a bursting gas container, oxygen cylinder or some other part of the wreckage blown into the sky during the fire.

Several witnesses testified that Sgt. Julien spoke of an explosion. According to Dr. Lowenthal, he first said there was a crash and then an explosion and later said there was an explosion and then a crash. According to Nurse McGrath, he said there was an explosion when the aircraft was on the runway. Senior Inspector Allen made the following statement to the Rhodesian Board of Investigation regarding his conversation

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with Sgt. Julien and confirmed it before the United Nations Commission:

"I told him that we had last heard of you over the runway at Ndola airport and we didn't hear anything more: 'What happened?' He said: 'It blew up'. I said: 'Was this over the runway?' and he said: 'Yes'. I said: 'What happened then?' and he replied: 'There was great speed—great speed'."

Sgt. Julien's reference to an explosion may relate either to the shock and sound of the left wing being torn off as it struck the first tree, or to the explosion of the fuel tanks at the time of impact. The idea that this occurred over the runway seems to have been inadvertently suggested to him by Senior Inspector Allen and in his state of shock and sedation, this probably has no significance. It is possible that the reference to great speed reflected the sensation of the aircraft passing through the trees, as suggested by the Rhodesian Commission of Inquiry.

#### Aircraft Observed

It must also be noted that several witnesses who saw SE-BDY fly over the airfield and disappear in a west or north-westerly direction reported seeing a flash in the sky at times varying from 20 seconds to 4 or more minutes thereafter. The Swedish observers at the Rhodesian Board of Investigation, noting this discrepancy in time, suggested that the possibility should be examined whether there had been two flashes, one of them while the aircraft was still in the air. However, when test flights were made with the witnesses observing the aircraft from positions which they had occupied on the night of the disaster, one of

these witnesses, Mr. Peover, realized that from the fourth story balcony of his apartment building he must have seen SE-BDY through most of its procedure turn. He concluded that it had disappeared from his vision only a few seconds before the actual crash. Some of the other witnesses who had made their observations from the ground would have lost sight of the aircraft several minutes earlier. Discrepancies in the times given by other observers may possibly be explained by their relative field of vision according to the nearness or remoteness of the tree line.

As another possibility of internal interference the Commission notes the sensational story carried in several newspapers in some countries during January 1962 to the effect that a seventeenth man boarded the aircraft at Leopoldville for the purpose of hijacking it. The story speculated that the crash occurred when this man tried to take over the aircraft from the pilot. While this story falls clearly in the category of rumor, the Commission carefully investigated whether or not it was true. Dr. Liner and others who saw the plane take off from Leopoldville testified that they knew or were introduced to all persons who went aboard. Moreover, Dr. Ross considered the possibility of there having been a seventeenth body in the wreckage unlikely in the extreme, while the police, who did not know how many persons were aboard, examined the scene of the crash in order to discover if anyone had wandered into the bush but found no trace of this.

#### 2. Attack or external interference

The Commission has carefully examined the possibility of SE-BDY having been shot down by another aircraft or by attack from

the ground. It has also considered the possibility that the crash may have resulted from evasive action, or from momentary distraction of the pilot by an attack or feigned attack from the air or from the ground. The Commission has found no evidence to support such a hypothesis.

The Commission received testimony from experienced Air Force officers of the great difficulties attached to the successful shooting down of an aircraft at night, particularly where the aircraft route and time of arrival are uncertain. With respect to the latter points, however, it is noted that aircraft landing at Ndola frequently pass close to the crash site and that the approach of SE-BDY to Ndola was disclosed approximately two hours before its arrival, and estimated times of arrival were given in communications to Salisbury FIC and to Ndola tower which could be readily intercepted by any interested person. The possibility cannot, therefore, be ruled out completely.

#### Katanga Plane

The possibility of other aircraft being in the area of Ndola at the time of the crash was examined. Since the Fougua Magister of the Katangese Armed Forces had been operating against the United Nations in Katanga, the possibility of its reaching Ndola was examined by the Rhodesian Board of Investigation and the Rhodesian Commission of Inquiry.

It was established that it could not have made the flight from its normal base at Kolwezi to Ndola and returned to Kolwezi since the distance is greater than its operational range. It was also stated by its captain and others that the Fougua was on the ground at Kolwezi the night of 17/18 September and could not have operated that night. This evidence is not entirely conclusive since the captain admitted before the Rhodesian Commission of Inquiry that on at least one occasion the Fougua had taken off from an unpaved track. While this particular track was said to be at an even greater distance from Ndola, nothing would appear to preclude the use of a track within range of Ndola. Nevertheless, there is no evidence that the Fougua was in the vicinity of Ndola on the night of the crash.

The Rhodesian authorities have stated that they have no knowledge of any aircraft other than SE-BDY being in the air in the Ndola region between 2035 Z. when OORIC landed, and the time that SE-BDY is presumed to have crashed. The Commission has, however, been informed that no radar watch was maintained in the Ndola area during the evening and night of 17 September 1961 and, therefore, the possibility of an "unknown aircraft" cannot be entirely excluded.

Certain witnesses testified that they saw or heard a second, or even third, plane. In particular, some of them testified that they saw a second smaller aircraft flying close to SE-BDY after it had passed over the airport or immediately before the crash and that the smaller aircraft was beaming lights on the larger. The Commission visited with some of these witnesses the spots from which their observations had been made and endeavored to obtain an understanding of their testimony. The Commission considers that several of these witnesses were sincere in their accounts of what they believed they

saw. The Commission is also of the opinion, however, that these witnesses may have misinterpreted their observations and reported some incidents which may not in fact have occurred in the way or at the time that they believed when they testified before the Commission.

The Commission notes that SE-BDY, a DC-6B, is a larger aircraft than normally seen in the Ndola area and was equipped with a red flashing anti-collision beacon located on an unusually high tail fin. It seems possible that the "smaller plane" may in fact have been the tail assembly of SE-BDY whose flashing beacon would have given different impressions depending on the angle of vision. This possibility is supported by witnesses' testimony that the smaller plane flew above and behind the larger plane at a fairly steady interval.

This theory does not explain all aspects of their testimony, particularly the statement of some of these witnesses that the small plane flew away after the crash. It is possible, considering the time lapse between the crash and their testimony, that some of the witnesses may have believed that they saw or heard phenomena which, in fact, they did not, or have compressed into a single day observations of events occurring over a longer period. Other witnesses showed strong anti-Federation feelings and it is probable that some of their testimony was given for political motives. . . .

With the foregoing exceptions none of the witnesses who observed SE-BDY as it flew over the airfield and disappeared from sight saw another aircraft, and no one reported hearing the sound of gun-fire before the crash.

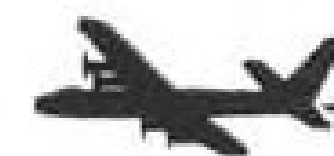
#### Ground Fire

The Commission also considered the possibility of an attack from the ground. It was observed that there were clearings which could have afforded a field of fire. On the other hand, an attack with prospects of success would, in the opinion of experts, have required a concentration of fire and there was no evidence direct or indirect, to suggest that this had taken place. No strangers were reported to have been in the bush, nor, as noted above, was any sound of gun-fire heard before the crash.

When the wreckage was first examined several holes were noted which it was thought might have been bullet holes. Closer examination established to the satisfaction of all experts that this was not the case, with the possible exception of a hole in the right hand window frame of the cockpit. At the suggestion of the Swedish representative, the Rhodesian Commission of Inquiry ordered a spectrographic examination.

This examination, the United Nations Commission was informed, established to the satisfaction of the Swedish experts that the hole had not been made by a bullet.

