Aviation Week

Including Space Technology

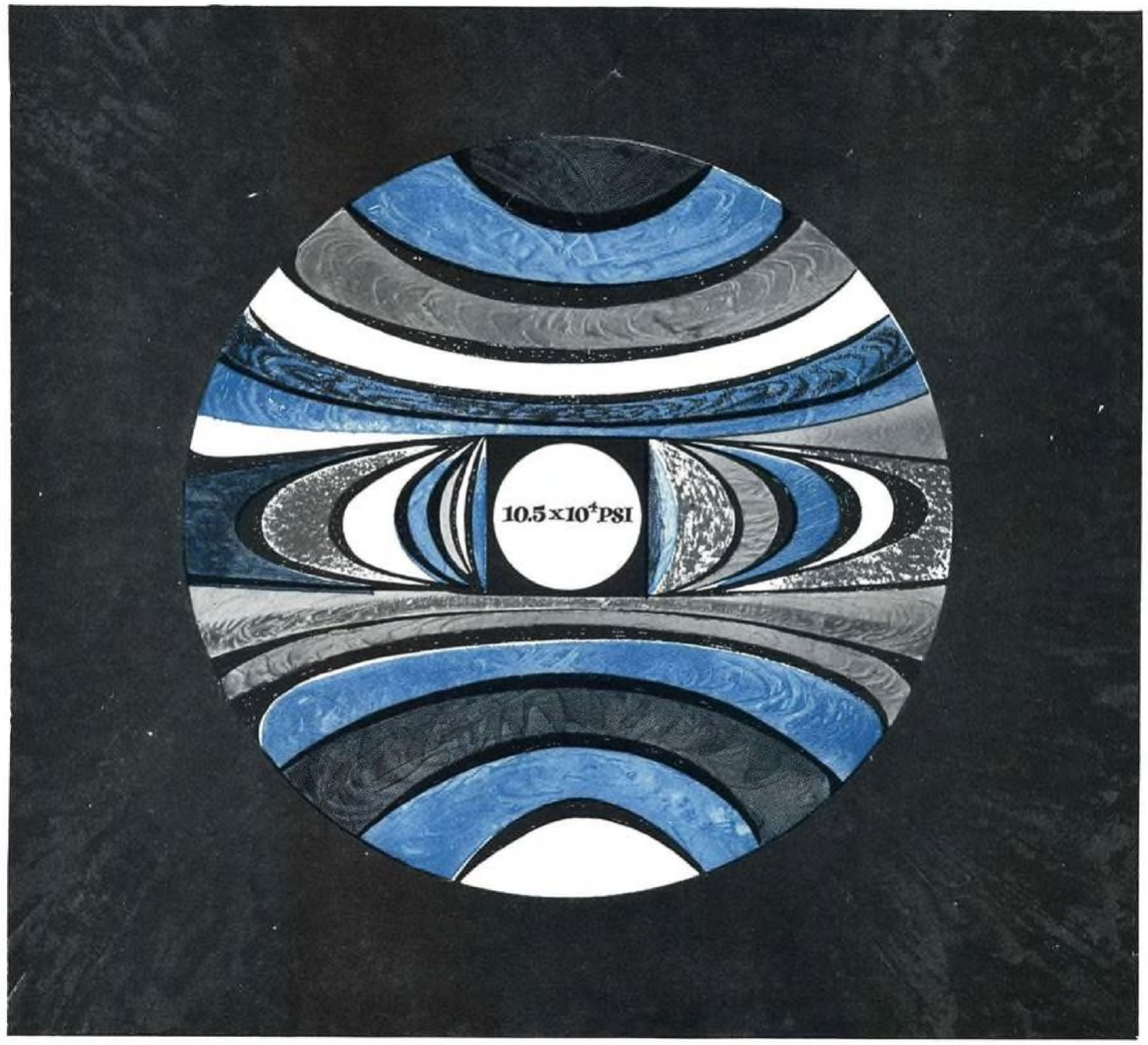
75 Cents

A McGraw-Hill Publication

December 22, 1958

Pilot Report On Electra's Flight Characteristics

Kaman H-43B Helicopter



BRUNSWICK'S SBP HELPS TAME PRODIGIOUS PRESSURES

Brunswick's unique Strickland "B" Process (SBP) cures a multitude of headaches in the pressure vessel field because of its unique combination of features. From rocket motor cases to helium-nitrogen bottles, SBP filament-wound laminates give the highest strength-to-weight ratios possible, plus resistance to extremely high temperatures (up to 600° F). Tough SBP laminates are also ideal for pressure vessels that undergo many operating cycles.

Not just another filament-winding process, Brunswick SBP is an exclusive machine method for precise placement of fiberglas filaments. Each roving is nested and packed for the highest glass-to-resin ratio, and hence highest strength. Strength can be further increased by stress designing bodies to meet special types and areas of pressure. And the system permits mass production of shapes to meet the most exacting space-age specifications.

Continuing, extensive research and development projects have given Brunswick a special knack for solving strength and leakage problems, in existing fields as well as new and more difficult areas of design, development and fabrication. Talk to Brunswick about the multitude of advantages SBP laminates offer. Write or call: Brunswick-Balke-Collender Company, Defense Products Division Sales Manager, 1700 Messler St., Muskegon, Michigan.

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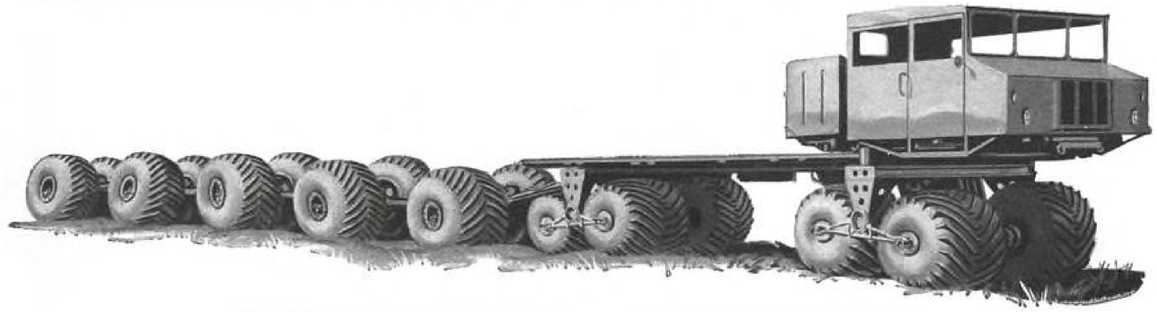
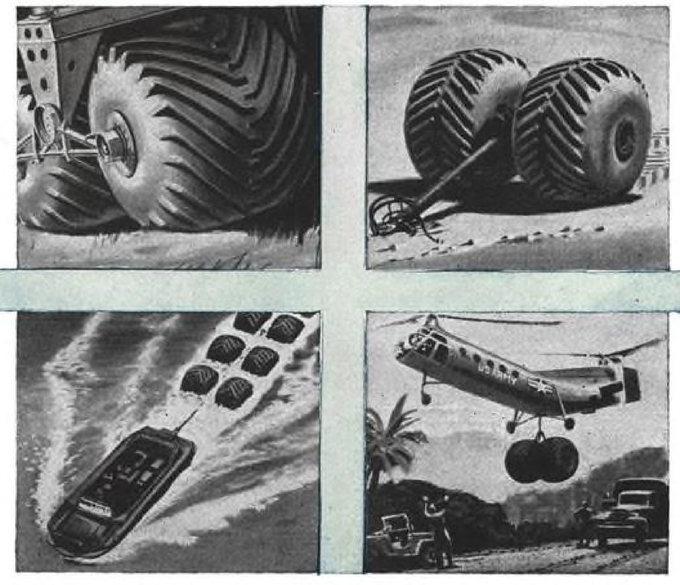
5,000 GALLONS OF FUEL— ROLLING IN UNIQUE TIRE-LIKE CONTAINERS CALLED ROLLI-TANKER—ARE CAPABLE OF FOLLOWING AMAZING "GO-ANYWHERE" TIRES INTO HERETOFORE **IMPASSABLE** AREAS!



ROLLI-TANKER TERRA-TIRE

LET YOUR PROJECT UTILIZE THIS AMAZING

mobility



Wide Ground Contact Area of the axle-driven Terra-Tire by Goodyear can traverse sand, mud, marshland, snow and roughest going without failing. Principle lends "go-anywhere" mobility to vehicles—and liquids.

Filled with fuel, these Rolli-Tanker units—mounted in pairs and available in sizes with filled capacities of from 140 to 500 gallons each—can travel most anywhere! Tow-bar units can be equipped with own filling, emptying, braking systems.

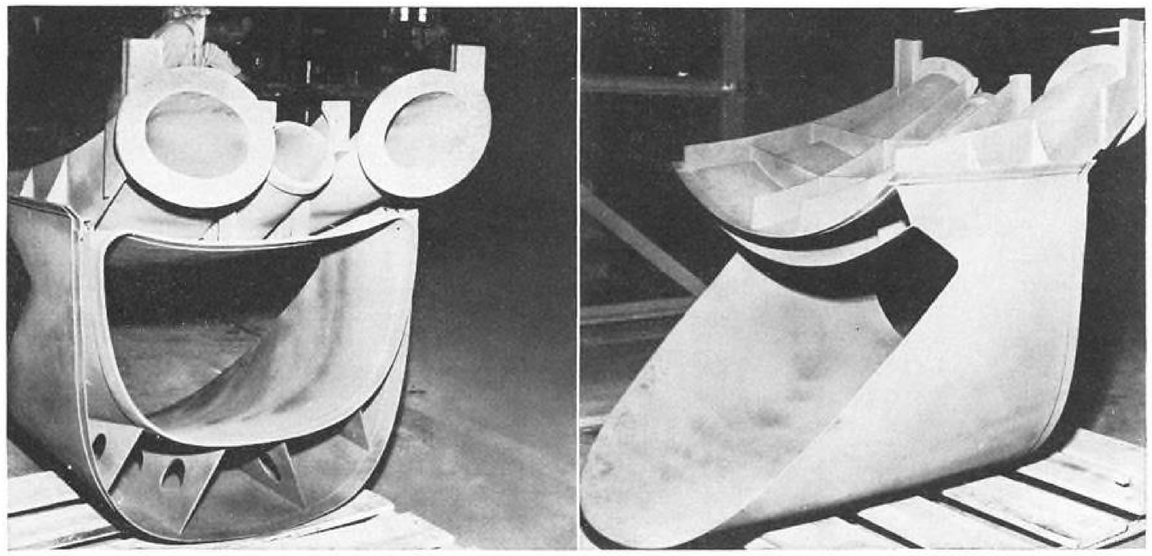
Float fuel ashore—the Rolli-Tanker makes it no problem to get bulk fuel or liquid supplies ashore. No costly pumping or long-line hoses needed with this new Goodyear advance.

Fuel ready, where needed—this unique system is easily the most foolproof answer to needs for mobile fuel supplies. An advanced Goodyear development for national defense.

For details contact: Goodyear, Aviation Products Division, Dept. X-1715, Akron 16, Ohio.

GOODYEAR

Terra-Tire, Rolli-Tanker—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



Engine air scoop casting made by R. H. Osbrink Mfg. Company, Los Angeles

MAGNESIUM "SUGAR SCOOP" HELPS REGULUS II BREATHE

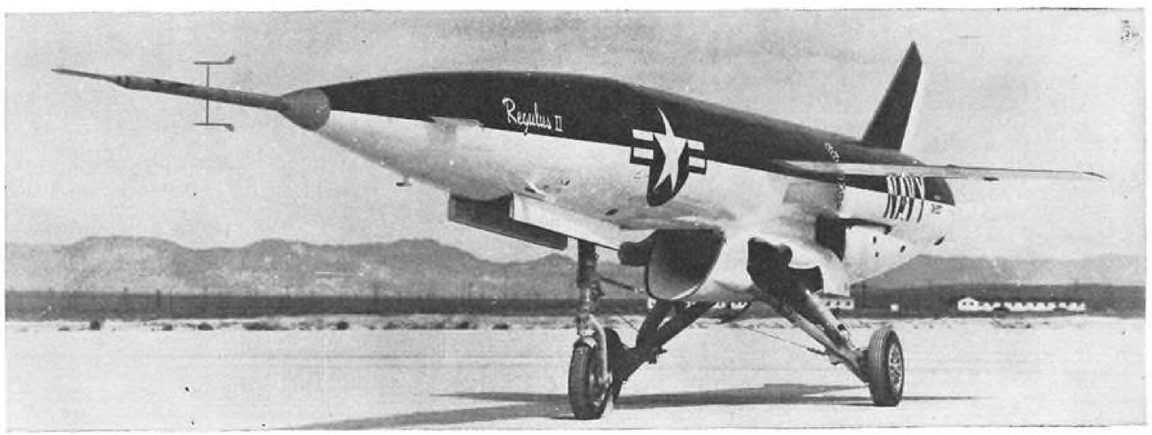
Huge thin-wall magnesium casting satisfies appetite for air

At supersonic speeds more than ten miles above the earth, Chance Vought Aircraft's Regulus II consumes enormous quantities of air through a 150 lb. magnesium casting.

This complex, close tolerance magnesium casting supplies air for the Regulus' powerful J-79 jet engine. It also provides ducting for boundary layer control and for air conditioning. Nominal thickness on walls and webs is 0.24 inch and the solid leading edge tapers to a 0.015 inch cast radius. Casting tolerance is + or −0.03 inch on dimensions up to 12 inches, with an additional + or −0.002 inch per inch on dimensions above that. That's real casting accuracy!

This air scoop is an excellent example of the versatility and usefulness of magnesium alloy castings in aircraft design. Thin-wall casting designs can be produced in magnesium to replace complicated, costly fabrications involving several production operations.

For more information about magnesium sand castings and their use in aircraft design, contact your nearest magnesium foundry or Dow sales office.



MAGNESIUM DESIGN, a 235-page handbook, discusses in detail: properties, structural design, product design including castings and mill products, fabrication and finishing. Large section of tables on properties, sizes, tolerances, etc. For your copy contact a Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1463K-3.

YOU CAN DEPEND ON DOW

AVIATION CALENDAR

Dec. 27-30—Fifth Annual Meeting, American Astronautical Society, Hotel Statler, Washington, D. C. Meeting will be held in conjunction with the 125th Annual Meeting of the American Assn. for the Advancement of Science.

Dec. 27-30—Fifth King Orange International Model Plane Meet, Miami, Fla.

Dec. 30—Scientific Manpower Conference, Sheraton Park Hotel, Washington, D. C. Sponsors: Engineering Manpower Commission of Engineers Joint Council, Scientific Manpower Commission, National Research Council, National Science Foundation, and the Engineering Section of the American Assn. for the Advancement of Science.

Jan. 12-14—Fifth National Symposium on Reliability and Quality Control in Electronics, Bellevue-Statler Hotel, Phila.

Jan. 12-16—1959 Annual Meeting and Engineering Display, Society of Automotive Engineers, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

Jan. 13-14—Symposium on Cathode Ray Tube Recording, sponsored by Systems Development Corp., Engineers Club, Dayton, Ohio.

Jan. 19-21—11th Annual Convention, Helicopter Assn. of America, Villa Hotel, San Mateo, Calif.

Jan. 21-23—South West Electronic Exhibit, Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 26-27—Annual Meeting, Assn. of Local and Territorial Airlines, National Aviation Club, Washington, D. C.

Jan. 26-29—27th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York, N. Y. Honors Night Dinner, Jan. 27.

Jan. 27-29—Fifth Annual Radar Symposium (classified), Rockham Bldg., University of Michigan, Ann Arbor, Mich.

Jan. 27-30—15th Annual Technical Confer-

(Continued on page 6)

AVIATION WEEK Including Space Technology

December 22, 1958

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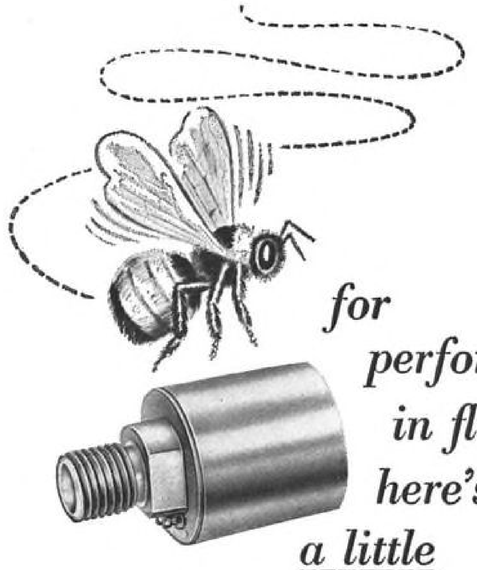


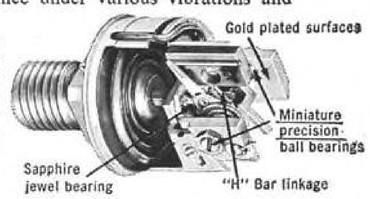
for performance in flight..... here's a little honey

FAIRCHILD'S NEW 1 INCH PRESSURE TRANSDUCER

...as small as a bumble bee, but can take shock, acceleration and vibration like no other pressure transducer its size. It was designed specifically for airborne instrumentation to meet the most stringent environmental requirements. Output signal resolution is less than 0.25% with single or dual wire wound potentiometer pick-off.

The excellent performance under environmental conditions is due to an improved "H" bar linkage between the diaphragm push rod and the potentiometer wiper arm which permits the moveable parts to be statically and dynamically in balance under various vibrations and accelerations.

Fairchild's line of Pressure Transducers include bourdon tube and capsular diaphragm types for measuring pressures from 1 to 10,000 psi, absolute, gauge, or differential. Standard units have pot pick-offs; a.c. type pick-offs available on special order.



SPECIFICATIONS AND CHARACTERISTICS			
Vibration	10 to 55 cps, 0.1" da; 55 to 2,000 cps 15g. Error less than 1%. Will withstand 25g, 10 to 2,000 cps.	Pressure Range	0-5 psi to 0-350 psi a, g or d.
Acceleration	40g in 3 planes; error less than 1%. Withstands 75g.	Linearity	±1.0%
Shock	50g without damage or permanent calibration shift.	Size (Volume)	¾ cubic inch (1" dia x 1" long)
		Temperature	—54°C to +100°C. Error less than 1% for most ranges.

For more information write Fairchild Controls Corporation, Dept. 23Y

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COMPONENTS DIVISION

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A subsidiary of Fairchild Camera & Instrument Corp.

Potentiometers • Gyros • Pressure Transducers • Accelerometers

AVIATION CALENDAR

(Continued from page 5)

ence, Society of Plastics Engineers, Hotel Commodore, New York, N. Y.

Jan. 28-29—Fifth Annual Midwest Welding Conference, sponsored by Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Feb. 3-5—14th Annual Technical and Management Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago.

Feb. 12-13—1959 Solid State Circuits Conference, sponsored by Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and University of Pennsylvania, Philadelphia.

Feb. 14—Meeting on Short Range Navigational Aids, International Civil Aviation Organization, International Aviation Bldg., Montreal, Canada.

Feb. 21-22—13th Annual Pacific Coast Mid-Winter Soaring Championships, Torrey Pines Gliderport, San Diego, Calif.

Feb. 26-March 1—1959 Engineering Exposition, Balboa Park, San Diego, Calif. Address inquiries to: 422 Land Title Bldg., San Diego, Calif.

March 3-5—1959 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Assn. for Computing Machinery, Fairmont Hotel, San Francisco, Calif.

March 5-6—Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.

March 5-7—Western Space Age Conference and Exhibit. For information: Domestic Trade Dept., Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles 54, Calif.

March 8-11—Engineering meeting on the turbine in action, sponsored by Gas Turbine Division of the American Society of Mechanical Engineers, Cincinnati, Ohio.

March 16-20—11th Western Metal Exposition and Congress, American Society for Metals, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

March 23-26—National Convention, Institute of Radio Engineers, Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

March 31-Apr. 2—Polytechnic Institute of Brooklyn's Ninth International Symposium. Subject: Millimeter Waves, Auditorium, Engineering Societies Bldg., New York, N. Y. Cosponsors, Department of Defense Research Agencies and Institute of Radio Engineers.

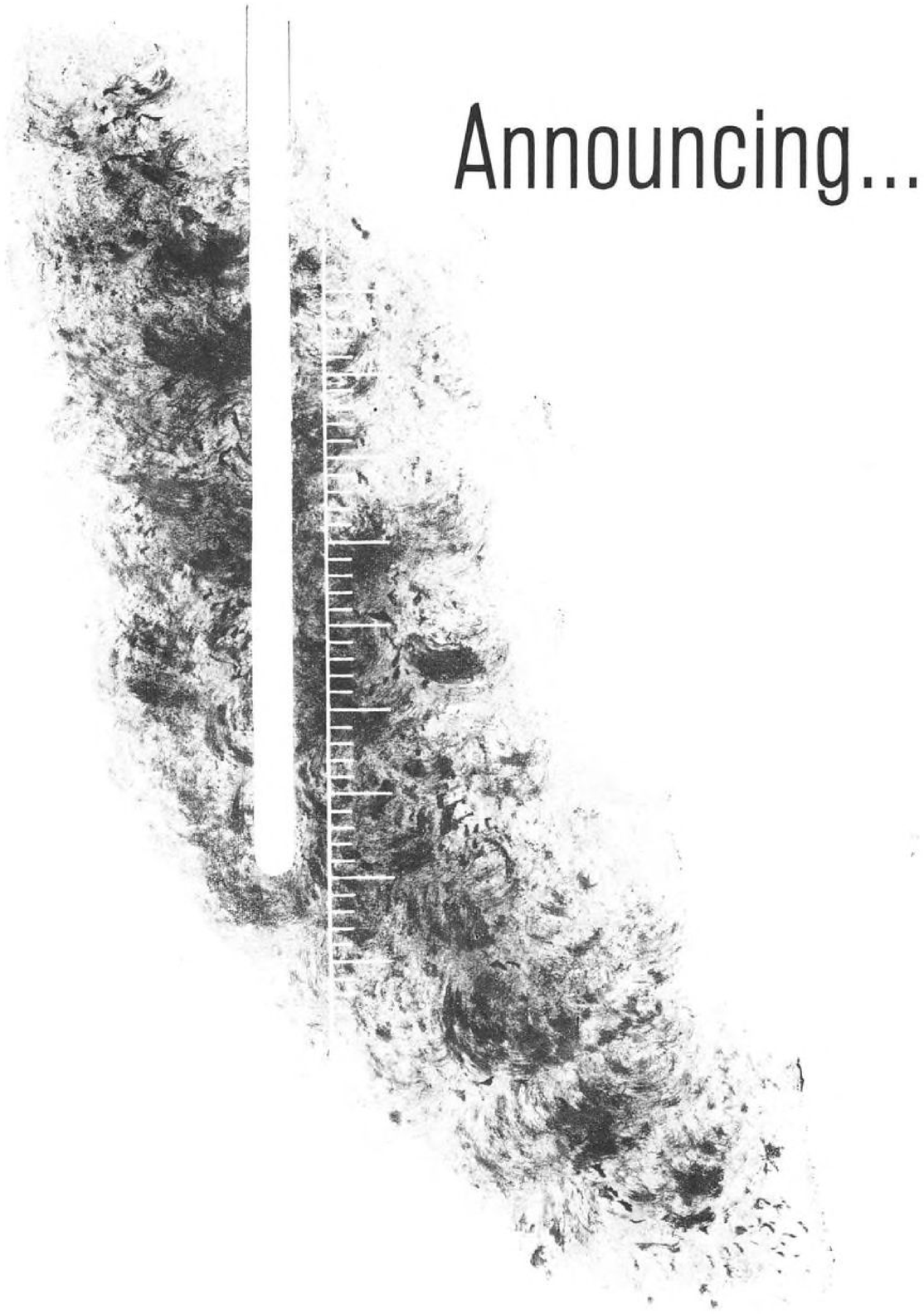
March 31-Apr. 3—National Aeronautic Meeting, Society of Automotive Engineers, Hotel Commodore, New York N. Y.

Apr. 5-10—1959 Nuclear Congress, Municipal Auditorium, Cleveland, Ohio. For information: Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

Apr. 7-10—1959 Welding Show and 40th Annual Convention, American Welding Society, International Amphitheatre and Hotel Sherman, Chicago, Ill.

Apr. 12-19—Air Force Assn.'s World Congress of Flight, Las Vegas, Nev.

May 4-6—National Aeronautical Electronics Conference Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.



Announcing... USS 9% Nickel Alloy Steel

for the world's coldest applications down to -320°F

Nothing gets much colder than liquid nitrogen, which exists at temperatures of minus 320° F and below. At such temperatures, most container materials get brittle —lose their toughness.

To meet the need for an economical material that can be used for low-temperature pressure vessels, U. S. Steel is making an alloy steel containing 9% nickel. This steel is stronger, tougher and less expensive than other metals used for handling liquefied gases such as methane, oxygen, and nitrogen. For test purposes, plates in thicknesses of ¼ and ½ inch are ready for immediate delivery. Sheet sizes and heavier plates, as well as structural shapes, bars, and semi-finished products, are also available upon inquiry.

Higher Strength. USS 9% Nickel Steel can be furnished to meet all requirements of ASTM Specification A-353, Grades A or B. The ASME Boiler and Pressure Vessel Code allows a maximum working stress of 22,500 psi for 9% Nickel Steel. This is about 17% higher than allowed for other metals used for this purpose.

Greater Toughness. The toughness of 9% Nickel Steel has been well established in drop tests of actual vessels containing liquid nitrogen at minus 320° F. Charpy keyhole-notch impact values have been observed to be as high as from 31 to 38 ft.-lbs. at minus 320° F, from 73 to 84 ft.-lbs. at room temperature.

Weldability. Joints of 100% efficiency are possible with either manual or automatic welding in the inert gas metal-arc process. Suitable welding rods are available.

Weight Reduction. Greater strength permits USS 9% Nickel Steel to be used in thinner sections with substantial weight reduction. This is important for stationary storage and shipboard storage tanks for methane—and for other severe low-temperature storage applications.

Lower Costs. The steel itself costs less than competing materials by about 40%—and products such as tanks and heads can be made stronger with less material.

We urge you to consider USS 9% Nickel Steel for better, less expensive low-temperature vessels.

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United States Steel Export Company

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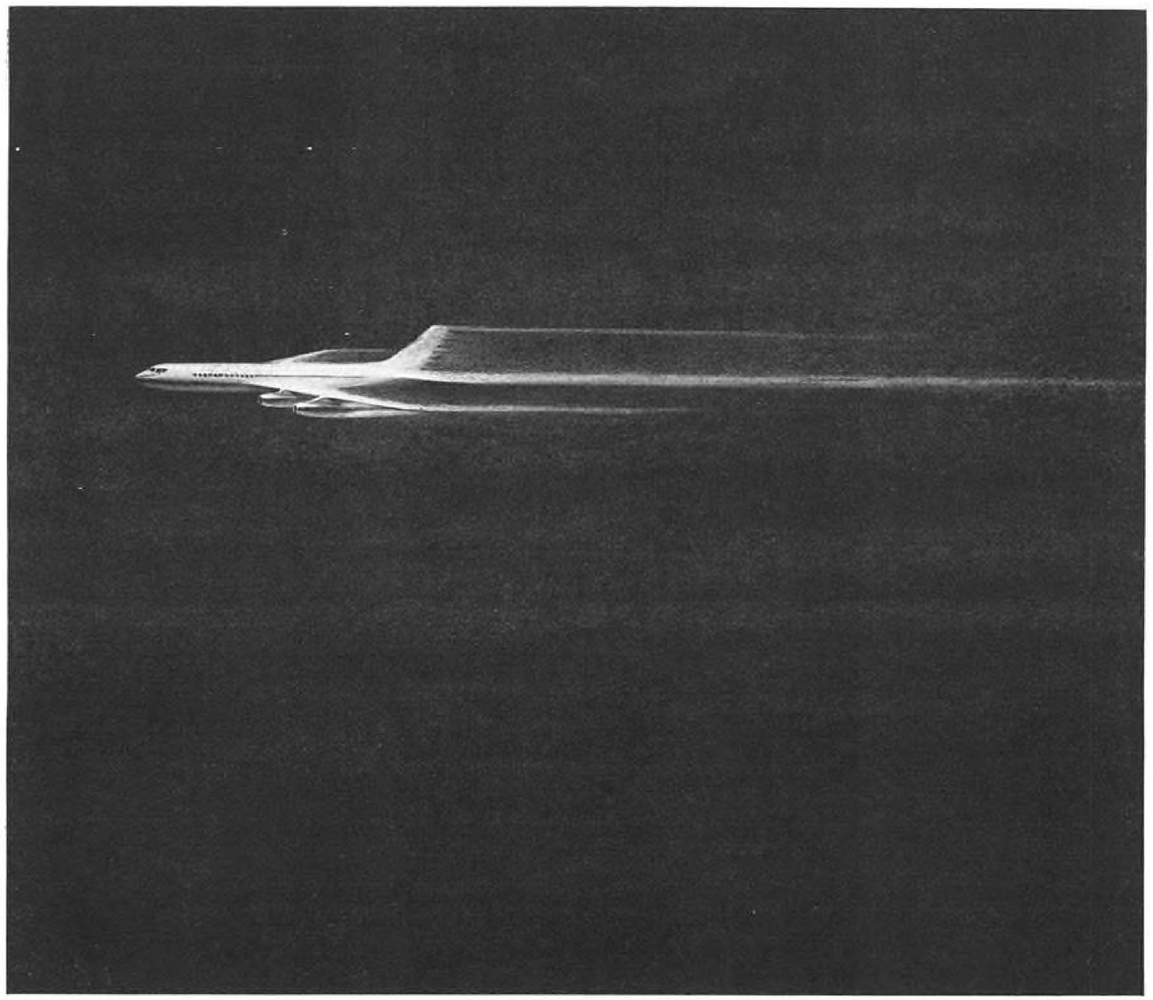

Engineering aircraft components to meet the needs of modern speeds

More strength and efficiency with less weight . . . that's the story of the ever-increasing demands in today's and tomorrow's aircraft performance requirements.

Through vigorous design research, and constant developments in structural concepts and materials, Rohr engineers are keeping up with . . . and ahead of these demands in the production of aircraft components.

It's another reason for Rohr's position as leader in the design and production of major components for flight.

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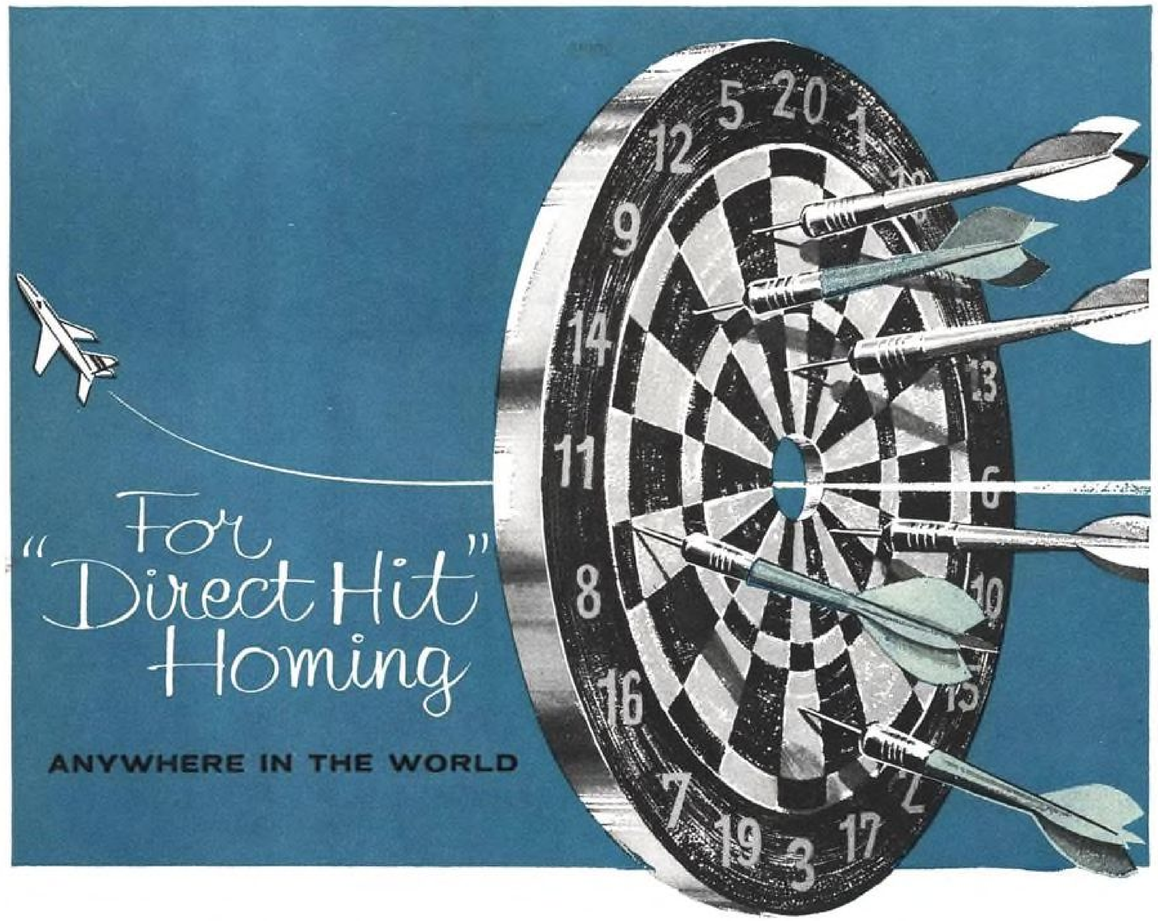

ARC'S TYPE 21A AUTOMATIC DIRECTION FINDER

As every pilot knows, a reliable ADF is still a basic and useful navigation aid. Throughout the world there are some 60,000 transmitters that offer pin-point guidance, over land and sea.
ARC's Type 21A ADF can be depended upon for precision homing under long-continued use in humid tropics, frigid northlands or burning deserts. It is one of ARC's outstanding contributions to air navigation. Its low weight (less than 20 pounds) and compactness make dual installations practicable even in light twins. If you plan to modernize existing equipment or are purchasing a new aircraft, specify the Type 21A for a long term investment in air safety.
Ask your ARC dealer for a quotation on this and any of the other ARC equipment listed below.