Mr. Virving, a Transair official, put before the Commission a theory that SE-BDY might have been attacked and shot down by a plane armed with rockets. This theory was based in part on an analysis of the statements of various witnesses concerning their observations of planes and of flashes in the sky. No substantial evidence was submitted in support of this theory and the Commission is of the opinion that most of



# 2

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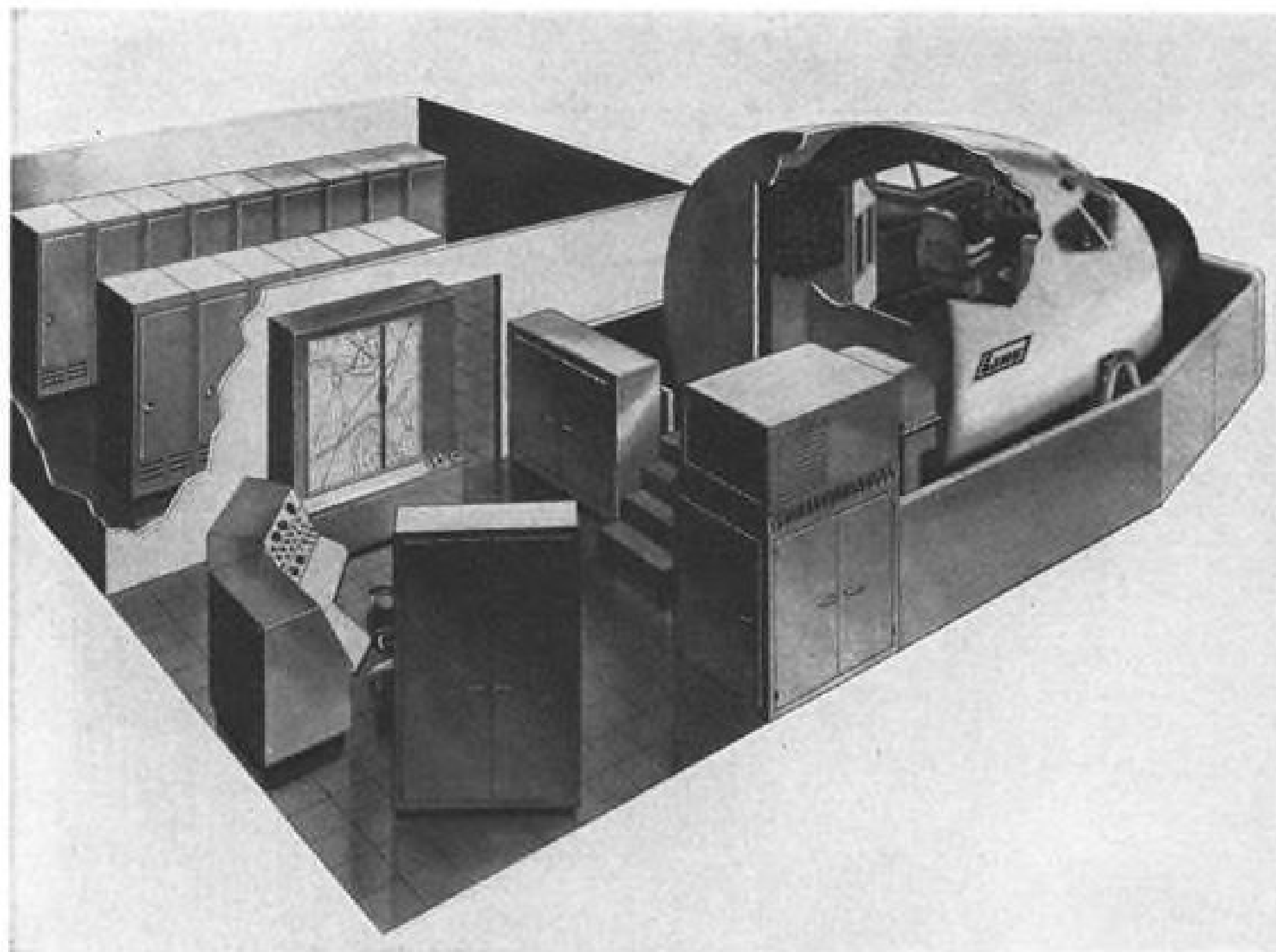
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### C-135 Simulator to Use Digital Computer

Mark I digital computer, developed by Link Division of General Precision, Inc., will be used in two USAF C-135 jet transport simulators (AW June 11, p. 95), configured as shown in artist's concept. Simulators will incorporate Link's three-point motion system to provide realistic flight characteristics. The three-point motion system was developed for the B-58 simulator, also is utilized in the C-130 simulator.

the phenomena referred to by Mr. Virving are susceptible of other and more logical explanations. The Commission also consulted rocket experts with ONUC who expressed considerable doubt concerning the possibility of such an attack. Finally, as already noted, no signs of a pre-crash explosion or traces of a rocket were found in the wreckage.

The Commission also noted the opinion of experts that, had the aircraft been shot down, its descent might have been expected to have been at a steeper angle than that indicated by the path of the crash. Had SE-BDY been attacked and evasive action attempted, the normal reaction of the pilot, if time permitted, would have been to retract the undercarriage and flaps and to apply full engine power. None of these measures was taken.

#### 3. Material failure

##### (a) Technical or structural defect

There is no evidence whatever to suggest that the crash of SE-BDY may have been caused by technical or structural defect in the aircraft or its engines. In the opinion of technical experts the aircraft was trimmed, and the engines and propellers appropriately set, for a normal approach to the runway. Such is unlikely to have been the case had there been any defect, failure or malfunctioning of any important component. Since the state of the wreckage did not permit a full examination this possibility cannot be completely excluded, but it appears unlikely for the reasons stated.

##### (b) Altimeter failure

An examination of the altimeters by the United States Civil Aeronautics Board and the Kollsman Instrument Corporation, the manufacturers, did not reveal any defects existing before the crash. Each altimeter also had the correct barometric setting as given by the Ndola control tower.

One altimeter, when found after the crash, was disconnected from its static supply. The effect of such disconnection would be for the altimeter to show an altitude based on the pressure inside the aircraft instead of on the outside pressure. Normally the result would be an indication of an altitude lower than true, and the consequent reaction of the pilot would be to gain height. When at high altitude the cabin pressure of SE-BDY was said to be maintained at a pressure equivalent of 6,000 feet. However, on descent the pressure should automatically increase and at no time should it be less than the pressure outside the aircraft.

Disconnection could have occurred as a result of the impact. Had it occurred in flight the captain should have had an instant warning since his rate-of-climb indicator, connected to the same static supply, would also have been affected. The captain's and copilot's altimeters in SE-BDY were provided with separate static supplies and consequently any disconnection or leakage should also have been revealed by discrepancies in the readings of the altimeters.

##### (c) Fire in flight

There has been no evidence before the Commission of any fire aboard the aircraft before it struck the ground. The experts who examined the crash site reported no scorching of the tree-tops and no horizontal streaks on the parts of the aircraft examined which would indicate a fire in flight. Two hand fire extinguishers were found in a discharged condition and the Commission requested their examination in an attempt to determine whether they had been manually operated during flight or discharged by heat or other causes after the crash. The results of the dismantling and examination were inconclusive

but it was noted that at least one of the fire extinguishers had still been attached to the bulkhead of the aircraft at the time of the crash. It was therefore unlikely that it had been used in flight. Moreover, it is believed that had there been a fire, traces of remedial action by the pilot such as emergency decompression of the cabin would have been found. From the evidence it appeared that no such action had taken place.

Finally, there was no evidence of carbon monoxide poisoning and the traces of carboxyhaemoglobin found in a few bodies could readily be accounted for either by cigarettes or by a few seconds survival after the fire had started. While the possibility of fire in flight cannot be completely excluded, there is no evidence of any kind to support it.

#### 4. Human failure

##### (a) Incapacitation of pilots

The theory was advanced that one or more of the pilots became suddenly incapacitated. The Commission did not receive any evidence to support this hypothesis. The Commission notes that there is no evidence in the medical reports that any of the pilots had been unable, for physical reasons, to perform his duties. However, since all forms of incapacity would not necessarily be revealed by a post-mortem examination, this possibility cannot be excluded.

#### No Pilot Fatigue

The Commission is also satisfied that the accident was not due to pilot fatigue. In this connection the following is noted:

(a) The total flying time from Leopoldville to Ndola was only 6 hours and 30 minutes;

(b) There were three experienced pilots on board, at least one of whom had had 14 hours rest;

(c) There was sleeping accommodation on board for the pilots;

(d) There was an automatic pilot;

(e) Navigation by dead-reckoning in these parts of Africa did not present particular problems under the circumstances, and should not cause exceptional fatigue.

##### (b) Use of wrong instrument landing chart

Considerable attention was given in the proceedings before both the Rhodesian Board of Investigation and the Rhodesian Commission of Inquiry to the possibility of confusion between Ndola in Northern Rhodesia, with an elevation of 4,160 feet above sea level, and Ndolo, a small aerodrome with an elevation of 951 feet above sea level, close to Leopoldville. In the wreckage of SE-BDY, copies were found of a U.S. Air Force flight information manual containing an instrument landing chart for Ndolo, but none for Ndola. In January 1962, a member of the Rhodesian Board of Investigation noted that in one of these manuals the altitude of Ndola (4,160 feet) was written in green ink on the Ndolo landing chart.

It was eventually established that the handwriting was not that of any of the pilots aboard SE-BDY.