TYPE 21A ADF WEIGHS ONLY 19.7 POUNDS
Component Unit Weights: Receiver, 6.8 lbs.; Loop, 4.3 lbs.; Loop Housing, 0.5 lbs.; Indicator, 1.3 lbs.; Control Unit, 1.6 lbs.; Power Unit, 5.2 lbs.;

CAA Certificate No. 1R4-9 U.S. Military: AN/ARN-59 British Certificate of Approval VC-78

Aircraft Radio Corporation BOONTON, N. J.

Dependable Airborne Electronic Equipment Since 1928

OMNI/LOC RECEIVERS • MINIATURIZED AUTOMATIC DIRECTION FINDERS • COURSE DIRECTORS • LF RECEIVERS AND LOOP DIRECTION FINDERS
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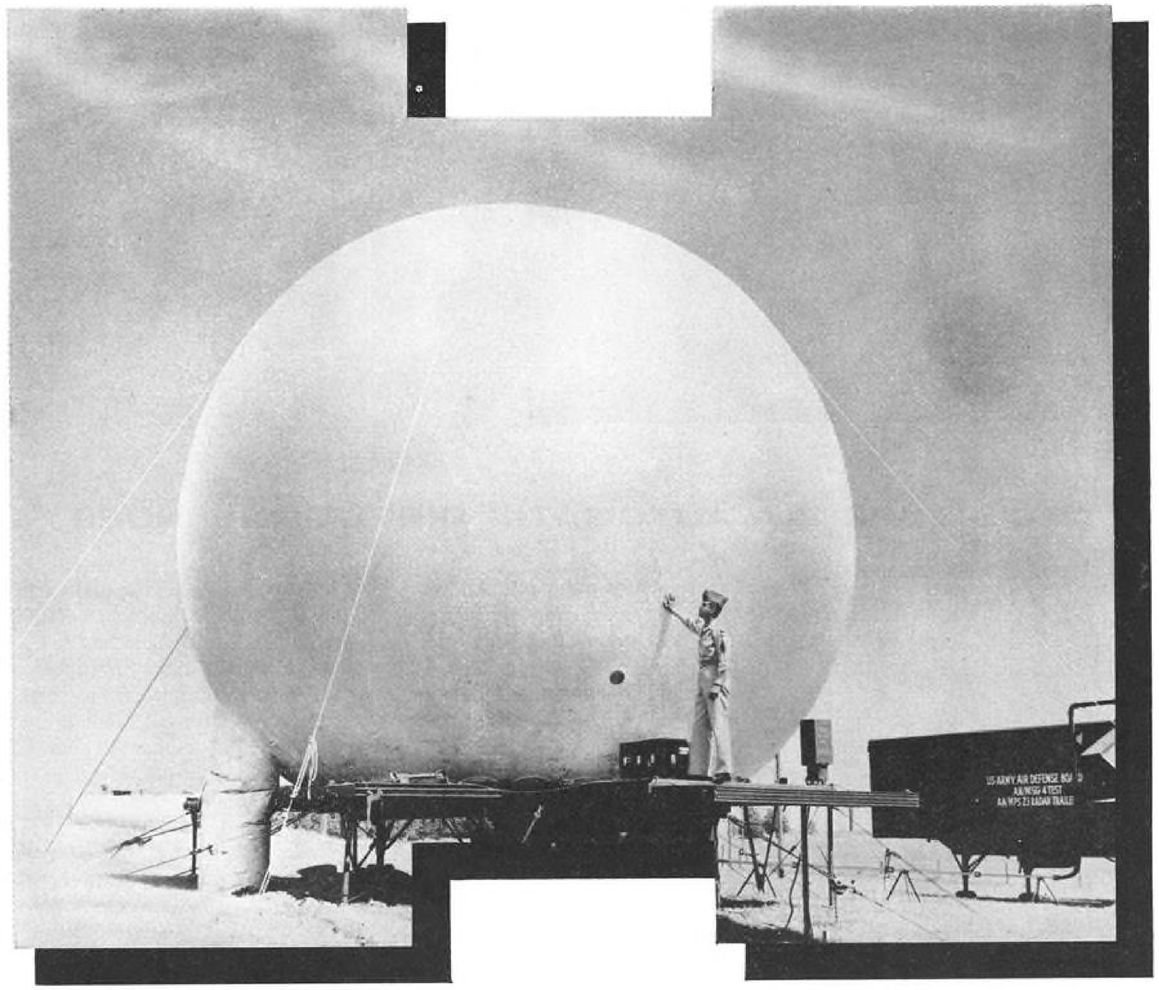
30 YEARS OF ACHIEVEMENT IN AIRBORNE ELECTRONICS 1928 ARC 1958

The strange shape of defense



This plastic balloon, resting on a mobile trailer bed like a golf ball on a tee, protects the new Hughes three-dimensional radar antenna.

Frescanar, the exclusive system combining high-speed data processors and a frequency scan radar antenna, has been developed by Hughes engineers in Fullerton, California.

Sensitive to the inadequacies of conventional radar, these Hughes Fullerton engineers have devised a radar antenna whose pointing direction is made sensitive to the frequency of the electromagnetic energy applied to the antenna. This frequency sensitivity results in the radar beam being radiated from the antenna at different angles, depending on the frequency of the energy supplied. With the supply of a succession of frequencies, the antenna beam can be moved through a succession of positions. Utilizing this advanced technique, range, bearing and altitude can be detected . . . on a single antenna.

This Hughes-developed radar system has been combined with compact, high-speed Hughes data processors to provide a completely self-sufficient, mobile radar defense system.

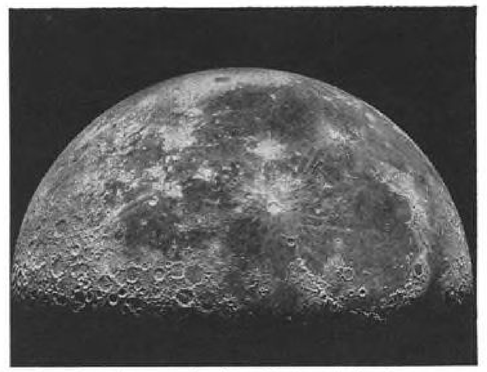
Other Hughes projects provide similarly stimulating outlets for creative engineering talents. Current areas of Research and Development include Advanced Airborne Electronics Systems, Space Vehicles, Nuclear Electronics, Subsurface Electronics, Ballistic Missiles . . . and many more. Hughes Products, the commercial activity of Hughes, has assignments for imaginative engineers for research in semiconductor materials and microwave tubes.

The diversity and advanced nature of Hughes projects provides an ideal environment for the engineer or physicist interested in advancing his professional status.

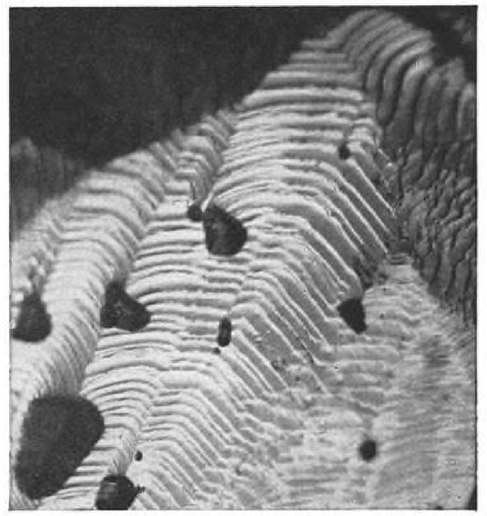
An immediate need now exists for engineers in the following areas:

Microwave & Storage Tubes	Reliability Engineering
Field Engineering	Systems Analysis
Quality Control	Circuit Design
Semiconductors	Communications
Digital Computer Engineering	Radar

Write in confidence, to Mr. Phil N. Scheid,
Hughes General Offices, Bldg 6-B-2, Culver City, California.



The Hughes Communications Laboratories have as one objective the development of systems capable of deflecting their signals from meteors, artificial satellites and even the moon.



This photomicrograph of an etched silicon sphere is used in basic studies of semiconductor materials at Hughes Products, the commercial activity of Hughes.

The West's leader in advanced ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton and Los Angeles, California
Tucson, Arizona

December 22, 1958

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USAF to Ask Bids for Air-Launch IRBM 22
► Decision to begin industry competition follows six-month testing of one- and two-stage vehicles.

Convair Rolls Out Its First Model 880 34
► Maiden flight will be within two months, inaugurating a 16-month testing program.

Electra Shows High Degree of Flyability 56
► Lockheed turboprop transport, designed for economical operation, demonstrates pilot ease in handling.

SPACE TECHNOLOGY
Flickinger Views Survival in Space... 43
Monkey's Physiological Changes..... 23
House Unit Urges Space Study..... 26
NASA Organization 27
Aerobee 300 Test Firing..... 29
Zero Gravity Tests 52

MISSILE ENGINEERING
Air-Launch IRBM 22
First Vandenberg Thor Firing..... 24
Rocketdyne Million lb. Engine..... 29
USAF Cancels Fairchild Goose..... 27

AERONAUTICAL ENGINEERING
Lockheed Electra Pilot Report..... 56
F4H Wins 22
B-58 Crash 22
Research in France 25
C-130B Makes First Flight..... 63
Nuclear Test Bomber Shielding Data.. 64
H-43B Tailored to USAF Rescues..... 71
Flight Photo of U-2..... 78

EQUIPMENT
Camera Tracks Satellites..... 25
New Aviation Products 77

AIR TRANSPORT
Convair Rolls Out First 880..... 35
Strike Situation 35
Engineers Ask ALPA Examination.... 36
PanAm 707 Ingestion Damage..... 37
Japanese YS-11 Turboprop Mockup... 37
Subsidy Payments to Increase..... 39
Airline Traffic—October 40
Shortlines 41
Airline Observer 41

MANAGEMENT
Defense Surplus Policy Rapped..... 28
Army Broadens Overhaul..... 30
Carmichael Named 33
Army Aviation Broadens Base..... 30
Who's Where 19
Industry Observer 19
Washington Roundup 21
News Digest 33
USAF Contracts 75

Calendar 5
Letters 86

EDITORIAL
Laurels For 1958..... 17

COVER: Kaman H-43B, turbine-powered helicopter designed for U. S. Air Force crash-rescue work, is powered by Lycoming T53-L-1A engine installed above the fuselage to permit use of clamshell doors at rear. For additional pictures and story on the helicopter, formally rolled out last week, turn to p. 71.

PICTURE CREDITS

COVER—Kaman; 23—Wide World; 24—United Press; 25—U. S. Navy; 29, 52, 53, 55—USAF; 33, 69—Douglas; 49—Rocketdyne; 35, 64, 65, 66—Convair; 56, 59, 63—Lockheed; 71, 73, 74, 75—Kaman; 78—Pratt & Whitney.

75,160 copies of this issue printed

EDITORIAL

Laurels for 1958

We are reaching the end of another tumultuous and exciting year in the aviation business and its related technologies, and, once again, it is appropriate to look back and chart the major peaks of achievement that stand out clearly above the plains of steady progress.

This year now ending has seen the technological race between the U.S. and the Soviet Union develop into such sharp and obvious focus that it is no longer fashionable even in the highest political circles to disdainfully dismiss the subject by commenting that "we are not in a race with anyone over anything." Recovering from the shock of the Soviet Sputniks and long-range missile achievements, the democratic process ground slowly but surely toward putting our own technical effort on a broader and sounder base and cranking in a small measure of acceleration. Once again, though, the list of goats who have thrown sand into this accelerating machinery or have pleaded to allow the cobwebs of complacency to grow undisturbed would be perhaps even longer than those who merit kudos. Here are the people and organizations we think made significant contributions during 1958:

• **Lockheed Aircraft Corp. and General Electric Co.** Gas Turbine Division for bringing the world altitude record back to the U.S. and setting a new world speed record with the F-104 Starfighter powered by the J79 turbojet. Speed 1,404.19 mph. and altitude 91,249 ft.

• **Jet Propulsion Laboratory of CalTech** and the Army's Ballistic Missile Agency at Redstone Arsenal for successfully placing three Explorer satellites into orbit that contributed to new knowledge on outer space.

• **Dr. James Van Allen** and his Iowa State University group for their instrumentation of the Army Explorer satellites and the Army and USAF Pioneer moon probes that discovered and outlined the intense radiation belt that now bears Van Allen's name.

• **Maj. Gen. Joseph "Smoky" Caldara** for his intense, persistent campaign to reduce aircraft accidents and his successful blunt diplomacy in getting equipment manufacturers and operational commands to work more effectively on solving basic safety problems.

• **Pan American World Airways** for becoming the first U.S. flag line to operate jet transports across the North Atlantic and assisting National Airlines to become the first to operate jet transports in domestic service.

• **The 322nd Air Division** based at Evereux and Dreux, France, and commandered by Col. Clyde Box for its effective logistic support of the Lebanon crisis operations with its C-130 turboprop transports.

• **Rear Adm. John S. Thach** and his task force ALFA for his efforts in developing new anti-submarine warfare techniques and cutting through Department of Defense red tape to establish direct and effective contact with industrial organizations capable of tackling the many unsolved problems in this vital area.

• **Rep. John McCormack** for his understanding and speedy handling of the legislation establishing the National Aeronautics and Space Administration as House majority leader and chairman of the Select Committee on Astronautics and Space Explorations.

• **Sen. Leverett Saltonstall** for his courageous initiative in tackling the vital problem of eliminating the mass of outmoded legislation that now hampers effective military procurement of complex modern weapons and making the first effort to develop new procurement legislation that fits the modern problem.

• **William Allen,** president of Boeing Airplane Co. for continuing his able and courageous spearheading of the aircraft industry's battle against arbitrary and inequitable handling by the Federal Renegotiation Board.

• **Maj. Gen. Donald Keirn** for his persistent effort in the face of top-level indifference to keep the aircraft nuclear propulsion program going within the severe financial limits imposed by presidential scientific advisers.

• **Army Ballistic Missile Agency** for its work in developing the ablating type nose cone used on Jupiter IRBM.

• **Orval Cook** for his injection of stronger and more effective leadership into the Aircraft Industries Assn. and his willingness to publicly grapple with the basic critical issues facing the industry.

• **West Coast and Piedmont Airlines** for their introduction of the first modern equipment into feederline operations with their inauguration of service with the Fokker-Fairchild F-27 turboprop transport.

• **Sen. Mike Monroney and Elwood P. Quesada** for their vigorous bipartisan effort that brought the Federal Aviation Agency into action exactly one year before the time the original legislative blueprint had specified.

• **Boeing Airplane Co.** for its successful flight testing of the Bomarc air defense missile against the X-10 target drone, making successful intercepts and kills of a target moving faster than 1,000 mph.

• **Lt. Gen. Thomas S. Power, head of Strategic Air Command,** for his concept and execution of Operation Reflex, putting a significant element of SAC megaton striking power on a 15-min. alert aimed at countering any form of enemy attack including ballistic missiles.

• **Convair Astronautics Division** for its accelerated development and test program that proved out its Atlas ICBM weapon system, with three successful shoots on the Atlantic Missile Test Range including a final 6,325 mi. shot with warhead impact within six miles of the pre-determined impact area.

• **Staff of the Atlantic Missile Test Range** at Cape Canaveral, Fla., including Air Research and Development Command, Pan American and Radio Corp. of America range personnel and contractors' test operation teams, for maintaining as high a level of missile development test operations as budget limitations permitted.

• **Scientists at Harvard, Massachusetts Institute of Technology and Bell Telephone Laboratories** and other laboratories whose work in Masers and parametric amplifiers promises needed breakthrough in extending range and performance of early warning radars.

• **Passenger service agents** of all the airlines who do such a valiant and diplomatic job of trying to unsnarl all of the myriad mishaps that now occur in handling of airline passengers. The amount of goodwill and repeat business these men and women salvage for their individual companies and air transport as a whole is incalculable and they deserve far more recognition in the airline organization than they now receive.

• **Chicago Helicopters Airways Inc.** for its outstanding job in developing an effective passenger carrying short-haul operation in a metropolitan area in such a short period.

—**Robert Hotz.**

WHO'S WHERE

In the Front Office

Walter C. Thompson, board chairman, The Torrington Co., New York, N. Y. **Milton E. Berglund** succeeds Mr. Thompson as president. Also: **Rodney T. Dunlap,** executive vice president.

John Mihalic, a vice president, Avco Manufacturing Corp., New York, N. Y., and president of Avco's newly formed Nashville, Tenn., Division. **F. C. Reith** named group executive in charge of both the Crosley and Nashville Divisions; he continues as president of Crosley.

Ralph W. Barnes, president, Fluid Regulators Corp., Painesville, Ohio.

A. C. DeAngelis, president and a director, Radio Engineering Laboratories, Inc., subsidiary of Dynamics Corporation of America, Long Island City, N. Y.

Joseph S. O'Flaherty, president of the newly formed Continental Device Corp., Hawthorne, Calif. Also: **James P. Hynes,** vice president, and **Dr. Delbert M. Van Winkle,** vice president and technical director.

Joseph R. McPhee, Jr., administrative vice president, Telechrome Manufacturing Corp., Amityville, N. Y.

E. William Place, vice president and chief engineer, Holex, Inc., Hollister, Calif.

Henry A. Correa, vice president-marketing, ACF Industries, Inc., New York, N. Y.

Dr. Erwin Donath, technical vice president, Applied Science Corporation, Princeton, N. J.

John C. Pirie, a vice president, Pan American World Airways, Inc.

Dr. A. L. Antonio, vice president-chemical division, Aerojet-General Corp., Azusa, Calif.

Hull Wickham, vice president-engineering and maintenance, Frederick B. Ayer & Associates, Inc., New York, N. Y.

James A. Montllor, vice president, Essex Electronics, Berkeley Heights, N. J. Mr. Montllor continues as chief engineer.

Harold L. Rodgers, Jr., vice president, Titanium Fabricators, Inc., Burbank, Calif.

Honors and Elections

Gen. Edward P. Curtis, former Special Assistant to the President, has been named recipient of the Collier Trophy Award for 1957 for his "Aviation Facilities Planning" report to the President.

Gordon Banerian, manager of Aerojet-General Corp.'s Turbo-Machinery Division, has been named chairman of the National Aeronautics and Space Administration's Research Advisory Committee on mechanical power plant systems.

Dr. Michael Ference, Jr., director of Ford Motor Co.'s Scientific Laboratory, has been appointed a member of the National Academy of Sciences' Committee on Atmospheric Sciences.

E. J. Manganiello, Assistant Director of the National Advisory Committee for Aeronautics, has been elected vice president-aircraft powerplants of the Society of Automotive Engineers for 1959.

(Continued on page 79)

INDUSTRY OBSERVER

► Boeing Airplane Co. and Chance Vought Aircraft Corp. have teamed up in the National Aeronautics and Space Administration design competition for a man-in-space capsule. One other team has been reported thus far—North American Aviation Inc. and General Electric Co. (AW Dec. 1, p. 32).

► **Cluster of North American Navaho boosters proposed as a first stage for space vehicles bears the company designation G-38. Three-barrel Navaho boosters using Rocketdyne engines have developed in excess of 450,000 lb. thrust. Cluster of three would provide almost 1.5 million lb. thrust.**

► Look for announcement by USAF's Ballistic Missile Division that its Titan intercontinental ballistic missile has, with modest modification of its second stage engine to permit using high energy fuels, a potential range of 9,500 nautical mi. This range could be achieved with the Titan carrying its standard high yield warhead. Even greater ranges could be attained by reducing payload weight.

► **First Convair Atlas test vehicle in the C series is scheduled to be fired from Air Force Missile Test Center this week. Last of the B series was due to be launched late last week for less than the full-range shot. Operational missile will be the D series. An Atlas-D also will be used as the first stage for National Aeronautics and Space Administration's Project Mercury (man-in-space) launchings and for the full-scale versions of the Sentry reconnaissance satellite.**

► Royal Canadian Air Force team has been shopping in the U. S. for a replacement for the Canadair-built Sabre for use in Canada's NATO squadrons. Team has seen the Grumman F11F-1F, Northrop N-156, Lockheed F-104 and Republic F-105. Any aircraft chosen would be built by Canadair Ltd. RCAF had considered using the Rolls-Royce Avon engine in the F11F-1F but now is favoring the General Electric J79-7.

► **Approximately 75% of the cost of Navy's new Eagle air-to-air missile will go for avionics guidance and control, with powerplant representing 10% of the cost; the airframe 15% of the total.**

► Air Defense Command reportedly has doubts about using high frequency (HF) data link to control the North American F-108 Mach 3 interceptor because of possible outages in the far north during auroral disturbances. ADC prefers to stick with existing ultra high frequency (UHF) data link, which is not affected by aurorae, and extend its line-of-sight range by ground or airborne relay stations. Current ADC thinking is ironic because Air Force decision to reject North American's original choice of an F-108 avionic contractor (AW Dec. 1, p. 30) was largely based on the desire to use an Air Force-sponsored HF data link developed by Hughes Aircraft Co.

► **French SS-10 anti-tank missile will be produced in the U. S. under license if Army and Nord Aviation can agree on the choice of a manufacturer. At least 17 U. S. firms have approached Nord for a license. Company's chief engineer is now in the U. S. for discussions with Army officials.**

► Second stage of the first Discoverer satellite research vehicle scheduled for firing before Christmas Day is shorter and fatter than the second stage of USAF's Thor-Able and has a slight "pinched-waist" effect midway along the otherwise cylindrical body. Engine is the Bell Hustler which was designed originally to power a Convair B-58 pod (AW Dec. 8, p. 31).

► **French government reportedly has ordered a sufficient quantity of Dassault Mirage III interceptors to ensure production for the next two years.**

► Navy plans to send its Blue Angels acrobatic demonstration to Europe for the first time next summer to perform at the Paris Air Show.

► **Massachusetts Institute of Technology's Department of Aeronautical Engineering will become a department of Aeronautics and Astronautics. Faculty will be expanded and broader program in space technology will be offered. Dr. Charles Draper will head the department.**

Washington Roundup

New Job for Johnson?

Probability that Roy W. Johnson and Dr. Herbert York will head the new office of Director of Research and Engineering in the Defense Department, at least on a temporary "caretaker" basis, increases rapidly as time for the return of Congress draws nearer. Johnson now heads the Advanced Research Projects Agency and York is its chief scientist.

The Administration presented a strong argument on the need for the new post when it presented its Defense reorganization plan to Congress last spring. But in months of searching it failed to find anyone outside of government who would take the job.

Concern over this failure and embarrassment it would cause before the next session of Congress has prompted consideration of emergency solutions. Report that Johnson, York and probably some other personnel would be given stewardship of the research office was denied last week by Defense spokesmen. But the final choice apparently lay between Johnson and Guided Missiles Director William Holaday, with Johnson nosing out Holaday.

Why Spending Increases

Sen. Harry F. Byrd (D.-Va.), leader of the southern economy bloc in Congress, says domestic civilian expenditures—and not national defense and foreign assistance expenditures—account for the rise in total federal spending from $67.8 billion in Fiscal 1954 to an estimated $81.7 billion for the current Fiscal 1959 year. This is the picture:

- **Total "national security" outlays**—including military functions, stockpiling and defense production, atomic energy, foreign military and economic assistance—declined slightly from $48.6 billion to $48.3 billion over the five years. Spending by the Department of Defense rose slightly from $40.3 billion to $40.8 billion. This was more than offset by a drop in foreign military assistance from $3.6 billion to $2.2 billion.
- **"Domestic civilian" expenditures** shot upward by $14.3 billion: from $19.1 billion in Fiscal 1954 to $33.4 billion in Fiscal 1959. Spending for agricultural support programs alone increased by almost $4 billion: from $2.6 billion to $6.4 billion.

Although civilian activities are the prime target of Byrd's budget-cutting drive, he says there also is room for defense savings. "We should rechart the whole military program and re-evaluate the objectives of our spending in view of changing methods of warfare," he comments. "I yield to no one in advocacy of national defense, but, as the President has said, there is waste and duplication in the military departments."

Crew Debate

Civil Aeronautics Board last week threw the much debated "third crew member" issue between the Air Line Pilots Assn. and the Flight Engineers International Assn. into the lap of the Federal Aviation Agency. In reply to a telegram from Florida Governor Leroy Collins asking that CAB establish minimum qualifications for and the number of flight personnel needed to man a commercial transport as a means of settling the Eastern Airlines strike, Board members said they had already done so with requirements for a minimum of a pilot, copilot and flight engineer. The Board added that it had no evidence to change the minimums in the interest of public safety and pointed out that it is not empowered to solve labor disputes. Recommendations of presidential fact finding board calling for pilot-qualified engineers on jets were addressed to a labor dispute and involved no safety measures not formerly considered, the CAB said. Reminding the governor that FAA will assume CAB's safety functions by Jan. 1, the Board said both CAB and FAA hope the labor dispute "will be settled promptly."

ALPA Expulsion

In another move, Air Line Pilots Assn., along with its international federation, was expelled last week from the International Transport Workers Federation. Reason given for the expulsion is ALPA's stand on the jet transport crew complement, and, in particular, its running battle with the Flight Engineers International Assn. ITWF said ALPA's stand violates past agreements with the world-wide transport workers union and could lead to union raiding.

CAB Penalty Plan

Also, watch for the Civil Aeronautics Board to push for congressional legislation that would impose fines and penalties on any airline ignoring CAB requests for information. Board attorneys say carriers comply readily when such information involves applications for subsidy or route extensions but seldom bother to comply when they "have nothing to lose."

Corporate Mergers

A Senate Judiciary Subcommittee headed by Sen. Joseph O'Mahoney (D.-Wyo.) is viewing research and development as a new factor to impel corporate mergers. A report by a subcommittee consultant, Murray N. Friedman, professor of economics at Queens College, New York City, lists these as the circumstances in which research and development factors may be important in causing mergers:

- **Where companies desire to secure** an established patent base in a new field which it contemplates entering.
- **Where a company desires to secure** the services of the technologists and scientists who have developed a line of patent innovations.
- **Where mergers may present** an opportunity to broaden product lines.
- **Where a large company has** the financial resources to exploit the research and development of a smaller firm.

O'Mahoney, longtime skeptic of the trend toward the concentration of economic power in the U. S., questions whether the concentration of technological resources will discourage competition and hinder advancement. He said:

"News of mergers and corporate acquisitions abound on the pages of our financial journals. At the same time, the leaders of science, technology, business and government are seeking to increase our technological resources. Consequently, it is necessary to ascertain to what extent research and development activities are, and will be, a factor in the merger movement. It is also necessary to estimate the effect which mergers may have upon subsequent research and development."

—Washington staff

USAF to Ask Bids for Air-Launch IRBM

Decision to begin industry competition follows six-month testing of one and two-stage vehicles.

Washington—Industry will soon be asked to bid on development of a full-scale version of USAF's solid-propellant, air-launched ballistic missile, first reported by AVIATION WEEK last Aug. 25 (p. 15). Range would be 1,000 to 2,000 mi.

Decision follows a six-month program of test firings of one and two-stage vehicles, using a Boeing B-47 and a Convair B-58 to airlaunch the vehicles over the Atlantic Missile Range.

Air Force's general operational requirement for the new missile was in the office of Director of Guided Missiles William Holaday last week for approval. No opposition was expected.

Major advantages of a family of these missiles would include extension of the useful life and range of B-47, B-52 and B-58 bombers and extensive use of existing hardware, making possible a rapid development program. Larger versions would be carried by the North American B-70 and nuclear bombers and B-58.

These same advantages are the principal features of the feasibility study program now under way under Air Research and Development Command Study Requirement 168. Project name for these firings is Bold Orion. Weapon system designation is WS-199.

Contractors for the study phase are the Martin Co., whose effort has been aimed largely at guidance requirements; Lockheed Aircraft Corp. and Convair Division of General Dynamics Corp., have been concentrating on air-launching from high speed vehicles.

Contractors interested in the long-range version include Martin; Lockheed and Convair; a General Electric Co.-Douglas Aircraft Corp. team; Bell Aircraft Corp., which probably will be teamed with another contractor; North American Aviation, Inc.; Boeing Airplane Co., and Northrop Aircraft, Inc.

First two-stage test vehicle was fired by Martin from a B-47 over the Atlantic range last Tuesday and traveled for more than 700 mi. Five single-stage vehicles had been fired by the same team from the same aircraft previously, beginning last June.

Lockheed-Convair team last week had not yet fired a two-stage vehicle, but single-stage test vehicle has been fired from a B-58 in supersonic-dash runs that begin in the vicinity of Eglin AFB to a point a few miles east of Cape Canaveral, Fla., where the missile is dropped and fired. Vehicle is carried in the pod position.

Range at the Air Force Missile Test Center is used both for instrumentation and safety reasons and because the center's Azusa impact predictor can provide information on flight trajectory that could not be obtained otherwise.

Martin vehicle is dropped from the B-47's bomb bay at 35,000 ft. altitude, some four to five miles seaward of the Cape. As the missile is dropped from the aircraft, a lanyard jerks free, firing the first stage. During first stage burning, the missile travels in a path horizontal to the earth. At separation of first stage, the second stage is spun for stabilization. Shortly after ignition of the second stage, the missile programs upward at an angle of approximately 45 deg. into its ballistic trajectory. Apogees of final version may reach as high as 90 mi. B-57 is used for chase and instrumentation.

Vehicle uses Martin-developed Doppler guidance system, with the missile carrying a beacon and the launching aircraft carrying antennas.

Length is approximately 28 ft. Body of the missile is cylindrical but at a point approximately two-thirds of the way back from the rounded nose, it begins a flare into a bell-shaped aerodynamic skirt that is almost 6 ft. in diameter at its final expansion. Firings were preceded by air drops of dummies.

Lockheed-Convair test vehicle draws heavily on the USAF-Lockheed X-17 nose cone re-entry test vehicle. Lockheed's Missile Systems Division proposed such a vehicle for use with the B-58 earlier this year (AW June 2, p. 15). At one time, Boeing and Northrop also had proposed a solid-propellant missile for use with the B-58 (AW Sept. 15, p. 23).

X-17 used a first stage composed of four Thiokol Sergeant rockets, a second stage using three Sergeants and a third stage using one Sergeant.

Martin vehicles are designated WS-199B and Lockheed-Convair are designated WS-199C.

Initial firings of these test vehicles preceded the firing of the first North American WS-131B Hound Dog, which is being developed for the B-52G. Hound Dog is powered by a Pratt & Whitney J52 jet engine. Range of the Hound Dog is some 250 to 500 mi.

While development of a 1,000 to 2,000 mi. range air-launched missile would take some time even with the use of off-the-shelf hardware, there is a possibility that the vehicles used in the Martin and Lockheed-Convair test might be developed rapidly into interim missiles with ranges up to 1,000 mi. B-47 would carry three—one under each wing and one in the bomb bay.

If USAF's requirement is recognized and development is approved and founded, supervision over the development will be transferred from the Air Force Missile Development Center at Holloman AFB to ARDC's Detachment 1 at Wright-Patterson AFB.

B-58 Hustler Crashes

Ft. Worth—Convair B-58 Hustler crashed during a test flight over New Mexico last week in the first major accident involving the supersonic jet bomber.

The B-58 was on a scheduled test flight involving navigation equipment and was flying straight and level at about 30,000 ft. Reports from the scene indicate the bomber nosed over and dove into the ground without any apparent explosion or fire in the air. All three Air Research and Development Command crew members ejected after the B-58 nosed over. The pilot, Maj. Richard E. Smith, was killed, and the navigator and defense systems operator were injured.

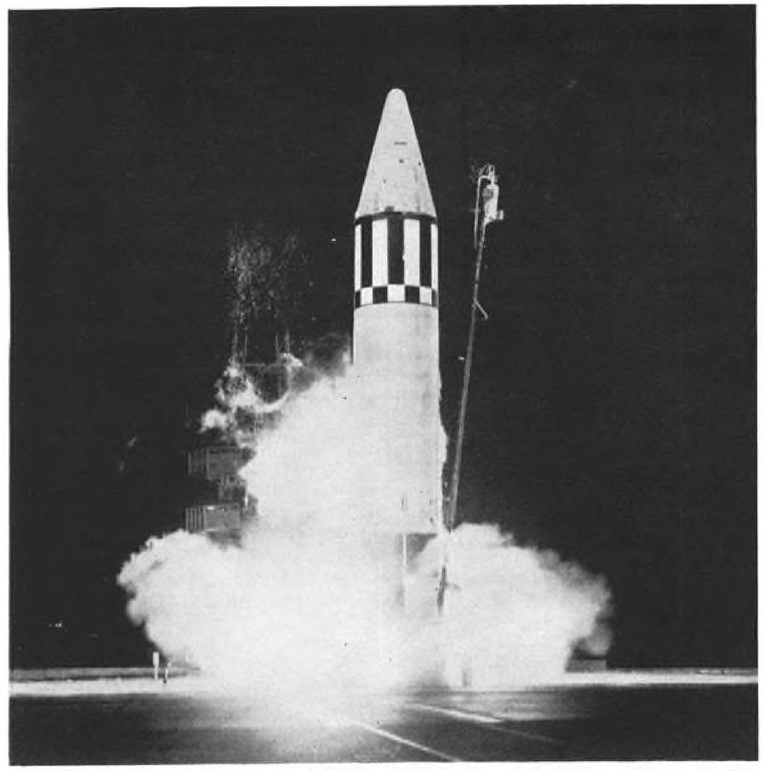
F4H Wins Competition

Washington—McDonnell F4H-1 last week was named the winner of Navy's flight test competition for a new carrier-based all-weather fighter. Competing aircraft was the Chance Vought F8U-3, a single place interceptor powered by the Pratt & Whitney J75 plus a small rocket engine for maximum performance.

Navy cited the F4H-1 design features of two General Electric J79 engines and provisions for a radar operator as decisive factors in the selection of the McDonnell aircraft. The F4H-1 is scheduled for operational use in the early 1960s and will be produced in quantity at St. Louis.

Fred O. Detweiler, president of Chance Vought Aircraft, flew to Washington the day after the Navy announcement to discuss the status of the Regulus II missile program as well as the F8U-3 termination. The Regulus II program is being renewed for possible cancellation as are all air-breathing missiles in the current budget discussions (AW Dec. 8, p. 25).

Navy decision to drop the F8U-3 and terminate its $96 million development contract resulted in the immediate layoff of 1,400 Chance Vought employes with less than one day notice. Chance Vought expects that about 1,100 others will have to be dropped from the payroll within the next three months.



ARMY Jupiter intermediate range ballistic missile is launched at Cape Canaveral, Fla., carrying a monkey in its nose section to 300 mi. into space. Monkey survived 13.3 min. weightlessness with no significant physiological changes.

Few Physiological Changes Noted In Monkey's Weightless Flight

Cape Canaveral, Fla.—Longest weightless period achieved thus far with a primate produced no significant physiological changes in a 1 lb. squirrel monkey, fired 300 mi. into space in a ballistic missile nose cone.

Weightless period of about 13.3 min. was achieved in the joint Navy-Army medical experiment. Monkey was launched in an Army Jupiter intermediate range missile as a secondary part of a nose cone test. Monkey was not recovered.

Second Monkey

Late last week a second monkey was a stand-by passenger for a scheduled Air Force Thor-Able shot designed to test a new ablation material for nose cones. The animal was to be included as a secondary experiment if the nose cone test left enough telemetry channels free.

Capt. Norman Lee Barr, chief of Navy's aviation and space medicine program, said initial telemetry information indicated that:

- "**The prolonged gravity-free state** does not produce significant physiological change.
- "**During the period of the gravity-free state**, the respiratory pattern and rate were normal.
- "**The heart was only slightly** accelerated (under zero G) and the electrocardiogram remained normal throughout the entire period of observation."

Takeoff Acceleration

Acceleration of takeoff produced:

- "**Mild physiological change** and no significant physiological impairment.
- "**Respiratory rate was slowed** and the respiratory pattern assumed slight irregularity.
- "**Pulse rate was increased slightly** during the acceleration."

Total telemetry time was about 800 sec., including the 500 sec. of weightlessness.

Physiological telemetry system developed by Capt. Barr was used. An Army telemetry system also provided information.

Signals are being studied further at the Naval Medical Research Institute, Bethesda, Md. Capsule was built and tested and monkey was tested and prepared at Navy's School of Aviation Medicine, Pensacola, Fla. Army Ballistic Missile Agency assisted with capsule design.

Two Navy destroyer escorts, a rescue ship and several P2V-7 aircraft were prepared to assist in recovery, but recovery gear in the nose cone failed.

Monkey was named "Gordo," the Spanish word for "fat." He was enclosed in a small metal cylinder placed inside a larger capsule of about 789 cu. in.

Capsule with the monkey in it weighed 29.5 lb.

It was self-contained except for one electrical connection.

Capsule was attached to the internal structure of the cone, about an inch from the side of the shell near the base, and was placed in the cone 5 hr. before launch.

Capsule Measurements

Capsule measured 10 by 13¾ in., with one end 4¾ in. deep and the other end 7 in. deep.

Rubber ribs supported the monkey's cylinder. It was insulated with fiber glass and foil. Absorbers were provided to remove excess moisture and carbon dioxide.

Gordo was placed supine, with his knees drawn over his chest, on a bed molded of silicone rubber and overlaid with a thin sheet of foam rubber. He wore a helmet of electrical potting compound molded over chamois. Fixed to the helmet was a fiber glass-coated wire mesh of cross design, which held a respiratory sensing element above the nostrils.

Nylon straps on the helmet were tied to rubber posts embedded in the rubber bed. Gordo wore thermistors in his armpits.

A microphone was encased in a pad of foam rubber, held over his chest by a nylon mesh belt.

A sheet of foam rubber covered by a second nylon mesh belt restrained the rest of the body.

Measurements included heart action, blood pressure, respiration, pulse rate, voice response, and temperature and pressure inside the smaller cylinder.

Mice carried in three Air Force Thor-Able nose cone test vehicles and the Russian satellite dog passenger, Laika, experienced even longer periods of weightlessness than Gordo, but his flight is more significant because he more closely resembled man anatomically and physiologically. Instrumentation was more extensive with Gordo than with the mice. However, both instrumentation and the time of flight—about one week before the dog's death—were longer with Laika.

Thor Firing Signals U.S. IRBM Capability

By Irving Stone

Vandenberg AFB, Calif.—Strategic Air Command opened the era of U. S. intermediate range ballistic missile operational capability when a Douglas Thor IRBM was successfully launched here last week in a far-reaching trajectory over a portion of the huge Pacific Missile Range.

First "blue suit" firing of an IRBM, this training shot by an 11-man crew of SAC's 1st Missile Division's 704th Strategic Wing in effect inaugurated the operation of Pacific Missile Range and Vandenberg. The Air Force base will have both intermediate and intercontinental range ballistic missile training and operational capability, but will underscore ICBM retaliatory potential.

Specific details of the trajectory were not revealed, but AVIATION WEEK has learned that distance programmed into this first IRBM shot over the Pacific Missile Range was about 1,250 naut. mi. Azimuth heading of the trajectory was approximately 251 deg., considering a due west value as 270 deg.

No announcement has been made on accuracy of trajectory, but it was learned that the nose cone hit within five miles from the intended impact point on the range.

In less than 20 min. after "the key was turned" the missile was on its way—lifting slowly off the pad, then gathering momentum rapidly as it roared up and programmed over the Pacific Ocean with initial portion of its trajectory easily pinpointed because of its white-hot exhaust. Main engine thrust of about 150,000 lb. cut off about 160 sec. after liftoff, while Thor's two vernier engines burned for about 10 sec. more for additional thrust input.

Telemetry Package

Missile carried a small telemetry package in the nose cone, which was not scheduled to be recovered. Approximately 25 measurements were made with the telemetering installation. Explosive charge in the nose probably signaled the impact point, which was slated to be somewhere in a 65-sq. mi. area within another surrounding 120 sq. mi. area cleared by the Navy. Sufficient tracking was available at Vandenberg to provide range safety and determine that the initial portion of the launch conformed to the programmed path. Navy supported with downrange information and telemetry.

Maj. General David Wade, commander of 1st Missile Division, declared that "indications are that everything was as successful as we had hoped." He said that the Thor could be considered on the operational threshold, adding that "we can't say we have a squadron that is combat ready, but on the basis of today's performance, both missile and ground support equipment are operationally ready."

Missile was originally scheduled to be launched at about noon but did not come off until about three and a half hours later. Gen. Wade stressed the fact that this was the first SAC shot and that small technical difficulties had been expected. Almost everything went according to schedule, the general declared, but he added that small adjustments had been necessary to ensure a successful launch.

Five Southern Pacific Railroad trains running through the base area also contributed to the launching delay. Wade declared that SAC would try to set future shots to avoid conflict with train schedules. There is no intention now to move the railroad tracks.

Douglas Thor which was developed under the jurisdiction of Air Force's Ballistic Missile Division, and Space Technology Laboratory which provided technical direction and systems engineering, normally is composed of four major systems—nose cone (manufactured by General Electric), inertial guidance (AC Spark Plug Division of General Motors Corp.), propulsion system (Rocketdyne Division of North American Aviation), and airframe (Douglas Aircraft Corp.).

Operationally, Thor is normally stored under shelter in a horizontal position. Following the order to fire, the shelter is removed and the missile is automatically erected into vertical position for launching. Nuclear warhead is not armed until specific requirements of speed, guidance and positioning have been satisfied. Final stage of arming occurs during re-entry over enemy territory.

Thor squadron is made up of a launch control officer, launch control console operator, launch and placement specialists and a number of technicians. There also is a central servicing team in the squadron.

THOR intermediate range ballistic missile is raised half way to its launch position by a transporter erector in preparation for firing from Vandenberg AFB launch site.

Research in France Detailed by Roy

Washington—Magnetically suspending models in wind tunnels to eliminate all solid supports such as stings and bayonet struts was described here last week by Prof. Maurice Roy, a key figure in French aviation.

Delivering the 22nd Wright Brothers Lecture, Roy said powerful coils surrounding the wind tunnel test section hold the metal models in place. Quantitative aerodynamic data is obtained by measuring model movement through the use of luminous beams and photoelectric cells.

Prof. Roy, Director of the Office Nationale d'Etudes et de Recherches Aeronautiques (ONERA), also described interferential strioscopic wind tunnel instrumentation so sensitive that it can record the little known pulsations of a bow shock wave in the process of formation.

STOL and VTOL experiments at Roy's agency, similar to the U.S.'s former National Advisory Committee for Aeronautics, has been directed toward blown rather than suction applications to wing sections and flaps.

One of the most unusual French STOL research vehicles is a small aircraft called the Deltaviex, which weighs 2,080 lb., has a useful wing area of about 36 sq. ft., a wingspan of 124 in. and a turbojet engine delivering 940 lb. of thrust. This small aircraft with a 70 deg. sweepback on its wing is virtually uncontrollable around its roll axis at low speeds but with wing trailing edge blowing utilizing 2% of engine air, it has normal piloting characteristics.

Creation of groups of rocket model and missile launching specialists was described by Prof. Roy as the French answer to the complex problem of obtaining adequate telemetered data from such short duration flight tests. He said that only long experience would enable such groups to define their operational and instrumentation techniques to the degree now required.

One interesting aspect of ONERA's structural and flutter work is the use of portable equipment available for transportation to a manufacturer's plant. It has been successfully used in France and Italy to determine the critical flutter speeds of aircraft and missiles. Ten days are required for this analysis.

In flight, checks on these ground flutter analyses are made by setting off very short duration rockets of 40 lb. to 1,000 lb. thrust on the wing tips and through the use of variable frequency generators in the fuselage. One of the aircraft involved in this work is the Sud Caravelle transport, and efforts are being made to increase its permissible speed.

Roy also discussed a "polyvalent" turbojet that is in the early research stages at ONERA. Main element of the engine is a two-stage compressor that delivers maximum mechanical compression at zero speed and zero mechanical compression at the maximum design speed of Mach 2 to 2.5. This is achieved through the use of variable angle guide vanes for the low pressure portion of the two stage compressor and its single stage turbine. This unit windmills after the low stage compression is cut off.

ONERA operates some of the most important wind tunnels in the world. The most modern are situated at Modane at the base of a 3,000 ft. waterfall and employ direct hydraulic drive with the water impinging in turbines connected to the propellers. Until the completion of the large transonic wind tunnel at Arnold Air Development Center, the Modane 26 ft. transonic tunnel was the world's largest.

It has been used for many full scale tests at high subsonic speeds including testing of the Nord Griffon, with its ramjet running and its pilot in the cockpit.

Regulus II Fired From Surface Vessel

First firing of Chance Vought Regulus II missile from a surface vessel was made from the USS King County, a Navy landing ship (tank) converted for missile tests. Regulus II was successfully recovered 47 min. later at Antelope Dry Lake, near Tonapah, Nev. Test was made on Pacific Missile Range, off Point Mugu, Calif. Launch system will be installed aboard submarine Halibut, first nuclear-powered submarine designed for missile launching.

Navy Develops Camera To Track Satellites

China Lake, Calif.—Open aperture camera in which film travel rate can be synchronized to that of targets at orbital distances and velocities to obtain record of satellites has been developed by Naval Ordnance Test Station.

Each camera covers a 20 deg. field—nine in a system would cover horizon to horizon on a path 20 deg. wide, with some overlap. When camera film speed is matched to that of a satellite, the satellite appears on the film record as a dot while light sources such as stars traveling at a different velocity or in a different path appear as light streaks.

Using this technique, exposures up to 10 min. can be made with a camera system on one satellite passage. With the system constantly exposing film at a rate which would closely synchronize with that of known or suspected orbital vehicles, a 3-hr. camera watch or record could be made. The only limit here is the 56-ft. length of film loaded in magazine, but this can be expanded so that longer watches are kept with larger film loadings. Currently, targets are acquired on an "anticipated arrival time" basis, or are recorded under the constant scanning technique.

The camera, largely developed by NOTS Photo-Technologist Jack Leininger, is termed a synchronized smear camera for satellite surveillance and detection. Prototype utilizes a 3.5f. lens with a 10-in. focal length. Focal plane aperture is 5x5½ in.

House Unit Urges Space Legislation Study

Washington—Creation of a basic code of ethics on which policies and international rules of outer space can be developed is urgently recommended by the House Space Committee staff in a survey of space law being released today.

The survey, submitted in the form of a report to Rep. John W. McCormack, (D.-Mass.), chairman, and members of the House Select Committee on Astronautics and Space Exploration, is the second in a series involving specialized subjects. The first, covering international cooperation in space exploration, was released in October (AW Oct. 20, p. 33).

The report said that, at the end of 1958, "the world finds itself approaching a unique crisis—a crisis demanding clarification of the legal positions of nations as they reach into outer space. The simultaneous fruition of two closely related situations is dramatically bringing this need into focus."

Capability of nations to explore and use outer space, the report said, is advancing much more rapidly than had been expected. It added that the end of the International Geophysical Year on Jan. 1 signals the need for consideration of a code of space behavior. Precise effect which the IGY has had upon the legal status of man-made objects in space is in dispute, the report said. It added, however, that whatever the effect may have been toward permitting the free passage of space vehicles over nations of the world, its cause will no longer exist in 1959.

The report does not recommend the immediate drafting of a complete set of principles and rules designed to resolve all international questions and differences now apparent in space exploration, or those anticipated for the future.

What Committee Wants

Instead, the space committee staff urged immediate attention be given a number of issues that might serve as starting points. In this way, the staff said, it may be possible to develop a body of space law aimed initially at creation of legal principles to cover scientific and commercial matters, bypassing for the present the larger policy decisions bound up in security and defense matters.

Specifically, the staff recommended that the following steps be taken:

- **Begin development of rudimentary** space law.
- **Identify and concentrate upon** the most urgent areas that show some promise of settlement.
- **Attempt agreement on principles** and on methods of settling disputes, leaving the specifics for a later date when necessary.
- **Emphasize agreements on scientific** and commercial uses of space, working from there toward the larger issues such as national sovereignty.

The report said there appear to be several alternatives as to how the initial studies of space law should be conducted and who should do the spadework.

One suggested approach, it said, is to leave the entire matter under the purview of the United Nations or one of its specialized agencies. The staff said this could be either an existing agency or subdivision or an agency brought into special relationship with the U. N. for this purpose. The staff predicted that in view of the committee established by the U. N. General Assembly on Dec. 13 to study legal problems that may arise in space exploration, this alternative is perhaps the most likely to be adopted.

A second alternative, the report said, would be to follow the quasi-governmental procedure used for the IGY and leave the initiative with an organization such as the International Council of Scientific Unions, which has worked closely with national governments.

Another alternative suggested by the House space staff would be to turn the job over to a private group, such as the International Astronautical Federation, which has no strong formal ties with governments, and request it to draft a space code for later consideration by the United Nations or a special international convention.

Still another agency that might be used to advantage for arbitration and decision, the staff said, is the International Court of Justice.

On the need to begin to establish a general space law, the report said, there is wide disagreement among officials and legal experts throughout the world.

Arguments against an early plan, the report said, are that there is as yet insufficient scientific knowledge of the physical nature of space to draft rules for its regulation and that premature rules could prove dangerous in terms of the reduced level of national security.

The logical way to handle the regulatory problems of space, they contend, is to consider each individually as it arises or shows concrete evidence that it is about to rise.

An argument advanced in favor of an early plan, the report said, is that a fundamental cause of failure to agree is the belated tackling of grave international problems when they have gone beyond the stage of control or easy compromise.

Early Move Favored

The report said this position seems more convincing for the following reasons:

- **Legal uncertainties which may come** into being with the expiration of the IGY.
- **Rapid development of the state** of the art. Planned programs call for deep space probes, scientific satellites for data collection and weather control and manned satellites in the foreseeable future. Military capabilities for using space go hand in hand with this trend, the implications of which are obvious.
- **Very considerable risk of wrongly** identifying objects moving through space, such as mistaking a satellite for an intercontinental ballistic missile.
- **When space becomes subject to** vested interests on the part of any nation it tends to acquire legal stature, and it would be difficult to get any nation to surrender those rights except by force.
- **Scientists will soon be severely** hampered by unprogrammed satellites or other spacecraft, particularly if the satellites are far enough from the earth to continue in orbit indefinitely and their electronic transmissions are not synchronized with programs of other countries. Space "cluttered up" with dead satellites or pieces might pose a threat to eventual space navigation. In addition, the report said, the objects would interfere with astronomical studies by fouling photographic plates or hamper accurate transmission of data due to radio interference.
- **Probability that a number of smaller** military powers may reach a parity with the larger powers by acquiring the capability of using space at an early date. Possible action that might be taken by a politically immature state once it acquires the ability to use space is cause for serious concern, the report said.

Possible Headway

Until now, the report said, the bulk of legal discussion on space law has centered on the question of national sovereignty, territorial rights in space and defining the boundaries of airspace and outer space.

It said chances of an early agreement on these questions appear to be very remote.

The report added, however, that there are many other imminent legal problems involved in space exploration on which a certain amount of headway might be made.

These include:

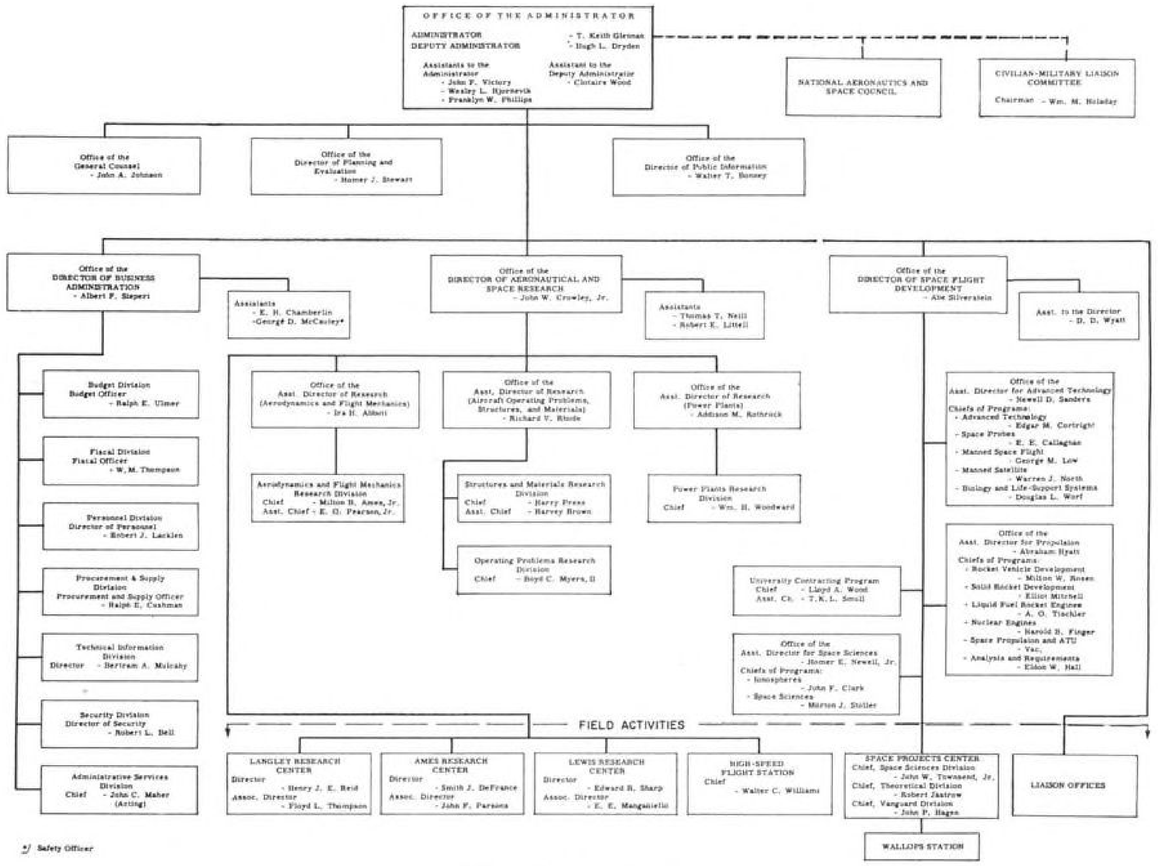
- **Fixing liability for damage** caused by satellites returning to earth.
- **Filing of flight plans** for space vehicles before launching and decision as to whether to press for inspection in order to be assured that the vehicle is of its announced character.
- **Establishment of rules governing** the surrender of spacecraft and their instruments to the originating nation when it is downed in another country.
- **Use of transmission frequencies.** Violation of existing international rules have already been found in space activities.
- **Cooperation on navigational problems.** Erroneous navigational fixes could be fatal, even in the early stages of manned space flight, and the correlation and synchronization of data from different parts of the earth may be needed to help prevent them.
- **Distribution of data** such as performance and location of spacecraft and meteorological and other scientific information to some international center might be invaluable scientifically and essential in settling disputes, the report said.
- **Registration and identification of** spacecraft along the lines of established practices governing use of seagoing vessels and aircraft.

Pershing Award

Cape Canaveral, Fla.—Army-Martin Pershing missile launching complex, consisting of a blockhouse, two launch pads and a nose cone installation building, will be built here beginning early next year.

Pershing nose cone test vehicles will use a spin bucket of small rockets, roughly similar to that used on Army's Jupiter-C and Juno II test vehicles. Final version will not use a bucket. Pershing is a solid propellant tactical range missile designed to be smaller, lighter and more mobile than Redstone.

Army has awarded R. E. Clarson Inc., of St. Petersburg, Fla., a $2,062,152 contract for construction of the complex.



NASA Organization

Above chart shows tentative organization plan of National Aeronautics and Space Administration. Chart, however, does not include California Institute of Technology's Jet Propulsion Laboratory over which NASA recently assumed jurisdiction (AW Dec. 8, p. 30).

Air Force Cancels Fairchild Goose

Washington—The Fairchild Goose, ground-launched diversionary missile for use against intercontinental targets by the Strategic Air Command, has been canceled by the Defense Department after an expenditure of $70-75 million.

Considerably smaller than the Northrop Snark intercontinental cruise missile, the Goose was designed to carry electronic countermeasures equipment over enemy territory after being originally launched from bases in the U.S.

A number of successful Goose firings have been reported during the last year. The Fairchild J-83 powerplant which powered the Goose is now being re-evaluated by the Air Force and no decision has been reached regarding its status.

Richard S. Boutelle, Fairchild president, said the termination of the Goose project would result in the release of about 350 employes.

U.S. Dealers Rap Defense Surplus Policy

By Ford Eastman

Washington—Surplus aircraft dealers last week charged that the U.S. is selling excess military planes to foreign governments at prices below market value and threatening to deprive the industry of its main source of income.

The Charlotte Aircraft Corp., one of the largest dealers, said in a letter to Defense Secretary Neil McElroy that "recent variations from previously established policies regarding sale of excess aircraft, parts and services are causing considerable alarm among the surplus dealers."

Defense Department officials, on the other hand, contend that there had been no deviation from policy governing disposal of surplus equipment.

H. J. Caldwell, president of Charlotte, said a total of 78 first-line military aircraft were sold recently to three Latin American countries at prices lower than those at which the surplus dealers could obtain "stripped aircraft" from the government by competitive bidding.

Mexican Purchase Cited

Caldwell said his company had bid on 12 North American T-28 trainers and had firm orders from the Mexican government for at least six. Before arrangements could be completed, however, he said the Mexican government negotiated for 30 complete T-28s from the Air Force at prices below the Charlotte company's bid for stripped-down aircraft and, therefore, canceled its order with the private firm. As a result, he added, the Charlotte company turned down the 12 T-28s it had received on bids and paid $25,000 in penalties rather than try and dispose of the aircraft elsewhere at a possible loss.

Other purchases questioned by Caldwell were the sale of 30 North American SNJ-5C trainers with carrier capability to Argentina and 18 SNJ-6Bs to Bolivia. He said that, although the types sold to Argentina and Bolivia were not available to surplus dealers, they were still sold at a price lower than that which his company could obtain a similar type aircraft.

In the past, Caldwell said, foreign governments largely depended upon surplus dealers for aircraft and parts that had become obsolete in the U.S. As a result, he said, the dealers were among the Defense Department's best customers for obsolete planes and parts.

A continuation of this policy can prove very expensive to the U.S. government, Caldwell said. If foreign governments can purchase complete flyable aircraft far below market value, he contended, the government has not only lost on the sale of each plane, but it can also lose on the sale of other excess, he added. Surplus dealers will not purchase this material for resale when the government is already supplying their markets so its value will be reduced to scrap.

Defense Department officials explained that surplus aircraft or parts are disposed of in any one, or more, of the following ways:

- **Through the Mutual Security** Military Sales Program.
- **Armed Forces Supply Support** Center.
- **Competitive sale at the base** or depot where bids are received on the surplus.
- **Through authorized negotiation** at major overseas commands.

When equipment is first declared surplus, officials explained, friendly foreign governments are notified and are given the first opportunity to buy through the Armed Forces Supply Support Center at prices based upon the fair market value.

Any aircraft or spares not purchased there are usually placed on the competitive market, where governments or individuals can submit their bids, and prices range from scrap to market value.

The field of foreign military assistance, however, covers a wide range of price policy, officials said. At one end of the scale, the U.S. furnishes the required military equipment to the authorized foreign government at absolutely no cost to the recipient. This could be surplus, used materiel or material specifically procured for the purpose of free issue to the recipient.

In the middle of the scale, the material is sold at prices which oblige both the recipient and the U.S. to share certain costs. At the other end of the scale, the foreign government is required to pay 100 cents on the dollar for anything purchased from the U.S.

The selection of pricing policy in the area of foreign aid is dependent upon many factors, such as the ability of the recipient to pay for the desired equipment, the military contribution expected of the receiver and the utility of the equipment for further U.S. need, officials said. The Joint Chiefs of Staff, with the advice of the Administration and the Congress, set the policy.

The Navy's spare parts supply system also came under fire, but from a different source—the General Accounting Office—for allegedly not adequately meeting the aircraft spare parts requirements of the fleet.

In a report to Congress, GAO said a review of the aviation segment of the Navy supply system disclosed serious deficiencies in several critical areas. The agency charged that, not only did the system fail to meet fleet requirements, but also resulted in the accumulation of substantial quantities of excess material.

For example, the report said, an average of 8% of the Navy's operational aircraft were reported grounded for lack of parts in September; for certain first-line aircraft, it said, the rate was much higher. The report added that material valued at $823 million was declared excess for disposal purposes during fiscal years 1955 through 1958 and that an additional $274 million of aeronautical materiel will be declared excess in the near future.

The report said, however, that now practically all of GAO's recommendations have been accepted by the Navy and that officials have advised that necessary corrective action has been initiated.

Deficiences Cited

Deficiencies contributing to the ineffectiveness of the Navy's present system listed by the report included:

- **Use of inaccurate and unrealistic** factors in requirement computations.
- **Inaccurate field reporting** of quantities and conditions of assets on hand.
- **Unrealistic use of available** information.
- **Questionable aviation material** provisioning policies.
- **Untimely allocation, distribution** and redistribution of materials.
- **Frequent changes in programs.**
- **Frequent technical changes.**

The report said many of the factors used in the determination of requirements need to be made more realistic and accurate to ensure more effective and economic spare parts support. In addition, it said application of these factors need to be made to be consistent with the actual use of spare parts.

In turn, the effectiveness of budgeting, procurement, distribution and disposal programs depends upon the reliability of requirement determinations.

The report said inventories of repairable material valued at about $6 million at three Naval air stations were not reported for periods or six to 12 months and that these inventories were not considered in the computation of requirements. In addition, GAO staff audits at several Naval air stations reported inadequate control over aeronautical materiel, resulting in the submission of inaccurate stock status reports to the Navy's Aviation Supply Office.

Other areas involving inventory management which the report says need improvement, include:

- **Ineffective control over existing** quantities and procurement of excess amounts of short shelf-life items have necessitated the disposition of significant quantities of material which became overage and resulted in system shortages that required emergency purchases.
- **Limited operational life of repairable** helicopter components has not been considered in determined requirements. This has resulted in critical shortages of the components.
- **Contemplated procurement** has not always been adequately screened against lists of items in excess to preclude purchase of identical items scheduled for disposal.
- **Screening procedures applicable** to furnishing material for military assistance program requirements were not fully effective.
- **Order and shipment record cards,** which contain important data for use in requirement determinations, have not been maintained accurately or currently.
- **Use of a limited requisitioning** objective to replenish stocks of general aeronautical material has frequently caused system shortages, work stoppages and uneconomical repetitive procurement.

As a result of action taken to improve most of these deficiencies, the report said, it was estimated that $113,000 will be saved annually in the future procurement of just one short shelf-life item, for example. Also, comparison of a number of items for disposal with outstanding purchases resulted in the immediate cancellation of orders of about $77,000.