The possibility of confusion between the two airports appears to the Commission to be remote. The approach procedure for Ndolo is to the east of the airport and that for Ndola is to the west. The aircraft was apparently following, at least generally,

approach procedure for Ndola at the time of the crash. There are prominent topographic features such as the Congo river on the Ndolo chart which would be difficult to overlook. Moreover, Captain Hallonquist is reported to have discussed with others the similarity in the names of Ndola and Ndolo, and the fact that the altitude of Ndola was very close to that of Elisabethville in Katanga with which he was thoroughly familiar. Finally, there is no reason to believe that Captain Hallonquist was not using the Ndola chart from the Jeppesen Manual which was aboard the aircraft and was normally used by Transair pilots. The page containing the Ndola landing chart was missing from the copy of the Jeppesen Manual which was found in the wreckage. It is believed that the pilot, as is customary, removed the page, for use in landing, from this loose-leaf publication and clipped it next to him in the cockpit where it burned during the fire. Thus the absence of this page is a strong indication that it was in fact being used.

##### (c) Misreading of altimeters

The Commission examined the question of whether the crash could have resulted from a misreading of altimeters by the pilots. It noted several accident reports in which experienced pilots had misread their altimeters. The most common mistake appears to be a misreading of 10,000 feet, due to the small size of the 10,000 foot pointer. The manufacturer of the altimeters used on SE-BDY has changed this pointer in their newer instruments to make it more easily readable. It seems unlikely in the present case, however, that a mistake of 10,000 feet could have been made immediately after flying over a well-lit airfield. The possibility was also suggested by a member of the Rhodesian Board of Investigation that the pilot might have misread 4,600 feet for 6,400. However, a mistake would have to be repeated several times and no explanation was offered of how he might have descended to that particular height without noting the altitude.

Although on the one hand there is no evidence to support this particular hypothesis, on the other hand the possibility of some misreading of the altimeter cannot be completely excluded.

##### (d) Distraction of the pilot's attention

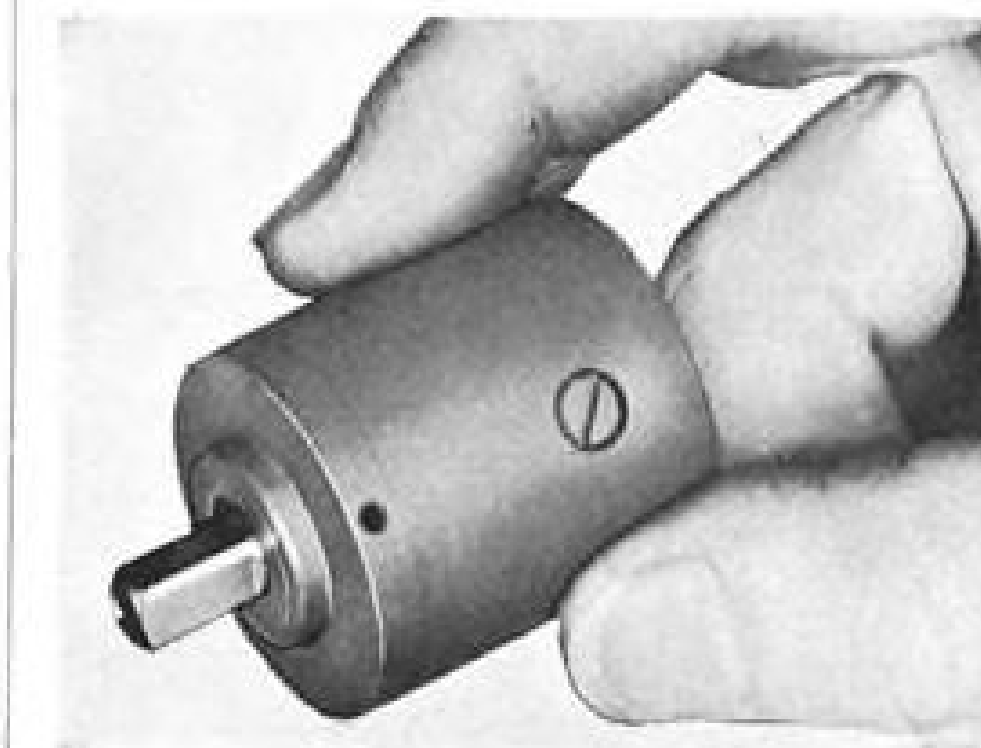
If the pilot had for some reason descended to 5,000 feet in the course of his procedure turn, as is permitted in some instrument landing charts for Ndola, or in a visual or semi-visual approach, his margin of safety over the crash site then could have been reduced to less than 650 feet.

It is possible that some momentary distraction, either from inside or from outside the aircraft, during the precise flying needed for his procedure turn, may have caused him to lose the remainder of this rather narrow margin. It would be extremely difficult either to prove or to disprove this hypothesis as a possible cause of the accident.

##### (e) Misleading or incomplete information provided to the pilot of SE-BDY

It may be noted that ICAO specifications for Instrument Approach Charts require depiction of topographical information pertinent to the safe execution of the

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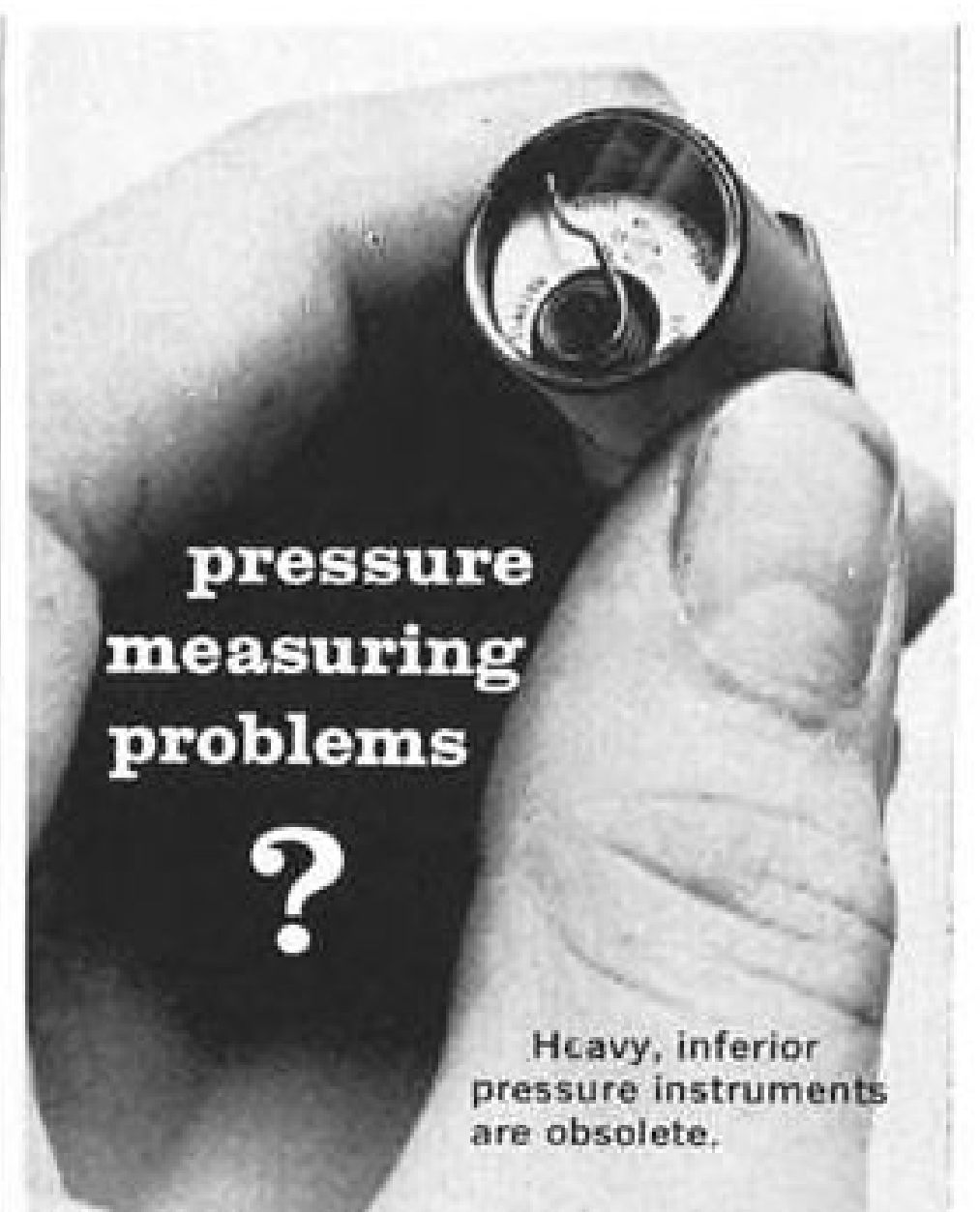
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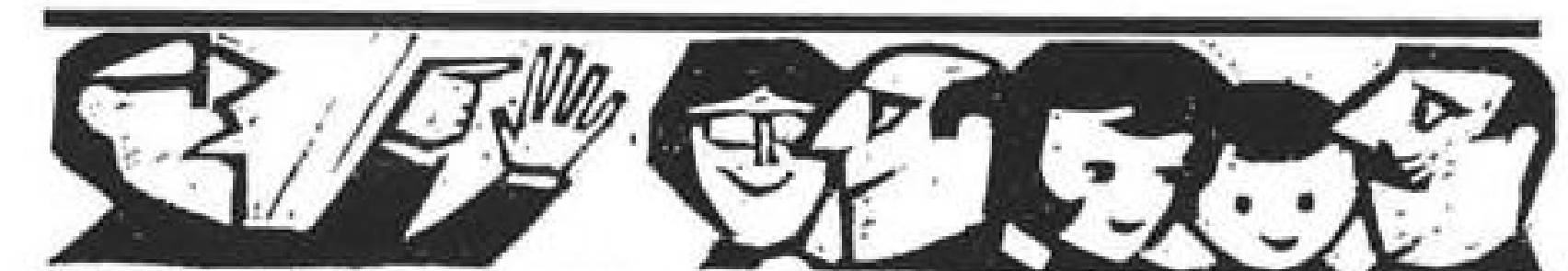
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## PROBLEMATICAL RECREATIONS 124