Rocketdyne Selected by NASA To Develop Million lb. Engine

Washington—Rocketdyne Division of North American Aviation Inc. has been selected to design and develop a single barrel rocket engine developing from one to one-and-one-half million lb. thrust by the National Aeronautics and Space Administration.

Total cost of the program is expected to exceed $200 million, and it is estimated that four to six years will be required to produce useful hardware.

Five other companies—Aerojet-General Corp., General Electric Corp., Curtiss-Wright Corp., Reaction Motors Division of Thiokol Chemical Corp. and Pratt & Whitney Aircraft, a division of United Aircraft Corp.—submitted unsuccessful proposals in the NASA competition which was initiated in late October. Bell Aircraft Corp. was invited to bid but declined.

Feasibility Study

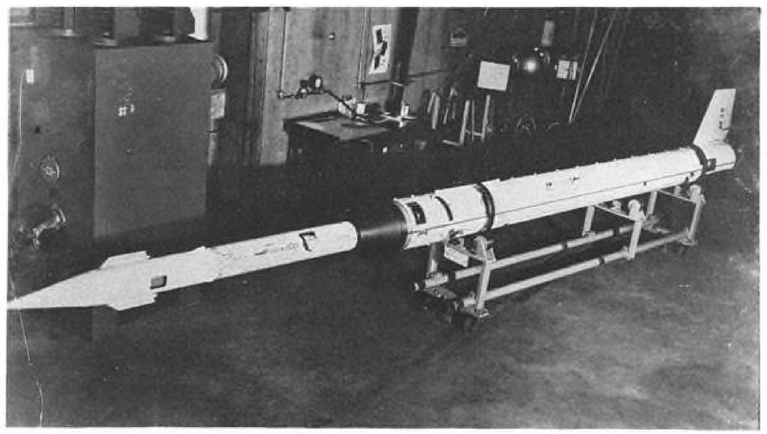
Rocketdyne's work on the engine, which will be capable of sending a number of tons into orbit, began last May under an Air Force contract for a feasibility study and some hardware development. The program was later transferred to the Defense Department's Advanced Research Projects Agency but continued to be administered by Air Force. Feasibility of the engine was established while the project was in the process of being transferred from ARPA to NASA.

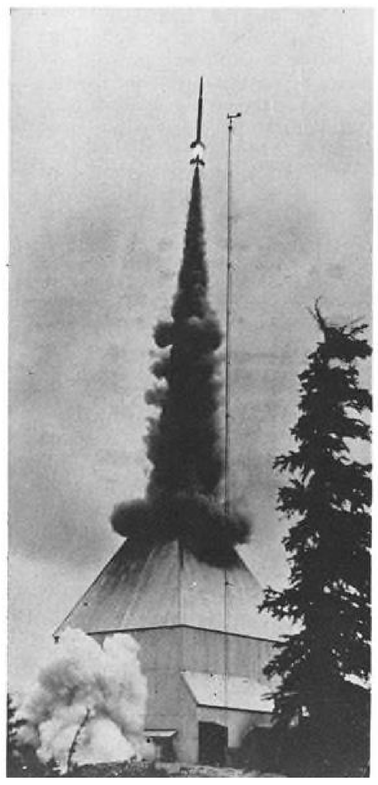
It has been possible to make these administrative changes without slowing the technical work because NASA has provided the Air Force with the funds to continue their original contract which will probably run for another four to five months. Total money spent on this particular contract will be more than $1 million.

NASA describes the engine as a liquid oxygen and hydrocarbon propellant. It may be altered, however, to use other liquids without major change. Special emphasis will be placed upon developing reliability and simplifying thrust control and pressurizing propellant tanks. First engine made is scheduled to develop one-million lb. thrust and have a 50% growth potential.

The program includes the construction and use of government test facilities at Edwards AFB, Calif., and government furnished fuel for development testing of components.

NASA administrative officers for the program include Abe Silverstein, director of space flight development; Abraham Hyatt, assistant director of propulsion development, and Adelbert O. Tischler, chief of liquid fuel rocket engine programs, who will be the principal project officer.





Aerobee 300 Reaches 260 Mi. Altitude

Aerobee 300 research rocket called Spaerobee—composed of Aerobee-Hi liquid propellant rocket as first stage with a second stage solid propellant Sparrow I air-to-air missile and a small Aerobee solid propellant booster for launching, reached an altitude of 260 mi. in its first test firing (right) at Fort Churchill, Manitoba, Canada. Rocket above was developed by Air Force Cambridge Research Center, with Aerojet-General as principal support contractor. Data telemetered back from first test shot showed that the system design requirement of carrying normal 50 lb. payload to 300 mi. altitude had been achieved; actual payload was heavier-than-normal 65 lb. due to increased instrumentation for the flight. After burnout, Aerobee 300 used a microphone-type of instrument to measure micrometeorite impact. Flight lasted approximately 640 sec.

Army Aviation Broadens Base Through Civil Overhaul Plan

Washington—Integration of civilian overhaul facilities into U.S. Army Aviation's depot maintenance capability is on the upswing. Lt. Col. A. J. McDermott, Jr., told a symposium sponsored by Aeronautical Training Society and the Aircraft Service Assn. here last week.

Col. McDermott told civilian training and overhaul base operators that Army Aviation's program, designed to reduce that service's capital investment necessary for internal depot maintenance, not only is broadening its industrial base, but is also providing a valuable training program for contractors in event of expansion required during an emergency.

Indications are that Army Aviation will represent a healthy market in future years for civilian contractors, although currently it is still restricted because of budget limitations. Major expansion period, both for pilot training and overhaul work, will probably await the 1960s.

Currently 80% of total Army Aviation maintenance contracts is going to commercial overhaul facilities, with 15% being handled by prime manufacturers. The remainder are handled in Army Ordnance Depots, according to Col. McDermott, Chief, Contract Maintenance Division, Directorate of Procurement and Production, Army Transportation Supply and Maintenance Command, St. Louis, Mo.

In Fiscal 1958, Army's TSMC let 150 contracts with civilian base operators and 36 intra-and/or inter-service agreements representing approximately $8 million on its "repairables" program; 18 SCAMP (Standard Configuration and Modification Program) contracts totaling approximately $3 million. Higher workload is seen for civilian contractors in Fiscal 1959 due to new aircraft entering the inventory and the fact that current aircraft are getting older and requiring additional work.

Col. McDermott emphasized to contractor representatives that Army considers their facilities part of Army Aviation's maintenance echelon. According to a military source, who would not permit quotation, Army has no intention of deleting civilian participation by setting up large-scale depot maintenance facilities.

At policy-making level, the current feeling appears to be that contractors will continue to serve piloted aircraft areas—airframes, engines, equipment and training—and are not now considered in playing a similar role as regards Army missile programs. Major reason: their complexity requires such a large and expensive inventory of shop facilities that major modification and overhaul will probably continue to be funneled through the primes rather than to civilian servicing organizations.

Army's SCAMP program, which it introduced in Fiscal 1958 to replace former IRAN (Inspect and Repair as Necessary), will be refined in Fiscal 1959 so that where contractor has know-how and ability, he will perform maximum accessory overhaul, formerly prohibited under former IRAN and early SCAMP contracts, which envisaged contractor replacing accessory with serviceable item and returning former equipment to the Army which had planned to consolidate this work under separate contract. New system may return out-of-service aircraft to users in shorter time.

SCAMP program's major innovation was that all deficiencies are corrected by the contractor, regardless of what echelon of maintenance was responsible. Previously, under IRAN, a contractor finding more deficiencies than had been considered required, returned some aircraft to using commands under the concept that they were responsible for organizational and field maintenance. This system was criticized by using commands because of delay getting aircraft fully operational due to high attrition of skilled Army personnel.

Army noted that in order to aid civilian contractors who have had difficulty in obtaining long lead time items to full overhaul contracts, TSMC is developing a listing of such material and will procure and stock it to support the contracting system.

Problem of price cutting on bids to get Army contracts at almost any cost was a major concern voiced by industry representatives and the Army—the former indicating that price appeared to be the top factor considered by Army contracting officers rather than quality. Some industry personnel voiced opinion that U. S. Air Force placed a prime consideration quality in weighing contract awards and that Army's apparent emphasis on price was a big factor in some awards being given to bidders who didn't have experience and facility requisites to do the job.

Such practices, they point out, hurt operators who find it difficult to retain skilled personnel since many contracts are on a one-year basis and follow-on work may be granted a competitor.

Army pointed out that often, if it considered a bidder not eligible to handle work, pressure was received from Small Business Administration and congressmen to grant the contract. Indications are that office of Deputy Chief of Logistics is accumulating case histories of such awards which have turned out unsatisfactorily because the contractor was unable to handle it properly and will make a presentation to SBA. Army noted that of 18 SCAMP contracts in Fiscal 1958, three turned out unsuccessfully.

Both industry and Army representatives indicated that setting up a "qualified bidders list" that would closely screen maintenance facilities and disqualify those who did not meet certain standards, could alleviate this problem. Aeronautical Training Society-Aircraft Service Assn. representatives said that they would work to get such a list made a part of future requirements.

Closer cooperation between Army maintenance officials and civilian operations was advocated by Rex H. Madeira, executive vice president, Page Aircraft Maintenance, Inc. Maderia urged that maintenance industry be worked into a war-mobilization program, so that in event of an emergency, its management and personnel would be fully acquainted with Army doctrines, techniques and procedures, to minimize delay in fitting civilians into Army's requirements. Such a program would minimumize disruption of contractor's staff by retaining key men rather than have them taken into military service where their skills might be lost.

Airborne 'SAGE' Unit Developed by Litton

Washington—An airborne "little SAGE system" that automatically analyzes the fleet air defense situation and the capability of available Navy interceptors, then directs interceptors into contact with enemy bombers, has been developed by Litton Industries, Beverly Hills, Calif.

The Air Tactical Data System, or ATDS for short, performs a function similar to that of a giant land-based SAGE computer, but is small and light enough to be installed on carrier-based airborne early warning and control (AEW&C) aircraft. The entire system is believed to weigh less than 2,000 lb.

Information on location of enemy targets is obtained from the airplane's own airborne radar and from ship-based radars, the latter being transmitted by ship-to-air data link. Information on the interceptor's position, altitude, fuel reserves and available weapons is fed to ATDS via air-to-air data link. Airborne computers calculate effectiveness of interceptor-weapon combinations in destroying attacking bombers and transmit information to ship-based combat information centers via air-to-ship data link.

Douglas DC-8s Undergo Final Assembly

Douglas DC-8s are shown in final assembly area at Long Beach, Calif. The aircraft is to enter scheduled service at the end of 1959. Eighteen airlines have ordered 140 DC-8s at a cost exceeding $700 million. Markings of Pan American, United and Trans-Canada Airlines are visible.

News Digest

Britain made a long-expected decision to go ahead with development of a supersonic strike-reconnaissance aircraft to replace the Canberra. Plane would meet RAF's operation requirement OR 339. Order may be placed soon with Hawker Siddeley group or a consortium headed by English Electric and Vickers Supermarine.

Sikorsky Aircraft Division of United Aircraft Corp. has received a $17 million contract from the Navy Bureau of Aeronautics for production of HSS-2 helicopters. The HSS-2, (S-61), powered by two General Electric T58 gas turbine engines, has a flying boat hull and all-weather flight capabilities.

Photon sail space vehicle studies at the University of California's Los Alamos Scientific Laboratories have produced a proposal for a 50 lb. vehicle which could be launched by a Vanguard-type booster. Half the weight would be for the sail—made of thin plastic coated with evaporated aluminum about 50 yd. in diameter and spread either by centrifugal force or by foam plastic which would be formed into ribs of the sail. Other 25 lb. would be payload.

Electronic Specialty Co., Los Angeles, has been selected to design and build the antenna subsystem for North American's F-108 interceptor. Company won the evaluation over five competing companies for the several million dollar contract. F-108 is first airplane to use integrated antenna system for all communications components.

Northrop Division of Northrop Aircraft, Inc., and U. S. Air Force have completed negotiation of a $50 million contract covering production of additional Snark SM-62 missiles. New contract provides for continuation of program through December, 1960.

Boeing Airplane Co. has contracted with Canadair Ltd., Montreal, Canada, for engineering services in U. S. Bomarc missile program. Under the contract, Canadair will send 150 missile men to Boeing factory for six months.

Total aircraft sales volume of $95,889,733, with net earnings after taxes of $3,324,663, is reported by Beech Aircraft Corp. for its 1958 fiscal year ended Sept. 30. Of sales, $32,103,569 represented commercial business aircraft. Previous fiscal year figures show total sales of $103,904,870 with net income of $3,369,340 and commercial sales of $35,746,094. Backlog as of Dec. 1, 1958 exceeded $90 million.

Certificate of airworthiness has been granted for Rolls-Royce Conway R.co. 10 turbojet engines for use in Boeing Intercontinental 707-420 jet transports, at minimum operating dry thrust of 17,000 lb. Conways being delivered weigh 140 lb. under the company's guaranteed maximum weight.

Johns-Manville Corp. will buy L.O.F. Glass Fiber Co., Toledo, Ohio, on the basis of one share of Johns-Manville common stock for each 2½ shares of the glass company's common stock.

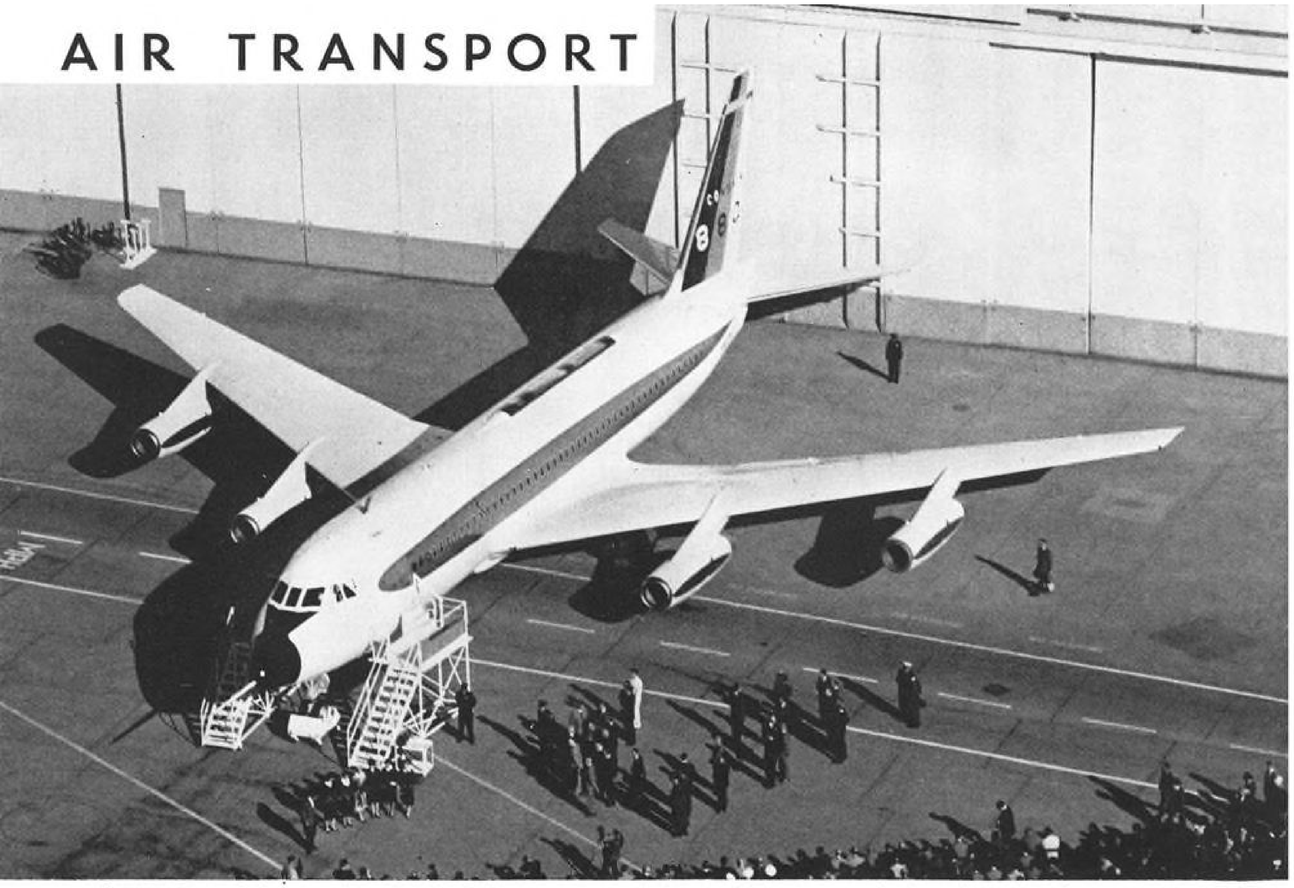
Carmichael Named Fairchild President

Hagerstown, Md.—James H. Carmichael was elected president and chief executive officer of Fairchild Engine & Airplane Corp. last week, replacing Richard S. Boutelle who steps up as vice chairman of the board of directors.

Carmichael, president of Capital Airlines for 11 years, was elected vice president of Fairchild's Commercial Transport Division in August and promoted to executive vice president last month.

Boutelle has served as president and director of the company since 1949. From 1941 to 1949, he was vice president and general manager of the airplane division. Sherman M. Fairchild, board chairman, said Boutelle will continue in an active capacity with the company, placing special emphasis on the company's long range development program.

Both Carmichael and Boutelle were named to the executive committee. In addition, Carmichael was elected to the board of directors, replacing E. Ainsworth Eyre, who resigned.



ANTENNAS are flush-mounted in semi-circular housing on top of Convair 880 jet transport fuselage. Engine sound suppressors and reversers are scheduled to be installed soon.

Convair Rolls Out Its First Model 880

San Diego—Intensive engineering and production effort for fast introduction of its commercial jet transport entry paid dividends last week for General Dynamic's Convair Division when it rolled out its first 615-mph.-cruise Model 880 two weeks ahead of schedule. Ships 2 through 9 already are in major assembly at Convair-San Diego.

Maiden flight of this first 880 will be within two months. The initial four aircraft will be put through a 16-month testing program. Cabins of the first three aircraft will carry test instrumentation. The fourth plane, for Delta Air Lines, will be the first to be equipped with a complete passenger cabin.

Second Model 880 off the assembly line will be used for structural integrity tests on the ground. Third plane will fly in April, 1959, and the fourth in June. Model 880's debut into scheduled airline service is slated for May, 1960, with Trans World Airlines.

Purchasers of the 880 include TWA, 30 aircraft; Delta 10; Swissair and SAS Scandinavian Airlines, joint order for five Intercontinental 880s; Real-Aerovias of Brazil and Transcontinental of Argentina each four Intercontinental 880s. American Airlines has purchased 25 Convair 600s, sister ship of the 880. Sales, including 880s and 600s, now total 78 planes. Capital Airlines is currently negotiating with Convair for purchase of 10 880s.

When TWA flies its first 880 in scheduled airline service, it will have received approximately 12 of the aircraft, according to a schedule which pinpoints one for delivery in November 1959, another in December, a third in January, 1960, two each in February, March and April, and three more in May.

Delta Schedule

Delta will receive its first 880 in January, 1960, another in March, two more in April and the fifth in May.

Deliveries of two Intercontinental 880 versions to Swissair and SAS are scheduled for October, 1960, one each in November and December, and a fifth in January, 1961.

Commenting on the degree of engineering accomplishment in the 880, Earl D. Johnson, executive vice-president of General Dynamics Corp., declared:

"Today, the 880 is no gamble—I mean every facet of it—its structure, engines, speed, reliability, and comfort. We have the finest. . . . If you look at the flexibility of the plane, we will be selling it 10, 15 and 20 years from now."

There is no chance of a supersonic transport pushing into the stage length regimes the 880 would cover, Johnson declared, indicating that these would be hops from 200 to 2,500 mi.

At time of rollout, the 880's General Electric CJ805-3 jet engines, (commercial version of GE J79) were not fitted with sound suppressors or reversers. Sound suppressors are scheduled for installation in about a week; the installation of reversers is further down the line. Each engine will deliver 11,200 lb. static thrust.

Inlet guide vanes of the CJ805-3 are about 5 ft. aft of the lip of the nacelle intake duct. This duct distance apparently is provided to smooth the incoming airflow in off-angles of attack. Nacelle exhaust section extends about 5 ft. aft of the turbine wheel to accommodate the thrust reverser, cascades and sound suppressor installation.

Inboard nacelle is slung from the bottom wing surface by a pylon which puts the middle of the nacelle at about shoulder height, indicating a high degree of accessibility for work directly from the ground. Outboard nacelle's middle is at head height.

Compact Appearance

Cockpit of ship No. 1 gave a distinctly compact appearance, yet indicated ample room for accommodating flight personnel. Visibility is excellent from the pilot seats.

Looking aft into the fuselage from the cockpit, the aircraft appears very large in length and girth. External fuselage is 11½ ft. wide, vertical diameter is 12 ft. 5 in. In first class, four-abreast seating arrangement, the 880, will carry 88 passengers. Converted to five abreast seating, it will carry 110. Normal high altitude cruise will be 35,000 ft., at which cabin will be pressurized to 6,000 ft. At 20,000 ft. the cabin will provide sea-level pressure. Maximum cabin pressure differential of 8.2 lb./sq. in. will be permissible.

Soundproofing installation already is fitted inside the fuselage shell of the first 880, but interior equipment of this test vehicle principally is a group of 50-gal. drums manifolded to move water from one drum to another to simulate changing load conditions in the fuselage during flight, as passengers move up and down the aisle.

Flush antennas are contained in a semi-circular housing on top of fuselage. Small box-type enclosures on fuselage and wing of ship No. 1 house pickups for use in ground vibration tests.

Development testing of General Electric's CJ805 engine was accelerated by experience gathered on the J79 and by flight testing the CJ805 in Douglas XF4D and B-66.

In addition to flight data, General Electric simulated airline schedules during thousands of hours of running in factory test cells, including operational extremes which covered hailstorms and severe icing.

Airline Strike Situation

New York—Settlement of American Airlines' dispute with its pilots despite a new strike deadline was indicated last week by hints that the airline might agree to pilot qualification of its flight engineers on turbine aircraft. Strike was set for last Friday night, but negotiations between the carrier and Air Line Pilots Assn. were continuing in Chicago last Thursday.

In other labor disputes in the industry, Eastern Air Lines still was shut down although it had reached agreement with International Assn. of Machinists members. Dispute with Flight Engineers International Assn. members had not been resolved, although Eastern's flight engineers were meeting with a federal mediator.

Pan American World Airways and its pilots were in active mediation in Chicago. PanAm and its Transport Workers Union employes were mediating in Washington. TWU had lifted an overtime ban temporarily forstalled by a court retraining order. The order was ended following an agreement by TWU that the ban would stay off during the talks.

American's pilots were free to strike after a federal court denied the airline an injunction against such a move. The court had halted a strike under a restraining order until it heard argument as to whether Railway Labor Act bargaining had been exhausted and whether the parties had acted in good faith. In effect, the court decided that legal bargaining under the Act had been carried out.

Bright note in the labor picture was Trans World Airlines, back in 100% operation after settling with striking IAM employes.

Convair 880 Specification, Performance Data

	Basic	International
PERFORMANCE:		
Cruising speed	615 mph.	615 mph.
Range full first-class payload and normal reserves	3,450 mi.	4,210 mi.
Stalling speed	113 mph.	106 mph.
Maximum cruise altitude	40,000 ft.	40,000 ft.
Rate of climb (sea level, normal power takeoff weight)	3,700 fpm.	3,140 fpm.
Fuel consumption (30,000 ft. average cruise power)	1,700 gal./hr.	1,700 gal./hr.
Takeoff CAR runway (sea level standard conditions—1,750 mi. trip)	5,200 ft.	5,500 ft.
Landing CAR runway (sea level standard conditions—1,750 mi. trip)	5,300 ft.	4,930 ft.
CAPACITIES:		
Passengers (coach version 110)	88	88
Payload (coach version 26,780 lb.)	23,150 lb.	23,150 lb.
Fuel	10,770 gal.	13,870 gal.
Oil	28 gal.	28 gal.
Cargo capacity	863 cu. ft.	863 cu. ft.
DIMENSIONS:		
Over-all wing span	120 ft.	120 ft.
Wing area	2,000 sq. ft.	2,000 sq. ft.
Over-all length	129 ft. 4 in.	129 ft. 4 in.
Height over tail	36 ft. 4 in.	36 ft. 4 in.
WEIGHTS:		
Maximum landing gross weight	132,800 lb.	155,000 lb.
Maximum takeoff gross weight	184,500 lb.	203,400 lb.
Maximum ramp weight	185,000 lb.	204,000 lb.
Maximum zero fuel weight	117,000 lb.	126,000 lb.

ENGINES: Four General Electric CJ805-3 jet engines, equipped with silencers and thrust reversers.

* With wing leading edge devices.

American Petition Denied by CAB

Washington—Civil Aeronautics Board last week denied an American Airlines petition to operate coach service in aircraft with first-class seating configuration during the "off-peak" hours between 10 p.m. and 3:59 a.m.

In its decision, the Board agreed with an examiner's findings that the proposed service was not "off-peak since the hours from 10 p.m. to 4 a.m. were not shown to be inconvenient in the transcontinental market. . . ."

In this connection, American contended that the shortening of flight time created by the Douglas DC-7 and the even shorter flight times which the turbojet transports will achieve, make the hours from 10 p.m. to 4 a.m. more inconvenient for transcontinental passengers than they were in 1949.

Flight Engineers Ask Investigation Of ALPA Examination Techniques

By Robert H. Cook

Washington—Flight Engineers International Assn. charges that airline pilots taking Civil Aeronautics Administration examinations are "cribbing" are being investigated by CAA.

The current investigation, begun last week, marks the second time the accusations have been made by the engineers' union this year and may result in cancellation of the present CAA written examinations for flight engineers.

Six months ago, CAA examiners canceled a flight engineer examination because of almost identical charges brought by FEIA against the Air Line Pilots Assn.

The FEIA charge is based upon ALPA's use of a specially compiled 64 page "study guide" designed to aid copilots desiring to obtain flight engineer tickets.

CAA has obtained a copy of the guide and is comparing it, question for question, with its current flight engineer examinations to determine if the guide contains the same questions and answers.

The charge stemmed from FEIA's battle with ALPA over the "third crew member" issue. The pilots' union has insisted that engineers serving on turbojet aircraft be pilot-qualified as recommended by a special presidential fact finding board (AW July 28, p. 32), while the engineers remain equally firm in their stand that safe operation of commercial jets demands the use of a mechanic-qualified engineer.

Job Protection

While both unions premise their demands on the issue of safety, the union fight is also a matter of job protection since operation of the new jet transports may result in a need for fewer pilots.

Although CAA has voiced concern over the FEIA charges, ALPA says its research is legal in every manner and similar to many study curriculums used by government job applicants. The pilots' union also has denied FEIA charges that each time the CAA changes its written flight engineer examination, many of the new questions appear on the ALPA study guide.

Changes in guide questions and problems come primarily from flight engineer courses conducted by the airlines and approved by the Civil Aeronautics Administration, the union explained.

On this point, CAA is careful to point out that it will take no official stand on the flight engineer charges until it has completed an analysis of the flight engineer examinations given during the past six months, along with a study of the study guide being used by ALPA.

CAA spokesmen said that almost a year ago their concern over an ALPA study guide caused them to send an order to all CAA inspectors and examiners advising them of "numerous reports of the growing controversy between the ALPA and FEIA" over the third crew member issue.

Referring to an ALPA study guide in use at the time, the letter said it was "almost identical to the CAA flight engineers examination" and added that there was "no doubt the examination has been nearly duplicated."

Exam Directions

To combat any possible compromise the letter then directed CAA personnel to:

- **Review all documentary evidence** submitted by applicants for the flight engineer examination.
- **Monitor all written examinations** and note the time taken to complete it by the applicant. The CAA says it expects the completion time for the examination to be approximately six hours. Applicants who finish in much less time, such as only three hours in some past cases, are open to suspicion, they say.
- **Review and re-evaluate** the qualifications of all company-employed CAA designated flight examiners with recommendations of changes where necessary. FEIA says favoritism could become a factor where an airline may have a pilot qualified as a flight engineer and designated by CAA to give oral and flight tests for flight engineer certification. The pilots' union, however, reports that it knows of no cases of discrimination against its members where the CAA designee has been a mechanic-qualified flight engineer.
- **Use qualified CAA** inspectors when possible and particularly where any controversy between engineers and pilots may exist.

Exam Changed

This letter, still officially in effect, received wide distribution, and in midyear the CAA canceled the then current flight engineer examination and substituted a new one.

Results, the agency says, were immediate "with the old passing percentage of 68% under the cribbing suspicions" dropping to only 40% with the new flight engineer examination.

The study guide now being investigated covers a broad range of subjects, many of them merely review material of existing Civil Aeronautics Regulations.

However, some sections are prefaced with such introductory paragraphs as the following:

"The study guide material was compiled from your fellow pilots' experience with the examination. We are aware that a large segment of the pilot group has had no experience with fuel injection engines. Another large segment has had no experience with turbine engines.

"If you experience unfamiliar questions or material not covered in the study guide, drop us a note at the home office."

Another part states: "A question has appeared on new tests regarding the change to a.c. electrical units. The choice of answers is as follows . . ."

CAA says it agrees with the pilots that their union did not break any laws with their past study guide and may not with the present but only because the study questions were reworded and not printed verbatim.

The problem is not new or unfamiliar. CAA two years ago tried unsuccessfully to obtain increased appropriations to combat any possible damage to its examining program by providing funds for the frequent design of new exams and the hiring of additional personnel to monitor the program. Also defeated was a proposal that would have made any proven "cribbing" charges a misdemeanor.

Decrease Designees

CAA already has taken steps to avert any possible "cribbing" damage by such measures as decreasing the number of CAA designees conducting oral and flight phases of the flight engineers examination and, wherever possible, supplanting them with regular CAA examining officers.

In addition, qualifications for appointment as a CAA designee have been tightened by requiring the designee applicant to conduct a minimum of 10 individual examinations a year with a Civil Aeronautics Administration examiner present for at least one oral and flight check.

Oral examinations conducted by CAA examiners have been greatly expanded to cover nine hours, as a further measure.

In the event that its current investigation of the ALPA study guide, along with an analysis of passing grades during the past six months, should disclose "concrete evidence" of the engineers "cribbing" charges, CAA says it has on hand 500 new questions as the basis for a new flight engineers examination.

PanAm Records First Ingestion Damage

By Glenn Garrison

New York—Pan American World Airways last week experienced its first premature jet engine removal resulting from ingestion damage, the major operational worry based on Air Force jet experience (AW Oct. 20, p. 41). Unscheduled change was the third premature removal from any cause since scheduled Boeing 707-120 service was begun by the airline in October.

Damage to inlet guide vanes and first stage compressor blades of No. 1 engine was caused by the ingestion, which caused overnight delays to two flights departing from Paris last week. A spare engine was flown in from London and the change took about a day.

Both other removals took place earlier and followed failure in flight. One plane turned back to New York after departing Boston, and the other landed at Santa Maria and waited for an engine to arrive via PanAm cargo DC-6A.

Cause of the first removal was thought to be failure of a water pump seal which let water into the lubrication system; the other incident involved a bearing failure apparently from an oil line break.

The airline has sought strenuously to avoid the engine ingestion problem by getting airport operator cooperation in keeping ramp and taxiway areas clean and by clapping plugs on the engines when shut off to preclude leaving objects such as tools in the way.

In its transatlantic jet operation, PanAm continues to experience high load factors on its daily round trips between New York and Paris and daily-except-Monday round trips between here and London. Eastbound and westbound load factor percentages run consistently in the nineties. The airline is tightening up its operation as it gains working knowledge with its new aircraft. Nonstop flights are still a rarity, due in large part to Port of New York Authority anti-noise restrictions.

Extension of Runway 13R at Idlewild from 9,500 ft. to 11,200 ft. has been completed, but this low-priority runway cannot often be used by the jets. Extension of Runway 25 from 8,200 to 10,000 ft. will be completed soon and will help the situation but won't cure it.

Pan American recently made its first westbound nonstop revenue flight, flying from London in 8 hr. 13 min. with 91 passengers and a crew of 10, BOAC on Dec. 3 flew its de Havilland Comet 4 nonstop from London to Boston in 8 hr. 4 min.

Operationally, one problem PanAm experienced was a limitation in engine manufacturer Pratt & Whitney's warranty to 85% of rated maximum except takeoff (METO) power. This was strictly a warranty matter; Civil Aeronautics Administration of course approved 100% of rated power. The airline found that its Mach .79 best long-range cruise speed could not be maintained at 85% power. Furthermore, climb to the desired initial cruise altitude of 33,000 ft. was impossible with the limitation and 27,000 ft. was used instead. This meant an increase in fuel consumption. Also, high speed cruise formula, building up to Mach .82, was impracticable because only near the end of a long flight could that speed be reached.

The manufacturer and PanAm recently worked out a partial solution involving a test program allowing 93.7% of METO power during long-range cruise, but not applicable to high speed cruise.

A major difference between flight planning a jet and a piston-engine aircraft, according to Verne Fulmer, PanAm's flight control supervisor at Idlewild, is the critical temperature factor. Temperature affects performance not only at the terminal during takeoff but at en route altitudes. As an example, if temperature at the initial 33,000 ft. altitude is —50C, climb to that altitude can be made at full gross takeoff. If the reading at 33,000 ft. is —40C, with correspondingly higher temperatures to the ground, the jet can get only to 27,000 ft. after a full gross takeoff under the step climb flight plan.

In connection with this temperature factor, PanAm pilots have occasionally run into unexpected trouble by encountering the tropopause, or where temperatures do not continue to fall as altitude is increased. Thus a pilot, climbing to the next step of altitude and expecting a power-speed-weight condition based on a lower temperature, finds he cannot maintain the new altitude and has to go back down again or use an undue amount of fuel.

This situation might make it profitable for a jet to sacrifice considerable knots of tailwind in order to find a better temperature condition on an alternate route. North of the great circle route to Europe, Fulmer says, a jet might find favorable winds of 100 kt. but the tropopause might be down to 27,000 ft. In this situation, the flight would be better conducted somewhere else even if tailwinds were only 50 kt.

Ground temperatures can affect take-

Japanese Build YS-11 Turboprop Transport Mockup

Japanese YS-11 turboprop transport mockup, on view at Japan Aircraft Mfg. Co. plant at Sugita, was built by Airplane Design Research Institute as the nation's first transport since World War II. Institute was organized by six aircraft companies—Mitsubishi Heavy Industries, Nippon Aircraft, Kawasaki Aircraft, Fuji Aircraft, Meiwa Sankyo, and Showa Aircraft. Twin-engine transport will be powered by Rolls-Royce Dart R. Da.10 engines producing 2,665 eshp. each (AW Aug. 4, p. 43). YS-11 has a wingspan of 105.6 ft., length of 87.5 ft. and height of 29.3 ft. Institute says cruising speed will be 305 mph. for a range of 670 mi. at 20,000 ft. altitude.

National Interchange Meets Delays

New York—National Airlines' schedules to Miami with leased Pan American World Airways jets have run into trouble through delays in the tight utilization cycle worked out between the two carriers (AW Dec. 15, p. 38).

Main cause of the delays, affecting about half of National's New York departures during the first week of its jet operation, was European weather which held up Pan American flights so that the Boeing 707-120s were turned over to National behind schedule. The delays ranged from 10 min. to 6 hr.

National last week began its second daily round trip with the leased jets as planned, but was considering changes in the arrangement to give a little more play in the cycle. Exclusive use by National of one jet, instead of working all schedules in between PanAm flights, was under consideration. Another possibility was spreading the two National New York departure times so the second flight leaves in the late instead of early afternoon, giving more cushion between that flight and the morning departure. Situation should get easier, however, because delivery of PanAm's sixth and final 707-120 was expected last weekend.

Scheduling of training flights in the jets has been played by ear, using a plane for this purpose whenever one is available. National training flights have been conducted in New York and Miami.

The six-hour delay took place Dec. 11, while three planes were grounded in Europe waiting for a weather break. According to National, all but two of its passengers chose to wait for the jet ride rather than accept accommodations on a Douglas DC-7 piston plane.

off weights in several ways, one of them being use of water injection. When temperature is below 22F, water injection cannot be used and maximum gross automatically falls to 244,000 lb. regardless of runway length. Without takeoff injection, the aircraft can't make the required climb gradient, no matter how many feet of runway it has, at a greater weight than that.

Icing conditions on the ground also cut allowable load because de-icing the engine nose area drains some power from the engine. This de-icing equipment, separate from the wing de-icing system, bleeds hot air from the engine. When this is in use at a sea-level airport, gross weight drops 8,000 lb. off full maximum.

Eastbound Stops

Pan American currently makes most of its eastbound stops at Gander, an airport with serious problems for the jet. One end of its 8,200-ft. runway has a .9 deg. upward slope, cutting its effective length to 7,650 ft. In addition its height above sea level is about 500 ft., another limiting factor for a jet. The icing takeoff conditions noted above also are encountered at Gander.

Pan American now checks with the military before dispatching each flight to see if high-altitude transatlantic airspace will be pre-empted by a military movement. Formerly, flight plan changes en route were made when altitudes became suddenly unavailable from this cause.

Jet air traffic control altitude separation on the Atlantic in practice has been 2,000 ft., although there has been no CAA notice to this effect. Normal separation is 1,000 ft.

In shaking down their jet operation, PanAm personnel have had to make an adjustment in thinking to fit the new scale of things. Weight and balance people, for example, are getting used to working with almost tripled capacities. Handling 109 passengers on a flight makes life harder for reservations personnel. And when relief equipment must be sent, as to Santa Maria to take care of passengers left there by the engine change, two piston-engine planes must be dispatched to take care of the single jet load.

The ingestion-damaged engine was being flown back to Idlewild for complete examination. Trouble was discovered during ground check at Paris. It had not been determined what foreign material had entered the engine or how it got there.

CAB Predicts Increase In Subsidy Payments

Washington—Subsidy payments to certificated air carriers will continue to spiral upward for the next 10 years at least the Civil Aeronautics Board has estimated.

In its eighth annual review of subsidy, the Board reported that local service carriers now collect 79% of all industry subsidy and will continue to draw heavily upon these payments as a result of new equipment programs and route expansions. Underscoring the desires of Congress to continue expanding air service to small communities, Board members taking "at least a cautious and probably a pessimistic view," said this group of carriers may achieve a subsidy-free status over the next decade.

On the other hand, domestic trunks and international carriers apparently will not require subsidy, the report said, based upon the assumption that the carriers will continue their "high level of activity" and that the introduction of commercial jets will prove profitable.

Fiscal 1960 figures allot $61.7 million in subsidy for all qualified carriers, with $48.9 million of the total earmarked for local service operations. The 1960 figure includes $4.5 million to cover the added expenses expected from the introduction of new aircraft.

The remaining $12 million balance for 1960 will be distributed between the helicopter operators and the carriers serving within and to Alaska. The CAB report estimated a total of $5 million in subsidy for the three helicopter operators now serving New York, Chicago and Los Angeles.

Noting that they do not expect to certificate any additional helicopter services, Board members said it is their policy to maintain this certificated helicopter experiment in approximately its present framework.

While present models of helicopters are costly to operate, CAB said it believes larger and more economical types will be manufactured some time in the early 1960s. Purchase of this new equipment, it said, would "bulge" the subsidy bills of these operators in much the same manner as jet transports have for the local service carriers but would later reverse the subsidy trend.

Subsidy for intra-Alaska and mainland-Alaska carriers has ranged between $5 million and $8 million for the past seven years and has been estimated at $7 million for Fiscal 1960.

Future payments should decrease, according to the CAB, because of recent passenger fare increases allowed these carriers coupled with Board plans to rearrange route systems as part of the Intra-Alaska Case. The Board says it also is considering the possibility of reducing the number of carriers participating in the mainland-Alaska market.

Transfer of CAA Scheduled for Jan. 1

Washington—Operations of the Civil Aeronautics Administration will be formally transferred to the Federal Aviation Agency Jan. 1.

All funds and functions of the CAA will be taken over by the new agency and a civilian complement totaling 27,771 personnel will be reassigned to the FAA.

Approximately 24 Civil Aeronautics Board employes will be moved to FAA to handle functions of safety rule making.

Airline Traffic—October, 1958

	Revenue Passengers	Revenue Passenger miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	704,020	455,701	68.8	1,938,099	1,023,487	9,644,605	56,395,861	60.2
Braniff	193,064	81,913	61.3	339,232	204,168	594,096	9,004,818	51.1
Capital	189,909	76,392	63.6	291,031	160,237	206,825	7,979,036	52.4
Continental	77,218	37,372	53.0	95,452	38,239	159,553	3,882,733	46.2
Delta	247,505	116,938	59.4	420,018	321,070	1,317,052	13,311,312	55.2
Eastern	668,854	332,241	49.73	984,236	580,945	1,390,910	34,937,990	49.50
National	114,904	59,565	49.8	257,475	58,748	520,369	6,599,600	42.8
Northeast	73,333	24,390	35.8	59,205	32,831	108,428	2,532,259	30.1
Northwest	149,442	100,892	58.8	528,687	288,202	1,127,677	11,629,737	52.5
Trans World	420,852	331,184	66.4	1,221,110	692,603	2,407,945	36,045,978	59.5
United	625,645	439,332	64.4	2,708,546	1,136,558	7,102,062	53,095,289	58.4
Western	123,322	62,491	52.1	280,937	85,190	334,176	6,692,084	43.4
INTERNATIONAL								
American	10,145	8,842	44.8	11,334	787	241,053	1,171,638	46.7
Braniff	3,543	6,693	45.6	17,980	.....	95,137	846,034	48.2
Caribbean-Atlantic*	.....	.....	....	.....	.....	.....	.....	.....
Delta	3,714	4,307	42.4	8,201	.....	41,262	532,159	38.5
Eastern	26,360	38,084	44.99	79,718	.....	148,336	4,135,194	47.96
Mackey	5,091	1,249	39.5	.....	.....	1,275	136,095	39.3
National	6,416	4,978	51.6	9,444	5,024	42,615	589,895	46.1
Northwest	12,381	29,088	55.0	1,494,509	20,093	913,570	5,500,960	69.9
Pan American								
Alaska	2,279	2,570	39.3	29,549	.....	173,884	465,501	46.8
Atlantic	107,819	134,010	64.5	1,323,531	.....	3,153,090	18,541,152	62.6
Latin American	84,702	91,074	60.2	395,963	.....	4,442,800	13,887,103	61.3
Pacific	22,473	87,219	70.7	1,321,769	.....	2,120,938	12,380,358	68.5
Panagra	11,086	14,454	57.6	70,863	.....	436,450	2,087,900	.....
Resort	.....	.....	....	.....	.....	3,668,232	3,668,232	78.2
Trans-Caribbean*	.....	.....	....	.....	.....	.....	.....	.....
Trans World	34,208	107,048	67.3	950,560	.....	2,050,744	14,057,307	68.4
UMCA	187	61	42.1	.....	.....	2,612	8,849	55.4
United	7,761	19,285	56.9	160,850	.....	74,550	2,206,534	54.6
Western	2,130	3,312	59.6	1,738	.....	6,957	368,212	60.7
LOCAL SERVICE								
Allegheny	47,748	8,643	55.0	14,053	26,625	27,812	893,394	55.5
Bonanza	15,404	3,619	45.2	6,053	2,660	6,942	362,206	43.4
Central	13,570	2,601	36.1	6,715	3,452	11,717	271,116	32.7
Frontier	18,729	4,748	42.2	17,824	9,239	64,161	549,006	51.3
Lake Central	18,444	2,997	43.2	3,524	19,482	.....	314,730	48.0
Mohawk	48,583	9,498	59.7	9,413	19,133	18,941	953,438	60.0
North Central	71,554	11,962	51.9	30,367	42,681	.....	1,215,889	51.0
Ozark	41,656	7,443	52.1	11,469	22,765	22,312	767,220	54.4
Pacific	34,662	7,619	52.5	9,770	4,340	7,631	748,615	50.3
Piedmont	41,013	8,437	58.5	14,662	16,901	17,611	857,476	58.4
Southern	20,625	3,933	42.2	8,671	14,289	11,223	411,006	41.6
Trans Texas	23,511	5,527	43.5	15,641	9,579	30,677	585,487	44.2
West Coast	22,637	4,492	52.35	5,128	2,321	7,763	444,179	50.38
HAWAIIAN								
Hawaiian	30,750	8,459	56.4	4,712	.....	122,142	879,795	58.7
Trans Pacific	12,394	1,672	49.8	697	.....	6,648	141,434	50.6
CARGO LINES								
AAXICO	.....	.....	....	4,194	.....	3,512,878	3,535,056	74.3
Aerovias Sud Americana	.....	.....	....	.....	.....	693,350	693,350	78.9
Flying Tiger	2,893	13,249	100.00	45,459	52,873	12,924,955	14,348,115	89.5
Riddle								
Domestic	.....	.....	....	22,767	40,746	4,198,549	4,262,062	88.4
International	.....	.....	....	.....	.....	1,063,726	1,063,726	89.1
Seaboard & Western	.....	.....	....	230,362	.....	1,777,136	2,017,895	46.74
Slick	2,811	17,018	90.69	.....	.....	.....	1,754,509	93.50
HELICOPTER LINES								
Chicago Helicopter	11,654	212	39.6	1,214	.....	.....	21,410	29.6
Los Angeles Airways	2,709	108	54.5	4,390	2,613	.....	17,301	60.0
New York Airways	9,188	184	47.7	1,566	972	608	20,546	45.9
ALASKAN LINES								
Alaska Airlines	7,568	4,116	44.1	61,161	4,670	190,439	684,634	40.0
Alaska Coastal	3,581	330	61.8	5,141	.....	3,724	42,817	68.2
Cordova	768	141	34.9	4,622	.....	31,684	50,808	46.5
Ellis	3,886	224	62.4	2,022	.....	1,899	26,785	74.4
Northern Consolidated	1,707	578	45.3	24,407	.....	66,786	156,331	62.8
Pacific Northern	8,886	7,985	46.1	112,045	6,173	374,533	1,361,057	63.7
Reeve Aleutian	1,044	836	45.0	40,112	.....	80,906	212,016	63.0
Wien Alaska	3,069	813	13.8	31,032	.....	223,194	332,247	54.8

* Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SHORTLINES

► **Allegheny Airlines** has received Civil Aeronautics Board permission to provide a 33⅓% discount to group passengers making round trips between certain points on the company's routes. Travel by a minimum group of 10 must be round trip and be completed within five days. Allegheny also has begun a daily family-fare program with discounts of 33⅓% for members of any family after the head of the family purchases a first-class ticket.

► **British Overseas Airways Corp.** plans to inaugurate de Havilland Comet 4 jet service from London to the Far East and Australia in 1959, with South American service following in 1960. Provisional schedules call for four weekly flights between London and Tokyo beginning in April and increasing to five weekly flights in July, with Singapore being included on a twice weekly basis in August. By the end of 1959, BOAC plans to begin five flights per week from London to Sydney and four flights weekly to Johannesburg.

► **Braniff Airways** has declared a dividend of 30 cents per share on its 2,948,119 outstanding common shares, payable on Dec. 31, to stockholders of record Dec. 19. The airline announced company earnings for the period January-September, up 10% from the 1957 period, were composed of a profit of $1,664,635 on domestic routes, up 10% from 1957, and a loss of $172,783 on international routes, down from a profit of $331,363 in 1957.

► **Chicago Helicopter Airways** carried 9,094 passengers during November, a 45% increase over the same month in 1957. The airline says it has carried over 100,000 passengers in the first 11 months of 1958, claiming a new industry record for helicopter airlines.

► **Ethiopian Airlines** will become the 87th member airline in the International Air Transport Assn. on Jan. 1.

► **Trans Mar de Cortes of Mexico** plans new service in the near future from Los Angeles to La Paz, Baja California, Mexico, using Fairchild F-27 aircraft.

► **TSA-Transcontinental** has been authorized by the Venezuelan government to make stopovers at Caracas on its express routes from New York to Rio de Janeiro, Sao Paulo and Buenos Aires. TSA said, however, reservations for New York-Caracas-New York traffic still cannot be accepted, but passengers can board at Caracas for destinations to either the north or south.

AIRLINE OBSERVER

► Sharp decline in available seat miles offered by domestic trunklines during November—the first decline registered since World War II years—reflected strikes against Capital, Eastern and Trans World (AW Dec. 15, p. 43). Although revenue passenger miles for the month also showed a slight drop, the 10.5% decline in available seat miles created one of the largest monthly increases in load factors ever recorded by the industry. Load factor for November climbed to 59.42%, eighth monthly increase in this category reported by the industry during the past three years. Despite this rise, however, November load factor of 59.42% was five points lower than the 1956 average of 64.42%.

► **United Air Lines is forecasting an 8% increase in the number of passengers carried during 1958 and a 5.8% increase in revenue passenger miles compared with the less than 1% expected in 1958 for the entire industry (AW Dec. 8, p. 26). United also predicts a 16% increase in freight ton miles for the year.**

► Trans World Airlines has mothballed six Martin 202s at Kansas City for lack of buyers. Three other Martins are on lease to two local service airlines.

► **Garuda Indonesian Airways is now staffed and operated entirely by native Indonesians. Technical assistance agreement between Garuda and KLM Royal Dutch Airlines terminated in February and, since then, Indonesian personnel have maintained all domestic and international schedules with its fleet of Convair 440s, 330s and 240s and Douglas DC-3s without outside aid.**

► London airport is installing new fueling system for jet aircraft at a cost of $1.7 million. Facilities include three-quarter-mile pipeline linking two new fuel storage depots at the airport. Third depot, now under construction, eventually will provide a storage capacity of one-and-one-quarter million gallons of fuel. Since estimates indicate fuel demand for jets will exceed 600,000 gal. daily by 1966, proposal is before Parliament seeking approval for construction of two six-inch pipelines from main storage depots to London airport—a distance of 8 mi.

► **New aircraft manufacturing company has been organized in Mexico in cooperation with Lockheed Aircraft Corp. Known as Lockheed-Azcarate, the company will begin production with the manufacture of a light utility airplane designed to meet topographical needs of Mexico and other Latin American countries. Majority ownership is held by Mexican citizens.**

► Renault of France is using air freight for delivery of spare parts for its fast-selling Dauphine automobiles to the U.S. Renault feels higher cost of air freight is offset by a reduction in handling and packing costs and by elimination of middlemen shippers. Savings in delivery time over surface methods of shipping has been cut from nine weeks to one week. Company operates a fleet of six especially equipped ships to move automobiles to the U.S.

► **Cuban government will purchase $11 million in Compania Cubana de Aviacion stock to help the carrier meet its financial obligations. Cubana has two Bristol Brittanias and four Vickers 810 Viscounts on order.**

► First regular Soviet passenger helicopter service has been inaugurated between Simferepol and Yalta; Tass, the Soviet news agency, reports that Mi-4 helicopters can cover the distance in only 25 min. as compared with five hours by bus. The Mi-4 is designed to fly at speed of 193 mph. Tass says the first passengers were people arriving from the city of Kishinev to spend their holidays on the Black Sea coast.

► **Washington, D. C., Board of Trade is working on plans for a multi-million dollar airline terminal-hotel-garage-office building and heliport development to cover a downtown city block. Airline terminal portion of the building is expected to handle three million passengers a year and would tie in with the roof top heliport to serve Friendship International Airport in Baltimore and the new Chantilly airport now under construction in nearby Virginia.**

Gen. Flickinger Views Survival in Space

(Man is on the threshold of flight into space. His first tentative steps will be brief orbits of the earth. Bioscientists and engineers are working to ensure the safety and success of these early attempts—and to prove eventually the fallacy of predictions that space is uninhabitable for man, as they have proved many times in the past the fallacy of predictions that man had at last reached his tolerance limits in the safe operation of aircraft.

At a recent meeting of NATO's Advisory Group for Aeronautical Research and Development in Copenhagen, Denmark, Brig. Gen. Don Flickinger outlined his views on the biomedical aspects of space flight. Gen. Flickinger is assistant to the commander of Air Research and Development Command for Bio-Astronautics and assistant deputy commander for research. Because of the thoroughness of his survey of these vital problems, AVIATION WEEK *is presenting his AGARD paper in three installments. The first begins with a consideration of metabolic requirements in closed environments.)*

By Brig. Gen. Don Flickinger

Our past work in oxygen systems and pressurized cabins and cockpits in high-performance aircraft, both military and civilian, has provided us with an excellent basis for the task of developing a complete life support capsule capable of sustaining a human payload in the vacuum of space with the necessary degree of reliability. Even in this area, however, despite this basis of knowledge and technology, there are many requirements for augmented efforts and new approaches.

Standard information on metabolic requirements is not directly applicable to the space capsule and new data must be collected on oxygen consumption, CO_2 production, water loss, and the excretion of metabolic wastes through the skin and expired air on man in an isolated closed environment. Simulated space chambers at both the Air Force and Navy Schools of Aviation Medicine have been vigorously prosecuting this problem and, in addition, the man-carrying capsules of our Man-High balloon flights under the direction of Colonels Hessberg and Simons have provided an excellent and practical means of testing both hypotheses and equipment.

Results thus far have indicated that the following data obtained in these space chambers are different when compared with standard values:

• **Oxygen consumption** for one man sitting and awake is just above the basal level (240 cc. per man hour). This value is obtained when the observation is more than a few minutes, e. g. 3 hr., 12 hr., etc. The data are similar to average figures for submarine experience for many men and many days.

• **Metabolism of trace substances** must be examined critically. The loss of small quantities of urea, volatile amines, and other substances cannot be ignored when the occupied space is sealed.

• **Since there may be practical** value in hypothermia and the artificial hibernation induced by chlorpromazine, such altered metabolic states should be actively investigated. There may be long time periods in space flight when man's usefulness is limited and supplies could be conserved by reducing his metabolic level.

• **The value of nitrogen,** which is usually considered an inert gas in air, may be greater than simply its function as a diluent. Research must be done on life in a pure oxygen atmosphere at 5 psi. The metabolic usefulness of other trace components must be examined.

Brig. Gen. Don Flickinger is assistant to the commander of USAF's Air Research and Development Command, assistant deputy commander for research, and surgeon to ARDC headquarters. He has served as commander of the ARDC's European office and as its first Director of Human Factors. Gen. Flickinger also was first commander of the Air Force Office of Scientific Research. He was graduated from Stanford University and Stanford Medical School and took postgraduate training at Vanderbilt and Harvard Schools of Medicine. He is a fellow of the American College of Physicians and the Aeromedical Association and a member of the Association for the Advancement of Science, Association of Military Surgeons and Institute of Aeronautical Sciences. Gen. Flickinger was medical officer of the day at Pearl Harbor on Dec. 7, 1941, and served in Hawaii, the Philippines and the China-Burma-India theater in World War II. He holds the Legion of Merit, Distinguished Flying Cross, Bronze Star, Soldiers Medal and Air Medal.

Closed System Needed

When we balance the metabolic requirements against the payload available for biomedical needs we find that using our most economic components to maintain the livable atmosphere we end up with a total time in capsule capability of something between 2-4 days for a single occupant. Possible state of the art improvements in existing componentry in the form of liquid oxygen systems capable of function in the weightless state with little if any boil-off, a reversible method of scrubbing the carbon dioxide, plus a closed system for water recycling might extend this time capability to as much as 2-4 weeks but beyond that we are faced with the necessity of making a major breakthrough in the form of a completely closed regenerative ecological system. This requirement is truly one of the major challenges which we face in space operations.

I would be remiss at this point if I were not to mention the fact that our knowledge of space physiology as it concerns the effects on man of spending days or weeks at a time in a hypobaric environment equivalent to 25,000 ft. altitude breathing 100% oxygen, (though at near-normal partial pressure), is far from complete though not too unassuring. One could well ask why we do not insist upon a complete duplication of the sea level environment in the space capsule to begin with and avoid these worries.

Payload in Orbit

The answer is as you might well expect and again resolves itself around payload in orbit and the off-the-shelf componentry available. In going from 5 psi. to 1 atmosphere pressure in the capsule we require from 3-5 times the weight of the basic structure. And if we ask for a true replica of the composition of sea level air in our closed environment we are faced with a requirement for a 2-gas demand regulator with each operating different partial pres-

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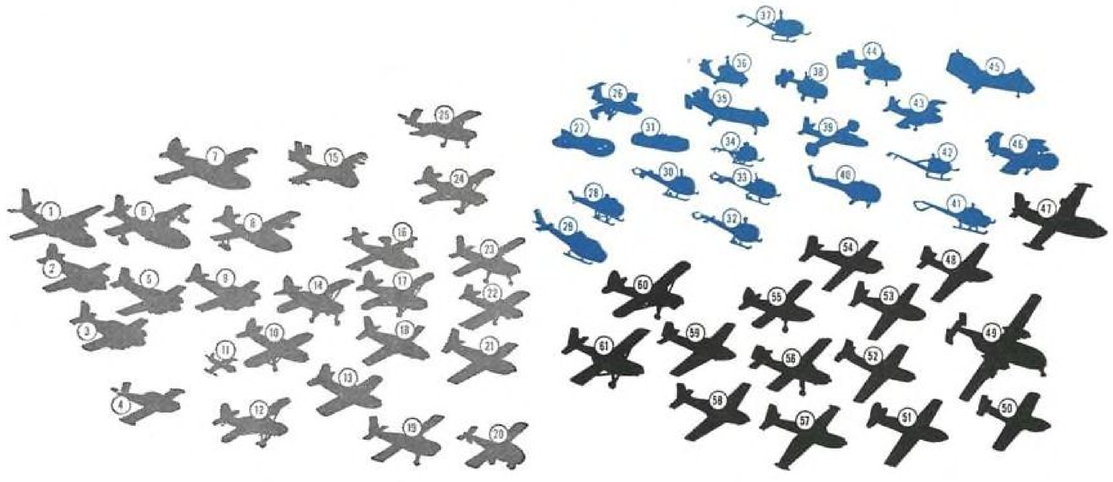

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12. Champion DXer
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15. Grumman AO-1 Mohawk
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42. Hiller H-23D Raven
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sures, and this is not yet to be had.

At this point our consideration quite logically turns toward the question of natural adaptation and acclimatization and to the possible uses of drugs to precondition our space man to live easier and function better in the type of environment which we can afford him.

A great amount of excellent work has been done in high-altitude laboratories throughout the world on the problem of adaptation and acclimatization to constant low oxygen pressures and there is no question but that acclimatization does occur in which, through certain historical changes, the vital organs develop a measurably greater capability for efficient functioning under these sub-optimal conditions. Whether or not in actual practice, the time spent (2-3 weeks) in acquiring this acclimatization would be worth the effort in terms of appreciable gains in safety of performance is a matter still open to question.

Certainly, the relatively narrow limits under the best of conditions in man's ability to adapt to major alterations in his habitual physical environment, would lead us to base our hopes rather upon the future improvements in structures, design, and componentry to provide a completely livable, long-duration environment in space.

At least brief mention should be made of the thermal fluxes to be expected and the possible methods available to maintain adequate thermal balance within the capsule. Many estimates have been made of the temperatures in orbit and during re-entry and considerable useful data have been accumulated from earth and nose cone experiments. Upon superficial examination of these estimates we are very easily and quickly lulled into complacency regarding the extent and complexity of the temperature control problem, yet many of us are extremely chary of writing it off so glibly.

We do not really know all that we need to about space heat relationships particularly as they concern such measurements as solar loads on a stabilized orbital vehicle, the accurate time-altitude variations of the earth's albedo and what heat-drains into the space sink can be expected under various conditions.

Lacking this necessary information, we have assumed that the major problem will be heat loss rather than heat retention and that the major heat source will be one-third man and two-thirds his supporting equipment. These heats can be fairly accurately predicted and in presently contemplated systems are being dealt with by means of a water-ice heat sink.

This system by means of a 5-stage heat exchanger handles about 1,100 Btu. per pound of ice, but suffers from excessive weight penalty, appreciable pressure resistance, and relatively high power requirements. A more promising avenue is offered by a recirculating working fluid in contact with the space heat sink, though the inaction of this system during the re-entry phase causes us some mild concern.

To sum up the heat problem, then, we can say that the present estimates of temperature range during orbit and re-entry are well within long-term comfortable and short-term livable limits. We feel that much additional data need to be collected on orbital and re-entry thermodynamics, after which some high energy heat engineering must be carried out before completely effective temperature control becomes a reality.

Capsule Design Aspects

The anthropological techniques used in space cabin design are in all respects almost identical to the techniques used in the design of present aircraft. That is to say, the space cabin must be laid out in such a way that the occupant has the most efficient possible use of his work space. He must be able to reach and recover any items that could stray under zero gravity conditions (and these items must be minimized). He must be properly oriented in his cabin with respect to both directions of flight and the earth.

Orientation in a space cabin must be obtained for both physiological and psychological reasons. It is of primary importance that the pilot be maintained in the optimum position (or close to it) for taking G during those portions of the flight in which he is enduring massive acceleration loads. This position consists of a supine position with a back angle 20 to 25 deg. to the horizontal, the thighs vertical, and the lower legs 5 deg. above horizontal. This may be varied for pilot comfort by repositioning the thighs 20 deg. without a serious loss of protection. It is of interest to note that a 95th percentile man may be accommodated in a 61-in. long seat.

For psychological reasons, it is desirable to have the subject oriented in such a way that, during the orbital phase of the flight, he is facing towards the direction of flight with his feet towards the earth. This will give him a reference with his earth-bound experience, to replace his gravity orientation.

It is further desirable that he does not move more than a few degrees in rotation with respect to his surroundings within the capsule, or severe disorientation will most probably result. On later flights, it will, of course, be desirable to determine the effects of disorientation in zero-G by deliberately including it, but it had better be avoided for the first few flights at least.

Another anthropological factor which the space cabin designer must consider is the protective equipment which the pilot will wear. This will consist in a form of pressure suit to protect him against a decompression emergency and provide emergency backup in event of life support system failure.

To cite a specific example of how such equipment will alter the specifications, let us consider the use of the USAF MC-2 full pressure suit. The subject's sitting height is increased 1.5 in. with the addition of the helmet. When the suit is inflated, another 1.3 in. is added to the seated height. The elbow breadth increases 2.8 in. with the donning of the suit and 4.6 in. when the suit is inflated. An absolute minimum hatch size for entry and exit into the capsule is 27 by 17 in.

Earlier it was mentioned that the anthropological techniques used in designing the space cabin were all basically similar to those used in designing aircraft cabins, save one. The one basic difference which is little understood and immensely significant to the space cabin designer is not a characteristic of the new environment in which he will place the pilot, but rather a characteristic of the pilot himself.

In much of the popular literature and in all too many serious proposals, the pilot of the first manned satellite is described as a light-weight, short individual because of the enormous penalty that must be paid in terms of extra fuel for every pound of pilot weight placed into orbit. Only later when space flight becomes routine, these authors say, will pilots of heroic stature roam the space lanes.

The fact is that the first satellite pilots must be a thoroughly picked group. We must screen our personnel to find those who are experienced observers, who have demonstrated qualities of cool-headedness and resourcefulness in tight situations, who have good intelligence, who can tolerate various extremes of physical punishment, and who are stable, calm, and confident.

We must reject those who, although able to give a good account of themselves, do so primarily to prove something to themselves or the world. Then we must narrow this select pool of potential satellite pilots down to those six to 10 who are best fit to undertake such a mission.

Let us examine more closely the group of people with whom we would begin our search. We could not search the entire United States Air Force to find our potential satellite crew. Strategic Air Command, Tactical Air Com-

mand, and the other operational commands could hardly consent to our pulling off some 200 of their best pilots for a testing program. The search would doubtless start in Air Research and Development Command itself. Even considering all the test pilots, balloonists, parachutists, flight surgeons, etc. within ARDC, it would take a rash man to estimate a list of much more than a hundred subjects with satellite pilot potential. The elimination of 90% of these for one reason or another would probably be all too easy.

Thus, it can be seen that satellite crewmen will be at a premium for many years, just as X-15 pilots, Man-High balloonists, etc. are today.

Husky Specimen Likely

The problem now begins to take shape. We must select our crewmen on considerations which leave optimum height and weight fairly far down on the list. If we now look at the anthropometric characteristics of the population defined earlier in terms of desirable attributes (and called by the Air Force the "Tigers") we notice a very interesting phenomenon. The "Tiger" population is significantly larger and heavier than average.