Maynard the Census Taker visited a house and was told, "Three people live there. The product of their ages is 1296, and the sum of their ages is our house number." After an hour of cogitation Maynard returned for more information. The house owner said, "I forgot to tell you that my son and grandson live here with me." How old were the occupants and what was their street number?

—Contributed

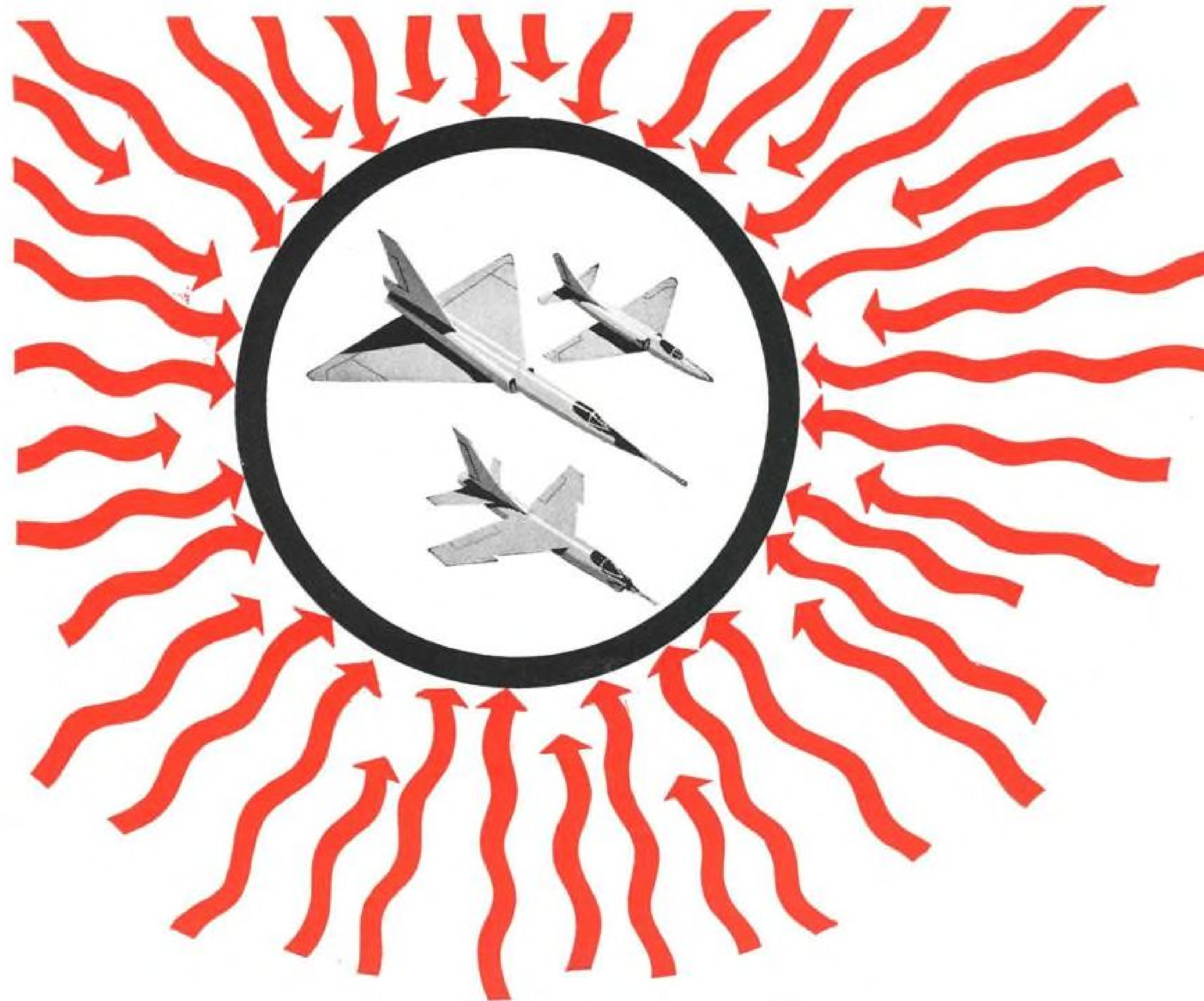
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ANSWER TO LAST WEEK'S PROBLEM: The highest possible number is 81; therefore, the root is less than 300 but it can't be over 200 because as a palindrome it would not be a prime. Being in the 100's the final square of the number can only be 01 or 81. Only 5 or 9 as a central digit will yield these. Therefore: 36481 = 191<sup>2</sup>.

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instrument approach and provide that "relief shall be shown in the manner best suited to the particular elevation characteristics of the area." Consequently it is customary for States to include terrain contours and spot heights wherever pertinent. Instrument approach charts for Ndola indicate significant spot heights in the vicinity of the aerodrome. In the area of the procedure turn and in the approach area there are neither spot heights of elevations nor terrain contours. Nor do the profiles on some charts adequately represent the elevation. If for some reason the pilot had descended to 5,000 feet he might not have been aware that his margin of safety over the terrain was so small. The possibility cannot, therefore, be completely excluded that the disaster may have resulted indirectly from incomplete information supplied to the pilot for use at this most critical phase of his flight to Ndola. . . .

### Arrival Time

Except for the fact that the departure from Leopoldville was for several reasons delayed until late on the afternoon of 17 September, and that the aircraft took a less direct route requiring an additional hour and a half to two hours and a half of flight, there does not appear to have been

any delay in its arrival over Ndola. In fact the aircraft arrived over the airfield some minutes before its latest estimated time of arrival. As will be noted in the following part of the report, when the aircraft disappeared, speculation arose that it might have delayed its landing or flown off elsewhere. Instead it had crashed during what must have been its approach to the airfield with the intention of landing. . . .

In concluding its report, the Commission wishes to submit the following summary of its views on the conditions and circumstances surrounding the tragic death of Dag Hammarskjöld and the members of his party.

### Preparation for the flight

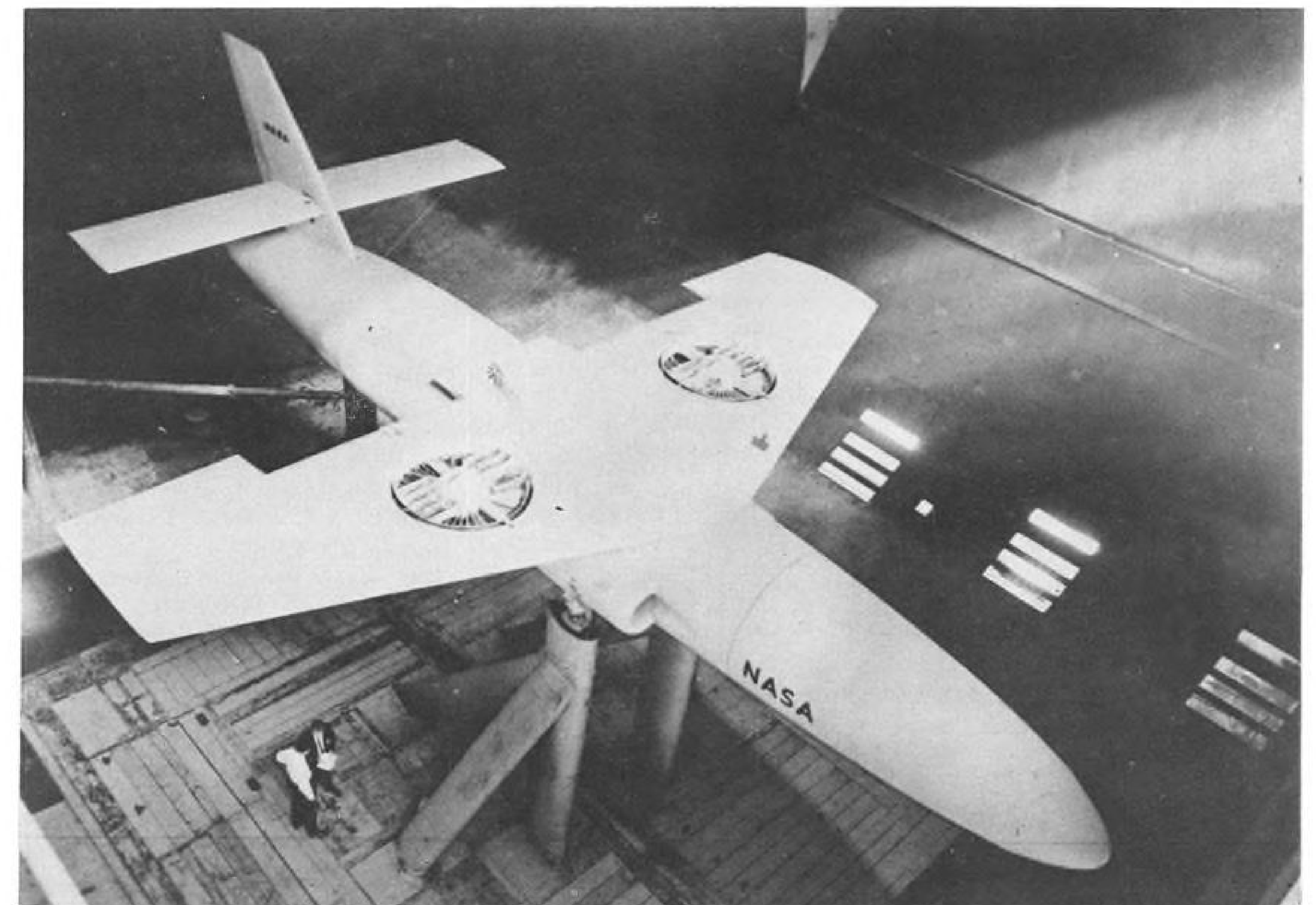
The Commission believes that the decision to leave for Ndola by air in the afternoon of 17 September 1961 was taken by the Secretary-General himself in view of the mission which he had to perform. In taking that decision the Secretary-General was fully aware that the flight would have to be carried out without escort and that most of it would be made by night. The Commission also believes that the crew of the aircraft chosen for the Secretary-General was fully qualified to undertake the flight, to navigate in radio silence and

to land at Ndola in darkness. The Captain and the other crew members were experienced, competent and conscientious. No violation of the rules limiting flight hours of crew members appears to have been committed.

### Plane Airworthy

The Commission is satisfied that the Secretary-General's aircraft had been properly maintained and was fully airworthy. It believes, in particular, that the damage suffered by the aircraft at Elisabethville on the previous night had been adequately repaired. The Commission observes that no flight plan or departure message was communicated to the FIC at Salisbury. It is of the opinion that the situation created by the hostilities in Katanga, in particular by the activity of the jet aircraft equipped for aerial combat which was at the time in the service of the Katangese armed forces, explains this departure from the rules applicable to international civil aviation.

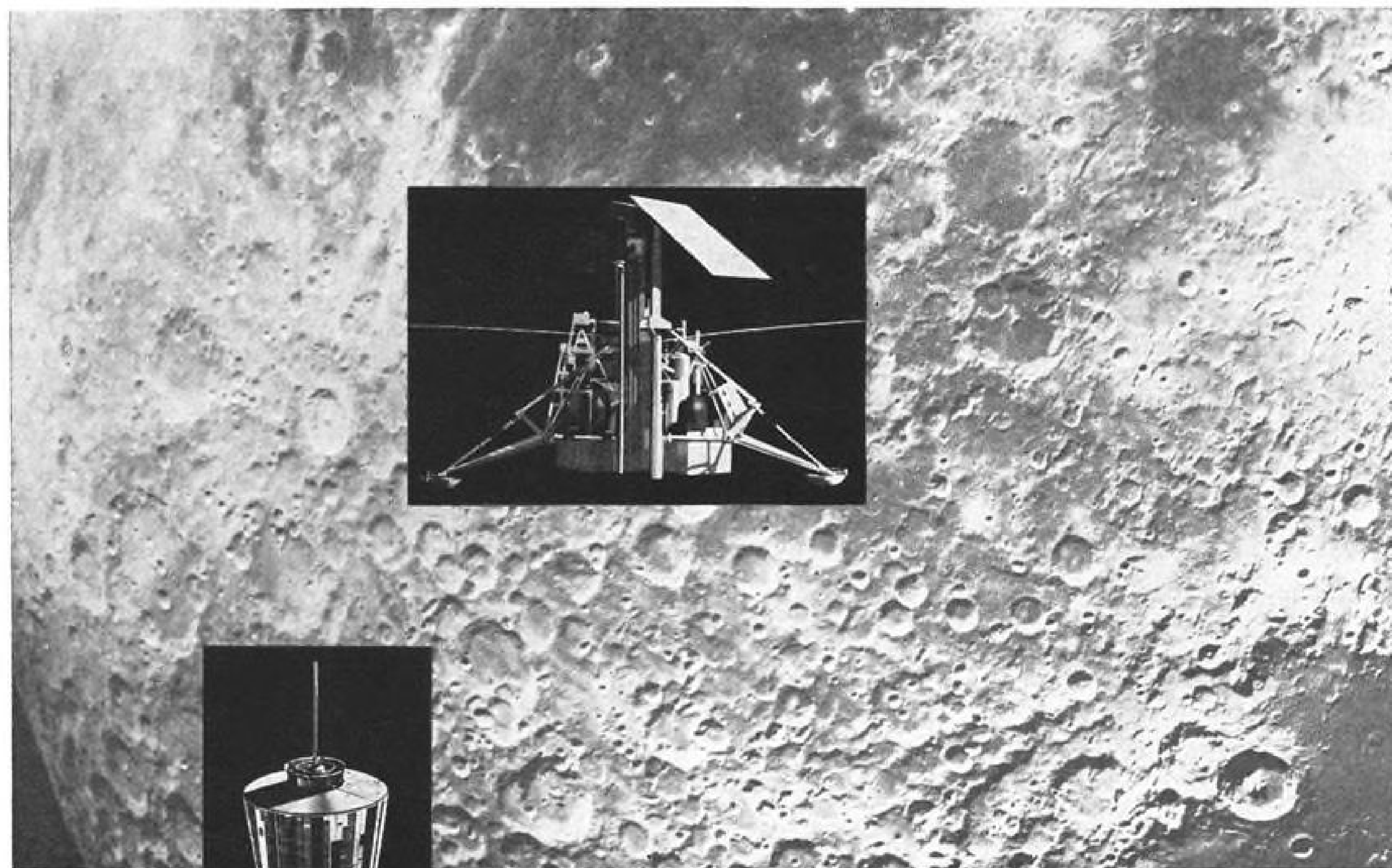
The Commission regrets, however, that before the takeoff from Leopoldville, information was not given to a responsible official of ONUC of the route which the pilot intended to follow. It also believes that special security measures should have



### G.E., NASA Test VTOL Wing-Fan Model for Army

Series of wind tunnel tests have been carried out by General Electric, Cincinnati, and National Aeronautics and Space Administration's Ames Research Center on full-scale VTOL fan-in-wing model vehicle under G.E. contract to conduct research on Army's lift fan flight research program (AW Jan. 15, p. 54). Wind tunnel tests proved acceptability of inlet performance, control characteristics, transition capability and aircraft stability. Wind tunnel model and much of test hardware were fabricated by NASA, while G.E. fabricated and tested propulsion systems including two lift fans, two diverter valves and two YJ85 engines.





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been taken to guard the Secretary-General's aircraft at N'Djili airport before the takeoff. Though it has no reason to believe that either of these omissions was a contributing cause of the crash, it considers that both were potentially dangerous.

### Careful Examination

The Commission has carefully examined all possible causes of the accident. It has considered the possibility of sabotage or of attack and the material or human failures which could have resulted in an accident. It has found no evidence to support any of the particular theories that have been advanced nor has it been able to exclude the possible causes which it has considered. In this connection it notes that the United Nations and the Swedish observers who participated in the work of the Rhodesian Board of Investigation also expressed the opinion that it was impossible to exclude any of the possible causes which they considered or to establish an order of priority among them.

With respect to sabotage it has noted that the aircraft was without special guard while it was at N'Djili Airport in Leopoldville and access to it was not impossible. The Commission is aware that there are many possible methods of sabotage. No evidence of sabotage has come to its attention but the possibility cannot be excluded.