The 200 "Tigers" were selected from various sources: past and present Air Force record holders, jet fighter aces, past and present rocket plane pilots, special mission flying personnel, skilled parachutists, balloonists, and Edwards AFB test pilots. In each group, the trend was the same: the taller and heavier man made up a disproportionate amount of the population.

In most every case, it is important to note that extra height tended to be a handicap for these men in their jobs, that is, they succeeded in spite of their greater size and not directly because of it.

We find that we can obtain the greatest number of potential subjects for an adjustment in height of 2 in. if we design our space cabin for the range between the so-called 50th and 75th percentile. If we were to restrict our design to the 5th percentile or below individual, we would have only 2% of the "Tiger" population to work with, and with a total available population in the neighborhood of 100, we couldn't even start a man-in-space program.

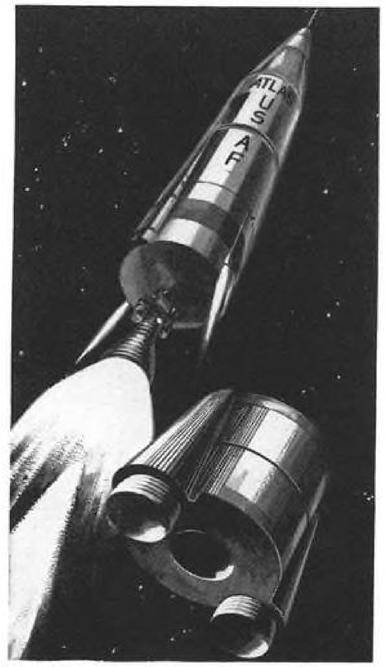
If we restricted our design to the 25th percentile and below, we would have 17% of the group to select from. Again, this is hardly enough, with any sort of realistic washout rate. It turns out that men of "average" height or less comprise only 35% of the sample, and we must include the 80th percentile man in our design to have two-thirds of the population available.

When we examine the "Tiger" weight distribution, we see the picture is only slightly better, with the average or less massive individual comprising only 39% of the total.

Considering the 11 rocket-plane pilots (past, present, and future flights) for whom data were available (Armstrong, Bridgeman, Crossfield, Everest, Kincheloe, McKay, Rushworth, Walker, A. White, R. White, and Yeager) only one falls below the 25th percentile range in height (20th percentile) and he is 28th percentile in weight. One other falls below 50th percentile in height, and two fall below in weight. All the rest exceed the standard 50th percentile man in most critical dimensions. And this is in a profession with a premium on small size, due to extremely cramped cockpits.

All of this is not to say that a good average or small man is not as good or better than a good big man. Indeed, from the standpoint of the designer, the smaller the man, the better. It is just that the odds are very good that the first men into space will be fairly husky specimens. This is simply another problem for the space cabin designer which will diminish in seriousness proportionately to the speed of its recognition.

Owing to the great potential risk and large investment inherent in any



Booster Separation

Booster separation of U. S. Air Force Atlas during long range flight is shown in this artist's concept by Rocketdyne Division of North American Aviation, Inc. Twin-chambered booster engine (foreground) is jettisoned at relatively low altitude.

manned satellite program, regardless of orbital altitude and duration, biological instrumentation must have high priority in the design of early manned satellites.

Only as manned satellites become more reliable and sophisticated, as time in orbit and orbital altitudes increase and as space flight becomes more routine, will the need for thorough biological measurements of the crew diminish.

Unknown Areas

Because we are investigating some totally unknown areas of biology at tremendous expense we shall wish the maximum amount of biological information per flight and we shall need information that will be meaningful for future flight.

Next, because we are investigating a potentially hazardous area we will require the maximum amount of usable information on the pilot's actual and potential condition at all times during the flight.

This is so that we can terminate the experiment within the time required to assure the safe recovery of our volunteer.

Biological instrumentation falls then into two functional categories: information for the record; and safety of flight information. Information for the record will be environmental, such as cabin humidity and acceleration; psychological, such as tracking and reasoning tests; physiological, such as skin temperature and galvanic skin response; and general, such as visual appearance and recorded comments.

Safety Has Priority

Safety of flight information consists of environmental data such as cabin pressure, the partial pressures of oxygen and carbon dioxide, cabin air temperature, and oxygen and power reserves; physiological data such as EKG and respiration rate; and general information, such as visual appearance and vocal comments when over a ground control station.

The safety of flight information has priority, of course, and must be telemetered to the ground even if other information does not get through. Once action has been taken to break orbit and re-enter, the priority of this instrumentation automatically drops to that of information for the record.

Information for the record may be recorded and/or telemetered, whichever is most efficient, but there is no particular need for it to be read out on a real-time basis.

Biological Measurements

Of all the biological measurements, the physiological instrumentation appears to be the most ready-to-fly. The basic problem lies in base-line wander, trace stabilization, etc., of the non-digital data (EKG, GSR, etc.).

The environmental instrumentation can be all off-the-shelf equipment, with the exception of the carbon dioxide partial pressure sensing equipment, which requires some additional development.

Psychological measurements should be made with a maximum of usability and a minimum of interference; that is, any test result must be usable in the widest possible number of space flight situations, and it should be a valid result for each situation. At the same time, the tasks must not be so universal of correlation and application that they lose significance to the pilot in the dramatic situation of his first orbital flight.

Psychometer Tests

Perhaps on later flights the classic psychomotor tests can be applied to measure exact performance increments or decrements, but on the first flight, the subject will probably be too interested in monitoring his survival to participate in mission-unrelated tests and his performance level.

Thus, the psychologist must tax his ingenuity in coming up with meaningful tasks such as an astrogation problem (Where is my orbit? Where am I in my orbit? How long till re-entry?) which contain elements of performance from which he can deduce or extrapolate meaningful data.

The usefulness of vocal and visual communication (2-way and 1-way) and vocal and visual records of the flight, particularly the critical parts, is so obvious it need not be belabored. Here the instrumentation consists mainly in the application of various engineering devices to cut down on what appear to be the most massive of the biological instruments.

A 2-speed camera with different rates for different phases of the flight is an obvious film-saver. A voice-operated voice recorder is another. Two-way radio communication to satellites presents no major problem, in fact this has already been done (although not with voice, of course).

Television Band-Width

Television presents an interesting band-width and power problem. In order to get a picture of sufficient number of frames per second, and lines per frame to be used as a diagnostic and decision-making tool by ground-based medical officers, either a large amount of power must be carried aloft, or an extensive and expensive ground station layout must be made. In any event, the problem does not appear to be insuperable and with the passage of time, larger and more efficient ground antenna installations will reduce the problem greatly.

PUMP PRIMERS

by
Arthur A. Nichols

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Fig. 1. Multiple function pump.

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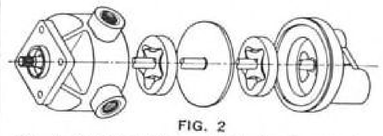

FIG. 2

Fig. 2. Exploded view multiple function pump.

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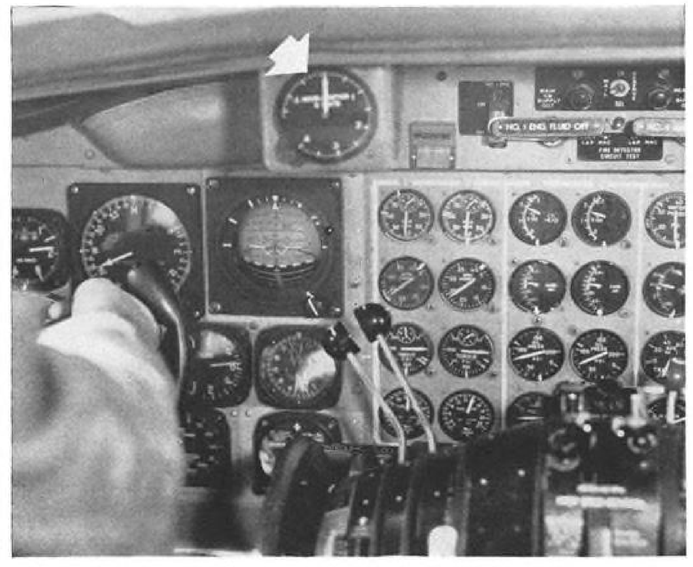


SWITCH actuation test stand shown at center was used in early experiments. At right, arrow points to sensitive gravity meter.

Zero Gravity Tests Show Man Can Adjust to Space

Washington—Weightlessness in space may not cause the serious crew problems many biomedical scientists have envisioned.

Early experiments at Wright Air Development Center, Dayton, Ohio, in which man has been subjected to weightlessness in an operating environment—admittedly for short periods of time—indicate that his reactions are much the same as those experienced under normal conditions. Flying a specified flight regime with a modified Convair C-131B in which the stripped-down cabin is used for experimentation, the members of the Crew Stations Research Section of Wright's Aero Medical Laboratory's Engineering Psychology Branch have attained zero gravity periods of from 10 to 15 sec.

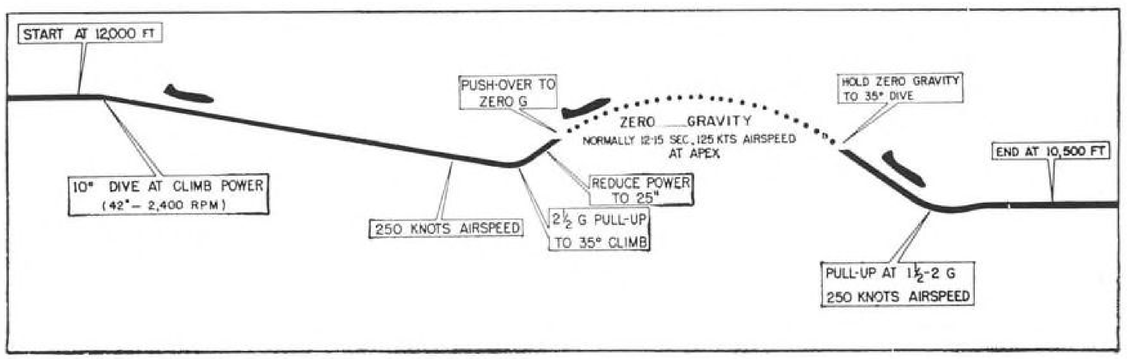
The flight experiments, conducted over the past six months, indicate that "no serious decrement in man's performance should occur as a result of zero gravity," according to Capt. Edward L. Brown, chief of the Crew Stations Research Section.

In one experiment, a special test unit has been devised to test the speed and accuracy of operation of a number of different types of switches and levers. The unit has a vertical lever, a horizontal lever, rotary switch, push-button switch and a toggle switch which the experimenter turns on and off in a pre-determined pattern. Once he has become accustomed to the sensation of weightlessness, he can operate the various switches at approximately his normal dexterity, accuracy and speed during the periods of weightlessness attained thus far.

Longer periods of zero gravity and further tests may upset the conclusions reached to date. But, as of now, Capt. Brown said in a recent speech at the National Academy of Sciences:

. . . "The results of this series of experiments indicate that no special provision, such as wider spacing of switches and levers, or springs or other restraints to prevent the arm overshooting when reaching for objects need be considered. Without exception, the subjects have been able to accommodate to the zero gravity condition in a matter of a very few seconds. . . .

"In fact, subjects who perform experiments in which the arm must be extended and then raised and lowered over a considerable portion of its possible arc, report that it is easier to perform the task during zero gravity."



ZERO gravity flight path (above) is made about 15 times each flight under radar control, about twice a week.

To achieve the periods of weightlessness in which the tests are conducted, the C-131B is flown through a Keplerian trajectory. The maneuver is accomplished by diving the aircraft in a 10 deg. angle until it reaches a speed of 250 kt. The plane is then pulled up at 2½Gs to a 35 deg. climb angle. While this angle is being attained, the throttles are reduced to approximately 25 in. of manifold pressure; the propellers are left at 2,400 rpm., a power setting which has been found to result in minimum longitudinal accelerations.

Zero Indication

When the 35 deg. climb angle is obtained, the control column is pushed forward until a zero indication is reached on the G meter. The pilot pulls out again when the aircraft reaches a 30 deg. dive angle in order to make the recovery without exceeding the G or airspeed limits specified for the C-131B. Recovery is made at about 2½Gs and at an airspeed of 250 kt.

In motion studies, test subjects have been allowed to float without restraint in the aft portions of the cabin during zero gravity in a work space approximately 6 ft. high, 10 ft. wide and about 25 ft. long. In one demonstration of how inhabitants of a space vehicle may move from one place to another, the experimenter floats up the back wall of the aircraft and then pushes gently away with his feet. If performed correctly, he will float the entire length of the open area. If performed incorrectly, he may come into the ceiling or sides of the aircraft.

Members of the Crew Stations Research Station also have managed to propel themselves forward with swimming-type motions of the arms and feet which man apparently makes as a natural reaction when he finds himself floating in space. The swimming motions can be used to accelerate or change direction.

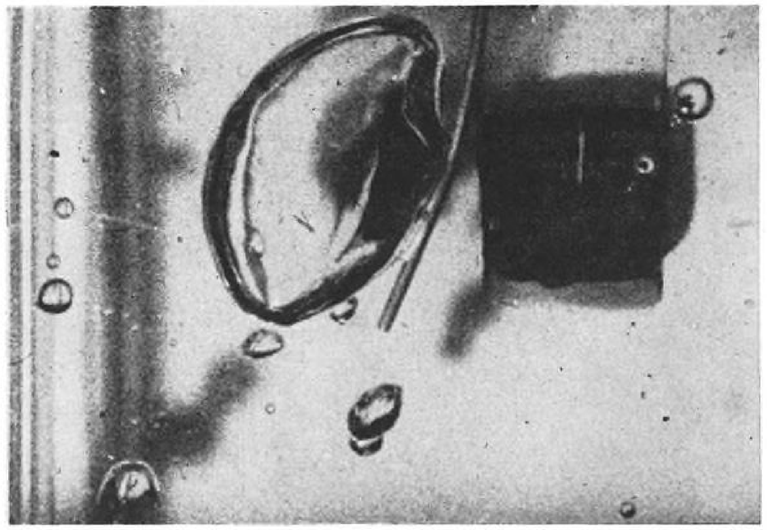
The experimenters have found that they can tumble over and over while suspended during the period of weightlessness. With correct timing, several revolutions can be obtained during the 10-15 sec. of zero gravity. Capt. Brown reports, however, that "all subjects who accomplish this maneuver report extreme disorientation after a few revolutions. In fact, the disorientation borders on a severe case of vertigo at times."

Aircraft Modifications

To equip the C-131B for zero gravity flights, a number of modifications were necessary. They included:

• **Special pitch-lock mechanism** was installed to the propellers after the crew found itself with two runaway propellers during one experiment, to prevent the propellers from overspeeding

CHARACTERISTIC weightless pose is demonstrated by Miss Margaret Jackson, of Aero Medical Laboratory, first woman to achieve free-floating during zero gravity tests.



AIR BUBBLE in a tank of water during zero gravity behaves in unconventional manner. Small bubbles ride on larger bubbles without breaking through the surface, unless agitated.

when the engine oil pressure drops. During zero gravity, the engine oil pressure drops to approximately 30 psi., which is insufficient to control the speed of the propellers.

• **Specially designed battery caps** were installed to prevent the spillage of battery acid whenever a slight negative gravity condition was encountered.

• **Modified sensitive gravity meter** for the pilot to use in holding the required gravity readings for the various parts of the maneuver. It is possible for the pilots to fly this instrument to within 0.05G.

The aircraft is flown through the zero gravity maneuver an average of 15 times each flight. The flights, now being made approximately twice a week, are under radar control throughout the test periods in order to maintain adequate separation from other aircraft and, as an added safety precaution since the runaway propeller incident, must actually be made within visual sight of the airfield.

Nuclear Blasts May Propel Space Ships

Los Alamos, Calif.—University of California's Scientific Laboratory, Los Alamos, is studying a method of propelling a rocket by a series of small nuclear explosions. If successful, the technique might be applied to space ships.

Los Alamos studies will determine how effectively blasts from explosions can be directed to get maximum thrust for the rocket from given masses of exploding materials. The method is believed to be capable of giving several times more push for each pound of propellant than by the reactor method. Care would have to be taken to avoid subjecting rocket structure to excessively high pressures and temperatures.

The laboratory will share ideas and information with General Atomic Corp. during the studies.

General Atomic has a contract to consider possible structure and operation of such a space ship.

X-15 Pilot's Suit Cooled by Nitrogen

Inglewood, Calif.—Full pressure suit to be used by North American X-15 pilots will be cooled by expanding liquid nitrogen through it. Gaseous nitrogen exhausted from the suit will serve as cockpit pressurizing medium at altitude. Cabin pressure differential is only 3.5 psi. When the cockpit is nitrogen-pressurized, the pilot is completely dependent on his suit and its sub-systems for survival.

But the pilot, however, can open a ram gate to keep oxygen-bearing cabin atmosphere at lower altitudes.

Pressure in his helmet is kept slightly higher than in the suit to ensure passage of oxygen from lungs into the bloodstream.

In the X-15 program, pilots will be instrumented and observed closely.

Pilot monitoring package in the parachute seat pack will pick up data from various sensors attached to his body. Seven telemetry channels will be used to carry some of it directly to the ground stations.

Other data will be recorded on oscillographs.

LOCKHEED Electra turboprop, bearing Eastern Air Lines markings, is standard production model shown in takeoff configuration.

Aviation Week Pilot Report (Part I):

Electra Shows High Degree of Flyability

By Richard Sweeney

Burbank—Lockheed's turboprop Electra, designed for economical operation on yo-yo (up-down-up-down) flight profiles, demonstrates a saving in pilot effort that blends well with the aircraft's work-horse mission.

For example, smoothness of the transport's Allison 501-D13 constant speed turbine engines and Aeroproducts 606 propellers help reduce pilot fatigue by cutting down sound pressure levels and heavy surges associated with large power changes and landings and takeoffs of piston-powered aircraft. Basically, it is a pilot's airplane with a high degree of flyability.

Flight Qualities

The plane's basic flight qualities were graphically demonstrated to AVIATION WEEK's pilot in his first left-hand seat flight in the Electra. Takeoff and landing were accomplished under reduced visibility conditions which, while legally still VFR, required instrument flight for all practical purposes. Los Angeles famed smog strongly influenced a transition to gages seconds after liftoff in mid-afternoon. Landing, 3 hr. later, was after dark, and reduced visibility strongly indicated landing out of ILS approach to Lockheed Air Terminal here.

Both landing and takeoff were accomplished with reasonable quality, no undue strain.

Electra flight evaluation was accomplished with both production and test aircraft. First flights were made in prototype Electra, N1881 (Lockheed No. 1001). Final flight in the program was made in standard production Eastern Electra N5509, Lockheed No. 1013.

Evaluation work accomplished in prototype 1001 was done during Lockheed test program on a new configuration of a Bendix autopilot and other items requiring engineering test flight data. AVIATION WEEK work was sandwiched between regular flight test card maneuvers and added to flight programs after completion of regular test cards.

Accomplishing the Lockheed card in addition to AVIATION WEEK evaluation work, some 9 hr. 22 min. were flown in the left seat of 1001, giving AVIATION WEEK's pilot additional indication of the airplane's over-all characteristics. Some of the Lockheed work dovetailed with the AVIATION WEEK program, demonstrating certain characteristics.

In line with the Electra's short to medium haul role (AW March 31, p. 46), particular emphasis was placed in evaluation on low speed (holding), approach, instrument flight, takeoff and landing characteristics, in varying configurations, including engine out and control boost off.

Air work was done in 1001 as well, investigating the edges of the flight envelope, without completing those maneuvers which would have shaken up the plane's load of flight test instrumentation too badly or knocked it too far out of calibration.

For the pilot, walkaround inspection of the Electra is simple and straightforward. Usual inspection of surfaces, wheels, brakes, wells, structures and examination for hydraulic or other fluid leakage are standard. Plumbing in the aircraft is such that there are no hidden corners or difficult gages to read and check. Having one pilot in the cockpit, or the flight engineer, serves very well for controls and trim surfaces movement checkout.

Cockpit of the Electra is well laid out, with adequate working space for pilots and flight engineer, all controls within easy reach. Instrument panel layout in the production Eastern Air Lines aircraft flown is excellent, and adherence to basic T format without additional clutter provides grouping for good readability and integration and interpretation.

Dual Gages

Instrument panel in 1001 had flight test configuration, included dual sensitive airspeed gages with single knot markings spaced so that 1 kt. airspeeds could be read accurately. Both Electras flown in evaluation had the new altimeter configuration, sweep hand reading hundreds of feet while a drum in a window indicates thousands. This is the same altimeter used in the Boeing 707-120 flown earlier this year in an AVIATION WEEK evaluation (AW Oct. 6, p. 70).

The test airplane had a Bendix Series 200 integrated pilot display while the production Eastern aircraft incorporated a Collins FD-105 display.

Center engine panel was substanti-

ally the same for both aircraft. Although controls are well within reach of pilot and copilot for all required operations; much work is handled by the flight engineer from his central station behind the center control pedestal.

Pilots are not involved in starting procedures necessarily, although they can accomplish the operation from their stations.

Prestart checklist is primarily a functional checklist which is run out by the flight engineer.

While a detailed checklist is used in standard airline operations, an abbreviated form is used in Lockheed test work after the airplane is signed off for flight, and this form was used in all 1001 flights. Prestart, that part done with all crew members at stations, is short and simple, and after start and during taxi, just four additional items are accomplished to ready aircraft for takeoff.

Result was that usually when taxi clearance was given the 1001, takeoff clearance also was given unless there were other aircraft ahead waiting to go.

Several times, the run from release of parking brakes on the Lockheed engineering flight test ramp to liftoff was made without one full stop, although a fair hesitation was made when the aircraft was aligned for takeoff and takeoff power was applied.

Existing ground temperatures during the flight evaluation period remained in the middle and high 70's, and combined with gross weights, resulted in V_2 (liftoff or unstick speed) values of 121 to 123 kt. indicated airspeed (IAS). Takeoff gross weight for majority of 1001 flights was 97,694 lb., one takeoff was made at 109,573 lb., and the production Eastern Air Lines plane took off at approximately 88,000 lb.

Critical engine-out speed, V_1, the go, no-go value for accelerated stop distance, was approximately 115 kt. for 1001 flights.

Takeoff and Climbs

Majority of takeoffs, first and second segment climbs, followed standard procedures. A variety of final segment climbs used—high rate, high angle, Lockheed flight test procedural speed of 180 kt. IAS, and airline standard en route climb speed of 210 kt. IAS.

Standard takeoff procedure calls for the pilot to steer using nosewheel steering wheel on left console, until aerodynamic control is obtained with rudder, usually about 50-60 kt. As the wheel is released, the pilot assumes yoke control through the final stages of acceleration and liftoff.

With the Electra's propellers, rotation speed V_r at takeoff is not so critical as it is in pure turbojet aircraft, and V_r usually is assumed at 2-3 kt. below V_2.

Rotation is not so great as with a swept-wing jet either, is completed quickly and the aircraft is airborne. With less severe rotation, more leeway on speed points, Electra takeoff technique is more closely related to piston-powered aircraft methods than to the pure turbojets.

One high climb rate takeoff was made from Burbank, using Runway 15 which is approximately 6,000 ft. long. Takeoff was initiated from a running start, ie., takeoff power applied as the plane rolled straight after assuming takeoff position and alignment on runway.

At far end of runway, Electra had approximately 500 ft. altitude. Airspeed used was 147 kt., approximately V_2 plus 26 kt. As a check of the plane's normal obstacle clearance abilities, values used were considered valid when projected for normal operations.

A somewhat higher angle and rate would have been achieved with reduced airspeed, but settings used were probably more realistic in their relationship to a fully loaded aircraft and resultant parameters.

Over-all impression of Electra in takeoff is one of ample power and margins; propeller efficiency at low speeds is a welcome feature; the aircraft is simple and straightforward; conventional techniques as used with piston-powered planes are valid, and although high-temperature operations are affected by turbine power losses, there are enough built-in cushions all around to keep the airplane off the critical handling list.

Handling qualities and techniques remain substantially the same regardless of gross weight and center of gravity position, and with due consideration for power factors, probably remain pretty much the same for hot day operations.

Final segment climb rates varied according to airspeeds used, with maximum values at times exceeding 2,000 fpm., while minimum values were only slightly less than 1,000 fpm. at altitudes exceeding 20,000 ft. In several cases where lower indicated airspeeds were used, climb rates stayed above 1,000

PRESTART checklist is run through in Electra cockpit by Aviation Week evaluation pilot Richard Sweeney. Instrument at right of pilot's panel is a radar scope.

C-130 Hercules

proven champion of U.S. Strategic Airlift

92 battle-ready troops can be flown in the C-130 HERCULES from U.S. bases to any trouble spot on earth—all the way, with no change of planes—in 24 hours or less.

Powered by 4 Allison Prop-jets, the HERCULES can land on or take off from short, rough fields, sand, snow and ice—a capability demonstrated dramatically in 2 years of world-wide USAF service.

Designed specifically for transport of troops, supplies, and supporting equipment, the C-130's crew and cargo compartments are air-conditioned and fully pressurized.

20 tons of pallet-loaded cargo can be winched in or out of the HERCULES *in only 40 seconds*—cutting normal loading/unloading time from 3 hours to 15 minutes or less.

The HERCULES' huge hydraulically-controlled 9-foot by 10-foot aft cargo door and mammoth cargo capacity will accommodate big missiles and ground support equipment.

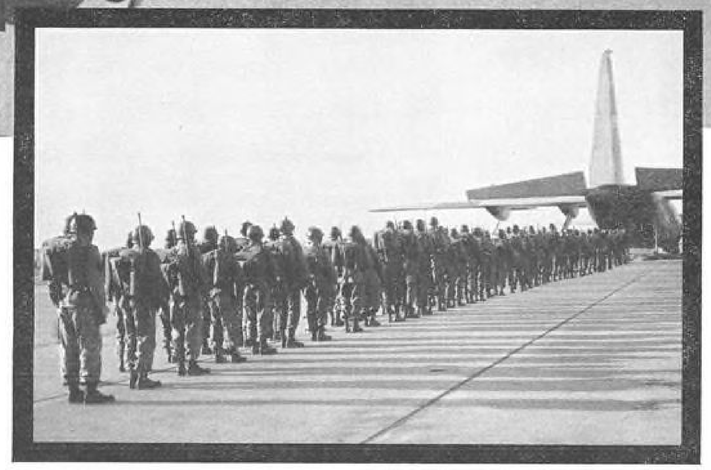
62-tons big, 6-miles-a-minute fast, the HERCULES cruises at altitudes above the weather to deliver cargo or troops to airheads over 3400 nautical miles away.

Recent events of world-wide importance have emphasized the unmatched strategic airlift capability of the Lockheed C-130 HERCULES. No other aircraft can do so many personnel/cargo hauling jobs so well, so fast, so economically. Now being produced in the world's largest aircraft plant under one roof, the HERCULES can readily be manufactured in accelerated quantities to meet the needs of our Armed Forces and give U.S. taxpayers more airlift per dollar.

LOCKHEED *means leadership*

Lockheed Aircraft Corporation, GEORGIA DIVISION, Marietta, Georgia

PROP-JET TROOP TRANSPORTS/AIR FREIGHTERS • JET UTILITY TRAINERS/TRANSPORTS • NUCLEAR-POWERED AIRCRAFT • NUCLEAR PRODUCTS
AIRCRAFT MODERNIZATION/MODIFICATION • GROUND HANDLING EQUIPMENT • MISSILE SUPPORT EQUIPMENT



During 11 days of the Middle East crisis 100 C-130s were the backbone of a 200-plane aerial armada that transported over 5,000 troops and 8 million pounds of cargo to the trouble zone.

The C-130 HERCULES can carry 90% of all known missiles in operational use today. It flies missile cargoes, support equipment, and personnel 3,400 nautical miles non-stop to launching sites.

fpm. to 24,000 ft., the standard altitude used for Lockheed autopilot test program.

On one takeoff and climb to test altitude at flight test procedural speed of 180 kt. IAS, elapsed time from liftoff to altitude was 18 min., for an average climb rate of 1,333 fpm.

One climb was made at 150 kt. IAS for a sustained period, in a sampling of low speed climb characteristics. Climb rate exceeded 2,000 fpm. most of the time, with the airplane in clean configuration, aft center of gravity position; climb power setting used is 895C turbine inlet temperature, yielding approximately 3,300 hp.

Controllability and stability are excellent, while control response is excellent with comparatively light forces.

Margin between V_s and speed used was of the order of 28 kt., and while forces were light, there was no indication of lessened response or excessive sensitivity. Aircraft does not labor to sustain the airspeed or climb rate.

When using Lockheed flight test procedural climb speed of 180 kt. IAS, climb rate stayed close to 2,000 fpm. until above 10,000 ft., remained between 1,500 fpm. and 1,000 fpm. throughout remainder of climb to altitude.

At normal airline en route climb speed of 210 kt. IAS, rates were correspondingly reduced, but stayed within approximately 300 fpm. of flight test climb speed values.

One instance where Lockheed work demonstrated Electra characteristics was an investigation of certain cooling situations. Conditions specified No. 2 (instrumented) engine at rated power for the test, an airspeed of 130 kt., 5,000 ft. altitude, gear down and remaining three engines as required to maintain altitude.

Instrument Techniques

Due to time of day, after dusk, the run was accomplished primarily by instrument flight techniques. During part of this run, water ballast was being transferred to shift center of gravity from aft position required by autopilot tests to a more normal landing position, resulting in a constant trim change for quite a few minutes.

Taking advantage of the situation, the aircraft was held against the trim change manually to sample forces and responsivenesses, also was retrimmed incrementally as required by changing center of gravity, to sample trimout characteristics under these conditions. In final stages of run, the aircraft was trimmed out to hands-off flight after ballast transfer was completed.

Gross weight approximated 89,392 lb. at run's start, some 5,000 lb. less than maximum landing weight. Center of gravity started at 33.8% Mean Aerodynamic Chord (aft position) and was shifted to 23.2% by ballast transfer.

Minimum Trimout

Throughout the exercise, the aircraft remained stable and developed no trim changes in yaw and roll (after stabilization in run configuration). The aircraft was held against pitch trim changes without excessive effort. Trimout for constantly changing center of gravity was accomplished with minimum effort.

Trimout for hands-off condition followed on very well, and the aircraft retained excellent stability in all axes after trimout was completed.

Over-all, control and responsiveness remained excellent at the relatively low speed, although care was required in holding manually against trim change since sensitivity was increased at this speed, producing a sensation somewhat akin to flying along balanced on a ball bearing.

Electra uses pilot-operated trim control wheels in all three axes, with direct cable connections to tabs. Pitch trim gearing is such that one complete revolution of wheel produces 3 deg. tab angle change.

Takeoff elevator trim tab setting for Electra is 10 deg. nose up, a function of the aircraft's geometry. Observations by Aviation Week's pilot at several points during the flight evaluation indicated trim setting remains on the high side in most of flight regimes, including during high rate descents.

Largest trim change observed in Electra flight work occurs when flaps are extended from takeoff-approach setting (80% of travel) to landing positions at 100% travel. Electra has Fowler-type flaps, and last percentage of travel is primarily downward to increase drag effectiveness, whereas earlier part of travel primarily increases wing area and lift coefficients.

In landing condition, airplane can be held and flared for landing against the approach trim setting, although forces are increased. Landing from this situation is not difficult if proper power handling and airspeeds are observed.

General Observations

During evaluation, several general observations were made:

• **Using Negative Torque System** (NTS), which produces the effect of free wheeling the propeller when an engine loses power, flight qualities and handling characteristics changed very little from those which are obtained when an engine is completely shut down and propeller feathered. The Allison-developed NTS is a mechanical system which, when engine power is lost and propeller begins to turn the engine (high drag condition), automatically actuates the propeller feathering pump to move blades toward coarse pitch positions until drag is relieved as blades reach the proper angle to produce zero thrust-zero drag condition. Unit is located on engine gear case. A plunger is moved when propeller starts to drag the engine, and actuates a cam which in turn controls amount of propeller feathering pump work. As propeller no longer drags engine, plunger movement is relieved, in turn moving the cam again to shut down feathering pump. Changes in attitude, airspeed or any other parameter which would tend to reinduce propeller-dragging-engine condition is immediately and automatically offset by Negative Torque System to keep the zero thrust-zero drag condition in force. Although not yet accepted as a substitute for autofeathering controls on Electra, Negative Torque System may well replace this unit at future date, since flight characteristics using NTS are so close to those produced when a propeller is feathered. While proper procedure is to feather inoperative or malfunctioning engine, NTS considerably relieves pilot strain during the critical period of several seconds after engine failure during takeoff, final approach or landing pattern maneuvering, and has several advantages over autofeathering.

• **At 24,000 ft.,** using Negative Torque System, engine-out qualities in maneuverability, controllability and control response are excellent. In this and other single engine investigations, No. 1 powerplant was shut down, which is the critical engine for Electra according to Civil Air Regulations. Additional engine-out work was accomplished in general flight qualities evalaution at 15,000 ft. and 5,000 ft., with aircraft showing up extremely well in standard climbs, descents and turns.

• **Manual flying** characteristics at 24,000 ft., which may well be an average altitude for the Electra on medium stage length trips, are excellent. High altitude efficiency of engine-propeller combination along with the aircraft's aerodynamic characteristics will make the aircraft relatively easy to fly by hand should this become desirable.

• **Flight control forces,** which are direct airload derived and are proportional to the total force required to move surfaces when hydraulic boost is operating, are very good. Proportion is in form of parallelogram, with pilot force as one side, hydraulic boost the other. With boost off, pilot supplies total force required. Boost off operation is simply a bypassing of hydraulic fluid around actuating cylinders, and control cables and tubes transmit pilot movements directly to surfaces.

• **Standard high rate** descent was made from 24,000 ft. to 15,000 ft., with airspeed held to 310 kt. indicated airspeed, descent rate approximating 4,000 fpm. Aircraft flies down well, and trim change is negligible after initial compensation for nose down attitude.

A maximum rate descent is accomplished in Electra at maximum air speed (V_{mo}) which is Mach .64 down to 8,000 ft., and 364 kt. equivalent air speed under that. At this velocity descent rate will be at least 5,500 fpm., probably 6,000 rpm. or better.

(This is the first portion of a two-part pilot report on the Lockheed Electra. The concluding portion will appear in next week's Aviation Week.)

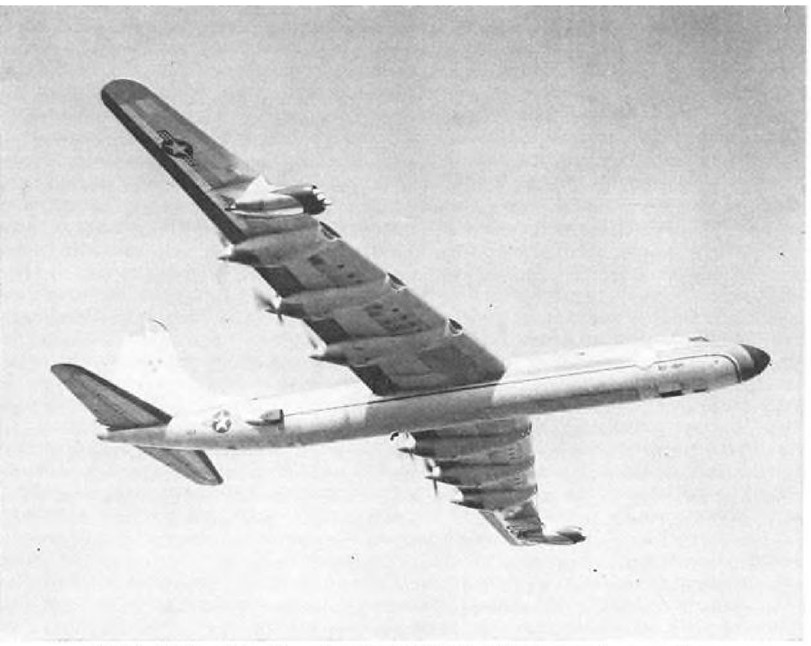
Electra Specifications

Maximum takeoff gross weight	113,000 lb.
Maximum landing weight	95,650 lb.
Maximum zero fuel weight	80,910 lb.
Maximum speed (sea level to 8,000 ft.) V_{ne}	364 kt. EAS*
Maximum speed (8,000 ft. alt.) V_{ne}	Mach .640
Normal operating speed V_{no} (sea level to 12,000 ft.)	324 kt. EAS
Normal operating speed V_{no} (12,000 ft. alt.)	Mach .615
Maneuvering speed V_A	203 kt.
Maximum flap speed, takeoff and approach (80%)	190 kt.
Maximum flap speed, landing (100%)	170 kt.
Maximum speed, landing gear extension	190 kt.
Maximum speed, landing gear extended	217 kt.
Minimum control speed, engine out (sea level, standard day)	110 kt.
Acceleration limits, flaps up (to maximum takeoff gross weight)	2.5G
Acceleration limits, flaps down (to maximum landing weight)	2.0G
Fuel dump limits, clean configuration	140 kt. to 200 kt.
Maximum operating altitude	30,000 ft.

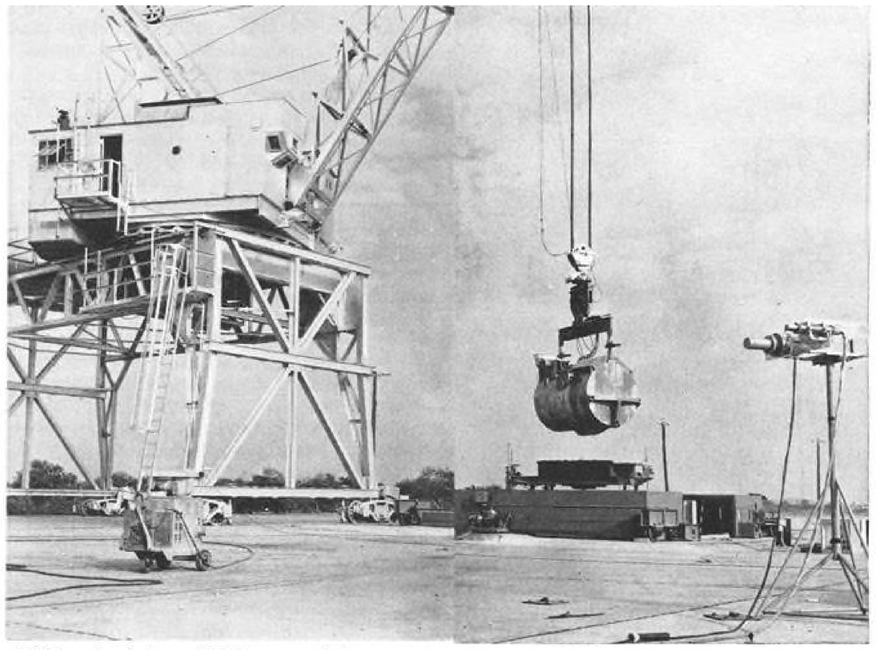
*—Equivalent air speed

USAF's C-130B Makes First Flight

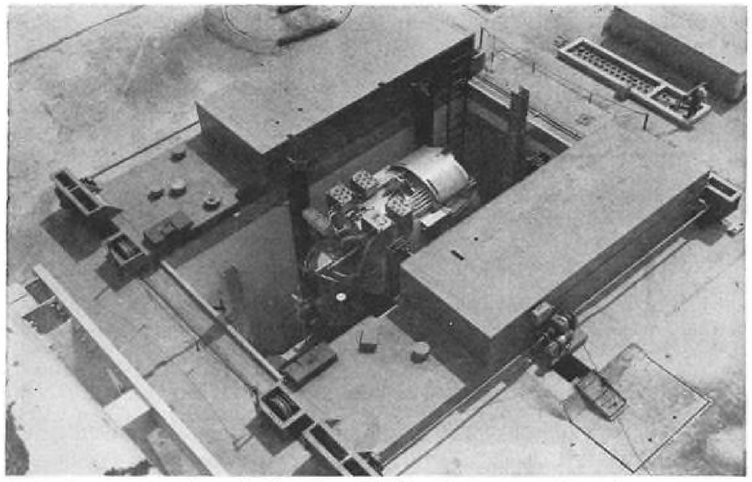
U. S. Air Force's Lockheed C-130B turboprop transport makes its first flight at Marietta, Ga. The first version of the C-130B will be delivered to Tactical Air Command early in 1959. The transport is powered by four Allison T56-A-7 turboprops (4,050 esh_p. each) with four-bladed 13½-ft. dia. Hamilton Standard 54H60 Hydromatic propellers (AW Sept. 15, p. 37). Additional fuel-carrying capacity of the C-130B extends nonstop range to 4,000 mi., compared with 3,000 mi. for the C-130A. First flight lasted one and a half hours.



AIR INTAKE on aft section of modified B-36H leads to heat exchanger section.



TEST reactor is lowered into ramp pit by crane on rails. The ramp pit is shielded.



STEEL doors are closed over loading pit, to shield radiations from the nuclear test reactor. Hydraulic and electrical couplings protrude from the test reactor top.

Nuclear Test Bomber Provided Valuable Shielding Data

By Craig Lewis

Ft. Worth—Under a generally low pressure nuclear aircraft development program, and in the face of the Soviet feat of flying a nuclear powered bomber, Convair tests of an operating reactor in a modified B-36H remain the only airborne reactor research done in this country.

Convair nuclear flight test program has now been phased out, but while it was active it provided valuable data for nuclear engineers and aircraft designers, especially in the problem area of crew shielding. It also provided vital practical experience in the handling of radioactive aircraft and airborne reactors.

Airborne nuclear work was part of a nuclear research program. A division of General Dynamics Corp., Convair has conducted tests for the Air Force since 1951. Most of the work has been in the study category, but the company is also involved in the actual design of a nuclear-powered airframe now called CAMAL (AW Dec. 1, p. 27). Last month, Air Materiel Command continued this work until March with a $2,671,557 contract. Convair's airframe design studies have been linked to the General Electric Co.'s nuclear powerplant project (AW Sept. 22, p. 55).

Nuclear airframe design competition includes Lockheed Aircraft Corp., a company which also has done extensive nuclear research work and which was linked with a now-canceled United Aircraft's Pratt & Whitney Aircraft Division nuclear engine project. Air Research and Development Command now is comparing the merits of the Convair and Lockheed design studies and considering the award of a prototype CAMAL contract.

Convair has used both ground and airborne test reactors in its nuclear work. Ground test reactor can be used for testing radiation effects on materials, and it is also useful for research on crew shielding. But ground testing is complicated by ground scatter of the radiation, so an airborne program was necessary.

Test Aircraft

Nuclear test aircraft, a modified B-36H, made its first flight with an operating nuclear reactor in September, 1955. During a program of 47 flights, the aircraft explored the effects of air scatter and airframe scatter on radiation patterns. Last flight was made in March, 1957, and a few months ago the aircraft was towed away to be scrapped, after it was apparent that no more USAF money would be supplied to support more flight testing.

This year, the aircraft shield test reactor which was used in the nuclear test aircraft program was taken to Oak Ridge National Laboratories where it and the aircraft's crew compartment were suspended from 300 ft. towers in the same relative positions they had in the aircraft. This step eliminated airframe scatter and provided radiation data affected only by air scatter.

When it became evident that flight tests would be necessary to get adequate scatter effect data, the B-36 was chosen for the program because of its large fuselage and great payload capacity. Nose section was removed from a disarmed B-36H, and it was replaced with a nose that would accommodate the shielded crew compartment. Local beefing was adequate to tie the loads from the 12 ton crew capsule into the main fuselage structure.

Shielded compartment had room for five crew members, compared with the normal complement of 11. Shielding consisted of layers of lead and rubber; lead thickness varied from ¼ to 2½ in., and the rubber ranged from seven to 17 in. thick. Only the pilots could see out, and visibility was provided with a combination of leaded glass and Plexiglas varying in thickness from nine to 11 in. Compartment was pressurized and air conditioned.

Careful design was necessary to avoid radiation leakage where the cabin was penetrated for the various systems. Control linkage used a series of concentric rotation tubes, and electrical connections were made through disconnect panels inside and outside the cabin which were connected by a short harness routed around baffle shields and potted with a shielding material in the panel.

Emergency hydraulic reservoir and pump was in the compartment, and fluid was not allowed to circulate through the radioactive part of the airplane because it would come back into the compartment contaminated.

Main entrance hatch to the cabin was a hydraulically-closed 500 lb. door that would fall open when unlatched in an emergency. Emergency escape hatch in the roof was spring-loaded, and it automatically opened and locked when unlatched.

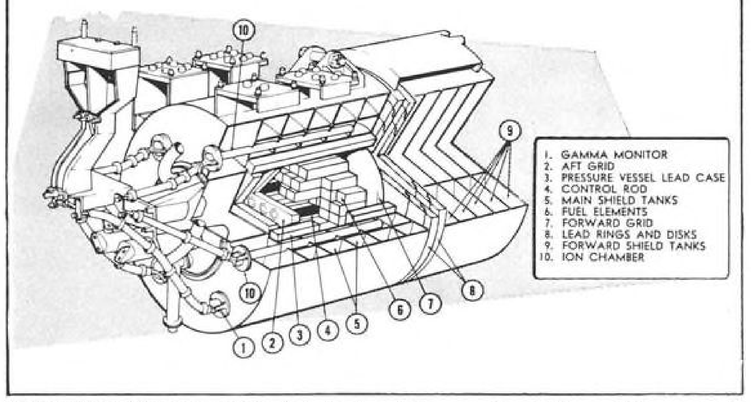
Part of the crew job in a standard B-36 is to monitor the pusher engines for the flight engineer, but in the nuclear test aircraft this job had to be done with a closed circuit television system. Conventional aircraft electronic equipment was carried forward of the crew compartment in an environment-controlled nose compartment.

A split shielding approach was taken to protect the crew. The crew compartment itself was shielded from radiation coming in from various directions, and an 8,000 lb. lead disk was installed in the center of the fuselage in front of the reactor to block direct radiation toward the front section of the airplane.

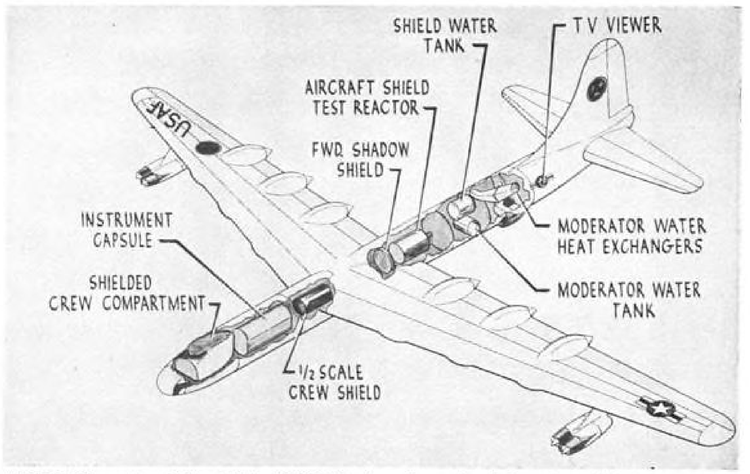
Water Shields

In addition to lead, the reactor itself had water shields which could be varied in flight, lending considerable flexibility to the test program. Each of nine shields tanks could be drained or filled at any time, and the lead shields on the front of the reactor could be changed between flights. In all, 26 combinations were possible.

The 35,000 lb. reactor was hung in the aft bomb bay by a single hook which could be opened to jettison it in an emergency. No beefing was necessary since the bay was designed to carry a 40,000 lb. bomb load. Reactor heat was carried off through heat exchangers



TEST reactor, shown in cutaway view above, weighs more than 20 tons. Airborne reactor can be operated at power levels as high as 1,000 kw. at altitudes up to 40,000 ft.



AIRBORNE reactor is located in B-36H fuselage just aft of the wing. Television cameras are installed for engine scanning; note extensive shielding around crew compartment.

cooled by ram air from a scoop on each side of the fuselage. The same system was used to supply hot water for reactor starting and to prevent freezing. In this case, the cold air was bypassed and hot air bled off the B-36 tail anti-ice system.

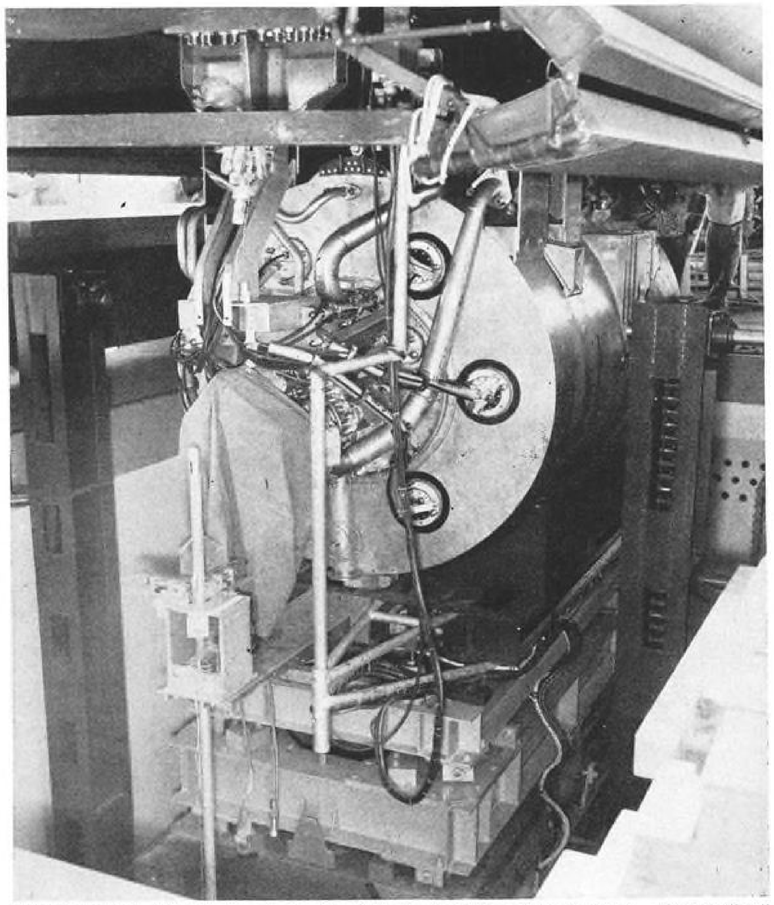
A scale model of the crew shield was placed in the forward bomb bay, and shielding was varied between flights. Data was collected from detectors inside the model, as it was from radiation detectors inside the crew compartment and at various points in the aircraft. Detectors were developed from basic laboratory systems, then miniaturized and adapted to the aircraft.

Data was recorded in an instrument capsule in the forward bomb bay just behind the crew cabin. Capsule was maintained at standard temperature and sea level pressure and contained 12 gamma scintillation channels and 12 neutron detector channels, as well as voltage and frequency monitoring equipment for all the instrumentation electrical power. Analog to digital 24 channel tape recording system recorded in cycles and could take 27,200 data points on a 12 hr. flight.

Instrumentation systems, air conditioning, moderator and shield transfer pumps and related equipment took about 30 kw. of aircraft electrical power, but this was no strain on the aircraft's four 30 kw. alternators.

The aircraft shield test reactor was designed and built here by Convair. It was designed to be flexible enough to operate both on the ground and in an aircraft at altitudes up to 40,000 ft. and power levels up to 1,000 kw. It is water cooled, moderated and reflected, and its core is made up of MTR-type fuel elements containing enriched uranium. The reactor has three control rods which are withdrawn against springs when the reactor is taken to power. This means they can be released to travel back into the core regardless of reactor attitude.

Designed solely as a radiation source for working on shielding and handling problems, the reactor has no relation to an actual aircraft propulsion system. Its power level is substantially lower than the power which would be required for a propulsion unit and it was designed to operate in any position, but



REACTOR is installed in bomb bay (top) during "cold" practice insertion. During "hot" insertions, all personnel were stationed in shielded control room (note men at rear).

normally only with the core horizontal.

Maintenance and operation of the reactor was carefully planned and carried out in an isolated, heavily secured area. Facilities and procedures used by Convair in maintaining the reactor and in loading and unloading it during flight operations provide valuable experience in planning eventual operation of a nuclear-powered aircraft.

For maintenance and some ground test programs, the test reactor was kept in the bottom of a handling tank that could be filled with water to shield personnel. It rested on a rotatable cradle which could be tilted so each end of the reactor was accessible for work by remote handling tools. When maintenance work was complete, it rested horizontally on its cradle and was ready to be moved.

Reactor Handling

Roof of the building housing the handling tank was rolled back, and a gantry crane picked up the reactor. The crane operator sat in a shielded cab and had remote control over all movements of the hook supporting the reactor. The crane removed the reactor from the maintenance building and moved it to the loading pit in the ramp area.

The reactor was placed on a hydraulic lift platform which extended from the loading pit, then was lowered into the pit where it was covered by 7 in. steel doors. This pit has a shielded control room from which the reactor could be observed, and a preflight check was carried out here to make sure that all drive motors were functioning, all instrumentation was registering properly and that all the control rods could be withdrawn. Core and shield tanks has been filled with water, and the reactor then was ready to be loaded.

Nuclear test aircraft was towed to the reactor area by a shielded tow vehicle, and one main gear chocked on a turntable. The aircraft was towed around in a tight circle until it was over the loading pit, then all personnel retired to shielded area during the loading operation, a period of about 20 min.

Loading operator in the pit control room opened the doors and began the job of aligning the reactor so that all latches and quick-disconnect panels mated. Reactor panels connected with panels in the aircraft and provided the crew with control over the water transfer and electronics systems. Lift is comprised of four movable platforms to permit precise alignment.

When the lift reached a certain point, probes on each end were extended until they engaged in their mating places in the reactor bay, and indicators showed the lift operator any degree of misalignment. When properly aligned, the reactor was driven into the bay and latched in place. The lift was lowered into the pit and the bomb bay doors closed, leaving the NB-36H ready for flight.

Planned sequence of steps in preflighting a test flight started 48 hr. before takeoff when work began in the handling tank to ready the test reactor for flight. At the same time, a complete preflight inspection was started on the test aircraft, and special test equipment was checked out. Convair engineer G. G. Johnson said this thorough preflight program paid off in flight results which show that no flights were ever terminated because of a failure in the complex instrumentation systems used in the aircraft test program.

Several hours elapsed between loading of the reactor and actual takeoff. Final checkout of the airplane, reactor and nuclear instruments was made during this period, and escort aircraft were checked out at the same time. Moderator water was drained from the reactor core before takeoff as a safety precaution.

NB-36H was taxied from the reactor isolation area, crew-checked for flight readiness, then took off on its mission at a gross weight of 367,000 lb. The test aircraft had to fly to a prescribed flight corridor in its West Texas-New Mexico test area, and during this time the reactor engineer prepared the reactor and auxiliary systems for operation while the flight test engineer prepared data gathering gear.

Flights were monitored from a Boeing B-50 chase plane which could observe the NB-36H in flight and which carried nuclear instrumentation for mapping radiation fields around the nuclear test aircraft. An Air Force transport also accompanied the aircraft on its test flights carrying a team of paramedics which could parachute to the ground to isolate and monitor any area where the reactor might have to be jettisoned in an emergency.

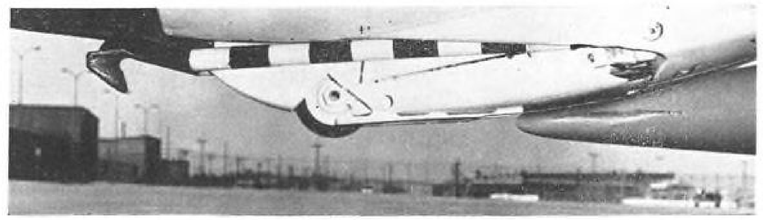
When the aircraft arrived in the test area, the core of the reactor was filled with water, and the control rods were withdrawn to start it operating. Data was taken at several altitudes and with various power levels and shield configurations. Measurements were taken by the nuclear engineer in the crew compartment, as well as at various remote points in the aircraft.

Low Level Run

One flight was made outside the regular test corridor. On a day when atmospheric conditions were favorable, a low level run was made over the Gulf of Mexico. Air scattering data was gathered at a pressure altitude near sea level, while the airplane was high enough to avoid ground scattering effect.

Air scatter data was measured on the runs by the B-50. Using its modified AN/APG 32 radar, the chase plane established the range between itself and the test aircraft and recorded detailed mapping information on radiation field intensities. B-50 pilots found they could maintain range between the aircraft by watching a portable radiation monitoring instrument which showed changes in radiation intensity.

When a data run was completed, the reactor was shut down by scramming the control rods, and the aircraft returned to the Convair facility here. Cooling water was circulated through the reactor core during the return trip to remove the after-heat, and moderator water was drained from the core before landing.



F4D Will Use Polyurethane Tail Wheels

Douglas F4D Skyray fighter will employ tail wheels made of Disogrin, an abrasion resistant polyurethane material the manufacturer says is five times more durable than the rubber wheels now in use. Disogrin Industries, Inc., Mount Vernon, N. Y., will produce 3,070 wheels under a $355,261 Navy contract. Tail wheel, which protects the low tail cone of the aircraft, receives hard wear during arrested landings, field carrier landing practice and during nose-high aerodynamic braking on normal landings.

Skywarrior ECM Version Makes Initial Flight

First flight of A3D-2Q, electronic counter-measure version of Douglas Skywarrior, was made from Los Angeles International Airport to Edwards AFB, Calif., with test pilot Calvin Shoemaker at controls. Plane is powered by Pratt & Whitney J57 turbojet engines.

Schedule for Douglas El Segundo plant is to build between 20 and 30 of the aircraft which will carry at least four persons.

VENTRAL fin design permits free passage of turbine exhaust gases. Note large windows on clamshell doors, for rearward vision.

H-43B Tailored to USAF Rescue Concept

By Erwin J. Bulban

Bloomfield, Conn.—Design of Kaman H-43B Huskie turbine-powered helicopter, which was formally rolled out here last week, is keyed primarily to U.S. Air Force concept of employing rotary wing aircraft throughout its commands as crash-rescue vehicles to reduce loss of valuable flight personnel.

Kaman engineers sought to provide maximum crash-rescue capabilities in the new H-43B built on experience from live demonstrations of helicopter rescue capabilities, including the fire-fighting role, and on results of evaluation by an experienced USAF pilot team of its earlier piston-powered H-43A —a re-equipped but basically similar version of the Navy's HOK-1.

USAF's initial intent was to procure a quantity of local crash-rescue (LCR) helicopters on an "off-the-shelf" basis, but evaluation indicated that existing equipment was marginal as regards range, or cabin space, altitude performance or handling characteristics in relation to mission requirements.

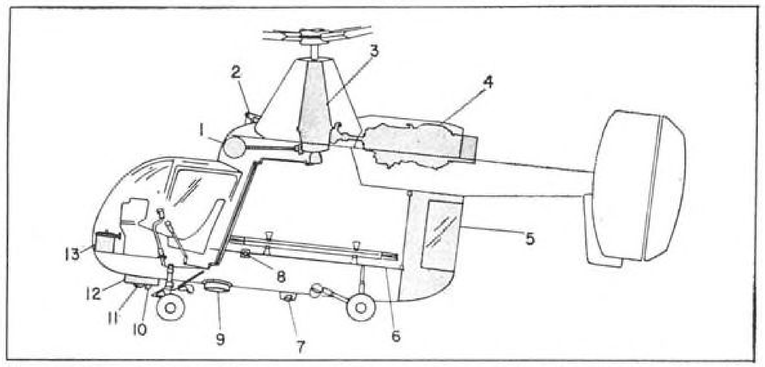
H-43A scored high in the evaluation and was recommended choice of the Air Force team with some criticism aimed at range and cabin capacity; USAF ordered 18 H-43As.

To improve the H-43A's characteristics for the crash-rescue mission, Kaman engineers considered use of the Lycoming T53 turbine to replace the lower-powered, heavier Pratt & Whitney R1340-48 piston engine, increased fuel and cabin capacity and incorporation of other ideas that would tailor the aircraft to the job.

H-43B characteristics exceeded Air Force requirements and USAF followed its initial H-43A order with contract covering procurement of 98 H-43Bs. Tentative distribution will be: Air Research and Development Command, 6 H-43Bs; Strategic Air Command, 34 H-43Bs; Air Defense Command, 33 H-43Bs; Air Materiel Command, 10 H-43Bs; Air Training Command, 6 H-43Bs; Military Air Transport Service, 5 H-43Bs; Tactical Air Command, 4 H-43Bs and 18 H-43As. Total dollar volume of H-43A and H-43B contracts is over $20 million. Both models are in quantity production: initial H-43A was delivered in November and first H-43B will be delivered in mid-1959.

Complete redesign of the basic HOK configuration, incorporating the Lycoming T53-L-1A turbine, provides the H-43B with approximately twice the cubic capacity of the earlier model. Smaller, lighter T53 is installed above

DISTANCE between rotor hubs is increased 25% over H-43A, reducing blade coning angle, increasing couple and turn moments.



INBOARD PROFILE of H-43B showing: 1. blower and air cooler; 2. rescue hoist (right side); 3. transmission; 4. Lycoming T53-L-1A; 5. clamshell doors; 6. floor; 7. cargo hook; 8. fuel filler; 9. ARC-52 antenna; 10. landing light; 11. floodlight; 12. ultra high frequency (UHF) antenna, and 13. battery.

the fuselage, freeing the entire rear of the aircraft for additional carrying capacity and also permits use of clamshell type doors allowing easier entrance and exit.

New fuselage provides a maximum width of 63 in. and 46 in. of headroom. Basic makeup is a torsion box formed by roof and tub (belly) structures bounded by two main members built up of aluminum sheet and angles; a forward bulkhead canted from Station 75.4 at the floor line to Station 93.8 at the top deck, and a rear main frame canted from Station 156 at the floor line that jogs at the sill line and hits the top deck at Station 142.8. Other frames are built-up webs and extruded angles or are sheetmetal members formed on Hydropress. Torsion box structure is designed to offset vibration and resonance stresses primarily imposed by the rotor.

Basic main assemblies comprise the tub structure, the overhead deck structure and side panels. Deck structure supports the transmission, which is attached by means of angle fittings riveted to main frames and braced to fore and aft bulkhead and main frame. Flooring and roof are aluminum honeycomb panels; the roof panels hinged at the fuselage sides to open downward from the centerline and expose approximately 80% of the roof area. Floor panels, having tie-downs for cargo and seats, provide access to fuel cells mounted in the tub between Stations 80-156. Fuel capacity is 198 gal. of JP-4; fuel is carried in two flexible interconnected cells that form one tank. Normal tankage requirement to meet USAF 75-mi. crash-rescue mission would 168 gal., Kaman notes. H-43B can also be fitted with auxiliary fuel tanks providing an additional 100 gal.

Cockpit and bubble nose are carried on a platform extension of the tub structure. A closed section fuselage frame carries torsion loads of the large bubble.

Two tail booms and the engine support structure are built as one unit and brought up and attached to the top deck by two tension bolts on each boom. Turbine powerplant is carried on a platform located between the tail booms and mounted on transverse beams.

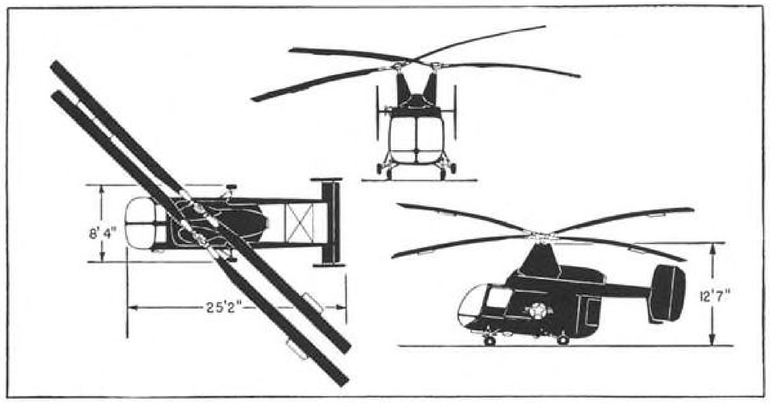
Tail section of the H-43B comprises end-plate type fins and controllable rudders and two ventral fins on the boom center lines. Rudders, a feature of the H-43B design, are controlled by an automatic stabilization augmentor device, so that as speed decreases, input from a "black box" increases to provide more effective control at low speeds. Plan is to provide airplane handling characteristics throughout the entire speed range: Kaman engineers told AVIATION WEEK that on "breadboard" models of the sys-

H-43B Crash

Bloomfield, Conn. — No. 2 Kaman H-43B Huskie crash-rescue helicopter, scheduled to participate in an official rollout here Dec. 16, crashed near the conclusion of a rigging and tracking test flight Dec. 14, killing senior engineering test pilot Fred Feinberg and seriously injuring Winfield R. Newton, chief test pilot.