The possibility of attack from either the air or the ground has also been fully examined. The Commission has found no evidence that an attack of any kind occurred. It has also noted the opinion of experts that it is improbable that the plane would have been in the apparently normal approach position indicated by the crash path and wreckage analysis had it been under attack. Nevertheless it cannot exclude attack as a possible cause of the crash.

### Structural Defects

The Commission has also considered various possibilities of material failure, including technical or structural defects, altimeter failure or fire in flight. A thorough analysis of that part of the wreckage capable of being examined was made by technical experts, including members of the Rhodesian Board of Investigation and United Nations and Swedish observers. The altimeters were examined in the United States by the Civil Aeronautics Board and the manufacturer. No evidence of material failure of the aircraft was found, but this possibility cannot be excluded, mainly because of the destruction of a major part of the aircraft by fire.

The Commission also considered various possibilities of human failure. It found no evidence that any of the pilots had been incapacitated. It cannot, however, completely exclude this possibility as some forms of incapacity might not be revealed by a post-mortem examination. It also considered various possibilities of pilot error, including the use of a wrong instrument approach chart or a misreading of altimeters. It noted that the Rhodesian inquiry, by eliminating to its satisfaction other possible causes, had reached the conclusion that the probable cause of the crash was pilot error. The Commission, while it cannot exclude this possibility, has found no indication that this was the probable cause of the crash.

The Commission considered the possi-



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bility that during the course of a visual or semi-visual approach or through the use of an instrument procedure involving a descending turn, the aircraft might have come below the accepted safety margin of 1,000 feet above ground level. On some landing charts, information concerning exact elevations in the approach area is not provided and should the aircraft have descended below the accepted margin a momentary distraction, either from inside or outside the aircraft, might have caused the pilot to lose the remainder of his margin of safety. The Commission, however, has found no evidence that this could have been a possible cause of the crash.

The Commission considers it its duty to record that it has examined the various rumors that have come to its attention concerning the cause of the crash and has found no evidence in their support.

### Search and Rescue

As regards search and rescue action, the Commission notes that, although SE-BDY crashed 9.5 miles from an airfield on which 18 military aircraft capable of carrying out an air search were stationed, the wreckage was located by the Rhodesian authorities only 15 hours after the crash and more than 9 hours after first light on 18 September 1961. The Commission is fully aware of the difficulty of conducting an air search over an area covered with bush and forest. It believes, nevertheless, that in the present

case the delay in commencing search and rescue operations was increased by shortcomings in liaison and cooperation between the aviation officials concerned, by lack of initiative and diligence on their part and by delay in applying the prescribed procedures. Undue weight appeared to be attached to the groundless impression that the Secretary-General had changed his mind after flying over Ndola and decided to land at another airport without informing the Ndola tower. Had that degree of diligence been shown which might have been expected in the circumstances, it is possible that the crash could have been discovered at an earlier hour and Sgt. Julien's chances of survival materially improved. Had he survived, not only would one life have been saved but there would have existed a possible source of direct knowledge of the conditions and circumstances surrounding the tragedy.

The present report is transmitted to the Secretary-General for submission to the President of the General Assembly in accordance with paragraph 4 of resolution 1628 (XVI) of 26 October 1961.

The Commission places on record its appreciation of the services rendered by the Secretariat during its mission.

Done at the European Office of the United Nations on the eighth day of March, 1962.

RISHIKESH SHAHA, Chairman, RAUL QUIJANO, Rapporteur, SAMUEL BANKOLE JONES, EMIL SANDSTROM, NIKOLA SRZENTIC.



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## WHO'S WHERE

(Continued from page 23)

### Changes

Marwin R. Johnson, general manager of the newly organized Military Communications Department within General Electric Co.'s Defense Electronics Division, with headquarters in Oklahoma City, Okla.

J. Heston Heald, technical adviser of the Armed Services Technical Information Agency, Arlington, Va., succeeding Dr. Charles L. Bernier (AW June 4, p. 125).

George A. Peck, director of manufacturing operations for communications, ITT Federal Laboratories, Nutley, N. J.

John W. Scheck, marketing manager-electronic instruments, Allen B. DuMont Laboratories, Divisions of Fairchild Camera and Instrument Corp., Clifton, N. J.

R. C. Wells, director of administration, Martin Co.'s Support Division, Middle River, Md.

F. N. Karmatz, manager of information services for Edgerton, Germeshausen & Grier, Inc., Boston, Mass.

Alex J. Keller, manager of the newly organized Defense Products Department, Garlock, Inc., Palmyra, N. Y.

R. C. Collins, manager of flight engineering, United Air Lines.

Tracy W. McFarlan, product manager-ultrasonic testing equipment, Magnaflux Corp., Chicago, Ill., a subsidiary of General Mills.

John Hassenforder, manager of Leach Corp.'s new Huntsville, Ala., regional office.

Space Technology Laboratories, Inc., a subsidiary of Thompson Ramo Wooldridge, Inc., Redondo Beach, Calif., has appointed Harold J. Klein and Jackson D. Maxey to the Staff Engineers' group, Re-entry Systems Department. Jan N. Roos succeeds Mr. Klein as head of the Department's Design Analysis and Evaluation Section; Morris Rosen succeeds Mr. Maxey as head of the Department's Systems Analysis Section.

Max E. Bleck, chief engineer of fixed-wing aircraft, Military Aircraft Division, Cessna Aircraft Co., Wichita, Kan., succeeding Henry F. Waring, resigned.

Frank W. Vargo, quality control manager, Lear-Romce Division of Lear, Inc., Elyria, Ohio (AW June 18, p. 33).

Leonard G. Voorheis, director of finance, Kaynar Mfg. Co., Inc., Pico Rivera, Calif.


Matthew H. Portz, associate director of public information, Aerespace Corp., Los Angeles, Calif., succeeding Eugene Phillips, now director of the company's Washington (D. C.) office. James K. Ready succeeds Mr. Portz as manager of news and special projects.

Robert W. Bemer, director of systems programming, Univac Division of Sperry Rand Corp., New York, N. Y.

R. J. Konig, Eastern regional manager of Information Processing Centers, General Electric Co.'s Computer Department, with headquarters in Bethesda, Md.

Harold M. Watson, manager, S-52 satellite program, Westinghouse Air Arm Division, Baltimore, Md., and A. W. Kimball, technical director-development and fabrication of the S-52 satellite. Also: H. A. Reuter, supervisory engineer, Radar Design Group, Gemini program.