Charles Kaman, president of Kaman Aircraft Corp., said that the H-43B was flying at about 30-40 mph. at some 50 ft. altitude when he saw a "ball of flame" appear atop the fuselage between the rotor pylons. Pieces broke away from the area and the helicopter nosed downward, breaking up until it struck the ground. Newton was thrown clear of the wreckage.

Investigation is under way with Kaman, Air Force and Lycoming—maker of the T53 powerplant—participating. Kaman planned to hold rollout ceremonies using No. 1 H-43B, which had been torn down to be instrumented.



LARGER CAPACITY H-43B varies only slightly (in cabin width) over earlier piston type.

tem, they have been able to make turns with rudder only at 40-45 kt. and up.

To increase rescue effectiveness, Kaman engineers have placed pilot and winch operator on the same side of the fuselage.

Double door, on right side only, can be pushed back along tracks so that only the pilot's position is exposed; or rear portion only can be moved back to expose winch operator—or both sections can be completely retracted, to give both crew members full view.

As an aid to improving hillside landing characteristics, four-wheel gear has a wider track and air component of the shock strut component has been replaced with stiff rubber and steel mechanical units to provide better stability. Both front and rear wheels will be 5.00 x 15 size.

H-43B is approximately a month ahead of schedule. Transmission has completed 150-hr. bench testing and number one airframe (Serial 58-1841) has passed mechanical instability and 54-hr. tiedown testing—it went through the latter in a little more than a week with no deficiencies, according to Kaman.

Transmission system is basically a well-proven HOK-1 type with some detail changes and is capable of taking later, more powerful T53 engines without major change.

It currently is designed to take 720 hp. at 5,500-6,300 rpm. in the military rating; 600 hp. at 5,100-6,300 rpm. at normal maximum power. This compares with manufacturer's ratings of 860 hp. at 6,680 rpm. military power and 770 hp. at 6,610 rpm., respectively.

The aircraft has completed preflight requisites and number one airframe is being instrumented for additional testing. Aircraft will undergo a recently formulated joint USAF-contractor flight program during which Air Force personnel will work with Kaman at Bloomfield. Normal procedure has been for the contractor to complete his test program and then transfer the aircraft to an Air Force station for evaluation by military personnel. New system is expected to cut time and costs over previous system.

Air Force concept of local crash-rescue (LCR) helicopter closely follows system used for many years by Navy of having a rotary wing aircraft standing plane guard during flight deck operations.

Studies of Air Force crashes have indicated that helicopters, because of their ability to rapidly cover territory that would be difficult or impassable to ground rescue and fire vehicles, could save many crew personnel. Tests have shown the helicopter's efficiency in fire fighting and rescue roles due to the fact that heavy rotor downwash not only can be used to beat flames away from crew quarters, permitting airborne rescue workers to get in and open the wreck so that crew can escape or be carried out; but cool downwash also keeps crew from being exposed to high heat while rescue operations are carried out. Heat, not flames, has been the cause of many fatalities that fire didn't reach, according to data available.

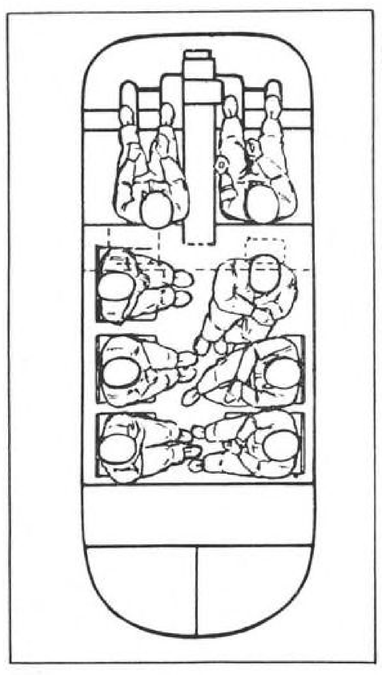
Mission range is based on studies of USAF Safety Center data covering all commands over 1955-1957 period. According to statistics, of a total of 986 crashes in this period, 952 occurred in a radius of 61 mi. of the base; 712 occurred in a radius of 10 mi. of the base. Of all the crashes, 436 or some 45%, resulted in fire. Of the crash fires, 96.9% happened within a 51 mi. radius of the base.

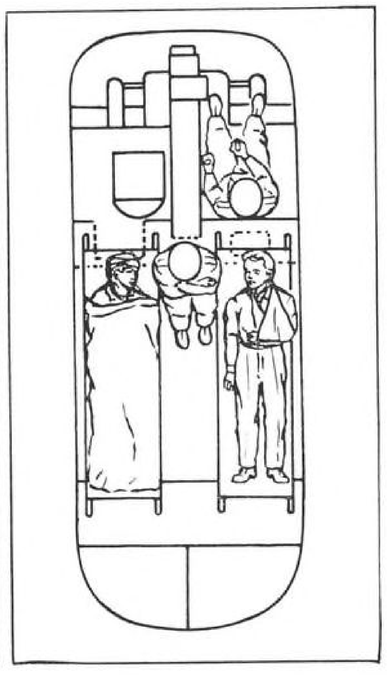
Kaman H-43B Huskie

Normal gross weight	5,870 lb.
Alternate gross weight*	6,948 lb.
Empty weight	4,278 lb.
Useful load	1,592 lb.
Maximum speed (sea level)	104 kt.
Cruise speed (sea level)	98 kt.
Range at cruise speed	183.5 n.m.
Maximum rate of climb	2,000 fpm.
Vertical rate of climb	1,540 fpm.
Service ceiling, fully loaded	25,700 ft.

*Alternate mission as fire fighter; useful load is 2,787 lb.

EXTERNAL MOUNTING of T53 turbine permits full use of fuselage internal area for payload and entrance is eased by fitting clamshell doors (shown open, above). H-43B has approximately twice the cubic capacity of previous piston-engine H-43A/HOK-1, its cabin measuring approximately 63 in. wide x 46 in. high x 103 in. long. Varied personnel loading accommodations (below) permit carrying up to seven passengers plus pilot.





Program will provide two helicopters per station, so that one machine could always be on standby while the other might be undergoing maintenance. Normal H-43B load could include up to one and a half tons, which might be split between crew, two fully garbed fire fighters and 1,000 lb. of fire fighting and rescue gear.

USAF Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Air Force Contracting Offices:

HEADQUARTERS, AIR FORCE OFFICE OF SCIENTIFIC RESEARCH, ARDC, Washington 25, D. C.

Regents of the University of Minnesota, Minneapolis, Minn., research in "Gaseous Electronics." (AF 49(638)-478), $25,280.

University of Michigan, Ann Arbor, Mich., research on "Speed Analysis." (AF 49(638)-492), $25,000.

California Institute of Technology, Pasadena, Calif., research on "Secondary Flows in Axial Compressor Stages." (AF 49(638)-497), $41,950.

Northwestern University, Evanston, Ill., continuation of "Study of the Role of Interstitial Elements and Oxygen Upon the Grain Boundary Cohesion of Metals." (AF 18(600)-1598), $56,009.

Johns Hopkins University, Baltimore, Md., continuation of research on "New Micro-Catalytic Chromatographic Technique for Studying Catalytic Reactions." (AF 18(600)-129), $37,512.

Regents of the University of California, Berkeley, Calif., research on "Internal Stresses in Ceramic Bodies." (AF 49(638)-1), $28,817; continuation of research on "Ductile Ceramics." (AF 49(638)-56), $100,000.

AIR FORCE CAMBRIDGE RESEARCH CENTER, ARDC, Laurence G. Hanscom Field, Bedford, Mass.

Ohio State University Research Foundation, Columbus, Ohio, research and related operational services for simplified international aeronautical language, (RFP 36110), $80,000.

General Mills, Inc., Minneapolis, Minn., construction of balloon-borne particulate fractionator and platform, (RFP 06779), $49,970.

University of Utah, Salt Lake City, investigation and development of circuitry on the falling sphere experiment, (RFP 57926), $57,075.

Donald G. Jones, an individual doing business as Pioneer Construction Co., Watertown, Mass., construction of an addition to base infirmary to expand existing base medical facilities, (IFB 19-604-59-38), $48,328.

HEADQUARTERS, OGDEN AMA, USAF, Hill AFB, Utah.

Cleveland Pneumatic Tool Co., Cleveland, strut assembly, nose landing gear, applicable to C-124 series aircraft (D.O. on contract AF42(600)-19253), 24 ea., $205,656.

Goodyear Tire and Rubber Co., Akron, Ohio, recapping of reparable aircraft casings (D.O. on contract AF42(600)-19367), $32,940.

Northrop Division, Northrop Aircraft, Inc., Hawthorne, Calif., technical data for F-89 aircraft components (D.O. on contract AF42(600)-19242), $27,150.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., spare parts applicable to B-66, B-26, C-119, F-100 and F-102 aircraft (D.O. on contract AF42(600)-19480), $33,408.

McDonnell Aircraft Corp., St. Louis, Mo., modification kits, 468 ea., spare parts, engineering and technical data, 24 sets, applicable to F-101 aircraft (D.O. on contract AF42(600)-19284), $80,190.

Hydro-Aire, Inc., Burbank, Calif., spare parts applicable to QF-80F aircraft, (PR-SM-9-03B-2021), $160,240.

McDonnell Aircraft Corp., St. Louis, Mo., modification kits, 67 ea., engineering and technical data, 21 sets, spare parts applicable to F-101 aircraft (D.O. on contract AF42(600)-19284), $69,525; modification kits, 94 ea., engineering and technical data, 21 sets, spare parts applicable to F-101 aircraft (D.O. on contract AF42(600)-19284), $27,150.

Northrop Division, Northrop Aircraft Corp., Hawthorne, Calif., accomplish F-89J weapon system capability study, phase III (PR 00-9-ENG-2358), $365,162.

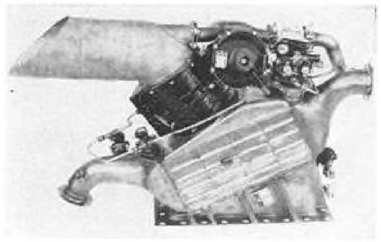
NEW AVIATION PRODUCTS

Inertia Reel Seat Belt

Airline seat belt with inertia reel similar in principle to that used in military aircraft shoulder harnesses permits freedom of body movement yet safety in the event of sudden loads. It is thought that the freedom of the belt will encourage passengers to keep belt fastened, particularly when sleeping.

Inertia reel weighs 11 oz. and is 1¾ in. in diameter. Mechanism locks on an acceleration of approximately .8G, and is effective in less than 1 in. of travel. Belt retracts into reel when not in use, leaving about 15 in. projecting so that it may be easily grasped by passengers.

The Aerotherm Corp., Bantam, Conn.



Air Duct Cooler

Heat exchanger pre-cools engine bleed air for air conditioning system prior to passage to the wing fuel cells of the Boeing B-52G. Heat exchanger reduces air temperature, which fluctuates as high as 750F, to 450F without electrical power.

Ram air passing over the tube-type welded and brazed stainless steel exchanger is regulated by a modulating valve which responds to a sensor in the bleed air outlet. Jet pump induces sufficient cooling airflow at low speeds and during ground operation. Precooler weighs 50 lb., handles 100 lb. of air per minute at about 135 psig.

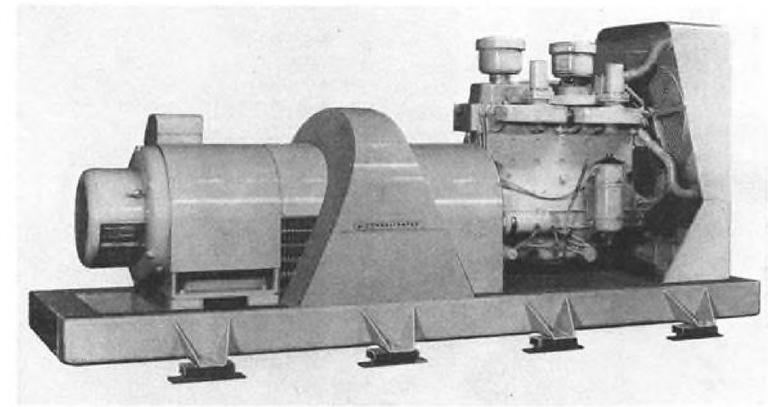
AiResearch Manufacturing Division, 9851 Sepulveda Blvd., Los Angeles, Calif.

Section-Profile Projector

Projection instrument for inspection of turbine blades will enable an operator to measure dimensions to within .0005 in. and twist to 5 min. of arc, according to the maker.

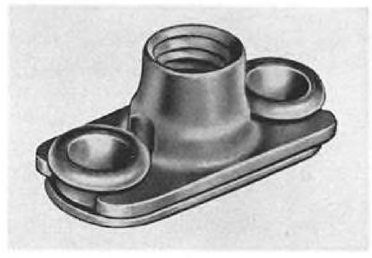
Two mercury vapor lamps illuminate both sides of the blade. Two lens systems at 35 deg. on both sides of the turbine blade prevent interference by blade twist and permit inspection of long blades. Mirror system and Fresnel bi-prism redirect the image to correctly enter the projection lens. Blade section contour appears on a screen as a dark image outlined by a bright band of light. Projector will inspect work to 16 in. in length, with 2¼ in. of chord and 45 or more degrees of twist.

Eastman Kodak Co., 343 State St., Rochester 4, N. Y.



Uninterrupted Power Supply Generator

Standby generator provides uninterrupted power to 100 kw. for missile tracking stations and other constant power applications. Diesel-powered unit, produced by Consolidated Diesel Electric Co., restores full voltage in less than 1.5 milliseconds and does not permit a voltage drop of more than 70% of normal. Flywheel supplies inertia until engine can be brought to speed. Con Diesel states that the generator has been subjected to 1,500 power loss cycles without failure.



Floating Locknut

Miniature, deep counterbore floating locknut is designed for access doors and openings where different thicknesses of material ordinarily would require shims. Model MF19058 locknut has shorter, narrower lugs and is 30 to 39% lighter than standard lightweight deep counterbore locknuts, the maker states.

Kaylock Division of Kaynar Mfg. Co., Inc., Los Angeles, Calif.

Aircraft Clock

Aircraft clock presents Greenwich Mean Time on inner 24 hr. (twice around) dial and local time on outer dial. Local time zone adjustments are made by shifting the outer bezel and reading directly. Clock will avoid confusion in filing flight plans in Greenwich time, the maker states.

Spring-wound eight-day type clock fits in standard 2¼ in. panel hole.

Allied Instrument Co., 8238 Travelair, Houston 17, Tex.

Bomb-Rocket Rack

Combination bomb rack and rocket launcher, designed to BuAer specifications, can carry any standard two-lug, 14 in. suspended store weighing 500 lb. or less. This includes bombs, mines, rockets, rocket pods, expendable fuel

tanks and Sidewinder and Zuni air-to-air missiles.

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Flight Photo of U-2 Reconnaissance Aircraft

Flight photo of U. S. Air Force's Lockheed U-2 shows the unusually high aspect ratio wing of the aircraft. The subsonic U-2 is used by the Strategic Air Command for upper air research and weather reconnaissance, including studies of clear air turbulence, wind shear, jet stream air currents, convection cloud formations cosmic rays, and ozone and water vapor content of the atmosphere. What appears to be a radome for a navigation or mapping radar can be seen at bottom of the fuselage. Powerplant is a Pratt & Whitney J57C turbojet rated at about 10,000 lb. thrust. The U-2 can attain altitudes of more than 55,000 ft. and can remain aloft for a relatively long time. U-2s are assigned to the 4028th Strategic Reconnaissance Squadron (Weather), Laughlin AFB, Tex., and Ramey AFB, Puerto Rico. The U-2 was used by the National Advisory Committee for Aeronautics for research and weather reconnaissance in 1957 (AW Feb. 11, 1957, p. 30). Photo of Typhoon Kit, which appeared on the Dec. 15 cover of Aviation Week, was taken during an NACA U-2 weather mission. Outrigger landing gear (bottom) are jettisoned at takeoff; turned-down wingtips serve as landing skids.

WHO'S WHERE

(Continued from page 19)

Changes

Dr. Merit Scott, scientific advisor to the staff, Applied Sciences Division of Fairchild Engine and Airplane Corp., Alexandria, Va.

Jack H. Zilman, general manager, Daystrom Pacific, Los Angeles, Calif.

Alfred W. Tucker, chief engineer, Cleveland Pneumatic Tool Company Division of Cleveland Pneumatic Industries, Cleveland, Ohio.

Joseph Hussey, manager of engineering, Berkeley Division of Beckman Instruments, Richmond, Calif.

Charles A. Naegeli, Jr., chief engineer, Missile Products Division, Beckman & Whitley, Inc., San Carlos, Calif.

John L. Taggart, director of marketing, American Bosch Arma Corp., Hempstead, N. Y.

Capt. Fred J. Shaw, director of flight administration, American Airlines, Inc. Also: **A. B. Bowman,** assistant director-dispatch, and **Florian J. Stevens,** director-cargo sales service.

Charles R. Plum, general manager, Defense Products Division of American Air Filter Co., Inc., Rock Island, Ill. Also: **Hillary Williams,** manager of marketing, and **Ralph A. Anderson,** manager of sales.

G. Franklin Montgomery, Chief of the Electronic Instrumentation Section, National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

George L. Downs, program manager for new communications project, Buffalo Operations of Sylvania Electric Products, Inc., Buffalo, N. Y. **Donald M. Christie** succeeds Mr. Downs as manager of Sylvania's Buffalo Systems Plant.

William Rieke, JetStar project manager, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga.

R. E. Honer, assistant chief engineer-electronics, Convair Division of General Dynamics Corp., San Diego, Calif.

Peter G. Kappus, manager of a newly organized Aircraft Gas Turbine Division Product Analysis Operation, Flight Propulsion Laboratory Department, General Electric Co., Cincinnati, Ohio.

George A. Franco, manager, Radio Communication Laboratory, Research and Advanced Development Division, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

Douglas Hembrough, manager-commercial avionic sales, and **Lewis M. Lawton, Jr.,** manager-commercial avionic engineering, General Precision Laboratory, Inc., Pleasantville, N. Y.

General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa., has appointed the following team of engineering managers: **J. Katzen,** systems design and integration; **L. L. Farnham,** vehicle engineering; **E. Fthenakis,** navigation and control; **J. Hungerford,** ground support; **C. Botkin,** nuclear ordnance projects.

Dunstan Graham, head of the newly instituted Systems Management Office, Astronics Division, Lear, Inc., Santa Monica, Calif.

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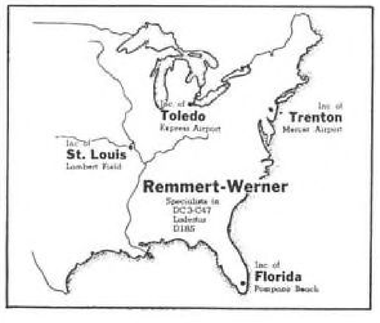

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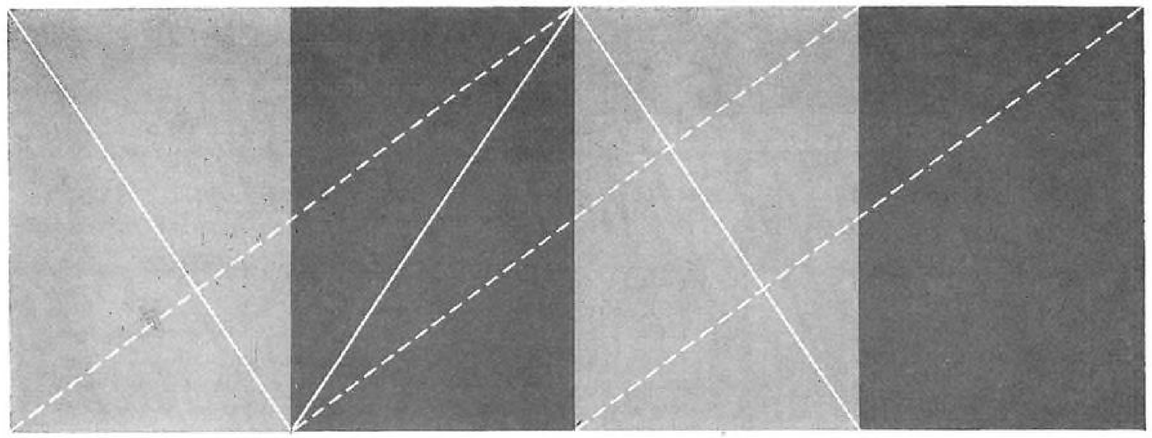

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AVIATION WEEK, DECEMBER 22, 1958

AIRCRAFT RADIO CORPORATION 11
Agency—Burke Dowling Adams, Inc.
AIRWORK CORPORATION 62
Agency—Gene Wyble Advertising
ALUMINUM CO. OF AMERICA 14
Agency—Fuller, & Smith & Ross, Inc.
AMERICAN TUBE BENDING CO. 6
Agency—Neary Adv.
AUTONETICS DIV. NORTH AMERICAN AVIATION, INC. 71
Agency—Batten, Barton, Durstine, & Osborn, Inc.
AVCO MANUFACTURING CORPORATION, LYCOMING DIVISION 44-45
Agency—Benton & Bowles, Inc
AVCO MANUFACTURING CORP. RESEARCH AND ADVANCED DEVELOPMENT DIV. 84
Agency—Benton & Bowles, Inc.

BRUNSWICK BALKE COLLENDER COMPANY ..... 2nd Cover
Agency—McCann Erickson, Inc.

DE HAVILLAND AIRCRAFT OF CANADA LTD. 57
Agency—Paul-Phelan d Adv. Ltd.
DETROIT CONTROLS DIV. AMERICAN STD. 46
Agency—S. Gunnar Myrbeck & Company
DOW CHEMICAL COMPANY 4
Agency—MacManus, John & Adams, Inc.

ELECTRICAL ENGINEERING & MFG. CORPORATION 31
Agency—West Marquis, Inc.
ELECTROSNAP CORP. 32
Agency—Stoetzel & Assoc., Inc.

FAIRCHILD CONTROLS CORP. 5
Agency—Wilbur & Ciangio

GARRETT CORPORATION—AIRESEARCH MFG. DIVISION 66-67
Agency—J. Walter Thompson Company
GENERAL PRECISION LABORATORY, INC. 7
Agency—Gaynor & Ducas, Inc.
GOODYEAR TIRE & RUBBER COMPANY, INC. 3
Agency—Kudner Agency, Inc.
GRUMMAN AIRCRAFT ENGINEERING CORPORATION 48-49
Agency—Fuller & Smith & Ross, Inc.

HI SHEAR RIVET TOOL COMPANY 72
Agency—Aircraft & Missile Consultants
HOLLEY CARBURETOR COMPANY 54
Agency—Clark & Bobertz, Inc.
HUGHES AIRCRAFT COMPANY 12-13
Agency—Foote, Cone & Belding

LEACH RELAY COMPANY, DIVISION OF LEACH CORPORATION ..... 3rd Cover
Agency—Hixson & Jorgensen, Inc.
LOCKHEED AIRCRAFT CORPORATION 60-61
Agency—Foote, Cone, Belding Adv.

NETWORKS ELECTRIC CORP. 50
Agency—The McCarty Co.
NICHOLS COMPANY, W. H. 51
Agency—Chambers Wiswell, Shattuck, Clifford & McMillan, Inc.
NORTH AMERICAN AVIATION, INC. 55, 79, 85
Agency—Batten, Barton, Durstine & Osborn, Inc.
NORTHROP AIRCRAFT, INC. 70
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.

ONTARIO INTERNATIONAL AIRPORT 73
Agency—The Essig Co.

RANDALL ENGINEERING CORP. 16
Agency—Dewey Moore & Co.
ROHR AIRCRAFT CORPORATION 10
Agency—Barnes Chase Company

SCINTILLA DIVISION—BENDIX AVIATION CORPORATION 68
Agency—MacManus, John & Adams, Inc.
SERVOMECHANISMS, INC. ..... 4th Cover
Agency—Sanger-Funnell, Inc.
SILICONES DIVISION—UNION CARBIDE CORPORATION 20
Agency—J. M. Mathes, Inc.
SIMMONDS AEROCESSORIES, INC. 47
Agency—Burke Dowling Adams, Inc.
SOLAR AIRCRAFT COMPANY 40
Agency—The Phillips-Ramsey Company, Inc.
SPHINX AMERICAN CORP. 73
Agency—Harold Marshall Adv. Co.
STANDARD PRESSED STEEL COMPANY 58
Agency—Gray & Rogers Adv.
SURFACE COMBUSTION CORPORATION (JANITROL AIRCRAFT AUTOMOTIVE DIV.) 76
Agency—Odiorne Industrial Adv.

UNION CARBIDE CORPORATION 20
Agency—J. M. Mathes, Inc.
U. S. STEEL CORPORATION 8-9
Agency—Batten, Barton, Durstine & Osborn, Inc.

VERTOL HELICOPTER CORPORATION 18
Agency—Gaynor & Ducas, Inc.
VICKERS ARMSTRONG, LTD. 38
Agency—McCann Erickson, Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 80-83

EQUIPMENT
(Used or Surplus New)
For Sale 83

WANTED
Miscellaneous 83

ADVERTISERS INDEX

Air Transport Department 83
Butler Overseas Corporation 83
Cessna Aircraft 82
Collins Engineering Corp. 83
East Coast Aero Technical School 83
Engine Works 83
Furlong, Fuzzy 83
General Bronze Corp. 82
General Electric Company 81
General Precision Labs. 80
Marquardt Aircraft 80
National Surplus Sales 83
Pacific Propeller, Inc. 83
Raway Sales 83
Regina Cargo Airlines, Inc. 83
Solar Aircraft Company 81
Stanford Research Institute 80
Remmert-Werner Inc. 83

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LETTERS

Soviet Nuclear Plane

Upon receiving my copy of AVIATION WEEK today, I immediately ran across and read with a great deal of interest your timely and surprisingly frank article on the Soviet nuclear-powered bomber (AW Dec. 1, p. 27).

I feel I would be doing your fine editorial and my personal feelings a great injustice if I did not sit down and take the time to commend you on this editorial. Though I have never been stirred to write the Editor a letter, I feel that this is certainly the time, or better still, far past time.

Being a naval aviator currently flying high performance aircraft, I have always been amazed and disappointed at the lack of interest, effort, and the relatively cold shoulder offered to the research and development of nuclear flying. When the subject is approached among professional aviators it is merely shrugged off with the comment, "that's years in the future." Though I cannot say for certain, I believe I would not be far wrong in stating that many of our nation's leaders perhaps hold the same opinion and there the subject ends.

Indeed, this is and has been a fallacy for so long that now we are once again faced with another Soviet triumph in an ever growing series of triumphs.

As late as this week when the newspapers carried the accounts of the Russian prototype nuclear bomber my contemporaries still seemed unconcerned. I shall heartily recommend your article on this subject to each and every one of them, and in turn I hope someone recommends to our nation's leaders that we are far past the time of lethargic daydreaming and drastic military spending cutbacks.

This letter will probably seem to step on many toes and so I will ask my name to be withheld, and instead try to convince more people that your article and any others along these same lines state the actual facts —the sad, discouraging facts—that once again we are not a day late and a dollar short, but years too late, and many, many dollars too short.

A CONCERNED NAVAL AVIATOR
Lt., USN
San Jose, Calif.

The enclosed clipping (Baltimore Sun, Dec. 1, p. 1) quotes your magazine as saying that the Russians now are testing a prototype of an atomic-powered airplane. I am dismayed but not surprised to see them get ahead of us.

In my six years as an aircraft design engineer, much of the time the whole engineering department would be in a stupor from easily correctible air contamination. This was true of both a large East Coast aircraft plant and one of the largest West Coast aircraft plants. Conversations with other engineers in other aircraft plants indicate that such conditions are general throughout the industry. The situations are caused by careless architectural practices that ignore the entry of airborne toxicity into the ventilating systems. The so-called air-conditioned building is particularly vulnerable. Engineering focus and concentration are two of the first things that disappear with toxicity.

The medical, safety and industrial hygiene people seem to become both rigid and addicted to these things and refuse to help correct or even inspect the condition in many cases.

I have been told that the Russians have stricter standards than we do for air contamination. Theirs are based on minor brain function impairment while ours, with a few exceptions, are based on gross organic damage.

If this is true they can beat us by the simple expedient of letting us defeat ourselves with poor air hygiene. Our culture may die with a whimper rather than a bang. I do not exaggerate. The truth is bad enough.

Your courageous news reporting is of utmost importance to our survival. Keep it up.

FRANCIS SILVER
Chemical Engineer
Martinsburg, W. Va.

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.

Your overwhelming article on the Soviet nuclear bomber (AW Dec. 1, p. 27) may well provide the belated stimulus the U. S. program has lacked to date. Certainly, when the Russian aircraft cruises by for the third time without landing, even the most naive observer will have despaired at the cracker barrel homilies (circa 1957) of the "shitepoke," a bird that flies slowly with both feet in its mouth. One wonders if, in the present twilight of our international splendor, he would now be willing to walk a mile for a CAMAL.

The balance of the Dec. 1 issue (devoted to strikes, CAB disputes, and space-toys-we-are-going-to-have-for-Christmas-someday) pales in comparison. Unfortunately, it serves to clearly distinguish the technological merits of a government system which is repugnant to us.

Whatever happened to the (W)right brothers.

USAF MAJOR
McGuire AFB
Trenton, N. J.

Project Management

Two references to technology management in your issue of Nov. 10 prompt this suggestion.

On p. 26 Navy Capt. Robert C. Truax, an ARPA military assistant, is quoted as advocating the establishment of a combined ARPA-NASA technical planning and management group to include "the man of vision, the big picture systems man who has a grasp of costs as well as hardware, and specialists in all the fields of technology that contribute to space flight."

On p. 126 an aeronautical engineer in a letter to the Editor complains about lagging technological projects and states, "Our engineering managers more or less grow like Topsy, and this is rather borne out by our loss of technological margins with the Russians, our slippage in schedules, high development costs, and inadequacy of some of our first line weapon systems."

At the same time the display of employment opportunities advertising on p. 115 through 122 is exclusively devoted to pleas for engineers, including a chief aerodynamicist with 12 to 15 years engineering experience, without a single word devoted to any requirement for management skills. It is difficult to believe that industrial concerns with weapon system management responsibilities consider their management systems to be adequate. Many senior executives in this area must shudder when they contemplate the void which exists between their own level of operations and the technological management level concerned with project and sub-project development.

While every effort should be made to develop competent technological managers, it is questionable that we can afford the 10-year waiting period recommended by the aeronautical engineer. It is also questionable that 12 to 15 years as a technologist qualifies an individual to manage a technology.

There is only one constructive solution to this apparent dilemma. It behooves senior executives of firms responsible for weapon system technology to seek out and employ for management purposes, individuals who are trained and experienced in management as such.

It is proposed that lack of specific technological training or experience will be no obstacle to the application of management techniques by one who has a firm grasp of such techniques. Numerous instances can be cited of the successful management of engineering personnel by non-engineering qualified managers.

It seems probable that better management would result in requirements for fewer technicians and would greatly speed and improve the attaintainment of our technological targets.

J. K. GERDEL
U. S. Army Transportation
Supply & Maintenance Command
St. Louis, Mo.

Facts as They Are

I've just read the comments of George W. Sager of Williamsburg, Va. (AW Nov. 24, p. 126), concerning the letter "Lightplane Rules" written by H. B. Davis of Burbank, Calif.

It's really refreshing to see a ray of practical common sense projected into an area of vague, exaggerated gobbledygook—especially when it comes from someone like Mr. Sager, who's not a professional airman but who's still able to look at the facts as they are, not as someone would like to have them appear.

MAX KARANT
Vice President
Aircraft Owners and Pilots Assn.
Washington, D. C.

SPACE AGE ALCHEMY

New materials, capable of withstanding extremely high temperatures and encompassing properties that meet specific requirements are now being created at Servomechanisms' Research Laboratory. SMI's research has been in the field of solid state physics, wherein the study of basic atomic and molecular properties of matter has resulted in materials that can actually be designed to accomplish specific tasks. The challenging space age will depend heavily upon such techniques.

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