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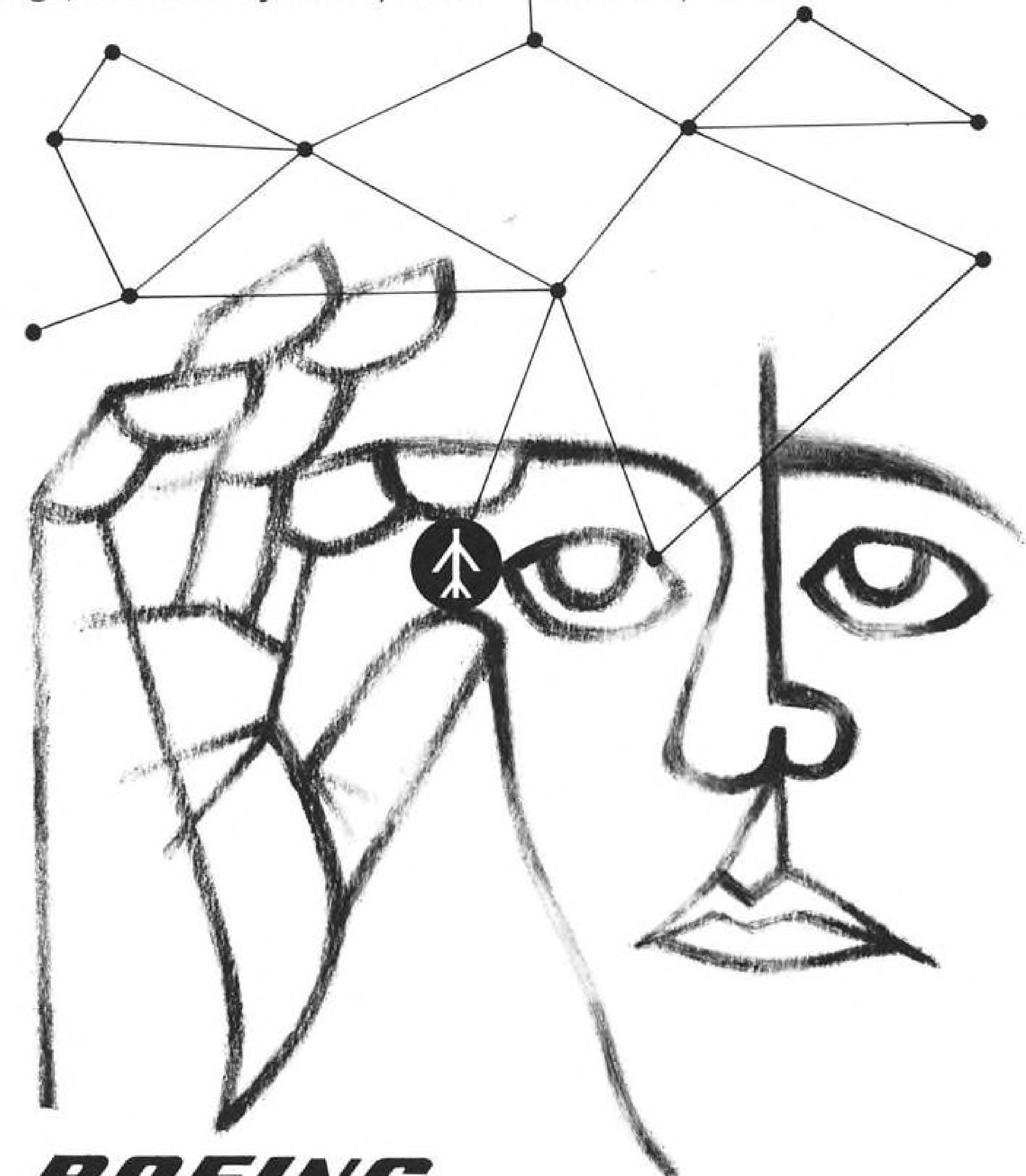
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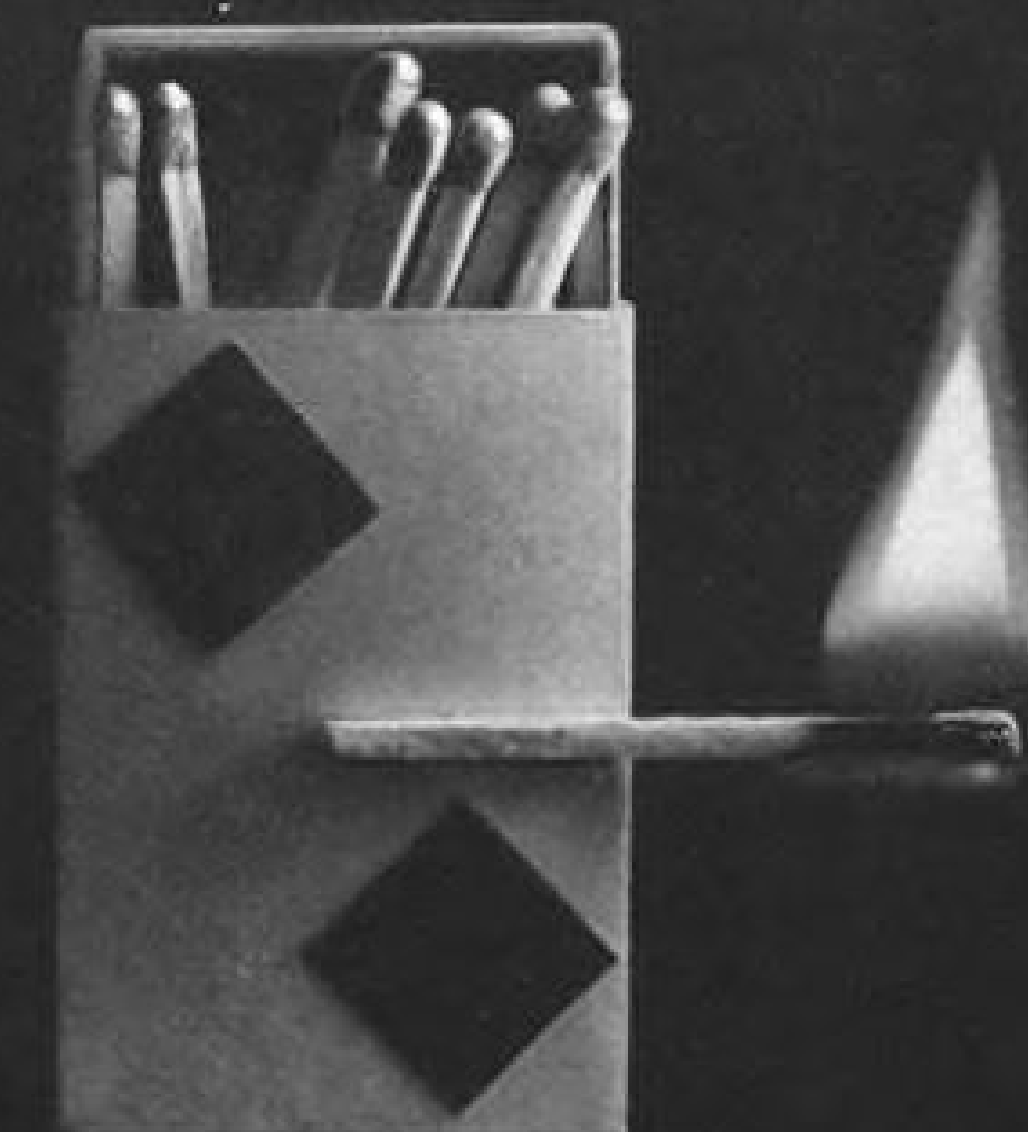
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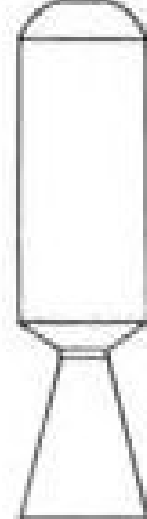
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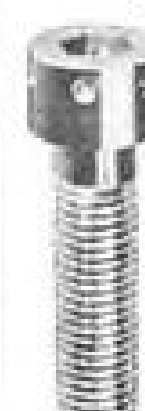
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## LETTERS

### Lot of Advantage

Having looked for an answer to Daniel W. Gunnarson's question, why should the B-70 program be implemented? (AW May 21, p. 126), in the May 28 issue and not finding one, prompted this letter.

The answer is supplied by Mr. Gunnarson himself in the clouds of his second paragraph: "The only significant advantage the B-70 would have over the B-52 is a greater possibility of penetrating enemy defense systems." That, sir, is a lot of advantage.

The answer to whether a missile-carrying B-52 would have more or less penetrating ability is "less." True, missile-carrying aircraft do not have to penetrate to their targets, but to assume that the CEP (circular error probability) of our airborne and ground-based missiles is such that we can render complete destruction to enemy hardened missile sites would not only be naive but disastrous. The fact is that the present state-of-the-art, and that of the near future, is such that we cannot wage war with missiles alone.

Let us look into the cost of a missile system in comparison with that of the B-70 program.

With even the most optimistic assumptions of missile CEP's, a statistical approach will indicate a large number of missiles required per target.

With any reasonable assumption on the number of targets to be destroyed, we find ourselves with a missile requirement of several thousand; a very attractive contract to the missile industry and a very costly one to the taxpayer.

For the B-70 program it was stated that \$491 million dollars for Fiscal 1963 would allow the program to proceed at full speed.

Assuming a six-year development program, this would amount to about \$10 dollars per taxpayer per year for the next six years, a fraction of the cost of a missile system.

But after all that has been said and written, the reason for the B-70 is still behind the clouds of dust.

The need for the B-70 is real.

It is not a political toy.

It is not a general's nostalgia.

It is not a profit seeking scheme.

It is a need of those who man today's bomber fleets. It is for those bomber crews who stand alert and dream of the B-70 as a hope of something more than just a one way ride when the klaxon blows. It is something the American people have never refused to their fighting men—the best weapon money can buy.

Having spent many lonely hours in the alert shacks of the Strategic Air Command as a B-47 pilot, I can assure you that \$10 per year buys more than just an airplane named "B-70"; it buys hope and peace of mind.

Therefore, the question is not "why should the B-70 program be implemented?", but "how soon?"

BILLY PASSINOS  
Riviera Beach, Fla.

*Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.*

### Engine Economics

David Hoffman's interesting articles on the DC-3 replacement (AW Apr. 30, p. 49; May 21, p. 42; June 4, p. 31) described the continuing uncertainty about a problem that has been with us for 15 years.

But the DC-3 has been replaced as first-line equipment already (by the DC-4) and has never been profitable since, at least on scheduled services. The real question is: What new engineering developments are needed to enable local airlines to meet their payrolls?

None of the published discussions by the CAB, FAA, Assn. of Local Transport Airlines, or Senate subcommittee have mentioned the fact that all successful airplanes are designed around proven engines. It is not surprising that the airframe industry is cautious about building new short-range transports, because with current engines the only airplane cheaper than the F-27 would be a mongrel like the turbinized DC-3 that British European Airways operated about ten years ago for proving the Dart engine.

The reason why French manufacturers are now able to offer a variety of interesting aircraft for this market is precisely because they have made a serious effort to build suitable engines, i.e., simple and cheap.

A \$400,000 transport suitable for local service will have to be unpressurized and fly no faster than 300 mph. It will thus have, in round figures, a gross weight of 30,000 lbs. and require two turboprops flat-rated to about 2,000 hp. Each engine, with propeller, cannot cost more than \$35,000 installed. This is less than half the price of the only commercial turboprop in this class (which is imported), and its achievement will require a high order of engineering talent and dedication.

However, U.S. engine developments in this power class are moving in exactly the opposite direction—to dual shafts, movable-stator compressors, high-temperature air-cooled turbines, complex reduction gearing, elaborate control systems, etc. These costly features have all been encouraged and paid for by the Armed Forces in order to demonstrate low specific weight and specific fuel consumption—parameters of negligible economic value to an airline flying an 80-mi. stage with 40% load factor.

There is another aspect of the discrepancy between military demands and commercial solvency, in line with Mr. Halaby's statement that "development of such an aircraft in conjunction with the military could result in an over-designed, all-purpose, all-geography product." The Army requires

oversize engines and propellers to ensure rough-field, STOL performance, whereas local carriers do not lack good airfields—they have too many. In fact, one point in six along their routes is now threatened with loss of service unless more passengers are forthcoming.

I suggest that if the FAA now appropriates a sum equal to only 5% of the \$70 million annual subsidy to local carriers, and invests it in serious development of a really low-cost commercial turboprop engine over three years, there will be no lack of offers from the airframe industry at that time to build the airplane that will make subsidy obsolete by 1970.

And looking beyond the present decade, the potential market is unlimited. In a lecture to the Institute of the Aerospace Sciences five years ago Grover Loening showed that if a turboprop cargo airplane could be built for about \$300,000 and operated on high-volume intercity freight services, it would "put motor transport out of business at its own price."

J. M. STEPHENSON  
Fairfield, Conn.

### More 'Imagineers'

The first thing to come to my mind while reading Mr. Jacobson's letter, "A Patent Case" (AW Apr. 30, p. 98), was bravo! bravo!

It has been a long time coming, and perhaps with more people like Mr. Jacobson the inventor will be recognized as such. All too often the inventor is the forgotten man and is classified as just another engineer that came up with an idea. This, I believe, is where management makes its mistake. To back up his belief, I want to quote from one of America's leading aeronautical engineers, now deceased, Mr. William B. Stout of the Ford Motor Co. and later of the Stout Research Laboratories. Mr. Stout said, "What the world needs is fewer engineers and more imagineers."

I would like to inject one other item as food for thought; an engineering degree can say a man is an engineer but it cannot make him an inventor.

ROY P. GIBBENS  
Orlando, Fla.

### Simple Remedies

With reference to an article appearing on p. 39 of your issue dated June 4, entitled "Bomb Is Suspected in 707 Crash," does it require the brains of Messrs. Halaby and Boyd to come to the conclusion that if the temptation is that of getting rid of your in-laws and gaining a few hundred thousand dollars on the side, somebody will try it? Is it necessary to wait for the sixth bombing to introduce such simple remedies as—removal of coin-operated vending machines, inspection of luggage (X-ray) of passengers who take out more than nominal insurance, say \$25,000?

B. J. SOLAK  
Morton, Pa.

# Information About Hose Made of Teflon From The People Who Invented It

No. 1 in a series

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most exacting controls, Teflon resin displays a wide range of lubricant retention capability. Hence, the carbon black particles, in their function as a moderating agent, serve as suppliers of additional lubricant or receivers of excess lubricant during the passage of the resin mix through the vital constricting throat of the tubing extrusion dies. For this reason black tubing has consistently shown uniformity of structure.

Some have assumed carbon black was merely a color coding for identification. Some have even thought coloring was to hide defects. Some colorings used, because of their poor dispersal characteristics, have resulted in serious agglomeration problems and unreliable structure. Uncolored hose, while not aggravated by the improper use of pigment, continues to be plagued by structural defects resulting from the variation in resin lubricant absorption capability.

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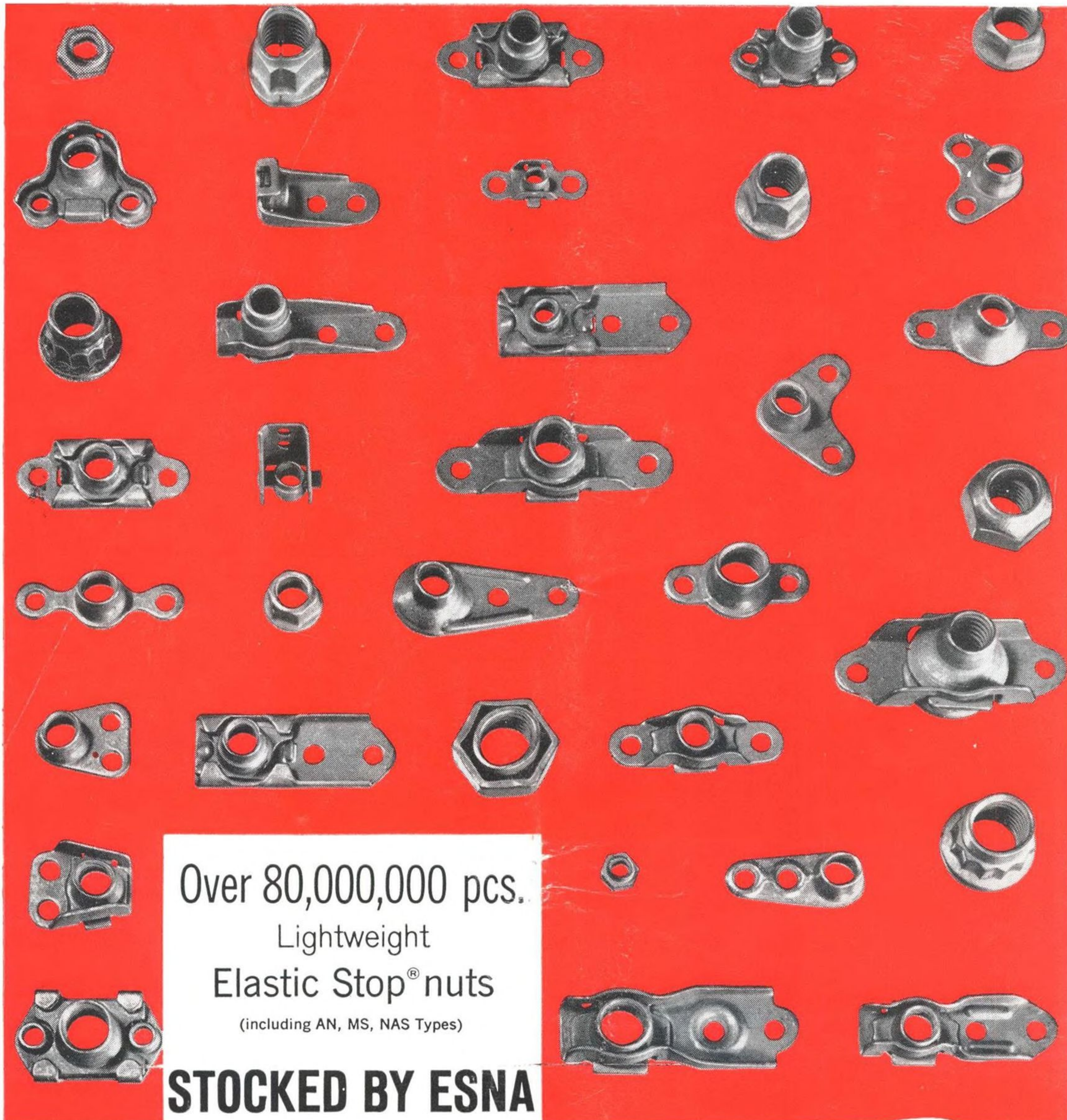
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Union, New Jersey Phone MU. 6-6000 TWX-UNVL. 691	Elastic Stop Nut Corp. of America 2330 Vauxhall Road
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In addition to providing "availability," ESNA's leadership in the field of lightweight self-locking nuts is based on dependable quality and production of the full range

of shapes and sizes to meet every fastening requirement of the design engineer. This photograph, for example, illustrates *only part of the complete line of fully qualified NAS parts* which ESNA produces and stocks as standard items. For your copy of ESNA's Aerospace Fastener Catalog of miniaturized, lightweight designs, write Dept. S68-625.



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